

Animal Welfare in a Changing World

Edited by **Andy Butterworth**



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Andy Butterworth

University of Bristol, UK



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Panagiotis (Panos) has served, since 2015, as a raptor/avian and wildlife vet in the Dubai Falcon Hospital and Wadi Al Safa Wildlife Centre, Dubai, United Arab Emirates. He graduated in 2006 from the Veterinary

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Professor Daniel Berckmans obtained a master's degree and a PhD in bio-science engineering from KU Leuven. In 1998 he became a full professor at KU Leuven and the Head of the Division M3-BIORES (Measure, Model and Manage Bioresponses). The main field of Professor Berckmans' research consists of real-time signal analysis of humans and animals by using technology like wearables, cameras and microphones.

The activities comprise the measurements, modelling and monitoring or management of individual living organisms. His research team is considered a worldwide leader in Precision Livestock Farming. Half of the team is working on animal applications and half on human applications. Professor Berckmans is the co-author of 273 scientific articles in peer-reviewed journals and 389 papers in conference proceedings. Since 1982, 15 products have been developed for the world market in cooperation with industrial partners and 18 patents have been submitted. Professor Berckmans is the coordinator of several European Union (EU) projects with a total value of over €10 million and is the co-founder of two spin-off companies: BioRICS NV in 2006 and SoundTalks NV in 2011.

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When recently qualified, Charlotte (Lotta) worked at a large animal practice in south-western Sweden, partly also covering small animal medicine. She then started her research career at the Department of Animal Hygiene in Skara, SLU, where she later received a PhD based on a thesis focusing on the epidemiology and prevention of management-related diseases of welfare relevance in broilers. She has been working with poultry, cattle, pigs and other farm animals, but also with companion animals, laboratory animals and wildlife. For a number of years, she worked for the Swedish Government on writing and updating animal welfare legislation nationally and internationally and supporting the operational control authorities in their animal welfare work. She kept in touch with the university and later became an associate professor in animal hygiene and a senior lecturer in animal welfare at the Department of Animal Environment and Health. She holds a Diplomate certificate of the European College of Animal Welfare and Behavioural Medicine; Subspeciality of Welfare Science, Ethics and Law. She has been a member of the Animal Health and Animal Welfare (AHAW)

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Until 2007 Professor Blokhuis worked for almost 30 years in the Netherlands where he carried out research projects and was managing research groups in the area of animal behaviour and welfare. Since 2007 he is the Professor of Ethology at the Swedish Agricultural University in Uppsala.

Professor Blokhuis's field of specialization is behaviour and animal welfare. His studies involved abnormal behaviours such as feather pecking and stereotypies and the development of alternative housing systems for poultry. He was also involved in studies in other species and managed and coordinated projects with all major farm animals as well as horses and dogs. Recent and ongoing research projects concern the match between horse and rider, welfare assessment in horses and automatization of welfare assessment in broilers.

Professor Blokhuis coordinated seven EU-funded international research programmes. This includes the coordination of the Welfare Quality project which was the largest coordinated research effort in this area to date. Currently he coordinates collaborative work between former leading partners in Welfare Quality called the 'Welfare Quality Network' and is involved in several European initiatives.

For many years Professor Blokhuis was a member of the Scientific Veterinary Committee and later the Scientific Committee on Animal Health and Animal Welfare advisory bodies to the European Commission. Between 2002 and 2009 Professor Blokhuis was a member of the Scientific Panel on Animal Health and Animal Welfare of the European Food Safety Authority (EFSA). He is a fellow of the Royal Swedish Academy of Agriculture and Forestry.

Prof Blokhuis published about 290 publications as first author or co-author, of which about 115 in refereed journals.

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Dr John Bradshaw is a visiting fellow at the University of Bristol, where he was formerly Reader in Companion Animal Behaviour. His main interests are in the behaviour and welfare of domestic cats and dogs, and their relationships with people; he has published over 100 research papers and book chapters on these topics, as well as two editions of *The Behaviour of the Domestic Cat* (CAB International). He was one of the founders of the International Society for Anthrozoology, and set up the Clinical Animal Behaviourist certification scheme for the Association for the Study of Animal Behaviour. Honours received include the Royal Society for the Prevention of Cruelty to Animals (RSPCA)/British Society of Animal Science (BSAS) Award for Innovative Developments in Animal Welfare (2014) and the British Veterinary Association (BVA) Wooldridge Medal (2015).

Since 2009 he has focused his attention on the dissemination of animal welfare science to pet owners: his books *Dog Sense/In Defence of Dogs* and *Cat Sense* (Basic Books/Penguin) were non-fiction bestsellers in both the USA and UK, and have been translated into more than a dozen other languages. His television appearances have included six episodes of *Horizon* for BBC2, NBC's *Pets: Their Secret Lives*, ZTL's *Geschichte der Tiere: Die Katze*, CBC's *The Lion in Your Living Room* and *Dogs: Their Secret Lives* for Channel 4.

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Professor Victoria Braithwaite was a faculty member at Edinburgh University prior to her current appointment at Penn State University. Her research uses neuroscience and animal behaviour to investigate what animals perceive and how they use this information to change their behaviour. One of her research projects on pain perception in fish generated considerable debate and led her to write a popular science book *Do Fish Feel Pain?*, which was published by Oxford University Press in 2010. More recently, her research has focused on the emotional component of pain, and what it means for an animal to be aware of its emotions. She collaborates with fish biologists, fisheries scientists and industry to determine what it means to provide good welfare for fish in captivity, particularly those we farm.

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Henry Buller works principally in the area of non-human geographies and human–animal relations. Having previously worked in the field of environmental and agricultural policies and practice, largely in France,

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Andy works at a national and international level on animal production, animal ethics and animal use and abuse issues, and animal welfare assessment systems. He has researched and published on poultry production and poultry disease and pathology, cattle disease, and welfare and disease assessment methods in pigs, cattle, poultry and wild animals, with over 250 peer-reviewed, trade and general reader publications. He is a current member of the EFSA Animal Health and Welfare Panel, and of the Farm Animal Welfare Committee in the UK, and is Editor-in-Chief of the Elsevier Journal, *Veterinary and Animal Science*, and a member of the Council of British Poultry Science.

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David Fennell researches mainly in the areas of ecotourism, tourism ethics and moral issues tied to the use of animals in the tourism industry. He has published widely in these areas and in all of the field's top journals. Fennell has written several books, including *Ecotourism* (4th edition), *Ecotourism Programme Planning*, *Tourism Ethics*, *Codes of Ethics in Tourism* and more recently a book entitled *Tourism and Animal Ethics*. A major thrust of his research involves the use of theory from other disciplines (e.g. biology, philosophy) to gain traction on many of tourism's most persistent issues and problems. Fennell is the founding Editor-in-Chief of the *Journal of Ecotourism* and is an active member on editorial boards of several academic journals.

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She has also developed an objective scoring system for assessing handling of cattle and pigs at meat plants. This scoring system is being used by many large corporations to improve animal welfare. Other areas of research are cattle temperament, environmental enrichment for pigs, reducing dark cutters and bruises, bull fertility, training procedures, and effective stunning methods for cattle and pigs at meat plants.

She obtained her BA at Franklin Pierce College and her MSc in animal science at Arizona State University. Dr Grandin received her PhD in animal science from the University of Illinois in 1989. Today she teaches courses on livestock behaviour and facility design at Colorado State University and consults with the livestock industry on facility design, livestock handling and animal welfare. She is the author of *Thinking in Pictures*, *Livestock Handling and Transport*, *Genetics and the Behavior of Domestic Animals* and *Humane Livestock Handling*. Her books *Animals in Translation* and *Animals Make Us Human* were both on the *New York Times* best seller list.

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Dr Elly Hiby is an independent animal welfare consultant and scientific coordinator to the International Companion Animal Management (ICAM) Coalition. This coalition aims to improve understanding of effective dog and cat population management by combining knowledge to produce documents outlining best practice. The most recent project, led by Elly, is focused on affordable and meaningful impact assessment of dog population management interventions. Previously she worked at the Dogs Trust as International Director, and before that, at World Animal Protection (previously the World Society for the Protection of Animals, WSPA) for 8 years, including leading on the companion animal welfare programme and advising on humane rabies control internationally. She has also worked as a technical expert with the World Organisation for Animal Health (OIE), the World Health Organization (WHO) and the Food and Agriculture Organisation (FAO) on dog population management. It was through her work with World Animal Protection that she first came into contact with the Alliance for Contraception of Cats and Dogs (ACC&D) and subsequently joined their board of directors. The ACC&D works as a catalyst for the successful introduction of methods to non-surgically sterilize dogs and cats – tools that could improve humane management of dog and cat populations and hence improve welfare and save lives. Prior to joining World Animal Protection, Elly completed a PhD in dog welfare and behaviour with a focus on improving the welfare of working dogs and the impact of training methods on pet behaviour.

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Dr Bonny Van Ranst obtained his degree in veterinary medicine at the University of Ghent, where he started working in the ambulatory clinic afterwards. He left the faculty 6 years later to continue his work in dairy practice. An important part of his time went to the development of dairy management and herd health software. First there was ARGOS and then UNIFORM farm management software. Following that he founded DDW (Dairy Data Warehouse). Nowadays his focus lies on the development of 'MmmooOgle', a cloud-based big data dairy application. He is an independent academic consultant, and a member of the Department of

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Over a 45-year career, 37 years were dedicated to pure and applied research into animal welfare and production, specializing in behaviour, transport, stunning and slaughter across all commercial red/white meat species at the Meat Research/Food Research Institute, Bristol and finally as a research/teaching fellow at the University of Bristol School of Clinical Veterinary Science. As well as research programmes, in 1992 and 1993 Paul developed and authored the first Animal Welfare and Poultry Welfare Officer (WO) training courses, respectively.

Since their inception, Paul continued to author, develop and deliver all University WO courses, Senior WO courses and training trainer programmes worldwide up to his departure from the university in late 2010. Combining a unique mix of pure and applied research, multimedia skills and 24 years of international training experience, Paul now continues the creation and delivery of training and consultancy to major production companies, retailers, government, NGOs and academic institutions worldwide through his company Animal Welfare Training Ltd (AWT – www.awtraining.com).

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Introduction

ANDY BUTTERWORTH

A Changing Welfare World?

The world is changing, and animals are being swept along, either ‘with’ humans in farms, zoos and game parks as companion animals, or ‘alongside’ humans through the effects of human activity on the environment and the wild. Human influence, powered by oil and gas, electricity, the aeroplane, the car, the gun, air and water pollution, can be felt across the entire surface of the planet. The creeping tentacles of human population growth are affecting huge areas, and huge numbers of animals. The United Nations estimate that the global human population will reach 10 bn in 2100, and the cities of Delhi and Tokyo are forecast to reach 40 million people each within the next decade (UN Department of Economic and Social Affairs, Population Division, 2015). Humans and their towns and cities need food and fuel, they spread across land, and human waste and ‘needs’ are linked with climate change, land and soil damage, deforestation, ocean pollution, air pollution and marine debris. Even if population growth slows, humankind and its mark on the planet, and its animals, are already deeply scored into the earth.

All of the animals discussed in the chapters of this book are influenced by human change. All these animals: (i) probably have complex experiential worlds, and mental needs and natures; (ii) can probably experience pain (or at least pain analogues, as evidenced through their response to aversive conditions); (iii) are probably aware of their own surroundings; (iv) probably have an emotional dimension; (v) are probably aware of what is happening to them; (vi) probably have the ability to learn from experience; (vii) are probably aware of bodily sensations – hunger, heat, cold; (viii) are probably aware of their relationships with other animals; (ix) have the ability to choose between different objects and situations; and (x) probably have the capacity to ‘suffer’. I use the word probably repeatedly and with purpose. I think that the accumulation of ‘probables’ is compelling. In a world where it is

often necessary to prove ‘beyond reasonable doubt’ that a cause of suffering is real, there is a tendency to put off practical action until there is ultimate proof. In the realm of animal welfare, this has been the cause of much diversion, delay and distress – the animals continue to be used (and abused) while more proof of, for example, ‘can these animals really feel pain?’ or ‘do these animals really need so much space?’ is collated, analysed and debated. The application of the ‘precautionary principle’ (‘informed prudence’) could, and perhaps should, be the protective norm when animals and people collide, and when there are compelling accumulations of ‘probables’. To try to ensure that the well-being and welfare of the animals is given weight and importance, a welfare positive position could be the default position, rather than the position towards which man and animals move after divisive confrontation, and this is discussed in many of the chapters in this book.

Why These Topics, Why These Authors?

I have invited the authors to write because I admire them. They are individual thinkers. They have worked with animals in diverse topic areas that are not always easy (or popular), and have sometimes proposed ideas that have not received universal support.

There is a risk that people who express views on animal welfare can be viewed as ‘armchair commentators’, as John Webster (2005) said:

It is easy to ride the philosophical cable car to fashionable areas of the moral high ground (third-world poverty, animal welfare) and make impeccable judgements without losing a bead of metaphorical sweat when these are made at little or no cost to ourselves.

I think that the authors of the chapters in this book have *not*, in general, taken the cable car. They have often had to push through resistant waters of critical opinion, and *have* sweated in slaughterhouses,

shivered on the ice where animals are hunted, been criticized, been heckled, occasionally threatened and often misquoted.

The writing in each chapter is personal, sometimes very opinionated, and is an amalgam of fact, experience, science and opinion. Some people will not like this 'style', as the pieces are neither 'journal review papers' nor 'journalism' but something which is somewhere in between.

This book does not try to bring much, if any, new science to the debate. There are many hundreds, even thousands, of papers and books, which do that well. The pieces are, however, 'referenced' or have a 'bibliography', and each author could choose either route to indicate where their information was sourced. The authors had the freedom to describe experiences, without the absolute requirement for all that they describe to be fully tied to 'referenced justification' for every moment of content.

Why Would Animal Welfare be Challenged by a Changing World?

Animals are often adaptable, and some animals link themselves, voluntarily, or less voluntarily, to humankind (see, for example, Chapters 4, 9, 14, 16, this volume). It might be foreseen that change in the world, created by humans, could be paralleled by change in animals, and to an extent this is happening (see Chapters 1, 7, 15). However, some of the human-induced changes are so profound that they affect the lives of whole populations of animals, perhaps irreversibly. For example, it seems that human activity is now altering huge numbers of animal lives and 'welfare': (i) by removing all possibility for some farmed animals, reared in single age groups to learn from animals of different ages (see Chapters 8, 20); (ii) by creating changes in the environment which are impossible to avoid (see Chapters 2, 3); (iii) by altering migration or feeding patterns (see Chapters 4, 6); or (iv) by changing the ways in which wild animals are 'used' (see Chapters 5, 24).

Is the Meaning of 'Animal Welfare' Changing?

The word 'animal welfare' is variably understood in different parts of the world. Many languages have their own word for 'welfare' as used in the

context of animal welfare or well-being, for example: (i) in Spanish, *benestar* – state of health, prosperity; (ii) German, *wohlbe finden* – well-being, wellness, physical comfort; and (iii) French, *bien-être* – well-being, a sense of well-being.

Animal welfare science is a well-developed discipline with its own language and agreed way of looking at things (see Chapters 13, 21, 22, this volume), and to a degree, has become an 'expert domain' (which may not readily welcome 'non-expert' voices). If 'animal welfare' discussion becomes considered the realm of specialists only, this could be a failing. All humans are 'users' of animals, and all humans who have contact with animals will have opinions on their welfare, and some of the chapters explore this area (see Chapters 11, 17, 23, 26).

Science and ethics do try to address positive as well as negative aspects of animals' lives, and can also address animal death, as 'animal death' affects the 'quantity' of animal life and the overall quality of an animal's life (see Chapters 12, 16, 19). Perhaps there is space for 'reasonable/justifiable anthropomorphism' when we try to interpret and understand welfare issues (see Chapter 18). How animal welfare is protected through public resource, retailer and NGO (non-governmental organization) activity has been changing, and this is explored in Chapters 10, 25 and 26.

The meaning, and applicability, of the term 'animal welfare' is changing. Animal welfare used to be almost synonymous with animal protection and 'avoidance of cruelty'. Now 'animal welfare' is used in many contexts.

It is now one of the barometers included when, for example, discussing whether farming systems, wild animal reserves, or human expansion into an area are sustainable.

When so much of the world is now influenced by human activity, realistic questions are being asked about whether humans now have 'responsibility' for the welfare of wild animals.

When considering 'human welfare', the role played by animals as companions, the link between good animal welfare and job satisfaction for farmers, and human mental health and animal care are now becoming established areas of interest.

Animal welfare science encompasses positive aspects of animals' lives, their emotions, what constitutes behaviourally rich environments (enrichment), 'duration of life', and the complexities of human-animal/animal-human bonds.

The chapters in this book can barely scratch at the surface of a deep deposit of animal welfare topics. The world is changing for animals. Humans have never before farmed or controlled so many animals, and how humankind makes future choices when resources become more pressurized will greatly affect the world of animals. I hope that you find things that interest, and perhaps challenge you, in this book.

References

- UN Department of Economic and Social Affairs, Population Division (2015) *World Population Prospects: The 2015 Revision*, Volume I: *Comprehensive Tables* (ST/ESA/SER.A/379). United Nations (UN), New York.
- Webster, A.J.F. (2005) *Animal Welfare: Limping Towards Eden*. Wiley-Blackwell, London.

1

Habitat Loss: Changing How Animals Think?

PAUL C. PAQUET AND SHELLEY M. ALEXANDER

1.1 Introduction

What if ecologists, conservationists, animal advocates, and decision makers conceived of habitat as an ‘experience’ comprising more than suitable patches of land and water where animals live, find food, shelter, protection, and mates for reproduction? How might we view the effects of habitat loss and degradation if scientists and others considered that habitat for animals mirrors how we, as humans, experience our own environment: giving rise to language, emotion, feeling, morality, and culture? We might then understand habitat to be the fabric of being, extending beyond the physical and numerical aspects that have traditionally limited the concept when applied to wild animals. Accordingly, we would recognize that the destruction of habitat means more as well; likely resulting in the impoverishment of community and individual well-being, and dramatically changing the way animals perceive and experience their environment. This ghettoization of experience in these otherwise vital ‘places’ is not unlike what homeless people who have been forced to live a marginal existence might suffer.

Because of human population growth, wild animals and the terrestrial and aquatic environments that sustain them are being pushed to the brink, shaping the present and future of species. Almost all wild animals now live in environments that have been altered, often radically, by humans. Moreover, the world’s lands and oceans are being increasingly transformed to exclusive human uses as garbage repositories, transportation corridors, industrial farms, urban developments and places for resource extraction. These disturbances are depriving native species of life-sustaining habitats and impoverishing the lives of those that persist. As would be expected, many species are threatened or endangered because they have been deprived of their native habitats, or now live in habitats that have been degraded, or converted to other uses. Undeniably, habitat loss is

now the dominant threat to species around the world (Sala *et al.*, 2000).

The principal influences in this destruction are humankind’s limitless demand for space, intensified by the over-exploitation of species, pollution, climate change, and rampant poaching. Consequently, wild animals are continually being exposed to environmental change more rapid than that which they have experienced in their evolutionary past (Palumbi, 2001). The result is altered species interactions and declines that include extinctions and changing ranges (Parmesan, 2006; Jackson and Sax, 2010). In turn, these changes are driving adaptive responses, including speciation and hybridization (Hendry *et al.*, 2011; Lankau *et al.*, 2011). Seldom considered, however, this loss of habitat also impinges upon the health and well-being of the animals that depended on that habitat for subsistence. Deprived of a home in which to live, or compelled to survive in suboptimal environments, suffering and death is inevitable for many species. Destroying species’ homes, therefore, is a profoundly harmful activity that intrinsically constitutes a form of animal abuse (White, 2017). When humans convert land and seascapes for exclusive use, they inevitably reduce or eliminate its usefulness as habitat for the other species that live there. This is because species respond to their environment in ways that maximize their likelihood of survival, and these responses are conferred through evolution and experience. However, the loss of habitats alter the landscape’s inherent qualities, resulting in novel conditions that affect the ability of the environment to provide conditions appropriate for individual and population persistence.

How different animals perceive and respond to their changing environment, and how those perceptions and responses affect their well-being is not well understood. In theory, we would expect a spectrum of responses reflecting evolutionary histories

and contemporary adaptations to local environments. Notably, human alteration of the landscape often occurs more rapidly than species can adapt to the resulting novel environment, potentially leading to maladaptive responses. Some resilient species, however, are less likely to be affected by changes in their environment than those who might perish because of disturbance, whereas some species might even thrive.

To understand how other animals might change their thinking, not by choice but by necessity, we first have to change how we think: and pay attention to the science of animal sentience, acknowledging that non-human animals have the capacity to feel, perceive, or experience subjectively. Herein, we challenge the traditional concept of habitat (which we first define) and understanding of the consequences of habitat alteration and loss. Applying a multispecies ethnography and animal sentience perspective, we consider the variety of ways in which habitat modification changes the way animals sense, think about, and experience their environment. As Dawkins (1990) stated 'The animals' viewpoint ... provides the only plausible bridge between observable events such as physiological and behavioural changes ... and the subjective experiences of animals ...'.

1.2 Reviewing Contemporary Ideas of Habitat

The term habitat is one of the more ambiguous constructs of ecology and conservation science. Interpretation and application of the concept is inconsistent and lacks uniformity, often resulting in conflicting and vague scientific descriptions (Mitchell *et al.*, 2012). The most common uses of the term habitat are grounded on ecological niche theory. Here, every species in an ecosystem occupies a niche, which comprises the sum total of its relationships with the biotic and abiotic elements of its environment – more simply, what it needs to survive. Hutchinson (1957) first framed the view used by most ecologists, defining niche as the intersection of all of the ranges of tolerance under which an organism can live, including temperatures, climate, type of shelter, food sources, and many other factors. Hall *et al.* (1997), reflecting contemporary definitions derived from seminal ecologists (Grinnell, 1917; Leopold, 1933; Hutchinson, 1957; Odum and Barrett, 1971), defined 'habitat' as the resources and conditions present in an area that

produce occupancy – including survival and reproduction – by a given organism. Mitchell *et al.* (2012) similarly describe 'habitat' to include abiotic and biotic factors, and emphasize that organisms 'select' the resources and conditions that increase fitness.

These definitions, however, remain deficient – lacking, we would argue, the essential 'essence' of habitat. Instead, they favour thinking about habitat as patches of vegetation filled with differing numbers of animals – all discrete, countable, objectifiable things and connections. They ignore that non-human animals are conscious and sentient beings who experience their environment as individuals, and that there is more to habitat than we can count (Cameron, 1963). Moreover, these definitions fail to recognize that non-human animals likely experience (maybe respond to) the world similarly to humans. The effects of habitat loss on animals then, should consider factors contemplated when studying how habitat loss or change affects people. For example, an animal can exist and persist in a compromised habitat but still be suffering owing to anxiety and trauma of displacement. What this all means is that current definitions of 'habitat', and therefore our evaluation of the effects of habitat loss, fall short of the reality experienced by non-human animals.

1.3 Animal Sentience and Habitat

Conservation scientists do not know everything about the effects of habitat loss on wild species, but we know a lot – enough to extrapolate and predict consequences. Our current understanding, however, is incomplete and remains fraught with speciesism (see Chapter 19, this volume) and ideas of human exceptionalism (Dawkins, 1990). Accordingly, existing frameworks for evaluating effects of habitat loss often fall short because many scientists are reluctant to recognize non-human animals as conscious and emotionally responsive beings, endowed with capacity for logical thought. They are consequently unwilling to extend the potential for psychological or psychosomatic ramifications of severe habitat change to non-human animals. Yet, the notion that humans are individuals and will experience dire consequences from rapid ecological change is readily accepted.

There are, however, sound biological reasons for recognizing non-human animals as conscious beings who employ rational adaptive strategies to address problems as they change and evolve. Charles Darwin's reflections on morality and ideas about

evolutionary continuity stressed that anatomical, physiological, and psychological differences among species are differences in degree rather than kind (Darwin, 1874), suggesting that stripping animals of the traits they clearly possess is questionable science. Moreover, the ability of some animals (particularly resilient ones) to adapt to unpredictably changing conditions or novel stimuli shows they are conscious and able to assess what needs to be done in a given situation. This ability for adaptive reasoning has persuaded many scientists that some sort of cognition must be required to orchestrate such versatile behavior (Griffin, 2013).

Bekoff (2011) argues that we share with other mammals and vertebrates the same areas of the brain that are important for consciousness and processing emotions and:

we don't have to go beyond the science or embellish what we know to appreciate how they express their intellectual skills and emotional capacities. When we say animals are conscious and smart we mean they know what to do to adapt to ever-changing environments.

(Bekoff, 2011)

In 2012, leading scientists from around the world reached a unanimous decision that animals – specifically mammals and birds – are conscious beings:

The absence of a neocortex does not appear to preclude an organism from experiencing affective states. Convergent evidence indicates that non-human animals have the neuroanatomical, neurochemical, and neurophysiological substrates of conscious states along with the capacity to exhibit intentional behaviors. Consequently, the weight of evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness. Non-human animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates.

(Low, 2012)

Clearly, wild animals are thoughtful animals that make adaptive decisions in response to their changing environment, including to the loss of habitat. In so doing, they change their thinking from what might be considered the undisturbed norm. That they change their thinking, however, does not mean their new strategies for survival are always successful. We contend that depriving any animal (including humans) of their life requisites by destroying or impoverishing their surroundings adversely affects and causes suffering to individuals through trauma

of displacement, distress, reduced security, and sometimes starvation. These discomforts (sufferings) are well beyond and additive to what might occur naturally (i.e. non-anthropogenic) (Fig. 1.1).



Fig. 1.1. (a) Humans adversely affect the habitat security of gray wolves in countless of ways. Wolves are often killed by hunters for recreation and trophies, and by commercial trappers for fur. (b) When hunters and trappers kill breeding females, pups are orphaned and their survival consequently compromised, which in turn affects the persistence of the pack. (Image credits: Paul Paquet.)

Reflecting evolutionary history and resilience to change, animal species reside on a scale with ‘generalists’ on one end and ‘specialists’ on the other. When environmental conditions change, generalists are able to adapt but specialists tend to fall victim to extinction much more easily (Townsend *et al.*, 2003). Specialist species can thrive only in a narrow range of environmental conditions or have limited and restrictive diets. An example of a specialist would be the koala (*Phascolarctos cinereus*), which lives in eucalyptus trees and mainly consumes eucalyptus leaves. Specialist species are sensitive to environmental change and often fail to thrive in the face of habitat loss. An example of a generalist would be the common red fox (*Vulpes vulpes*), which can adapt to a broad range of living conditions and opportunistically consume a variety of foods (MacDonald, 1980). Using a diversity of different resources, generalist species are able to thrive in a wide variety of environments, which enables them to adapt to changes in habitat. Confronted with loss of habitat, most animals likely change the way they think so they can change the way they live. Generalists, having more flexible biology than specialists, can often develop new strategies for survival and adapt to a changed environment. Specialists, on the other hand, although aware of the need to change, often fail to adapt because they are physically constrained by their biology. We think those species are more likely to suffer more because they are unable to respond effectively.

The remainder of our chapter expands our understanding of the effects of habitat loss to derive a more encompassing construct that recognizes there are multiple ways to experience the world.

1.4 Multispecies Ethnographies and Habitat Experience

Extending outdated notions of habitat into the realm of animal sentience to consider habitat experience requires a multispecies ethnographic lens. Ethnographic research focuses on individual and cultural experiences of humans – it involves the deep description of everyday life and practice (Smart, 2014). A multispecies ethnography then, recognizes that sentience is not a unique capacity of humans. The approach acknowledges that humans ‘live amongst a host of other social creatures’ (Lynn, 1998). And as we noted previously, humans are not

the only species to experience community, space, self, existence, or have behavioural flexibility.

Through the multispecies ethnographic approach we can argue that non-human animals perceive habitat as more than the sum of the parts (patches, connections, numbers of animals, species interactions): Habitat is imbued with meaning. Habitat has *places* with significance beyond the mere physical attributes (Alexander and Lukasik, 2017). Habitat for any animal can be thought of as the storyline of individuals, its generational and inter-generational history, relationships, successes, failures and emotional consequences. Although rarely considered for non-human animals, all are tightly coupled with the quantitative measures of individual *and* population survival, fitness, and persistence. There is a moral imperative here, aptly stated by Bekoff (2007): ‘As self-conscious, sentient beings ourselves, we are able to recognize suffering, and we are obligated to reduce it whenever we can’. Scientists would not hesitate to consider that the unpredicted loss of homes, food, community, friends, language, moral justice, have implications for the human experience.

1.5 How Might Habitat Loss Change How Animals Think?

Using a multispecies ethnographic approach, the world should *exist* to all animals, but likely each species thinks distinctively about ‘their’ world. Characteristically evolved sensory equipment, detection sensitivities, and ranges mean the experiences that other species have are different from our own (humans). The same world can, and does, seem very different to a wolf (*Canis lupus*) compared with a human. Wolves see just fine, but communicate, experience, and think about their environment primarily through olfaction (Paquet, 1991), a world that is difficult for us to imagine (Horowitz, 2016). But different from human does not mean inferior. We can confidently expect they perceive and understand objects, themselves, and others and that canids are better at some tasks than humans (Horowitz, 2016).

All sentient beings perceive the world through patterns and experience. Researchers have shown that animal brains are composed of billions of neurons, which are specifically adapted to detect ‘shapes, colours, smells, sounds, movement, and so on ... and that brains are endowed with mechanisms that enable extraction of what neuroscientists

call “global” or “pattern like”, relationships’ (Verey, 1993; Mingyur and Goleman, 2007). The ability to recognize these patterned relationships helps us understand how we should and should not act, to perceive and understand our environment, and determine how to preserve ourselves. They are the basis of emotions and confer survival (Bekoff, 2007). Humans and non-humans alike share these gifts. And even if the brains of other animals differ from our own, they are structurally similar enough to have evolved a capacity to think about and understand space, patterns, and relationships. As such, changing the patterns of the landscape through loss and degradation will affect how animals think, and have attending – sometimes devastating – emotional consequences (e.g. the loss of a life partner).

Although many researchers identify and assess animal suffering only by physiological measures (heart rate, respiration) (Bekoff, 2007), suffering is now understood to include an organism’s interaction with environmental stimuli that evoke fear and anxiety, affective states consciously recognized and responded to by thinking individuals. Animals can cope with fear and anxiety, but if these states are excessive in either intensity or duration, distress will occur and the welfare of the animal will be compromised (Webster, 2005). Hence, if we consider what loss of habitat feels like and how non-human animals think about it, we need to extend ideas of what that might look like for a human.

In the realm of humans, we would expect responses to habitat loss or rapid ecological change (e.g. the loss of one’s home to a bulldozer) to have cognitive and even social consequences, including significant effects like post-traumatic stress disorder (PTSD), degradation of economic/social status, and epigenetics (see below for further discussion on epigenetics) (Badyaev, 2005). For animals, the loss of freedom, loss of access to resources, fear, isolation, and inability to carry out tasks that would normally ensure fitness, reproduction, and survival, create a situation of chronic stress not unlike displaced human populations. Individuals exposed to repeatable but consistently unfamiliar stressors develop ‘stressful helplessness’, losing their ability to react to any stressor (Badyaev, 2005). Epigenetics, the study of changes in organisms caused by modification of gene expression rather than alteration of the genetic code, suggest these effects have

multigenerational consequences for fitness in humans and other animals (Badyaev, 2005). The moral is that habitat confers welfare effects on all animals and its loss needs to be understood in such a perspective.

Intended to engender further discussion, we offer a few examples of behavioural evidence supporting multispecies ethnographic views of adaptive thinking (and suffering) related to habitat loss. Neale *et al.* (2007) noted that with loss of habitat comes ‘potential for increased transients (unfamiliar animals) possibly, less ability to hold space’ and so a reduced perception of the security of their territory. His research focused on coyotes (*Canis latrans*), noting that this species characteristically has high site fidelity for familiar places where they are less vulnerable to people. We know that transient coyotes are more likely to have conflicts with people. Hence, habitat loss may generate conflict, which triggers stressors caused by management approaches to deal with that conflict. More critically, unfamiliar animals transgressing territorial boundaries can result in the need for resident animals to engage more actively in patrolling, enforcement of boundaries, and protection of mates, pups, and food resources.

Activity patterns may directly change owing to species/individual influx and more contact with ‘threat species’ like humans, and this may evoke fear, which in turn has fitness implications. For example, Smith *et al.* (2017) found that ‘when people are nearby, female pumas (*Puma concolor*) tended to abandon or eat less of their kill’. Such changes have been observed to alter circadian rhythms, which entrain animal experience and can negatively affect thinking. Consider a situation in which humans are forced to upend circadian rhythms and move constantly to avoid detection. A common understanding is that sleep deprivation in humans leads to psychiatric and physical suffering (McEwen and Karatsoreos, 2015; Murphy and Peterson, 2015).

Physiological indicators of social and nutritional stress can provide insight into the responses of species to changes in food availability, and the effects of resource availability on fitness-related physiology. Food is a major component of habitat and its lack of availability is in some cases equivalent to loss of habitat. In coastal British Columbia, Canada, grizzly bears evolved with spawning salmon as an abundant but spatially and temporally constrained

source of food. Recent and dramatic declines in salmon (*Oncorhynchus* sp.) owing to habitat loss and overfishing appear to have consequences on bear health and ultimately fitness. Studies suggest that coastal bears could be experiencing nutritional and social stress in response to ongoing salmon declines, forcing bears to rethink long-established strategies for survival (Bryan *et al.*, 2013, 2014) (Fig. 1.2).

Habitat loss coupled with human disturbance (including physical presence, sound, light) could affect species movements, interrupt activity patterns, and lead to subsequent health and adverse welfare effects. Van der Meer *et al.* (2011) found that the daily activity in two parapatric (in which ranges do not significantly overlap but are immediately adjacent to each other) Zimbabwean populations of African wild dog (*Lycaon pictus*) showed similar behavioural consequences, with the dogs adjusting their hunting activity to reduce chances of encountering humans. This, however, had the unfortunate cost of increasing the dog's risk of encountering hyena (*Crocuta crocuta*) and lions (*Panthera leo*), with upwards of 70% increasing risk of predation by these competitors.

Social carnivores usually rely on communication systems that have evolved within the non-human dominated soundscape. Communication through

sound is essential to many species for reproductive success, acquisition of prey, territorial maintenance, and social cohesion. Wolves, for instance, have an elaborate repertoire of vocalizations (Harrington *et al.*, 2003), used to find fellow pack members when apart, for social purposes such as maintaining relationships with members of the pack, and as warnings to alien wolves and other species. Habitat loss, urbanization, and mechanization change the way sound moves across a landscape, potentially altering the social fabric of wolves and their communities.

Adverse effects of habitat loss on communication have also been observed in marine mammals like killer whales (*Orcinus orca*), where ambient noise and disturbance have affected their ability to communicate, which is central to mate selection, feeding, and security (Fig. 1.3). For example, as obligate predators of Chinook salmon (*Oncorhynchus tshawytscha*), Southern Resident killer whales off Canada's Pacific Coast enter the Salish Sea in the spring to feed, but their ability to successfully hunt salmon is hindered by the acoustic and physical disturbance of commercial and recreational vessels that are concentrated in their feeding grounds (Lusseau *et al.*, 2009). Moreover, Chinook salmon have been severely depleted in number by commercial and recreational fisheries. This impoverishment



Fig. 1.2. Deprived of many life-sustaining requisites, grizzly bears living in Canadian industrial forests must adapt to significantly altered habitat in order to survive. (Image credit: Paul Paquet.)



Fig. 1.3. Resident killer whales in coastal British Columbia, Canada struggle to survive in an environment degraded by the activities of humans. The major threats are disturbances from vessels and sound, nutritional stress associated with reduced prey abundance and availability, chronic pollution, and persistent contaminants including polychlorinated biphenyls (PCBs). (Image credit: Paul Paquet.)

and loss of the whales' critical habitat via the loss of important habitat components has resulted in the endangerment of the Southern Resident population (Hanson *et al.*, 2010).

To contrast with a human experience, the reduced ability of either wolves or whales to communicate or engage in social interactions as a result of human-induced habitat pressures would have a direct effect on how they think about their environment – the loss of access to food and the security of a social network would likely evoke emotions including fear, loneliness, and grief. In a human analogue, these emotions, if chronic, could result in reduced fitness and sometimes death.

1.6 Concluding Thoughts

Contemporary constructs of habitat are an inadequate concept, and a poor reflection of reality, and consequently, the loss of habitat has been insufficiently evaluated. We contend that habitat should be viewed in space and time as the fabric that enmeshes cultures of all animals (including humans) – it includes the qualitative and quantitative relationships of the actors' personal and collective experience – it is alive, individual, and all the changes are felt.

Sentient animals are thinking beings, which have an experiential reference and sense of *place* about where they live. Habitat loss, therefore, affects how animals see, feel, and think. All animals have co-evolved with, and are shaped by, an environment to which they consciously respond and depend for survival. When confronted with loss of life-sustaining habitat, animals are compelled to change their way of thinking: to adapt or die. Some are successful; the more vulnerable are not (particularly specialists), but all likely agonize and suffer (Fig. 1.4).

We know that humans in similar circumstances suffer from social deprivation, confusion in novel environments, stress from lack of food, and fear of the unknown. Notably, chronic conditions of fear, vigilance, or episodic extreme upheavals often have devastating consequences, such as PTSD. Although the acknowledgement of such suffering in non-humans 'does not require we consider animals on equal ground' (Dawkins, 1990), we can and should choose to do so. Non-human animals possess intrinsic value and deserve to be treated with respect, with concern for their welfare, and in a just manner. The universality of this reasoning is captured by the principle of ethical consistency: treat others as you would consent to be treated (Vucetich and Macdonald, 2017).



Fig. 1.4. Human encroachment destroys, degrades, and alienates the habitats of gray wolves and other animals, exposing them to widespread harms, including deaths resulting from collisions with cars, trucks, and trains. (Image credit: Paul Paquet.)

Bibliography

- Alexander, S.M. and Lukasik, V.M. (2017) Re-placing coyote. *Lo Squaderno – Explorations in Space and Society* 42, 37–41.
- Badyaev, A.V. (2005) Role of stress in evolution: from individual adaptability to evolutionary adaptation. In: Hallgrímsson, B. and Hall, B.K. (eds) *Variation*. Elsevier Academic Press, Burlington, Massachusetts, pp. 277–302.
- Bateson, P. (1991) Assessment of pain in animals. *Animal Behaviour* 42, 827–839.
- Bekoff, M. (2007) *The Emotional Lives of Animals: a Leading Scientist Explores Animal Joy, Sorrow, and Empathy, and Why They Matter*. New World Library, Novato, California.
- Bekoff, M. (2011) Animal minds and the foible of human exceptionalism: let's replace human exceptionalism with species exceptionalism. *Psychology Today*. Posted 30 July 2011. Available at: <https://www.psychologytoday.com/blog/animal-emotions/201107/animal-minds-and-the-foible-human-exceptionalism> (accessed 30 July 2011).
- Brainerd, S.M., Andrén, H., Bangs, E.E., Bradley, E.H., Fontaine, J.A. et al. (2008) The effects of breeder loss on wolves. *Journal of Wildlife Management* 72, 89–98.
- Braithwaite, V. (2010) *Do Fish Feel Pain?* Oxford University Press, New York.
- Bryan, H.M., Darimont, C.T., Paquet, P.C., Wynne-Edwards, K.E. and Smits, J.E. (2013) Stress and reproductive hormones in grizzly bears reflect nutritional benefits and social consequences of a salmon foraging niche. *PLOS One* 8, e80537. DOI: 10.1371/journal.pone.0080537
- Bryan, H.M., Darimont, C.T., Paquet P.C., Wynne-Edwards, K.E. and Smits, J.E. (2014) Stress and reproductive hormones reflect inter-specific social and nutritional conditions mediated by resource availability in a bear–salmon system. *Conservation Physiology* 2. DOI: 10.1093/conphys/cou010
- Cameron, W.B. (1963) *Informal Sociology: a Casual Introduction to Sociological Thinking*. Random House, New York.
- Darimont, C.T., Carlson, S.M., Kinnison, M.T., Paquet, P.C., Reimchen, T.E. and Wilmer, C.C. (2009) Human predators outpace other agents of trait change. *Proceedings of the National Academy of Sciences* 106, 952–954.
- Darwin, C. (1874) *The Descent of Man*, 2nd edn. Murray, London. (1922 reprint)
- Dawkins, M.S. (1990) From an animal's point of view: motivation, fitness, and animal welfare. *Behavioral and Brain Sciences* 13, 1–9.

- Fox, C.H., Papouchis, C.M., Hirsch, K. and Lamont, G. (2005) *Coyotes in Our Midst: Coexisting With an Adaptable and Resilient Carnivore*. Animal Protection Institute, Sacramento, California.
- Gorman, J. (2017) How demands of female birds changed the DNA of a species. *New York Times*, 24 May 2017. Available at: <https://www.nytimes.com/2017/05/24/science/darwin-finches-beaks-video.html?hpw&rref=science&action=click&pgtype=Homepage&module=well-region&region=bottom-well&WT.nav=bottom-well&r=0> (accessed 24 May 2017).
- Griffin, D.R. (2013) *Animal Minds: Beyond Cognition to Consciousness*. University of Chicago Press, Chicago, Illinois.
- Grinnell, J. (1917) The niche-relationships of the California thrasher. *The Auk* 34, 427–433.
- Hall, L.S., Krausman, P.R. and Morrison, M.L. (1997) The habitat concept and a plea for standard terminology. *Wildlife Society Bulletin* 25, 173–182.
- Hanson, M.B., Baird, R.W., Ford, J.K., Hempelmann-Halos, J., Van Doornik, D.M. et al. (2010) Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range. *Endangered Species Research* 11, 69–82.
- Harrington, F.H., Asa, C.S., Mech, L. and Boitani, L. (2003) Wolf communication. In: Mech, L.D. and Boitani, L. (eds) *Wolves: Behavior, Ecology, and Conservation*. University of Chicago Press, Chicago, Illinois, pp. 66–103.
- Hendry, A.P., Kinnison, M.T., Heino, M., Day, T., Smith, T.B. et al. (2011) Evolutionary principles and their practical application. *Evolutionary Applications* 4, 159–183.
- Hennessy, C.A., Dubach, J. and Gehrt, S.D. (2012) Long-term pair bonding and genetic evidence for monogamy among urban coyotes (*Canis latrans*). *Journal of Mammalogy* 93, 732–742.
- Horowitz, A. (2016) *Being a Dog: Following the Dog into a World of Smell*. Scribner, New York.
- Hutchinson, G.E. (1957) Concluding remarks. *Cold Spring Harbor Symposia on Quantitative Biology* 22, 415–427.
- Jackson, S.T. and Sax, D.F. (2010) Balancing biodiversity in a changing environment: extinction debt, immigration credit and species turnover. *Trends in Ecology & Evolution* 25, 153–160.
- Lankau, R., Jørgensen, P.S., Harris, D.J. and Sih, A. (2011) Incorporating evolutionary principles into environmental management and policy. *Evolutionary Applications* 4, 315–325.
- Leopold, A. (1933) The conservation ethic. *Journal of Forestry* 31, 634–643.
- Low, P. (2012) The Cambridge Declaration on Consciousness. *Francis Crick Memorial Conference on Consciousness in Human and non-Human Animals*, 7 July 2012, Churchill College, University of Cambridge, Cambridge.
- Lusseau, D., Bain, D.E., Williams, R. and Smith, J.C. (2009) Vessel traffic disrupts the foraging behavior of southern resident killer whales *Orcinus orca*. *Endangered Species Research* 6, 211–221.
- Lynn, W.S. (1998) Animals, ethics and geography. In: Wolch, J. and Emel, J. (eds.) *Animal Geographies: Place, Politics and Identity in the Nature–Culture Borderlands*. Verso, London, pp. 280–298.
- Macdonald, D.W. (1980) The red fox, *Vulpes vulpes*, as a predator upon earthworms, *Lumbricus terrestris*. *Zeitschrift für Tierpsychologie* 52, 171–200. DOI: 10.1111/j.1439-0310.1980.tb00710.x
- McEwen, B.S. and Karatsoreos, I.N. (2015) Sleep deprivation and circadian disruption: stress, allostasis, and allostatic load. *Sleep Medicine Clinics* 10, 1–10.
- Mingyur, Y. and Goleman, D. (2007) *The Joy of Living: Unlocking the Secret and Science of Happiness*. Harmony Press, Eaton, Pennsylvania.
- Mitchell, M.S., Hebblewhite, M., Boitani, L. and Powell, R.A. (2012) Carnivore habitat ecology: integrating theory and application. In: Boitani, L. and Powell, R.A. (eds) *Carnivore Ecology and Conservation: a Handbook of Techniques*. Oxford University Press, New York, pp. 218–255.
- Murphy, M.J. and Peterson, M.J. (2015) Sleep disturbances in depression. *Sleep Medicine Clinics* 10, 17–23.
- Neale, J.C., Sacks, B.N. and Blejwas, K.M. (2007) Coyote flight movements relative to territory boundaries: an experiment in the field. *American Midland Naturalist* 158, 162–167.
- Odum, E.P. and Barrett, G.W. (1971) *Fundamentals of Ecology*, Volume 3. Saunders, Philadelphia, Pennsylvania.
- Palumbi, S.R. (2001) Humans as the world's greatest evolutionary force. *Science* 293, 1786–1790.
- Panksepp, J. (2005) Affective consciousness: core emotional feelings in animals and humans. *Consciousness and Cognition* 14, 30–80.
- Paquet, P.C. (1991) Scent marking behavior of sympatric wolves (*Canis lupus*) and coyotes (*C. latrans*) in Riding Mountain National Park. *Canadian Journal of Zoology* 69, 1721–1727.
- Parnesan, C. (2006) Ecological and evolutionary responses to recent climate change. *Annual Review of Ecology, Evolution, and Systematics* 37, 637–669.
- Rohr, J.R., Kerby, J.L. and Sih, A. (2006) Community ecology as a framework for predicting contaminant effects. *Trends in Ecology & Evolution* 21, 606–613.
- Sala, O.E., Chapin, F.S., Armesto, J.J., Berlow, E., Bloomfield, J. et al. (2000) Global biodiversity scenarios for the year 2100. *Science* 287, 1770–1774.
- Shettleworth, S.J. (2001) Animal cognition and animal behaviour. *Animal Behaviour* 61, 277–286.
- Smart, A. (2014) Critical perspectives on multi-species ethnography. *Critique of Anthropology* 34, 3–7.
- Smith, J.A., Suraci, J.P., Clinchy, M., Crawford, A., Roberts, D. et al. (2017) Fear of the human 'super predator' reduces feeding time in large carnivores. *Proceedings of the Royal Society B* 284. DOI: 10.1098/rspb.2017.0433

- Townsend, C., Begon, M. and Harper, J. (2003) *Essentials of Ecology*, 2nd edn. Blackwell, Oxford, p.54–55.
- Urbanik, J. (2012) *Placing Animals: An Introduction to the Geography of Human–Animal Relations*. Rowman & Littlefield Publishers Inc., Lanham, Maryland, 191 pp.
- van der Meer, E., Moyo, M., Rasmussen, G.S. and Fritz, H. (2011) An empirical and experimental test of risk and costs of kleptoparasitism for African wild dogs (*Lycaon pictus*) inside and outside a protected area. *Behavioral Ecology* 22, 985–992.
- Vereyly, F. (1993) *The Embodied Mind: Cognitive Science and Human Experience*. MIT Press, Cambridge, Massachusetts, 309 pp.
- Vucetich, J.A. and MacDonald, D.A. (2017) Some essentials of coexisting with carnivores. *Open Access Government* August Issue, 216–217. Available at: www.openaccessgovernment.org/ (accessed 21 February 2018).
- Weaver, J.L., Paquet, P.C. and Ruggiero, L.F. (1996) Resilience and conservation of large carnivores in the Rocky Mountains. *Conservation Biology* 10, 964–976.
- White, R. (2017) Animal abuse resulting from wildlife habitat destruction. In: *The Palgrave International Handbook of Animal Abuse Studies*. Palgrave Macmillan, London, pp. 249–268.

2

Whale Entanglement – a 21st-century Challenge in the Ocean

SARAH DOLMAN, REGINA ASMUTIS-SILVIA AND CONOR RYAN

2.1 Introduction

Entanglement in fishing gear is the most significant threat to wild cetacean welfare (IWC, 2016) and entanglement in active fishing gear is a significant cause of morbidity and mortality in baleen whales. Although there are currently no quantitative assessment methods, and so comparison of the scale from region to region, existing data indicate that entanglements are occurring throughout the geographic range of several species, encompassing breeding, feeding and migratory routes. Therefore, large whale entanglement is a global concern (IWC, 2010). In most areas, entanglement is not an intentional practice and many fishermen are involved in strategies to reduce the accidental capture of whales.

More than 1700 large whale entanglements have been reported globally since 1979 (IWC, 2010) although it is recognized that entanglement reporting is grossly underestimated, with, according to at least one study, fewer than 10% of active entanglement cases being reported (Robbins *et al.*, 2009). While all large whale species can become entangled, smaller individuals/species appear to be less likely to survive entanglement events (Leaper *et al.*, 2006; Cassoff *et al.*, 2011). Fishing gear type and origin is rarely known, but based on gear analysis, it appears that fixed gear fisheries pose the greatest risk to baleen whales (Johnson *et al.*, 2005; Song *et al.*, 2010; Saez *et al.*, 2013; van der Hoop *et al.*, 2013; Young, 2015) with individuals either becoming anchored in place by the gear, or after entanglement the animals tow all or a portion of the attached entangling gear with them.

Entanglements are a concern for the welfare of individuals as well as a conservation concern given the population-level impacts for some species. For example, previously hunted North Atlantic right whales (NARW) (*Eubalaena glacialis*) remain a critically endangered species as entanglements

impede their recovery. At least 83% of individually identified NARW have been entangled and the number of repeat entanglements has ranged from one to six per individual (Knowlton *et al.*, 2012). Similarly, at least half of all Gulf of Maine humpback whales (*Megaptera novaeangliae*) have been entangled at least once (Robbins and Mattila, 2001) with an average of 12.1% of the population becoming entangled annually (Robbins *et al.*, 2009) resulting in an estimated annual mortality rate of 3%, or up to 29 individuals per year (Robbins *et al.*, 2009), but again this is likely to be an underestimate. These reported rates of mortality and serious injuries exceed the threshold that the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) has deemed sustainable for these stocks to reach or maintain their optimal sustainable population level (Waring *et al.*, 2015). Furthermore, using a different methodology, the estimated annual lethal entanglement probability for a humpback whale if it were resident in Scottish inshore waters is very high at 12% (Ryan *et al.*, 2016). There are, however, only a few published assessments regarding the welfare implications of entangled whales (Moore *et al.*, 2006; Moore and van der Hoop, 2012).

2.2 Case Study: NARW, a 21st-century Conservation and Welfare Challenge

Following hunting that decimated the original population, NARW were listed as endangered in US waters in 1970. The current population is estimated to contain fewer than 450 individuals, and entanglement in static fishing-pot gear lines is a primary cause of death, along with ship strikes. More has been done to understand and reduce entanglements for this population than for any other.

Examination of large baleen whale entanglement mortalities has shown a variety of chronic impacts

for persistent terminal entanglements. Juvenile and adult NARW appear to have a lower probability of survival in the year following entanglement than unaffected animals (Robbins *et al.*, 2015). The apparent survival rate for an entangled adult NARW is 23% lower than for unaffected adult females and 26% lower than adult males of other species. The post-entanglement survival of entangled juveniles was comparable to entangled adults and 25% lower than unaffected conspecifics. This is the first reported estimate of reduced survival rates following entanglement, and sets a baseline against which to evaluate the success of future mitigation efforts (Knowlton *et al.*, 2016). Larger whales which break the fishing gear free from its attachment to the seabed, and subsequently carry fixed trap and net gear, are subject to a very slow and likely extremely debilitating demise, averaging 6 months in the case of many NARW, but there are cases of chronic entanglement that persist for many years (Moore and van der Hoop, 2012). Disentanglement (gear removal) improves the survival outcome of NARW, as disentangled whales can achieve a subsequent survival rate that approaches that of unaffected animals (Robbins *et al.*, 2015). The reasons for a protracted death include: (i) impaired foraging during entanglement, resulting in emaciation through reduced mobility and foraging ability; (ii) energy budget depletion leading to starvation after many months or years; (iii) systemic infection arising from open, unresolved entanglement wounds; and (iv) haemorrhage or debilitation due to severe gear-related damage to tissues. Serious gear-induced injury can include: (i) laceration of large blood vessels; (ii) impacts on the ability to breathe; (iii) embedding of line in growing bone; and (iv) painful arthritic changes in new bone as it regrows in an attempt to wall off constricting, encircling lines (Cassoff *et al.*, 2011). Gear-induced wounds can lead to death by impairing critical biological functions, becoming a source of haemorrhage or providing a portal of entry for pathogens (Cassoff *et al.*, 2011) (Fig. 2.1).

It has been suggested that disruption of the oral seal (Fig. 2.2), the way in which the mouth remains closed in cetaceans by holding the lower mandible closed, could have a significant impact on propulsion efficiency and energy expenditure (Lambertsen *et al.*, 2005). van der Hoop *et al.* (2013) identified significant alterations in swimming patterns, and significant drag from towed fishing gear resulting in energy depletion in a chronically entangled

NARW. The added drag of towing gear could substantially affect the energy budget of an entangled whale (Moore and van der Hoop, 2012), and entanglement could increase drag and the propulsive power required by 1.47-fold (van der Hoop *et al.*, 2015) and seemingly small entanglements (short pieces of line, small floats) can still impart significant drag (van der Hoop *et al.*, 2015). Additional drag from the entangling gear has been shown to have energetic costs that can be equivalent to the cost of migration or reproduction (van der Hoop *et al.*, 2015). Thus, from a population biology viewpoint, chronically entangled whales are perhaps best seen as ‘dead whales swimming’ in that females that are significantly and chronically entangled are unlikely to reproduce. Laceration and consequent infection can be another cause of death in chronic entanglement of large whales, with secondary bronchopneumonia (Cassoff *et al.*, 2011). Entanglement in fishing gear is sufficiently stressful to cause both a behavioural and a physiological stress response in baleen whales (Cassoff *et al.*, 2011). Faecal glucocorticoid studies have



Fig. 2.1. Deep incised lesion resulting from chronic entanglement with rope around the rostrum of an immature minke whale (*Balaenoptera acutorostrata*) from the North Sea. (Image credit: Andrew Brownlow, Scottish Marine Animal Stranding Scheme (SMASS).)



Fig. 2.2. Ventral view of a North Atlantic right whale (NARW) (*Eubalaena glacialis*), showing damage caused by rope entanglement around both flippers. The animal was significantly decomposed having lost most of its skin post-mortem. The animal died 6 months after it was last sighted alive, without an entanglement. (Image credit: Virginia Aquarium. Permit No. 932-1905-01-MA-009536-1.)

shown markedly elevated stress hormone levels in a severely entangled right whale (Hunt *et al.*, 2006), and the relationships between entanglement stress and metabolic rate are complex. Long-term stress from being chronically wrapped in gear may explain why examined whales were unable to fight off the initial insult of infected gear lacerations, most likely leading to their demise (Cassoff *et al.*, 2011). Many baleen whales are able to release themselves from fishing line or net, or are disentangled by humans, as evidenced by scarring patterns on many individuals (Knowlton *et al.*, 2005; Mathewson, 2012). However, visual health assessment of NARW using photographs has demonstrated that stress responses existed that may have impacted health and fecundity even after the gear was no longer attached (Pettis *et al.*, 2004). Lethal entanglement events are the extreme and relatively infrequent end of a more widespread, persistent and repetitive problem and the cost of non-lethal entanglement, in terms of energy, stress and pain, may significantly reduce fecundity in NARW (Moore and van der Hoop, 2012). Ultimately entanglements can lead to eventual lethal trauma

through a drawn-out cumulative loss of body condition and constriction of body parts, with or without secondary infection, and the level of pain and stress is presumably extreme (Moore and van der Hoop, 2012). Lethal entanglements of baleen whales (Fig. 2.3) are, arguably, one of the worst forms of human-caused mortality in any wild animal (Cassoff *et al.*, 2011). Both the US Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA) prevent activities which harass, harm or kill NARWs, but developing, implementing and enforcing regulatory measures to reduce human-caused impacts has taken years to enact and has met with only limited success. At the time of writing, political pressure to amend both the ESA and MMPA puts a question mark over the effectiveness of both legislative instruments at reducing entanglement impacts in the future.

Attempts to reduce ship strikes to NARWs can be traced back to the implementation of a Mandatory Ship Reporting System in 1999. However, it was a 2008 rule requiring vessels 20 m or longer to slow to 10 knots in seasonally managed areas, along with an apparent decrease in shipping activity, that



Fig. 2.3. A fatally entangled minke whale (*B. acutorostrata*) discovered by divers in Scottish waters. (Image credit: SMASS.)

resulted in meaningful risk reduction along the US East Coast (Conn and Silber, 2013; Silber *et al.*, 2015; van der Hoop *et al.*, 2015). Efforts to reduce entanglement risk have been developed in conjunction with the fishing industry as part of a legally mandated stakeholder process. According to Section 118(f) of the MMPA (NOAA, 1972), if anthropogenic mortality exceeds a species'/stocks' designated potential biological removal (PBR) level¹ the development of a so-called Take Reduction Team (TRT) is triggered. Federally appointed TRTs must include appropriate representatives of State and Federal Agencies, fishery managers, scientists, conservationists and fishers whose gear type is involved in the lethal takes. The TRT is an advisory body to the US NMFS and it is tasked with developing a Take Reduction Plan (TRP) to reduce these takes to below PBR within 6 months of the plan's implementation.

The first meeting of the Atlantic Large Whale (ALW)TRT was convened in 1996, and the first rule-making to mitigate fishery entanglements was released the following year. According to the NMFS, the initial large whale TRP 'emphasizes cooperation with the fishermen and takes advantage of their presence on the water to improve the disentangling effort and to enlist their aid in developing gear modifications that will reduce

bycatch while minimizing costs to the fishery' (62 FR 39157; US Government Publishing Office, 1997). Gear modifications included: (i) weak links attached to buoy lines; (ii) prescription of maximum buoy line diameters; (iii) a requirement of the use of a sinking line for buoy lines; (iv) minimum anchor strength for gillnets; and (v) seasonal fishing restrictions within portions of what was then the designated NARW critical habitat (62 FR 39157; US Government Publishing Office, 1997). In 2002, the ALWTRP was modified to include voluntary Dynamic Area Management (DAM) and mandatory Seasonal Area Management (SAM) provisions which aimed to protect aggregations of NARWs. These measures temporarily restricted fixed gear fishing within designated areas. The SAM programme focused on two well-known, high-use, habitats for NARWs where times and locations of restrictions were predetermined. The DAM programme would be triggered by sighting at least three NARWs within a 75 nautical mile (1 nautical mile = 1.1508 statute miles = 1.852 km) area and it requested that the fishery restrict its fishing in the area for at least 15 days. Both of these programmes were removed from the ALWTRP in 2009 when additional gear modifications were expected to further reduce entanglement risk.

In response to the death of a right whale calf in 2006, the ALWTRP was again modified in 2007 to permanently prohibit gillnet fishing in portions of right whale calving habitat in the south-east USA. This revision and mandatory closure came at a time when the ALWTRT was meeting to develop broad-based gear modifications along most areas of the east coast of the USA. The modifications under consideration included requiring sinking ground line in fixed gear fisheries (2008) and a strategy to increase trawl-line length in trap/pot fisheries and thereby reduce vertical line use in lobster fishing (2014). An additional Massachusetts Bay seasonal closure (February–April) was imposed in 2015. Despite over 20 years of ALWTRT meetings and numerous iterations of the ALWTRP, NMFS researchers have determined that incremental measures to modify fishing gear have failed to significantly reduce serious injury and mortality rates to NARWs (Pace *et al.*, 2014).

2.3 Out of Sight, Out of Mind?

Evidence of welfare impacts to NARW and other whales, particularly in US waters, but increasingly elsewhere too, have been mounting. Yet, existing legislation includes no provision for the protection of cetaceans from incidental entanglement on welfare grounds (Soulsbury *et al.*, 2008). Papastavrou *et al.* (2017) argue that management decisions should better reflect societal values. This would have the benefit of treating welfare and conservation issues in unison. Such a paradigm would allow for changes to be made early on before threats such as entanglement become difficult to reverse, for example because fishing methods have been allowed to develop in ways that are incompatible with entanglement reduction (Papastavrou *et al.*, 2017).

Explicit policy decisions and rigorous implementation are urgently needed to bridge the gap between our poor biological and impact knowledge and what is happening at sea (Dolman *et al.*, 2016). To this end, political will and explicit consideration of the sublethal costs of entanglement in conservation strategies and decision making are necessary. The questions about the extent of baleen whale entanglement and resulting mortality and welfare impacts must be more thoroughly investigated. Investigations into the sublethal effects of entanglement-related injury and stress on fitness are required, including improved understanding of the injuries suffered, the length of time to insensibility

and death, and the implications of individuals dying, including information on the effects on conspecifics. Evidence indicates that individual whales may suffer through multiple entanglement events over a lifetime (Knowlton *et al.*, 2012) further prolonging welfare impacts to the individual. Thus, while management has largely focused on the extreme lethal impacts of entanglement, efforts should also consider mitigation of the more widespread, persistent and repetitive problem and individual cost of non-lethal entanglement in terms of energy, stress, pain and fecundity.

Our understanding of large whale entanglements is hindered by inadequate reporting and detection on a global scale (summarized in IWC, 2010). The majority of fisheries are not monitored for entanglements by national or regional fishery commissions. In addition, entanglement mortalities are likely to be greatly underestimated, due to a low probability of detection and an apparent high rate of entanglement (Cole *et al.*, 2006). Fishery observer programmes or opportunistic reporting probably underestimate the actual rates by at least an order of magnitude, if not more in some areas (IWC, 2010). These issues may be accentuated in some places due to strict laws prohibiting the landing of protected species such as whales. This reduces the opportunities for pathologists to assess fresh carcasses where both the provenance and the gear type could be identified.

There are biases in existing entanglement data, including whale size and the species that may be present in that region. Lighter gear may tether smaller whales, while heavier gear is more likely to ‘anchor’ large whales in place, making them more likely to be observed and reported. Also, in some countries fishermen may have a strong financial incentive to report entangled whales, while in others there may be no incentive, no awareness or even perceived disincentives to reporting – such as the fear of being reprimanded or prosecuted (IWC, 2010). In addition to these biases, reports may come from a variety of both experienced and inexperienced sources, and may receive various levels of validation and screening at the country level prior to final inclusion in reports, for example to the International Whaling Commission (IWC) (IWC, 2010). It is critical that efforts are made to raise awareness of the importance of reporting entangled whales. Fishers who report entanglements should feel confident that their report will be handled in a way that does not blame or even threaten them.

'Anchored' large whales may be more likely to be observed and reported, including by a wider range of marine users such as recreational and commercial wildlife-watching vessels, and reporting of all entanglements, including mobile whales should be actively encouraged. Reporting might be incentivized in some way.

Estimating the financial impacts of entanglements on the fishing industry is a knowledge gap as economic losses incurred by fishing communities are poorly quantified. With a reliable estimate of the financial impact of fishing restrictions or gear lost due to entanglements, a common cause could be established using economic arguments to provide further motivation for the prevention of entanglements, particularly in areas of high occurrence. Data should be collected on all possible entanglement events, live sightings of entangled animals, and strandings. Necropsies can provide fuller information, including assessment of the health of the individual and detail of the injuries sustained due to entanglement. Full case reports would be useful if provided for all whale entanglement response events. These case reports should, where possible, be living documents that include: (i) an overview of entanglement responses (disentanglement efforts); (ii) action plan(s) developed; (iii) operational debriefings; (iv) photo-documentation; (v) gear investigation report; and (vi) animal assessment (including case history information prior to and following the entanglement response, as available) (IWC, 2011). The IWC recently recommended that coastal nations establish adequate programmes for monitoring entanglement of whales, and that member countries report to the IWC through national progress reports (IWC, 2010). The issue of reporting and reducing entanglements needs to be elevated to all stakeholders including fishermen, scientists, non-governmental organizations (NGOs) and decision makers, and efforts might usefully include cross-border/international collaboration. Longitudinal studies should be encouraged to provide information on the rate and evidence of entanglement and survival (Robbins *et al.*, 2009, 2015).

Expansion of large whale disentanglement response networks is required, such as that led by the IWC, as well as standardized data collection, follow-up and, in particular, post-release monitoring of animals following disentanglement interventions (IWC, 2010). Inadequate marking of fishing gear makes it impossible to determine the fishery of

origin, the physical part of the gear involved, and the geographical location of where the gear was set. Gear removed from entangled whales should be collected, analysed and archived where possible and the information obtained be used to prevent future entanglements, and to this end individual identification of all gear would be useful. Any dead whale that has been entangled should receive a complete necropsy upon death when this is feasible (IWC, 2010). Additional key research requirements include improved understanding of the mechanisms by which whales become entangled in gear, as well as ongoing development and evaluation of gear modifications to reduce entanglement risk. Collecting a suite of accurate information from both entangled and disentangled whales based on long-term sighting histories, knowledge of entanglement outcomes and inferences from annual entanglement wound acquisition are recommended (IWC, 2010). An international database, as discussed previously (IWC, 2015) would be beneficial, but consideration is required of onerous reporting and vetting processes as well as the associated database maintenance and implementation costs. The successful efforts to establish, promote and implement the global IWC ship strike database serves as a positive example.

Measures proposed to reduce entanglements include measures to modify the gear, for example the use of weaker rope, weak links, sinking lines, pop-up pots, coloured ropes, longer or shorter pot lines, neutrally buoyant lines, and the use of sinkers on lead lines. Yet, entanglements continued to increase in the north-west Atlantic in spite of the implementation of measures such as weak links on buoy lines and sinking ground lines between fishing traps and pots (Pace *et al.*, 2014). While it is impossible to determine if these measures resulted in a slower rate of increase than would have occurred without them, it is clear that different or additional mitigation measures are required. The success of some of these measures is likely to be species- and site-specific and dependent on the percentage of the fishing fleet that implement them. Caution is warranted regarding the scale of required implementation to effect any positive reduction in entanglements. As an example, to reach the 72% proposed reduction in mortalities to NARW from entanglement, using weaker ropes would require gear changes to be coast-wide in the USA and have a reduced breaking strength throughout the entire length of the line (new) (i.e. not weak links) (Knowlton *et al.*,

2016). It is important to note that this modification would not reduce entanglements per se, but potentially reduce serious injuries and mortalities.

2.4 What Can Be Done to Reduce Whale Entanglements?

The ultimate solution to the issue of large whale entanglements is prevention (IWC, 2011). Entanglement is not inevitable. There are ways to minimize unintended mortality and welfare impacts by avoiding areas where endangered or vulnerable species or small populations are known to be present, and through ongoing enforcement of monitoring and mitigation to enable quantitative metrics and to improve compliance.

Myers *et al.* (2007) suggested that reduced fishing effort in the American lobster fishery would not only reduce entanglement risk but could be economically advantageous to fishermen as reduced fishing effort did not appear to significantly impact yield of target species. Therefore, measures to reduce entanglements might include a reduction in overall fishing effort, to include a cap on the number of pots, boats or time at sea, although it is important that such measures would be cognisant of possible displacement impacts (fishers taking up other fishing activity) which could elevate risk of entanglement in other locations. Other measures might include either spatial or seasonal restrictions, or providing fishing rights to fishermen using gear effective in reducing entanglements.

Experimentation on visibility of rope should be investigated further. Kraus *et al.* (2014) found a statistically significant difference in reaction of NARW to differently coloured mimic lines in Cape Cod Bay. However, consideration must be made for lines which are used at greater depth, night fishing and the potential attraction to certain colours by different species. In Canada, floating lines were replaced with neutrally buoyant lines in 50 trap strings, and the entanglement rate appears to have diminished from two to three humpback whales per year to none observed since the modification was implemented (IWC, 2015).

Best practice should include: (i) minimizing rope length and so eliminating unnecessary slack in the surface system and line profile; (ii) not leaving inactive gear in the water to maintain territory; and (iii) minimizing soak time. An overall reduction in the amount of rope used might be achieved by regulating the number of pots per fleet and, where possible, the

spacing between pots. But careful consideration must be taken to ensure that the trade-off between reduced rope and increased risk of fatality for longer sets of gear is optimized, and this will be specific to certain regions, depending on species assemblage and age cohorts (i.e. big versus small whales). Minke whale entanglements have a higher fatality rate and are less likely to be noted ante mortem, because minke whales are not such powerful swimmers as humpbacks and may be less likely to reach the surface to breathe while entangled (Knowlton *et al.*, 2016). Emerging research on ropeless fishing techniques should also be considered (Partan and Ball, 2016), but the success of this approach will be dependent on local dynamics in fisheries. For example, while uncommon, ocean zoning has effectively minimized gear conflict between mobile and fixed gear fisheries in some areas (Kaiser, 2014). As such, zoned fishing areas for different gear types may reduce the need for surface markers and therefore reduce the amount of rope in the water column.

Effective bycatch mitigation will require coordinated actions by the range of stakeholders to develop a combination of technological gear fixes, changes in fishing practices, modification of fishing effort and international agreements that, together, can monitor and reduce levels of bycatch (Lewison *et al.*, 2004).

Managers should gather baseline data on the number of lines used, temporal and spatial fishing effort, and estimated gear loss (and reasons, where known) for all fisheries, including pots, as well as the temporal and spatial distribution of large whales. This information should be regularly updated to review for any changes in fishing effort or whale distribution. In some areas, these data may be useful in examining risk in a spatially explicit manner and may also help establish a baseline for the potential financial impact of gear lost to entanglement. Adequate management should also include providing funds for any mitigation measures taken, and for monitoring efforts to test the effectiveness of such measures. In most areas, entanglement is not an intentional practice, and many fishermen are involved in strategies to reduce the accidental capture of whales. All solutions are dependent on positive relationships and involvement with fishermen. Participation of fishermen in the management process is necessary (Bisack and Das, 2015), and bycatch reduction approaches can be implemented successfully from the bottom up (Teh *et al.*, 2015), and individual level incentive-based management measures are likely to be more effective, depending

upon long-term maintenance. Furthermore, an economic case for entanglement reduction is likely to gain greater traction with the fishing industry compared with arguments couched solely on welfare and conservation grounds. As such, in regions where it is likely to be beneficial, efforts to quantify the gear lost due to entanglements should be a priority for fishers, conservationists and management alike.

Global efforts to mitigate entanglements vary. The IWC has put in place a programme for entanglement response and carried out three workshops on large whale entanglement issues (IWC, 2010, 2011, 2015). Ongoing expansion of global disentanglement training effort would be beneficial, including for fishermen. The cumulative effects of individuals experiencing repeated entanglements should be more thoroughly reviewed. At the same time, it is important to consider that entanglements to individuals and populations do not happen in isolation. Along with fishery-related entanglements, large whales are simultaneously impacted by chemical and noise pollution, the effects of climate change, ocean acidification, offshore energy, vessel strikes, and, in some areas, whaling. Aiming to implement policies to address entanglement in isolation should be avoided. Furthermore, policies which require evidence of population-level effects before actions are taken, may be putting these animal populations at risk, because it takes many years and adequate levels of monitoring to acquire good evidence (Taylor *et al.*, 2006).

Incremental mitigation measures implemented to date have had limited beneficial results for NARW. With this in mind, a focus is required on entanglement prevention and reduction, and efforts to minimize other pressures that this population and other whales face. As entanglements are certain to continue, an increase in understanding of the sublethal costs of whale entanglements and an appropriate level of response are both essential.

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Note

¹ Potential biological removal (PBR) level: the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (US code reference for definition of PBR: 16 U.S.C. § 1362(20)).

References

- Bisack, K.D. and Das, C. (2015) Understanding non-compliance with protected species regulations in the Northeast USA Gillnet Fishery. *Frontiers in Marine Science* 2, 91. DOI: 10.3389/fmars.2015.00091
- Cassoff, R.M., Moore, K.M., McLellan, W.A., Barco, S.G., Rotstein, D.S. and Moore, M.J. (2011) Lethal entanglement in baleen whales. *Diseases of Aquatic Organisms* 96, 175–185.
- Cole, T., Hartley, D. and Garron, M. (2006) Mortality and serious injury determinations for baleen whale stocks along the eastern seaboard of the United States, 2000–2004. Reference Document 06-04, Northeast Fisheries Science Center, Gloucester, Massachusetts.
- Conn, P.B. and Silber, G.K. (2013) Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. *Ecosphere* 4, 43. DOI: 10.1890/ES13-00004.1
- Dolman, S.J., Baulch, S., Read, F., Ritter, F. and Evans, P. (2016) Towards an EU Action Plan on cetacean bycatch. *Marine Policy* 72, 67–75.
- Hunt, K.E., Rolland, R.M., Kraus, S.D. and Wasser, S.K. (2006) Analysis of fecal glucocorticoids in the North Atlantic right whale (*Eubalaena glacialis*). *General and Comparative Endocrinology* 148, 260–272.
- International Whaling Commission (IWC) (2010) Report of the Workshop on Welfare Issues Associated with the Entanglement of Large Whales. IWC/62/15. Available at: <https://iwc.int/private/downloads/Gfdl-xvNM2BPpwF9XMuQw/Report%20of%20First%20IWC%20Workshop%20on%20Large%20Whale%20Entanglement.pdf> (accessed 5 September 2017).
- International Whaling Commission (IWC) (2011) Report of the Second IWC Workshop on Welfare Issues Associated with the Entanglement of Large Whales with a Focus on Entanglement Response. IWC/64/WKM&AWI REP1. Available at: https://iwc.int/private/downloads/7gymI5V2qIJ_ekqPLQ5ZTQ/Report%20of%20Second%20IWC%20Workshop%20on%20Large%20Whale%20Entanglement.pdf (accessed 5 September 2017).

- International Whaling Commission (IWC) (2015) Report of the Third Workshop on Large Whale Entanglement Issues. Provincetown, Massachusetts, 21–23 April 2015. SC/66a/COMM/2. Available at: https://archive.iwc.int/pages/search.php?search=!collection220&bc_from=themes (accessed 5 September 2017).
- International Whaling Commission (IWC) (2016) Report of the Workshop to Support the IWC's Consideration of Non-Hunting Related Aspects of Cetacean Welfare. IWC/66/WKM&WI Rep 01. Available at: <https://iwc.int/iwc-workshop-on-welfare-may-2016> (accessed 5 September 2017).
- Johnson, A., Salvador, G., Kenney, J., Robbins, J., Kraus, S. *et al.* (2005) Fishing gear involved in entanglements of right and humpback whales. *Marine Mammal Science* 21(4), 635–645.
- Kaiser, M.J. (2014) The Conflict Between Static Gear and Mobile Gear in Inshore Fisheries. Report produced for the European Parliament's Committee on Fisheries. Available at: [http://www.europarl.europa.eu/RegData/etudes/STUD/2014/529070/IPOL_STU\(2014\)529070_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2014/529070/IPOL_STU(2014)529070_EN.pdf) (accessed 5 September 2017).
- Knowlton, A.R., Marx, M.K., Pettis, H. and Hamilton, P.K. (2005) *Scarification Analysis of North Atlantic Right Whales* (*Eubalaena glacialis*): *Monitoring Rates of Entanglement Interaction*. Technical Report 43EANF030107, National Marine Fisheries Service, England Aquarium, Central Wharf, Boston, Massachusetts.
- Knowlton, A.R., Hamilton, P.K., Marx, M.K., Pettis, H.M. and Kraus, S.D. (2012) Monitoring North Atlantic right whale *Eubalaena glacialis* entanglement rates: a 30 yr retrospective. *Marine Ecology Progress Series* 466, 293.
- Knowlton, A.R., Robbins, J., Landry, S., McKenna, H.A., Kraus, S.D. and Werner, T.B. (2016) Effects of fishing rope strength on the severity of large whale entanglements. *Conservation Biology* 30(2), 318–328. DOI: 10.1111/cobi.12590
- Kraus, S., Fasick, J., Werner, T. and McFarron, P. (2014) Enhancing the visibility of fishing ropes to reduce right whale entanglements. *Bycatch Reduction Engineering Program* 1, 67–75.
- Lambertsen, R.H., Rasmussen, K.J., Lancaster, W.C. and Hintz, R.J. (2005) Functional morphology of the mouth of the bowhead whale and its implications for conservation. *Journal of Mammalogy* 86, 342–352.
- Leaper, R., Papastavrou, V. and Sadler, L. (2006) Consideration of factors affecting time to death for whales following entanglement in fishing gear. Paper IWC/58/WKM&AWI 14 presented to International Whaling Commission, 6 pages. Available at: https://iwc.int/document_1762 (accessed 5 September 2017).
- Lewison, R.L., Crowder, L.B., Read, A.J. and Freeman, S.A. (2004) Understanding impacts of fisheries bycatch on marine megafauna. *Trends in Ecology and Evolution* 19, 598–604. DOI: 10.1016/j.tree.2004.09.004
- Mathewson, A. (2012) Non-lethal entanglement of minke whales (*Balaenoptera acutorostrata*) in fishing gear in the Hebrides. BSc thesis, University of St Andrews, Scotland, UK.
- Moore, M.J. and van der Hoop, J.M. (2012) The painful side of trap and fixed net fisheries: chronic entanglement of large whales. *Journal of Marine Biology*. Available at: <https://www.hindawi.com/journals/jmb/2012/230653/> (accessed 21 February 2018).
- Moore, M.J., Bogomolni, A., Bowman, R., Hamilton, P., Harry, C. *et al.* (2006) Fatally entangled right whales can die extremely slowly. Paper presented at *Conference, Oceans '06 MTS/IEEE*, 18–21 September 2006, Boston, Massachusetts.
- Myers, R.A., Boudreau, S.A., Kenney, R.D., Moore, M.J., Rosenberg, A.A. *et al.* (2007) Saving endangered whales at no cost. *Current Biology* 17, R10–R11.
- National Oceanic and Atmospheric Administration (NOAA) (1972) Marine Mammal Protection Act of 1972. Available at: <http://www.nmfs.noaa.gov/pr/pdfs/laws/mmpa.pdf> (accessed 20 February 2018).
- Pace, R.M., Cole, T.V.N. and Henry, A.G. (2014) Incremental fishing gear modifications fail to significantly reduce large whale serious injury rates. *Endangered Species Research* 26, 115–126. DOI: 10.3354/esr00635
- Papastavrou, V., Leaper, R. and Lavigne, D. (2017) Why management decisions involving marine mammals should include animal welfare. *Marine Policy* 79, 19–24.
- Partan, J. and Ball, K. (2016) Ropeless Fishing Technology Development. Report no. # NA10NMF4520343 for the Consortium for Wildlife Bycatch Reduction. Available at: http://www.bycatch.org/sites/default/files/Partan%26Ball_2016.pdf (accessed 5 September 2017).
- Pettis, H.M., Rolland, R.M., Hamilton, P.K., Brault, S., Knowlton, A.R. and Kraus, S.D. (2004) Visual health assessment of North Atlantic right whales (*Eubalaena glacialis*) using photographs. *Canadian Journal of Zoology* 82, 8–19.
- Robbins, J. and Mattila, D.K. (2001) Monitoring entanglements of humpback whales (*Megaptera novaeangliae*) in the Gulf of Maine on the basis of caudal peduncle scarring. Report to the 53rd Scientific Committee Meeting of the International Whaling Commission, Hammersmith, UK. Document No. SC/53/NAH25.
- Robbins, J., Landry, S. and Mattila, D. (2009) Estimating entanglement mortality from scar-based studies. Paper presented to the *Scientific Committee Meeting of the International Whaling Commission*, 22–25 June 2009, Madeira, Portugal, SC/61/BC3.
- Robbins, J., Knowlton, A.R. and Landry, S. (2015) Apparent survival of North Atlantic right whales after entanglement in fishing gear. *Biological Conservation* 191, 421–427.

- Ryan, C., Leaper, R., Evans, P.G.H., Dyke, K., Robinson, K.P. *et al.* (2016) Entanglement: an emerging threat to humpback whales in Scottish waters. Paper presented to the Scientific Committee Meeting of the International Whaling Commission, 20–28 October 2016, Portoroz, Slovenia, SC/66b/HIM/01. Available at: http://www.seawatchfoundation.org.uk/wp-content/uploads/2016/12/Ryan_et-al_IWC.pdf (accessed 20 February 2018).
- Saez, L., Dawson, D., DeAngelis, M., Petras, E., Wilkin, S. and Fahy, C. (2013) Understanding the co-occurrence of large whales and commercial fixed gear fisheries off the west coast of the United States. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum National Marine Fisheries Service (NMFS) NOAA-TM-NMFS-SWR-044. Available at: http://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/noaa-tm-nmfs-swr-044_final.pdf (accessed 5 September 2017).
- Silber, G.K., Adams, J.D., Asaro, M.J., Cole, T.V.N., Moore, K.S. *et al.* (2015) The right whale mandatory ship reporting system: a retrospective. *PeerJ* 3, e866. DOI: 10.7717/peerj.866
- Song, K.-J., Kim, Z.G., Zhang, C.I. and Kim, Y.H. (2010) Fishing gears involved in entanglements of minke whales (*Balaenoptera acutorostrata*) in the East Sea of Korea. *Marine Mammal Science* 26, 282–295.
- Soulsbury, C.D., Iossa, G. and Harris, S. (2008) The animal welfare implications of cetacean deaths in fisheries. A University of Bristol report to the Whale and Dolphin Conservation Society (WDC). Available at: <http://uk.whales.org/sites/default/files/wdc-bycatch-report-2008.pdf> (accessed 5 September 2017).
- Taylor, B.L., Martinez, M., Gerrodette, T., Barlow, J. and Hrovat, Y.N. (2006) Lessons from monitoring trends in abundance of marine mammals. *Marine Mammal Science* 23, 157–175.
- Teh, L.S.L., Teh, L.C.L., Hines, E., Junchompoo, C. and Lewison, R.L. (2015) Contextualising the coupled socio-ecological conditions of marine megafauna bycatch. *Ocean and Coastal Management* 116, 449–465.
- US Government Publishing Office (1997) 62 FR 39157. Available at: <https://www.gpo.gov/fdsys/pkg/FR-1997-07-22/html/97-18997.htm> (accessed 21 February 2018).
- van der Hoop, J.M., Moore, M.J., Fahlman, A., Bocconcelli, A., George, C. *et al.* (2013) Behavioral impacts of disentanglement of a right whale under sedation and the energetic cost of entanglement. *Marine Mammal Science* 30(1), 282–307. DOI: 10.1111/mms.12042
- van der Hoop, J.M., Corkeron, P., Kenney, J., Landry, S., Morin, D. *et al.* (2015) Drag from fishing gear entangling North Atlantic right whales. *Marine Mammal Science* 32(2), 619–642. DOI: 10.1111/mms.12292
- Waring, G.T., Josephson, E., Maze-Foley, K. and Rosel, P.E. (eds) (2015) *US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2014*. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NMFSNE 231; 361 pp. DOI: 10.7289/V5TQ5ZH0
- Young, M.O. (2015) Marine animal entanglements in mussel aquaculture gear. Documented cases from mussel farming regions of the world including first-hand accounts from Iceland. MSc thesis, University of Akureyri, Iceland, 121 pp. Available at: http://skemman.is/stream/get/1946/22522/50582/1/CMMthesis_final_Madeline_Young.pdf (accessed 5 September 2017).

3

The Welfare Effects of PCBs in the Ocean

MARK PETER SIMMONDS

3.1 Introduction

One of the penalties of an ecological education is that one lives alone in a world of wounds. Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either harden his shell and make believe that the consequences of science are none of his business, or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise.

(Aldo Leopold from his essay 'The Round River: A Parable' (c.1940–1948); Leopold, 1993)

In the world of animal issues, and perhaps especially at an international level, animal welfare lags far behind conservation in terms of interest and investment of time and money. Yet how we treat the other living, feeling and sentient animals around us is clearly a mark of our own humanity. The way I look at it is that, even if the world ends tomorrow, at least we should feel that we have tried to make sure that those non-human beings around us have had lives as free from unnecessary pain and other suffering as possible.

This is a book about challenges in a changing world, and one of the challenges faced when considering the topic of this chapter is that chemistry is such a 'turn-off' for many people. When faced with a chemical formula or long chemical name (both of which are coming up shortly), some people will flee from the topic and swiftly go and read something else instead. Memories of days trapped in a schoolroom, baffled or indifferent to layers of formulae on the whiteboard, may be to blame. However, this chapter is more about history and philosophy (with some biology and just a touch of chemistry thrown in), so please persevere.

The polychlorinated biphenyls (or PCBs) are a group of persistent organic pollutants (or POPs). They persist in the environment, accumulate in the bodies of animals and in food webs, and pose a risk

of adverse effects in humans and wildlife (UNEP, 2017a). Their story has now become a long-running saga across many decades and in which there are four 'acts'. In the first they are created and used widely. In the second they are identified as a major environmental problem. Next (act three) they are outlawed; production ends and levels in the environment fall, but then comes an unexpected recent twist in the fourth and latest part of this saga. This is that, in some places, levels have *not* continued to fall but, instead, the decline has levelled off and concentrations in the tissues of some biota remain high enough to be of concern for conservation and also, as this chapter seeks to establish, to be a significant and widespread welfare concern.

3.2 A Short History of PCBs

PCBs do not occur naturally. They were first synthesized in 1881 and became commercially available around 1930 (Tyler and Goodhead, 2010). Consisting of carbon, hydrogen and chlorine atoms, the number of chlorine atoms and their locations in the molecules determine their properties (Fig. 3.1). There are 209 PCBs recognized today (known as congeners) and they consist of biphenyl rings with varying numbers of chlorine atoms attached in varying positions. These chemicals were typically manufactured as mixtures of 60–90 different congeners and, in concentrated form, PCBs are either oily liquids or solids. As the number of chlorine atoms in a PCB mixture increases it becomes less combustible and PCBs with the largest numbers of chlorine atoms are the more stable and thus resistant to biodegradation. Hence, the most chlorine-dense congeners are the most problematic. They fit well into the category of environmental threat that Aldo Leopold would have called 'quite invisible to laymen', with no known taste or smell. Their non-flammability, chemical stability, high boiling point

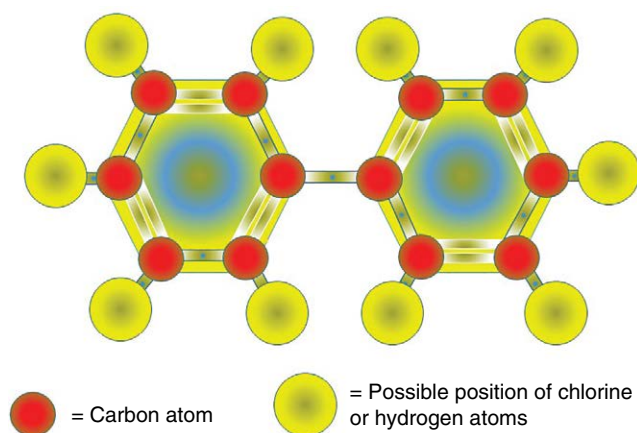


Fig. 3.1. The generic chemical formula for PCBs is $C_{12}H_{10-x}Cl_x$. The 209 recognized congeners consist of joined phenyl rings of carbon atoms with varying numbers of attached chlorine and hydrogen atoms. (Image credit: M.P. Simmonds.)

and electrical insulating properties caused them to be used in hundreds of industrial and commercial applications including: (i) electrical, heat transfer and hydraulic equipment; (ii) plasticizers in paints, plastics and rubber products; and (iii) as pigments and dyes.

The products that may contain PCBs include (EPA, 2017a):

- transformers and capacitors;
- electrical equipment – voltage regulators, switches, bushings, electromagnets;
- oil used in motors and hydraulic systems;
- old electrical devices or appliances containing PCB capacitors;
- fluorescent light ballasts;
- cable insulation;
- thermal insulation material including fibreglass, felt, foam and cork;
- adhesives and tapes;
- oil-based paint;
- caulking materials;
- plastics;
- carbonless copy paper; and
- floor finishes.

The stable, heat-resistant nature of PCBs, combined with their high dielectric constant, meant that they were widely used as coolants for large transformers (Peterle, 1991). (This particular use remains important, as the disposal of these transformers can be a significant source of PCB release into the wider environment.) Once released from their original uses – perhaps when equipment was

dumped – and free in the environment, PCBs were transported by leaching, volatilization and movement in air, the last being particularly important in terms of causing widespread contamination. For example, it was estimated that more than 80% of the PCBs deposited in Lake Michigan were transported there in the air (Peterle, 1991).

These compounds started to spread around the world and high levels were soon detected in predatory species and in aquatic systems. Rachel Carson identified the potentially devastating effects of POPs on wildlife in the early 1960s and wrote about them to good effect in her book *Silent Spring* (Carson, 1962). Further to this book, and mounting evidence of impacts combined with growing public concern, a ban on PCB manufacture followed in 1979 in the USA. Similarly, use and manufacture were then banned in the UK in 1981 and, in 1987, across Europe. Environmental levels then started to fall slowly in biota sampled from around the world (Jepson and Law, 2016).

Over several decades, highly refined scientific detective work – using sensitive detection tools that allow trace concentrations to be identified and measured in wildlife and the wider environment – has pieced together not only the degree of contamination of wildlife, but also the pathways along which these contaminants are passed and, also, the ways in which PCBs and similar compounds can affect animals. Contaminant-induced endocrine disruption (modification of hormone systems) in wildlife emerged as a recognized and widespread phenomenon in the early 1990s, although there was already some knowledge of this based on laboratory

studies dating from the 1930s (Tyler and Goodhead, 2010). Importantly (and unfortunately) for marine mammals and other top predators, PCBs bioaccumulate up the food chain, with the highest concentrations and greatest impacts at the apex.

Hundreds (probably thousands) of scientific papers now detail the work that has gone into examining the presence, levels, and effects of PCBs and other POPs in wildlife. For example, Cockcroft *et al.* (1989) provided key evidence when they looked at contaminant levels in a large sample of bottlenose dolphins (*Tursiops truncatus*) that had died in shark nets off Natal in South Africa. The sample showed that levels of PCBs, and some other POPs, increased with age in the male dolphins sampled and the researchers suggested that levels could be reached that would impair the production of male hormones. In contrast, in the females sampled, levels increased until the age when they started to reproduce, when levels then decreased because of 'offloading' to their offspring – as a result of the high concentrations of POPs which were passed to the calves (mostly in mother's milk) and mainly to the first-born calf. Based on the concentrations observed, the researchers suggested (perfectly reasonably) that calves – especially the first-borns – might be physiologically impaired or even killed outright by the quantities of PCBs passed to them. This basic pattern of bioaccumulation with age, and transfer to the young, is now known to be widespread and was also well documented for seals and other pinnipeds by the early 1990s, by which time it had also been associated with a range of disorders (Hutchinson and Simmonds, 1994; Reijnders, 1996). Pollution-associated endocrine disruption has also been reported from a wide range of other wild mammals such as the Florida panther (*Puma concolor coryi*), Eurasian otter (*Lutra lutra*), black bear (*Ursus americanus*), grizzly bear (*Ursus arctos horribilis*), polar bear (*Ursus maritimus*) and white-tailed deer (*Odocoileus virginianus*) and associated effects include masculinization and genital deformities (Tyler and Goodhead, 2010).

As noted above, the latest part of the PCB story – and hopefully not the final act – was revealed by new scientific detective work led by Paul Jepson, Robin Law and their colleagues in the UK (Jepson and Law, 2016; Jepson *et al.*, 2016; Law and Jepson, 2017). This shows that, in some cetacean populations, PCB declines had recently levelled off: specifically Jepson *et al.* (2016) looked at a large sample of harbour porpoise material (*Phocoena phocoena*) from the

north-east Atlantic and striped dolphins (*Stenella coeruleoalba*) from the western Mediterranean. In the porpoises, PCBs declined slowly from 1990 to 1998 and then remained relatively stable. In the dolphins there was a marked decline but then stabilization from 2003. This might, perhaps, not have been an issue if the levelling off was at concentrations of no concern, but this was not the case. In many of the animals, blubber PCB concentrations consistently exceeded established toxicity limits and, in fact, striped dolphins, bottlenose dolphins, and orcas (*Orcinus orca*) all had mean PCB levels that markedly exceeded all known marine mammal PCB toxicity thresholds (Jepson *et al.*, 2016). What this meant, building on earlier research, was that there was a very strong likelihood, supported by carefully collected scientific evidence, that such animals were having their health negatively impacted.

Moreover, population declines in these same species have been ascribed to reproductive failure and this is consistent with the observed detection of high PCB concentrations in adult females (Jepson *et al.*, 2016). Jepson *et al.* (2016) also identified particular hot spots for PCBs in marine mammals in Europe, such as the western Mediterranean Sea and South-west Iberia but they also noted that all regions of Europe have high PCBs compared with non-European countries.

Another recent study, which measured female reproductive success, provides an important insight into the proportion of wild populations that can be significantly impacted by PCB toxicity. Murphy *et al.* (2015) investigated a large sample of harbour porpoises from around the UK and found that almost 20% of females showed direct evidence of reproductive failure (fetal death, abortion, dystocia or stillbirth) and another 16.5% had infections or tumours of the reproductive tract that could contribute to reproductive failure.

Jepson and colleagues stress that orcas (Fig. 3.2), also known as killer whales (although they are in fact a large dolphin species), are being very significantly impacted by the effects of PCBs. Found all around the world, but mainly in colder waters, orcas live in populations that exhibit a very high degree of specialization in range and diet. For example some groups eat large bony fish, others prey on other marine mammals (seals and/or whales) and others specialize in eating elasmobranchs (sharks and rays). These diets all put them high on, or at the very apex of, marine food chains and, therefore, expose them to significant quantities of PCBs and



Fig. 3.2. Orcas (*Orcinus orca*), also known as killer whales, in Iceland. Orcas are regarded as the most vulnerable species to PCB toxicity because of their position at the top of the marine food chain. (Image credit: Rob Lott.)

other persistent pollutants. A strong link has been made between this exposure and the fact that there are now only a few remaining coastal populations of orcas in Europe and that these, in the most industrialized regions of Europe, are close to extinction (Jepson and Law, 2016; Jepson *et al.*, 2016).

In addition to adverse effects on reproduction, PCBs are regarded as carcinogens and Jepson *et al.* (2016) also identified pathological findings that were consistent with increased susceptibility to disease, including macro-parasitic and bacterial pneumonias, high lung (upper airway) and gastric macro-parasite burdens, and septicæmias (bacterial infections). Figure 3.3 shows some of the pathways of PCBs in the environment.

3.3 Addressing the PCB Threat

Writing in 1996, Peter Reijnders, noted that it was clear that PCB levels had declined in areas where there were local sources, such as Lake Ontario and the Baltic Sea, and he ascribed this to regulation of disposal and restrictions on use. Levels in marine

biota in the Baltic had fallen, but then levelled off by the end of the 1980s, and there was a similar pattern reported from polar bears in the Arctic (Reijnders, 1996). More recently, Stuart-Smith and Jepson (2017) comment that after the general fall in levels, ‘many scientists and policy makers may have been forgiven for thinking that the PCB problem was effectively solved and that PCB levels would continue to decline sharply for many years to come’. Simmonds (2017) commented, similarly, that for environmental campaigners, the issue may have appeared to have been addressed, and that they, too, then moved on to other matters.

However, a 1989 preliminary ‘inventory’ of PCB sources provided an early warning about the quantities of PCBs yet to move into the environment (Maquenie and Reijnders, 1989, cited in Reijnders, 1996). This report suggested that more than 2 million tons of PCBs had been produced and that, until that point, only 1% of this manufactured material had reached the oceans; as around 30% had accumulated (temporarily) in dump sites and the sediments of lakes, estuaries, and coastal zones. More recently,

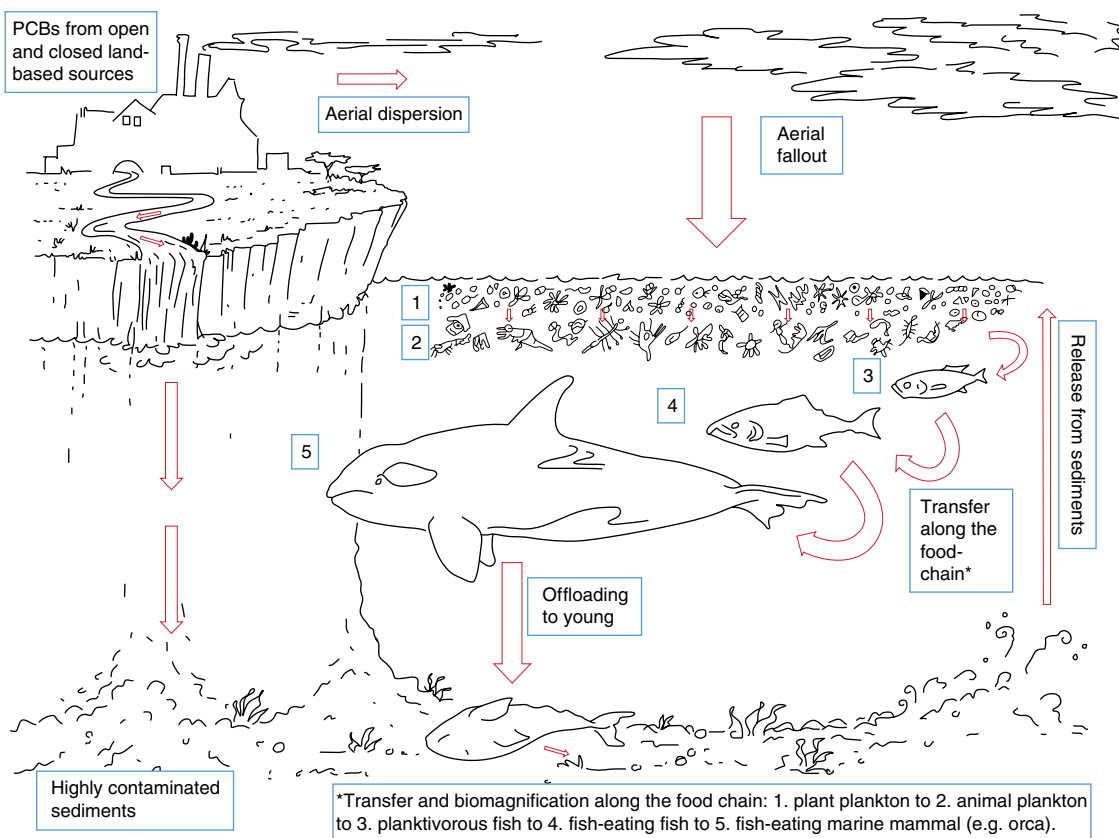


Fig. 3.3. A diagram showing some of the main pathways of PCBs in the environment. (Image credit: M.P. Simmonds.)

a 2015 United Nations Environment Programme assessment estimated that the vast majority of PCB-contaminated equipment and materials, estimated at around 14 million t, still requires elimination (Stuart-Smith and Jepson, 2017). The Advisory Committee of the PCB Elimination Network (PEN – a body established at the fourth meeting of the Stockholm Convention) has recently highlighted that countries are ‘far from achieving the 2025 and 2028 goals of the Stockholm Convention’ (UNEP, 2017b). In fact, it is now estimated that only some 17% of the total amount of PCBs have been eliminated, whereas about 83% remain to be eliminated. PEN has called for realistic and urgent global and national strategies to be launched as soon as possible. Moreover, while much attention to date has been focused on use in physical equipment (particularly electrical equipment), attention is now also being drawn to a growing contempo-

rary threat from ‘open applications’ of PCBs, in materials such as solvents and sealants (Stuart-Smith and Jepson, 2017).

Set against this problem is a general lack of public appreciation of the PCB threat, although an indication that PCBs are again becoming a ‘hot topic’ in public view can be gained by considering recent news media. For example, the ‘word cloud’ in Fig. 3.4 is based on news items from May to July 2017. (The size of words reflects the degree of recurrence of the word in the sampled text.) This snapshot survey suggests greatest interest in PCBs in the USA and that this is focused around the activities of the United States Environmental Protection Agency (EPA) and clean-ups, especially of the Hudson River. However, several news stories during this period also relate to the contamination of whales – hence the presence of the words ‘orca’, ‘killer’, ‘whale’ and ‘Lulu’ in the word search. ‘Lulu’

- identifying and cleaning up highly contaminated areas such as dump sites and sediments in rivers and estuaries.

3.4 Making the Link to Animal Welfare Concerns

Maddalena Bearzi, an experienced field biologist, wrote the following in her excellent book *Dolphin Confidential – Confessions of a Field Biologist*:

I can't begin to count the times I've logged hours collecting data on dolphins feeding near a storm-drain outflow, in water the colour of dirt. And whilst they superficially appeared 'happy' and well, to me, it did not mean that they were not suffering the effects of exposure to pollutants . . . the more time I spent following dolphins in the wild, then scrolling through thousands of images [of the dolphins] . . . the more I began to recognize that the creatures I was studying weren't doing so well after all. I noticed signs of poor health in the form of lesions, spots and open sores on their bodies.

(Bearzi, 2012)

She goes on to say that nearly 80% of the animals in her study had some form of dermal lesion and that she also observed physical deformities including of the animals' spines. This is Leopold's 'world of wounds' and Bearzi is showing us, through her experienced eye, that the dolphin's fixed smile is not enough to guarantee its good health. She alerts her readers to a possible link between what she has observed and their polluted environment.

Putting cause and effect together for something observed in the wild is, however, never easy, neither in terms of investigation nor in terms of achieving proof that is acceptable to all parties. Skin lesions and other health concerns for wild dolphins (like any other wild animal) will be affected by many factors. These include: (i) genetic aspects (creating predisposition to particular diseases); (ii) nutritional status; (iii) exposure to disease and naturally occurring toxins (such as those generated by toxic algal blooms which are sometimes called red tides); (iv) wounds created by fighting, aggressive social interactions or predator interactions; and (v) other factors that may cause stress or other negative physiological changes, including sea temperature. Some factors may also act together synergistically. For example, much of the PCB contaminant load in a marine mammal is held in its fatty blubber layer – reflecting the fat-soluble nature of these compounds. A marine mammal failing

to find adequate prey, will mobilize the lipids stored in its blubber, bringing together poor nutritional status with increased exposure (from internal release) to these toxins. The same may apply to an animal affected by a viral infection, and not feeding properly, as its immune system is trying to fight off the infection. An internally sourced 'extra dose' of PCBs and similar compounds may be released as the animal loses body condition, perhaps further incapacitating its immune function at precisely the time when it needs it most!

Research to date shows that the survival of some, and the health of a great many more, marine animals – and especially marine top predators – is quite possibly being affected by PCBs (and in addition to the references cited above see, for example, Vos *et al.* (2000), Jepson *et al.* (2005) and Roos *et al.* (2012)). Wild animals are, of course, affected by many different factors across their lifetimes and, while the focus of this chapter is on PCBs, other endocrine-disrupting contaminants, other pollutants, disease agents, and stressors will also be contributing to poor health and increased disease. However, the overriding point is that the evidence shows a strong signal for a major contribution from PCBs; they remain a major concern for certain marine mammals and, potentially, other long-lived predatory species such as polar bears. Making a link between PCBs and welfare offers some challenges because consideration of the welfare of wild animals is itself a relatively new endeavour, and marine animals offer some particular difficulties – as much of what happens to them is invisible to us – and pollution as a welfare concern is rather a novelty!

A new multi-authored book on marine mammal welfare looks in detail at welfare concerns for many different marine mammal species and situations, and shows that multidisciplinary science being used to research animal welfare includes some tools that may be helpfully deployed (Butterworth, 2017). A framework that is widely applied to livestock is the 'five freedoms' (Farm Animal Welfare Council, 1992):

- freedom from hunger and thirst;
- freedom from discomfort;
- freedom from pain, injury or disease;
- freedom to express normal behaviour; and
- freedom from fear and distress.

Joining them more recently as an interpretative tool is the sophisticated 'Five Domains Model' (Mellor and Reid, 1994). The five domains are:

nutrition, environment, health, behaviour, and mental health – and in this model for welfare assessment, each ‘domain’ is divided into positive and negative welfare factors. In the health category, for example, little or no disease, injury, functional impairment and poisoning, ‘body condition appropriate’ and ‘good fitness level’ are all assessed as ‘positive’; whereas the opposite situations would all be negative. Much of this would seem intuitive but there are some significant differences between the biology of the farmed livestock around which these tools have been shaped and wild marine animals, which will need to be further explored if these tools are to be developed for use in the field of wild animal assessment. Limiting consideration here to marine mammals, the known chronic effects of PCBs can be viewed through the lens of the five domains – and clearly Domain 3 ‘health’ applies, as PCBs can cause poor health, including ‘increased disease’ (Jepson *et al.*, 2016). Less clear and more debatable is whether PCBs might relate to Domain 5 ‘mental health’, for example by causing depression or behavioural changes as a result of loss of young or of reproductive capacity.

This is not the first article to seek to associate pollution to welfare. Jordan (2005) provided a list of indirect human actions that should be considered ‘welfare concerns’, including habitat loss and pollution and he specifically mentioned PCBs. Similarly, Simmonds (2017) very recently linked PCBs to disease and suffering and asked these additional questions about pollution-associated welfare:

- Do animals suffer when deprived of young or as a result of impeded ability to reproduce, noting that this can include the loss of well-developed unborn young through stillbirth and/or the death of young calves or pups?
- Does the absence of young in a pod adversely affect social dynamics and/or in some other way deprive the animals of something that would positively affect their welfare, noting that the animals so far reported to be mainly affected – such as orcas – are among the most behaviourally sophisticated and social of all mammal species?

Such questions are difficult to test scientifically and might become mired in debate about what emotions animals are capable of. That said there is an impressive body of work that ascribes grieving to cetaceans, including for lost young (see, for example, Simmonds, 2006; Reggente *et al.*, 2016; Bearzi *et al.*, 2017).

The International Whaling Commission (IWC) recently held a workshop on the welfare aspects of non-whaling issues for cetaceans (IWC, 2016) and the gathered experts considered pollution alongside other issues such as ship strikes and entanglement. The workshop explored several pollution-related scenarios, including the effects of PCBs (i.e. pilot whales (*Globicephala melas*) in the Mediterranean with moderate exposure and killer whales in the Mediterranean with high exposure), as well as an example scenario of an oil spill (bottlenose dolphins in the Gulf of Mexico). For PCBs, discussion focused around immunosuppression and reproductive suppression, including increases in abortions and mortality of live-born calves. It was noted that, for these scenarios, the impacts on some domains in the Five Domains Model were secondary in effect, for example once an animal is diseased (as a result of immunosuppression) then nutrition and behaviour (for example) might start to be more affected. In the circumstances of the death of a calf as a result of toxicity from the high levels of PCBs in milk, it was suggested that the welfare status of a female could improve following offload of PCB burden to her calf, but that reduced welfare could also be observed due to a grieving response.

3.5 Conclusions

In conclusion, recent research shows an ongoing and significant threat from PCBs to the survival of some marine mammal populations. Future research will probably broaden understanding of this threat. These man-made chemical compounds also provide a more widespread health concern to many animals and, for marine top predators, evidence indicates immunosuppression and reproductive impairment which can clearly have the potential to create negative impacts on animal welfare. The long-lived species at the top of aquatic food chains typically have the highest tissue concentrations and suffer the greatest toxic effects. Orcas are now thought to be the most highly PCB-contaminated mammalian species on earth and are likely to suffer ongoing population declines and even localized extinctions in industrialized regions (Stuart-Smith and Jepson, 2017).

Law and Jepson (2017) have recently drawn particular attention to the situation in Europe. They state that many European Union (EU) member states are not assessing or decontaminating PCB-contaminated materials, sites or waste stockpiles

sufficiently and that in Europe only Norway, Sweden and Switzerland have established procedures for secure disposal or destruction of highly contaminated PCBs in joint sealants. These authors contrast the EU situation with that in the USA (originally the biggest producer of PCBs) where action – including that taking place at Superfund Sites – seems to have produced sustained and ongoing PCB declines, as assessed through tissue sampling in wildlife.

3.5.1 Addressing the threat

As indicated above, progress to comply with the Stockholm Convention in relation to PCBs has been decidedly poor and the Convention requests the establishment of robust compliance and enforcement mechanisms. Resourcing of efforts, prioritization of elimination efforts and the adoption of a more precautionary approach to waste management generally, especially to improve engagement with potential ‘open applications’ of PCBs, have all recently been called for (Stuart-Smith and Jepson, 2017). The need for more action is essential from both a conservation and a welfare perspective as, not only are individuals being killed and populations declining, but wild animals are also being affected in large numbers as a result of ongoing PCB contamination. Fuller public and political recognition of the significance of the suffering caused by these compounds will hopefully help speed up responses at national and international levels.

3.5.2 Developing better understanding of welfare-related concerns

Readers may detect a marine mammal (or perhaps even a cetacean) bias in this chapter. There are two excuses for this: first, this is where much of the evidence lies; and, secondly, there are particular reasons for being especially concerned about such species. As Dolman and Moore (2017) recently put it ‘as sentient, highly intelligent beings, cetaceans are considered by many to be in the highest category of animals on a scale of sensibility to pain and suffering ...’. Dolman and Moore (2017) were commenting on the welfare implications of cetacean bycatch and entanglement, where lethal entanglement of baleen whales has been characterized as one of the worst forms of human-cause mortality in any wild animal (Cassoff *et al.*, 2011).

The effects of PCBs are less immediately obvious, but sadly, far from insignificant.

It may seem remarkable that it is the IWC, which historically focuses on whaling activity, that is now leading efforts to investigate and improve non-whaling-related cetacean welfare (IWC, 2016). However, its workshops on non-whaling welfare issues have helped to spawn several work streams addressing major welfare issues, including bycatch and how to best respond to stranded whales, dolphins, and porpoises. The IWC is also helping to develop tools to better understand and address cetacean welfare issues. In a ‘world of wounds’, such work needs to be encouraged and supported.

In terms of animal welfare impact, PCBs might be seen as a trans-species chemical ‘plague’ and, for many people, knowing that the pernicious PCBs facilitate widespread disease and reproductive suppression will be enough for them to accept that this is a major welfare issue crying out for action.

Acknowledgements

Any discussion of PCBs stands on the shoulders of giants – those that developed the technical capabilities to trace pollutants in animal and other environmental samples and those, many of whom are identified in the references below, who brought to bear their ingenuity and integrity to explore and report on these matters. It must, at times, have been a thankless task as society often looked elsewhere. This short overview of a small part of their work is intended to salute them.

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References

- Bearzi, G., Eddy, L., Piwetz, S., Reggente, M.A.L. and Cozzi, B. (2017) Cetacean behavior toward the dead and dying. In: Vonk, J. and Shackelford, T.K. (eds) *Encyclopedia of Animal Cognition and Behavior*. Springer International Publishing AG, Cham, Switzerland. DOI: 10.1007/978-3-319-47829-6_2023-1
- Bearzi, M. (2012) *Dolphin Confidential – Confessions of a Field Biologist*. The University of Chicago Press, Chicago, Illinois.

- Butterworth, A. (ed.) (2017) *Marine Mammal Welfare – Human Induced Change in the Marine Environment and its Impacts on Marine Mammal Welfare*. Series *Animal Welfare*, Volume 7. Springer Nature, Cham, Switzerland. DOI: 10.1007/978-3 319-46994-2
- Carson, R. (1962) *Silent Spring*. Houghton Mifflin Mariner Books, New York.
- Cassoff, R.M., Moore, K.M., McLellen, W.A., Barco, S.G., Rotstein, D.S. and Moore M.J. (2011) Lethal entanglement in baleen whales. *Diseases of Aquatic Organisms* 96, 175–185.
- Cockcroft, V.G., De Kock, A.C., Lord, D.A. and Ross, G.J.B. (1989) Organochlorines in bottlenose dolphins *Tursiops truncatus* from the east coast of South Africa. *South African Journal of Marine Science* 8, 207–217. DOI: 10.2989/02577618909504562
- Dolman, S.J. and Moore, M.J. (2017) Welfare implications of cetacean bycatch and entanglements. In: Butterworth, A. (ed.) *Marine Mammal Welfare – Human Induced Change in the Marine Environment and its Impacts on Marine Mammal Welfare*. *Animal Welfare* series, Volume 17. Springer Nature, Cham, Switzerland, pp. 41–65. DOI: 10.1007/978-3 319-46994-2_4
- Doward, J. (2017) Race is on to rid UK waters of PCBs after toxic pollutants found in killer whale. *The Observer*, Sunday 14 May. Available at: <https://www.theguardian.com/environment/2017/may/14/race-on-rid-uk-oceans-pcbs-killer-whale-lulu> (accessed 31 July 2017).
- EPA (2017a) Polychlorinated Biphenyls (PCBs). United States Environmental Protection Agency (EPA). Available at: www.epa.gov/pCBS (accessed 25 June 2017).
- EPA (2017b) Hudson River Cleanup. United States Environmental Protection Agency (EPA). Available at www3.epa.gov/hudson/cleanup.html (accessed 28 July 2017).
- Farm Animal Welfare Council (1992) FAWC updates the five freedoms. *Veterinary Record* 17, 357.
- Hutchinson, J.D. and Simmonds, M.P. (1994) Organochlorine contamination in pinnipeds. *Reviews of Environmental Contamination and Toxicology* 136, 123–167.
- IWC (2016) Report of the workshop to support the IWC's consideration of non-hunting related aspects of cetacean welfare. IWC/66/WKM&WI Rep 1. International Whaling Commission (IWC), Cambridge. Available at: <https://iwc.int/welfare> (accessed 19 February 2018).
- Jepson, P.D. and Law, R.J. (2016) Persistent pollutants, persistent threats. *Science* 352, 1388–1389. DOI: 10.1126/science.aaf9075
- Jepson, P.D., Bennett, P.M., Deaville, R., Allchin, C.R., Baker, J.R. and Law, R.J. (2005) Relationships between polychlorinated biphenyls and health status in harbor porpoises (*Phocoena phocoena*) stranded in the United Kingdom. *Environmental Toxicology and Chemistry* 24, 238–248. DOI: 10.1897/03-663.1
- Jepson, P.D., Deaville, R., Barber, J.L., Aguilar, À., Borrell, A. et al. (2016) PCB pollution continues to impact populations of orcas and other dolphins in European waters. *Scientific Reports* 6, 18573. DOI: 10.1038/srep18573
- Jordan, B. (2005) Science-based assessment of animal welfare. *Revue Scientifique et Technique* 42, 515–528.
- Law, R.J. and Jepson, P.D. (2017) Europe's insufficient pollutant remediation. *Science* 356(6334), 148.
- Leopold, L.B. (1993) *Round River – From the Journals of Aldo Leopold*. Oxford University Press, New York.
- Mellor, D.J. and Reid, C.S.W. (1994) Concepts of animal well-being and predicting the impacts of procedures on experimental animals. In: *Improving the Well-Being of Animals in the Research Environment*. Australian and New Zealand Council for the Care of Animals in Research and Teaching, Glen Osmond, South Australia, Australia, pp. 3–18.
- Murphy, S., Barber, J.L., Learmonth, J.A., Read, F.L., Deaville, R. et al. (2015) Reproductive failure in UK harbour porpoises *Phocoena phocoena*: legacy of pollutant exposure? *PLOS One* 10(7), e0131085.
- Peterle, T.J. (1991) *Wildlife Toxicology*. Van Nostrand Reinhold, New York.
- Reggente, M.A.L., Alves, F., Nicolau, C., Freitas, L., Cagnazzi, D. et al. (2016) Nurturant behaviour towards dead conspecifics in free ranging mammals: new records for odontocetes and a general review. *Journal of Mammalogy* 97, 1428–1434. DOI: 10.1093/jmammal/gyw089
- Reijnders, P.J.H. (1996) Organohalogen and heavy metal contamination in cetaceans: observed effects, potential impact and future prospects. In: Simmonds, M.P. and Hutchinson, J.D. (eds) *The Conservation of Whales and Dolphins*. Wiley, Chichester, UK.
- Roos, A.M., Bäcklin, B.-M.V.M., Helander, B.O., Rigét, F.F. and Eriksson, U.C. (2012) Improved reproductive success in otters (*Lutra lutra*), grey seals (*Halichoerus grypus*) and sea eagles (*Haliaeetus albicilla*) from Sweden in relation to concentrations of organochlorine contaminants. *Environmental Pollution* 170, 268e275.
- Simmonds, M.P. (2006) Into the brains of whales. *Applied Animal Behaviour Science* 100(1–2), 103–116. DOI: 10.1016/j.applanim.2006.04.015
- Simmonds, M.P. (2017) Of poisons and plastics: an overview of the latest pollution issues affecting marine mammals. In: Butterworth, A. (ed.) *Marine Mammal Welfare – Human Induced Change in the Marine Environment and its Impacts on Marine Mammal Welfare*. Series *Animal Welfare*, Volume 7. Springer Nature, Cham, Switzerland, pp. 27–37. DOI: 10.1007/978-3 319-46994-2_3

- Stuart-Smith, S.J. and Jepson, P.D. (2017) Persistent threats need persistent counteraction: responding to PCB pollution in marine mammals. *Marine Policy* 84, 69–75.
- Tyler, C.R. and Goodhead, R.M. (2010) Impacts of hormone-disrupting chemicals on wildlife. In: Maclean, N. (ed.) *Silent Summer: The State of Wildlife in Britain and Ireland*. Cambridge University Press, Cambridge.
- UNEP (2017a) The Stockholm Convention on Persistent Organic Pollutants. United Nations Environment Programme (UNEP), Nairobi, 2001. Available at <http://chm.pops.int/default.aspx> (accessed 25 June 2017).
- UNEP (2017b) Report by the United Nations Environment Programme on the activities of the Polychlorinated Biphenyls Elimination Network UNEP/POPS/Cop 8/INF 11. Presented to the Eighth Conference of the Parties to the Stockholm Convention on Persistent Organic Pollutants, Geneva, Switzerland, 2017. Available at: chm.pops.int/Default.aspx?tabid=692 (accessed 21 February 2018).
- Vos, J.G., Dybing, E., Greim, H.A., Ladefoged, O., Lambré, C. *et al.* (2000) Health effects of endocrine-disrupting chemicals on wildlife, with special reference to the European situation. *Critical Reviews in Toxicology* 30, 71–133.

4

The Fence – the Welfare Implications of the Loss of the True Wild

ADAM G. HART

4.1 Introduction

Territoriality, the occupancy of space, is a trait common to many animals. In some cases, individuals are able to develop, or take advantage of, discrete and defined physical territory that can be relatively easily defended. Mound-building termites, for example, have a well-defined colony boundary provided by their mound perimeter and intruders are vigorously repelled. This type of ‘fortress’ nest is a feature common to other social insects such as the honeybees, ants and paper wasps. Cavity-nesting birds have a similar physical space that can be occupied and defended. Ownership of such space is frequently critical for survival and successful production of offspring. Wider territory, beyond the immediate physical space of a nest, may be required by animals to provide sufficient space for foraging and to find potential mates. Animals typically signal occupancy, and ownership, of such extended territorial space by communication. Territory boundaries are commonly defined by signals such as song in birds and urine spots in mammals and these limits can be defended if they are breached.

Humans also own and occupy space. While non-physical boundaries are common, our ability to manipulate the physical environment, combined with the advantages of occupying and defending resource-rich or strategically useful territory, make artificial physical boundaries inevitable. Thus, much of the world has space defined by anthropogenic barriers – of which the most common are fences.

This chapter will explore some of the impacts of fencing on wildlife. It is not intended to be an exhaustive review of the impacts of fencing but rather an introduction to some of the general issues. A case study, a wildlife reserve in South Africa, will be used to demonstrate some of the general issues and considerations of fencing in conservation and wildlife welfare at a local level. Large-scale fencing can fundamentally influence

the ecological interactions of organisms within the wider (and sometimes much wider) landscape. The effects of fencing at this larger landscape scale will be explored with special reference to the Greater Mara ecosystem.

The overall conclusions are complex. Landscape-scale fences that impede the large-scale movement of animals are having, and will continue to have, a detrimental impact on certain ecosystems. Smaller-scale fencing can also present some welfare and conservation challenges. However, macro-scale fencing can be hugely beneficial to some species, while smaller-scale fencing is often essential for conservation and welfare. Fencing can even provide novel ecological opportunities. As with so much in conservation, for example trophy hunting (Chapter 5, this volume), highly polarized arguments (fences ‘good’ versus fences ‘bad’) fail to capture the complexities of the issue and are seldom helpful to conservation in practice.

4.1.1 Why we fence

There are at least four non-mutually exclusive motivations for constructing a fence:

- to act as a territory boundary that defines and/or protects space;
- to keep people, livestock or wildlife (or a combination of these) within a space for security, to keep animals under owner control, or both;
- to exclude people, livestock or wildlife, or a combination of these, from a space; and
- to prevent wildlife and livestock interacting and thereby transmitting diseases (a ‘veterinary fence’).

As with most environmental management decisions, the financial cost of the intervention is a crucial factor to consider. Ultimately, fencing is expensive and so the benefits of the fence in the long term need to exceed its construction cost and the costs of maintaining

it. In practice, however, it can be difficult to put an exact figure on the benefit of fencing through time. For example, a well-constructed and expensive fence built to define a wildlife reserve and to protect against poachers can suddenly become far more valuable if a disease outbreak occurs in surrounding cattle-grazing land. Another consideration is whether there are any legal obligations to fence, for example to prevent livestock from endangering motorists or straying into residential areas.

Once the decision is made to construct a fence it is necessary to consider the practicalities of that construction. Many of the factors that might be considered here are also important in determining the impact of fencing on conservation and wildlife, including:

- The scale of the fence (both its length and its height) – a large-scale fence is likely to have greater environmental and ecological impact than a smaller fence.
- The type of fence (its construction) – more expensive and elaborately constructed fences are likely to be a more effective barrier to the movement of certain animal species.
- The location of the fence – a fence cutting across a well-used migration route will have a far larger effect than one located away from that migration route.

The motivation for constructing a fence will, to a very large part, determine where the fence is, the type and scale of fence required and therefore the impact of that fence. Local regulations (if they exist) on fence construction and the amount of resource (money, time, labour and expertise) available to construct the fence will also play a part in the final fencing plan. Thus, it is important to understand the motivations behind the construction of a fence if we are to assess its impact.

4.1.2 Micro-fences

At the smallest scale (1–10¹ m), fencing is often used to protect plants and trees from grazing or browsing animals. Rare and endangered plants, or the food plants of rare and endangered insects such as butterflies, can be protected with a micro-scale fence that may extend to produce what is in effect a cage protecting, in some cases, individual plants. Small fences can also be erected around trees, and especially saplings, where they can exclude deer and other animals that can damage trees by eating bark or browsing leaves. Such micro-scale fences also have the advantage of protecting from human

impact, including accidental damage (e.g. from trampling) or deliberate action such as vandalism or theft, although determined individuals are not likely to be deterred. At this scale, fencing has a negligible detrimental impact on wildlife.

4.1.3 Macro-fences

At the other extreme, macro-scale fences are also frequently used for exclusion. The longest fence in the world is the 5614 km pest-exclusion fence built in Australia to keep dingoes, a voracious predator of sheep, out of south-eastern Australia and the southern parts of Queensland. Dingoes had largely been exterminated from this area of Australia by 1885 when the initial phase of fence construction was finished. It has mostly worked although, as is perhaps inevitable, some dingoes have made it through. Australia is also home to another well-known pest-exclusion fence. The so-called rabbit-proof fence, properly called the State Barrier Fence of Western Australia was designed to prevent rabbits (a non-native pest species) from entering Western Australia. Comprising three separate fences, the Number 1 fence was completed in 1907 and at that time it was the longest unbroken fence in the world (1833 km).

Fencing can also be used to contain wildlife and livestock for reasons of ownership, to prevent the problem caused if animals stray onto roads or into areas of human habitation or to prevent the mixing of wildlife and livestock and the resulting transmission of disease. Indeed, disease control, especially for cattle, is a primary motive for the construction of many fences. The prevention of animals straying onto roads has resulted in extensive fencing in some locations. Roads passing through agricultural areas of the UK, for example, are frequently bounded by long runs of fencing, which although discontinuous, collectively sum to a distance far in excess of the exclusion fences of Australia. Depending on local tradition and culture, roadside fencing may be supplemented or replaced by walls (such as the famous dry stone walls of Yorkshire, UK), hedgerows, ditches, or a combination of these barriers. In cases when the barrier is more complex than a simple wire fence, such as the hedgerows of the UK, it may itself become valuable habitat.

Macro-scale fencing clearly has the greatest potential for causing detrimental ecological effects. However, the vast majority of fences neither extend for thousands of kilometres nor enclose single plants. Most fences are at a mesoscale, enclosing land or

defining boundaries at scales from 10^1 to 10^6 m. Such fences surround agricultural land, wildlife areas and reserves, housing developments, transport infrastructure, industrial land, private land, and public land throughout the world.

4.2 Mesoscale Fencing – a Case Study

In South Africa, private individuals can own wildlife and can profit from wildlife on land under their control. Consequently, wildlife ranching has become an attractive business and has led to more than 10,000 privately owned ‘game farms’, often on land converted from cattle ranching. One such game farm, located in North West Province and run largely as a conservation education business, provides a useful case study for some of the general issues related to mesoscale fencing.

The reserve area is 47.5 km² and it has an approximately triangular perimeter c.39 km long. Within the central portion of the reserve is an industrial area currently used to store explosive fuse cord used in the mining industry (the area is a global centre for platinum production). The wildlife reserve has developed on land that was originally set aside to provide

a buffer zone in case of an explosion in the storage magazines, which at one time were used to store high explosives. The reserve has a wide variety of managed game that has been introduced over the years, including giraffe (*Giraffa camelopardalis*), zebra (*Equus quagga*), kudu (*Tragelaphus strepsiceros*), eland (*Taurotragus oryx*), impala (*Aepyceros melampus*), wildebeest (*Connochaetes taurinus*), blesbok (*Damaliscus pygargus phillipsi*), hartebeest (*Alcelaphus buselaphus caama*), waterbuck (*Kobus ellipsiprymnus*), and gemsbok (*Oryx gazella*). There is also a rich variety of largely unmanaged and un-introduced species such as jackal (*Canis mesomelas*), warthog (*Phacochoerus africanus*), bush pig (*Potamochoerus larvatus*), and steenbok (*Raphicerus campestris*). A metalled road borders the reserve on one side and connects the two largest towns in the region. Poorly managed agricultural land used mainly for grazing cattle and goats border the second and third sides. There is also a rapidly expanding township, the margins of which are located within 500 m of the reserve’s perimeter.

There are two principal fences associated with the reserve. The first is the external perimeter fence (Fig. 4.1), some 39 km long, which serves four



Fig. 4.1. The external perimeter fence of a wildlife reserve in South Africa. Multiple strands of wire are stretched between well-anchored posts to give a continuous boundary fence that keeps wildlife in and neighbouring cattle out. (Image credit: Adam G. Hart.)

purposes. First, it acts as a clear boundary for the reserve. This is important in an area that sometimes has difficult land tenure arrangements rooted in the recent, and not so recent, history of the region. The ability to be able to mark out territory clearly and legally allows the land within the boundary to be managed and controlled. Secondly, the fence needs to keep wildlife within the reserve, keeping them safe from people and, if they were to stray onto the roads surrounding the reserve, people safe from them. Animals that stray outside of the reserve boundary are likely to end up as roadkill, to cause an accident, or to be killed by people for food. Thirdly, the fence keeps livestock from neighbouring properties out of the reserve. This has the dual benefits of preventing cattle and goats from grazing on the grassland within the reserve (especially important in times of drought) and preventing the potential transmission of disease between sometimes poorly managed herds and the wildlife within the reserve. Finally, the fence helps to keep people out of the reserve. There are substantial townships surrounding the reserve and poaching, illegal hunting, by local people is a constant threat. Indeed, a recent enforcement operation discovered a butchery within one township that was more or less exclusively dealing in wildlife species hunted from within the reserve, including various managed antelope species, warthog, and even species such as genet (*Genetta genetta*).

The design of the perimeter fence reflects these purposes. First, it is an unbroken fence surrounding

the entire reserve and is well maintained. A graded road runs inside the fence and is visible from most points on the fence line. Furthermore, to prevent fire from spreading into the reserve, a fire-break strip outside the fence is maintained by regular burning around much of the reserve. The well-maintained nature of the fence and the areas immediately adjacent to it ensures the fence retains its integrity but also reinforces a strong sense of ownership. The fence is 2.5 m high consisting of 15 strands of 3.5 mm wire. This fencing wire is strung between solidly anchored posts about 10 m apart with regularly placed vertical wire spacers and stabilizers between each main post. Running the entire length of the fence at c.1 m above the ground is a three-wire electrical system (two live wires and a central earth wire) delivering 10,000 V (Figs 4.2 and 4.3). The construction of the fence is sufficient to prevent the managed and commercially valuable species from moving out of the reserve, although unmanaged smaller species like warthog, jackals, and even hyena are able to breach it by digging under the lower wire. The fence is also relatively easy for a person to breach, either by digging under the wires or by cutting through the lower wires, avoiding the electrified portion. Thus, although a major management issue is incursion by people, the fence is only weakly effective in preventing this. It is far more effective in retaining animals and in clearly marking out the reserve's boundary.

The second fence is within the reserve, and completely encloses the explosive storage facility. This



Fig. 4.2. Electrified wires run through insulated collars held out from the main fence on wire spacers. This has the sole purpose of preventing wildlife from getting close to the fence and does nothing to stop the ingress of poachers from outside the reserve. (Image credit: Adam G. Hart.)



Fig. 4.3. Even well-managed fences are rarely 100% effective. Here, a cow from a neighbouring property has found loose lower wires that allow it to graze on the improved grasses growing within the reserve. The management decision not to treat the base of the fence with herbicide exacerbates this problem and such 'cow holes' can be seen along many fence sections. Wire loosening by these large grazers then allows the passage of smaller animals including warthog and duiker. Without good management it is quickly possible to open up holes large enough to allow impala and even waterbuck through. (Image copyright: William Carpenter, used with permission.)

is a substantial construction motivated purely by wanting to exclude people from the dangerous and valuable explosives stored within the fence. The fence is a double fence, with the two fence lines separated by a well-mown strip of 'no man's land' 8 m wide (Fig. 4.4). The length of the double fence is c.11 km, making 22 km of fencing overall. This fence is regularly breached by wildlife, including warthog, spring hare (*Pedetes capensis*), and baboon (*Papio ursinus*), and even larger species such as waterbuck and kudu have been sighted within the no-man's land strip. Despite its formidable appearance, in practice this fence would be relatively easy for a person to breach using wire cutters or by taking advantage of the numerous holes that have been formed, largely by the action of determined warthogs.

4.2.1 Problems caused by the reserve fences

Both fences on the reserve are partly motivated by a desire to contain wildlife although this is only a minor consideration for the interior double fence. Despite this, a number of animal species seemingly move freely through both fences, and to make such a fence truly wildlife-proof (much higher, more strands or chain-link, fully electrified, doubled barrier, substantial buried depth, constant maintenance patrolling) would be prohibitively expensive and could not

be justified by the reserve (Fig. 4.5). Similarly, the perimeter fence is not effective in excluding people from the reserve. However, a full security fence that could not be breached would never be cost-effective in such a location. This type of cost-benefit trade-off governs the type and scale of any fence – usually 'good enough' has to prevail over 'perfect'.

Wildlife can be injured by the fence. A number of species have been recorded as trapped in the fencing wire. These include unmanaged smaller species such as chameleons and snakes, as well as larger managed and commercially valuable species. In one incident a kudu bull got its horns trapped in a gate within the fence that it was able to lift clear of the fence. The gate was eventually disentangled from the kudu but the incident caused considerable stress to the individual and put a number of people involved in the rescue at risk of serious injury or worse. Had the animal managed to flee into the bush with the gate attached then it is entirely possible that it would have perished. Such incidents are exceedingly rare but exposed wire and fittings on the fence can more commonly cause injuries (usually minor) to animals. Thus fences, although partly motivated by a desire to protect wildlife can, in some circumstances, pose a direct physical threat to animals. Fences contain wildlife and prevent species from moving freely across the landscape. In this



Fig. 4.4. The double inner perimeter fence, with the two fence runs separated by a well-mown strip of 'no man's land', contrasting here with the grass overgrowth around the run of fence directly bordering the reserve. The chain-link and closer support posts, together with the overhanging barbed wire upper section make this a far more substantial construction than the main perimeter fence. (Image credit: Adam G. Hart.)



Fig. 4.5. The contrast between the wildlife-proof fence and a basic stock fence retaining cattle is quite clear, with cattle fences often being low, of basic construction and sometimes poorly maintained. (Image credit: Adam G. Hart.)

reserve this is an advantage since wildlife would not survive outside of the reserve, but as we will see, impeding the free movement of wildlife is one of the major issues of fencing, especially at macro-scale.

The perimeter fence has two further potentially negative impacts on wildlife. First, it provides an

easy source of wire that can be used by poachers to make snares. Snaring remains the most popular hunting technique for poachers and fences are a major source of the wire needed to make snares. Hundreds of snares have been removed from the reserve over the past few years and all of these have

been constructed from fencing wire. Secondly, the fence itself has the potential to alienate those living outside the reserve and exacerbate poaching. The grazing lands outside the reserve are almost universally poorly managed and overgrazing on this land is having two catastrophic effects. In many areas, grazing land has rapidly degraded into thick, thorny bush, capable of supporting only low numbers of goats and incapable of supporting cattle. Furthermore, a recent 2-year drought has caused some overgrazed areas to degenerate into a dust bowl, incapable of supporting even sparse grass and unlikely to regenerate in the short term or even medium term. The contrast with the well-managed grassland inside the reserve is stark, and that contrast is further highlighted by the presence of the perimeter fence. With local people measuring wealth in cattle and having little regard for wildlife (from which they rarely benefit financially), the thriving wildlife within the reserve using grass that could be used to graze their dwindling cattle herds is a source of resentment. This does little to help reduce the poaching problems faced by the reserve.

4.2.2 Advantages of the reserve fences

There are some advantages of fences to wildlife that extend beyond the protection they may afford. The inner fence has seemingly become part of the hunting ecology of the resident caracals (*Caracal caracal*) (lynx-like medium-sized cats) on the reserve. These predators chase antelope species (predominantly impala, although sometimes also blesbok) such that they are run into the fence at full speed. The impact is sufficient to incapacitate and most likely kill the prey allowing caracals to hunt larger species that would normally be difficult for them to take down. The impact with the fence is such that the supporting angle irons can be bent quite dramatically (Fig. 4.6).

The upper wires, and especially the supporting posts, have become important landscape features for many birds. They offer solid and stable perching points in relatively clear locations with good all-round visibility. Consequently, they are used by many species as display perches and for resting. The grass overgrowth that occurs at the base of the fence in many places is a common resting place of larger snakes, including rock pythons (*Python sebae*) that stretch out along the fence length in the cooler grass. This fence-associated overgrowth also seems to encourage small flies and other insects,

and birds such as swallows (*Hirundo*) are often seen hawking along fence lines. Small mammal runs are frequently seen running along the fence line where the fence itself, as well as the overgrowth it encourages, makes life difficult for avian predators (although may encourage snakes). It is common practice to use herbicide to reduce vegetation around the base of fences but that is not the management practice used in the reserve. It is costly and introduces pesticide pollutants, but grass touching the electric fence is responsible for reducing the voltage from 10,000 V to just 4000 V in places (still enough to deter). Grass growth also makes it hard to see fence damage but as with all management decisions, there are trade-offs between costs and benefits at the reserve level that need to be considered.

The fencing on the case-study reserve is motivated by the need to protect wildlife from people. However, in some cases fencing is put in place primarily to protect people from wildlife. The Pilanesberg National Park in South Africa was developed in the 1970s on land within the Pilanesberg caldera that was formerly used for farming, and included at its centre a small town. The park has developed into an important wildlife site, both for the many species contained within it and for the local and national tourist economy. However, the park is bordered by several towns, highways, mines, and an airport by the tourist resort of Sun City. There are also camping and recreation sites associated with the park that attract large numbers of visitors. The presence of lions (*Panthera leo*) and elephants (*Loxodonta africana*) within the park is an obvious security concern and consequently the park is completely surrounded by a predator-proof and elephant-proof fence.

Such an extensive and expensive fence clearly greatly restricts the movement of species contained within it, but without such a fence it would not be possible to have potentially dangerous species on-site. As human-wildlife conflict and competition for land increase it is likely that fenced reserves will increase in Africa and beyond, and, in areas with dangerous species, the fences required will likely be the major expense in establishing such reserves. However, many grazing species in ecosystems throughout the world have a wide-ranging spatial ecology, the range of which might well exceed the land being fenced off as a reserve. Such species also have potentially high productivity and are capable, in good years, of greatly increasing their population.



Fig. 4.6. The inner perimeter fence line facing into the reserve. The support post has been bent by the impact of impala or blesbok that have been run into the fence by caracal. These medium-sized cats have learned to use the fence as part of their hunting strategy. (Image credit: Charles Theron, used with permission.)

This means that fenced reserves need careful monitoring and management, which would typically entail culling or regulated hunting of certain species to manage forage, grazers, and predators to prevent overstocking. However, the ecological issues caused by fences at this scale are negligible compared with the potential ecological problems caused by large-scale fencing.

4.3 Macro-scale Fencing – a Case Study

At a landscape level, anthropogenic pressures on land and widespread changes in land use are causing fragmentation of habitat and even entire ecosystems.

This fragmentation is directly related to the declines in large mammal populations being reported globally. A number of factors are at play here, including increasing human population and increasing human demand for resources, especially space for, among other uses, infrastructure, agriculture, livestock, industry, urban development, and tourism. Fragmentation of ecosystems massively affects the movement of species across ecosystems and can have chronic effects that include reduced gene flow. However, the effects of fragmentation can be more acute. Interrupting the free movement of animals that include large-scale seasonal migration as part of their ecology has the potential to cause rapid

and catastrophic collapse of ecosystems. Although the factors outlined above are those primarily driving habitat fragmentation, fencing is identified by many commentators as a critical threat to ecosystems based on migration.

The Greater Mara is an ecosystem currently threatened with collapse as a consequence of large-scale fencing. A 668,500-ha area in south-western Kenya, the Greater Mara is famously home to one of the largest and most biodiverse mammalian migration anywhere in the world. This migration comprises at least 1.3 million wildebeest, 200,000 zebra and several hundred thousand Thomson's gazelle (*Eudocas thomsonii*). The ecosystem is vital to both the Serengeti migration and the Loita Plains migration, with both migrations using the high-rainfall region of the Mara as dry-season range with reliable forage. As well as being home to these large-scale mammal migration routes, the Greater Mara ecosystem encompasses the tribal rangelands of the Maasai. The Maasai are also, to a certain extent, migratory, since they move their cattle, sheep and goats around the ecosystem to follow shifting patterns of grazing availability. However, changing patterns of land use within the Greater Mara since the 1970s have led to gradual but accelerating use of fencing, which is having serious ecosystem consequences.

Land privatization and the formalization of land tenure across the Greater Mara have led to the establishment of fenced land plots, with fences both defining ownership and allowing for management of the fenced land. Land within large plots is increasingly being subdivided for sale and this process is rapidly eroding the area of land usable, even in principle, for wildlife. In practice, although some land is set aside for wildlife conservation, often driven by ecotourism, much of the fenced land is being used for profit-making ventures such as wheat and maize cultivation, grazing and the creation or development of settlements. Wildlife in Kenya is owned by the government, and hunting has been banned since the late 1970s, thus private landowners can only benefit from wildlife via ecotourism rather than through sport hunting and meat production. As a consequence, in the many areas of Kenya unsuitable for ecotourism, wildlife has no financial value to those that own the land on which it ranges. This is a major, although not the only, factor in the collapse of wildlife in Kenya, both directly (wildlife is illegally killed for food and to prevent grazing competition) and indirectly

(land is used for profitable activities that usually excludes wildlife).

The proliferation of fenced land plots is eroding the Greater Mara ecosystem and is also influencing the Maasai. Increasingly, the semi-nomadic lifestyle of the Maasai, that has traditionally relied on seasonal grazing and the sharing of common resources, is being replaced by a sedentary, European farming tradition, characterized by the private ownership of plots formerly considered communal tribal land. Such plots are increasingly marked and defined by fences.

The effects of fencing were felt early. In the 30 years following the formalization of land tenure in the Greater Mara, resident wildlife populations were estimated to have declined by 70%. Despite this dramatic decline, there were still substantial and important populations of wildlife within the ecosystem. This was largely because, up until 2014, fenced plots in open savannah were limited and were mostly found in the periphery, where their impact on wildlife in general, and migratory wildlife in particular, was limited. However, in 2014 the pattern changed, as fences began to appear in 'expansion fronts' inside the main Greater Mara area and then as 'fill-in' fences within larger fenced plots. The overall pattern is one of greatly increased, and increasing, fencing with the consequent loss of connected open savannah. The density of fencing in the north of the ecosystem is already affecting the Loita Plains migration, with the risk of wildebeest becoming completely excluded. The Serengeti migration route uses the Maasai Mara National Reserve and the Mara North conservancy areas in the south of the ecosystem and currently there are policies in place to prevent the spread of fencing. The hope is that these policies will prevent fence encroachment from affecting the Serengeti migration, although the planned road across the northern part of the Serengeti National Park may be equally, or more, disruptive.

4.4 Other Macro-fencing Examples

In the Greater Mara ecosystem of Kenya fences are being erected to delimit owned land and to allow owners to profit from that land. This creates a complex landscape-level network of fences with the resulting fragmentation directly and indirectly affecting wildlife. Macro-scale fences that do not form complex networks can also affect wildlife. Simple border fences, such as those being constructed

in parts of Eurasia in response to the refugee crisis, are already causing the type of large-scale habitat fragmentation that can negatively affect species with large home ranges likely to straddle borders. Well-maintained border fences act as absolute barriers to many larger species and wolves (*Canis lupus*), brown bear (*Ursus arctos*), and Eurasian lynx (*Lynx lynx*) are considered to be under threat from fencing projects in Slovenia and Croatia. Other species, including red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), moose (*Alces alces*), and mouflon (*Ovis orientalis orientalis*) are also affected. However, sometimes border fences can be beneficial. Asiatic wild ass (*Equus hemionus*) populations in the border area between China and Mongolia, for example, are prevented from entering Inner Mongolia by a 4700 km border fence and this protects them from unregulated, and unsustainable, hunting.

Botswana in southern Africa is home to some of the largest populations of wildlife species in Africa but here, too, fencing has had a profound effect on wildlife. Beef production plays a major role in its economy, and in order to continue exporting to the European Union it was necessary for Botswana to meet a high standard of veterinary disease management. To achieve this, Botswana is divided by a network of veterinary fences, in a fencing process that began as early as 1958. These cordon fences divide the country into disease control areas between which the movement of livestock is restricted and tightly regulated. Of course, such fences also restrict the free movement of wildlife across Botswana. Concern about the impact of this national fencing strategy has been focused on the Okavango Delta region in the north-east of the country. This wildlife hot spot, an important tourist destination, is home to the so-called Buffalo Fence. This fence runs north–south across the delta and has been successful in preventing buffalo (*Syncerus caffer*) from the inner delta transmitting foot-and-mouth disease to cattle in the outer parts of the delta. However, the fence also cuts across the migratory routes of species including elephant, zebra, and wildebeest. Locally, it restricts the movement of species such as eland, roan (*Hippotragus equinus*), sable (*Hippotragus niger*), tsessebe (*Damaliscus lunatus*), and giraffe. As well as restricting movement, studies have shown that veterinary fences also cause mortality with entrapment of elephant, roan, giraffe, and buffalo being recorded along the northern Buffalo Fence, and many other

species suffering mortality at other sections of fence in the delta. The decline of species in the region is blamed largely on fencing and is predicted to be reversed if fences were to be removed – but the initial purpose of fencing, to protect cattle, still remains. Many are calling for the better integration of the needs of wildlife in the decision-making process and a more thorough ecological impact assessment to be carried out, but in the short term human–wildlife conflict often ends poorly for wildlife, especially those species with large ranges.

4.5 Conclusions

Fencing is one of the most controversial topics in modern conservation. The local needs of those erecting fences are often in direct conflict with a broader international conservation agenda. In contrast, in many parts of the world, local people's needs may be excluded from conservation plans. Such plans might well be overseen by foreign organizations that prioritize wildlife through a 'fortress conservation' approach that prevents local people from gaining any real benefit from that wildlife. Fencing is one of the battlegrounds for human–wildlife conflict and for different approaches to land use and conservation. Large-scale fencing, including linear border fences and veterinary barriers, as well as the proliferation of fences within fencing networks, such as in the Greater Mara, has led to, and will undoubtedly lead to, significant declines in wildlife species. However, smaller-scale fencing is essential for wildlife management in many parts of the world. As human–wildlife conflict intensifies we will see an increase in fencing for human needs as well as a likely increase in the fencing of areas managed for wildlife conservation. Understanding the parallel needs of people and wildlife, especially the broader scale ecology of species with large ranges, will be crucial in ensuring that the negative impacts of fences are reduced. However, in reality, even with careful planning and mitigation, the costs imposed on wildlife by large-scale fences are unlikely to disappear.

Bibliography

- Boone, R.B. and Hobbs, N.T. (2004) Lines around fragments: effects of fencing on large herbivores. *African Journal of Range and Forage Science* 21(3), 147–158.
- Dickman, C.R. (2012) Fences or ferals? Benefits and costs of conservation fencing in Australia. In: *Fencing for Conservation*. Springer, New York, pp. 43–63.

- Lindsey, P.A., Masterson, C.L., Beck, A.L. and Romañach, S. (2012) Ecological, social and financial issues related to fencing as a conservation tool in Africa. In: *Fencing for Conservation*. Springer, New York, pp. 215–234.
- Linnell, J.D. (2016) Border controls: refugee fences fragment wildlife. *Nature* 529, 156.
- Løvschal, M., Bøcher, P.K., Pilgaard, J., Amoke, I., Odingo, A. et al. (2017) Fencing bodes a rapid collapse of the unique Greater Mara ecosystem. *Scientific Reports* 7, article number 41450.
- Mbaiwa, J.E. and Mbaiwa, O.I. (2006) The effects of veterinary fences on wildlife populations in Okavango Delta, Botswana. *International Journal of Wilderness* 12(3), 23–41.
- Van Dyk, G. and Slotow, R. (2003) The effects of fences and lions on the ecology of African wild dogs reintroduced to Pilanesberg National Park, South Africa. *African Zoology* 38(1), 79–94.

5

Trophy Hunting and Animal Welfare

MARK JONES AND CHRIS DRAPER

We should protect the most vulnerable and helpless in society, not destroy them – much less derive pleasure from doing so.

Sir Roger Moore KBE 1927–2017

5.1 Introduction

The idea of trophy hunting may conjure up a picture of ‘hunters’ stalking individual ‘big game’ animals belonging to iconic species across often inhospitable terrain, sometimes for days, pitting their wits against often dangerous adversaries and enduring the discomforts and hardships of the bush for the chance of bagging an animal to display on a wall in a trophy room back home.

Whether or not this was ever a reality, trophy hunting has expanded in scale and scope and now encompasses a diverse range of activities, in large part driven by commercial interests. Many individuals or groups of animals belonging to a very large number of species, some threatened with extinction, are targeted. Some are hunted in their natural environment, although increasingly populations are managed, or in some cases bred specifically for hunting, and even hunted while in captivity, to provide trophies for paying clients.

Recent high-profile incidents have stimulated significant public debate over the ethics, conservation, and economic credentials of trophy hunting, and have been partly responsible for a tightening of international rules governing the conduct of sectors of the hunting industry (CITES, 2017). Some jurisdictions have also restricted imports of trophies from certain species (such as through the listing of species on the United States Endangered Species Act, or through restrictions on imports to the European Union (EU) of certain trophies derived from countries where the sustainability of hunting operations is in question). Public pressure has also resulted in a number of airlines and shipping companies restricting or banning the carriage of certain hunting trophies (*Economist*, 2015).

The justifications for these changes have largely centred on concerns over the conduct and sustainability of the trophy hunting industry, and in particular its conservation credentials. However, while the impacts of trophy hunting on animal welfare have featured prominently in some public forums, concern for animal welfare has not, thus far, been a significant driver for regulatory change.

This discussion focuses on the impacts of trophy hunting on the welfare of animals, and the need for society to fully account for animal welfare implications when contemplating the future of the hunting industry.

5.2 What is Trophy Hunting?

Understanding of the term trophy hunting may vary, and a comprehensive definition of trophy hunting is lacking. In its *Guiding Principles on Trophy Hunting as a Tool for Creating Conservation Incentives* (IUCN SSC, 2012), the International Union for the Conservation of Nature (IUCN)’s Species Survival Commission (SSC) describes ‘trophy hunting’ as being:

managed as part of a programme administered by a government, community-based organization, NGO [non-governmental organization], or other legitimate body; characterized by hunters paying a high fee to hunt an animal with specific ‘trophy’ characteristics (recognizing that hunters each have individual motivations); characterized by low off-take volume; and usually (but not necessarily) undertaken by hunters from outside the local area (often from countries other than where the hunt occurs).

(IUCN SSC, 2012)

While this description is not necessarily a definition, it serves as a useful benchmark that encompasses most key aspects of trophy hunting.

While in some cases, parts of a hunted animal may be subsequently utilized for other purposes (e.g. the meat from some animals killed by trophy hunters may be offered to local people, once the

‘trophy’ has been removed), the definition above implies that the prime motivation of the hunter is some aspect of the individual animal’s morphology, be it size, colouration, or adornment, and that he or she seeks to acquire an animal, or part thereof, as a ‘trophy’.

This places trophy hunting in partial contrast with other forms of recreational hunting. For example, hunting foxes with dogs may result in parts of the hunted animal being removed and retained as tokens, but the hunted animal is not usually selected for its individual physical attributes. While trophy hunting can certainly contain a competitive element, the motivation for other ‘competitive’ forms of hunting may be the numbers of individuals killed or their combined body weight, for example in driven ground-bird shoots, coyote killing contests, or some kinds of sport fishing activity.

There are clearly similarities between these various types of recreational hunting, and all have significant animal welfare implications. While the discussions here focus on the hunting of individual ‘high value’ animals as per the IUCN description above, where appropriate, reference is also made to wider hunting activities.

5.2.1 Scope and scale

According to official figures submitted by governments,¹ in the decade to 2015 (2006–2015 inclusive), close to 350,000 trophy items derived from more than 300 animal species listed in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) were traded internationally. These trophies originated from 123 different countries, with South Africa, Canada, Zimbabwe, Mozambique and Namibia accounting for more than three-quarters of the total. They were imported by 166 other countries, with the USA accounting for almost two-thirds of imports, and EU member states for a further 15%. The most commonly exported trophies were derived from African elephants (*Loxodonta africana*: 76,000), American black bears (*Ursus americanus*: 59,000), Nile crocodiles (*Crocodylus niloticus*: 53,000), hippopotamus (*Hippopotamus amphibius*: 28,000), and African lions (*Panthera leo*: 14,500).

These figures are limited to CITES-listed species, the international trade in which is regulated to ensure that it does not threaten the survival of these

species, and the data are reported by governments to a central database. However, these are by no means the only species targeted by trophy hunters. US trophy hunters imported more than 1.26 million wildlife trophies into the USA in the decade to 2014, almost two-thirds of which were derived from Canada and South Africa (HSUS and HSI, 2016). Every year hunters also kill many millions of birds belonging to 350 or more species as they migrate through the Mediterranean region, using a variety of methods including shooting, poisoning, and trapping; BirdLife (www.birdlife.org) estimates that 11–36 million of these birds are illegally killed or taken, with even larger numbers being legally killed by hunters, often as ‘trophies’ (Brochet *et al.*, 2016).

In South Africa, thousands of carnivores, particularly lions, are intensively bred in more than 200 captive breeding centres across the country, in order, in part at least, to meet a demand among time-pressed, predominantly foreign, paying trophy hunters for relatively ‘constrained’ animals which they can shoot in an enclosed area and ‘bag’ a guaranteed trophy. These animals are specifically ‘bred for the gun’ and live lives that are very far removed from those of their wild counterparts.

Wider hunting activities involve even greater numbers of animals. The breeding of animals for the purpose of recreational hunting may date back centuries. Game birds were probably introduced into the UK in Roman times, primarily as food, although pheasants, partridge, and ducks are now reared in very large numbers on game farms to supplement wild populations for commercial shoots. In the UK, where a substantial proportion of the countryside is managed for shooting, the British Association for Shooting and Conservation estimates that 35 million pheasants and red-legged partridge are bred for release onto shooting estates each year to be killed for ‘sport’ (BASC, 2015) (Fig. 5.1). Further, tens of thousands of brown hares, a priority species under the UK Biodiversity Action Plan and described as a ‘minor shooting quarry’ by the Game and Wildlife Conservation Trust (Aebischer *et al.*, 2011), comprising between 28% and 69% of the national spring population, are shot by paying hunters annually (Stoate and Tapper, 1993).

If animal welfare impacts are measured as a function of the degree and duration of individual welfare compromise and the number of animals involved, which can be very large, then the potential welfare implications of these hunting activities are clearly very significant.



Fig. 5.1. An estimated 35 million pheasants and red-legged partridge are bred for release onto British shooting estates each year to be killed for ‘sport’. (Image copyright: Elena Fedulova Dreamstime, used with permission.)

5.2.2 History and motivation

While the hunting and killing of iconic animals by wealthy individuals has been long practised, the emergence of ‘commercial’ trophy hunting is relatively recent. In 1892, London taxidermist Rowland Ward published *Horn Measurements and Weights of the Great Game of the World*, which, along with subsequent editions, was the first resource of its kind publishing information on where in the world trophy hunters could find sought-after animals. In 1930, the Boone and Crockett Club (founded by President Roosevelt some 43 years earlier) established its Trophy Scoring System for North American Mammals, and the International Council for Game and Wildlife Conservation (CIC) established its own trophy formula in 1930, providing a comparative analysis and achievements of the then newly fashionable practice of commercial trophy hunting (Damm, 2008). These recognition systems arguably stimulated the emergence of ‘competitive’ trophy hunting, which has culminated in hunters seeking recognition among their fellows in part through the pursuit of various ‘awards’ conferred by major hunting organizations (Safari Club International, 2016).

Anthropologists and others have explored the motivations behind modern trophy hunting, concluding that the high monetary costs of hunting, and the communication of these costs to others, may be significant factors (Darimont *et al.*, 2017). The hunting industry has perpetuated the often false perception that the ‘bagging’ of a trophy involves the conquering of dangerous animals and demonstrates the bravery or prowess of the hunter (Simon, 2017). The more recent emergence of

‘canned hunting’ mainly in South Africa, involving release of intensively bred lions and other predators into enclosed areas to be killed by a paying ‘hunter’, has divided hunting enthusiasts, and the IUCN has called for an end to the practice (IUCN, 2016a).

5.2.3 Legislation

International and national regulations concerning trophy hunting are predominantly focused on conserving threatened species rather than protecting the welfare of targeted animals. In 2016, CITES, which regulates international trade in specimens derived from species listed on its Appendices, adopted a resolution on the international trade in hunting trophies of listed species (CITES, 2017). This requires that: (i) trophies for export conform to relevant definitions; (ii) trophies for export are legally obtained in their country of origin; (iii) their export is not detrimental to the survival of the species concerned; and (iv) the trophy hunting operations are sustainably managed. However, there are no provisions relating to the welfare of the animal or animals from which the trophies are derived.

Animal welfare legislation in countries which allow trophy hunting may not apply to wild animals at all, or if it does it may be restricted to animals that are bred, raised, or maintained in captivity. South Africa’s Threatened Or Protected Species Regulations (TOPS), and associated norms and standards and provincial regulations, provide some minimal requirements for predator breeding operations with regard to space and provision of veterinary services, although the welfare of the animals is not specifically referenced. The UK’s Department

for Environment, Food and Rural Affairs published a *Code of Practice for the Welfare of Gamebirds Reared for Sporting Purposes* which apply to England², highlighting relevant legal requirements under the Animal Welfare Act of 2006, although these are restricted to periods while the birds are being raised in captivity (Defra, 2009).

While some hunting organizations may operate codes of practice or provide guidance to members, laws regulating the method by which trophy animals are killed, or requiring the hunter to undertake training or demonstrate competence, are lacking.

5.3 Conservation and Management

The value of trophy hunting to the conservation and management of animal populations has been the subject of intense and often acrimonious debate. Studies and reports have increasingly questioned the economic, conservation, and societal values of trophy hunting activities, and its sustainability (Economists at Large, 2013; Grijalva, 2016). With money to be made, animal populations are often manipulated and quotas set to maximize profits, recommended age-based and area-based limitations are frequently ignored, and hunting levels often exceed quotas (Creel *et al.*, 2016; IUCN, 2016b). The amount of money generated by trophy hunting is relatively small compared with non-consumptive wildlife tourism, and evidence suggests that in the majority of cases very little of the money generated by trophy hunting ever reaches local communities or is used to benefit wider wildlife conservation (Economists at Large, 2013).

Far from removing surplus or undesirable animals, trophy hunters often covet the largest trophies with the most impressive traits (Fig. 5.2). Also, because hunters value rarity, threatened species may be disproportionately targeted, potentially pushing them further towards extinction (Palazy *et al.*, 2011). Examination of hunts advertised and awards conferred by major hunting organizations reveals a clear focus on the size and traits of trophies, with little evidence of any effort to encourage hunters to restrict themselves to identified problem animals. Parts of the trophy hunting industry have been associated with accusations of corruption (Leader-Williams *et al.*, 2009), and with the trafficking of wildlife through so-called ‘pseudo-hunting’, where trophy hunting has been used as a front to facilitate the acquisition and export of valuable parts of protected animals for

illegal commercial trade (Traffic, 2012). Such associations further damage the credibility of the trophy hunting industry.

5.4 Animal Welfare Implications

The impacts of human activities on the welfare of wild animals are notoriously difficult to objectively assess or reliably quantify. There have been a number of studies that have attempted to evaluate the direct welfare impacts of open-field shooting of mammal species, including deer (Bradshaw and Bateson, 2000) and badgers (Independent Expert Panel, 2014), and some indirect welfare impacts associated with the shooting of hares (Butterworth *et al.*, 2017). However, academic studies of trophy hunting have predominantly focused on issues concerning sustainability, population and species conservation, and ethics; objective evaluations of the welfare impacts of trophy hunting are lacking.

The killing of Cecil the lion in Zimbabwe in July 2015 by a wealthy American trophy hunter generated intense public interest, which in turn has resulted in a greater focus on animal welfare implications. Cecil was a particularly impressive black-maned 13-year-old male lion who had sired numerous litters of cubs and at the time of his killing controlled two prides of females and cubs alongside another male. Researchers from the University of Oxford had collared the lion as part of an ongoing research project in Zimbabwe’s Hwange National Park (WildCRU, 2017). Cecil was reportedly lured out of the park into an adjacent area where hunting was permitted, and initially shot with a bow and arrow. Reports also suggested that the first shot was not fatal, and that the wounded lion was subsequently tracked and only finally killed some hours later.

Associated media stories reached nearly 12,000 per day, and social media mentions peaked at nearly 90,000 (Macdonald *et al.*, 2016). The reasons for the intense public and media reaction to this particular incident are the subject of speculation and analysis, particularly given that the killing of a lion by a trophy hunter is not in itself an unusual event. Researchers have suggested that animal welfare concerns may have played a significant role. The circumstances of Cecil’s death, and the public and media response to it, certainly highlighted a number of animal welfare-related issues, which can by extension be considered in the context of wider trophy hunting activities.



Fig. 5.2. The economic, conservation, and societal values of trophy hunting activities, and its sustainability have been questioned in recent years. (Image copyright: Farek Dreamstim, used with permission.)

5.4.1 Point of death and method of killing

When considering the welfare implications of lethal animal interventions, the point of death of the target animal is often the primary consideration. In most circumstances in which the deliberate killing of animals takes place, convention demands that the methods used should minimize negative welfare impacts. For example, the *Terrestrial Animal Health Code*, published by the World Organisation for Animal Health (OIE), recognizes the need to ensure the welfare of food animals during pre-slaughter and slaughter processes; it also recommends that, when killing animals for disease control purposes, methods used should result in immediate death or immediate loss of consciousness lasting until death, and that anxiety, pain, distress, or suffering in animals should be avoided (OIE, 2016).

While these principles were developed to guide the international community in relation to domestic livestock, they can equally be considered in, and applied to, other circumstances in which animals are deliberately killed. Most societies implement such principles by specifying permitted slaughter methodologies that usually include the need for pre-slaughter stunning to render animals insensible prior to killing, for operatives to undertake appropriate training, and for oversight inspections to ensure requirements are being adhered to. However, hunted animals enjoy no such protections.

Some hunting organizations acknowledge that trophy hunters have a responsibility to avoid inflicting undue suffering, and to aim to make quick and humane kills (Boone and Crockett Club, 2014). However, several trophy hunting organizations offer awards for methods of killing a trophy animal which might include the use of bows and arrows, handguns, or ‘traditional’ weapons such as muzzle loaders (Safari Club International, 2018), and clearly do not prioritize the welfare of the target animal. Cecil the lion was a case in point, having initially been targeted with a bow. Studies show that the use of bows may result in a 50% wounding rate (animal shot but not recovered) in targeted white-tailed deer, suggesting this method of killing is far from guaranteed to result in a clean kill (Ditchkoff *et al.*, 1998).

Since at least part of the motivation of the paying trophy hunter is to procure a good quality ‘trophy’, there is clearly an incentive to avoid damaging specific parts of the animal that will subsequently be displayed. If, as is often the case, the head of the animal forms an integral part of the trophy, then use of a method that will damage the head may be disincentivized, resulting in areas of the body being targeted for reasons other than minimizing welfare harms. The circumstances in which trophy animals are targeted, the fact that many trophy hunters are not necessarily expert shots, and the promotion of methods of killing that are clearly not primarily

aimed at achieving an instantaneous death, mean that trophy-hunted animals do not enjoy the protection from harmful welfare impacts at the point of death that would be expected for other types of animals that are deliberately killed. This anomaly raises substantial animal welfare concerns.

5.4.2 The impact of the chase

The welfare of targeted animals may also be compromised by the extent to which the animal is stalked or chased before a kill is attempted or achieved. Target animals may be pursued for considerable periods of time (in some cases days) during hunts. Individuals may be separated from family groups or populations, which may result in considerable distress. In some cases, target animals may be deliberately lured into areas in which they may also experience distress because of the presence of potential predators or competitors.

Prey animals such as deer and antelope may run when chased to the point of exhaustion, and studies have demonstrated elevated levels of stress hormones (including endorphins and cortisol) in hunted deer compared with those that are ‘cleanly shot’ without a prolonged chase, suggesting they suffer significant stress (Bateson and Bradshaw, 1997). In the case of Cecil the lion, reports suggest he was lured out of the National Park in which he was protected, in order that he could be targeted in an area where hunting is permitted. The failure of the hunter to exact a ‘clean kill’ at the first time of asking also resulted in the injured lion being tracked for a number of hours before finally being killed.

Hunting proponents frequently speak of the concept of ‘fair chase’ where the hunter does not have an ‘improper advantage’ over the hunted animal, and the animal has a ‘fair’ chance of escaping the hunter (Boone and Crockett Club, 2017). However, the failure of a trophy hunter to exact a kill cannot be taken to imply that there has been no impact on the welfare of the hunted animal.

5.4.3 Non-target animals

Trophy hunting also has wider implications for the welfare of non-target animals. As noted above, separating a ‘trophy animal’ from a social group or population may cause considerable stress to the individual concerned. The removal of that animal can also have significant consequences for the remaining animals in the group.

Animal societies can be complex, with individuals having specific roles within, or knowledge valuable to, the group. Trophy hunters will usually seek animals with certain traits, and these are often the larger, older or more ‘impressive’ animals within a group or population. Depending on the species, mature male animals may be preferentially targeted, and hunting proponents often claim that the targeting of such animals limits the wider population impacts because they are past peak breeding age and no longer contribute to the genetic diversity of future populations. In some cases, for example black rhinos, hunting proponents claim that removing ‘surplus’ males helps stimulate wider population growth by reducing competition between animals confined to restricted areas (Leader-Williams *et al.*, 2005).

However, research indicates that removing particular animals on the basis of specified individual traits may have a disproportionate impact on the remaining animals in the group. The targeting of ‘tusker’ bull elephants by trophy hunters has resulted in a serious decline in the number of such animals, with the consequent loss of vitally important accumulated social and ecological experience from which younger animals learn (Bale, 2015). There is also research suggesting that older bull elephants ‘control’ younger males, who become more volatile when the older bulls are removed, with the potential for increased aggressive interactions and associated injuries (Slotow *et al.*, 2000). In the case of lions, the removal of older males who control prides may result in the influx of younger male animals and a consequent rise in infanticide, which may have serious welfare impacts for cubs and the adult females who care for them, and may severely disrupt social cohesion and population stability (Loveridge *et al.*, 2016).

Where female animals of breeding age are targeted, any dependent young might suffer starvation or predation, with serious consequences for their welfare. This issue has been identified as a significant risk during hare shoots in England and Wales that take place in the early part of the breeding season for brown hares (Butterworth *et al.*, 2017).

5.5 Breeding for the Gun and Wildlife Management

While the targeting of free-living wild animals by trophy hunters raises concerns relating to the welfare of target and non-target animals at the time of the hunt, the commercial nature of trophy hunting

has resulted in the emergence of wildlife management practices designed specifically to generate animals for the purposes of trophy hunting. Such practices have potential implications for the welfare of affected animals throughout their lives. The most extreme form of such management practices is the intensive breeding of animals for so-called ‘canned hunting’.

South Africa’s Biodiversity Management Plan for African Lion estimates that there were, at the time of its publication, as many as 6000 lions held in over 200 captive predator breeding facilities in the country (DEA, 2015). The makers of the film *Blood Lions*, which exposed the practice of ‘canned hunting’, suggested the number of predators in breeding facilities could be as high as 8000 with the majority being lions (Young and Chevallier, 2015).

The conditions in which these animals are bred and reared raise serious welfare concerns in addition to those associated with the point at which they are pursued and killed. These captive-bred animals are typically hand reared from a very young age, in order to expedite the return of their mothers to breeding condition. As they grow, they are exploited for commercial gain through a number of mechanisms, including by attracting paying ‘volunteers’ to

help with their rearing on the usually mistaken understanding that they are destined for release into the wild as part of a conservation programme, and advertising various ‘experiences’ for tourists such as lion petting (Fig. 5.3) and walking with lions (Hunter *et al.*, 2013). According to *Blood Lions*, between 800 and 1000 of these animals are subsequently released each year into enclosed areas to be shot by paying clients in so called ‘canned hunts’.

South Africa’s National Council of Societies for the Prevention of Cruelty to Animals states that canned hunting, as well as being unethical, is directly linked to animal abuse that is unacceptable to society at large, and that in the context of professional and recreational hunting the humane treatment of animals cannot be ensured without including the breeding, transportation, and holding standards of wildlife in the related game industry (NSPCA, 2017). Some sport hunting organizations, including Safari Club International and the Dallas Safari Club, have issued statements denouncing ‘canned hunting’ (<https://www.safariclub.org/detail/news/2018/02/02/sci-adopts-policy-on-captive-bred-lions>; <http://dsc-newscenter.org/2018/01/dsc-position-on-captive-bred-lion-hunting/>), and disagreements over the issue resulted in a serious split among members of the



Fig. 5.3. Intensive lion breeding operations advertise various ‘experiences’ for tourists such as lion petting and walking with lions. (Image copyright: Beth Jennings, used with permission.)

Professional Hunters Association of South Africa (<https://conservationaction.co.za/media-articles/uproar-among-professional-hunters-continue-embrace-canned-lion-hunting/>).

The practice of breeding other types of animals specifically for hunting purposes also raises serious welfare concerns. According to the British Association for Shooting and Conservation, each year an estimated 35 million or more pheasants and red-legged partridge, most of which are captive reared, are released onto shooting estates in the UK for the purposes of sport hunting (BASC, 2015). During rearing, these birds do not benefit from the minimum European legal standards that exist for the protection of birds bred or kept for food production, because of an exemption for ‘animals intended for use in competitions, shows, cultural or sporting events or activities’. The welfare of game birds during transport, following release, and during shoots when many may be injured but not retrieved, is also an issue of serious concern (Bicknell *et al.*, 2010), as are practices employed by shooting estates to prevent predation of game birds by natural predators, including mammals and birds of prey (League Against Cruel Sports, 2015).

5.6 Ethical Considerations

While many conservationists argue that trophy hunting is acceptable if it can be shown to benefit wildlife conservation, ethical and ‘emotive’ arguments should not be dismissed (Nelson *et al.*, 2016). Given the potentially high risk to animals’ welfare and the lack of clarity over the claimed conservation benefits, arguments for or against trophy hunting involve complex ethical questions that are not solely utilitarian. It may not be as simple as positioning animal welfare against conservation: questions regarding the motivations for hunting seem to play a large part in ethical considerations and public concerns. Many of the ethical defences of subsistence hunting lack read-across in the context of trophy hunting, since the primary objective is not to kill the animal for food, but apparently for prestige and enjoyment of the act of killing. An increasing public distaste for killing animals may, for example, permit killing animals for necessity but not for pleasure or leisure. Even within the hunting industry, ethical considerations vary, with some considering the use of certain methods more ethical than others: for example, using a rifle to kill an American black bear might be considered by some as acceptable, whereas using a spear may not (Summers, 2016).

5.7 So Where Do We Go From Here?

Trophy hunting is a contentious practice, which generates strong and often emotive opinions. In policy terms, the discussion centres on the sustainability of the practice, and its claimed role in support of population (and by extension species) conservation. The animal welfare implications are rarely given significant consideration in the policy context. However, because of the scale of trophy hunting, its highly commercial nature, and the motivation of and methods used by paying hunters, the impacts of the activity on animal welfare are clearly highly significant and deserve far greater consideration. In most other policy contexts where animals are deliberately killed, the welfare of the animals affected both directly and indirectly by the activity would be given a high priority.

Albeit focused on the welfare of livestock, the so-called ‘five freedoms’ first formulated in the Brambell Report of 1965 and published by the then Farm Animal Welfare Council in the UK (FAWC, 1979), alongside subsequent refinements and developments (Mellor, 2016), continue to form the basis for many animal welfare assessments. Elements of these principles, coupled with modern approaches towards wild animal interventions such as the International Principles for Ethical Wildlife Control (Dubois *et al.*, 2017), can be helpful in developing a framework for evaluating the welfare implications of trophy hunting.

Public concerns and pressure relating to the sustainability of trophy hunting and its claimed conservation benefits continue to result in increased international regulation, restrictions on the imports of trophies by some countries, and increasing numbers of airlines and other transport companies that refuse to ship trophies internationally. The impacts of trophy hunting on the welfare of both target and non-target animals are coming into the spotlight, adding significantly to calls for further review of trophy hunting practices.

While there remain people willing to pay large amounts of money for the ‘privilege’ of killing a wild animal, it seems likely the practice of trophy hunting will continue to persist in one form or another. However, as our knowledge of animal sentience and the implications of human activities on individual animals and their societies expands, the animal welfare implications should be given far greater prominence in the ongoing debate on the rights and wrongs of trophy hunting.

Notes

¹ CITES trade statistics derived from the CITES Trade Database (no date), United Nations Environment Programme (UNEP) World Conservation Monitoring Centre, Cambridge, UK. Search conducted in June 2017 for declared exports associated with Purpose Code 'H' (Hunting Trophy), for the period 2006–2015 inclusive.

² Administrations in Scotland and Wales have adopted similar codes of practice.

References

- Aebischer, N.J., Davey, P.D. and Kingdon, N.G. (2011) National Gamebag Census: Mammal Trends to 2009. Game & Wildlife Conservation Trust, Fordingbridge. Available at: <http://www.gwct.org.uk/ngcmammals> (accessed 23 June 2017).
- Bale, R. (2015) Why Killing a Bull Elephant With Big Tusks Hurts the Herd. Available at: <http://news.nationalgeographic.com/2015/10/151017-zimbabwe-elephant-tusker-trophy-hunting-poaching-conservation-africa-ivory-trade/> (accessed 23 June 2017).
- BASC (2015) British Association for Shooting and Conservation (BASC) Statement on Game Bird Release Numbers. Available at: <https://basc.org.uk/blog/press-releases/latest-news/basc-statement-on-game-bird-release-numbers/> (accessed 23 June 2017).
- Bateson, P. and Bradshaw, E.L. (1997) Physiological effects of hunting red deer (*Cervus elaphus*). *Proceedings of the Royal Society B* 264(1389). DOI: 10.1098/rspb.1997.0237
- Bicknell, J., Smart, J., Hoccom, D., Amar, A., Evans, A. *et al.* (2010) Impacts of non-native gamebird release in the UK: a review. *RSPB Research Report* Number 40. Royal Society for the Protection of Birds (RSPB), Sandy, Bedfordshire, UK.
- Boone and Crockett Club (2014) Boone and Crockett Club Position Statement: Long Range Shooting. Available at: <https://www.boone-crockett.org/about/LRS.asp?area=about&ID=6B455080&se=1&te=1> (accessed 23 June 2017).
- Boone and Crockett Club (2017) Fair Chase Statement. Available at: https://www.boone-crockett.org/huntingEthics/ethics_fairchase.asp?area=huntingEthics (accessed 23 June 2017).
- Bradshaw, E. and Bateson, P. (2000) Welfare implications of culling red deer (*Cervus elaphus*). *Animal Welfare* 9, 3–24.
- Brochet, A.-L., Van den Bossche, W., Jbour, S., Ndag'ang'a, P.K., Jones, V.R. *et al.* (2016) Preliminary assessment of the scope and scale of illegal killing and taking of birds in the Mediterranean. *Bird Conservation International* 26, 1–28. Available at: <http://www.seo.org/wp-content/uploads/2016/03/Illegal-killing-and-taking-of-birds-Mediterraneo.pdf> (accessed 23 June 2017).
- Butterworth, A., Turner, K.M.E. and Jennings, N. (2017) Minimising orphaning in the brown hare (*Lepus europaeus*) in England and Wales: should a close season be introduced? *Wildlife Biology* wlb.00279. DOI: 10.2981/wlb.00279
- CITES (2017) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Resolution Conference 17.9: Trade in hunting trophies of species listed in Appendix I or II. Available at: <https://cites.org/sites/default/files/document/E-Res-17-09.pdf> (accessed 23 June 2017).
- CITES Trade Database (no date) Available at: <https://trade.cites.org/> (accessed 21 June 2017).
- Creel, S., M'soka, J., Dröge, E., Rosenblatt, E., Becker, M.S. *et al.* (2016) Assessing the sustainability of African lion trophy hunting, with recommendations for policy. *Ecological Applications* 26(7). DOI: 10.1002/eap.1377
- Damm, G.R. (2008) Recreational trophy hunting: 'What do we know and what should we do?'. In: Baldus, R.D., Damm, G.R. and Wollscheid, K. (eds) *Best Practices in Sustainable Hunting – A Guide to Best Practices from Around the World*. The International Council for Game and Wildlife Conservation, Budakeszi, Hungary, pp. 5–11.
- Darimont, C.T., Coddling, B.F. and Hawkes, K. (2017) Why men trophy hunt. *Biology Letters* 13, 20160909. Available at: <http://dx.doi.org/10.1098/rsbl.2016.0909> (accessed 23 June 2017).
- DEA (2015) National Environmental Management: Biodiversity Act, 2004 (act no. 10 of 2004) Biodiversity Management Plan for African Lion (*Panthera leo*). Department of Environmental Affairs (DEA), South Africa. Available at: https://www.environment.gov.za/sites/default/files/gazetted_notices/nemba_africanlion_managementplan_gn351g38706.pdf (accessed 23 June 2017).
- Defra (2009) *Code of Practice for the Welfare of Gamebirds Reared for Sporting Purposes*. Department for Environment, Food and Rural Affairs (Defra), UK. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69379/pb13356-game-birds-100720.pdf (accessed 23 June 2017).
- Ditchkoff, S.S., Welch, E.R. Jr, Lochmiller, R.L., Masters, R.E., Stary, W.R. and Dinkines, W.C. (1998) Wounding rates of white-tailed deer with traditional archery equipment. *Proceedings of the Annual Conference of the Southeast Association of Fish and Wildlife Agencies* 52, 244–248.
- Dubois, S., Fenwick, N., Ryan, E.A., Baker, L., Baker, S.E. *et al.* (2017) International consensus principles for ethical wildlife control. *Conservation Biology* 31(4), 753–760. DOI: 10.1111/cobi.12896
- Economist (2015) Carriers Lighten their Load With a Hunting Trophy Ban. Available at: <http://www.economist.com/blogs/gulliver/2015/08/airlines-and-public-opinion> (accessed 23 June 2017).

- Economists at Large (2013) The \$200 million question: how much does trophy hunting really contribute to African communities? A report for the African Lion Coalition, prepared by Economists at Large, Melbourne, Australia. Available at: <http://www.ecolarge.com/work/the-200-million-question-how-much-does-trophy-hunting-really-contribute-to-african-communities/> (accessed 23 June 2017).
- FAWC (1979) Farm Animal Welfare Council (FAWC) Press Statement. Available at: <http://webarchive.nationalarchives.gov.uk/20121007104210/http://www.fawc.org.uk/pdf/fivefreedoms1979.pdf> (accessed 23 June 2017).
- Grijalva, R.M. (2016) Missing the mark: African trophy hunting fails to show consistent conservation benefits. A Report by the Democratic Staff of the House Committee on Natural Resources. Available at: <http://democrats-naturalresources.house.gov/imo/media/doc/Missing%20the%20Mark.pdf> (accessed 23 June 2017).
- HSUS and HSI (2016) Trophy Hunting by the Numbers – the United States’ Role in Global Trophy Hunting. The Humane Society of the United States (HSUS) and Humane Society International (HSI). Available at: http://www.hsi.org/assets/pdfs/report_trophy_hunting_by_the.pdf (accessed 23 June 2017).
- Hunter, L.T.B., White, P., Henschel, P., Frank, L., Burton, C., Loveridge, A. *et al.* (2013) Walking with lions: why there is no role for captive-origin lions (*Panthera leo*) in species restoration. *Oryx* 47, 19–24.
- Independent Expert Panel (2014) Pilot Badger Culls in Somerset and Gloucestershire: Report by the Independent Expert Panel. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300382/independent-expert-panel-report.pdf (accessed 23 June 2017).
- IUCN (2016a) World Conservation Congress (WCC) Resolution 013. Terminating the Hunting of Captive-bred Lions (*Panthera leo*) and Other Predators and Captive Breeding for Commercial, Non-conservation Purposes. International Union for Conservation of Nature (IUCN). Available at: https://portals.iucn.org/library/sites/library/files/resrecfiles/WCC_2016_RES_013_EN.pdf (accessed 23 June 2017).
- IUCN (2016b) Informing Decisions on Trophy Hunting. A Briefing Paper for European Union Decision-makers Regarding Potential Plans for Restriction of Imports of Hunting Trophies. International Union for Conservation of Nature (IUCN). Available at: http://cmsdata.iucn.org/downloads/iucn_informing_decisionsontrophyhuntingv1.pdf (accessed 23 June 2017).
- IUCN SSC (2012) *Guiding Principles on Trophy Hunting as a Tool for Creating Conservation Incentives*, Version 1.0. International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC), Gland, Switzerland. Available at: https://cmsdata.iucn.org/downloads/iucn_ssc_guiding_principles_on_trophy_hunting_ver1_09aug2012.pdf (accessed 23 June 2017).
- Leader-Williams, N., Milledge, S., Adcock, K., Brooks, M., Conway, A. *et al.* (2005) Trophy hunting of black rhino *Diceros bicornis*: proposals to ensure its future sustainability. *Journal of International Wildlife Law and Policy* 8, 1–11. Available at: <http://dx.doi.org/10.1080/13880290590913705> (accessed 23 June 2017).
- Leader-Williams, N., Baldus, R.D. and Smith, R.J. (2009) The influence of corruption on the conduct of recreational hunting. In: Dickson, B., Hutton, J. and Adams, W.M. (eds) *Recreational Hunting, Conservation and Rural Livelihoods: Science and Practice*. Wiley-Blackwell, Oxford. DOI: 10.1002/9781444303179.ch18
- League Against Cruel Sports (2015) Pheasant and Partridge Shooting. Available at: www.league.org.uk/cruelgame (accessed 23 June 2017).
- Loveridge, A.J., Valeix, M., Chapron, G., Davidson, Z., Mtare, G. and Macdonald, D.W. (2016) Conservation of large predator populations: demographic and spatial responses of African lions to the intensity of trophy hunting. *Biological Conservation* 204(B), 247–254. Available at: <https://doi.org/10.1016/j.biocon.2016.10.024> (accessed 23 June 2017).
- Macdonald, D.W., Jacobsen, K.S., Burnham, D., Johnson, P.J. and Loveridge, A.J. (2016) Cecil: a moment or a movement? Analysis of media coverage of the death of a lion, *Panthera leo*. *Animals* 6, 26.
- Mellor, D.J. (2016) Updating animal welfare thinking: moving beyond the ‘Five Freedoms’ towards ‘A Life Worth Living’. *Animals* 6, 21.
- Moore, R. (2015) Available at: <http://www.telegraph.co.uk/news/worldnews/africaandindianocean/zimbabwe/11771713/Cecil-the-lion-Sir-Roger-Moore-says-hunting-is-a-cowards-pastime.html> (accessed 19 February 2018).
- Nelson, M.P., Bruskotter, J.T., Vucetich, J.A. and Chapron, G. (2016) Emotions and the ethics of consequence in conservation decisions: lessons from Cecil the lion. *Conservation Letters* 9, 302–306. Available at: <http://onlinelibrary.wiley.com/doi/10.1111/conl.12232/full> (accessed 23 June 2017).
- NSPCA (2017) Canned Hunting. National Council of Societies for the Prevention of Cruelty to Animals (NSPCA), South Africa. Available at: www.nspca.co.za/canned-hunting/ (accessed 23 June 2017).
- OIE (2016) *Terrestrial Animal Health Code*. World Organisation for Animal Health (OIE). Available at: <http://www.oie.int/standard-setting/terrestrial-code/access-online/> (accessed 23 June 2017).
- Palazy, L., Bonenfant, C., Gaillard, J.-M. and Courchamp, F. (2011) Cat dilemma: too protected to escape trophy hunting? *PLOS One* 6(7), e22424. DOI: 10.1371/journal.pone.0022424

- Safari Club International (2016) World Hunting Awards. Available at: <https://www.safariclub.org/what-we-do/record-book/world-hunting-awards> (accessed 23 June 2018).
- Safari Club International (2018) World Hunting Award Field Journal. Available at: <https://www.safariclub.org/docs/default-source/default-document-library/wha-breakdowns-field-journal-2018.pdf?sfvrsn=0> (accessed 23 June 2018).
- Simon, A. (2017) The competitive consumption and fetishism of wildlife trophies. *Journal of Consumer Culture* February, 1–18. DOI: 10.1177/1469540517690571
- Slotow, R., van Dyk, G., Poole, J., Page, B. and Klocke, A. (2000) Older bull elephants control young males. *Nature* 408, 425–426.
- Stoate, C. and Tapper, S.C. (1993) The impact of three hunting methods on brown hare (*Lepus europaeus*) populations in Britain. *Gibier Faune Sauvage* 10, 229–240.
- Summers, C. (2016) Wife of hunter who killed bear with a 7ft homemade spear is fired by her Under Armour sponsors over horrifying video. *Daily Mail* 19 August 2016. Available at: <http://www.dailymail.co.uk/news/article-3748486/Wife-hunter-killed-bear-7ft-homemade-spear-fired-Armour-sponsors-horrifying-video.html#ixzz4jJPLhbg0> (accessed 23 June 2017).
- Traffic (2012) The South Africa–Viet Nam Rhino Horn Trade Nexus: A deadly combination of institutional lapses, corrupt wildlife industry professionals and Asian crime syndicates. Available at: http://www.traffic.org/species-reports/traffic_species_mammals66.pdf (accessed 23 June 2017).
- Ward, R. (1892) *Horn Measurements and Weights of the Great Game of the World: Being a Record for the Use of Sportsmen and Naturalists*. Biodiversity Heritage Library, London. DOI: 10.5962/bhl.title.15203
- WildCRU (2017) Cecil and the conservation of lions. Wildlife Conservation Research Unit (WildCRU), Department of Zoology, University of Oxford. Available at: <https://www.wildcru.org/cecil-home/> (accessed 23 June 2017).
- Young, B. and Chevallier, N. (directors) (2015) *Blood Lions*. Film directed by Bruce Young and Nick Chevallier. Available at: <http://www.bloodlions.org/> (accessed 23 June 2017).

6

Carry on Carrion: the Fall of the Scavenger

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6.1 Introduction

The Allied troops who occupied Macedonia during the war had a very different method of living to the former inhabitants. The roads, which were strewn with the carcasses of ponies and mules etc. when British troops arrived in the country were speedily cleared up, and as all refuse was afterwards destroyed with military precision, the country rapidly became cleaner. Egyptian vultures seemed to be most numerous in the direction of the Serbian frontier, where the state of the country must have been more congenial to their wants than the cleaner area occupied by the British forces.

(Chasen, F.N. (1921), Officer of the British Army, Norfolk Regiment, Salonica front, World War I)

Hundreds of scavenger species, ranging from microbes to insects, fish, mammals and birds, perform a vital task for the function of life on earth, by consuming decomposing dead meat. Among them, vultures are unique obligate scavengers that first appeared 50 million years ago (mya) (Campbell, 2015). Since the first hominids walked on earth, 4 mya, various co-evolutionary processes have tied human life with the vultures. Old World and New World vultures infiltrated myths and became symbols of peoples in all continents where these magnificent species exist. In the long course of human prehistory and history, from followers of scavengers in their quest for food, humans gradually became the 'leaders' of the vultures, by providing carrion at an increasing rate during the last c.10,000 years of hunting and animal husbandry. However, since the end of the 20th century, rapid and extensive landscape and land use changes and implementation of new sanitary practices are depriving scavengers of their main food source. Moreover, 'progress' and expansion of human societies in the modern world bring new threats such as wind farms, power lines,

and poison baits, and these make vultures' status very unstable. Modern societies should ask themselves if they will allow vultures to perform their ecosystem services in the future or just let them perish.

6.2 Vultures' Spectacular Lives

Vultures evolved in a world of plenty, during the peak of the Age of Mammals, when vast herds of large mammals were found in Africa, Europe, and North America. Each massive meal could feed huge flocks of large vultures much more easily than could an alternative predatory lifestyle (Campbell, 2015). Over several millions of years, vultures developed special morphological, anatomical, and behavioural adaptations enabling them to better exploit the food resource of carcasses (Beasley *et al.*, 2015). Acute vision, large wings for soaring flight, social foraging, association with large predators, and flight patterns that create informational transmission networks in the sky enhanced their efficiency for locating and exploiting carcasses fast over vast areas, enabling them to cope with the spatial and temporal unpredictability of carrion resource distribution (Ruxton and Wilkinson, 2013; Cortés-Avizanda *et al.*, 2014; Campbell, 2015).

The bare head of the vulture, in combination with the production of strong stomach acids, reduces the risk of disease from potentially lethal microorganisms that exist in carrion (Buechley and Şekerciöğlu, 2016). Obligate scavenging has shaped these animals' spectacular life histories by selecting for delayed maturity and relatively high adult survivorship, resulting in some of the lowest reproductive rates among birds, which limits population growth over time and renders vultures particularly vulnerable to

colony destruction and human- or naturally induced high mortality (Ogada *et al.*, 2012).

Globally, there are 23 vulture species, of which 16 species occur in the Old World and seven species in the New World (Ogada *et al.*, 2012; Campbell, 2015) (Fig. 6.1). The New World and Old World vultures are a textbook example of convergent evolution, which is the independent evolution of similar or identical features in species of different genera, families, or orders, in geographical isolation, and according to the variation of carrion resources on different continents (Campbell, 2015). Old World vultures are from the eagle and hawk family (Accipitridae) and mainly use their eyesight for discovering food, while New World vultures are of obscure ancestry and some (in the family Cathartidae) use their sense of smell as well as sight when hunting. It is quite imperative to understand this rough categorization in order to be able to understand the reasons for their decline, and the conditions which cause vultures to struggle for survival in the 21st century.

In Africa, Old World vultures depend for food mostly on wild ungulates, while in Europe they have been mostly dependent on livestock through pastoral practices such as transhumance and slaughterhouse animal by-products. In Asia's lowlands, they forage within cities on human waste dumps, on dead sacred cows, or even on human corpses (Schüz and König, 1983; Cocker and Tipling, 2013).

In South America's tropical forests, New World vultures venture into the forest, while in North America

they forage on wild ungulates, farmed livestock, and marine mammals (Campbell, 2015).

6.3 The Human–Vulture Nexus

Our relationships with vultures are considered one of the most ancient interspecific relationships, dating back to the Late Pliocene, *c.*4 mya (Morelli *et al.*, 2015). The many benefits that humanity gained from such relationships are part of what is termed today 'ecosystem services' (MEA, 2005), which include provisioning, regulating, cultural, and supporting services (see below). Unfortunately, an appreciation of the 'ecosystem services' provided by scavengers to humanity is emerging only as vertebrate scavenger populations become significantly at risk (Moleón *et al.*, 2014).

Food provisioning represents the first ecosystem service that humans obtained from scavengers (Moleón *et al.*, 2014), when early hominins started exploiting carcasses, either killed by other predators or which died without predation, for access to meat as a food source (Domínguez-Rodrigo, 2002). Vultures were used as 'eyes in the sky' in order to locate carcasses by observing their flight movements (Morelli *et al.*, 2015), a practice still used in the 21st century by some hunter-gatherer tribes (Ruxton and Wilkinson, 2013). By observing vulture behaviour, it is argued that selection pressures acted for anatomical and physical changes of early hominin scavengers selecting for their running ability over short distances (Ruxton and Wilkinson, 2013) or even for endurance running in their 'need' to reach carcasses before other large terrestrial scavengers (Bramble and Lieberman, 2011, cited in Moleón *et al.*, 2014). Besides helping early hominins to locate carcasses, it has been shown that vultures still facilitate African predators, such as lions and hyenas, in locating food resources, thus contributing to the maintenance of their populations (Ogada *et al.*, 2012). Food provisioning became somewhat reversed in the course of human history as (eventually) vultures gradually became dependent on the abundant food coming from human waste (Houston, 2001) or pastoral practices (Olea and Mateo-Tomás, 2009).

From the Palaeolithic era (2.6 mya) until today, vultures have provided unparalleled sanitary ecosystem services to humans by controlling the spread of disease and pests (Azmanis, 2009; Ogada *et al.*, 2012), through the removal of animal debris and other refuse around settlements and garbage



Fig. 6.1. Egyptian vulture (*Neophron percnopterus*) and black vulture (*Aegypius monachus*). They have coexisted for millions of years and are still found together in the 21st century. (Image credit: 2015, Petros Babakas/Management Body of Dadia-Lefkimi-Soufli Forest National Park.)

dumps (Schüz and König, 1983; Houston, 2001; Donazar *et al.*, 2009; Finlayson *et al.*, 2012; Moleón *et al.*, 2014). This is a service that vultures continue to offer today in urban areas of Central and South America, India and West Africa, where they appear as regular scavengers (Houston, 2001; Finlayson *et al.*, 2012). Socotra Island, in the Indian Ocean, hosts the highest world density of the critically endangered Egyptian vulture (*Neophron percnopterus*), with over 1000 pairs foraging in dumps around villages and cities on the island. Consuming an estimated 250 t of organic matter annually, the birds are recognized by island inhabitants as ‘soeydu’, which literally means ‘garbage bin’ (Gangoso *et al.*, 2013).

Over the course of human civilization, the symbolic and ritualistic significance of vultures has persisted through time and across cultures (Morelli *et al.*, 2015). Extraction of feathers from birds by Neanderthals for use as decoration was a widespread phenomenon taking place over thousands of years (Finlayson *et al.*, 2012). Up until our century, vulture feathers, skin, and bones have been used as body adornments, ornamental artefacts, or objects of practical use with the expectation that they also magically convey the powerful nature of the bird itself (Houston, 2001; Morelli *et al.*, 2015; Stara *et al.*, 2016), but above all, it is their association with death that dominates perceptions among cultures.

For thousands of years vultures’ ‘necrophagous’ (feeding on corpses or carrion) nature has provided a strong source of ‘metaphor’, based on diverse appreciations of death, ancestry, and the world of spirits among cultures. Ranging from associations with an opportunity for spiritual rebirth, to a connection with evil, misfortune, and miasma (Cooper, 1979; Alexiou, 2002), vultures were perceived as omens or gods. In Ancient Egypt the goddess of childbirth Nekhbet and mother goddess Mut, symbols of maternal love and protection, were portrayed as vultures (Mundy *et al.*, 1992; Morelli *et al.*, 2015). In North America, California condors (*Gymnogyps californianus*) were conceived as a source of shamanistic power (Simons, 1983). Likewise, in Africa, birds’ immune defences and purification symbolism are often magically transmitted to people via traditional medicine or black magic (Sánchez-Pedraza *et al.*, 2012; Ogada *et al.*, 2015), while in the Balkans, Egyptian vultures were considered as the precursors of spring (Stara *et al.*, 2016) (Fig. 6.2).



Fig. 6.2. Egyptian vultures (*N. percnopterus*) nesting above a shepherd hut in Meteora, Central Greece. The species in this area is called ‘tyrocomos’, literally meaning the ‘cheese maker’, and was considered a symbol of plenty for successful dairy production. (Image credit: 2012, Dimitris Vavylis.)

African people’s perceptions of vultures were contested by Western ideas about ‘progress’ and the domination of people on earth (Mundy *et al.*, 1992) and were combined with Christian ideas that connect death with evil (Kambanis, 2006). In Christian societies, the exposure of a human corpse is considered a sin, and vultures were perceived as ill-fated and evil creatures. In some societies, a purification ritual was implemented to ensure the ‘safe use’ of vulture parts, as in modern Greece, where vulture ulna bones were used for flute making (Stara *et al.*, 2016). In the late 15th century, European explorers to Africa loathed the ‘gaunt ravenous harpies’ that were not allowing ‘noble animals’ (i.e. elephants) to die in peace. Vultures were ‘feared predators’ and Egyptian vultures were poisoned with strychnine by the first European

ostrich farmers, as a reaction to their unique ability to crack and eat ostrich eggs (Mundy *et al.*, 1992).

At the opposite end of cultural perceptions, lay the practices of ‘excarnation’, by disposal of human dead bodies to vultures. Excarnation dates back to c.6000 BC, and is depicted in wall paintings from Çatalhöyük, southern Turkey (Cocker and Tipling, 2013). Other evidence for excarnation is found in various parts of the prehistoric world such as the platform burials of the Comanche Indians of New Mexico and Colorado areas (Sitnikov, 2016). Similar rituals are also currently practised today in Asia. The most pronounced cultural association with vultures are the Parsees’ ‘towers of silence’ and the ‘sky burials’ of the Tibetan Buddhists of the Himalayas, where human corpses are disposed of to the birds during special rituals, in order to avoid contamination of the sacred elements: fire, earth, and water (Cocker and Tipling, 2013).

Among Western cultures of the modern world, vultures are perceived in very diverse and contradictory ways. Local beliefs and the linkage of local peoples to land, nature, and wildlife have faded under the pressure of rapid westernization processes in rural societies of Europe and North America. Age-old perceptions expressed as myths, fables or rituals have been gradually replaced by a depreciation of, or even a contempt for, vultures. As a result, although vultures are being advertised positively as ‘nature cleaners’ in various public awareness campaigns aimed at their conservation, at the same time their mass media image and perception is often related to economic catastrophes expressed with phrases such as ‘vulture capitalist’, ‘vulture funds’ or ‘vulture culture’. Vultures are also often presented as stupid, evil characters in stories and cartoons, and are associated with negative emotions and poor cultural stereotypes (Morelli *et al.*, 2015; Stara *et al.*, 2016). Stripped of their glory and awe, vultures are now being used as a spectacle in artificial feeding sites, killed recklessly by poisoned baits, and are subject to the marginalization effects of our ‘advancing civilization’.

6.4 A Global Vulture Crisis

Over the last few decades, vulture populations have declined at catastrophic rates, especially in South-east Europe, Asia, and Africa (Andevski, 2011; Ogada *et al.*, 2012; Buechley and Şekercioğlu, 2016) so that, today, obligate scavengers are the single most threatened avian functional group in

the world (Şekercioğlu *et al.*, 2004) with 61% of vulture species worldwide (i.e. 14 out of 23 species) threatened by extinction, and most African-Eurasian species listed as critically endangered (Ogada *et al.*, 2012; Botha *et al.*, 2017).

India’s recent massive vulture population crash has shocked the global conservation community: between 1993 and 2003 there was an estimated decline of 99.7% for *Gyps indicus* and 97.4% for *Gyps tenuirostris*, previously two of the most numerous raptor species in the world, with a former population of c.40 million individuals (Markandya *et al.*, 2008). Similar declines of more than 90% of vulture populations have happened in Pakistan and Nepal (Ogada *et al.*, 2012). In the African continent, a vulture crisis has been confirmed by surveys in 2015, with population collapses of 60–80% and regional extirpations (complete local destruction) of three species. Today, six out of Africa’s 11 vulture species are listed as critically endangered (Ogada *et al.*, 2015; Botha *et al.*, 2017).

At the beginning of the 21st century, European avian scavenger communities were one of the few exceptions to the global decline in Old World avian scavenger birds (Margalida and Colomer, 2012; Ogada *et al.*, 2012), with healthy populations retained mainly in South-west Europe (Donazar *et al.*, 2009), although in South-east Europe vultures are still at high risk, especially the migratory Egyptian vulture which is currently at the brink of extinction.

On the other side of the Atlantic, the Andean Condor in South America is undergoing a ‘moderately rapid decline’, while half of the vulture species of Central and South America are estimated to be in decline (Ogada *et al.*, 2012). In North America the population of California condor (*G. californianus*) had dropped to just 22 birds by 1981 and in 1987 the species became extinct in the wild (Alagona, 2004).

6.5 The Vulture Countdown – Welfare Effects of Human Activity

The culprit for the Asian vulture crash is diclofenac (2-[2-(2,6-dichloroanilino)phenyl]acetic acid), a non-steroidal anti-inflammatory painkiller broadly administered to domesticated cattle, which has proven to be toxic to vultures (Markandya *et al.*, 2008; Cuthbert *et al.*, 2014). Meanwhile, the

decline in Africa is attributed (61% of decline) to poisoning events (mainly due to ivory poaching) and trade for traditional medicines (29% of the decline), while electrocution in power lines seems to affect 9% of the African vulture population (Ogada *et al.*, 2015).

In North America and Europe though, vulture populations have been declining since the mid-19th century (Ogada *et al.*, 2012), these birds being heavily hunted for sport and taxidermy, or persecuted due to human–nature conflicts and prejudice against vultures. In Southern Europe, the first signs of vulture decline appeared with a delay of almost a century, mainly as a result of a rapid industrialization of livestock farming. Reduction of transhumance, reduced free-grazing livestock numbers and the replacement of donkeys,

horses, and mules by tractors in the modern agricultural landscapes resulted in a severe decrease of carcass availability (Fig. 6.3). The decline was further exacerbated by indiscriminate use of poisoning primarily against mammalian predators. Deliberate or non-deliberate (secondary) poisoning is still a major cause underlying recent extermination of vulture populations in South-east Europe (Andevski, 2011). In North America, condor populations were dwindling for decades but they were brought to extinction as a result of excessive mortality, especially from poisoning (Ford, R. 1986 cited in Alagona, 2004). Lead has been called the ‘silent killer’, causing acute poisoning or accumulative disorders resulting in significant reproductive failure (Alagona, 2004; Rideout *et al.*, 2012; Golden *et al.*, 2016).



Fig. 6.3. Transhumance, as practised in the Pindos mountains, Central Greece. Animals and people have followed the same ancient routes for centuries; routes similar to those used by wild ungulates during prehistoric times. The seasonal movement of large numbers of sheep and goats from lowland winter grazing to the summer subalpine pastures provides an important food source for vultures. (Image credit: 2015, Kalliopi Stara.)

In the mid-1990s, a new impact on vultures emerged in Europe, through the transmission of Creutzfeldt–Jakob disease to humans, acquired from cattle infected by bovine spongiform encephalopathy (BSE). Public health was protected by strict European Union (EU) sanitary regulations that led to 80% of all animal carcasses being destroyed industrially (rendered or burned), thereby depriving vultures of one of their main food sources in the wild (Donazar *et al.*, 2009; Margalida *et al.*, 2010). Last but not least, following the planet's growing demand for energy and mitigation of climate change, the construction of numerous, extensive wind farms is rapidly expanding in Europe, America, Asia, and Africa, creating further conservation conflicts for raptors and vultures; birds which are particularly vulnerable to collisions with rotor blades (Martínez-Abraín *et al.*, 2012; Tabassum-Abbasi *et al.*, 2014; Vasilakis *et al.*, 2016).

Towards the end of the 20th century, vulture populations worldwide struggled to survive, overcoming food shortage, poisoning, habitat loss, direct persecution, lead poisoning, and genetic depression by fragmentation or isolation of populations. On the other hand, the ecosystem services they provide are beginning to be appreciated by humans, as their absence is creating considerable environmental and cultural gaps. In Asia, the absence of vultures imposes tremendous costs to provide a sanitary service that was previously provided for free. For example in India, the growth in feral dog numbers, following the collapse of vulture populations, has contributed to an increase in risks associated with rabies transmission, with an estimated US\$34 billion additional health-care costs between 1993 and 2006 (Markandya *et al.*, 2008).

6.6 Conservation Efforts Fighting Against Time

Vultures today are a threatened and charismatic group of species that conservationists have used, among other top predators, as flagship species to acquire financial support, raise environmental awareness and to plan systems of protected areas (Sergio *et al.*, 2006). The ability to preserve vultures may be limited without political will, commitments by governments and scientists, and local community support (Ogada *et al.*, 2012; Morelli *et al.* 2015). At the beginning of the 21st century, intensive conservation programmes are beginning

to show some positive results. For example, in California, after the transfer of all surviving wild birds into captivity in 1987 and subsequent release and reintroduction of captive-bred birds, the tiny Californian condor population is slowly increasing, now numbering 104 adults in the wild, but still being critically endangered (Birdlife International, 2017).

Tremendous financial and human resources have been expended for the conservation and recovery of the small vulture populations that still persist in Asia. Since 2006, India, Nepal, and Pakistan have banned diclofenac and several other drugs which are toxic to vultures (Cuthbert *et al.*, 2016); various captive breeding centres have been set up in India, Bangladesh, Nepal, and Pakistan along with numerous feeding sites, while research for alternative pharmaceuticals of low toxicity to vultures has advanced (Swarup *et al.*, 2007; Markandya *et al.*, 2008; Buechley and Şekercioğlu, 2016).

In Europe, some vulture populations have recovered, but only where effective control of poisons and persecution has been achieved. Reintroduction programmes (e.g. of the bearded vulture (*Gypaetus barbatus*) in the Alps) have succeeded in bringing locally extinct species back in the wild. Recent amendments to EU sanitary regulations help to guarantee an adequate food supply for vultures, although further convergence between sanitary and environmental policies is still needed (Margalida *et al.*, 2010). Unfortunately, the situation in Africa, with sharp declines in many species, has received relatively little attention (Ogada *et al.*, 2012).

The ornithological community is starting to fight against time on many fronts: the International Union for Conservation of Nature (IUCN), the Vulture Specialist Group, and the Vulture Conservation Foundation have managed to join all of the smaller non-governmental organizations (NGOs) in Europe, Africa, and Asia together in a battle to save vulture populations, by launching the Multi-Species Vulture Action Plan in 2016 (Botha *et al.* 2017, Figs 6.4 and 6.5). Reversing the current critical state of vultures will require substantial amounts of funding for conservation programmes: in California, the condor recovery programme has cost US\$35 million over 23 years (Alagona, 2004). The EU has financed at least 76 LIFE projects related to vulture species and between 1993 and 2014 spent €121.9 million (Margalida and Oliva-Vidal, 2017). During the last two decades, a total of €19.14 million has been devoted to the



Fig. 6.4. Black vultures (*Aegypius monachus*) and griffon vultures (*Gyps fulvus*) fighting over a carcass in one of three supplementary feeding stations in the Dadia-Lefkimi-Soufli National Park, Thrace, Greece. The colony of black vultures in this area is the last remaining of this species in Eastern Europe, and is maintained by the long-term conservation efforts of WWF-Hellas and local authorities, as extensively free-grazing livestock declined and donkeys, horses, and mules have been replaced by tractors in the modern agricultural landscapes. (Image credit: 2011, Petros Babakas/Management Body of Dadia-Lefkimi-Soufli Forest National Park.)



Fig. 6.5. Long-term conservation actions on the island of Crete, Greece, have resulted in a threefold increase in numbers of griffon vultures (*Gyps fulvus*) in 30 years, with 60 colonies and a population of 250–300 egg-laying pairs, while bearded vultures (*Gypaetus barbatus*) are also increasing, having eight pairs and 50 living individuals; the biggest island population in the world. (Image credit: 2015, Nikos Samaritakis, Archive of Natural History Museum of Crete.)

recovery of the Egyptian vulture, but the species still remains critically endangered (Gangoso *et al.*, 2013; Veleviski *et al.*, 2015).

6.7 To Live or Not to Live: the Survival of Vultures in a Human-ruled Intensified World

Vultures have been intimately engaged with humans through complex ecological relationships: initially signallers and hence food providers, they gradually became refuse cleaners during the past 10,000 years, arriving eventually at the 21st century with decimated populations. Their continuing existence is currently supported by, and probably fully dependent on, large conservation programmes, which recognize their irreplaceable ecosystem services. However, it is not a utilitarian philosophy that will ensure their survival in the future, but a shift in our overall attitude towards nature and its circles of life and death.

Can we afford to stay indifferent about vultures? Controversies of symbolic perceptions among cultures give an insight into how important ethical aspects are in conservation. The California condor was rebaptized and turned into a symbol of 'wilderness' at the beginning of the 20th century, whereas previously it has been a depreciated creature, perceived as a 'pig with wings', and given disparaging names both by native and by colonial Americans. With its new-found symbolism it has gained respect, affection, and the commitment of American society, and this has contributed to its rescue from the brink of extinction (Alagona, 2004). The Parsees' perception of vultures as cultural and functional agents has recently changed. Vultures did not play a role spiritually *per se*, but were recognized for their practical utility in aiding the disposal of corpses. The 1200-year-old funeral rite of sky burials has been reinvented – substituting vultures with powerful solar concentrators which destroy the bodies (Markandya *et al.*, 2008; Cocker and Tipling, 2013).

The Indian vulture crisis reflects a break in the chain of the welfare for all of the actors involved: humans, domesticated animals, wild birds. Extreme poverty in Indian farmers led to the widespread use of a veterinary painkiller diclofenac that would prolong the lives of their hard-working cattle, saving them temporarily from the cost of replacing them. The toxicity of this drug has caused an agonizing and painful death for millions of vultures across the subcontinent (van Dooren, 2010) and

despite its ban for over a decade, it still causes mortality (Cuthbert *et al.*, 2016). At the end point, the same poor farmers are now deprived of a meagre surplus income they had from the cattle bones they sold to the fertilizer industry, and additionally their health is directly threatened by anthrax (when dealing with the carcasses) and rabies (as a result of increased feral dog populations) (Markandya *et al.*, 2008). The reaction of the high-welfare European society to a pandemic phobia of BSE, dioxins, severe acute respiratory syndrome (SARS), or highly pathogenic avian influenza (HPAI), based on the precautionary principle, has resulted in changes in carcass disposal which have affected vulture life. EU regulations have affected carcass availability, and this has nearly cancelled out efforts to restore European vulture populations, which had been running for decades.

Can vultures persist in a cleaner, safe, and sterile world? Less-developed countries are rapidly advancing towards achieving the living standards they merit, which drives better sanitary conditions for the population. Promotion of sustainable development requires the restructuring of mutualistic relationships with vultures and a conceptual shift from vultures as waste disposers to natural treasures (Gangoso *et al.*, 2013). The intensive conservation efforts put in place for the California condor highlighted the issue of wildlife welfare, an area that had been largely overlooked by conservationists (van Dooren, 2010). After a bitter political debate about 'hands-on' versus 'hands-off' conservation policies, the condors were eventually released to the wild, and remain dependent on intensive conservation management as they are feeding mostly on controlled human-supplied carcass depots. The 'carcass leash' of the California condor (Alagona, 2004) seems to be the inevitable fate of many other vulture species worldwide despite the fact that *in situ* fallen stock could be the most ecologically harmonious, inexpensive, and efficient management method for the conservation of scavengers (Donázar *et al.*, 2009), provided that basic sanitary precautions are taken.

In Europe, following a large-scale abandonment of low-intensity agricultural landscapes, a new appealing conservation scenario is emerging. The idea of 'rewilding', defined as the passive management of ecological succession through restoration of natural ecosystem processes, is a debatable concept raised to try to address the dilemma of active nature conservation in the face of human interference. Reintroduced vultures could survive in remote, high altitude, open areas, benefiting from

the population growth of wild carnivores and herbivores. In contrast, in the intensively managed lowlands, rewilding actions would not be enough to support any vulture populations without the preservation and maintenance of traditional agro-grazing systems (Cortés-Avizanda *et al.*, 2015).

Vultures inhabit a world of connectivities in which life is made possible by others' deaths (van Dooren, 2010). Their position in modern culture is liminal, by virtue of the reality that they stand actually and symbolically 'on the edge' between life and death, purity and dirt, wilderness and domestication. We need to agree on a conservation ethic that incorporates science and sentiment, utilitarianism and spiritual reverence, (Alagona, 2004) and converts indifference to care and affection for each and every individual with which we share our cosmos.

Bibliography

- Alagona, P. (2004) Biography of a 'feathered pig': the California condor conservation controversy. *Journal of the History of Biology* 37, 557–583. DOI: 10.1007/s10739-004-2083-6
- Alexiou, M. (2002) *O teletourgikos thrinos stin Elliniki paradosi* (Ritual Mourning in Greek Tradition). National Bank of Greece Cultural Foundation, Athens. [in Greek]
- Andevski, J. (2011) *Vulture Conservation in the Balkan Peninsula and Adjacent Regions: 10 years of Vulture Research and Conservation*. Internal report. Vulture Conservation Foundation/Frankfurt Zoological Society, Frankfurt, Germany.
- Azmanis, P.N. (2009) Regulations of transmissible spongiform encephalopathies (TSEs) and management of feeding sites for birds of prey: a comparative approach between Western Europe (Iberian Peninsula and France) and the Balkan Peninsula. *Munibe* 29, 510–525.
- Beasley, J.C., Olson, Z.H. and Devault, T.L. (2015) Ecological role of vertebrate scavengers. In: Benbow, M.E., Tomberlin, J.K. and Tarone, A.M. (eds) *Carrion Ecology, Evolution, and Their Applications*. CRC Press, Boca Raton, Florida, pp. 107–128.
- BirdLife International (2017) *Gymnogyps californianus*. The IUCN Red List of Threatened Species 2017-3. International Union for Conservation of Nature (IUCN). Available at: www.iucnredlist.org (accessed 17 May 2017).
- Botha, A.J., Andevski, J., Bowden, C.G.R., Gudka, M., Safford, R.J. *et al.* (2017) *Multi-species Action Plan to Conserve African-Eurasian Vultures*. CMS Raptors MoU Technical Publication No. 5. Coordinating Unit of the United Nations Environment Programme (UNEP)/Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MoU), Abu Dhabi.
- Buechley, E.R. and Şekercioglu, Ç.H. (2016) The avian scavenger crisis: looming extinctions, trophic cascades, and loss of critical ecosystem functions. *Biological Conservation* 198, 220–228. DOI: 10.1016/j.biocon.2016.04.001
- Campbell, M.O. (2015) *Vultures: their Evolution, Ecology and Conservation*. CRC Press, Boca Raton, Florida.
- Chasen, F.N. (1921) Field notes on the birds of Macedonia. With special reference to the Struma plain. *Ibis* 11, 185–227.
- Cocker, M. and Tipling, D. (2013) *Birds and People*. Jonathan Cape, London.
- Cooper, I.C. (1979) *An Illustrated Encyclopedia of Traditional Symbols*. Thames and Hudson, London.
- Cortés-Avizanda, A., Jovani, R., Donazar, J.A. and Grimm, V. (2014) Bird sky networks: how do avian scavengers use social information to find carrion? *Ecology* 95, 1799–1808. DOI: 10.1890/13-0574.1
- Cortés-Avizanda, A., Donazar, J.A. and Pereira, H.M. (2015) Top scavengers in a wilder Europe. In: Pereira, H.M. and Navarro, L.M. (eds) *Rewilding European Landscapes*. Springer, Heidelberg, Germany, pp. 85–106.
- Cuthbert, R.J., Taggart, M., Prakash, V., Chakraborty, S.S., Deori, P. *et al.* (2014) Avian scavengers and the threat from veterinary pharmaceuticals. *Philosophical Transactions of the Royal Society B* 369, 20130574. DOI: 10.1098/rstb.2013.0574
- Cuthbert, R.J., Taggart, M.A., Saini, M., Sharma, A., Das, A. *et al.* (2016) Continuing mortality of vultures in India associated with illegal veterinary use of diclofenac and a potential threat from nimesulide. *Oryx* 50(1), 104–112.
- Dominguez-Rodrigo, M. (2002) Hunting and scavenging by early humans: the state of the debate. *Journal of World Prehistory* 16(1), 1–54. Available at: <https://www.jstor.org/stable/25801183> (accessed 11 May 2017).
- Donazar, J.A., Margalida, A., Carrete, M. and Sánchez-Zapata, J.A. (2009) Too sanitary for vultures. *Science* 326(5953), 664. DOI: 10.1126/science.326_664a
- Finlayson, C., Brown, K., Blasco, R., Rosell, J., Negro, J.J. *et al.* (2012) Birds of a feather: Neanderthal exploitation of raptors and corvids. *PLOS One* 7(10). DOI: 10.1371/journal.pone.0045927
- Gangoso, L., Agudo, R., Anadón, J.D., de la Riva, M., Suleyman, A.S. *et al.* (2013) Reinventing mutualism between humans and wild fauna: insights from vultures as ecosystem services providers. *Conservation Letters* 6, 172–179. DOI: 10.1111/j.1755-263X.2012.00289.x
- Golden, N.H., Warner, S.E. and Coffey, M.J. (2016) A review and assessment of spent lead ammunition and its exposure and effects to scavenging birds in

- the United States. *Reviews of Environmental Contamination and Toxicology* 237, 123–191.
- Houston, D. (2001) *Vultures and Condors*. Colin Baxter Photography Ltd, Grantown-on-Spey, UK.
- Kambanis, P. (2006) Christians against the forces of evil. In: Zafeiropoulou, D. (ed.) *Esorcizzare il male. Credenze e superstizioni a Bisanzio*. Istituto Ellenico di studi Bizantini e Postbizantini di Venezia, Museo della cultura Bizantina di Salonicco, Greece, pp. 11–30.
- Margalida, A. and Colomer, M.À. (2012) Modeling the effects of sanitary policies on European vulture conservation. *Scientific Reports* 2(753). DOI: 10.1038/srep00753
- Margalida, A. and Oliva-Vidal, P. (2017) The shadow of diclofenac hangs over European vultures. *Nature Ecology and Evolution* 1(1050). DOI: 10.1038/s41559-017-0255-y
- Margalida, A., Donazar, J.A., Carrete, M. and Sánchez-Zapata, J.A. (2010) Sanitary versus environmental policies: fitting together two pieces of the puzzle of European vulture conservation. *Journal of Applied Ecology* 47, 931–935. Available at: <http://www.jstor.org/stable/40835713> (accessed 8 June 2017).
- Margalida, A., Campión, D. and Donazar, J. (2014) Vultures vs livestock: conservation relationships in an emerging conflict between humans and wildlife. *Oryx* 48(2), 172–176. DOI: 10.1017/S0030605312000889
- Markandya, A., Taylor, T., Longo A., Murty, M.N. and Dhavala, K. (2008) Counting the cost of vulture declines – economic appraisal of the benefits of the Gyps vulture in India. *Ecological Economics* 67(2), 194–204. DOI: 10.1016/j.ecolecon.2008.04.020
- Martínez-Abraín, A., Tavecchia, G., Regan, H.M., Jiménez, J., Surroca, M. and Oro, D. (2012) Effects of wind farms and food scarcity on a large scavenging bird species following an epidemic of bovine spongiform encephalopathy. *Journal of Applied Ecology* 49, 109–117. DOI: 10.1111/j.1365-2664.2011.02080.x
- Millennium Ecosystem Assessment (MEA) (2005) *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.
- Moleón, M., Sánchez-Zapata, J.A., Margalida, A., Carrete, M., Owen-Smith, N. and Donazar, J.A. (2014) Humans and scavengers: the evolution of interactions and ecosystem services. *BioScience* 64(5), 394–403. DOI: 10.1093/biosci/biu034
- Morelli, F., Kubicka, A.M., Tryjanowski, P. and Nelson, E. (2015) Human–vulture interaction. *Anthrozoös* 28(3), 449–468. DOI: 10.1080/08927936.2015.1052279
- Mundy, P., Butchart, D., Ledger, J. and Piper, S. (1992) *The Vultures of Africa*. Academic Press, London.
- Ogada, D.L., Keesing, F. and Virani, M.Z. (2012) Dropping dead: causes and consequences of vulture population declines worldwide. *Annals of the New York Academy of Sciences* 1249, 57–71. DOI: 10.1111/j.1749-6632.2011.06293.x
- Ogada, D., Shaw, P., Beyers, R.L., Buij, R., Murn, C. *et al.* (2015) Another continental vulture crisis: Africa's vultures collapsing toward extinction. *Conservation Letters* 9, 89–97. DOI: 10.1111/conl.12182
- Olea, P.P. and Mateo-Tomás, P. (2009) The role of traditional farming practices in ecosystem conservation: the case of transhumance and vultures. *Biological Conservation* 142, 1844–1853. DOI: 10.1016/j.biocon.2009.03.024
- Rideout, B.A., Stalis, I., Papendick, R., Pessier, A., Puschner, B. *et al.* (2012) Patterns of mortality in free-ranging California condors (*Gymnogyps californianus*). *Journal of Wildlife Diseases* 48(1), 95–112.
- Ruxton, G.D. and Wilkinson, D.M. (2013) Endurance running and its relevance to scavenging by early hominins. *Evolution* 67, 861–867. DOI: 10.1111/j.1558-5646.2012.01815.x
- Sánchez-Pedraza, R., Gamba-Rincón, M.R. and González-Rangel, A.L. (2012) Use of black vulture (*Coragyps atratus*) in complementary and alternative therapies for cancer in Colombia: a qualitative study. *Journal of Ethnobiology and Ethnomedicine* 8, 20. DOI: 10.1186/1746-4269-8-20
- Schüz, E. and König, C.A. (1983) Old World vultures and man. In: Sanford, R., Jackson, W. and Jackson, J. (eds) *Vulture Biology and Management*. University of California Press, Berkeley, California, pp. 461–469.
- Şekercioğlu, C.H., Daily, G.C. and Ehrlich, P.R. (2004) Ecosystem consequences of bird declines. *Proceedings of the National Academy of Sciences of the United States of America* 101(52), 18042–18047. DOI: 10.1073/pnas.0408049101
- Sergio, F., Newton, I., Marchesi, L. and Pedrini, P. (2006) Ecologically justified charisma: preservation of top predators delivers biodiversity conservation. *Journal of Applied Ecology* 43, 1049–1055. DOI: 10.1111/j.1365-2664.2006.01218.x
- Simons, D.D. (1983) Interactions between California condors and humans in prehistoric far western North America. In: Sanford, R., Jackson, W. and Jackson, J. (eds) *Vulture Biology and Management*. University of California Press, Berkeley, California, pp. 470–494.
- Sitnikov, I. (2016) The Taiwan 'Temple of Eighteen Deities' (Traces of Eurasia – Pacific cult). *Philosophical Anthropology* 2(1), 61–78.
- Stara, K., Sidiropoulos, L. and Tsiakiris, R. (2016) Bound eagles, evil vultures and cuckoo horses. Preserving the bio-cultural diversity of carrion eating birds. *Human Ecology* 44, 751–764. DOI: 10.1007/s10745-016-9864-3
- Swarup, D.P.R.C., Patra, R.C., Prakash, V., Cuthbert, R., Das, D. *et al.* (2007) Safety of meloxicam to critically endangered Gyps vultures and other scavenging birds in India. *Animal Conservation* 10(2), 192–198.
- Tabassum-Abbasi, Premalatha, M., Abbasi, T. and Abbasi, S.A. (2014) Wind energy: increasing deployment, rising

- environmental concerns. *Renewable and Sustainable Energy Reviews* 31, 270–288.
- van Dooren, T. (2010) Pain of extinction: the death of a vulture. *Cultural Studies Review* 16(2), 271–289.
- Vasilakis, D.P., Whitfield, D.P., Schindler, S., Poirazidis, K.S. and Kati, V. (2016) Reconciling endangered species conservation with wind farm development: Cinereous vultures in south-eastern Europe. *Biological Conservation* 196, 10–17. DOI: 10.1016/j.biocon.2016.01.014
- Veleviski, V., Nikolov, S.C., Hallman, B., Dobrev, V., Sidiropoulos, L. *et al.* (2015) Population decline and range contraction of the Egyptian vulture *Neophron percnopterus* in the Balkan Peninsula. *Bird Conservation International* 25(4), 440–450. DOI: 10.1017/S0959270914000343

7

Restoring What We Have Destroyed: Animal Welfare Aspects of Wildlife Conservation, Reintroduction and Rewilding Programmes

CHARLOTTE BERG

7.1 Introduction

For a long period of time, domestic animals and wildlife were seen as two completely separate entities. Animals were either domesticated or possibly wild, but were kept in enclosures in zoos, and were then under the responsibility of an owner or caretaker, or they were wild and roaming free in the wilderness. In the latter case, they were perceived as ‘nobody’s responsibility’ from an animal welfare perspective. Animal welfare and animal ethics have not always been prioritized issues within conservation practice, and this chapter aims at highlighting a number of aspects which may need to be taken into consideration.

7.1.1 Human-induced habitat changes and loss of biodiversity

Humans are increasingly influencing the welfare of wild animals. Human population growth and the general expansion of human-initiated activities, including food production, are taking place at the expense of wildlife and their habitat. A habitat can be described as the combination of physical and biological features preferred by a particular species. By intentionally or indirectly affecting and destroying wildlife habitat, humans may make the environment unsuitable for a large number of wildlife species and inevitably influence their quality of life, with aspects such as starvation, loss of environment choice, pain, suffering, and death. The human activities influencing wildlife habitat range from urban development, industrial development, infrastructure projects, and natural resource extraction

to overgrazing by domestic animals, wildfire suppression, active hunting, and periodic disruption and continuous disturbance. We keep vast numbers of domesticated animals that require food, space and other resources. Not only is this about competition for space, but also about the risks of introducing new pathogens from livestock into wildlife populations, or even failing to keep domestic species confined, and thereby indirectly introducing them as invasive species. Such species can constitute major threats to local wildlife, by competing for food sources, or by acting as predators to which indigenous wildlife have not been able to develop defence strategies. In some cases, hybrids between closely related wild and domestic species (e.g. wolf and dog) have been created, and caused considerable conservation-related disturbance.

All of these factors have led to loss of biodiversity and reductions in numbers, and, over time, to the extinction of some species. At some point, and already the case for some species, wildlife risk becoming confined to limited areas by landscape fragmentation and the quality of the habitats may no longer be sufficient to sustain viable wildlife populations. In this situation, population distribution starts to become ‘limited’. Basically, the more land used by humans and domestic animals, the less is available for wild animals. In some cases, domestic animals can be seen taking over entire ecosystems. Although some types of wildlife can persist and also thrive in highly altered habitats very close to human dwellings or even in big cities, we should bear in mind that many species are not sufficiently opportunistic and hence unable to adapt rapidly enough to these modified conditions.

The current anthropogenically driven biodiversity loss, which has led to numerous species extinctions, population extirpations, and serious declines in numbers of other species, is sometimes referred to as the anthropocene defaunation, and it can certainly be argued that biodiversity loss has animal welfare implications. Successful maintenance of ecological processes is vital for the conservation of species, for the persistence of populations and for the welfare of individual animals.

7.1.2 Wildlife welfare versus species conservation

The term ‘animal welfare’ normally refers to welfare as a characteristic of the individual animal, whereas ‘species conservation’ as a phenomenon is focused on population, species, and habitat levels. If an individual animal is suffering, this does not necessarily affect the conservation status of the population as a whole. Conservation efforts are normally focused on saving a certain species, or to increase population size, facilitate and ensure successful reproduction, and so on, to sustain or create a viable population. It should be emphasized that animal welfare goals and conservation goals are often highly compatible. Nevertheless, there are cases where a trade-off between individual animal welfare and species conservation actions must be understood and considered, and where it should be discussed whether ‘the ends justify the means’ from an ethical and moral perspective.

There are obvious ethical implications related to human activities that degrade the environment, thereby depriving wildlife species of important life requisites. There are also ethical implications of conservation efforts, initiated by man, which are made to combat the degradation of the environment and the threats to wildlife. Environmental ethics are, however, not restricted to the welfare of the individual animal, but can also take into account the value of the habitat itself and the right of any threatened species – animal, plant, or microbe – to continue to exist, irrespective of its potential value to humans.

7.2 Basic Nature and Wildlife Conservation Efforts

The most basic type of intervention to conserve nature and save endangered wildlife species is probably ‘*in situ*’ conservation activity, such as the creation of nature reserves, national parks and

other mechanisms used to protect dedicated areas of land or water. In its simplest form, this results in preservation of valuable habitats. Such efforts can be successful if the areas in question are large enough (depending on the species concerned) to support a viable population, interconnected with other areas relevant to the same species, and when management plans are sufficient to create or maintain suitable habitat features. Sometimes the management plans of such protected areas involve predator control and often also include restrictions on hunting. Conservation efforts can involve not only preservation, but can also require active restoration of important habitats, which have been partly or completely lost or damaged.

What is the ‘natural environment’ to be conserved? Some authors claim that the rather impoverished ‘nature’ (both landscape and flora/fauna) seen today in many countries have become normalized and sometimes even cherished and celebrated as ‘wilderness’. This is even more so the case for the landscapes developed during the pre-industrial era, whereas it could be argued that in fact we should rather look at the pre-agricultural natural landscape to find something that is reasonably pristine and desirable from the wildlife point of view. This would bring us logically to a discussion about what constitutes ‘naturalness’, and whether ‘preserved’ nature is more natural than ‘restored’ nature, and whether this actually makes a difference to the species concerned. Furthermore, it could be questioned whether the use of historical targets in terms of conservation would be sustainable, or even possible, with a changing climate, with the presence of invasive species, and with current human pressures and land transformation. In reality, some of the current conservation efforts will actually create novel ecosystems, although this is not necessarily the intention, and it is probably quite naïve to believe that a return to a completely ‘natural and pristine’ situation can be achieved.

7.2.1 General animal welfare aspects of various interventions

When pure conservation efforts are not enough, or when they are initiated too late (i.e. when population decline has already gone too far) other measures may be necessary to allow recovery of a population in addition to habitat protection and restoration. Such efforts may include translocation of wildlife for reinforcement purposes, complete reintroduction

after local extinction, captive breeding and reintroduction programmes, or rewilding. These different concepts will be dealt with in detail below.

Self-sustaining, free-ranging wildlife populations can only be sustained or created when suitable habitat is available in large enough areas, and is hence dependent on the long-term persistence of ecosystems and ecological functions on which the species in question depend. This brings us to the question of quality of life: whether the animals can live in a manner to which they are adapted, in terms of health and functioning. The final goal of wildlife-related conservation programmes is usually expressed as viable population persistence without continuous human intervention. This indirectly implies a reasonable quality of life for the animals in question, although the goal is not individual welfare, but a reduction in the long-term risk of extinction of the species concerned. This, however, is not necessarily easy to evaluate. It should be acknowledged that even under excellent conditions, translocation, reintroduction, or rewilding programmes will have welfare costs to the individual animals involved. With proper knowledge, understanding of welfare as a consideration in conservation decision making, meticulous planning, and proper follow-up, these risks can nevertheless be recognized and minimized.

Scientists focusing on animal welfare and traditional conservationists may, as a result of the differences in focus described initially in this chapter, come to different conclusions regarding what is acceptable from an animal welfare point of view during a conservation programme. It is, for example, generally acknowledged that events which represent major welfare problems, such as high morbidity disease outbreaks, can occur without necessarily threatening population viability, if the population in question is large and genetically varied enough to handle the consequences in terms of mortality or reduced reproduction. There may be unintended negative animal welfare side effects associated with some of the deliberate interventions in a conservation programme, such as translocation, marking, or tracking. Furthermore, some of the deliberate or unintended changes made to the environment during a conservation programme may have negative, perhaps unintentional, effects on other animal species. To ensure that the suffering in individual animals related to conservation programmes is not 'unnecessary' (i.e. proportional to benefit), it is vital to first eliminate the threat

that originally caused species decline, before translocation or reintroduction is carried out, or these actions are bound to be futile, and risk leading to considerable animal welfare problems without a successful outcome in the end.

7.2.2 Habitat restoration, headstarting programmes and supplementation

At the very basic level, species conservation is concerned with saving species before they become extinct, locally or globally. The focus then lies on conserving existing wild populations rather than focusing on reintroduction. If a species is threatened, this is often (but not always) the results of human activities, deliberate or not, and hence conservation efforts often aim to protect a given area from further deterioration of the habitat involved. As mentioned above, such activities can involve the creation of nature reserves and other types of protected areas, where wilderness or specific habitats or components of wilderness are preserved or, when necessary, restored. In the 'best case scenario', this is done before the species of concern has come too close to local or global extinction. If so, habitat conservation or restoration per se may be enough to ensure future viability of the species.

In some cases, a theoretically simple and straightforward approach such as the removal of one or more invasive species can be sufficient to indirectly lead to the 'natural' restoration of a habitat and the return of severely suppressed indigenous species. There are examples of successful programmes to remove invasive species that have been destroying the habitat by overgrazing (e.g. reindeer in South Georgia) or that are acting as extremely efficient predators on the naïve indigenous fauna (e.g. brown rats eating bird eggs and chicks on remote Subantarctic islands). From a conservation perspective, these approaches can certainly be successful, and likewise for the native species involved, welfare is likely to be much less compromised in the future. For the individuals of the invasive species, a careful choice of methods to be applied for removal and/or culling is of course crucial from a 'balanced' animal welfare perspective.

Sometimes habitat restoration is simply not enough to ensure viable populations. If this is the case, then these efforts can be complemented by so-called 'headstarting' programmes. Examples of headstarting would be: (i) the addition of new individuals to the threatened population by collecting and incubating eggs from near-extinct species, such

as the spoon-billed sandpiper (*Calidris pygmaea*) and European green toad (*Bufo viridis*) (Fig. 7.1); or (ii) taking very young animals from the wild, and rearing them for a brief period in captivity and then releasing them back into nature when they are old enough to have outgrown at least some of the threats posed to the very young individuals.

As a next intervention step, reinforcement or supplementation of a vulnerable population can be made by the translocation of individuals or groups to an existing population of conspecifics. The animals being used for reinforcement can then either originate from the wild, or from captive breeding projects, which will be discussed below. However, the common practice of large-scale game-bird rearing, and release of species such as mallards or pheasants for hunting purposes, is not covered here, as the primary aim is then neither to support a threatened population nor to improve the welfare of that population, but to create increased opportunities for hunting of species that are already relatively common.

7.2.3 Translocation and reintroduction

The International Union for Conservation of Nature (IUCN) uses ‘translocation’ as an overarching term

to describe any human-mediated movement of living organisms from one place to another, intentional or not. However, ‘translocation’ sometimes refers only to the intentional movement of wildlife from one part of their normal range to another: a wild-to-wild relocation. In some cases, this also involves a short period of time in captivity, between capture and release. ‘Reintroduction’ can be defined as an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become locally extinct. Having said this, the term ‘reintroduction’ is sometimes used as an umbrella term referring to the release of animals from wild *or* captive origins to areas with *or* without conspecifics. Hence, both ‘translocation’ and ‘reintroduction’ can be used in a way which covers also supplementation or reinforcement, to increase abundance within an existing population. Conservation breeding programmes, also known as captive breeding programmes, involve recovering a number of individuals of the endangered species of concern, whose offspring will then be reintroduced in suitable habitats (Fig. 7.2).

Regardless of whether the animals involved are wild-caught or captive bred, they are usually released in an area that was once part of their



Fig. 7.1. A combination of translocation and headstarting: European green toad (*Bufo viridis*) spawn has been collected at a site in another region, raised in captivity at the non-profit foundation Nordens Ark and then released at the Ottenby nature reserve, where shallow spawning grounds have been reconstructed. In connection with the release, interested members of the public are given the opportunity to learn more about the toads and their habitat needs. (Image credit: Magnus Hellström.)



Fig. 7.2. The enigmatic snow leopard (*Panthera uncia*) is native to the alpine and subalpine regions of South and Central Asia. The size of the global population is small, but reliable population estimates are hard to find due to the species' secretive habits. Their ecosystems are threatened (e.g. by global warming) and illegal hunting is a problem. This snow leopard is part of a captive breeding programme at Nordens Ark, Sweden. Such breeding in zoos is done to keep a viable parallel population, should possibilities for supplementation of the wild population occur in the future. (Image credit: Malin Skog.)

indigenous range but they can also be introduced in an area outside the species' natural historical range, wherever suitable habitat can now be found.

There may be good reasons for doing so: in some cases, the indigenous areas no longer physically exist or have been so drastically changed (e.g. by human activities such as infrastructure projects or industrial exploitation) that they can no longer be reversed into a suitable habitat for the species in question. If so, it may sometimes be relevant to reintroduce the species in an area which is reasonably similar to its original habitat, possibly after further habitat modification. This approach is sometimes referred to as 'conservation introduction' or 'assisted colonization'.

7.2.3.1 Captive breeding considerations

In all types of captive breeding projects, efforts should be made to minimize the loss of genetic variation, as this variation may be essential for the species' ability to adapt to the new home range after release. There is a risk of involuntary selection in any captive breeding programme, as some individuals are easier to handle, easier to keep in confined

areas or simply reproduce more efficiently in captivity than others. If captive breeding takes place over a long period of time, in relation to the life-span of the species, there is an obvious risk of loss of genetic variation and an indirect selection for traits that are not beneficial in the wild, which may be detrimental both to the survival of the individual animals post-release and for the chances of re-establishing a viable population. An optimal temperament is important for survival, but there is a risk of loss of some temperament types during captive breeding. Regardless of whether this is a consequence mainly of genetic selection or related to other factors, it is also considered important to maintain behavioural variation in a population during captive breeding, to ensure at least some level of adaptability post-release.

It can be questioned if the animals most easily captured during the first phase of a captive breeding programme are the most appropriate ones for the purpose, as the animals which are easiest to catch in the wild may not be the ones with the most suitable genetic traits for long-term survival post-release. For example, it has been argued that bold animals, which tend to enter traps, may carry genes that make their offspring less likely to avoid predators and other risks post-release.

7.2.3.2 Animal welfare aspects of translocations

There are a number of animal welfare issues linked to translocation and captive breeding programmes. In order to minimize the risk of animal welfare problems occurring, without jeopardizing an entire conservation project, a number of steps could, or even should, be taken to improve the chances of success for the programme, including the successful survival and reproduction of the individual animals involved.

For wild-caught animals, there is the risk of stress and injury during the capture operation and during transport. It has been reported that wild-caught animals may have more successful outcomes post-release, than their captive-bred conspecifics, and, although wild-caught animals are capable of fending for themselves, there is still an effect of the complete novelty of the release site. It will inevitably take some time for the released animals to become acquainted with the new area, to find out where the predators are, where useful dens or burrows can be found, or where the best sources of

food are located. This phase is associated with a certain amount of stress. Meanwhile, the risk of predation and starvation is higher compared with what it would have been at the animal's familiar home ground. Also for captive-bred animals, there is likely to be stress involved in being handled, transported and then released into an unfamiliar environment, and they are likely to encounter more completely unfamiliar events, perhaps including predator attention, than translocated conspecifics. It has been shown that the addition of wild-caught animals, which are able to demonstrate appropriate anti-predator behaviour, into groups of captive-bred animals, may help the group as a whole to avoid post-release predation.

There is also a risk of introduction of diseases through animal movement, regardless of whether the animals are translocated 'wild-to-wild' or if they have been held or bred in captivity. This relates mainly to the introduction of microorganisms *per se*, but also to host expansion or introduction, if the release is made outside the original range of the species. Furthermore, animals used in reintroduction programmes can bring disease vectors into new areas, and hence contribute to vector expansion. On the other hand, captive-bred animals may, at reintroduction, encounter new pathogens, which are present in the wild but not in the relatively clean, and highly human-modified environment, of captivity. This increases the risk of disease in newly released captive-bred animals, and constitutes a potential animal welfare problem.

It goes without saying that animals bred in captivity for future release should be properly prepared for a life in the wild, to avoid animal welfare problems and high mortality which are detrimental to the conservation goal. This means that behavioural training is necessary. The animals need to be accustomed to the appropriate habitat, skilled in finding their own food before they are released, and preferably also trained in anti-predator behaviour. This will inevitably lead to animal welfare conflicts, as some of these species which have been reintroduced would probably benefit from practising hunting live prey while still in captivity, which would not be good welfare for the prey species, and is not permitted for captive animals in zoos in many countries. Furthermore, exposing the species to be released to live predators in a controlled setting may not only be practically difficult, but also involves keeping suitable predators in captivity for this purpose (which cannot be said to be beneficial

for the welfare of the predator) and will of course lead to a certain amount of stress in the 'to-be-released' prey species during training. It can be argued that providing for a 'good' life in captivity (i.e. protection from predators, provision of shelter and plenty of food) is incompatible with the goals of introduction. Exposing the animals in captivity to conditions which mimic the life after release may cause poor welfare in the short term, but would promote survival and good welfare post-release.

Reintroduction biology is somewhat of a science in itself. The captive environment needs enrichment to prepare captive-bred animals for a life in the wild, while also accommodating the physiological and behavioural needs of the individuals. Not only does the environment have to mimic the post-release habitat, in addition the learning ability of the animals has to be stimulated, to develop proper explanatory and vigilance behaviours in order to make it possible for the reintroduced animals to adapt to the new challenges they may face post-release. To optimize post-release survival chances, rearing should include anti-predator training, although not necessarily by using actual live predators.

Depending on species, soft-release programmes can be applied, in particular for captive-bred animals (Fig. 7.3). Such programmes often involve on-site pre-release pens and various support systems, such as the provision of food and water, after release. In some situations, it may be beneficial to provide artificial nests, burrows, or dens. However, these additional resources are only useful if the animals remain in that specific area long enough to use them, and hence the released animals must find their new habitat attractive.

It is known that rearing conditions influence the tendency to group with conspecifics, which in itself influences the chances of establishing a viable population. The composition and social relationships of the release group can make a large difference to the success rate. The number of animals in a given area must be high enough to constitute a solid base for further reproduction. It has also been shown that family groups that are released together have higher reproductive success than unfamiliar individuals, and that they are also less likely to be killed by predators, and that releasing already pair-bonded and behaviourally compatible individuals can increase conservation success (Fig. 7.4). For naturally group-living species, it has been hypothesized that social companions can buffer individuals from external stressors linked to the release phase.

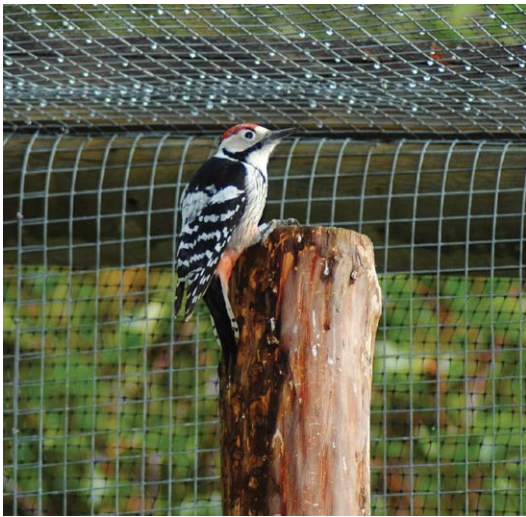


Fig. 7.3. The white-backed woodpecker (*Dendrocopos leucotos*) is not globally threatened, but numbers have decreased dramatically in the Nordic countries, mainly as a result of changes to the forest landscape and a lack of large areas of mature deciduous forests. In Sweden, habitat restoration projects are combined with captive breeding, including a soft-release programme. Male bird in a breeding pen, Nordens Ark, Sweden. (Image credit: Johan Loberg.)



Fig. 7.4. Przewalski's horse (*Equus ferus przewalskii*), an endangered species native to the steppe of Central Asia. Captive breeding at Nordens Ark, Sweden aimed at reintroduction later. (Image credit: Malin Skog.)

The habitat selection mechanisms of wildlife are often highly complex. Sufficient space is necessary, which relates to both the size of the protected area (if any) and the release density. For some species, competition and aggression may become a problem, counteracting the conservation efforts. From a

conservation point of view rapid dispersal after release, with animals disappearing from the release site and possibly even trying to home back to their original capture site, can be a huge problem for several reasons. It is well known that mortality is highest during the period directly after release, and this may partly be linked to dispersal including predator exposure, traffic accidents, and hunting if the animal ends up outside the dedicated area. Animals may use the presence of conspecifics as a cue to determine the suitability of a certain location or habitat, and if no conspecifics are found, the animals may continue to disperse looking for others. The aim of the conservation programme must be to provide the individual animal with the best chance of survival, by choosing, and possibly restoring, a suitable habitat and making sure that the animal has the skills to utilize it fully.

For any reintroduction programme to be successful, good habitat selection and restoration is essential, as is local community and government support, a well-designed captive environment preparing the animals pre-release, and well-designed post-release monitoring. If all of this cannot be achieved, the programme should be questioned both from a conservation perspective and from a welfare perspective (for the sake of the welfare of the individual animals), as failure rates may be very high.

7.3 Rewilding

Rewilding is a concept which may be perceived as radical and controversial, but is receiving increased attention. Simply put, it focuses on introducing wildlife or domesticated species into the wild, in places where they have not necessarily existed before, to restore entire ecosystem functions, including social and economic development. The perspective is holistic, and is aimed at the restoration of ecosystem function and natural processes rather than the conservation of single threatened species. The evolutionary value of wilderness is emphasized, and one of the underlying ideas is to let evolution proceed, at least locally, without human interference. Basically, this means moving the conservation agenda from rare species preservation and site protection to include ecological dynamics, and spatial aspects of the land- and seascapes.

The focus of rewilding lies on the reintroduction of large mammals, the megafauna, as these are seen

as a crucial component of the restoration of the 'ecological web' (i.e. the ecosystem food chain in different types of landscapes), with the ultimate goal of recreating self-sustaining ecosystems. As the focus is on functions rather than species, one aspect involves finding ecological replacements for extinct animal species. By ensuring the presence of wide-ranging large wildlife species, ecosystem diversity and environmental resilience may increase. Especially in North America there is an interest in 'ecological replacements', finding analogue species to replace extinct native species such as large carnivores and large herbivores, for both ecosystem restoration purposes and for purely aesthetic reasons. Reconnecting modern human society with wilderness is perceived as a goal in itself. As mentioned above, the concept is based on the idea of creating large protected areas of appropriate habitat, including live prey for the carnivores, and predators for the herbivores. For practical reasons, an approach without large predators but focusing on large herbivores is sometimes considered, and may be referred to as 'naturalistic grazing'.

Various types of rewilding experiments are currently ongoing, often in reasonably large areas with perimeter fencing. One of the major issues has been the presence – or not – of predators. For animals kept in zoos, separation of predator and prey species is often an animal welfare requirement, as the constant presence of predators is a major stressor for the prey species. For animals in a rewilding situation, the presence of predators is considered natural, but may of course still lead to considerable stress, especially if a reasonable or appropriate balance in numbers has not been achieved. There have been rewilding experiments where large predators have, for various reasons, not been included. This may imply a more relaxed life for the prey species, but may also lead to animal welfare problems once one of these individual large herbivores becomes sick, injured or very old. In nature, such an animal would most likely be killed by predators rather rapidly, instead of suffering for days, weeks, or even months, and then starving to death.

From a wildlife perspective, there is no 'empty land'. Although large mammals may certainly be absent, virtually no areas are completely empty, with no wildlife at all. Hence, translocation or rewilding may create difficult situations if it creates competitive exclusion of other species already present in the area. Lack of 'active' management may lead to excessive predation on the rewilded species,

and in some cases, there may even be calls to actively cull some predators, to protect the reintroduced animals, which is certainly not in the interest of the predators. As with reintroductions, zoonotic diseases may be a problem when new species are introduced into an area where other, pathogen-naïve species reside. Rewilded species themselves may become more or less invasive, proliferating and taking over to a much larger extent than expected.

Some rewilding plans involve a phenomenon referred to as 'species de-extinction' (i.e. the resurrection of extinct species using selective breeding or cloning). Possibly the rewilding of large, spectacular animal species can lead to a generally increased interest in habitat restoration among the public, but there is a need to discuss and understand what actually constitutes 'wildlife', and the process of domestication, and discussion on the possibilities and possible pitfalls of de-domestication (Fig. 7.5).

7.3.1 The domestication process

Domestication is a process where humans change the traits of animals, including behaviour, to fit our humanocentric purposes. This requires human control over breeding, and indirectly means that natural



Fig. 7.5. A domestic species, cattle (*Bos taurus*) are usually kept for meat and milk production. This breed, the Highland cattle, is hardy, but still certainly domesticated. Simple removal of management will not lead to de-domestication, but most likely to animal welfare problems. When planning for rewilding schemes involving domesticated species, a number of different aspects must be taken into account to handle the issue of human responsibility for animals in our care. (Image credit: Charlotte Berg.)

selection is replaced by active selection for desirable traits such as temperament, growth rate, feed conversion ratio, and physical appearance (e.g. coat texture or colour). The ability to find food and shelter, to avoid predators and to endure harsh climatic conditions become less important, as do cues indicating attraction to the opposite sex, as reproductive mates are chosen by humans. The domestication of our farm animals and companion animals is still an ongoing process.

Being domesticated is hence different from being tame; single individuals of many wildlife species can be tamed, but this is not domestication, neither at the individual nor at the species level.

Individual animals of domesticated species can become feral, 'wild' and live a feral life for many generations. Such animals can be very shy and impossible to approach. If a group of domesticated animals are released into the wild without human contact or interference for generations, the domestication process comes to a halt, as humans are no longer interfering with breeding, and the natural selection pressure reappears. Consequently, traits such as the ability to find feed and shelter, avoid predators, show aggression to intruding conspecifics, and demonstration of behaviours and physical appearance attractive to the opposite sex will become important again. However, the animals will not revert to some kind of non-domesticated 'original state', as some genetic traits and abilities may have been completely lost during many generations of human-mastered breeding. Nevertheless, such a group of animals will certainly, after a number of generations, differ from conspecific groups of animals that continue to undergo domestication.

Sometimes the term 'de-domestication' is used to describe the process (often over many generations) of actively trying to turn a domestic animal population into a self-sustainable wild or semi-wild animal population. It can, however, be argued that as long as humans are involved in the process, this is not a question of 'de-domestication', but rather a continued form of domestication with different goals and priorities. If anthropogenic selection pressure is completely removed, domestication will of course not continue, but it cannot be reversed by human intervention, only relaxed and, if 'left alone', allowed to take its own path of development.

Initiatives such as the 'Tauros' project, aimed at recreating the extinct aurochs by cross-breeding 'primitive' cattle breeds to create a large herbivore suitable for European rewilding projects may

become successful, but should not necessarily be labelled de-domestication.

7.4 Where Does Human Responsibility End?

Once a wild animal is taken into captivity its welfare will, morally and legally, be a human responsibility. There are undoubtedly numerous risks linked to living in the wild. These include: (i) poor nutritional status; (ii) disease; (iii) parasite infestation; (iv) risk of predation (or risk of shortage of prey, from the predator perspective); and (v) absence of veterinary care. The requirement for regular inspection by humans does not apply to wildlife in nature, but where does human responsibility end when we catch and release wildlife, apply captive breeding within reintroduction programmes, or tailor-make species for rewilding projects? When – if at all – are feral animals no longer to be considered domestic from a legal point of view?

Animal welfare legislation in many countries is described at the species level. A cow is a cow is a cow, and will remain a cow even when feral. Furthermore, several countries have animal welfare legislation prohibiting the abandonment of domestic animals. How should such legislation handle the reintroduction of animals into the wild, 'wild animals' which are based on domestic animals where genetic selection (still controlled by humans) has changed to favour 'wild traits'? Does all wildlife, reintroduced or not, deserve our concern from an animal welfare point of view? Scientific animal welfare considerations could be taken into account, but the expected, or even unexpected, reactions of the public could be strong, if reintroduced or rewilded animals are perceived to be suffering. It is also worth mentioning that in many countries, animal welfare legislation is mainly focused on mammals and birds. However, translocation or captive breeding and reintroduction programmes can cover other types of animals, such as fish, amphibians, or even insects, such as longhorn beetles (Fig. 7.6).

The managers of any reintroduction programme must take into the account the risk of introducing harmful pathogens to local wildlife or to domestic livestock in the area. If the introduced animals are predators, responsibility in relation to possible predator attacks on livestock should also be considered.

Some wildlife species, such as the fallow deer (*Dama dama*), will thrive in large enclosures, and



Fig. 7.6. It is not only animals with a ‘cute and cuddly’ appearance which may benefit from conservation efforts. Invertebrates are important for our ecosystems. At the Nordens Ark in Sweden, a programme for the conservation of the great capricorn beetle (*Cerambyx cerdo*), including a rearing system for this species, has been developed. Wild parent stock is collected from small native populations, eggs are collected and the adults are then returned to their original location. The captive-bred beetles are released into areas where the species has become locally extinct, but where habitats have now been restored. (Image credit: Johan Loberg.)

after a large number of generations, it is possible to discuss whether these ‘wild’ animals are now ‘to a degree’ (but not fully) domesticated. For captive breeding programmes it can sometimes be questioned if the animals actually remain truly wild after many years of breeding under non-natural conditions.

From an animal welfare point of view it can certainly be questioned if captive breeding programmes are meaningful and defensible if there are no suitable habitats available for reintroduction. In some cases parallel populations have been kept and bred at zoos for decades, to maintain a ‘back-up’ population when wild populations have reached a vulnerable level or when the wild population size is unknown. This is sometimes also done to build up a reserve of threatened animals, although actual reintroductions will not be possible within the foreseeable future, for instance due to circumstances such as political conflicts or wars.

7.5 Minimizing the Animal Welfare Risks

To summarize, a number of threats to the welfare of individual animals can be identified at different stages of various types of conservation efforts. It should, however, be stressed that the absence of

conservation measures could also lead to the persistence of animal welfare problems linked to the current rate and multiple types of defaunation. Many individual animals, of many different species, are facing loss of quality habitat, loss of the ability to feed themselves and reproduce, and often also loss of life in a stressful way, directly or indirectly linked to human activities such as agriculture, forestry, environmental pollution, infrastructure development and hunting.

For translocation and captive breeding programmes, the capture, quarantine and transport of wildlife deserves attention from an animal welfare point of view, to minimize the risks related to, for example, tranquilization, sedation, transport stress, and injury.

When wildlife are kept in captivity, animal welfare requirements should be linked to the housing and management of the breeding stock, and to minimize stress and frustration linked to the close involuntary contact with humans, and confinement in limited space. Enrichment and behavioural training may be relevant to both breeding stock and offspring destined for reintroduction. It can be concluded that captive-bred animals for release should be reared without too much human contact, and be trained to find food on their own. Furthermore, they should have a suitable temperament and be trained to develop the skills necessary for a successful survival in the wild, including fear of cars and trains. If not, humans could be viewed as not having taken the proper responsibility for adapting them to a life after release.

When planning for reintroduction, attention should be paid to the avoidance of creation of ‘new’ animal welfare problems in the existing wildlife at the release site, by considering the risk of introducing invasive species, new predators, and unfamiliar pathogens. It should be borne in mind that some pathogens may be zoonotic, and that fear of such diseases can limit human tolerance to introduced wildlife, and increase the risk of illegal hunting. In a similar way, crop destruction or wild predator attacks on livestock will risk illegal killing of reintroduced animals.

Furthermore, risks such as poor habitat quality in the release area, presence of predators, poor health in the animals prior to release, the risk of overt dispersal, the risk of being killed intentionally by humans for hunting, poisoning or collection purposes, road traffic accidents, starvation, and disease, should be thoroughly evaluated and ‘managed’

before a reintroduction programme is actually launched. If the risks for poor animal welfare or high mortality are found to be substantial, the programme should, at the very least, be refined and redesigned to mitigate these risks, or the programme will not be successful either in terms of conservation or in terms of animal welfare. If the released animal population is not viable and sustainable in the long term, then the conservation goals will not be met.

The selection of individuals for reintroduction is an important aspect from an animal welfare point of view. Reintroduction candidates should be screened for behavioural traits, such as temperament, vigilance, and anti-predator behaviours. Special attention should be paid to the composition of the release groups. Before any translocated or captive-bred animals are released into the wild, they should undergo health checks, vaccinations, parasite treatment, and other interventions which will improve their chances of survival. The timing of release should be carefully chosen and the number of individuals released must be high enough to facilitate the establishment of a viable self-sustaining population over time.

Post-release management must be planned for, to minimize post-release stress in the animals. This includes the temporary provision of food, water, and shelter post-release until the animals are self-sufficient. Whenever possible, or relevant, the provision of acoustic cues, visual cues, and olfactory cues may be included to improve habitat recognition. The animals should be imprinted on the habitat in which they are to be released, which means that the captive habitat should resemble the wilderness which they will later face. If there is a mismatch between the captive and the release environment, the animals may not be able to identify the release site as a suitable habitat, with poor conservation results and poor animal welfare as a consequence. In some cases, more long-term management input may be required, including rescue of sick or injured animals, and their temporary return to captivity for treatment, or, if necessary, humane killing of reintroduced animals that are experiencing severe suffering.

Long-term post-release monitoring of the animals in reintroduction programmes is the only reliable method to evaluate if the conservation efforts have been successful or not, and should be mandatory. Non-successful programmes should be thoroughly evaluated and problem areas should be identified, improved or terminated. Long-term

monitoring can, however, also involve animal welfare problems. This is the case, for example, when animals are fitted with radio or global positioning system (GPS) transmitters or other types of equipment which may influence their health and behaviour. This is especially so when the animals concerned have to be regularly recaptured and sedated to recover data from the electronic equipment, or for battery changes, as such intervention is often both stressful and risky to the animals involved. The interface between wildlife research and wildlife management is not always clear, and hence these measures are unfortunately not necessarily scrutinized by any research animal ethics committee.

For domesticated species used in rewilding programmes there are complicated ethical problems associated with animals that are neither fully domesticated nor wild. Aspects such as winter starvation need careful consideration in advance. It should be made clear that rewilding is not just the 'removal of management'.

If the reintroduced population reproduce far above the expected level they may exceed the capacity of the release site, or leave the designated area. This may lead to problems with competition within the species concerned, threats to the existing fauna, predator-prey imbalance and also to conflicts with humans in surrounding areas. If culling is then considered, the methods chosen should be acceptable from an animal welfare point of view. This applies also to the killing of invasive species and in the case where predator control efforts are required.

Other authors have correctly pointed out that the 3Rs approach, which is a standard tool for animal welfare improvements in research animals, can – with some modifications – be applied also in the reintroduction situation. The 3Rs refer to replacement, refinement, and reduction. In relation to reintroduction, one type of refinement can be early intervention and conservation efforts on-site, making translocations and reintroductions unnecessary without compromising species or individual survival. Refinement may relate to the development of methods, protocols and management tools to mitigate any negative animal welfare consequences during capture, captivity, and after release, and reduction may refer to minimizing the risks of suffering by carefully considering the number of animals to be involved in the actual reintroductions, but also in different types of more or less invasive follow-up procedures, which may pose a risk to their welfare.

Bibliography

- Bell, C.M. and Dieterich, R.A. (2010) Translocation of reindeer from South Georgia to the Falkland Islands. *Rangifer* 30(1), 1–9.
- Dirzo, R., Young, H.S., Galetti, M., Ceballos, G., Isaac, N.J.B. and Collen, B. (2014) Defaunation in the Anthropocene. *Science* 245(6195), 401–406.
- Donlan, J., Greene, H.W., Berger, J., Bock, C.E., Bock, J.H. *et al.* (2005) Rewilding North America. *Nature* 436, 913–914.
- Goderie, R., Helmer, W., Kerkdijk-Otten, H. and Widstrand, S. (2013) *The Aurochs – Born to be Wild*. Roodbont Publishers, Zutphen, the Netherlands, 160 pp.
- Harrington, L.A., Moehrenschrager, A., Gelling, M., Atkinson, R.P.D., Hughes, J. and Macdonald, D.W. (2013) Conflicting and complementary ethics of animal welfare consideration in reintroductions. *Conservation Biology* 27(3), 486–500.
- IUCN SSC (2013) *Guidelines for Reintroductions and Other Conservation Translocations*, Version 1.0. The Reintroduction and Invasive Species Specialist Groups' Task Force on Moving Plants and Animals for Conservation Purposes, International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC), Gland, Switzerland, p. viii and 57 pp.
- Jepson, P. (2016) A rewilding agenda for Europe: creating a network of experimental reserves. *Ecography* 39, 117–124.
- Kirkwood, J. (2013) Wild animal welfare. *Animal Welfare* 22, 147–148.
- Martin, A.R. and Richardson, M.G.R. (2017) Rodent eradication scaled up: clearing rats and mice from South Georgia. *Oryx*, 1–9. DOI: 10.1017/S003060531700028X
- Paquet, P.C. and Darimont, C.T. (2010) Wildlife conservation and animal welfare: two sides of the same coin? *Animal Welfare* 19, 177–190.
- Seddon, P.J., Griffiths, C.J., Soorae, P.S. and Armstrong, D.P. (2014) Reversing defaunation: restoring species in a changing world. *Science* 345(6195), 406–412.
- Swaisgood, R.R. (2010) The conservation–welfare nexus in reintroduction programmes: a role for sensory ecology. *Animal Welfare* 19, 125–137.
- Thulin, C.-G., Malmsten, J. and Ericsson, G. (2015) Opportunities and challenges with growing wildlife population and zoonotic diseases in Sweden. *European Journal of Wildlife Research* 61, 649–656.

8

Intensification – the Pressures of Volume

JOYCE D'SILVA

8.1 We Looked at Each Other

We looked at each other – she and I. Our eyes caught and held, despite the cacophony around us. She was just one of 65,000. I was with the farm manager and a colleague. She was in a cage with four other females, surrounded from above and below by others in similar cages. She had only a few matted feathers left on her neck. Her cage-mates showed similar nakedness. They had been there for about a year we were told. She would go for slaughter in another 6 weeks, most likely for pet food, paste or soup.

As we looked at each other I felt almost overwhelmed by the terrible state she was in and the knowledge that this was how most of her life had been spent – and how her final few weeks would be spent. We still held eye contact. From behind me I heard the farm manager say, 'We really do think this is the best way to keep hens'. That was one of the most surreal moments of my life.

At first there seemed to be good reasons to keep hens in cages, especially in the days before farms became pharms. They would be away from the floor, where they might have picked up infections like coccidiosis. Apparently they put one bird to a cage at first, but then realized they could put more birds into one cage and, amazingly, they still laid eggs. They could put lots of cages into one shed and still the hens survived, made easier by the post-war development of antibiotics and their uptake in animal agriculture. Plus the eggs were easy to collect, not hidden away under a bush or a heap of straw in a corner. This way, you could make a lot of money, especially as post-war austerity gave way to economic growth, rising incomes, and richer diets. We were all assured that the hens were warm and comfortable and safe from those wily old foxes.

But they had forgotten some very important things. They had forgotten that hens desperately want to lay their eggs somewhere secluded like a

nest, not in full frontal view of their cage-mates (Reed and Nicol, 1992). They had forgotten that hens like to strut around finding their own food, scratching and pecking at the earth for morsels and grubs. They had forgotten that hens like to have a dust bath every so often, shaking dry earth through their feathers to cleanse them of grease and dirt. They had forgotten that hens like to stretch and flap their wings and even fly up to a tree branch or shelf, especially at night, to perch and rest, safe from predators. It seems they had never actually looked at hens in a more natural setting.

By the time I visited that farm in the early 1990s it was common for tens of thousands of hens to be kept in barren battery cages in one shed. It still is, although, thanks to campaigning and lobbying by groups like Compassion in World Farming, those barren cages have been banned throughout the European Union (EU) and the hens are now kept in 'modified' or 'enriched' cages (European Commission, 1999a). Here they have a token shared nest, a narrow wooden rod on which to stand if they wish, and a Post-it note of extra space each. They may be kept in colony cages, of about 40–60 hens per cage, so there is a slightly better chance of finding enough space to stretch their wings. But the wire mesh is still all around and has to be endured by possibly sore feet.

I think something more fundamental is still being ignored – individuality. As anyone who has kept a few hens in their back garden will tell you, each hen has her own personality. One may be bossy, another meek, one friendly, another shy, one adventurous and another timid. Much like us. We've forgotten that hens originally laid eggs in order to hatch chicks – like their jungle ancestors did. So, if a hen had a purpose, biologically speaking, it was to keep her species going. That's why she only laid a couple of clutches of eggs a year, so she could put time and attention into caring for the chicks in their early days. We've warped all that through

breeding hens for our convenience to lay an egg a day, year round, or nearly so.

Modern farmed hens don't get to be mothers any more. Eggs for hatching are incubated in hatcheries. Male chicks get gassed, macerated or suffocated as they cannot be part of an egg-producing system. Female chicks survive but are orphaned. They are reared in large groups in rearing sheds where there is no mother hen to teach life skills or to cuddle up to under her protective wings. We've changed the biological purpose of the hen from one of survival to productivity, in order to enrich our own diets. Perhaps in so doing, we have changed our own moral compass from living alongside other creatures in comparative harmony to exploiting them to suit our own desires – and we've done this, I suggest – without really thinking about it at all!

8.2 Sows in Rows

In the late 1980s, I attended the Royal Agricultural Show at the National Agricultural Centre at Stoneleigh. I knew the facts about sow stalls, but had never seen them. (Industrial pig farmers didn't usually open their doors to Compassion in World Farming, perhaps understandably.) So I knew that most breeding sows were kept throughout their 16.5 week pregnancy in narrow stalls, unable to turn round or to take more than a step or two forwards or backwards. I knew that this system saved on labour and feed costs – stationary sows needed less feed.

I made my way to the sow stall shed. At the door I encountered 'man in white coat' and asked him what he thought of the system. He wasn't keen to

declare his hand, but did say 'Those animal welfare people want to see an end to it'. When I entered the building I could see why we 'animal welfare people' did indeed want to ban this horrendous system. Rows of stalls were lined up, each containing a large, pregnant sow (Fig. 8.1). The floor of each stall was concrete, with a slatted area at one end for drainage. There was no straw, no possibility of comfort for the animals. Some were flopped down on the concrete, others standing, all facing in the same direction, all appearing listless. It was hard to realize that these creatures were highly intelligent and curious, and that their free-range sisters would spend three-quarters of their waking hours in exploratory behaviour, digging up roots and tubers to eat with their strong and sensitive snouts, or just investigating their environment (Stolba and Wood-Gush, 1989). Of course such sows would expend more energy than if they had been confined, but they were also obtaining some extra calories from the food they found in their environment. No doubt, because they were exercising daily, their bodies were in better shape. One farmer, who had abandoned sow stalls and moved to group housing, told us that his sows no longer suffered from 'twisted gut', a fatal condition, which had occurred regularly in his confined sows.

I moved on to the farrowing shed, just in time to see a farm worker close off one of the crates from view. I asked why and was told that the sow was about to farrow (give birth). The crate for each sow was little wider than the stall in which she had spent her miserable pregnancy (Fig. 8.2). Each crate had an extra area for the piglets. They could move



Fig. 8.1. Pregnant sows in sow stalls, now not permitted in the European Union (EU), but common in many other parts of the world. (Image credit: Compassion in World Farming (CIWF).)



Fig. 8.2. Sow and piglets in a barren farrowing crate. (Image credit: CIWF.)

around within it, but again the sow could only stand up or lie down to let her piglets suckle from her. They would be taken away at around 4 weeks of age, although in natural conditions they would have continued to suckle for nearer 3 months and would continue to live in family groups. I asked the man why there was no straw for the sow. He said, 'Bungs up the slurry'. So the drainage system had been designed to take urine and faeces, but could not cope with straw. Bad thinking, Mr/s Designer.

I was pleased that Compassion in World Farming had decided to tackle the issue of the confinement of pregnant pigs. We had commissioned a research paper on the welfare impacts of sow stalls (Baxter, 1986). We learned that when first imprisoned, the sow would fight back fiercely, but she would then slowly give up hope and become despondent. The author compared the sow's ensuing state to the psychological state of depression suffered by humans. My colleague, Carol McKenna, made a film on a higher welfare pig farm showing a gilt (young sow) imprisoned for the first time in a stall, and she did indeed fight back fiercely until she was released on welfare grounds by the farmer (CIWF, 1986). We had a model made of a sow in a stall, and we took it to the House of Commons, where it was on show for a full week on the landing outside the Committee rooms. We obtained a heavy, metal neck collar, which was used in some farms to chain the sow to the stall. Sometimes a girth was tied around her belly and chained to the floor of the stall. It seemed there were an infinite variety of ways to imprison a pregnant sow! I took the neck collar with me onto BBC TV's 'breakfast show'. I was even allowed to hold it up and explain to viewers what it was used for. The farmer in the

outside broadcast studio could say little to defend it. I even took it into the House of Commons in my briefcase. I explained to the security man that I was taking it in for Labour MP Harry Cohen, who wanted to show it to the House that afternoon. (I think these days such a heavy metal object would certainly never be allowed in!) I gave it to Harry, who was a big animal welfare supporter, and he did indeed wave it to the House, as he spoke about a particular clause in an agriculture Bill.

8.3 The End of the Sow Stall (At Least in the EU)

But it was a Conservative MP who helped deal the final blow to the use of sow stalls and tethers in the UK. Sir Richard Body MP was also an animal welfare person and had kept free-range pigs at one time. He was sympathetic to our cause. In 1990 he came second in the Ballot for Private Members' Bills, which meant he had a chance to table the Bill of his choice. This ballot takes place annually, and the first four or five MPs whose names are drawn have a chance to have their Bill debated and voted on – on a Friday (when of course many MPs have left for their constituencies). Once the MPs' names are made public, the non-governmental organizations (NGOs) and charities plague the lucky MPs with requests for *their* Bill to be chosen. We began a dialogue with Sir Richard, who finally got down to choosing between our Bill (Sows) and a Bill on horse welfare. In our final phone call, he was still undecided. I remember saying to him, 'The thing is, Sir Richard, everyone loves horses and it's just you and I who love pigs'. 'You're right Joyce,' he said, 'I'll do pigs'. I could have yelled with joy!

My legal colleague Peter Stevenson helped to draft the Bill with him. We collected thousands of signatures on a petition and Joanna Lumley and Sir Richard handed it into the Ministry of Agriculture, Fisheries and Food (MAFF as it then was) to a posse of cameras and reporters outside. We wrote to our (then) 7000 Compassion in World Farming members and asked them to write to their MPs, requesting them to support the Bill at its Second Reading in January 1991.

Peter Stevenson and I attended the debate – on tenterhooks. Sure enough, a couple of Yorkshire MPs began to read from the telephone directory – a well-known delaying tactic. Finally Sir Richard got to make his speech and was supported ably from the Labour benches by Ron Davies, then the Agriculture

spokesperson for the Party. One MP pointed out that, to his amazement, he had had more letters on this pig welfare bill than he had received on the Gulf War. (The first Gulf War was then raging.) David Maclean spoke for the government and to our surprise it wasn't an outright rejection. When the bell went for voting time, lots of MPs appeared and the final count was 122 in favour and only two against! We wondered what would happen. The vote alone did not commit the government to action. But David Maclean seemed genuinely sympathetic and, sure enough, the government finally announced that they would commit to an 8-year phase out of sow stalls and tethers and they would become illegal from 1 January 1999 (Pig Husbandry Bill, 1991).

The phase out of sow stalls in the UK followed a similar ban in Sweden, inspired by the campaigning of the much-loved children's author, Astrid Lindgren. Better still, these national bans inspired the EU as a whole, and after much campaigning and lobbying, a partial ban was agreed and came into force in 2013 (European Commission, 2008). Why only partial? The pig industry made a major effort to stop the process, so a compromise was reached, allowing stalls to be used for the first 28 days of a sow's pregnancy. For the rest of her pregnancy she must be kept in group housing, or free range. That's an unacceptable compromise and Compassion in World Farming and other EU animal welfare groups are determined to see a complete ban introduced.

8.4 You Don't Have to Wait for Law to Rule

But you don't always have to wait for the law to rule. Many food businesses in the USA for example, are now committing to a phase out of sow stalls (called gestation crates in the USA) and some individual US states have already phased them out (ASPCA, no date). It seems higher welfare is catching!

Sometimes an animal's gender renders it particularly vulnerable to systematic cruelty. We've seen the suffering endured by the females in the laying flock and the females in the pig herd. In the dairy herd it's the male calves who've suffered in a special way because of their gender. With dairy cows being bred for thin bodies and huge, productive udders, the male calves, also being somewhat scrawny in physique, are not regarded as prime beef animals. Of course they can't produce milk either, so what to do with them?

The answers have varied, both in method and in callousness. Quite often, they've just been knocked

on the head soon after birth. For a few years, the EU even paid farmers to slaughter their male calves. To give credit to farmers, many of them found this a highly distasteful task. One told me it was a major reason why he was giving up dairy farming.

The other traditional method was rearing calves for veal. With 'white veal' being the desired outcome for picky consumers, the calves would be kept in narrow crates throughout their short 5–6 month lives and, like the sows, unable to turn round. Removed from their mothers at about a day old, they would be fed a liquid replacement made from powdered milk kept deliberately low in iron content. They were denied roughage throughout their lives in order to keep their flesh desirably pale, and in spite of the fact that young calves need to eat roughage like grass or hay from 2 weeks old.

By the time they got to be loaded up on the truck to go to the slaughterhouse, many could only stumble across the yard to the ramp. Many would by now be on the verge of clinical anaemia.

How devious we humans are – to breed a type of farm animal (in this case, the high-yielding dairy cow) which will inevitably suffer herself or result in her progeny being subjected to suffering.

8.5 We Seem to Have Tied Ourselves into a Dietary Routine

As a vegan since 1975, I still find it strange that, at the intellectual level, our species, when weaned and even when adult, continues to drink the milk of another species! No other mammal that I know of does that. Of course I realize that dairy products can make a positive contribution to the diets of impoverished peoples. They may even provide good protein and other nutrients for people of all types. But healthy dairy-free diets can work just as well, if the nutrients are provided in other ways (Key *et al.*, 1999).

We seem to have tied ourselves into a dietary routine, and a dependency which is rarely to the benefit of the individual animal. Because of course the mother cows also suffer. They appear to be deeply disturbed by the annual 'kidnap' of their calf, be the calf male or female. They themselves are milked to capacity, often producing up to ten times the amount of milk a calf would have suckled from them. The volume of milk produced places a huge strain on their metabolism and they often develop painful mastitis or become lame (Whay *et al.*, 2003). They may indeed enjoy pleasant summer days in the green fields of temperate countries, but

they are increasingly being kept indoors throughout their productive lives – zero-grazing being the apt term. If you add in the amount of cereals and soy they have to eat to maintain the levels of yield they have been bred for, we can see that this is a major environmental mistake too.

The final irony is that the most common reason to cull a dairy cow these days is because she has failed to become pregnant. Yet infertility is related to the high levels of yield she has been experiencing! (We remember those cases of overworked female teenage gymnasts who stopped menstruating as a result of the efforts they were forced to make in the search for Olympic gold.) It's a sad reflection on the dairy industry that most cows are culled after two or three lactations, when their original longevity could have taken them to 20 plus, not unlike a horse (Forbes *et al.*, 1999; Mohd *et al.*, 2013).

The industrial mentality of high-yield, high-volume farming has made the individual animal disposable, a number on a chart. The bond, which farmers used to have with their animals in small-scale farms, has been all but lost.

When the debate about bovine somatotrophin (BST), the genetically engineered version of the cow growth hormone, was raging in the early 1990s, I had a letter opposing its introduction published in the farming press. A dairy farmer phoned me to say he totally supported me. 'If you come to my farm you can put your arms around the neck of any of my cows' he told me, and went on to say that it wasn't like that on the farm down the road, where the cows were not treated as individuals and would be frightened of any neck-hugging. Luckily, working with a coalition of welfare and food policy NGOs we managed to persuade the EU to forbid the marketing of BST in the EU (Council Decision 1999/879/EC; European Commission, 1999b). Injected into the cow every couple of weeks, it was said to boost her yield still further. What was obvious to the animal welfare community was that all those production-related diseases like mastitis, would then increase too. BST is still being used in the USA and some other countries, but many early users have abandoned it, apparently because the cost-benefit ratio didn't add up in the end.

8.6 The Ultimate Victim of the Pressure for Yield and Volume, the Broiler Chicken

I think that the ultimate victim of the pressure for yield and volume is the broiler chicken. These chickens,

bred for meat, are now the most commonly farmed land animal in the world – we eat 58 billion of them a year globally – and that figure is rising (FAOSTAT, 2011). Yet you may never have seen them! The vast majority are transported from the hatcheries straight to the rearing farm at a day old. Globally, over 70% of chicken meat is produced in industrial, indoor systems (Fig. 8.3) (FAO, 2006). Unlike their egg-laying cousins, broiler chickens are not usually reared in cages, but on the floor of the shed, which will be covered in a layer of 'litter', usually wood shavings or straw. This is only cleared and replaced between batches of chickens, so it becomes increasingly soiled as the weeks go by. Lighting is usually artificial and heating controlled to maximize the birds' growth rate and health. Over 20,000 chickens may be kept in one shed. Obviously the potential for disease spread is high, so the birds are routinely vaccinated against a range of the most common diseases.

Antibiotics are also widely used in the poultry industry. Including antibiotics in the diet is one way



Fig. 8.3. Broiler chickens, farmed at high stocking densities. (Image credit: CIWF.)

to control the spread of infectious bacteria. The downside is that the more antibiotics are used, the more chance there is for resistance to these antibiotics to develop. This antibiotic resistance in bacteria is now a major threat to human – and animal – health. The World Health Organization has given stark warnings about the danger posed by over-use of antibiotics in both animal and human medicine (World Health Organization, 2016). The chicken industry in Europe used to use antibiotics in small doses to improve growth rates in the chickens, but this particular kind of use has now been banned in the EU – not necessarily in other countries, for example in the USA (Dibner and Richards, 2005). It still seems strange to me to use antibiotics – such precious infection-fighting agents – to simply prevent disease. If I go to the doctor with, say, a bacterial throat infection, he/she may well prescribe an antibiotic for me – but not for everyone else living in my house! But this is often how antibiotics are used on the farm.

Of course antibiotics are of no use against viral infections. With avian influenza constantly recurring in various parts of the world, we may need to reassess how we farm chickens in the near future. Viruses mutate and it may require only a very few further mutations of an avian flu virus to make it pathological and quickly spread among humans (Dibner and Richards, 2005). So far only people who work closely with poultry, and their immediate family members, have died from these flu viruses. We can still hope that a more infectious form does not evolve – but that could be wishful thinking. Once a virus is inside a shed of 20,000 chickens, there are umpteen chances for it to mutate.

Back to the chickens. They have been selectively bred to grow at an incredibly fast rate – getting from fluffy day-old chick to an average slaughter weight in just 5 or 6 weeks. The EU average is slaughter at 42 days of age at a weight of 2.5 kg (EFSA, 2010). This is an astonishing growth rate and carries many risks to the health and well-being of the birds. Growth is mainly of muscle (i.e. meat). The skeleton does not seem to keep pace, so many modern birds become awkward in their gait, tipped slightly forward by the weight of their heavy breasts, which carry the most desired meat. Lameness is rife in the chicken shed as the birds become heavier. A UK study put it as around 27% of the birds suffering from painful lameness before they got to slaughter weight (Kestin *et al.*, 1992). Other studies have put the rates even higher. A large

European study found that on average 57% of the fast-growing birds had severe walking problems (de Jong *et al.*, 2011).

Standing on damp, soiled litter, coupled with lameness (Fig. 8.4) and sitting down for long periods in the increasingly crowded sheds, may be why so many fast-growing chickens develop hock ‘burns’ on their knee joints, a figure put at 20% by an EU study based on evidence taken at slaughterhouses (de Jong *et al.*, 2011). Painful foot pad dermatitis was put at 22% in these fast-growing birds – yet more pain. Sometimes birds are prone to Sudden Death Syndrome – a self-explanatory term and believed to be the result of the pressure put on the metabolism by fast growth. When the day-old chicks are put into the shed, there is plenty of room. They often huddle together in groups, perhaps missing the comfort of a maternal wing. Food and water are provided in drinkers and feeders throughout the shed and the birds are encouraged to eat, so that they grow fast. Of course, the fast growth means that space gets tighter and tighter, as they get bigger. The EU has set maximum stocking densities for the birds but these are still so high that movement becomes harder as the birds get bigger (Estevez, 2007).

So it’s not a great life for the ubiquitous chicken. But spare a thought for their parents and grandparents! These birds have to produce the fast-growing chickens that we eat – yet they also have to survive long enough to do so. If they ate the same amount of food as their offspring they would very likely have gone off their legs completely by the time they got to puberty at around 18 weeks of age. (Remember, their offspring are going lame in large numbers before they are 6 weeks old (Kestin *et al.*, 1992; Weeks *et al.*, 2000).)



Fig. 8.4. Large numbers of broiler chickens become lame. (Image credit: CIWF.)

The industry strategy for dealing with this conundrum – keep the birds on very short rations (Jensen, *et al.*, 2000; Dr Tracey Jones, Compassion in World Farming, May 2013, personal communication). They get fed just once a day – and I’ve witnessed the mad scramble to gobble down as much as possible when the food comes through. In a few minutes it’s all gone and they have to wait 23 h and 50 min until the next feed. In 2003, when Compassion in World Farming took this situation to the High Court in the UK, the judge found that the birds were indeed ‘chronically hungry’ although he ruled against us and for the government on technical grounds (Neutral Citation Number, 2004).

To achieve the volume of meat, eggs (Fig. 8.5), and milk desired by our increasingly wealthy and urban populations, it appears that it’s the animals who have drawn the short straw (I’ve just realized the irony in this old saying – as so many of them never get to see straw at all ...). Our forefathers regarded meat as a more special, luxury item in the diet. Most of us who live in the richer countries probably eat three times more meat than our grandparents or great-grandparents did. The world’s health experts now advise us to cut back, especially on the consumption of red meat (beef, pork, lamb, and goat). There is an association between red meat consumption and colon cancer and such a strong link between colon cancer and processed meat (bacon, ham, salami, sausages) that they generally recommend avoiding these foods altogether (Chan *et al.*, 2011; Aykan, 2015). There appear to be links with cardiovascular disease too (Micha *et al.*, 2010).



Fig. 8.5. Across the world, laying hens are kept in cage systems, with little space and which cause damage to their feathers, skin and feet. (Image credit: CIWF.)

Does this give eating chicken a green light? The industrially farmed chickens are, like most indoor farmed animals, fed on soya and cereals – and we know how soya production is wreaking havoc on the environment in South America. We also know that this mass-produced chicken has a much higher fat content than the chicken of old (those chickens exercised and burnt off their fat) (Petracci *et al.*, 2013).

But most of all, we know how they suffer, as I’ve described. When people tell me ‘I don’t eat red meat any more, just chicken’ I feel sad that they’ve missed the whole suffering question. Industrially reared chicken may be a little less environmentally damaging than industrially produced beef or pork, but in terms of individual sentient beings suffering throughout much of their lives, it’s huge.

8.7 My Choice, My Influence

Although the vegan choice seems logical and compassionate to me, I’m a realist and I know that most people may tweak their diets, but only a few will undertake wholesale change. So what’s the recipe then? Reduce consumption of animal products. Eat only those produced to higher welfare standards like free range or organic. Be adventurous in trying new foods like tofu, plant-based burgers, nut or soya milks, even some of the new egg replacers. Try out new recipes with friends, partners, and children. Make it an adventure. Go online and find a whole world of veggie and vegan recipes.

If you want to get active, support an animal welfare organization and help to lobby your government and your food industry to make the lives of farm animals more sustainable for them.

Eat with your mind (knowledge) and your heart (compassion). Then you’ll help reduce the load of suffering in the world. What could be better than that?

Bibliography

- ASPCA (no date) Farm Animal Confinement Bans by State. American Society for the Prevention of Cruelty to Animals (ASPCA). Available at: <https://www.aspc.org/animal-protection/public-policy/farm-animal-confinement-bans> (accessed 14 June 2017).
- Aykan, N.F. (2015) Red meat and colorectal cancer. *Oncology Reviews* 9(1), 288.
- Baxter, M.R. (1986) *Does Close Confinement Cause Distress in Sows?* Athene Trust, Corsham, Wiltshire, UK.
- Chan, D.S., Lau, R., Aune, D., Vieira, R., Greenwood, D.C. *et al.* (2011) Red and processed meat and colorectal

- cancer incidence: meta-analysis of prospective studies. *PLOS One* 6(6), e20456.
- CIWF (1986) *Screaming for Change*. Film. Compassion in World Farming (CIWF), Godalming, UK.
- de Jong, I.C., Moya, T.P., Gunnink, H., van den Heuvel, J., Hindle, V.A. *et al.* (2011) *Simplifying the Welfare Quality Assessment Protocol for Broilers*. (Vereenvoudiging van het Welfare Quality protocol voor het meten van welzijn bij vleeskuikens). Report no. 533. Wageningen UR Livestock Research, Wageningen, the Netherlands.
- Dibner, J.J. and Richards, J.D. (2005) Antibiotic growth promoters in agriculture: history and mode of action. *Poultry Science* 84(4), 634–643.
- Estevez, I. (2007) Density allowances for broilers: where to set the limits? *Poultry Science* 86, 1265–1272.
- European Commission (1999a) Council Directive 1999/74/EC of 19 July 1999 laying down minimum standards for the protection of laying hens. *Official Journal of the European Communities* L53, 203–207.
- European Commission (1999b) Council Decision 1999/879/EC of 17 December 1999 concerning the placing on the market and administration of bovine somatotrophin (BST) and repealing Decision 90/218/EEC. European Commission, Brussels. Available at: eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999D0879 (accessed 27 February 2018).
- European Commission (2008) Council Directive 2008/120/EC of 18 December 2008 laying down minimum standards for the protection of pigs. *Official Journal of the European Union* L 47, 5–13.
- European Food Safety Authority (EFSA) (2010) Scientific opinion on the influence of genetic parameters on the welfare and the resistance to stress of commercial broilers. *EFSA Journal* 8(7), 1666. DOI: 10.2903/j.efsa.2010.1666/pdf
- FAO (2006) *Livestock's Long Shadow*. Food and Agriculture Organization of the United Nations (FAO), Rome.
- FAOSTAT (2011) Available at: <http://www.fao.org/faostat/en/#home> (accessed 11 August 2017).
- Forbes, D., Gayton, S. and McKeogh, B. (1999) Improving the longevity of cows in the UK dairy herd. *Longevity Report*. Ref. 97/R1/12. Milk Development Council, Cirencester, UK.
- Jensen, P., Berg, C., Bessei, W., Faure, J.M., Porin, F. *et al.* (2000) The welfare of chickens kept for meat production (broilers). Report of the Scientific Committee on Animal Health and Animal Welfare of the European Union (EU), SANCO.B.3/AH/R15/2000. Available at: https://ec.europa.eu/food/sites/food/files/safety/docs/sci-com_scah_out39_en.pdf (accessed 11 August 2017).
- Kestin, S.C., Knowles, T.G., Tinch, A.E. and Gregory, N.G. (1992) Prevalence of leg weakness in broiler chickens and its relationship with genotype. *Veterinary Record* 131(9), 190–194.
- Key, T.J., Fraser, G.E., Thorogood, M., Appleby, P.N., Beral, V. *et al.* (1999) Mortality in vegetarians and nonvegetarians: detailed findings from a collaborative analysis of 5 prospective studies. *American Journal of Clinical Nutrition* 70, 516S–524S.
- Micha, R., Wallace, S.K. and Mozaffarian, D. (2010) Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus. *Circulation* 121(21), 2271–2283.
- Mohd Nor, N., Steeneveld, W. and Hogeveen, H. (2013) The average culling rate of Dutch dairy herds over the years 2007 to 2010 and its association with herd reproduction performance and health. *Journal of Dairy Research* 81(1), 1–8.
- Neutral Citation Number (2004) Compassion In World Farming Ltd, R (on the application of) v Secretary Of State For Environment, Food & Rural Affairs [2004] EWCA Civ 1009 (29 July 2004). Neutral Citation Number: [2004] EWCA Civ 1009, Case No: C1/2003/2699, in the supreme Court of Judicature, Court of Appeal (Civil Division), on Appeal from the Queen's Bench Division, Administrative Court, The Hon Mr Justice Newman, CO/1779/2003.
- Petracci, M., Mudalal, S., Bonfiglio, A. and Cavani, C. (2013) Occurrence of white striping under commercial conditions and its impact on breast meat quality in broiler chickens. *Poultry Science* 92(6), 1670–1675.
- Pig Husbandry Bill (1991) House of Commons Debate 25 January 1991, Vol. 184 cc563–626.
- Reed, H.J. and Nicol, C.J. (1992) Effects of nest linings, pecking strips and partitioning on nest use and behaviour in modified battery cages. *British Poultry Science* 33(4), 719–727.
- Stolba, A. and Wood-Gush, D.G.M. (1989) The behaviour of pigs in a semi-natural environment. *Animal Production* 48(02), 419–425.
- Weeks, C.A., Danbury, T.D., Davies, H.C., Hunt, P. and Kestin, S.C. (2000) The behaviour of broiler chickens and its modification by lameness. *Applied Animal Behaviour Science* 67, 111–125.
- Welfare Quality® (2009) *Welfare Quality Assessment Protocol for Poultry (Broilers, Laying Hens)*. Welfare Quality Consortium, Lelystad, the Netherlands.
- Whay, H.R., Main, D.C.J., Green, L.E. and Webster, A.J.F. (2003) Assessment of the welfare of dairy cattle using animal-based measurements. *Veterinary Record* 153, 197–202.
- World Health Organization (2016) *Antibiotic Resistance*. Fact Sheet October 2016. Available at: <http://www.who.int/mediacentre/factsheets/antibiotic-resistance/en/> (accessed 30 June 2017).

9

Welfare Challenges: Feedlot Cattle

MIRIAM MARTIN AND TEMPLE GRANDIN

9.1 Introduction

In many countries, huge numbers of cattle are fattened on feedlots, and, in many countries outside Europe, beef cattle are housed for fattening in large outdoor pens on a soil surface. On a single site, large outdoor feedlots may contain from 2000 to over 100,000 cattle. Since the 1970s, many outdoor feedlots have been built in low rainfall areas such as the high plains area of the USA, Mexico, Northern Australia, and South America. In the USA outdoor feedlots are used to fatten (finish) over 75% of the young steers and heifers raised for beef.

Feedlot cattle welfare issues result from a range of challenges and management conditions which are present on feedlots and these are affected by environmental stressors relative to feedlot location (drainage and climatic effects), housing, genetics, and health problems. Many of the factors outlined in this chapter can overlap in their influence on feedlot cattle welfare. However, it should be noted that the management of facilities and the people that operate them often plays a more significant role in welfare than facility design. The four biggest issues in feedlot welfare are caused by mud and manure, heat stress, lameness, and bovine respiratory disease (BRD), and we discuss these issues in this order in this chapter. We also look at factors influencing some common diseases seen on feedlots – BRD, *Mycoplasma bovis*, liver abscesses, ‘other’ internal lesions – and aspects of ‘preconditioning’ to prevent health problems. We then finalize this chapter with sections on feedlot cattle handling, strategies to avoid fatigued cattle, and biologic constraints for feedlot cattle.

The use of outcome-based measures may enable the objective assessment of welfare challenges, and simple scoring systems can be used to assess improvement. Progress has been made in understanding of ‘best practice’ handling methods, and the use of outcome-based numerical scoring methods can show

how these improvements are working (Woiwode *et al.*, 2016a). Solutions to many of the unique welfare challenges for feedlot cattle do exist, through finding a balance between productivity and responsible management. This balance, if achieved, could create a lower stress environment that animals would be better adapted to, and could thrive in.

9.2 Mud and Manure

In outdoor feedlots receiving large amounts of rainfall, muddy conditions can quickly become aversive to welfare (Grandin, 2016). In the 2011 National Beef Quality Audit, mud was found to be on the legs of 36% of cattle in beef processing facilities and 50% of cattle had mud or manure on their body (McKeith *et al.*, 2012). Mud is a concern for carcass contamination when feedlot cattle reach the processing facility. Severely muddy conditions may reduce feed intake by as much as 30%, thus reducing daily gain and increasing feed conversion by 25% (Thomas, 2013). Cattle spend less time lying down in muddy conditions and higher moisture levels can result in reductions in white blood cell counts, presumably as a result of chronic infection challenge from poor hygiene (Chen *et al.*, 2017). Mud not only negatively affects productivity, but also impacts the behavior and health of the animal.

9.2.1 Possible mud solutions

Two solutions to muddy conditions which we propose are: (i) proper feedlot slope; and (ii) mound building. A slope of 3–4% away from bunks is recommended to enhance drainage (Mader and Griffin, 2015). Mounds allow cattle to spread out and in wet conditions are drier than the surrounding area. A simple scoring system could, and probably should, be implemented to assess muddy cattle. It can be as simple as: (1) clean; (2) mud on

legs; (3) legs and belly; and (4) legs, belly, and side (Grandin, 2016). For research, use of a five-point scale ranging from (1) completely clean to (5) completely covered in mud or manure can provide the basis for monitoring of cattle cleanliness. Divide the animal into sections and assign each section a score, with the animal divided into front legs, belly, tail head, upper rear limbs, and lower rear limbs (Reneau *et al.*, 2005).

Cattle covered in manure pose a serious welfare concern as poor hygiene leads to a higher pathogen load. Dirty cattle result from either poor management, lack of drainage slope, or high rainfall in outdoor feedlots. Regular removal of manure from pens, whether in outdoor or indoor feedlots will keep cattle cleaner. Fecal balls on the feet and tail are unacceptable and result from living in muddy and manure-laden conditions for long periods of time. The skin contamination with *Escherichia coli* and the total coliform count increase significantly in the summer months. This adds a seasonal component, and is a further reason why manure management

and good hygiene in feedlot cattle is important (Miller *et al.*, 2003). One cause of poor hygiene in cattle fed indoors is a lack of sufficient bedding to absorb moisture, and there are three common management methods used to keep cattle fed indoors clean. They are: (i) bedded pack; (ii) concrete flooring that is cleaned daily; or (iii) slatted flooring.

9.3 Heat Stress

Heat stress can be the result of high temperatures and humidity, dark coat color in sunshine, lack of shade, drinking water temperature, or the health of the animal. These all play a role in the threshold for an animal's heat load index (Gaughan *et al.*, 2008). Heat stress is dependent on the rate of environmental change, as well as the magnitude and duration of the environmental stress (Mader and Griffin, 2015). Sprinkler systems and shade are the two most successful heat stress mitigation tools (Fig. 9.1). Sprinkling allows for evaporative cooling, and is most effective when turned on in the morning prior



Fig. 9.1. Sprinkler systems allow for evaporative cooling and are an effective heat stress mitigation tool. (Image credit: Miriam Martin.)

to cattle beginning to encounter heat stress. Shade improves cattle performance in hot climatic conditions and is most important when cattle are not acclimated to hot summer conditions (Mader *et al.*, 1999). Panting is a good indicator of heat stress and can be measured via a scoring system with: (0) no panting; (1) slight panting, mouth closed; (2) fast panting, drool, closed mouth; (3) open mouth and excessive drooling, neck extended; and (4) open mouth with tongue fully extended, extensive drooling, and neck extended with head up (Gaughan *et al.*, 2008). If cattle breathe with their mouth open, they are severely heat stressed. The more extended the tongue, the greater the increase in internal body temperature (Mader and Griffin, 2015). Heat stress can become more of a threat to heavier feedlot cattle, who are more adversely affected by high ambient temperatures (Dikmen *et al.*, 2012).

9.4 Cold Stress

Weather still remains the largest uncontrollable risk to the feedlot animals. Extreme weather conditions can cause substantial production losses through mortality and reduced feed efficiency (Belasco *et al.*, 2016). Solutions to cold weather stress include: (i) bedding, with materials such as straw, or sawdust; (ii) windbreaks; (iii) providing cattle with more space; (iv) pushing snow out of pens to help surfaces dry more quickly; and (v) providing indoor access away from severe weather (Fig. 9.2). In western Nebraska, a rule of thumb was developed which seems to work: 1–2 kg of bedding per animal per day (Mader and Griffin, 2015). When considering the cost of feed, maintaining the (higher) feed requirements of an animal that is somewhat wet in winter conditions is up to three times as costly as provision of the amount of bedding required to keep them dry (Mader and Griffin,



Fig. 9.2. Cattle with indoor access have more protection from severe winter weather conditions in regions where large amounts of snowfall occur. (Image credit: Miriam Martin.)

2015). One way to reduce the need for bedding is to give animals more space. By doubling the space per animal in extreme weather events, the need for bedding can be reduced because the added space helps the animals to stay dry. Windbreaks can be particularly useful for heavyweight cattle, and both new cattle coming into the feedlot and heavy finished cattle are the most vulnerable to cold stress (Mader, 2003). It is important to remember that facilities and good management never completely eliminate cold weather stress; however, well-implemented strategies can minimize the severity and allow the animals to adapt. Lightweight cattle from nearby ranches, who are adapted to cold weather, typically encounter the least amount of cold stress. Heavyweight fed cattle transported in from warm climate areas, and which can lack heavy winter coats, become the biggest welfare concern in extreme cold weather conditions. Freezing rain can be deadly because a wet hair coat loses its ability to insulate the animal. Cattle which have become acclimated and have grown long winter coats can tolerate extremely cold weather.

9.5 Lameness

Lameness is the second biggest health issue in fed cattle, second to shipping fever (BRD complex) (Feedlot,

2011). Lameness has been a welfare challenge for dairy cows for a long time. More recently it has come to the forefront as an issue in feedlot cattle. Lameness becomes more problematic in indoor-fed cattle housed on concrete. Cattle housed on solid concrete or slatted concrete floors have a higher incidence of lameness and foot claw disorders; rubber flooring can help decrease lameness (Grooms and Kroll, 2015). Cattle on concrete flooring tend to lie down less than cattle on rubber flooring, and cattle housed on concrete slats have, on average, larger (swollen) joint circumferences when compared with cattle housed on slats covered with rubber mats (Wagner, 2016).

Osteoarthritis is a non-infectious joint disease that also causes lameness in fed cattle. The cause may have a primary hereditary component, or be a secondary consequence of poor husbandry, nutritional imbalance (Fig. 9.3), or joint instability (Nichols and Lardé, 2014). Lameness manifests itself in different forms, and it may be the result of many causes that are not well understood, and it poses a significant welfare challenge. A US study of leg conformational traits found that in fed cattle, 50% had less than ideal shoulder and hip conformation, 30% had less than ideal hock conformation, 15% of cattle did not demonstrate sufficient

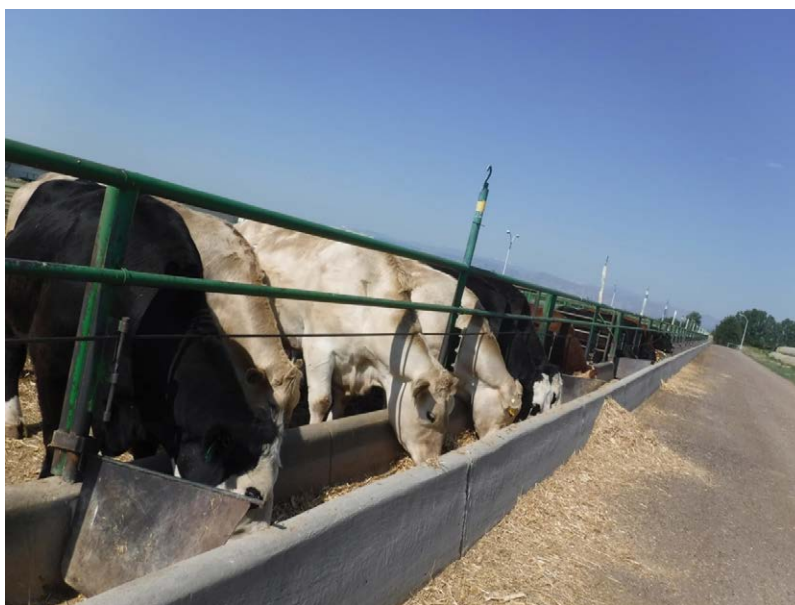


Fig. 9.3. Good nutritional management can help prevent lameness and rumenitis, both of which can negatively impact welfare. (Image credit: Miriam Martin.)

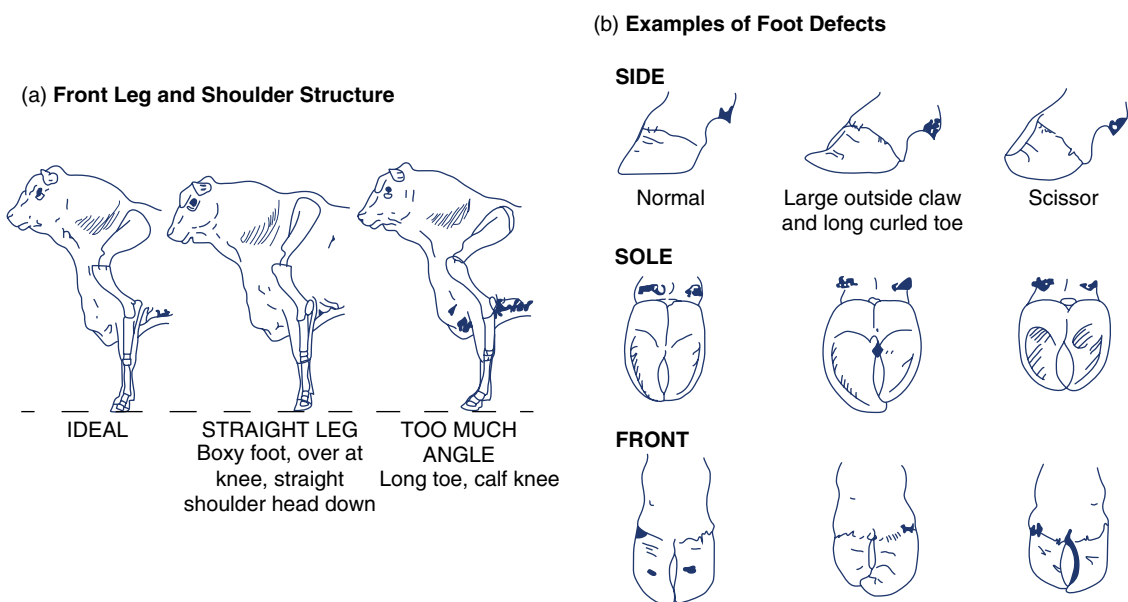


Fig. 9.4. Examples of (a) front leg and shoulder structure conformation guidance, and (b) foot defects. (Image credit: derived from Ashwood, 2011.)

soundness and mobility (i.e. were lame), and heavier weight cattle showed a significantly higher prevalence of front claw abnormalities (Fig. 9.4) (Vollmar, 2016). Breed associations in Australia and the USA are beginning to address lameness issues due to conformation. Through the use of technical bulletins, they describe how lameness due to genetics can be reduced through selection (Ashwood, 2011; Bertz, 2016). A good way to assess lameness is using a scoring system, and there are a number of scoring systems available. (See in addition the lameness scoring system found in ‘9.10 Fatigued Cattle’, this chapter.) Indoor cattle can also be scored for swollen joints, always scoring the worst affected leg: (1) normal leg; (2) hair loss on the joint; (3) joint swelling smaller than a tennis ball or baseball; and (4) swelling larger than a tennis ball or baseball (Fulwider *et al.*, 2007).

9.6 Preconditioning to Prevent Health Problems

Preconditioning is the term for weaning and vaccinating of calves at the ranch of origin, prior to and in preparation for shipment to a feed yard. Weaning, vaccinating, and training calves to eat from a bunk (feed trough) and drink out of a water tank (open

water source), along with castration should be done a minimum of 45 days prior to transport to a feedlot (Machen and Gill, no date; Stuttgart and Halfman, 2013). This greatly reduces the risk of animals developing BRD complex. Preconditioned cattle should ideally be weaned and vaccinated 60 days before they leave the ranch of origin (D. Griffin, Texas A&M Veterinary Medical Center, Canyon, Texas, 2016, personal communication). Steers are more likely to become sick with BRD than heifers, and this is likely due to castration being a predisposing cause (Snowder *et al.*, 2006). A lack of preconditioning for calves induces a higher level of stress on the animals that are weaned, and then shipped to a feedlot on the same day as weaning. Preconditioned calves tend to have improved health, weight gain, feed efficiency, and welfare outcomes along with increased carcass weight and carcass quality grade when slaughtered (Hilton, 2015). Three risk categories (high, medium, and low), have been defined for calves entering the feedlot, quantifying the level of stress calves have likely encountered, along with their risk of developing BRD (Krehbiel *et al.*, 2016). High risk calves are recently weaned, have not received vaccinations, nor have they been castrated or dehorned, and have been comingled with groups and moved through at least one auction market (Krehbiel *et al.*, 2016). Low risk calves are marketed

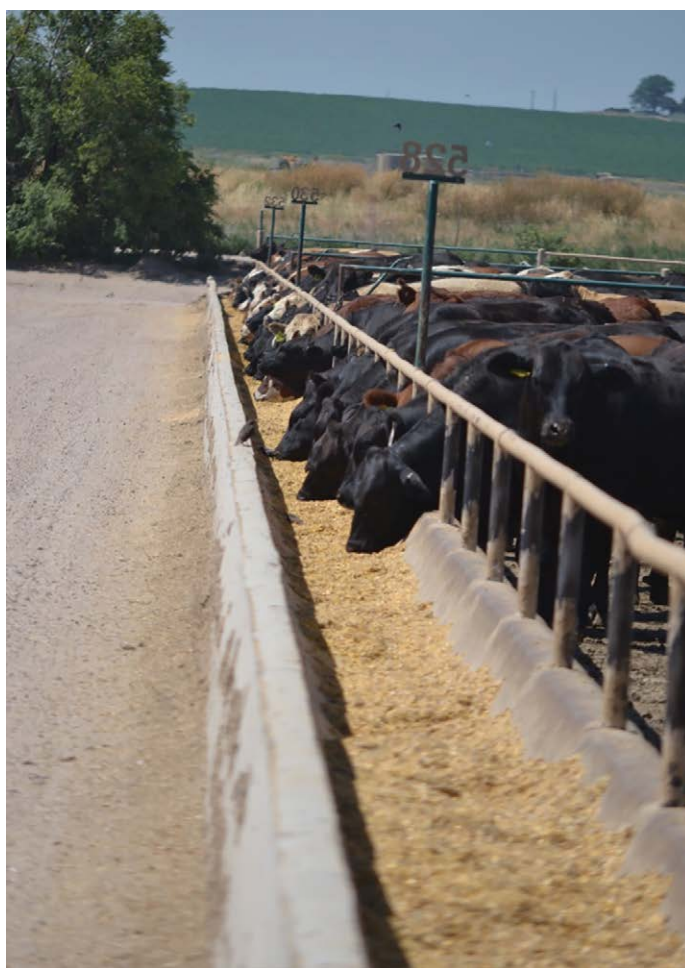


Fig. 9.5. Training calves to eat from a feed bunk as part of a preconditioning program prepares them to adapt well upon entering the feedlot setting. (Image credit: Miriam Martin.)

directly off the farm or ranch from a single source, and have been through an all-encompassing preconditioning program that includes vaccination, castration, along with being feed bunk trained (Fig. 9.5). Variation between these two extremes includes cattle that fall within the medium risk category. All efforts should be made to eliminate the incidence of high risk cattle as this will improve the long-term health status of the animals, and therefore the welfare of the animal once in the feedlot.

A lack of preconditioning and long periods of transport also increases the number of calves who test positive for *E. coli* O157:H7 after transport, along with increased fecal shedding of *E. coli* O157:H7 (Bach *et al.*, 2004). A general rule is that the longer an

animal is in the marketing chain, such as the number of auction markets it goes to and the number of times the animal is comingled with other groups of cattle, the greater the risk of health problems.

9.7 BRD in Feedlot Cattle

The most common health problem in feedlot cattle is BRD complex – known in the USA as shipping fever. It affects 16% of cattle in feedlots (Feedlot, 2011), and shipping fever is the most common cause of morbidity and mortality in feedlot cattle. A comprehensive United States Department of Agriculture study found that more than 90% of feedlots vaccinate arriving cattle against respiratory pathogens

such as bovine viral diarrhea virus and infectious bovine rhinotracheitis virus (Feedlot, 2011). Fifty-nine percent of feedlots treated cattle considered to be high risk metaphylactically, meaning mass medication of groups of animals with an antibiotic upon arrival to the feedlot or shortly thereafter. Mass treatment will greatly reduce death losses (D. Thomson, College of Veterinary Medicine, Kansas State University, Manhattan, Kansas, 2017, personal communication), and the use of mass medication is reviewed by Abell *et al.* (2017). However, in US antibiotic-free programs, metaphylactic (mass medication of a group of animals, in advance of an expected outbreak of disease) treatment of groups of high risk animals upon arrival, or individual treatment of animals who become ill, is not an option. As a result, high risk cattle go without treatment, and this can become a dire welfare concern. This provides another incentive for feedlots not to purchase high risk cattle for antibiotic-free programs. However, even for animals treated with antimicrobials, of those cattle treated for respiratory disease, 18% do not respond to treatment (Feedlot, 2011) and these animals' welfare suffers as a result.

Animals predisposed to acquire BRD can be susceptible as a result of a lack of preconditioning – meaning the animals were weaned and immediately transported to the feedlot; other factors include the actual timing when previous vaccinations were given, nutritional status, source (i.e. farm of origin), transport time, and stress. One in five cattle less than 320 kg develops BRD, so mass treatment upon arrival at the feedlot has been widely adopted (Feedlot, 2011). Lighter weight, younger cattle may have been exposed to fewer pathogens than older calves, and this could result in a less 'exposed' immune system when calves arrive at the feedlot, increasing their susceptibility to disease, and additionally the stress of transportation may result in an impaired immune response. A known history of a lack of vaccination when combined with information on cattle appearance (such as a rough hair coat or nasal discharge) are the two 'deciding factors' for most feedlots when deciding to mass treat cattle (Feedlot, 2011). The incidence of BRD increases dramatically after 5 days of arrival on the feedlot, and remains high until approximately 80 days on feed (Snowder *et al.*, 2006). Selection for respiratory disease resistance could be an effective solution (Snowder *et al.*, 2006). Cattle identified as sick should be moved to a hospital pen where hay is provided, along with less competition for bunk

space and at the water trough. This will ensure that they are provided with the best possible environment to respond to treatment.

9.8 Liver Abscesses and Other Internal Lesions

Liver abscesses are likely a consequence of ruminal acidosis and rumenitis in cattle fed rations high in readily fermentable carbohydrates and low in roughage (Amachawadi and Nagaraja, 2016). Negative effects of liver abscesses include reduced weight gain, lower carcass yield, and lower marbling scores relative to animals without liver abscesses (Brown and Lawrence, 2010). The incidence of severely abscessed livers is greatest in Holstein cattle in feedlot settings when compared with beef breeds. A likely contributor is that these animals (Holsteins) require more days on feed to achieve slaughter weight, but the precise cause still remains unknown (Amachawadi and Nagaraja, 2016). Many cattle on feed in the USA receive the antibiotic tylosin, which, when combined with nutritional management, can minimize the occurrence of acidosis and rumenitis, and thus reduce the incidence of liver abscesses as a result (Feedlot, 2011; Amachawadi and Nagaraja, 2016). However, liver abscesses are still found in 10–20% of all fed cattle slaughtered, and are highly variable by region of the USA. This indicates that our understanding of what causes liver abscesses, and our ability to prevent them, is in need of improvement. Liver abscesses can be scored: (Normal) edible liver; (A-) one to two small abscesses; (A) one to two large abscesses or multiple small abscesses; or (A+) multiple large abscesses (Brown and Lawrence, 2010). A study of 19,000 fed cattle harvested in the central USA observed lung, liver, and rumen gross pathology lesions (Rezac *et al.*, 2014), and found that 22% of cattle were observed with a severe lesion (lung, liver, or rumen). Of the 30% of cattle that had a liver abnormality, 28% also had pulmonary lesions and 20% displayed rumenitis lesions (Rezac *et al.*, 2014). Cattle with severe lesions, or a combination of lesions in the lungs, liver, and rumen are likely experiencing detrimental health and poor welfare, which may include pain, sickness, or malaise, and these may be manifested in less weight gain and decreased carcass value.

9.9 Handling

Good animal handling requires both a positive attitude of the handler and proper management of

facilities, and, in many instances, these human factors may be more important than facility design. Numeric scoring of handling provides a measurable way to evaluate improvement. The Beef Quality Assurance Feedyard Assessment (BQA FA) provides guidelines for feedlot handling practices and is a very useful assessment tool. The six categories that the BQA FA focuses on are: (i) driving aids/electric prod use; (ii) squeeze chute operation; (iii) vocalization; (iv) stumbling/tripping; (v) falling; and (vi) jumping and running (Woiwode *et al.*, 2016a). Each category can be evaluated as: (1) acceptable; (2) requires action; (3) unacceptable; or (4) not applicable. Benchmarks have been set at <10% electric prod use, 0% miscaught, <5% vocalizing, <10% of cattle stumbling/tripping, <2% of cattle falling, and <25% of cattle jumping or running (National Cattlemen's Beef Association, 2017). These benchmarks are applicable to any feedlot handling system and provide a clear set of expectations. In 2016, 28 large US feedlots were found to average 3.6% electric prod use, 4.2% miscaught in the squeeze chute, 1.4% of cattle vocalized during restraint in the squeeze chute, and 0.8% fell during handling (Woiwode *et al.*, 2016a). These thresholds suggest 'maxima' – and good companies work to reduce these to levels well below 'threshold'.

Hydraulic squeeze chutes (races) have been shown to increase vocalizations when cattle are restrained compared with manual chutes (Simon *et al.*, 2016), as this may be due to excessive pressure being applied. The chute should be adjusted to reduce pressure. This is a problem that feedlot managers have started to recognize, and have corrected for, and Woiwode *et al.*, (2016a) found much lower vocalization scores in feedlots using hydraulic chutes than Simon *et al.* (2016) had found on ranches. Corral modifications can be made easily, and these can include: (i) blocking the animal's ability to see workers who are within the animal's flight zone; and (ii) eliminating light and dark contrasts and shadows (Fig. 9.6).

Consideration of animals' natural following patterns and their desire to return to where they came from can help reduce stress (Lima, 2016). Calm handlers who do not yell, and the absence of barking dogs facilitates a less stressful handling environment. Animals should always be moved in small groups if possible, as individual animals are at greater risk of balking, vocalizing, stumbling, and running (Simon *et al.*, 2016). Cattle that vocalize during handling and while being restrained tend to

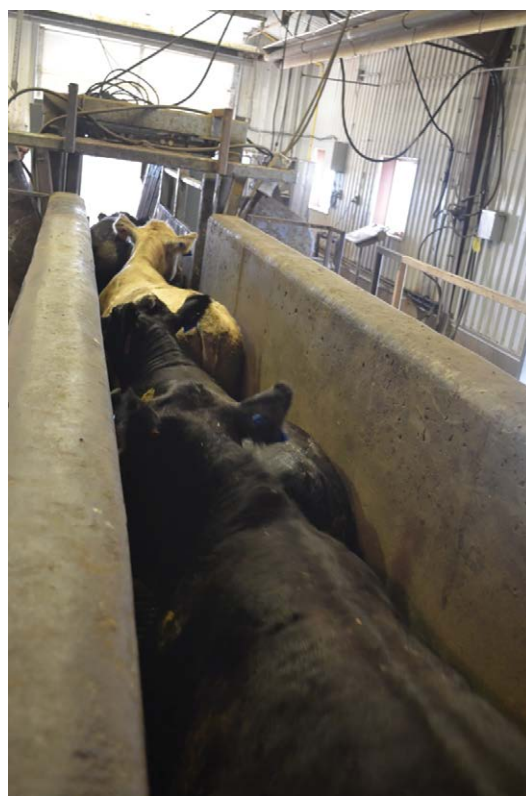


Fig. 9.6. Handling facilities that are designed to accommodate cattle's following behavior and are free of shadows help create a low stress environment where animals remain calm. (Image credit: Miriam Martin.)

have reduced weight gain as a result (Woiwode *et al.*, 2016b). Dr Temple Grandin has designed a feedlot handling system to minimize stress in cattle through taking advantage of their natural following behaviors and desire to return to where they came from (Fig. 9.7).

9.10 Fatigued Cattle

Over the past 10 years an increase in the numbers of fatigued cattle arriving at processing plants has emerged. Many different explanations have been hypothesized, but a single cause is yet to be identified. Clinical signs of fatigued cattle include fast and labored breathing, reluctance to move, lameness, a stiff gait, or recumbency with no clear sign of injury or disease, along with higher than normal serum lactate concentrations and creatine kinase activity levels (Thomson *et al.*, 2015). Variations in

CATTLE HANDLING SYSTEM FOR A FEEDLOT

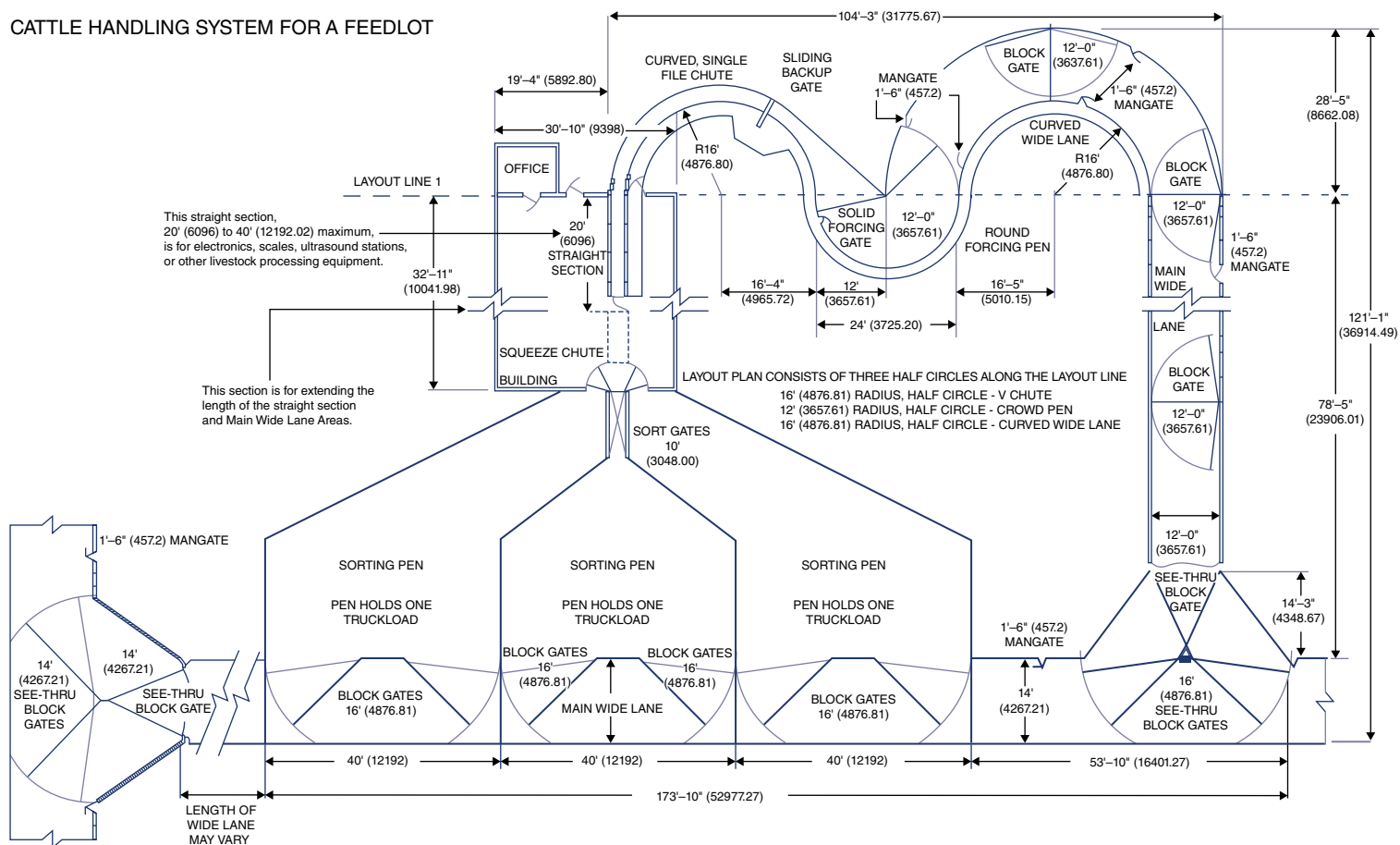


Fig. 9.7. Feedlot handling system designed by Dr Temple Grandin (Grandin, 2014, 2017).

the timing of the onset of fatigue exist once cattle arrive at the processing facility, and there seems to be a seasonal component with more cattle becoming fatigued in the summer months. This issue becomes relevant to the feed yard only if a feeding, husbandry, or handling practice at the feedlot is contributing to the welfare challenge of fatigued cattle at the slaughter facility. Lameness has been described in cases as extreme as hoof wall sloughing, or in less extreme cases where animals show stiffness and are reluctant to move with increased bouts of lying down in the pen.

A simple lameness scoring system can be implemented (Grandin, 2013; Edwards-Callaway *et al.*, 2017), with:

- (0) Normal: Stands and walks normally, long strides, easy to move, and vigorous. Beef breeds will have a definite flight zone unless reared in close confinement.
- (1) Mildly Lamé: Slightly stiff gait, sore-footed. Keeps up with normal cattle when the group is walking.
- (2) Moderately Lamé: Lags behind and fails to keep up with normal cattle when the group is walking. Head down while moving, stiff gait, sore footed.
- (3) Severely Lamé and Reluctant to Move: Limping, hard to move, reluctant to put weight on its feet. No flight zone and has difficulty moving.
- (4) Downed Cattle: Includes cattle not able to stand, or exhibiting severe damage to hooves.

9.11 Biological Constraints

As the beef industry continues to fatten younger cattle to heavier weights, welfare concerns begin to surface when the biology of the animal is pushed to gain more weight faster. The feeding of beta-adrenergic agonists (which are not permitted in the European Union) can contribute to this problem when not fed in accordance with label directions; extra precautions should be taken with cattle during the summer months with regard to stress levels and proper handling. An increased incidence of death rate in cattle fed beta-adrenergic agonists has been shown (Loneragan *et al.*, 2014). The incidence of right-sided congestive heart failure in feedlot cattle doubled in Canada from 2000 to 2012, and cattle treated for respiratory disease were three times more likely to develop right heart failure (Neary *et al.*, 2016). Cattle mortality at the feedlot

bearing similarities to Sudden Death Syndrome in broiler chickens has been observed, and recently, cattle exhibiting symptoms consistent with those seen in pigs with Fatigued Pig Syndrome have been identified after arriving at the slaughter facility (Thomson *et al.*, 2015). Conformation issues seen in cattle arriving at the feedlot (Vollmar, 2016) and non-infectious joint diseases (Nichols and Lardé, 2014) are contributing to lameness in ways that negatively affect welfare, and in numbers that have never been seen before. Better understanding of these issues will define feedlot welfare in the future.

9.12 Summary

When evaluating feedlot cattle welfare, outcome-based measures that include hide cleanliness, panting scoring, assessment of health records, and lameness scoring can be used. Cattle who are clean and free from swollen joints and lameness present a lower risk for welfare concerns. Emerging welfare issues can only be addressed if welfare is viewed from a holistic perspective, which takes into account the wide range of factors that can cause stress to the animal in a feedlot setting. These factors can be: (i) environmental stressors; (ii) lameness; (iii) sickness from a lack of preconditioning; (iv) stressful handling experiences; or (v) stress from production pressures which push the biology of the animal to its limits. Only when the relationships between these welfare challenges are taken into account, can long-term solutions come to fruition. Simple ways to improve welfare may exist, but successful implementation is likely to be dependent upon good feedlot management and by creating a ‘lower stress environment’ no matter what the location or feedlot design.

References

- Abell, K., Theure, M., Larson, R., White, B. and Apley, M. (2017) A mixed treatment comparison meta-analysis of metaphylaxis treatments for bovine respiratory disease in beef cattle. *Journal of Animal Science* 95(2), 626–635.
- Amachawadi, R. and Nagaraja, T.G. (2016) Liver abscesses in cattle: a review of incidence in Holsteins and of bacteriology and vaccine approaches to control in feedlot cattle. *Journal of Animal Science* 94(4), 1620–1632.
- Ashwood, A. (2011) Structure and Lameness. Available at: http://www.brahman.com.au/technical_information/selection/structureAndLameness.html (accessed 10 May 2017).
- Bach, S., McAllister, T., Mears, G. and Schwartzkopf-Genswein, K. (2004) Long-haul transport and lack of

- preconditioning increases fecal shedding of *Escherichia coli* and *Escherichia coli* O157: H7 by calves. *Journal of Food Protection* 67(4), 672–678.
- Belasco, E.J., Cheng, T. and Schroeder, T.C. (2016) The impact of extreme weather on cattle feeding profits. *Journal of Agricultural and Resource Economics* 40(2), 285–305.
- Bertz, H. (2016) Practical Ways to Improve Your Herd's Feet and Legs. Available at: http://assets.redangus.org/media/Documents/eNews/2016/HB_Feet_and_Legs.pdf (accessed 10 May 2017).
- Brown, T. and Lawrence, T. (2010) Association of liver abnormalities with carcass grading performance and value. *Journal of Animal Science* 88(12), 4037–4043.
- Chen, J.M., Stull, C.L., Ledgerwood, D.N. and Tucker, C.B. (2017) Muddy conditions reduce hygiene and lying time in dairy cattle and increase time spent on concrete. *Journal of Dairy Science* 100(3), 2090–2103.
- Dikmen, S., Ustuner, H. and Orman, A. (2012) The effect of body weight on some welfare indicators in feedlot cattle in a hot environment. *International Journal of Biometeorology* 56(2), 297–303.
- Edwards-Callaway, L.N., Calvo-Lorenzo, M.S., Scanga, J.A. and Grandin, T. (2017) Mobility scoring of finished cattle. *Veterinary Clinics of North America: Food Animal Practice* 33(2), 235–250.
- Feedlot, U. (2011) *Part IV: Health and Health Management on US Feedlots With a Capacity of 1,000 or More Head*. USDA-APHIS-VS-CEAH-NAHMS, Fort Collins, Colorado.
- Fulwider, W.K., Grandin, T., Garrick, D., Engle, T., Lamm, W. et al. (2007) Influence of free-stall base on tarsal joint lesions and hygiene in dairy cows. *Journal of Dairy Science* 90(7), 3559–3566.
- Gaughan, J., Mader, T.L., Holt, S. and Lisle, A. (2008) A new heat load index for feedlot cattle. *DigitalCommons@University of Nebraska-Lincoln Faculty Papers and Publications in Animal Science* 613.
- Grandin, T. (2013) Temple Grandin Explains Animal Welfare Problems with Beta-Agonists. Available at: <http://www.beefmagazine.com/processors/temple-grandin-explains-animal-welfare-problems-beta-agonists> (accessed 10 May 2017).
- Grandin, T. (2014) *Livestock Handling and Transport: Theories and Applications*. CAB International, Wallingford, UK.
- Grandin, T. (2016) Evaluation of the Welfare of Cattle Housed in Outdoor Feedlot Pens. *Veterinary and Animal Science* 6(12), 77. DOI: 10.3390/ani6120077
- Grandin, T. (2017) Cattle Handling System for a Feedlot. Available at: <http://www.grandin.com/design/cad/cad-6.html> (accessed 15 May 2017).
- Grooms, D.L. and Kroll, L.A.K. (2015) Indoor confined feedlots. *Veterinary Clinics of North America: Food Animal Practice* 31(2), 295–304.
- Hilton, W.M. (2015) Management of preconditioned calves and impacts of preconditioning. *Veterinary Clinics of North America: Food Animal Practice* 31(2), 197–207.
- Krehbiel, C., Wilson, B., Richards, C. and Step, D. (2016) 0276 Best management practices for weaned calves for improved health and well-being. *Journal of Animal Science* 94 (supplement 5), 131–132.
- Lima, M.L. (2016) Effect of corral modification for humane livestock handling on cattle behavior and cortisol release. In: *Joint Animal Science and Dairy Science Meeting Proceedings. Animals and Science: Big Solutions for Grand Challenges*. Proceedings of 2016 American Society of Animal Science (ASAS) Joint Annual Meeting, 22 July 2016, Salt Lake City, Utah. ASAS, Salt Lake City, Utah, Abstract 68.
- Loneragan, G.H., Thomson, D.U. and Scott, H.M. (2014) Increased mortality in groups of cattle administered the β -adrenergic agonists ractopamine hydrochloride and zilpaterol hydrochloride. *PLOS One* 9(3), e91177.
- Machen, R. and Gill, R. (no date) Preparing Beef Calves for Market. Texas A&M AgriLife Extension. Available at: <http://aglifesciences.tamu.edu/animalscience/wp-content/uploads/sites/14/2016/01/Preparing-Calves-for-the-Market.pdf> (accessed 12 June 2017).
- Mader, T.L. (2003) Environmental stress in confined beef cattle. *Journal of Animal Science* 81(14_suppl_2), E110–E119.
- Mader, T.L. and Griffin, D. (2015) Management of cattle exposed to adverse environmental conditions. *Veterinary Clinics of North America: Food Animal Practice* 31(2), 247–258.
- Mader, T., Dahlquist, J., Hahn, G. and Gaughan, J. (1999) Shade and wind barrier effects on summertime feedlot cattle performance. *Journal of Animal Science* 77(8), 2065–2072.
- McKeith, R., Gray, G., Hale, D., Kerth, C., Griffin, D. et al. (2012) National Beef Quality Audit-2011: Harvest-floor assessments of targeted characteristics that affect quality and value of cattle, carcasses, and byproducts. *Journal of Animal Science* 90(13), 5135–5142.
- Miller, J.J., Beasley, B.W., Yanke, L.J., Lamey, F.J., McAllister, T.A. et al. (2003) Bedding and seasonal effects on chemical and bacterial properties of feedlot cattle manure. *Journal of Environmental Quality* 32(5), 1887–1894.
- National Cattlemen's Beef Association (2017) Beef Quality Assurance Feedyard Assessment. Available at: <http://www.bqa.org/resources/assessments> (accessed 10 May 2017).
- Neary, J., Booker, C., Wildman, B. and Morley, P. (2016) Right-sided congestive heart failure in North American feedlot cattle. *Journal of Veterinary Internal Medicine* 30(1), 326–334.
- Nichols, S. and Lardé, H. (2014) Noninfectious joint disease in cattle. *Veterinary Clinics of North America: Food Animal Practice* 30(1), 205–223.

- Reneau, J.K., Seykora, A.J., Heins, B.J., Endres, M.I., Farnsworth, R.J. and Bey, R.F. (2005) Association between hygiene scores and somatic cell scores in dairy cattle. *Journal of the American Veterinary Medical Association* 227(8), 1297–1301.
- Rezac, D., Thomson, D., Bartle, S., Osterstock, J., Prouty, F. and Reinhardt, C. (2014) Prevalence, severity, and relationships of lung lesions, liver abnormalities, and rumen health scores measured at slaughter in beef cattle. *Journal of Animal Science* 92(6), 2595–2602.
- Simon, G.E., Hoar, B.R. and Tucker, C.B. (2016) Assessing cow–calf welfare. Part 2: Risk factors for beef cow health and behavior and stockperson handling. *Journal of Animal Science* 94(8), 3488–3500. DOI: 10.2527/jas.2016-0309
- Snowder, G., Van Vleck, L.D., Cundiff, L. and Bennett, G. (2006) Bovine respiratory disease in feedlot cattle: environmental, genetic, and economic factors. *Journal of Animal Science* 84(8), 1999–2008.
- Stuttgen, S. and Halfman, B. (2013) Pre-Conditioning Program Considerations for Feeder Cattle. University of Wisconsin-Extension. Available at: <http://fyi.uwex.edu/wbic/files/2013/11/general-pre-conditioning.pdf> (accessed 12 June 2017).
- Thomas, H.S. (2013) Feedlot Pen Maintenance Leads to Optimal Performance. Available at: <http://www.progressivecattle.com/topics/facilities-equipment/5784-feedlot-pen-maintenance-leads-to-optimal-performance> (accessed 10 May 2017).
- Thomson, D.U., Loneragan, G.H., Henningson, J.N., Ensley, S. and Bawa, B. (2015) Description of a novel fatigue syndrome of finished feedlot cattle following transportation. *Journal of the American Veterinary Medical Association* 247(1), 66–72.
- Vollmar, K. (2016) Survey of the prevalence of conformational defects in feedlot receiving cattle in the United States. MSc thesis, Colorado State University, Fort Collins, Colorado.
- Wagner, D. (2016) Behavioral analysis and performance response of feedlot steers on concrete slats versus rubber slats. In: *Joint Animal Science and Dairy Science Meeting Proceedings. Animals and Science: Big Solutions for Grand Challenges*. Proceedings of 2016 American Society of Animal Science (ASAS) Joint Annual Meeting, 22 July 2016, Salt Lake City, Utah. ASAS, Salt Lake City, Utah, Abstract 67.
- Woiwode, R., Grandin, T., Kirch, B. and Paterson, J. (2016a) Compliance of large feedyards in the northern high plains with the Beef Quality Assurance Feedyard Assessment. *The Professional Animal Scientist* 32(6), 750–757.
- Woiwode, R., Grandin, T., Kirch, B. and Paterson, J. (2016b) Effects of initial handling practices on behavior and average daily gain of fed steers. *International Journal of Livestock Production* 7(3), 12–18.

10 Public Opinion and the Retailer: Driving Forces in Animal Welfare?

HENRY BULLER

The way we treat animals is an important reflection of the values of our society.

(Defra, 2004, p. 11)

10.1 Introduction

As anyone reasonably familiar with contemporary food stores will be aware, whether they are massive hypermarkets or small, local butchers' shops, the welfare of food animals has become an important component of food marketing. Posters, flyers, publicity material, product labels, brand descriptors, adverts and even the layout of supermarket shelves increasingly draw attention, either directly or indirectly, to various aspects of the quality of life (and sometimes death) of the animals concerned. The discerning consumer can today choose products from animals and production systems variously described as outdoor reared, free-range, grass- or pasture-fed, low stocking density, long life, welfare approved, humanely killed, hormone-free, antibiotic-free, cage-free, non-GMO (genetically modified organisms), organic, biodynamic, and so on. Less specific claims are made through brand or assurance scheme labelling, signifying that animal products conform to a wider set of welfare standards (many of which are based on legal minima, but some of which go significantly further), and other quality requirements, relating to provenance, breed, and so on. While it is also possible to avoid confronting allusions to animal welfare when buying animal products, the growth and apparent ubiquity of such references strongly suggests that this is an area of expanding consumer and citizen concern and that this concern is having an increasingly significant impact upon food supply chains and production systems.

What drives this concern for the welfare of farm animals forward? The answer lies in an uneven and intermittent set of very different pressures and

forces, sometimes, though rarely, acting in concert, but more often pursuing diverse agendas with varied motivations and desired outcomes. As informed citizens, we might like to believe that some vaguely defined but none the less widely supported sense of human moral progress leads us to demand ever-increasing improvements in the treatment of farmed animals: 'Can they suffer?', asked Jeremy Bentham back in 1789. But our own ethical sensibilities are inevitably tempered by the economic realities of modern life, by the existence of other, competing, moral exigencies, by the need for cheap food, and by the unavoidable presence of animal products well beyond mere foodstuffs. Only very occasionally do we take to the streets in the name of the farmed animal. We might turn to animal and veterinary science, placing our trust in the veterinarians and welfare specialists who are forever extending our awareness not only of the capacity for farm animals to suffer but also their capacity to experience pleasure and positive states. But welfare science has not been consistent in its own approach to the definition and assessment of animal welfare and is often seen by some as a handmaiden to the intensification of husbandry. We might maintain that it is the regulatory and legislative duty of our governments to reduce animal suffering and deliver higher welfare in our name. Certainly, this has played an important part in establishing standards and legal requirements within husbandry and animal treatment. But governments also represent those working in, and for, the food and farming sector, whose livelihoods depend on a sustainable yet facilitative, legislative, and economic framework. Finally, we might place our faith in that very food and farming sector itself to 'do the right thing', to produce to higher standards, to meet our selective need for ethically righteous products (though only when we choose to express that need through purchasing decisions) or to create new (and in most

cases profitable) niche demands for food ‘quality’ that combines higher welfare with distinctive provenance, gastronomic individuality, bucolic charm, and retailer identity.

At the same time, however, in the face of all these diverse drivers, society continues to demand fast, cheap and safe food, which often means short, fast-growing, mass-produced, medicalized, and largely confined animal lives. Moreover, as countless studies have shown, many in society don’t want to have to think about those farm animal lives (and deaths) when they make their purchasing decisions. To do so is to open the Pandora’s box of our dissonant anthropocentric objectification of animals in general, and our (unavoidably) violent carnivorousness with respect to farmed animals in particular (Loughnan *et al.*, 2010). Yes, everyone supports the principle of farm animal welfare and many recognize that certain aspects of welfare are probably not as good as they could be, but few want to have to take that into account in their daily consumption practice or pay for it through substantially higher food costs. This has been the singular challenge of welfare advancement.

Nevertheless, despite, but also because of, the intersection of these very different drivers, welfare standards in many countries are improving, products from inherently low-welfare production systems, such as eggs from battery systems, are losing their market share (and increasingly, their access to retailer shelves) and certain husbandry, transport and slaughter practices that were once considered almost banal are now outlawed. That being said, many people would argue that this is far from being enough and that some areas of animal production remain both under-regulated and of consistently poor welfare. A further concern is that current higher standards of welfare are ultimately fragile – threatened, among other things, by the growing need for global food security.

In this chapter, I want to look at how this has been achieved by assessing specifically the role of public opinion, consumer choice, and retailer marketing strategies in driving the animal welfare agenda. Other chapters in this book have considered the regulatory and policy drivers of welfare. In this chapter, the focus is on the private, the individual, the market, and the societal driving forces. It should be recognized from the outset that these various non-governmental ‘driving forces’ do not necessarily represent a coherent or unified force. It is notorious that stated public opinions rarely

translate directly into individual consumer choices, and this across a wide range of issues, not only farm animal welfare. Equally, commercial marketing strategies may be interpreted either, or both, as a response to consumer demand or as an intentional structuring of that demand. As this chapter will go on to demonstrate, the welfare of farmed animals has, over the last 10 or so years, become increasingly commodified as a distinct element of market segmentation and product value. At one level, this is to be welcomed as it not only draws consumer attention to the welfare of the animals involved in the human food chain but it can also have the effect of driving up welfare standards within certain production systems, both in order to meet what is seen as a growing demand, and in order to achieve a degree of competitive advantage within that emerging market.

10.2 Early Public Opinion on Welfare of Farmed Animals

Public opinion about the welfare of farmed animals expresses itself in a number of ways: from the simple holding of beliefs, opinions or attitudes; through the encouragement of non-public animal welfare bodies and organizations, or backing of governmental regulatory policies that actively promote welfare gains; to the occasional or even consistent pursuit of behaviours and choices (from the economic to the political) that reflect specific individual commitments, whether they be in the purchase of animal products from higher welfare production systems or the deliberate avoidance of animal products altogether; to militant action. Public opinion is complex, temporally variable, culturally and, on occasion economically, contextual, and rarely, if ever, unanimous, even though it is often presented as a singular aggregate or consensus. ‘Public’ is formed of multiple publics and may include contradictory and dissonant positions. It is often informed by highly subjective perspectives, rather than robust and objective evidence, and, as has been demonstrated on many occasions, may be easily swayed by media, by targeted actions and discourses that play on emotions and prejudices and by influential actors or specific events. And yet, despite all this, public opinion has significant power as a moral touchstone, as a latent political force and as a persuasive economic influence.

We might trace the emergence of public opinion in favour of protecting the welfare of farmed animals back to the early animal protection movements of

the late 18th century. These could not be described as ‘popular’ in the sense of representing the societal mainstream, nor were they particularly focused upon farmed animals (their main concern being the cruel treatment of ‘beasts of burden’, dogs, and other animals used in entertainment). Yet, they had a significant, if largely symbolic impact both in the coalescence of distinctive and purposeful organizations and lobby groups (such as the Society for the Prevention of Cruelty to Animals) and in the promotion of early animal protection legislation such as, in the UK, the 1911 Protection of Animals Act (Ritvo, 1987; Kean, 1998). With the modernization and intensification of livestock farming during the 20th century, however, that early interest in outlawing and preventing acts of cruelty in animal treatment gradually gave way to a broader concern for the general conditions under which livestock were being kept and treated and the systematic suffering and poor welfare that often resulted from those conditions (Woods, 2011, 2012). By the second half of the 20th century, modern livestock farming was very different from what it was 100 years earlier. In order, on the one hand, to feed the expanding post-war human population with cheap animal products and, on the other hand, to supply the growing capitalization of the food industry with profits, far larger numbers of animals needed to be kept in more densely occupied, purpose-built housing. As a result, access to open air was reduced, manipulations and mutilations became a regular part of animal management, antibiotics and other medicines were used both to promote growth and to prophylactically prevent disease from occurring, and the time between birth and slaughter was forever being shortened as growth was intensified and accelerated. The increased productivity of the animals concerned was taken as evidence that they were coping well with the intensified conditions. At the same time, governments were extending their policy reach and remit. Early animal protection legislation was generally limited to acts of cruelty in public places. Reinforced by a new post-war democratic legitimacy, by a general liberalist optimism for societal advancement and by scientific gains in the understanding of animals, particularly through the emerging science of ethology, governments in a number of Western and European states, sometimes reluctantly, started to engage with the moral, economic, and disease-control issues surrounding contemporary livestock farming. In the meantime, citizens and consumers, benefiting from

cheap prices, remained largely unaware, and certainly poorly informed, of the welfare conditions of farmed animals.

The publication in the UK in 1964 of Ruth Harrison’s book *Animal Machines* shifted the agenda. Often compared to Rachel Carson’s *Silent Spring* in terms both of its scientific credibility and the enormous interest it generated beyond the scientific community, Harrison’s exposé of contemporary intensive livestock farming effectively alerted both governments and the public to what were increasingly being seen as not only the unacceptable excesses of intensive animal production, but also the unacceptable assumptions and principles upon which that production was being undertaken. Writing in the Preface to Harrison’s book, Rachel Carson asked for: ‘a consumers’ revolt of such proportions that this vast new agricultural industry will be forced to mend its ways’ (Carson, cited in Harrison, 1964). Although, in the UK at least, there was a substantial media response to the book, the drivers for change in the agricultural industry that ultimately resulted were investigative (notably the establishment of the Government’s Brambell Committee in 1965), regulatory (in the form of a slowly emerging raft of legal requirements and standards), and scientific (in the form of a nascent animal welfare science whose task was first to define welfare and then identify the parameters through which it could be assessed). While Harrison intentionally ‘aimed’ at least part of her book at those responsible for buying and preparing meals, arguing that industrially produced animal products were of poorer nutritional quality and were morally questionable, the response of consumers and citizens has been complex (Buller, 2013). For a relatively small number, this has involved driving genuine change through political mobilization (such as the sometimes violent demonstrations against live animal exports and veal crates that took place in the early 1990s) or supporting animal welfare non-governmental organizations (NGOs) in campaigns and ‘calling out’ animal abuses. For others, it has meant incorporating animal welfare into a more generic form of informed ethical consumerism, thereby providing new opportunities for a food industry keen to seek novel markets. The majority, however, remain broadly supportive of a gradual legislative agenda that involves little, if any, substantive change in purchasing behaviour. What is common to all three is that they represent a demand-led, rather than supply-led, set of drivers

for change. Whether through direct, militant action or genteel support for stronger regulation, citizens and consumers, and those that act in response to them – be they retailers, animal welfare NGOs or ultimately governments and regulatory authorities – have created, over the last 30 or so years a clear social demand for higher welfare standards in farm animals, one to which the supply sector has had to respond.

10.3 Mobilizing Public Opinion

There has been a clear shift of public attitudes towards animals over recent decades and how animals are considered in society. European consumers provide a good example of such a change in mind-set, with many consumers increasingly focusing on ‘clean and green’ production methods and being attracted by the possible food quality, safety, and animal health and welfare benefits of innovative production systems, such as free range or organic farming. The mindset of consumers and producers has undergone a seismic shift from merely preventing cruelty and avoidable suffering to animals, and instead is becoming focused on promoting their wellbeing and meeting their most important needs.

(European Commission, 2006, p. 11)

There is no doubt that what we might define as ‘Western’ public opinion in general is both concerned about animal welfare and, though broadly supportive of the direction of animal welfare regulation, feels that more could be done. ‘More than nine in ten EU [European Union] citizens believe it is important to protect the welfare of farmed animals’ reveals the 2015 Eurobarometer survey, going on to add that 82% of survey respondents believed the welfare of farmed animals should be ‘better protected than it is now’. In the USA, a survey conducted for the American Society for the Prevention of Cruelty to Animals in 2016 (quoted in Animal Welfare Institute, 2017) found 77% of respondents stated they were ‘concerned about the welfare of animals raised for food’ and 78% felt there should be more verification of welfare standards. Such findings are consistent with many other surveys undertaken in many different countries over the last 10–15 years. A survey by the US Animal Industry Foundation in 1989 found that 67% of respondents would support additional government regulation for farm animal welfare while another, by the US Caravan Opinion Research Corporation in 1995, had 93% of respondents agreeing with the statement: ‘Animal pain and suffering should be reduced as much as possible, even though the animals are

going to be slaughtered’ (quoted in Herzog *et al.*, 2001). For these majorities, responsibility for achieving suitable levels of welfare belongs either to government (through regulation) or food chain actors, from farmers to supermarkets (through husbandry standards). Consequently, as both anecdotal and survey evidence show, welfare is very rarely a dominant criterion in the choice of food products for large sections of the population. Moreover, where it is a criterion for consumers, it has usually more to do with the healthiness and quality of the product, than the quality of life of the animal (Eurobarometer, 2007). The paradox then is that despite there being high levels of expressed concern for farmed animal welfare, this does not effectively translate into effective demand for higher welfare products. This is because either such products are seen as ‘quality’ products which cost more, or because they are not identifiable as coming from higher welfare systems or because consumers simply do not want to have to make decisions based upon welfare. How to improve this situation, how to create genuine demand and thereby encourage higher standards (whether regulatory or private), has been the principal challenge faced by proponents of higher welfare production systems for many years. One response to this challenge has been to create more effective markets for food from higher welfare systems, effectively shifting responsibility away from government and legislation to the food and retail sector. Though undoubtedly effective with respect to certain food products (such as free-range eggs), this approach has its limitations, as we shall explore below.

What comes first, the demand or the supply, the chicken or the omelette? The market for animal products from higher welfare production systems has grown significantly since the 1980s. This has been a global phenomenon, though ‘Western’ consumer markets and the requirements of their supply chains largely drive it (Fig. 10.1). ‘Free-range’ products, particularly eggs, but also, though to a lesser extent, chicken and pork are the most obvious examples. In the UK, free-range eggs (including free-range organic eggs) currently comprise over 50% of total egg sales (57% shell and 50% processing) (AHDB, 2016). Overall, shell egg sales are growing in the UK as dietary advice shifts, and with them, the proportion of free-range eggs. The number of eggs from caged systems, which have replaced the now-outlawed high-density battery cages within EU member states, has remained

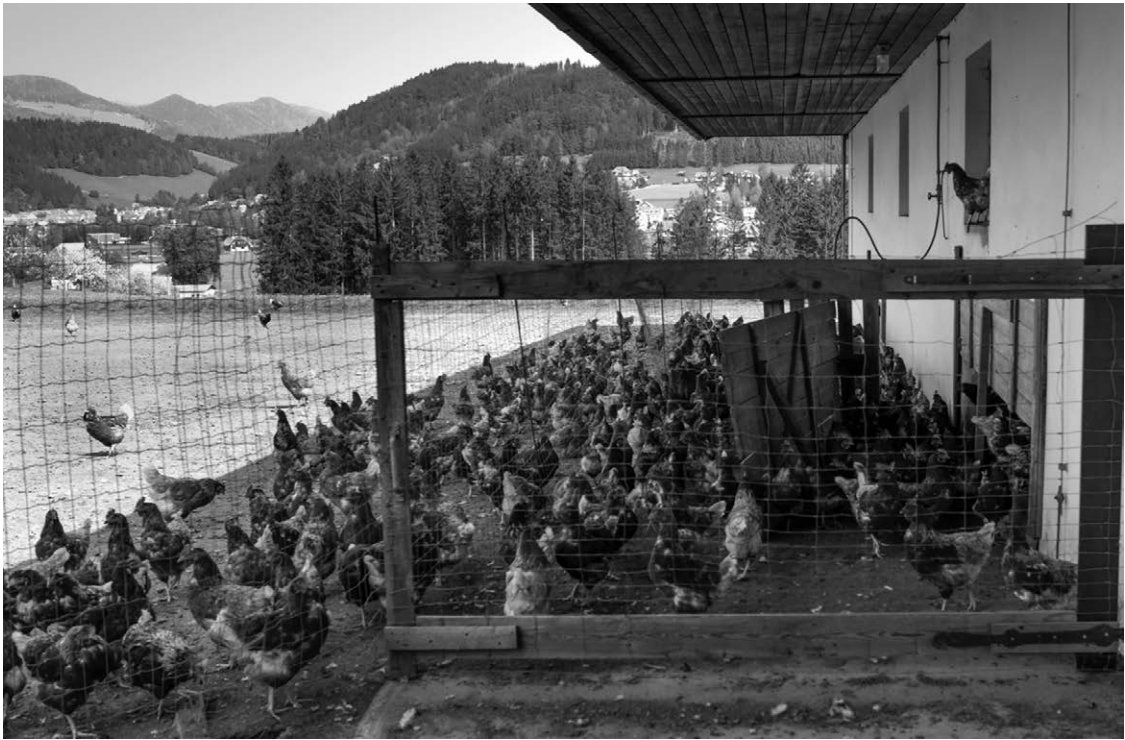


Fig. 10.1. Free-range egg-laying farm in Austria. (Image credit: Henry Buller.)

relatively constant, though a higher proportion of these eggs now go into processed foods. Many of the ‘top end’ retail outlets no longer stock either shell eggs from caged systems or processed food using eggs from caged systems and a number of others have promised to phase them out in the near future. While the price of organic free-range eggs remains considerably higher than others (with a market share of around 2%), free-range eggs, once notably more expensive for consumers than caged eggs, are increasingly competing with non-free alternatives on price, as retailers seek to compete by keeping prices low.

In the UK, the growth of the free-range egg market has been a long-standing trend, beginning in the 1980s and linked, at the time, to a well-publicized outbreak of salmonella in battery systems that led to the resignation of the Junior Health Minister at the time, Edwina Currie. Nevertheless, by 1999, free range still only accounted for around 16% of the total market. The EU ban on battery cages in 2012, following EU Directive 1999/74/EC created a market opening for free-range eggs but did not

entirely close down caged indoor production systems (Appleby, 2003). Indeed, higher welfare ‘enriched’ cages came to replace many battery systems and still produce almost half the eggs consumed in the UK. Arguably more important, however, was the market segmentation that the Directive introduced via the compulsory labelling of eggs as coming from ‘caged’, ‘free-range’, ‘barn’ and ‘organic’ systems. For many commentators, it has been a fertile combination of this creative market segmentation along with mandatory system labelling, expanding shell-egg consumption and the negative attention being given to battery hen welfare that has driven this sea change in the egg industry, creating a valuable price differentiation for producers, bringing ethical legitimacy and evidence of due diligence to retailers and, in some ways, a model of what can be achieved. Noble Food’s ‘Happy Egg’ brand is now one of the biggest free-range egg brands in the UK (see also, Miele, 2011). ‘Free range’ is an attractive proposition for many consumers and recent years have seen considerable investment in the segmentation of the previously

undifferentiated chicken and pork sectors, though the market for both is complicated by a non-statutory, and sometimes confusing, set of labels and definitions. Nevertheless, the broad process of: (i) segmenting a product according to different production criteria (that may include welfare standards); (ii) creating a mechanism of quality control or certification of producers; (iii) introducing a labelling scheme to allow consumers to identify the relevant product category; and (iv) establishing a product or brand identity, serves as a demonstration of how public opinion and consumer demand, coupled with innovative industry and retailer responses and a facilitative regulatory framework (whether legislative or voluntary) can deliver durable welfare gains, even at a marginally higher cost to consumers.

Many see this process as the most effective means of driving up welfare standards and rendering production systems that do not meet expected standards uneconomic. Animal welfare NGOs such as Compassion in World Farming and the Royal Society for the Prevention of Cruelty to Animals (RSPCA) have bought into this arena by operating welfare assurance and certification schemes that are adopted by producers and the food industry, or by offering awards to retailers and other food actors for the performance of their high-welfare production chains (Compassion in World Farming, 2017). These market mechanisms have some advantages over legislation: (i) in their ability to respond quickly across an entire production chain; (ii) in their non-mandatory nature; and (iii) in their capacity to mobilize public opinion. Moreover, evidence from research suggests that there is considerable potential for growth in the market for higher welfare products among a consumer population that is itself sufficiently segmented to respond to the differential product categories, and yet insufficiently informed as to how to locate and select higher welfare products (Kehlbacher *et al.*, 2012). Finally, such a market approach can also help to create a more positive social and economic environment for legislation to be subsequently enacted, and many commentators see them as the way forward (Ingenbleek *et al.*, 2013).

However, market approaches also have their limitations. First, they have been in the past exclusive, creating distinctive niches for products aimed at distinctive consumers (Fulponi, 2006). This is arguably changing somewhat as certain large-scale

food groups (retailers and food services) are increasingly sourcing exclusively from higher welfare systems with a potentially significant impact on higher welfare supply chains. Nevertheless, while the purpose of legislation is to create a level playing field of inclusive welfare standards, market mechanisms rely upon variability in standards to sell competitively to specific markets. Although they may ultimately generate across-the-board welfare gains, both producers (gaining a premium price for higher welfare products) and retailers (passing costs to consumers while at the same time gaining client fidelity) lose out if the new, higher standards become multiplied and ultimately generic.

Secondly, such market mechanisms depend highly upon consumers being able to identify, select, and pay for the higher welfare products, whether through distinctive product labelling, advertising, or store branding (Kehlbacher *et al.*, 2012). The apparent market success of the term ‘free-range’ (Janssen *et al.*, 2016) has drawn attention to other possible forms of production system labelling – though evidence suggests that many consumers are currently confused (or poorly informed) by labels (Brook Lyndhurst, 2010), while others prefer animal welfare to be bundled with other quality criteria (Verbeke, 2009). There is a risk here, however, of selectively focusing on those aspects of welfare that are likely to ‘sell’ at any one time as components of ‘quality’ rather than those that might be more likely to bring genuine and durable improvements to the lives of farmed animals (Buller and Roe, 2008), as the current lively debate over the welfare trade-offs in zero-grazing ‘mega farms’ reveals. Significantly, the complexity of uniform welfare labelling across different cultures, different welfare assessment methods, and broader socio-economic conditions has so far mitigated the establishment of a generic EU welfare label on the model of the current EU Organic labelling scheme (European Commission, 2009; Food Chain Evaluation Consortium, 2009; Toma *et al.*, 2012) despite indications that this would be valued by many consumers (Van Loo *et al.*, 2014).

While recognizing the potential of different forms of welfare labelling to both respond to consumer demand and to enhance the market for higher welfare systems and products, both of which would thereby increase the number of animals farmed under improved conditions, a final concern is that such a ‘commodification’ of animal welfare ultimately risks

shifting attention from the animal's way of life to that of the consumer. And there is fragility in this. Consumer attention can wane; other concerns can come to dominate the agenda (such as, most notably, food security and public health). Ultimately, concern for the welfare of the animals in our care must, if it is to be genuinely sustained, be driven by durable societal values. Although the market has proved adept at turning certain aspects of farm animal welfare into commercial advantage and, in conjunction with animal welfare NGOs, has helped to increase public awareness of many welfare issues, poor welfare externalities are in part the consequence of market failure (Norwood and Lusk, 2011; Harvey and Hubbard, 2013), a consequence, some would argue, which is implicit under the all-pervading 'animal use' policy paradigm (Garner *et al.*, 2016). To address such externalities in the long term and achieve acceptable levels of welfare requires a broad and integrated approach to welfare governance (FAWC, 2014; Clark *et al.*, 2017) combining the facilitative and regulatory intervention of government and other authorities with the inventiveness of market actors. But, at the end of the day, final responsibility for the welfare of farmed animals must lie, at least in part, with those who consume their products.

References

- AHDB (2016) *Poultry Pocketbook 2016*. Agriculture and Horticulture Development Board (AHDB), Kenilworth, UK.
- Animal Welfare Institute (2017) *Consumer Perceptions of Farm Animal Welfare*. Animal Welfare Institute, Washington, DC.
- Appleby, M.C. (2003) The European Union ban on conventional cages for laying hens: history and prospects. *Journal of Applied Animal Welfare Science* 6(2), 103–121.
- Brook Lyndhurst (2010) Are labels the answer? Barriers to buying higher animal welfare products. *Report for Department for Environment, Food and Rural Affairs (Defra)*. Brook Lyndhurst, London.
- Buller, H. (2013) Animal welfare: from production to consumption. In: Blokhuis, H., Miele, M., Veissier, I. and Jones, B. (eds) *Welfare Quality: Science and Society Improving Animal Welfare*. Wageningen Academic Press, Wageningen, the Netherlands.
- Buller, H. and Roe, E.J. (2008) Certifying welfare: integrating welfare assessments into assurance procedures: a European perspective: 25 key points. *Welfare Quality Report 17*. University of Cardiff, Cardiff, UK.
- Caravan Opinion Research Corporation (1995) *Attitudes Toward Protecting Farm Animals From Cruelty*. Opinion Research Corporation, Princeton, New Jersey.
- Clark, B., Stewart, G.B., Panzone, L.A., Kyriazakis, I. and Frewer, L.J. (2017) Citizens, consumers and farm animal welfare: a meta analysis of willingness-to-pay studies. *Food Policy* 68, 112–127.
- Compassion in World Farming (2017) Good Farm Animal Welfare Awards. Available at: <https://www.ciwf.org.uk/news/2017/06/good-farm-animal-welfare-awards-2017> (accessed 12 September 2017).
- Defra (2004) *Health and Welfare Strategy for Great Britain 2004*. Department for Environment, Food and Rural Affairs (Defra), London.
- Eurobarometer (2007) Attitudes of EU citizens towards animal welfare. *Special Report 270*. Eurobarometer, Brussels.
- Eurobarometer (2015) Attitudes of EU citizens towards animal welfare. *Special Report 442*. Eurobarometer, Brussels.
- European Commission (2006) Commission working document on a Community Action Plan on the Protection and Welfare of Animals 2006–2010 – Strategic basis for the proposed actions. SEC(2006) 65. COM (2006) 0014 Final. European Commission, Brussels.
- European Commission (2009) Options for animal welfare labelling and the establishment of a European Network of Reference Centres for the protection and welfare of animals. *Report to the European Parliament. SEC (2009) 1432. COM (2009) 584 Final*. Commission of the European Communities, Brussels.
- Farm Animal Welfare Committee (FAWC) (2014) *Economics and Animal Welfare*. FAWC, London.
- Food Chain Evaluation Consortium (2009) *Feasibility Study on Animal Welfare Labelling and Establishing a Community Reference Centre for Animal Protection and Welfare. Part 1: Animal Welfare Labelling*. European Commission, Brussels.
- Fulponi, L. (2006) Private voluntary standards in the food system: the perspective of major food retailers in OECD countries. *Food Policy* 31(1), 1–13.
- Gamer, R., Lyons, D. and Roberts, A. (2016) How to protect animal welfare. *CASJ Policy Research Briefing*. Centre for Animals and Social Justice (CASJ), Sheffield, UK.
- Harrison, R. (1964) *Animal Machines: The New Factory Farming Industry*. Vincent Stuart Publishers, London.
- Harvey, D. and Hubbard, C. (2013) Reconsidering the political economy of farm animal welfare: an anatomy of market failure. *Food Policy* 38, 105–114.
- Herzog, H., Rowan, A. and Kossow, D. (2001) Social attitudes and animals. In: Salem, D.J. and Rowan, A.N. (eds) *The State of the Animals*. Humane Society Press, Washington, DC, pp. 55–69.
- Ingenbleek, P.T.M., Harvey, D., Ilieski, V., Immink, V.M., de Roest, K. and Schmid, O. (2013) The European market for animal-friendly products in a societal context. *Animals* 3, 808–829.

- Jansesen, M., Busch, C., Rodiger, M. and Hamm, U. (2016) Motives of consumers following a vegan diet and their attitudes towards animal agriculture. *Appetite* 105(1), 643–651.
- Kean, H. (1998) *Animal Rights: Political and Social Change in Britain Since 1800*. Reaktion, London.
- Kehlbacher, A., Bennett, R. and Balcombe, K. (2012) Measuring the consumer benefits of improving farm animal welfare to inform welfare labelling. *Food Policy* 37(6), 627–633.
- Loughnan, S., Haslam, N. and Bastian, B. (2010) The role of meat consumption in the denial of moral status and mind to meat animals. *Appetite* 55(1), 156–159.
- Miele, M. (2011) The taste of happiness: free-range chicken. *Environment and Planning A* 43(9), 2076–2090.
- Norwood, F.B. and Lusk, J.L. (2011) *Compassion by the Pound: the Economics of Farm Animal Welfare*. Oxford University Press, Oxford.
- Ritvo, H. (1987) *The Animal Estate: the English and Other Creatures in the Victorian Age*. Harvard University Press, Cambridge, Massachusetts.
- Toma, L., Stott, A.W., Revoredo-Giha, C. and Kupiec-Teahan, B. (2012) Consumers and animal welfare. A comparison between European Union countries. *Appetite* 58(2), 597–607.
- Van Loo, E.J., Caputo, V., Nayga, R.M. and Verbeke, W. (2014) Consumers' valuation of sustainability labels on meat. *Food Policy* 49, 137–150.
- Verbeke, W. (2009) Stakeholder, citizen and consumer interests in farm animal welfare. *Animal Welfare* 18(4), 325–333.
- Woods, A. (2011) A historical synopsis of farm animal disease and public policy in twentieth century Britain. *Philosophical Transactions of the Royal Society of London B: Biological Sciences* 366(1573), 1943–1954.
- Woods, A. (2012) Is prevention better than cure? The rise and fall of veterinary medicine, c.1950–1980. *Social History of Medicine* 26(1), 113–131.

11 Vertebrate/Invertebrate – When Do We Start Caring?

MICHAEL J. KUBA

11.1 Introduction

Ultimately, our decision what to eat or not to eat, and how we treat our food before it is consumed, is a subjective one. It depends on our cultural background and our system of beliefs. Unlike their many invertebrate relatives, decapod crustaceans (Wiese, 2002) and cephalopods (Gutnick *et al.*, 2016) are complex animals, that are also sought as a food source throughout the world (Fig. 11.1). Yet their production, harvesting, transport and preparation for consumption are unregulated in most countries.

Perhaps this is why many ‘Westerners’ might be okay with throwing ‘Harry the lobster’ into a pot of boiling water, but will get upset to see a horse or donkey ending up in a sandwich. But in the 21st century should our culture and our emotions be the ones to guide us? Are there objective criteria to make an educated decision? Can science help solve this problem – *which animals should be protected?* Science is conducted by humans and disagreements are natural. They might get different results in similar experiments and sometimes reach different conclusions when interpreting the same results. Therefore, for anyone who is not an expert in a specific field of science, a scientific debate is often more confusing than enlightening.

This problem is one of the key issues in our modern world where we search for answers but often do not get them from the institutions or experts we hope to get them from. For example, the controversial debate on fish pain remains unsolved even after several years. The Victoria Braithwaite (2010) book on fish pain started a harsh discussion as to whether fish can feel pain or not. The critics (Rose *et al.*, 2014; Key, 2016) argue mainly that fish *cannot* feel pain, as they do not have the brain structures found in mammals that are needed for the perception of pain. In their answer to the Rose *et al.* article, Damasio and Damasio (2016) rebuke this argument, and these authors suggest that the lack of the

same brain structure does not have to result in the ‘non-existence’ of a behavior or a perception like pain. However, despite this ongoing debate there is no doubt that fish deserve at least some sort of protection through animal protection laws.

So why do we not simply extend these animal protection laws to decapod crustaceans and cephalopods? One major obstacle might be that every welfare measure targeting animals for human consumption, results in an increase in production costs. Better care, and more humane methods of catching and transport come with a price tag. And, since for commercial companies the main incentive is economic success, ultimately this would mean that the cost of these food items would increase, and we could probably no longer find shrimp in fast food restaurants.

11.2 Where Do We Stand at the Moment?

Looking at a 100-year-old cookbook I find useful tips which suggest placing bricks or rocks on the lid of the pot after putting a lobster into a pot of cold water, then slowly bringing the water to boiling point. According to the book the heavy weights are needed to counter the lobster’s escape attempts.

Some years ago Wallace (2004) wrote an essay called ‘Consider the Lobster’ pointing out that scientists have shown that lobsters, like other decapod crustaceans, have nociception and thus might be closer to feeling pain than we had previously thought. Since then a few countries (such as parts of Australia, New Zealand, Switzerland, Austria) have included at least some level of animal protection to invertebrates like crustaceans and cephalopods.

11.3 What Does Science Have to Say?

The general debate about avoidance behaviors, nociception and real pain is hard to follow. There

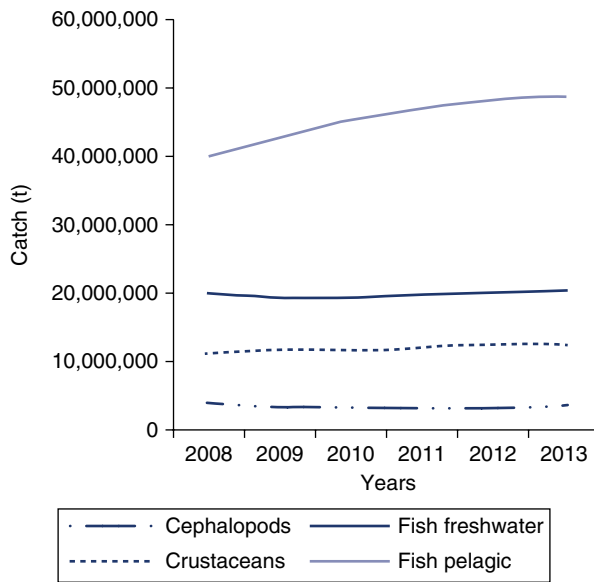


Fig. 11.1. Food and Agriculture Organization of the United Nations (FAO), fisheries statistic for the years 2008–2013, for pelagic fish, freshwater fish, crustaceans, and cephalopods (values on y-axis in metric tons). (Image credit: Michael Kuba.)

are two competing views: yes – decapod crustaceans and cephalopods feel pain; or, no they do not possess the proper ‘equipment’ (i.e. neural structure) to feel actual pain. Often, you find that opinions are entrenched and there is an unwillingness to see the other’s point of view.

In general, nociception is described as the acquisition and processing of harmful or problematic stimuli (Dubin and Patapoutian, 2010). There are several papers on nociception in crustaceans and very few on nociception in cephalopods (Crook *et al.*, 2013, see Sneddon *et al.* (2014) for a review of this topic). The main issues then center on: (i) whether nociception is pain; (ii) whether avoidance behavior indicates pain; or (iii) whether perhaps the only way to feel pain, as we understand it, is to have brain structures homologous to the mammalian pain centers. These discussions are important, they are scientific, and they strive to increase our understanding of comparative evolution. However, they are uninformative for protection laws.

Whether or not these animals feel pain and whether this pain is ‘real’, does not alter the fact that both nociception and avoidance behavior exist in these animals – and that should be enough to afford them some animal protection. So, why not just assume that decapod crustaceans and cephalopods deserve at least the amount of protection fish do? What culinary practices might be in conflict with welfare laws protecting decapod

crustaceans and cephalopods? And how could these problems be overcome?

11.4 Crustaceans

Apart from the production (farmed) or catching (wild caught) of some species of crustaceans (mainly shrimp), the main concerns would lie in the areas of transport, storage, and humane killing. Many large decapod crustaceans, like the lobster and its relatives, are solitary animals and are often very aggressive towards each other.

During transport, even over long distances, many species show a remarkable resilience even under ‘less than perfect’ conditions. They are shipped cooled, out of water, only in a moist environment. However, an increased level of stress hormones could be detected in these animals even after less than 4 h of transport (Ridgway *et al.*, 2006). A recent study by Powell *et al.* (2017) showed that simple measures, such as reducing the level of vibration during transport could help to reduce stress levels. This would require transport vehicles to be fitted with one of the many options available for vibration reduction in cars. Although the animals survive with only moisture, a better solution would be to ship them in water. However, this would require individual compartments instead of shared transport boxes, thus making transport more difficult (Powell *et al.*, 2017).

Another common practice during both transport and holding is to tape the big claws, so that the animals cannot injure each other – or the human handlers. Similarly, the antennae are often cut to prevent the animals from using them to fight. Many people have encountered antenna-less lobsters, with taped-up claws, crowded into a barren aquarium at the entrance to a more-or-less fancy restaurant, waiting for their end. Several countries have already identified this problem and have created national laws banning this practice (e.g. the animal protection law in Austria). Instead, shops or restaurants that wish to hold lobsters must provide individual shelters for the animals and prohibit cutting of antennae and taping of claws. This, of course, makes keeping a tank full of ‘happy lobsters’, as well as other marine life, in a fine-dining restaurant much more difficult, and indeed, as a result, the number of businesses that keep live animals has decreased. In terms of animal welfare it is a useful change, as it reduces the stress level for the solitary lobster.

Once the lobster has arrived in the restaurant, the next step is to prepare it for consumption. The method of killing a lobster is only regulated for a small number of countries through national laws or guidance. For example, the Australian Government, through its National Aquaculture Council, has published guidance on how to kill a crustacean prior to the trip to the cooking pot, BBQ, or the sashimi plate (Australian Government, National Aquaculture Council, 2017; RSPCA Australia, 2017). According to this, any form of preparation as food that involves cooking or disembodiment without prior killing is considered inhumane and is prohibited. Some effort has been made to develop methods of euthanizing a crustacean similar to those often used for other aquatic animals. The ‘Crustastun’ is a machine that was developed to quickly stun (and, in some cases, kill) lobsters and crabs by applying an electrical current. In 2008 Yue detailed the different killing methods currently available, but, without legal requirements or increased societal pressure, the usage of humane killing devices like this remains voluntary, and in fact, rarely used.

11.5 Cephalopods

In Western countries, the soft cephalopods are far better off than their hard-shelled cousins in terms of their ‘public welfare preception’. Many people consider them as something like the monkeys of the

sea, smart creatures that might very well have a consciousness similar to birds and mammals (see the Cambridge Declaration on Consciousness; Francis Crick Memorial Conference, 2012). Several European countries protect them in their laws, and whenever graphic videos of live or half-alive cephalopods being eaten in restaurants surface on the Internet, people get angry and complain about the cruelty of eating a poor, live octopus (*Daily Mail*, 2016). I have 20 years of scientific experience working with cephalopods, and, to me, it is very clear that the video shows an animal under severe pain or stress. I think it is legitimate to ask how far our lust for seeking the next extreme thrill and for creating a YouTube video with the most hits, should be at the expense of a living being. A dish, such as the one depicted in Internet videos, could be achieved with a significantly reduced level of stress and suffering to the animal, if the cook would first kill the animal, by destruction of the brain capsule. Although the animal would now be dead, the autonomous movement of the arms and body which occur when the brain is removed would result in a dish that looks the same to the customer (if that is what they seek!).

In some dishes, such as the Japanese dancing squid (Fig. 11.2), the chef is meant to remove the brain before serving the animal. If this does happen, then suffering would be greatly reduced. However, watching some of the videos on the Internet raises the question – how competent are some of these chefs in this task? This is an issue in which legislation, affording cephalopods protection by law, would raise the motivation of restaurants to serve only animals with a correctly removed brain.

In general, it is often hard to assess the time of death in an animal such as a lobster or an octopus. Even after death, electrical activity continues in the highly autonomous peripheral nervous system, resulting in continued movement of the body and limbs (see Wells, 1978, for a review of this).

With regard to protection, cephalopods, which are perceived as intelligent sentient beings, are a little better off than other invertebrates, and crustaceans have a much harder time. For example, cephalopods were included in the animal protection laws in Europe (Directive 2010/63/EU; European Commission, 2010), but decapod crustaceans were left out despite the fact that there are, for example, far more publications on nociception in crustaceans than in cephalopods. This might have its origins in the long-standing British



Fig. 11.2. ‘The dancing squid’ a local specialty at the city of Hakkodate in northern Japan. The animal should be de-cerebrated, but the arms reinitiate movements due to the ion gradient in the soy sauce poured over it. (Image credit: Michael Kuba.)

tradition (perhaps absorbed by the European Union) to extend animal protection to cephalopods, or are there other reasons?

11.6 ‘Conversation’?

While thinking about these problems, my dog, a 10-year-old bearded collie, slowly walks up to me. She sits down next to the table and looks at me expectantly. I look down, and as usual I start talking to her. She sits there, tilts her head slightly and looks back at me, right at my eyes. For me, like many millions of pet owners around the world, this is the start of a conversation – admittedly the conversation is mostly one-sided, but still. Of course, for the most part, I assume that my dog does not understand a fraction of what I am saying and probably just wonders ‘Why does my human not stop talking, and finally start feeding, playing or petting me?’.

As humans, we tend to associate eye contact with conversation; this makes it easier for animals with



Fig. 11.3. ‘Alvinbet’ an adult common octopus (*Octopus vulgaris*) in the laboratory. The animal is reaching out towards the caretaker. (Image credit: Michael Kuba.)



Fig. 11.4. ‘Mr Crabs’, a pet hermit crab collected locally at Okinawa Japan. (Image credit: Michael Kuba.)

eyes similar to ours to be addressed as near equals. In the world of invertebrates this means that an octopus, who will sit at the front glass of the aquarium and look back at us with big, familiarly shaped eyes, seems somehow closer to human ‘affinity’ (Fig. 11.3; see also ‘Mr Crabs’ in Fig. 11.4). So this might be an additional reason why lobsters have fewer advocates than cephalopods – their ‘cuteness’ factor is

just lower. Of course there are cultural differences regarding what, and how, we eat – but this should not stop one from lobbying on behalf of animals that are not protected at all but should be. My opinion – treat decapod crustaceans and cephalopods like fish – better safe than sorry – protect them!

References

- Australian Government, National Aquaculture Council (2017) Guidelines on Welfare of Fish and Crustaceans in Aquaculture and/or in Live Holding Systems for Human Consumption. Available at: <http://www.australiananimalwelfare.com.au/app/webroot/files/upload/files/AA%20welfare%20guidelines.pdf> (accessed 17 October 2017).
- Braithwaite, V.A. (2010) *Do Fish Feel Pain?* Oxford University Press, Oxford.
- Crook, R.J., Hanlon, R.T. and Walters, E.T. (2013) Squid have nociceptors that display long-term sensitization and spontaneous activity after bodily injury. *Journal of Neuroscience* 33(24), 10021–10026.
- Daily Mail (2016) The World's Cruellest Dining Experiences Revealed. *Daily Mail*, 22 November. Available at: http://www.dailymail.co.uk/travel/travel_news/article-3960266/Octopuses-dismembered-newborn-rodents-dipped-boiling-oil-frogs-skinned-ALIVE-world-s-cruellest-dining-experiences-revealed.html (accessed 13 October 2017).
- Damasio, A. and Damasio, H. (2016) Pain and other feelings in animals. *Animal Sentience* 2016.059.
- Dubin, A.E. and Patapoutian, A. (2010) Nociceptors: the sensors of the pain pathway. *Journal of Clinical Investigation* 120(11), 3760–3772.
- European Commission (2010) Directive 2010/63/EU of the European Parliament, on the protection of animals used for scientific purposes. *Official Journal of the European Union*. Available at: http://ec.europa.eu/environment/chemicals/lab_animals/legislation_en.htm (accessed 13 October 2017).
- Francis Crick Memorial Conference (2012) Cambridge Declaration on Consciousness. 'Consciousness in Human and non-Human Animals', Francis Crick Memorial Conference, 7 July 2012, Cambridge, UK. Available at: <http://fcmconference.org/img/CambridgeDeclarationOnConsciousness.pdf> (accessed 17 October 2017).
- Gutnick, T., Shomrat, T., Mather, J.A. and Kuba, M.J. (2016) The cephalopod brain: motion control, learning, and cognition. In: Salueddin, S. (ed.) *Physiology of Mollusca*, Vol. 2. Apple Academic Press, Waretown, New Jersey, pp. 139–177.
- Key, B. (2016) Why fish do not feel pain. *Animal Sentience* 2016.003.
- Powell, A., Cowing, D.M., Eriksson, S.P. and Johnson, M.L. (2017) Stress response according to transport protocol in Norway lobster, *Nephrops norvegicus*. *Crustacean Research* 46, 17–24.
- Ridgway, I.D., Taylor, A.C., Atkinson, R.J.A., Stentiford, G.D., Chang, E.S. et al. (2006) *Nephrops norvegicus*: physiological, immunological and pathological effects of aerial exposure. *Journal of Experimental Marine Ecology* 328, 251–264.
- Rose, J.D., Arlinghaus, R., Cooke, S.J., Diggles, B.K., Sawynok, W. et al. (2014) Can fish really feel pain? *Fish and Fisheries* 15, 97–133.
- RSPCA Australia (2017) What is the Most Humane Way to Kill Crustaceans for Human Consumption? Royal Society for the Prevention of Cruelty to Animals (RSPCA) Australia. Available at: http://kb.rspca.org.au/What-is-the-most-humane-way-to-kill-crustaceans-for-human-consumption_625.html (accessed 16 October 2017).
- Sneddon, L.U., Elwood, R.W., Adamo, S.A. and Leach, M.C. (2014) Defining and assessing animal pain. *Animal Behaviour* 97, 201–212.
- Wallace, D.F. (2004) Consider the lobster. *Gourmet Magazine*. Available at: www.columbia.edu/~col8/lobsterarticle.pdf (accessed 13 October 2017).
- Wells, M.J. (1978) *Octopus: Physiology and Behaviour of an Advanced Invertebrate*. Chapman & Hall, London.
- Wiese, K. (2002) *The Crustacean Nervous System*. Springer, Berlin. DOI: 10.1007/978-3-662-04843-6
- Yue, S. (2008) The Welfare of Crustaceans at Slaughter. Humane Society of the United States. Available at: <http://www.humanesociety.org/search/search-results.html?q=crustastun> (accessed 13 October 2017).

12 Animal Welfare at Slaughter – a Level Global Playing Field?

PAUL WHITTINGTON

12.1 Introduction

In scratching the surface of this subject, I do not seek to persuade any reader from the perspective of tables, graphs or any conventional scientific method of publication. After 45 years, of which 37 were dedicated to pure and applied research into farm animal welfare during production and processing, I can tell you, science alone will only take you so far. The 25 years to date of international travel, delivering training and consultancy worldwide, necessarily gives one food for thought, revealing irony, paradoxes as well as moral, ethical and cultural road blocks to actually delivering what, to any reasonable person would be considered positive welfare outcomes. Understanding this subject cannot be done only from a laboratory, an air-conditioned office or an international conference, useful though that is, but in the actual places where all this welfare stuff happens; sharing time, space, and life and death with the species we call on to provide humans with food. Animal welfare (within meat production) could be termed ... 'mitigating the human exploitation of animals'.

It's 16:24 local time, I'm climbing to 11,000 m (37,000 ft) as I traverse lake Kariba overflying Zimbabwe then into Johannesburg, then I'm off to the Middle East, Asia, Oceania and back to Africa. This international travel and work schedule has been a constant companion for the last 25 years, over which time I have been subjected to many challenges to my preconceptions regarding farm animal welfare. Why? In a word ... humans!

The humans that populate all areas of the farming and slaughter industry, research, government and non-governmental organizations (NGOs), but more specifically, the humans and their foibles which are more directly associated with farming and meat production – it is these people who determine almost entirely the welfare of the animals that they interact with. Many years ago, I created a PowerPoint slide

stating '*Animal welfare has absolutely nothing to do with animals*'. While I concede that broadly this isn't entirely true, in the area of meat production and especially at slaughter, I would argue that it substantially is. The welfare outcomes of any modern production system remain almost entirely due to the empathy, knowledge, understanding, skills and resources that humans bring to bear.

If you are lucky enough to travel extensively, the revealed dynamics of meat production, which only slowly become apparent, and which result from geographical, economic, political, commercial, cultural and religious differences around the world, can boggle the mind. Some examples are: (i) a village chief in Africa has to attest in writing to the lawful ownership of cattle, and this enables slaughterhouses to accept only owned (not stolen) cattle; and (ii) an exquisitely woven basket used to contain pigs during transport. When the pig in the basket arrives at the slaughterhouse, the basket then facilitates the individual drowning of pigs in the small hours of the morning (Fig. 12.1), and then the same basket is used to transport fruit to the local market during the day.

12.2 Drowning Pigs

Drowning of pigs, I hear you roar! Yes, but hang on. As a scuba diver, regrettably I have had occasion to understand and personally experience the drowning process (not to its conclusion obviously!). Before I set out on my world welfare travels I was associated with research programmes working on animal handling, stunning, and slaughter technology at the Meat Research Institute and the University of Bristol School of Clinical Veterinary Science. I worked on investigations on the use of carbon dioxide (CO₂) gas as a method of anaesthesia and killing within the pig and poultry industry. The researchers (including myself) exposed



Fig. 12.1. A pig being drowned as a slaughter method. (Image credit: Paul Whittington, Animal Welfare Training Ltd (AWT), 2017.)

ourselves to increasing concentrations of CO_2 so that we could fully appreciate the taste, pungency and subsequent hyperventilation caused by exposure to CO_2 . From personal experience of both water immersion and exposure to CO_2 – I can honestly say I'd use water 'every time' if I had to choose my route to death! Although we all spent the first 9 months of our lives in amniotic fluid, once we start to breathe air our fear of liquid immersion is soon established, and most humans have probably had a negative experience with water and found it to be stressful, even traumatizing, to be immersed in water. Thus, absent of any equivalent knowledge or experience with CO_2 , the stage is set for the 'playing field' to be artificially tilted in favour of CO_2 as a method for permitted slaughter and killing of animals. When I was a researcher, we tried many other gasses and gas mixtures, which included pure argon, which to me at least, had no adverse effects at all other than causing me to nearly pass out after three breaths, leaving me afterwards with no unpleasant memory, and only the residual smell of the old rubber face mask. (Please note, these 'self-experiments' were carried out by the research team under close supervision – and should not be repeated – as they were 'self-experiments' in the area of slaughter methods, the outcome of which could be obvious.)

When showing a video of 'pig drowning' (Fig. 12.1) to an audience in Santiago, Chile, some years ago, to answer the objections raised, I asked:

How would you do it? – How would you, absent of any advanced technology (a gun, a captive bolt or

electrical stunning equipment), or sufficient strength to kill an 80 kg pig, and if nobody had told you that this method was likely to be very aversive for the animal; so that you can provide meat for your family to eat, and to sell at the local market?

The room fell silent, and then someone finally revealed that, in spite of their personal misgivings, and profound objections, they conceded that drowning was a rather elegant, low-cost, readily available and labour-saving solution to a 'technical problem'. So, if an audience of welfare-focused people can concede that drowning might, at first analysis, seem an 'elegant solution' to the technical difficulties of slaughter – then, what do we need to know to be sure that one method is 'OK' while another is 'NOT OK'. I have become fascinated with the validation of procedures and practice associated with welfare outcomes, as I think that the answers to 'OK' and 'NOT OK' are complex, often subtle, and should not be considered lightly – because millions (even billions) of animals are affected.

12.3 A Disparate Welfare World

Many significant disparities exist across food production worldwide as a consequence of regulations and standards being created in one region or country, then followed by application of these standards directly or through 'equivalence' in other regions or countries. This is common, standards created in one part of the world being implemented in other parts of the world – in an attempt to seek assurance of positive welfare outcomes from international

producers. It makes sense to enclose a chicken lorry in Scotland in the winter when it's raining; however, the same procedure in Thailand or northern Brazil would conform to this 'alien' standard, while killing hundreds of birds, due to heat stress.

Is it possible to compare welfare outcomes associated with a 'slaughter slab' in, say, northern Ghana, Bali, or Nicaragua (Fig. 12.2) to the latest European Union (EU) technology (Fig. 12.3)? In a large modern slaughter complex, four bespoke gas stun/kill systems work in series, supplied with animals by fully automated gates, without any significant human involvement, providing capacity for up to 11,000 pigs a day to be processed; and multiphasic gas systems for poultry can kill 400,000

birds over two 8-h shifts. Maybe the only significant difference between the individual slaughter on the 'slab' in Ghana, and the 'modern' plant, is the technology, and sheer numbers of animals. The actual question of 'which provides the best welfare?' remains unanswered. To the animals, the ingenuity and determination of humans to advance technology, enabling ever more animals to be terminated in a shorter time, almost certainly goes unnoticed, but there is one potentially positive welfare outcome of increasing automation ... the gradual omission of the most significant stressor in the whole process ... humans. What do I mean? Witness 12 farmers (Fig. 12.4) (see a similar situation for pigs in Fig. 12.5) gathered at the rear of a rural

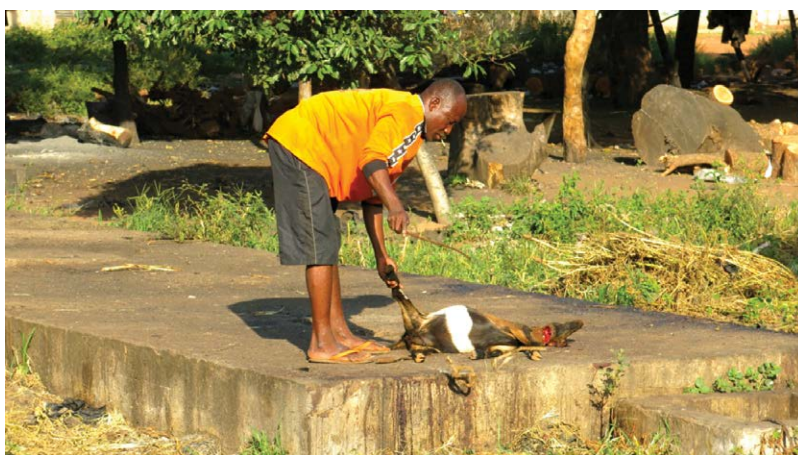


Fig. 12.2. Slaughter 'slab' in sub Saharan Africa for stunning and killing. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.3. Carbon dioxide 'simple stunning' of pigs (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.4. Animal handling – less is more! (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.5. The use of overwhelming force. (Image credit: Paul Whittington, AWT, 2017.)

abattoir in Indonesia, all of whom are contributing either physically or verbally to the absurd and arguably unnecessary pushing, dragging, beating, crushing, and leveraging of an exhausted animal up a rusty raceway to meet its fate at the hands of a

butcher wielding a similarly encrusted captive bolt pistol ([Fig. 12.6](#)).

In some regions of the world, hundreds, even thousands of animals meet their fate absent of any significant physical human coercion – due to the



Fig. 12.6. Corroded captive bolt pistol, corrosion makes the machine less likely to be effective. (Image credit: Paul Whittington, AWT, 2017.)

design of circular crowd pens, inclined serpentine raceways, and automated stop gates which utilize the ‘natural behavioural tendencies’ of the animals to move in the desired direction. These ‘well-designed’ systems can ‘supply’ animals to a modern electrical beef stunner, dispatching them ‘humanely’ every 28 s.

In the poultry industry, sometimes the opposite effects can be true, with automation having the potential to ‘reduce care’. The most advanced mechanical catching systems cannot approach the ‘care and quality’ shown by a team of 40 or 50 Thai or Brazilian operatives, who lift birds individually off the litter floor and place them one by one into the draws of a modular transport system (Fig. 12.7).

12.4 Criteria for a Level Welfare Playing Field?

How might we agree criteria that would enable us to even map out the ‘playing field’ of slaughter welfare, let alone reveal whether it is level across countries or systems? Not unlike the search for a grand unifying theory of matter, for the last decade at least the academic world has been rich in scientists and NGOs working to try to characterize and quantify ‘what is welfare?’, seeking the holy grail of criteria that will enable us to determine, under a variety of situations, whether an animal’s welfare is good or bad. To date, even the best scientifically based objective measures have sufficient ‘wiggle room’ such that they can usually be interpreted to satisfy personal, commercial, or cultural requirements.



Fig. 12.7. Chicken ‘whole bird’ catching. (Image credit: Paul Whittington, AWT, 2017.)

Private organizations, retailers, and NGOs constantly try to ‘out standard’ each other. Again, the human tendency is to move to a point of difference rather than to accept the ‘status quo’, fearing it would stultify or disadvantage individual retailers to ‘stay still’ in the marketplace. That said, the difference in welfare outcomes today compared with, say, 20 years ago is much to do with the (positive) effects of retailer standards and the influence they can exert on local/international suppliers through economic muscle than the effects of well-crafted regulations or codes.

Historically, both myself and colleagues have, and still do, work within this economic reality, by supplying professional training and consultancy to international organizations and companies who work to address the issue of ‘animal welfare’ essentially, although not exclusively, through retailer and corporate social responsibility and financial pressures. My own experience reveals that international financial institutions, wholly or partially supporting production companies in developing countries, are increasingly requesting companies to address animal welfare concerns under the heading of ‘risk assessment’. The risk being exposé of practices that significantly deviate from international norms of animal welfare, and which could result in unwanted collateral damage of image, integrity, and reputation, and to claims of good business practice.

It may be an unavoidable truth that human interests will always seek to generate a point of difference, thus the level playing field may be far from desirable in a commercial setting, or even impossible to achieve. In the meantime, the obvious answer to satisfying animal welfare outcomes would be to ‘leave the animals alone’! This would work well for the arguments for vegetarianism or veganism. However, even ‘leaving them alone’ would likely

result in natural events taking place which would reveal that nature is a 'mother' who is insatiably unforgiving. It is unlikely that arresting the global consumption of meat would be associated with either the reduction or abolition of trauma, pain, and suffering per se, but at least humans would be off the hook ... so to speak. Within the meat production industry, any 'level playing field' based on agreed standards may only exist as a local phenomenon, a regional and often bespoke expression of attempts to exercise the 'duty of care' which we owe to those animals destined to die in a pre-scheduled manner so that humans can consume their flesh.

Hollywood has placed many large spaceships in earth's orbit where aliens have harvested, and even farmed, humans as a food source. Would a more dominant (alien) species discuss among itself the disparities of, not humane, but 'alienane' farming and 'alienane' slaughter ('alienane' – the 'alien nation' concept similar to human 'humane') in various regions of their newly conquered biosphere? Perhaps aliens would relocate and specifically choose to 'farm' some ethnic human groups and/or sexes for reasons purely of cost efficiency. Why not? We do.

In order that the flesh is fit for purpose some sects within the alien mothership may require humans to be slaughtered head down, some require them to lie flat on their back facing the nearest volcano ... and some slaughtered only when the twin suns of their home planet are aligned on the eve of the Feast of Beetlejuice ... Why not? We do.

I wonder how we, as a sentient and self-aware species, would appreciate the myths and beliefs of another race if they were to be choreographing our demise. Staying with that imaginary scenario – would a farmed human conclude, while standing in the lairage, awaiting his/her fate, that there are 'better places on earth' to be bred, fattened, and slaughtered, and if possible would wish to relocate, taking advantage of the perceived or obvious and real differences between production and slaughter welfare in different alien regions? This is the central dilemma of the 'non-level playing field' problem – how you are treated and how you may die are very much influenced by 'where you are' – an accident of birth.

If you think humans aren't a food source then take a stroll across Kruger National Park or an early evening dip in the sea off Dyer Island (where the great white sharks live). The difference is, of course, that the lion or great white shark will hunt, kill, and possibly devour, apparently absent of any conscience, adopting what we would consider

'natural predator' actions. The aliens in orbit in our scenario above may be constrained by the same paradoxes we adopt, namely: morality, ethics, and beliefs – which confect to make an immiscible backdrop on which slaughter and consumption of meat takes place; but then again, they might not, and might operate to a completely 'alien' set of rules. Despite all the attendant debates, the arguments often culminate, in the oft heard justification ... 'Well, we gotta eat'!

An example – in a village festival, pigs in Vietnam are cut in half while being restrained, in order that boys can become men after drinking the freshly loosed blood. As a pig, that's one playing field I wouldn't want to set a trotter on, after all, there's always drowning in a fruit basket or immersion in CO₂ as another choice (if you had any choice)!

12.5 What Are 'Acceptable' Levels of Pain, Suffering, and Injury'?

When I'm in an argumentative mood I challenge welfare organizations to reveal 'how much pain, suffering, and injury' an interested party would 'accept', such that humans can continue to eat meat? Tell 'us' now at what point you'll be happy? No welfare enthusiast will ever succumb to this request even if the answer was available – the campaign would then be over. In any event, if it was ever possible to agree the threshold values for pain, suffering, distress, and injury – the welfare work would undoubtedly continue around other issues, different technologies, their design, operation and the ways these methods would exert levels of pain, suffering, and injury ... no one's going to leave this subject alone ... ever! The reason, of course, is that as a species, we too have fashioned morals, ethics, and sensibilities as a by-product of intelligence and self-awareness. So what? Well, there remain many regions on earth where individual moral and ethical values imported from another region, simply don't fly! And this is part of the fascination and motivation to work in this difficult and challenging area – there is *not* a level playing field, and the reasons for the lack of 'level' are interesting, frustrating, and sometimes seemingly unsurmountable.

So, a level playing field? – on what basis, commercial interests or welfare/quality outcomes? New technologies and increasing mechanization have certainly impacted poultry production, where today in 2018, chicks can hatch directly onto the litter of the growing area, be mechanically harvested

Of course there are many other inputs to this equation. I am mindful of repeated visits over many decades to wet markets in Central/South America, Africa, and Asia which, having been supplied with similar or identical genetic strains of birds as used

The debate continues within the poultry industry about the use of CO₂/inert gas and low atmospheric stunning versus the long-established use of electrical water baths. The arguments for and against each of these methods often refer to 'bird behaviour' (as an assessment for the degree of aversiveness, as evidenced by the bird's physical reactions) during induction of unconsciousness using gas versus the requirement for live-bird shackling and 'pre-stun' shocks where electrical systems are used.

In all systems (gas/electrical/low pressure) these are, of course, welfare concerns, as the bird is initially alive and conscious. Ironically, many experienced operatives who have used high frequency (nominally >100 Hz sine wave) electrical stunning now attest to better welfare and quality outcomes when using a water bath compared with the newly installed gas systems as, if configured correctly, an electrical system can achieve 'humane stunning'. 'Humane stunning' would mean that the bird



Fig. 12.8. Poor hygiene but great ‘quality’ (Image credit: Paul Whittington, AWT, 2017.)

‘didn’t feel the application of the electrical current’. Whereas, when using CO₂ at ≤40% (as permitted in European Commission (EC) Council Regulation 1099/2009) there will always be a degree of aversiveness before the onset of unconsciousness and insensibility, and so the bird will be ‘very much aware’ of the application of the gas. Those commentators who speak against the use of CO₂ would say that its use is inhumane for all birds ... and they would be right. Recent multi-phase CO₂ systems for poultry seek to reduce aversiveness by a four-stage increase in CO₂ from the same concentration as that in atmospheric air, up to 40% concentration – followed by an increase to ‘a higher concentration’ to kill (EC Council Regulation 1099/2009).

Has this technology been developed with a specific focus on bird welfare (aimed at minimizing aversion to ‘acceptable’ levels)? Or has it been a result of efforts to improve meat quality and yield by reducing the wing damage (wings impacting metal/plastic and other birds) associated with anoxic convulsions after the bird loses consciousness?

Wing damage due to anoxic convulsions following anaesthesia in gas systems is often reported to be higher than in electrical stunning systems. Ironically, this is especially true when using ‘welfare friendly’ (non-aversive) gases such as argon and nitrogen as they rely on anoxia alone to induce unconsciousness, and insensibility, then death. If a comparison between ‘pre-stun shocks’ versus ‘pre-stun aversiveness’ is made, electrical systems may look, overall, better. The big welfare advantage of a gas system is the absence of live-bird shackling. So, to answer the question ‘Has gas stunning technology been developed with a specific focus on bird welfare?’ – the

answer is probably ‘no’ – but there are welfare advantages (no live shackling) that may compensate for the very real aversiveness of exposure to gas – and it is this ‘compensation’ in such a concise and unpalatable area that is at the core of the difficulty in making a clear distinction of ‘better or worse’.

The same debate is true for pigs, where group handling preceding presentation into the gas represents a relatively benign form of coercion relying on more natural behaviours to move forwards (Figs 12.9 and 12.10). Protagonists against the use of CO₂ cite automated electrical stunning as a better alternative (to gas), while playing down the significant stress and injury associated with isolation and coercion of individual pigs in raceways and restrainers, not to mention misapplication of stunning electrodes by human operators, and/or insufficient stunning current. The electrical stunner – while arguably humane when correctly applied – suffers from often unacceptable levels of stress and injury during coercion and restraint, while the (more) benign group-handling systems associated with CO₂ use loses out because of the inevitable suffering of all pigs as a consequence of CO₂ aversion, and hyperventilation before loss of consciousness. The application of CO₂ makes the pig drowning in the fruit basket in Indonesia (Figs 12.1 and 12.11) look at least equal or even better than the Western equivalent ... but then, on the farm you have to get the pig into the basket head first in order to put it and six other siblings into their baskets, and then onto the truck to go to the slaughterhouse!

I can’t avoid observations regarding the slaughter of animals where stunning is either not used

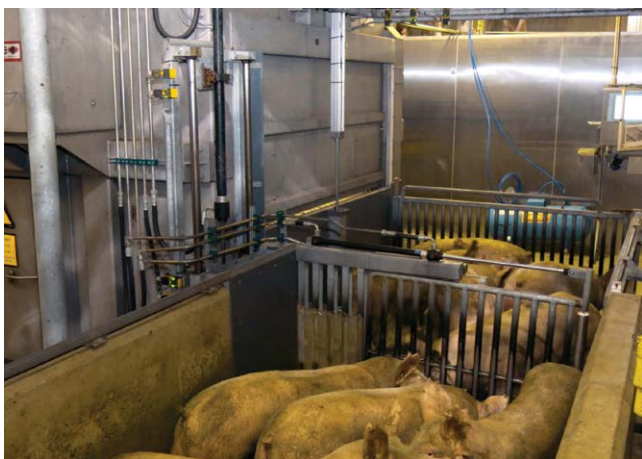


Fig. 12.9. Automated group handling of pigs. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.10. Restraint and coercion of pigs prior to electrical ‘simple stunning’. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.11. Fruit by day, pigs by night. (Image credit: Paul Whittington, AWT, 2017.)

(Figs 12.12 and 12.13), or not recommended, as in my experience, it presents many bumps in the proverbial playing field. Note, at this point I did not say religious slaughter. That is because there are many countries/regions where even today pre-slaughter

stunning is not used simply because it is not available, or even not wanted.

In some regions, the (high) technology required to allow stunning has been generously donated by well-meaning organizations. However, the unfortunate



Fig. 12.12. Cattle slaughter without stunning. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.14. Manual cattle restraint prior to slaughter, necessitated by the need to hold the animal still and expose the neck for an un-stunned neck cut. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.13. Chicken slaughter without stunning. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.15. Cattle restraint for an un-stunned animal. Rotary pen which tips the conscious cow onto its back before slaughter without stunning. (Image credit: Paul Whittington, AWT, 2017.)

long-term outcome can sometimes be that, with time (and a lack of maintenance and ongoing technical support), the use of 'high tech' methods in areas where tech is not routine can actually result in massively increasing abuse of animals at slaughter by mishandling (Fig. 12.14)/misuse/misapplication/misunderstanding and mis-maintenance of these technologies.

At the same time, religious rites, where they are associated with technologies or procedural requirements, can result in welfare outcomes that even the most observant may question (Fig. 12.15). I say this with the understanding, as much as one can, that slaughter without pre-stunning when carried out effectively (not from a religious perspective but from a neurological/physiological point of view)

may afford the animal protection from the pain of an incision before the onset of 'unconsciousness'.

Regrettably I have witnessed too many slaughter events worldwide, which no reasonable observer would claim are 'humane'. Even so, when objectively assessing slaughter without stunning, the observer may also conclude that the handling of the animals, the level of coercion required to force the animal into submission (casting, forcing to the

floor) and the method and/or severity of restraint required in order to enable an effective/compliant cut are often part of the overall ‘worsening’ of the overall procedure, which also includes attempts to apply a fatal incision in a conscious state.

Historically electrical water bath systems for poultry (Fig. 12.16) were not developed first for pre-slaughter stunning per se, but rather to place the poultry in a state of ‘electrically induced immobility’ such that the localizing of the neck, and bleeding of the birds, was carried out in an immobile and therefore more controllable state. Some people would argue, not unreasonably, that adding a genuine ‘electric shock’ to inversion and painful compression of the legs following shackling is not a sequence of events compatible with concern for welfare. With poultry, stun to stun (stun alone without killing the bird) as opposed to stun to kill is a notoriously difficult configuration to achieve. A concerning tendency is for operators to lower the applied voltage thus reducing the current below that which would be required to create an effective stun as a consequence of concerns for meat quality and downgrading.

12.6 The Incompatibility of Cultural Requirements with Slaughter ‘Standards’

There are many incompatibilities between cultural requirements, and the standards imposed by international companies as a prerequisite for compliance with their in-house, or adopted welfare policy, particularly when sourcing meat internationally. For example, rotary pens that invert cattle before slaughter which would satisfy local sensibilities (Fig. 12.15) are deemed non-compliant by some major international companies. This can result in



Fig. 12.16. Electrical water baths are still used to produce ‘tonic immobility’ rather than a stunned state. (Image credit: Paul Whittington, AWT, 2017.)

operatives cutting the necks of cattle in the upright position – while the cows stand in an expensive mechanism expressly designed to facilitate the opposite (cutting the neck while the animal is lying upside down). This results in poor or even ‘unacceptable’ welfare outcomes. Standards will almost universally have the requirement for ‘backup’ systems ... how do you back up a cut, another cut? No, what is meant as a backup in this kind of situation is a form of electrical or mechanical system capable of applying a ‘humane’ stun. This of course raises problems in ‘non-stun’ systems, and the ‘local’ problem is that the use of the backup procedure may render the carcass useless for local consumption (on cultural grounds, stunning not being permitted) and so may in fact be only rarely used.

Generally speaking, as you move away from ‘commercial’ operators in large purpose-built plants, and out into open country, the more bizarre permutations of slaughter procedure and practice are revealed. One cattle plant in sub-Saharan Africa, during the weekdays, had a slaughterman in possession of ‘his’ (own) large knife capable of a full ventral neck cut resulting in a bleed rate producing brain death in approximately 4 min (Fig. 12.17).

Quite poignant was the fact that this killing took place just inside the doorway and on the floor of an abattoir, following the stressful and physically exhausting (for the operators and the animal) casting of the cow, directly in front of a modern restraining pen with a captive bolt pistol and full EC approvable overhead dressing line. In this community, the task of slaughter had been allocated to certain religious minorities, and this resulted in the modern infrastructure being ignored in favour of traditional methodology. Witnessing the same



Fig. 12.17. Cattle slaughter in an un-stunned animal – using the ‘large knife’ (which is only available on weekdays in this slaughterhouse). (Image credit: Paul Whittington, AWT, 2017.)

process on a weekend, the ‘weekday’ slaughterman was at home with ‘his’ (big) knife, and this left the remaining butchers to carry on casting the animals to the floor of a bare concrete room, binding the animals’ legs, and then performing the cut using a worn down and blunt boning blade, resulting in brain death after in excess of 8 min (Fig. 12.18). I have seen this kind of scenario – exacerbated by practical ‘problems’ which significantly impact on the individual animal’s quality of death – too many times and in too many countries.

Foreign aid or investment capital can pour into a country or company – persuaded that the building of new facilities will benefit all concerned ... even the animals. Having constructed new facilities at great cost, and usually with a lot of publicity, all too often the knowledge and skill required to operate such facilities is absent.

Moreover, the supply of local animals to justify the investment in such large-capacity plants rarely materializes. Even if increased numbers of animals did start to arrive at the ‘new slaughterhouse’ – this in itself can result in poor welfare outcomes for animals, where transhumance is difficult/impossible, and the animals now need to be transported on

poor roads or rough tracks over long distances in inappropriate vehicles to a centralized facility. New words have to be created – injury during transport and DOA (death on arrival, death in transport). Farmers or cooperatives that seek to use the facility can only provide sufficient stock to enable the plant to open for 1 or 2 days a week. The operatives are therefore transient, only periodically carrying out the tasks of slaughter and dressing the carcass, and sometimes they remain substantially unfamiliar with the systems in place, as well as the procedures required to operate them efficiently. Maintenance of equipment, buildings or infrastructure (offloading ramps, raceways, restraining pens, etc.) falls away (Fig. 12.19), and much of what was initially shiny, new and excitingly filled with potential quickly deteriorates into a dirty, unserviceable condition.

Over a period of time – it is common for the facilities to be mothballed (Fig. 12.20), after the manpower involved in the planning, construction, and commissioning have trousered their fee. This characterizes some inter-organizational scenarios worldwide where municipal resources are constructed, initially with public health and safety in mind (food hygiene), and animal welfare as a possible add-on.



Fig. 12.18. Cattle slaughter – with the ‘small knife’ (available at weekends). (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.19. Infrastructure left to decay. (Image credit: Paul Whittington, AWT, 2017.)

It would be wrong to decry such projects out of hand. However, there may well be a private abattoir down the road which exists, not because of a governmental initiative, but as a 'business', with appropriate, and well-maintained facilities, permanent experienced staff with evolving food hygiene and welfare standards. Sometimes 'freestanding' government

initiatives prove to have a shorter and less effective lifespan than ongoing 'businesses'. Why? – because a business is likely to be an evolved commercial operation which has had to become sustainable through 'business practices' and economic natural selection, through a regular supply of animals and, critically, a market for the product (Fig. 12.21). Animal welfare



Fig. 12.20. Mothballed abattoir. (Image credit: Paul Whittington, AWT, 2017.)

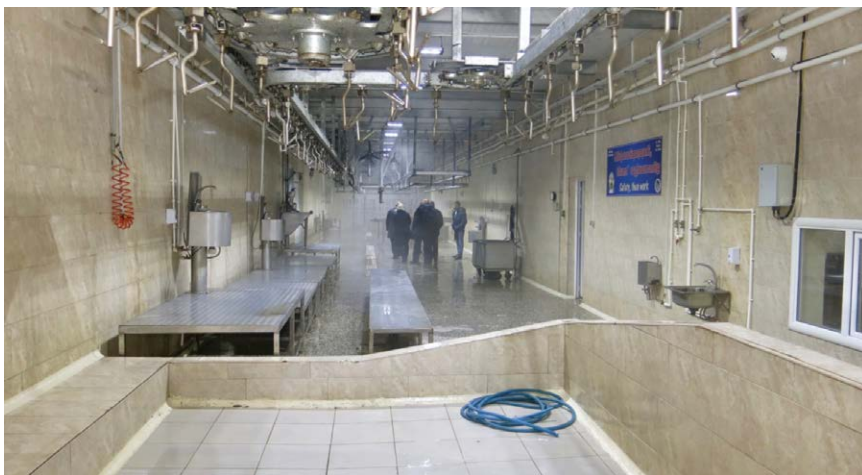


Fig. 12.21. Successful private abattoir. (Image credit: Paul Whittington, AWT, 2017.)

in these facilities is understood to be a prerequisite for assurance of quality in its widest sense, and can be provided for by experienced and well-trained staff who are seen, it is hoped, as assets to the company.

12.7 Conclusions – the Unevenness of the Playing Field

The unevenness of the slaughter playing field in respect of animal welfare, at least within commercial farming and meat production is enough to loosen the teeth of any interested party should they seek to travel across it at any speed. After a career where I have been fortunate enough to engage in both pure and applied research, as well as direct observation of commercial and rural production in many parts of the world – in farms, hatcheries, feedlots, and slaughterhouses – my view is that the welfare status of animals destined for food is dominated by the empathy, knowledge, experience, and skill of the humans charged with their care. Internationally all of these desirable characteristics (empathy, knowledge, experience, skill) are of course often unbalanced, absent, and elusive ... but occasionally, and sometimes unexpectedly, present in abundance.

Central to the debate on welfare at slaughter is an empathy towards, and understanding of, animal needs and behaviour, as well as the systems and procedures used by mankind to manage birth, growth, and death. This cocktail of understanding is not to be found exclusively within modern commercial operations, either on farm or in slaughter and processing. Positive welfare outcomes can

be a result of company policy, management ethos or appropriate use of technology, but can also be down to individuals whose personal ethic, or work practices make the difference between ‘NOT GOOD’ and ‘GOOD’ (Figs 12.22 and 12.23). Many farm animals are closely bound to the fate of human existence in small towns and rural villages, and are yet to be touched by commercial production methods, and live out their lives in environments closer to what might be considered ‘natural’, arguably free to express more ‘normal’ ... well, everything.

It is ironic to think that, as humans, we have to label what seems to be an advance in animal welfare as ‘free range’ or ‘organic’ and yet what we are really talking about is a modern reproduction of more local (Fig. 12.24), perhaps more sustainable farming which existed (and still exists in many places) before the surge in intensive production. It seems increasingly likely that ‘free-range’ farming, with all the potential benefits (and disadvantages) is slowly losing out to systems which attracted derision even 10 years ago, namely ‘high welfare intensive systems’. Should meat consumption mirror the inevitable growth in human population over the next few decades, it seems unlikely, if regrettable that that ‘high welfare extensive systems’ rather than ‘high welfare intensive systems’ will satisfy demand. Animal species and breeds have historically been associated with certain regions of our planet where geography, climate, crops, disease, economics, transport, and cultural/religious requirements favour their production. This is even more true today when considering red and white meat production, which is now truly a global trade. This raises the issue of animal transport which is a



Fig. 12.22. Good stockmanship, empathy and high levels of animal care can take place in rural areas. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.23. Good levels of stockmanship, empathy and animal care can ‘also’ take place on commercial farms. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.24. Cattle slaughter in the front part of the house, after dinner. Local farming, local slaughter. (Image credit: Paul Whittington, AWT, 2017.)

rabbit hole that goes as deep as you want it to in regard of welfare outcomes, without any real resolution in sight. Regrettably the thorny subject of global animal transport for meat is not simply about commercial opportunism, it is often also linked to the bringing of protein to humans living in certain areas of the world incapable of generating the livestock necessary to feed their rapidly expanding human population.

Meeting with a senior government official in a sub-Saharan country I was asked if the importation of 250,000 commercial broiler chicks as a government initiative would, ‘in my view’, contribute to a ‘kick start’ of their beleaguered poultry industry, if these birds were to be distributed among 12 farmers. I did not attempt to answer the question, but I did reflect on this praiseworthy initiative – which in reality, as an example of

‘scale’, would constitute only two-thirds (0.6) of a single day’s slaughter at a single UK processing plant. Needless to say, the country remains a large importer of Brazilian chicken meat. The ‘playing field’ for some animals, in some developed countries, and in some production systems, may indeed be ‘levelish’, and the welfare of animals at slaughter in these countries ‘may’ be higher than that of others. However, the determination of what would constitute real and meaningful measures of animal welfare outcomes at slaughter is not universally agreed. In spite of all the academic research, scholarly debate, and passionate argument, it may still be impossible to determine whether a Balinese cow – which drags a plough across a paddy field during the day, and is cared for like a member of the family at night (Fig. 12.22), and finally killed within the home – is better off than a sheep in a feedlot (Fig. 12.25), or a piglet in a modern production farm, or a broiler chicken bedded down on rice

hull or wood shavings. These animals will grow in single age groups, will often have no choice of diet or bedding, and will have to be caught, transported, and slaughtered, often using high-speed mechanized systems (Fig. 12.26).

To me, at least, it is evident that in the arena where animals service human requirements for food, the field will never be ‘level’. It has been, and always will be, subject to the vagaries of the physical world, human commerce, technology, traditions, myths, and beliefs. I suspect that, like us, the aliens gazing down from orbit while tucking into a slice of another life form, will substantially ignore, through their own form of myopia or clever intellectual reasoning, a number of difficult questions. They will conclude the same inevitable truth: namely, if you want to eat the flesh of another species, you necessarily remove from that animal not the five or even the 12 freedoms but the most important freedom of all ... choice!



Fig. 12.25. Dust to dust – sheep carcass in a feedlot. (Image credit: Paul Whittington, AWT, 2017.)



Fig. 12.26. If only they could speak! (Image credit: Paul Whittington, AWT, 2017.)

Bibliography

- Accles and Shelvoke (2016) Available at: <http://www.acclesandshelvoke.co.uk> (accessed 16 March 2016).
- Anton, F., Euchner, I. and Handwerker, H.O. (1992) Psychophysical examination of pain induced by defined CO₂ pulses applied to the nasal mucosa. *Pain* 49, 53–60.
- Berg, C. and Raj, A.B.M. (2015) A review of different stunning methods for poultry – animal welfare aspects. *Animals* 5, 1207–1219. DOI: 10.3390/ani5040407
- European Commission (EC) (2009) Council Regulation (EC) No. 1099/2009 of 24 September 2009 on the protection of animals at the time of killing. *Official Journal of the European Union*. Available at: <http://eur-lex.europa.eu/eli/reg/2009/1099/oj> (accessed 20 March 2018).
- European Food Safety Authority (EFSA) (2004) Welfare aspects of the main systems of stunning and killing the main commercial species of animals. *EFSA Journal* 45, 1–29.
- European Food Safety Authority (EFSA) (2013) Guidance on the assessment criteria for studies evaluating the effectiveness of stunning interventions regarding animal protection at the time of killing. *EFSA Journal* 11(12), 3486.
- European Food Safety Authority (EFSA) (2014a) Scientific opinion on electrical requirements for poultry waterbath stunning equipment. *EFSA Journal* 12(7), 3745.
- European Food Safety Authority (EFSA) (2014b) Scientific opinion on the use of low atmosphere pressure system (LAPS) for stunning poultry. *EFSA Journal* 12(1), 3488.
- Gerritzen, M.A., Reimert, H.G.M., Hindle, V.A., Verhoeven, M.T.W. and Veerkamp, W.B. (2013) Multistage carbon dioxide gas stunning of broilers. *Poultry Science* 92, 41–50.
- Gregory, N.G. and Wotton, S.B. (1990) Effect of stunning on spontaneous physical activity and evoked activity in the brain. *British Poultry Science* 31, 215–220.
- Hindle, V.A., Lambooi, E., Reimert, H.G.M., Workel, L.D. and Gerritzen, M.A. (2010) Animal welfare concerns during the use of the water bath for stunning broilers, hens, and ducks. *Poultry Science* 89, 401–412.
- McKeegan, D.E.F., McIntyre, J.A., Demmers, T.G.M., Lowe, J.C., Wathes, C.M. et al. (2007) Physiological and behavioural responses of broilers to controlled atmosphere stunning: implications for welfare. *Animal Welfare* 16, 409–426.
- McKeegan, D.E.F., Sandercock, D.A. and Gerritzen, M.A. (2013) Physiological responses to low atmospheric pressure stunning and the implications for welfare. *Poultry Science* 92, 858–868.
- Raj, A.B.M. and O'Callaghan, M. (2004) Effect of amount and frequency of head-only stunning currents on the electroencephalogram and somatosensory evoked potentials in broilers. *Animal Welfare* 13, 159–170.
- Raj, A.B.M., O'Callaghan, M. and Knowles, T.G. (2006) The effect of amount and frequency of alternating current used in water bath stunning and neck cutting methods on spontaneous electroencephalograms in broilers. *Animal Welfare* 15, 7–18.
- Small, A., McLean, D., Owen, J.S. and Ralph, J. (2013) Electromagnetic induction of insensibility in animals: a review. *Animal Welfare* 22, 287–290.

13 Precision Livestock Farming: the Future of Livestock Welfare Monitoring and Management?

TOMÁS NORTON AND DANIEL BERCKMANS

13.1 Introduction

Animal welfare refers to the physical and mental health of an animal. As a concept in livestock production, welfare is often difficult for farmers to understand, monitor and manage in the day-to-day care of animals. While significant physical health issues can be managed with the help of veterinarians, managing animal welfare issues is often unclear. Currently, there are no well-defined, practical, integrated welfare monitoring and management models or protocols, which are there primarily to help farmers improve the well-being of their animals in an active way (Main *et al.*, 2014).

Animal welfare has for a long time now been considered a high priority within the European Union (EU) (e.g. Council Directive 98/58/EC (Europa, 1998) and Animal Health Law: Regulation (EU) 2016/429 (Europa, 2016)). Over recent years, the EU has invested significantly in farm animal welfare research to identify ways of improving the lives of food-producing animals (Broom, 2017). However, to date animal welfare problems still regularly occur throughout the world, often being highlighted in the media (Rollin, 2011). The limitations in animal welfare science, associated technology and product developments greatly limit farmers when it comes to ensuring high welfare standards or communicating their current standards to consumers and society.

Animal welfare assessment is an important part of managing the standard of animal welfare. At the moment, welfare can be assessed by determining the level of resources available to the animal (FAWC, 1992) and through animal-based indicators of compromised health or behaviour. While being an important task, monitoring animal-based indicators is typically done after the animals have

been slaughtered, leaving no hope for the farmer to improve their (present) conditions, but offering the potential to influence the ‘next crop’ or cycle of animals. This is not the only way forward for modern livestock production, as society is putting more and more pressure on farmers to prove the active maintenance of good welfare standards. Moreover, consumers are beginning to factor welfare into their understanding of quality for animal-derived products (Harvey and Hubbard, 2013; Broom, 2017).

Given the many years of research efforts in the EU, science-based welfare assessment tools now exist. For example, the Welfare Quality® project contributed protocols to quantify animal welfare in a farm for cattle, pigs and poultry (Blokhuys *et al.*, 2010). The AWIN® project¹ produced indicators for species not considered in Welfare Quality®. However, many practical challenges in realizing these protocols still preclude their impact on the quality of farmed animals’ lives (Czycholl *et al.*, 2015). Some reasons include:

- The protocol is realized in farms by trained experts and thus is a subjective assessment of animal-based indicators.
- A wide range of welfare indicators needs to be monitored manually and audiovisually, which takes a significant amount of time.
- Experts moving between different livestock houses and farms is not an easy task from a hygienic and biosecurity viewpoint.
- The assessment protocols represent a point-in-time measurement that is carried out with limited frequency due to its expense.
- The manual assessment does not give real-time management advice during the production process for the animals at that specific moment.

Practically realizable welfare monitoring and management is the future of modern livestock production. However, it will require the use of the latest developments in information and communications technology (ICT) and sensor technology, as it is too much to expect farmers to do this manually. At the moment research and development has demonstrated how real-time automated welfare monitoring and management is practically realizable on the farm (Berckmans *et al.*, 2015). Automated welfare management is central to the field of precision livestock farming (PLF), a modern approach to farm livestock production using integrated sensors and ICT (Frost *et al.*, 2003). PLF is geared primarily to assessment of the animals, which means it is fundamentally different from all other engineering solutions and machines used in agriculture (Berckmans, 2014). As will be evidenced in this chapter, recent work has demonstrated that real-time welfare monitoring and management will become an important way to create value for the farmer and the animal alike by improving health, welfare and productivity.

The objective of this chapter is to demonstrate the current capacities and future prospects of PLF, by considering technology that has evolved from conceptual ideas in research laboratories into systems that are operational in commercial farms both now and into the future.

13.2 What is PLF?

Technology is developing at a rapid pace. Twenty years ago we could barely believe in carrying a personal computer to work where and when we liked, yet nowadays we have the same power and functionality in smartphones that fit in our back pockets (Kelly, 2017). This evolution in the ICT world has had a significant impact on the agricultural industry too. Those working in crop production have, for the last number of years, witnessed an explosion of new software systems, monitoring devices and machines that all exploit the latest capabilities in sensing, communication, processing, and power management (van Evert *et al.*, 2017). While perhaps not at the same pace, livestock production has begun to see more use of automated monitoring and management of different farming aspects (Halachmi and Guarino, 2016). For many years livestock farm management software has been available for the economic improvement of farming systems, as well as the automation of livestock

building-oriented processes. However, these tools are more focused on reducing labour input rather than the specific improvement of the health and productivity of the animals. The animals are the central part of the process and the technology must be exploited to support them at every moment.

PLF offers a different philosophy to the traditional view of livestock farming. PLF builds on the basis that fully automated continuous monitoring of animals will enable farmers to detect and control, in real time, the health and welfare status of their animals, and that this information can be used for management. Modern technology makes it possible to use cameras, microphones, and sensors sufficiently close to the animal so that they can replace the farmer's eyes and ears in monitoring individual animals, and this can take place 7 d a week, 24 h a day, 3600 s per hour. The development of PLF tools requires the connection of sensor data (derived from cameras, microphones, or other sensors) with the biological responses of animals through the implementation of real-time algorithms.

13.3 Fundamentals of PLF

The central focus of PLF technology is the animals. This means solutions must be developed in multidisciplinary teams comprising engineering and animal specialists using a common terminology. The first step in this direction was with the characterization of living organisms as complex, individually different, time-varying, and dynamic (CITD). The concept of the 'CITD system' first emerged at the European Conference on Precision Livestock Farming (EC-PLF) in 2003 (Berlin), and since that time this concept has enabled significant progress to be achieved in PLF tool development. The CITD nature of living organisms has an important impact on the type of algorithms we need to develop. It implies that algorithms to monitor time-varying individuals must continuously adapt to the individual and/or use principles that can be used in real time in the field application to adapt to the time variation of that individual (Fig. 13.1).

The CITD system framework recognizes that a living organism is much more complex than any mechanical, electronic or ICT system. The complexity of information transmission in a single cell of a living organism is, for example, much higher than in most man-made systems (e.g. today's most powerful microchip). In biological research and the management of biological process (e.g. medical

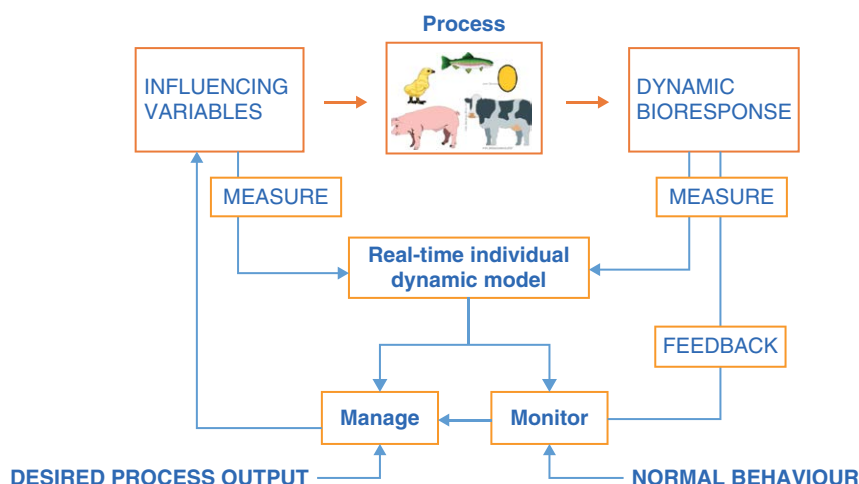


Fig. 13.1. The monitoring and predictive control scheme of precision livestock farming (PLF). (From Aerts *et al.*, 2017.)

world, livestock world) in industry and society, the general trend is still to compare groups of living organisms by looking for statistical differences in experiments. Statistical methods have been developed primarily to find significant differences between the averages of groups. However, there is not a single living organism that lives or acts as the purely theoretical average of a group since all living organisms are individually different in their responses. Moreover, the time-varying character of a living organism means that a living organism's response to a (environmental) stimulus or stressor might be different each time it happens. A living organism is constantly looking for a good energy balance and as a consequence is continuously changing its physical condition and mental status. Of course living organisms are dynamic systems.

13.4 Measuring a Biological Response with PLF

The basic methods used in PLF involve continuously measuring responses directly 'on the animal' rather than in the environment surrounding the animal. Since animal responses can be fast, it is useless to carry out a survey just once a year, once a month, or even once a week when aiming for improvements in management. It is the accumulation of impacts from these fast responses that determines the welfare of the animal.

A key criterion when measuring the bioresponse is to realize it in a cost-effective, robust way. This is

why sensors such as cameras and microphones are extremely powerful. There is no physical contact with the animal so there is no risk of influencing the animal in any way (hygiene, social, mental, etc.) while making the measurement and there is no need to recover sensors from living animals when battery life has expired, the sensor has failed, or for re-use. Secondly, the cost to the farmer can be kept low, as many animals can be monitored using a small number of sensors. On the other hand, wearable sensors have the unique opportunity to be attached to the animal, so that no behaviours go unobserved.

The first of these principles is to identify what is the target or goal, or what is the problem to be solved, as this is directly related to the final objective of the welfare-monitoring algorithm. Welfare-related targets include the footpad lesion score of a broiler, or gait score of a cow. Once the target is decided, the next question is whether we have a reliable gold standard. A gold standard or reference point can be defined as a state-of-the-art scientific measurement or method which enables us to draw a conclusion relating to the final objective of the algorithm. For welfare issues a gold standard is often a behavioural analysis carried out by a trained observer (e.g. gait analysis in the case of lameness detection). In this way the Welfare Quality® project might offer a gold standard for specific animal-derived targets. To do so the protocol must be applied much more often in time, and for a gold standard it has to be accepted that this assessment can be expensive and time-consuming.

The idea of the real-time monitoring system assumes that we can find new variables that can give an early warning of poor welfare (e.g. back arch value for lameness in dairy cows). These values can be calculated from the field measurements when that animal is in the farm environment. A key objective then is to understand the behaviour of these variables and understand the underlying biological meaning. Connecting this with more detailed manual audiovisual analyses of the variable from the measured field data is required to develop the real-time algorithms.

The finally developed algorithm must enable calculation of key variables in real time from the field data to detect the variation outside normal bounds. Whatever type of physical or mathematical simulation we use in the laboratory, experience shows that the hard work starts when the algorithm is implemented in a real livestock environment. The main reason for this is that animal-related processes in a commercial livestock house are much more complex than anything we can simulate in the laboratory. The final results in terms of performance of these algorithms can be expressed quantitatively using the criteria: sensitivity, specific, and overall accuracy (Exadaktylos *et al.*, 2008).

13.5 Health and Welfare Monitoring Examples with PLF

13.5.1 Broiler behaviour monitoring

The EU is a major producer of poultry meat with about 6 billion chickens being raised annually. In conventional production systems birds are slaughtered after 42 days at a weight of about 2.5 kg. In the current economic climate poultry farmers are required to grow more and more birds in order to make their business profitable. It is not uncommon to see broiler farmers raise close to 2 million birds per year (six buildings $\times$ six flocks per year $\times$ 50,000 birds). It has become impossible for a farmer to observe all of his or her animals often enough by audiovisual (direct, human) observations. Now, there is a need to monitor both birds and litter closely so their health and well-being can be managed. Farmers are rarely faced with an easy life as technical issues arise daily (e.g. climate control problems, blocked feeder lines, electricity problems, drinking lines, failing lightning systems, and so on). To carry out daily assessments of the welfare alongside the daily management routine takes

vital hours from the farmer's day, affecting the profitability of their business. It has been known for many years that, whatever production system is used, the farmer remains the most important factor in obtaining good results at the level of animal health and productivity (Geers *et al.*, 1986).

Access to feed, water, and a suitable thermal environment are primary components of good health and welfare, so the farmers must quickly be made aware of any restriction or deviation from acceptable conditions. The challenge is that, despite the level of technology available to farmers today, whether or not feeders and drinkers are working still needs to be checked manually. While environmental sensors provide information on the average house environment, they cannot give an animal-based measure of the animal and microclimate interaction. To address such challenges a PLF tool called eYeNamic (Fancom BV, the Netherlands) has been developed. This system is camera-based and continuously monitors the broiler flock, enabling the detection of daily problems in broiler houses. For a typical broiler house, the system employs three or four cameras mounted in the ceiling that give pictures of the distribution of the birds (de Montis *et al.*, 2013). The system uses an algorithm that compares the actually measured distribution of animals with a predicted value at that time of the day. When the real measured value is more than 25% different from the predicted value, an alarm is triggered and the farmer is alerted. As shown in Fig. 13.2, this alarm indicates a problem in the barn, such as a blocked water line (Kashiha *et al.*, 2013b).

Recent research with the eYeNamic system (A. Peña Fernández, E. Tullo, T. van Hertem, A. Youssef, V. Exadaktylos, T. Norton, E. Vranken, M. Guarino and D. Berckmans, 2017, unpublished work) has revealed correlations between activity and distribution indices and welfare problems, specifically hock burn and foot pad lesions (Fig. 13.3). The relationship between the deviations in occupation patterns and the foot-pad lesion scores is positive, indicating that birds which tend to cluster together for long periods present an increased chance of having higher levels of foot pad lesions. On the other hand the relationship found between the deviations in the activity pattern and the hock burn scores is negative, indicating that greater activity in the flock would improve the hock burn scores. This can be related to the fact that having less-active broiler chickens staying still for long

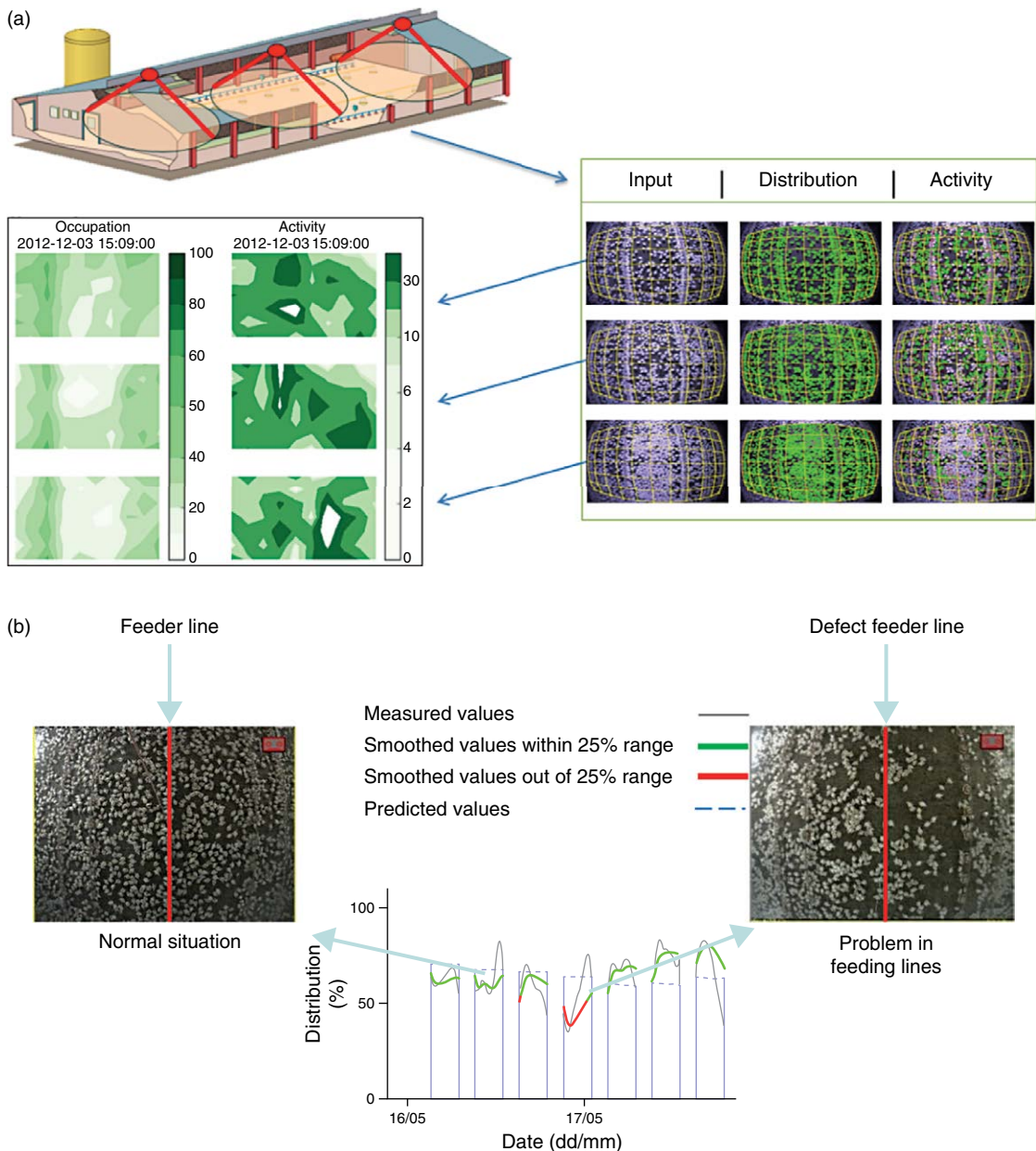


Fig. 13.2. The eYeNamic system in a common broiler house: (a) the physical set-up of the system; and (b) the early warning system indicating a blocked feeder line. (From Kashiha *et al.*, 2013b.)

periods on badly conditioned litter can worsen this kind of lesion (Haslam *et al.*, 2007).

Another camera-based monitoring approach similar to that of the eYeNamic has been recently developed by a research group at Oxford University

(Dawkins *et al.*, 2013). The approach is based on an analysis approach called optical flow. This approach derives the general movement flow patterns of birds from the images, as well as the variance, skew, and kurtosis of the flow. The approach

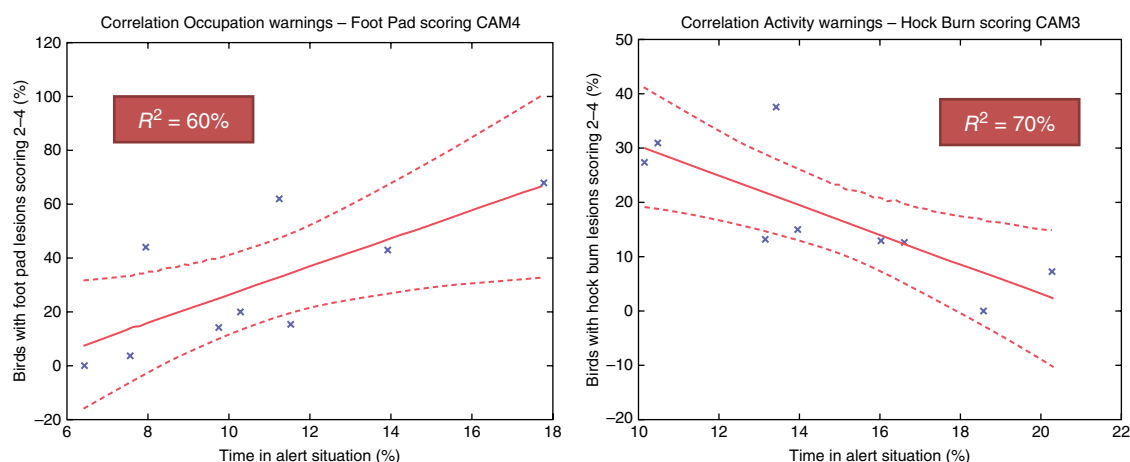


Fig. 13.3. Correlation between time spent in the alarm situation and welfare scores. (From A. Peña Fernández *et al.*, 2017, unpublished data.)

has already been correlated with health and welfare indicators, showing that a general indication of health and welfare problems is possible while the specific disease diagnosis may be less clear (Dawkins *et al.*, 2013).

13.5.2 Dairy cow gait monitoring

Milk is the EU's number one agricultural product, accounting for about 15% of agricultural output in terms of value. The EU dairy sector is supported by 650,000 specialized dairy farmers, 18 million milking cows and has a labour force of about 1.2 million people. However, since the abolishment of milk quotas in 2015, farmers are facing increased pressures to exploit the economies of scale by increasing the size of their herds. With larger numbers of cows per farm, farmers have less time than they traditionally had to audiovisually monitor their animals. Therefore, the application of technology is likely to become more important for EU dairy farmers in the future.

In dairy production, PLF systems can be important tools to complement and support the skills of the farmer in the monitoring and assessment of cow health and welfare. Automated PLF systems enable dairy farmers to manage larger herds in a more time-efficient manner (Rutten *et al.*, 2013). Milk production of dairy cows is affected by their health status, and automated systems have been developed to monitor behavioural activities for detection of lameness and oestrus (Dolecheck *et al.*, 2015).

One application where PLF can have significant impact is in the management of lameness on dairy farms. Lameness in dairy cows is one of the leading causes of compromised animal welfare and reduced productivity (van Hertem *et al.*, 2014; Van Nuffel *et al.*, 2015). The problem is that lame cows in the herd are often not detected, or are detected when they are already in a progressed state of lameness (Archer *et al.*, 2010; Leach *et al.*, 2010). Considerable research has already been performed to automatically detect lame cows in the herd and to detect lameness at an early stage of the disease (Chapinal *et al.*, 2011; Maertens *et al.*, 2011; Ghotoorlar *et al.*, 2012). Nevertheless, limited literature is available that focuses on translating this research into meaningful lameness monitoring solutions that create valuable information for the farmer to manage this problem.

Lameness monitoring systems have been developed by many authors but have the problem of being too costly for the farmers and the return on investment is not always clear (Van Nuffel *et al.*, 2015). However, by using camera systems, lameness monitoring can be done in a cost-effective way, as one sensor system can be utilized for the whole herd. Viazzi *et al.* (2013, 2014) developed systems to calculate back posture, providing values that reflect the degree of lameness of dairy cows by using images of a cow's back from a three-dimensional top-view camera (Fig. 13.4). Further work by Piette *et al.* (2016) in collaboration with a large dairy farm (2500 cows) led to a prototype automated

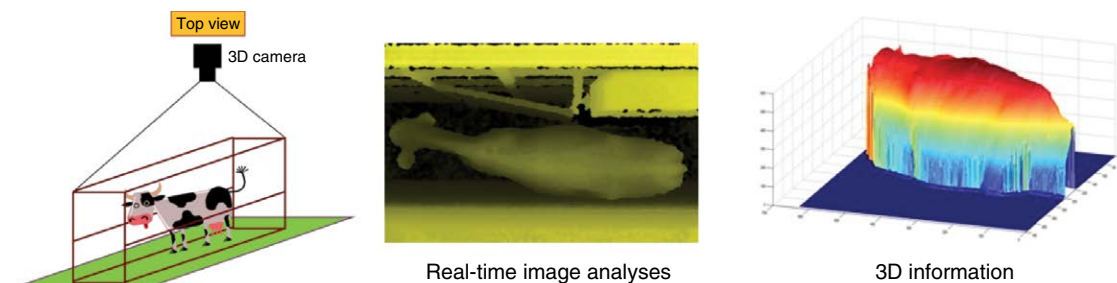


Fig. 13.4. Illustration of the information extraction from three-dimensional (3D) top-view image analysis. (From Viazzi *et al.*, 2014.)

lameness warning system based on the back posture values generated by Viazzi *et al.*'s algorithm (2013, 2014).

A key aspect of the system design of Piette *et al.* (2016) was working with good quality gold-standard data and developing a strong dialogue with the farmer. The aim was to create a system that could be implemented by the farmer into daily cow management. In order to ensure the quality of the collected data and the quality of the gold standard, only cows with a reliable manual score dataset were considered for further analysis. First, cows with fewer than four manual gold-standard scores during the scoring period were rejected, leaving 886 (out of 1908) cows for further analysis. Secondly, the evolution of manual scores was evaluated for each cow. Cows showing manual scores that were varying continuously between 1 (healthy) and 2 or higher (lame) were rejected from further analysis due to unreliable manual scoring. This resulted in a final dataset of 209 cows from a starting dataset of 1908 cows, and demonstrates the difficulties of developing PLF systems with real-life farm data.

Figure 13.5 shows the back posture values and manual scores of newly lame cow number 7126. During the scoring period, the manual scores of this cow evolve from 1 (healthy) to 2 and 3 (lame), which is why it is called 'newly lame'. This emerging lameness can also be seen in the back posture values of the cow that increase simultaneously with the manual scores. The objective of the automated lameness warning system is to detect this evolution from healthy back posture values to lame back posture values. The healthy baseline is calculated using historical data from the cows. A threshold is then defined to decide how much a back posture value can deviate from the healthy baseline before an alarm is generated. In the case of real-time lameness

monitoring, validation of these algorithms in the field, conducted in test farms in practice, demonstrated that the algorithms developed were able to classify the lameness correctly with a sensitivity of 76.1% and a specificity of 83.9%. While being successful experimentally, this system requires more development for practical implementation on the farm. In anticipation of an accurate, easily implementable solution for automated lameness detection, manual detection is currently the most appropriate approach.

13.5.3 Pig behaviour monitoring

Pig meat is a globally important protein source. In the EU-28 (the 28 countries of the EU), pig meat represents 55% of the total 40 million t of meat produced each year. EU pig production has traditionally been based around small-scale family farming, where what was grown directly on the farm was used to feed the family and local community. In recent years, however, the EU has been going through a period of consolidation, with the number of farms steadily decreasing, while the agricultural land area remains stationary and economic output increases (Eurostat, 2016). The result is that the process of livestock production is changing in the EU, and farmers need to exploit economies of scale by increasing animal numbers to dilute the fixed costs and buffer against volatility in the meat, feed, and energy markets. A key question now is how can farmers manage their ever-growing production systems to achieve high quality, sustainable, and safe pork production that can meet this demand while providing high animal welfare. Here we will show different examples of how PLF for pig farming can be made operational today in commercial farms (EU-PLF, 2017).

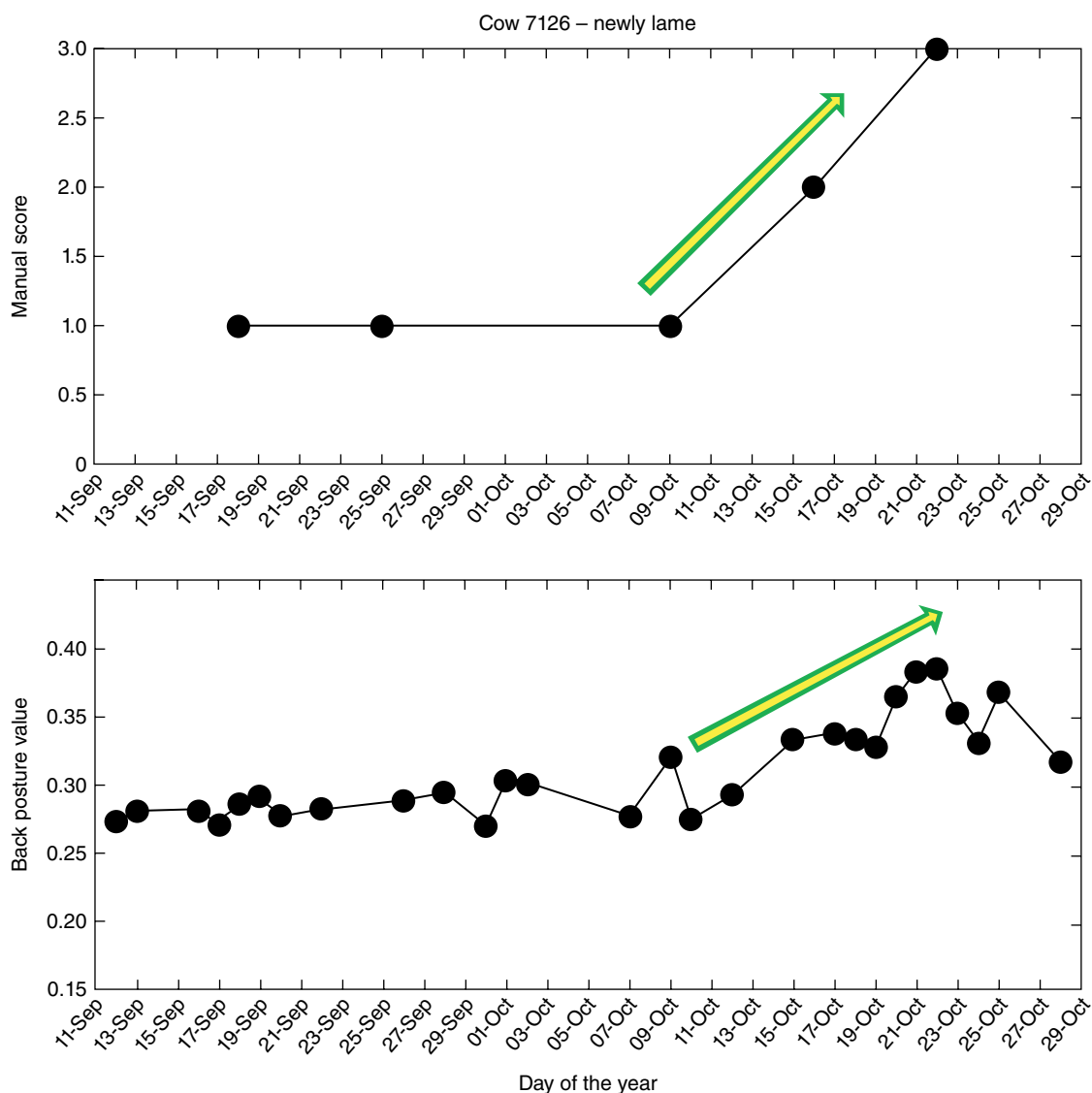


Fig. 13.5. Evolution of back posture values and manual scores of newly lame cow. (From Piette *et al.*, 2016.)

Drinking behaviour and water volume usage are important indicators of production performance, health, and welfare parameters in animal husbandry. Due to the high cost of water meters and the desire for individual water intake patterns, recent work has focused on the implementation of camera and radio-frequency identification (RFID)-based systems for drinking behaviour monitoring. Kashiha *et al.* (2013a) developed a drinking behaviour monitor for pigs which could be useful in

detection of diseases and other production-related problems too. The goal was to estimate half-hourly water volume usage (in litres) in a pig barn by analysing the half-hourly duration of drink nipple visits. To achieve this, a data-based dynamic model was developed to quantify the dynamics of water meter measurements and to relate it to half-hourly duration of visits. The model described the half-hourly measured water volume usage over the 13 days with R^2 of 92% (average error of 220 ml).

Maselyne *et al.* (2014) also successfully validated high frequency RFID systems, by comparing RFID-based visits with visual observations and flow meter measurements. They considered a static correlation analysis and found sensitivity was at least 92%, specificity 93% and with a high correlation with observed drinking duration ($R^2 = 0.88$). Therefore, with this rate of progress, it is becoming more feasible for farmers to monitor individual water intake patterns and use this to assess the health and welfare of pigs during the production process.

Pigs generally have a stable diurnal drinking pattern unless influenced by stressors from disease or the environment (Jensen and Kristensen, 2015). Andersen *et al.* (2014) found that tracking the dynamic characteristics of drinking behaviour within a day is important as part of health and welfare monitoring. Madsen and Kristensen (2005) were some of the first researchers to look at the dynamic modelling of water drinking patterns and demonstrated its power in detecting disease outbreaks. Recent work by Jensen and Kristensen (2017) found differences in water use patterns depending on whether animals were stressed from the environment and disease stressors. These findings highlight the possibility to separate welfare monitoring from production, so that welfare can be managed effectively.

13.5.4 Pig barn sound monitoring

Health and welfare are intimately connected, as a diseased animal is likely to be in a compromised state of welfare. Healthcare management of animals is therefore a critical and demanding issue. It is a problem that 700,000 people per year die globally because they do not respond to antibiotic treatment (O'Neill, 2014). Monitoring and management of health is a crucial process during pig production. As health monitoring becomes more of an issue, more effort is focused on quantifying measurable indicators of health status. Coughing is one of the most frequent presenting symptoms of many diseases affecting the airways and the lungs of both humans and animals. In piggeries, the continuous online monitoring of cough sounds can be used to build an intelligent alarm system for the early detection of diseases. Algorithms to distinguish between pig coughs and other sounds in the environment have already been developed and validated in the laboratory environment

(Van Hirtum, 2002). Initially, these algorithms were able to distinguish between sounds in general, then between pig coughs and other sounds, and then between pathological and non-pathological coughs. Validation of the sound algorithms in the field, conducted in a piggery in Lombardy (Italy), has shown that the algorithms developed were able to classify the cough correctly in 86% of cases (Ferrari *et al.*, 2008).

For field validation, the pig-cough monitoring system was deployed in four pig houses in Hungary, Spain, France, and the Netherlands for six production periods. The PLF technology detected respiratory problems faster than that possible by the farmer or vet, demonstrating the power of continuous monitoring and analysis of sound coupled to respiratory health monitoring. In fact, Berckmans *et al.* (2015) showed that PLF technology can detect problems up to 10 days before the farmer has noticed them, while some problems were never noticed by the farmer (Fig. 13.6). It is also important to translate new technologies to the real world by supporting new companies which are bringing these solutions to farmers. SoundTalks (NV) was started as a spin-off of Katholieke Universiteit (KU) Leuven, Belgium and the University of Milan, Italy to develop and bring animal monitoring products based on real-time sound analysis to the farmer.

13.6 New Approaches for Monitoring and Management of Welfare: Real-time Stress Monitoring

The mental state of an animal is a key factor in deciding the metabolic energy flows (and for example food intake, growth) for the animal, and therefore it is a state that can give or take money from the farmer. Looking beyond behaviourally induced indicators of welfare towards evaluating the stress of farm animals is also interesting. Stress is a physiological measure of the mental state and therefore in combination with the physical condition is intimately related to animal welfare. In specific terms, stress is a perturbation to the physiological homeostasis or psychological well-being (NRC, 2008). Farmed animals are faced with multiple stressors during the production process, and their stress response elicits deviations in normal behaviour, negatively impacting on their welfare, and the welfare of other animals in their group (Matthews *et al.*, 2017). By measuring the stress, we also measure the deviation from homeostasis, and therefore how much energy the animals

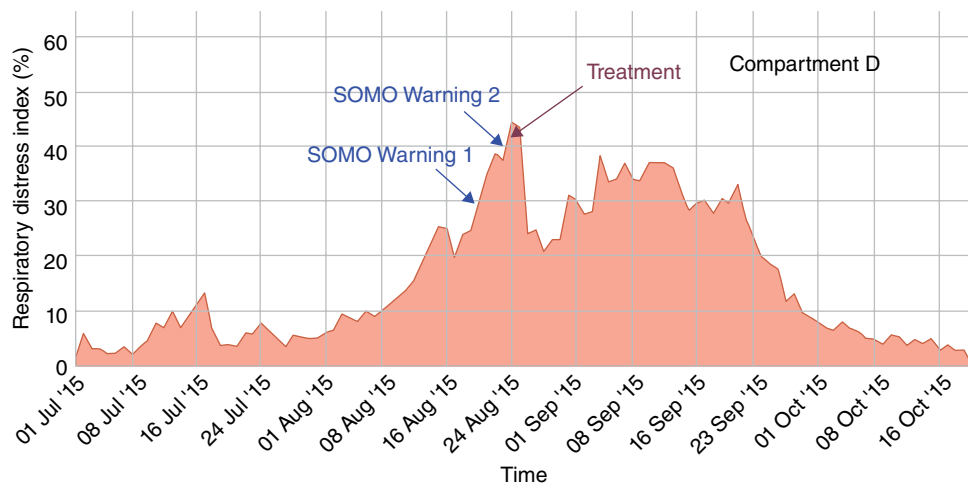


Fig. 13.6. Example of the early warnings raised by the pig-cough monitoring system (SOMO (SOund Monitor) warnings 1 and 2) compared with the treatment decision made by the farmer. (From Berckmans *et al.*, 2015.)

channel into dealing with their situation rather than producing meat, eggs, or milk.

Cortisol (one of the glucocorticoids), also known as the ‘stress hormone’ is produced by the adrenal glands, with the main role of keeping the animal’s energy at peak levels in preparation for ‘fight-or-flight’ situations. It is known that glucocorticoids (GCs), which include cortisol and corticosterone, can be measured non-invasively in saliva or faecal samples and can reliably indicate an individual’s hypothalamic–pituitary–adrenal axis activity and physiological stress responses (Nemeth *et al.*, 2016). However, whether measured in blood plasma, saliva, or faeces, each sampling route presents challenges, which make the quantification of stress based on GC measurement difficult in practice. Measuring plasma cortisol requires blood sampling (which itself is stressful) at a high frequency to measure the dynamic response to stressors. Saliva can be collected, and salivary cortisol level can be measured, but again frequent sampling is a challenge, and a slight delay can exist between stressor and stress response as the GC must be secreted into the saliva. This lag time is of course more pronounced with faecal GC measurement, as GC must first be metabolized by the liver, before being excreted by the gut (Nemeth *et al.*, 2016).

The measurement of GCs can be considered the gold standard, but for practical stress monitoring (e.g. with farm animals) non-invasive approaches are becoming popular. Research focused on monitoring

the stress response of animals has evaluated both heart rate (HR) and heart rate variability (HRV) as practical measures. HR is an important metric for stress when considered from the energy balance perspective (Horsch *et al.*, 2015). The application of a stressor causes the release of GCs in the blood, which then elevate HR to deliver the extra oxygen around the body. When the threat passes, the HR returns to its resting state. On the other hand HRV measures the variability of inter-beat intervals, thus providing a connection with the autonomic nervous system activity. Both the HR and HRV parameters can be measured by non-invasive wearable sensor systems, such as electrocardiogram (ECG) or photoplethysmogram (PPG) technology. However, at the moment the PPG principle (which looks at the volume change or pulsatile oxymetry changes) is the robust sensing solution on the market, as it can measure consistently even when the living system is in motion.

13.6.1 Stress monitoring: a horse application

The importance of real-time, simultaneous, monitoring of HR and activity was first shown by Aerts *et al.* (2008). They modelled the dynamic response of a horse’s HR to changes in exercise intensity and used this within a model-based control framework to optimize the physical condition of horses in a more efficient way than was previously possible. However, it is also well known in equine sports,

that a horse's temperament plays a significant role in training and competition performance (McBride and Mills, 2012). Jansen *et al.* (2009) were the first researchers to monitor the stress levels of horses using the dynamic energy balance modelling approach introduced above. They built upon the work of Aerts *et al.* (2008) by breaking down the real-time HR signal into two components: (i) a physical component; and (ii) a component containing information about the mental state of the horse. Once the mental component was known, the authors used this to detect the horse's mental response to a novel object. This work was the first to assess the real-time mental response of a horse during physical activity in a non-invasive way, paving the way for continuous real-time monitoring of animals, be it for agriculture, sport, or companionship. Figure 13.7 illustrates the results of stress detection achieved during the experiment.

13.7 The Future Potential of PLF in Livestock Production

The recent evolution in animal welfare assessment towards outcome-based measures is now taking hold, as evidenced by a number of recent projects

- **Objective:** Quantification of mental status (fear) of a horse in a non-invasive and continuous way during physical exercise
- **Experimental design**

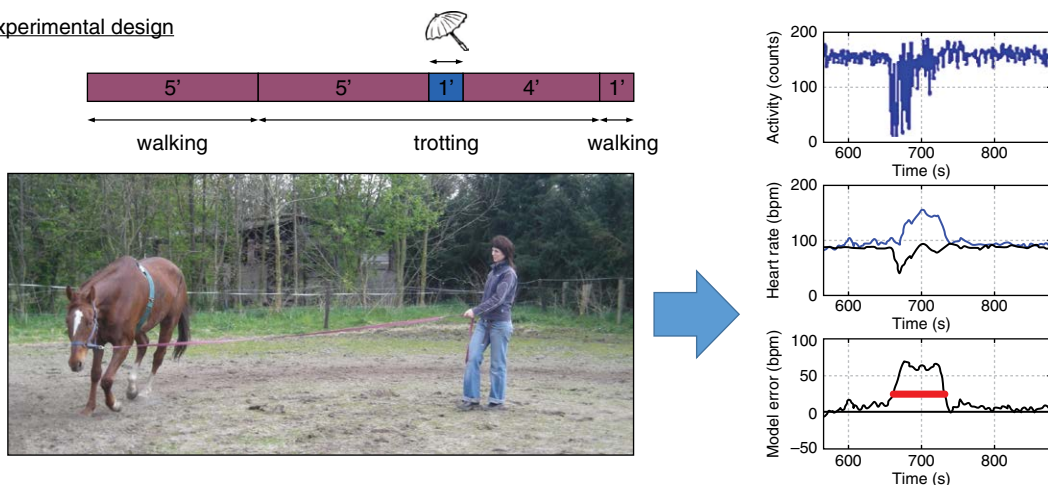


Fig. 13.7. Experimental protocol and results of emotional response detection based on model-based decomposition of heart rate (HR; measured in beats per minute, bpm). Top right is measured physical activity. Middle: measured HR (blue) and predicted HR by dynamic mathematical model (black). Bottom: model error (i.e. part of HR containing information about the emotional state of the horse) (black); detection of emotional response to novel object exposure (red). (From Jansen *et al.*, 2009.)

aimed at defining new assessment protocols (Welfare Quality®, AWIN®). These projects have taken into account the needs of the animals, farmers, and society, moving towards the development of standardized but balanced welfare assessments. Legislative measures also promote adoption of animal-based measures (e.g. EU directives, regulations, and new World Organisation for Animal Health (OIE) codes of practice) bringing welfare more into the focus of wider society. But while the intention of such complete welfare assessment is clearly positive, the realization is quite difficult in practice. For example, the Welfare Quality® protocols take between 4 h and 8 h to carry out, depending on species and farm, requiring thorough training and retraining of assessors (Czycholl *et al.*, 2015). Moreover, the combination of the various measured parameters into one overall 'aggregated' measure can become quite challenging and controversial. This, of course, impacts the quality of the assessments and their perception in the community. For example, for broiler production the view has emerged that current flock-level on-farm animal welfare assessments are not capable of detecting welfare problems unless the level is extremely poor (EU, 2015).

Along with defining complete welfare assessment programmes, in recent years there has also been parallel interest in identifying the best, or key, indicators of poor animal welfare, such as those that are easily detectable at the farm or slaughterhouse. Such indicators are also known as iceberg indicators (FAWC, 1992), as a single measure may tell a bigger story about the animal's quality of life. It can be assumed that this approach, as it is less complicated and perhaps less controversial, has the possibility to reach high throughput (via automation) in the slaughterhouse. For example, in broiler production contact dermatitis represents such an indicator (Butterworth, 2013). Contact dermatitis generally arises from wet litter, provoking lesions on the breast, hock and feet. Contact dermatitis can also be clearly linked with stocking density and by monitoring the incidence of this disease the authorities can be enabled to constrain production output of farms unless the disease is controlled to an acceptable level. On-farm monitoring of this disease is difficult because it currently requires manual handling of the birds, which is highly stressful as well as time-consuming. Slaughterhouse data, on the other hand, can be well exploited because shackled and plucked birds reveal this information more readily. However, gathering this information at the slaughterhouse is too late for the birds in question, and precluding 'real-time' welfare management on the farm.

Welfare management is today the key ambition of the PLF approach through real-time on-farm welfare monitoring, and many opportunities exist. For example, changes in how broiler birds use floor space in the house can give indications of environmental discomfort that they feel, and this information can be used to control the microclimate of the house. Fearfulness of broiler flocks can give an indication of how well the farmer interacts with the flock during the production process, enabling farmers to modify how they interact with their animals. Feeding and drinking behaviour patterns deviate when health and welfare is compromised, and so monitoring these variables can help farmers quickly assess the situation, and act appropriately. Only with continuous monitoring of key variables on the farm will real-time welfare management become possible. PLF technologies can bring this to the farmers.

While it is quite clear that PLF technology can improve animal welfare within the context of more sustainable animal production, it is often

less understood how the farmers are engaging with the technologies, and what their opinion actually is. Recently, as part of the EU-PLF project, Hartung *et al.* (2017) evaluated the farmers' view of PLF technology that was installed on their farms during the project (EU-PLF, 2017). This study made it quite clear that the interviewed farmers see PLF as a way to improve their productivity and reduce veterinary costs by enhancing feed conversion rate, and reducing their use of antibiotics. The farmers of course want to see a quick return on investment in such technology. From their perspective, welfare monitoring was a side benefit rather than the primary focus. They often don't make the connection that welfare management is key to improving productivity and sustainability (Berckmans, 2014). Therefore we, as the PLF research community, still have to do more work to realize the practical benefits of PLF technologies in commercial production. With robust systems we can start to convince farmers of the capacities of such technology to link productivity, health, and welfare management.

Only with all key stakeholders in a real collaboration across the table can the development of PLF technology reach its full potential and achieve maximum benefits for farmers. The research community has a significant part to play in this picture, and must continue to support efforts such as those initiated by the European Commission for PLF that began in 2003, with the view of arranging workshops and conferences to disseminate the findings of PLF researchers to the wider community. So far we have seen the hosting of seven EC-PLF conferences in the EU, with allied PLF-oriented conferences in China (First Asian PLF conference, 2016), Brazil (workshops at the University of Campinas), and an upcoming conference in the USA (First US PLF symposium at the American Society of Agricultural and Biological Engineers (ASABE) International Livestock Environment Symposium (ILES) in 2018). Given the strong position of the EU in the world of PLF and the innovation we are now capable of achieving, it is important that we maintain this foothold and demonstrate our capacity to bring real welfare management to the farmers with PLF. In response to this challenge the European Commission of PLF has now evolved into a legal entity called the European Association of PLF. This body will seek to form stronger engagement between the research, technology development, and farming communities in the future.

13.8 Conclusions

There is no doubt that PLF has evolved into a meaningful sector of the livestock industry. Twenty years of collaboration between industry and scientific researchers has meant that we are now at the point where the technologies can create value for the producer, the consumer, and society. Moreover, as discussed in this chapter, there is huge potential for expanding the monitoring capacity of PLF. Scientific evidence exists on the possibility for stress monitoring of individual animals in the near future and this could make a breakthrough in the way livestock production is carried out worldwide. One thing still missing though is the application of PLF technology in management. Closing the loop has to date only been realized in a small number of PLF applications. We see the future as being a place where PLF is used to actively manage the health, welfare and productivity of each individual animal on the farm.

References

- Aerts, J.-M., Gebruers, F., Van Camp, E. and Berckmans, D. (2008) Controlling horse heart rate as a basis for training improvement. *Computers and Electronics in Agriculture* 64(1), 78–84.
- Aerts, J.-M., Norton, T. and Berckmans, D. (2017) *Bioresponse Measurements and Process Control (B-KUL-H06A5A)*. Master Course in the Masters of BioSystems and of Human Health Engineering at the Katholieke Universiteit (KU) Leuven, Belgium since 2006, 168 pp.
- Andersen, H.L., Dybkjær, L. and Herskin, M.S. (2014) Growing pigs' drinking behaviour: number of visits, duration, water intake and diurnal variation. *Animal* 8(11), 1881–1888.
- Archer, S.C., Green, M.J. and Huxley, J.N. (2010) Association between milk yield and serial locomotion score assessments in UK dairy cows. *Journal of Dairy Science* 93(9), 4045–4053.
- Berckmans, D. (2014) Precision livestock farming technologies for welfare management in intensive livestock systems. *Scientific and Technical Review of the Office International des Epizooties* 33(1), 189–196.
- Berckmans, D., Hemeryck, M., Berckmans, D., Vranken, E. and van Waterschoot, T. (2015) Animal sound ... talks! Real-time sound analysis for health monitoring in livestock. In: *Proceedings of Animal Environment and Welfare*, 2015, Chongqing, China, pp. 215–222. Available at: <ftp://ftp.esat.kuleuven.be/pub/stadius/mhemeryc/isaew2015.pdf> (accessed 23 February 2018).
- Blokhuis, H.J., Veissier, I., Miele, M. and Jones, B. (2010) The Welfare Quality® project and beyond: safeguarding farm animal well-being. *Acta Agriculturae Scand Section A* 60(3), 129–140.
- Broom, D. (2017) Animal Welfare in the European Union. European Parliament. Study commissioned for the Peti Committee. PE 583.114. Available at: [http://www.europarl.europa.eu/RegData/etudes/STUD/2017/583114/IPOL_STU\(2017\)583114_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2017/583114/IPOL_STU(2017)583114_EN.pdf) (accessed 24 August 2017).
- Butterworth, A. (2013) On-farm broiler welfare assessment and associated training. *Revista Brasileira de Ciência Avícola* 15(2), 71–77.
- Chapinal, N., De Passille, A.M., Pastell, M., Hanninen, L., Munksgaard, L. and Rushen, J. (2011) Measurement of acceleration while walking as an automated method for gait assessment in dairy cattle. *Journal of Dairy Science* 94(6), 2895–2901.
- Czyrcholl, I., Büttner, K., Grosse Beilage, E. and Krieter, J. (2015) Review of the assessment of animal welfare with special emphasis on the 'Welfare Quality® animal welfare assessment protocol for growing pigs'. *Archiv fuer Tierzucht* 58(2), 237.
- Dawkins, M.S., Russell, C., Merelie, K. and Roberts, S.J. (2013) In search of the behavioural correlates of optical flow patterns in the automated assessment of broiler chicken welfare. *Applied Animal Behaviour Science* 145, 44–50.
- de Montis, A., Pinna, A., Barra, M. and Vranken, E. (2013) Analysis of poultry eating and drinking behavior by software eYeNamic. *Journal of Agricultural Engineering* 44(2s), 166–172.
- Dolecheck, K.A., Silvia, W.J., Heersche, G., Chang, Y.M., Ray, D.L. et al. (2015) Behavioral and physiological changes around estrus events identified using multiple automated monitoring technologies. *Journal of Dairy Science* 98(12), 8723–8731.
- EU (2015) *Use of Slaughterhouse Data to Monitor Welfare of Broilers on Farm*. Overview report. Directorate for Health and Food Audits and Analysis, European Union (EU). Available at: <https://publications.europa.eu/en/publication-detail/-/publication/9fbf913d-de15-11e6-ad7c-01aa75ed71a1/language-en/format-PDF> (accessed 24 August 2017).
- EU-PLF (2017) Final Report of the European Union – Precision Livestock Farming (EU-PLF) project. Available at: <https://cordis.europa.eu/docs/results/311/311825/final1-20170707v5-finalreport-gano311825.pdf> (accessed 23 February 2018).
- Europa (1998) The Protection of Animals Kept for Farming Purposes. Council Directive 98/58/EC, 20 July 1998. Available at: <http://data.europa.eu/eli/dir/1998/58/oj> (accessed 23 February 2018).
- Europa (2016) Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law'). Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2016:084:TOC> (accessed 23 February 2018).

- Eurostat (2016) Agricultural Production – Animals. Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_production_-_animals (accessed 24 August 2017).
- Exadaktylos, V., Silva, M., Ferrari, S., Guarino, M., Taylor, C.J. *et al.* (2008) Time-series analysis for online recognition and localization of sick pig (*Sus scrofa*) cough sounds. *Journal of the Acoustical Society of America* 124(6), 3803–3809.
- Farm Animal Welfare Council (FAWC) (1992) Five Freedoms. Available at: <http://www.fawc.org.uk/freedoms.htm> the original (accessed 24 August 2017).
- Ferrari, S., Silva, M., Guarino, M., Aerts, J.M. and Berckmans, D. (2008) Cough sound analysis to identify respiratory infection in pigs. *Computers and Electronics in Agriculture* 64, 318–325.
- Frost, A.R., Parsons, D.J., Stacey, K.F., Robertson, A.P., Welch, S.K. *et al.* (2003) Progress towards the development of an integrated management system for broiler chicken production. *Computers and Electronics in Agriculture* 39, 227–240.
- Geers, R., Goedseels, V., Parduyens, G. and Vercruysse, G. (1986) The group postural behaviour of growing pigs in relation to air velocity, air and floor temperature. *Applied Animal Behaviour Science* 16(4), 353–362.
- Ghotoorlar, S.M., Ghamsari, S.M., Nowrouzian, I. and Ghidary, S.S. (2012) Lameness scoring system for dairy cows using force plates and artificial intelligence. *Veterinary Record* 170(5), 126.
- Halachmi, I. and Guarino, M. (2016) Precision livestock farming: a ‘per animal’ approach using advanced monitoring technologies. *Animal* 10(9), 1482–1483.
- Hartung, J., Banhazi, T., Vranken, E. and Guarino, M. (2017) European farmers’ experiences with precision livestock farming systems. *Animal Frontiers* 7, 38–44. DOI: 10.2527/af.2017.0107
- Harvey, D. and Hubbard, C. (2013) The supply chain’s role in improving animal welfare. *Animals* 3(3), 767–785.
- Haslam, S.M., Knowles, T.G., Brown, S.N., Wilkins, L.J., Kestin, S.C. *et al.* (2007) Factors affecting the prevalence of foot pad dermatitis, hock burn and breast burn in broiler chicken. *British Poultry Science* 48(3), 264–275.
- Horsch, A., Wobmann, M., Kriemler, S., Munsch, S., Borloz, S. *et al.* (2015) Impact of physical activity on energy balance, food intake and choice in normal weight and obese children in the setting of acute social stress: a randomized controlled trial. *BMC Pediatrics* 15(1), 12.
- Jansen, F., Van der Krogt, J., Van Loon, K., Avezzu, V., Guarino, M. *et al.* (2009) Online detection of an emotional response of a horse during physical activity. *The Veterinary Journal* 181(1), 38–42.
- Jensen, D.B. and Kristensen, A.R. (2016) Temperature as a predictor of fouling and diarrhea in slaughter pigs. *Livestock Science* 183, 1–3.
- Jensen, D.B., Toft, N. and Kristensen, A.R. (2017) A multivariate dynamic linear model for early warnings of diarrhea and pen fouling in slaughter pigs. *Computers and Electronics in Agriculture* 135, 51–62. DOI: 10.1016/j.compag.2016.12.018
- Kashiha, M., Bahr, C., Haredasht Amirpour, S., Ott, S., Moons, C. *et al.* (2013a) The automatic monitoring of pigs water use by cameras. *Computers and Electronics in Agriculture* 90, 164–169.
- Kashiha, M., Pluk, A., Bahr, C., Vranken, E. and Berckmans, D. (2013b) Development of an early warning system for a broiler house using computer vision. *Biosystems Engineering* 116(1), 36–45.
- Kelly, K. (2017) *The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future*. Penguin, London.
- Leach, K.A., Whay, H.R., Maggs, C.M., Barker, Z.E., Paul, E.S. *et al.* (2010) Working towards a reduction in cattle lameness: 2. Understanding dairy farmers’ motivations. *Research in Veterinary Science* 89, 318–323.
- Madsen, T.N. and Kristensen, A.R. (2005) A model for monitoring the condition of young pigs by their drinking behaviour. *Computers and Electronics in Agriculture* 48 (2), 138–154.
- Maertens, W., Vangeyte, J., Baert, J., Jantuan, A., Mertens, K.C. *et al.* (2011) Development of a real time cow gait tracking and analysing tool to assess lameness using a pressure sensitive walkway: the GAITWISE system. *Biosystems Engineering* 110, 29–39.
- Main, D.C.J., Mullan, S., Atkinson, C., Cooper, M., Wrathall, J.H.M. and Blokhuis, H.J. (2014) Best practice framework for animal welfare certification schemes. *Trends in Food Science and Technology* 37(2), 127–136. Available at: <http://dx.doi.org/10.1016/j.tifs.2014.03.009> (accessed 23 February 2018).
- Maselyne, J., Saeys, W., De Ketelaere, B., Mertens, K., Vangeyte, J. *et al.* (2014) Validation of a high frequency radio frequency identification (HF RFID) system for registering feeding patterns of growing-finishing pigs. *Computers and Electronics in Agriculture* 102, 10–18.
- Matthews, S.G., Miller, A.L., Plötz, T. and Kyriazakis, I. (2017) Automated tracking to measure behavioural changes in pigs for health and welfare monitoring. *Scientific Reports* 7(1), 17582.
- McBride, S.D. and Mills, D.S. (2012) Psychological factors affecting equine performance. *BMC Veterinary Research* 8(1), 180.
- Nemeth, M., Pschernig, E., Wallner, B. and Millesi, E. (2016) Non-invasive cortisol measurements as indicators of physiological stress responses in guinea pigs. *Peer J* 4, e1590.
- NRC (2008) Stress and distress. In: *Recognition and Alleviation of Distress in Laboratory Animals*. National Research Council (NRC) (US) Committee on Recognition and Alleviation of Distress in Laboratory Animals, Washington, DC. Available at:

<https://www.ncbi.nlm.nih.gov/books/NBK4033/> (accessed 23 February 2018).

- O'Neill, J. (2014) Antimicrobial Resistance: Tackling a Crisis for the Health and Wealth of Nations. Review on Antimicrobial Resistance, London. Available at: <https://amr-review.org/publications.html> (accessed 24 August 2017).
- Piette, D., Norton, T. and Berckmans, D. (2016) Automated warning system for lameness monitoring in dairy cows. Paper presented at the *International Symposium on Animal Science 2016*, 24–25 November, Belgrade-Zemun, Serbia.
- Rollin, B.E. (2011) Animal rights as a mainstream phenomenon. *Animals* 1(1), 102–115.
- Rutten, C.J., Velthuis, A.G., Steeneveld, W. and Hogeveen, H. (2013) Invited review: sensors to support health management on dairy farms. *Journal of Dairy Science* 96(4), 1928–1952. DOI: 10.3168/jds.2012-6107
- van Evert, F.K., Fountas, S., Jakovetic, D., Crnojevic, V., Travlos, I. and Kempenaar, C. (2017) Big data for weed control and crop protection. *Weed Research* 57, 218–233.
- van Hertem, T., Viazzi, S., Steensels, M., Maltz, E., Antler, A. *et al.* (2014) Automatic lameness detection based on consecutive 3D-video recordings. *Biosystems Engineering* 119, 108–116.
- Van Hirtum, A. (2002) The acoustics of coughing. PhD thesis, Katholieke Universiteit (KU) Leuven, Leuven, Belgium.
- Van Nuffel, A., Zwervaeagher, I., Pluym, L., Van Weyenberg, S., Thorup, V.M. *et al.* (2015) Lameness detection in dairy cows: Part 1. How to distinguish between non-lame and lame cows based on differences in locomotion or behavior. *Animals* 5(3), 838–860.
- Viazzi, S., Bahr, C., Schlageter-Tello, A., Van Hertem, T., Romanini, C.E.B. *et al.* (2013) Analysis of individual classification of lameness using automatic measurement of back posture in dairy cattle. *Journal of Dairy Science* 96, 257–266.
- Viazzi, S., Bahr, C., Van Hertem, T., Schlageter-Tello, A., Romanini, C.E.B. *et al.* (2014) Comparison of a three-dimensional and two-dimensional camera system for automated measurement of back posture in dairy cows. *Computers and Electronics in Agriculture* 100, 139–147.

14 The Paradoxical World of the Dog

JOHN BRADSHAW AND ELLY HIBY

14.1 Introduction

There are thought to be around 700 million domestic dogs in the world today, roughly one for every ten humans, or two for each dairy cow (Hughes and Macdonald, 2013). From their sheer numbers alone, dogs therefore deserve to have their welfare needs taken seriously. However, these needs are rarely the same as those of other domestic animals, and the extent to which they are met varies widely, both globally and locally. Dogs have a wide range of different relationships with mankind, most of which are quite distinct from those experienced by other domesticated animals, with the partial exception of the domestic cat. Dogs are all the same biological species, but domestic dogs come in a vast range of shapes and sizes, greater than those found within any of the genera of wild canids (Wayne and vonHoldt, 2012), and the more extreme variations in body conformation pose their own welfare concerns. Dogs are capable of forming long-lasting, genuinely bidirectional relationships with individual humans, but millions of dogs have only loose attachments to people, and to communities rather than individuals, while a few are only distinguishable from wild animals by their DNA. At one extreme are the ‘handbag dogs’ whose world is entirely prescribed by their doting owners; at the other lies the dingo, the wild dog of Australia, which is descended from village dogs that strayed (with some human assistance) from South-east Asia some 5000 years ago (Clutton-Brock, 2017).

Reflecting this complexity, there can be no ‘one size fits all’ solution for the welfare of domestic dogs. Companion dogs crave human attention; unsocialized dingoes flee from it. Sterilization may enhance the lifespan and well-being of a free-ranging female; castration may increase the risk that a well-cared for male golden retriever will die prematurely from cancer.

14.2 The Consequences of Domestication

The dog is the only species within the Canidae to have been successfully domesticated, and also pre-dates all other domestications by many thousands of years, although there is still disagreement as to the precise location and date of the domestication event(s) (Freedman and Wayne, 2017). It is universally agreed that the grey wolf *Canis lupus* is the ancestral species, although the DNA of today’s dogs suggests that more than one race or subspecies was incorporated. The primary ancestor appears to be extinct in the wild, complicating comparisons between dogs and wolves; nevertheless, much has been made of the behaviour and social organization of (very distantly related) wolves in interpreting the behaviour of dogs.

Despite their wide range of morphologies and behavioural characteristics, all dogs seem to be adapted to interpreting and reacting to human behaviour to an extent not matched by any other species. Given appropriate socialization, even dingoes can become attached to their owners, though they tend to display more wild-type behaviour than modern breeds of dog (Smith *et al.*, 2017). The key change brought about by domestication may not have been any major alteration in cognitive abilities – the brains of dogs are, if anything, smaller than those of wolves of the same size – but rather the capacity to accept humans as social partners, which each dog has to learn during the so-called socialization period between about 3 and 16 weeks of age (Range and Virányi, 2017; Serpell *et al.*, 2017). The only other species that goes through a similar developmental window is the domestic cat (Bradshaw, 2016).

It is this acquired lack of fear of humans that enables dogs to form powerful social bonds with individual people: indeed, many dogs prefer the

company of a familiar person to that of a familiar dog (Tuber *et al.*, 1996). This in turn may be responsible for the relative ease with which dogs can be trained to perform a wide range of tasks, since in addition to rewards valued by other animals, such as food, they can be trained using human interaction alone to reinforce desirable behaviour (e.g. this method is widely employed in the training of military dogs; Rooney *et al.*, 2009). Dogs are also uniquely sensitive (among mammals, including non-human primates) to human gestures and general body language, to such an extent that it has been proposed that they are also capable of interpreting people's intentions, although evidence for the latter has been hard to come by (Range and Virányi, 2017).

14.3 The Companion Dog

The welfare of dogs kept as pets has not attracted a great deal of research attention, possibly because the devotion evident in the typical owner would seem to guarantee their well-being. Moreover, the dichotomy evident for most other domesticated animals, between the needs of the animal and the demands of their commercial exploiters (whether agribusiness, the pharmaceutical industry or misguided owners of zoos) is much more diffuse. Thus the well-being of a pet dog depends critically on how each owner perceives its needs.

There are several underlying motivations for acquiring a dog (Hirschman, 1994). Today, the most common is for companionship, the dog being perceived as a friend and a 'member of the family', although there are subtle distinctions here between canines and humans (Bradshaw, 2017, Chapter 5) – for example, in the West euthanasia of pet dogs is socially acceptable whereas euthanasia of children is not. Occasionally, the distinction between owner and pet can become blurred, as seems to occur in animal hoarders (Steketee *et al.*, 2011). Originally, dogs were more likely to serve more practical purposes, their primary functions being hunting, herding or guarding; in the developed world only a minority of dogs still fulfil such roles; however, in developing countries these roles are still common and valued. Dogs may also act as status symbols of various kinds, perhaps the most notorious being dogs trained for fighting. A small minority of owners breed pedigree dogs specifically for exhibition and sale: although not typical of the average dog owner, in the West these individuals exercise a

disproportionate influence on the genetics of pet dogs, about three-quarters of which have pedigrees, and many others are crosses between two or three breeds.

The companionship that a dog can provide is evidently rewarding enough to sustain a relationship over many years, which contrasts with the typically much more labile approach to other treasured but inanimate possessions, such as electronic gadgets. The precise nature of the 'payback' that pet dogs provide has not been comprehensively characterized, but may consist of several interacting elements (Dotson and Hyatt, 2008). Stroking a dog is followed by the release of hormones such as oxytocin and β -endorphin, accompanied by a feeling of relaxation (Odendaal and Meintjes, 2003; Miller *et al.*, 2009). Simply caring for a dog appears to be rewarding in itself, the dog's evident enjoyment of the meal provided or the shared walk providing the necessary positive feedback. For many owners, dogs provide a unique form of companionship that has been characterized, in comparison to human company, as 'non-judgemental', predictable, independent of the owner's social status, and unlikely to be excessively demanding (Antonacopoulos and Pychyl, 2008). Many owners also discover that their dogs are highly effective as social bridges with other people (see Fig. 14.1), partly because simply being seen with a dog enhances apparent trustworthiness (Wood *et al.*, 2015).

While owners clearly distinguish between their dogs and the human members of their families – for example, they use a unique variation on 'motherese' when talking to their dogs (Ben-Aderet *et al.*, 2017) – their comprehension of their dog's mind is essentially anthropomorphic: they imagine that their dogs have human-like senses, emotions, and thought processes (see Chapter 18, this volume). Since the carnivore brain is constructed differently to the primate brain, this can only be an approximation, albeit one that has evidently served both species well enough in the past. However, recent advances in scientific understanding of dogs' minds (Range and Virányi, 2017) have revealed that many of these assumptions are unjustified: some of the discrepancies have little impact on welfare, but others do, as the following two examples show.

Owners' perceptions of dogs' emotional lives are partially at odds with the predictions of science. Biologists and owners agree that dogs are capable of such basic emotions as joy, affection, fear, and anxiety – although, worryingly, one owner in five

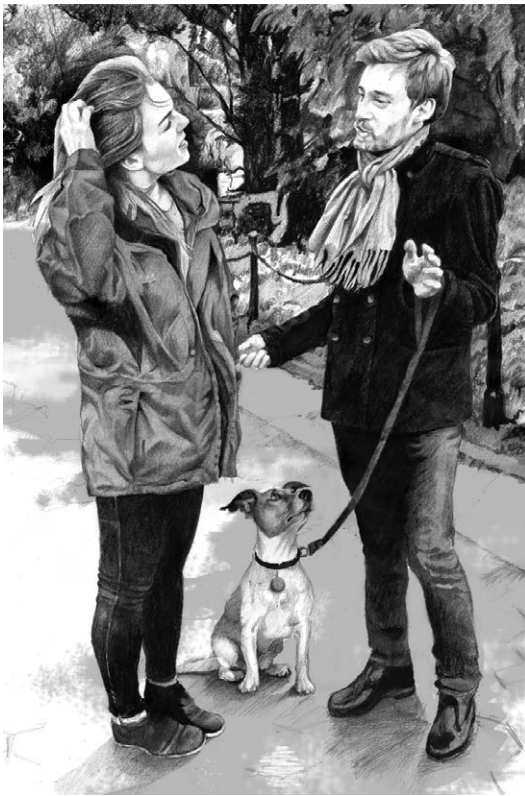


Fig. 14.1. The inclusion of a dog enhances apparent trustworthiness (see Guéguen and Ciccotti, 2008). (From Bradshaw, 2017; copyright Alan Peters, used with permission.)

seems not to believe that their dog ever feels anxious (Morris *et al.*, 2008). Three-quarters of owners hold that their dogs can feel guilt, an emotion that requires retrieval of a memory and comparison of that memory with an internal standard of ‘acceptable’ behaviour, which at least in humans is a product of consciousness. In experimental manipulations of situations in which a dog should or should not feel guilt, the behaviour of dogs confronted by their owners who have been led to believe that the dog has something to feel guilty about indicates that the ‘guilty’ behaviour of dogs is much more likely to be a reaction to the owner’s immediate body language (Horowitz, 2009). This misconception is likely to have undesirable consequences for the dog: if the owner’s perception that the dog ‘knows what he’s done wrong’ while she has been away leads to punishment, whether physical or simply verbal, the dog is highly unlikely to make the required connection,

but instead will learn that sometimes he is punished when his owner returns, other times he is greeted effusively, and his resulting inability to predict which will occur can in itself lead to chronic stress (Casey *et al.*, 2007).

Until the latter part of the 20th century, mainstream dog training relied on the concept that in cognitive terms a dog was little different from a wolf, and required punishment before it would ‘respect’ and thereby obey its owner. This idea is now known to be conceptually flawed on two levels: first, it is based on observations of wolf behaviour made under highly abnormal circumstances, and second, on an anthropomorphic presumption that dogs are capable of comprehending their ‘status’ within the household (Bradshaw *et al.*, 2009, 2016). Beginning with studies by Rudolf Schenkel in the 1940s, the 20th-century conception of wolf social structure was based almost entirely on artificially assembled groups in zoos, a situation likened by David Mech (1999) to basing all understanding of human behaviour on studies conducted in refugee camps. In captivity, wolves use aggressive behaviour to suppress breeding by other members of the group, resulting in a clear fear-based dominance hierarchy, which was adopted as homologous with the master–dog relationship, and thus used to justify forceful training methods. After studying wolves in the wild, Mech (1999) deduced that the normal social structure of the pack is that of a breeding pair, assisted by their young from previous seasons. Although wolves from neighbouring packs can be as aggressive towards one another as are wolves in zoos, aggression within a natural pack is rare: the younger adults remain in the pack voluntarily, rather than being forced to do so by an enclosure or by some undefined coercion from their parents. This new conception of wolf sociality supports reward-based methods for training dogs, and fits with the observation that dogs find human attention rewarding (Reisner, 2017). Also, these reward-based methods do not rely on the idea that dogs’ minds are capable of conceptualizing their ‘status’ in the household: dogs are superb observers of human behaviour, but it is still unclear whether dogs possess human-like theory-of-mind (Range and Virányi, 2017), and thus they may not be capable of realizing that their owners are thinking about them, which would be fundamental to any notion of ‘status’. Unfortunately, training methods based on dominance remain popular with the public, even though the escalation

of violence which they entail can result in both disobedient dogs and injury to owners (Rooney and Bradshaw, 2014).

Despite the long history of breeding types of dogs for specific functions, owners rely disproportionately on appearance when they choose a companion dog, with the most popular breeds at any one moment being determined by rapidly changing fashions (Ghirlanda *et al.*, 2013). Currently, the attribute with the strongest influence is ‘cuteness’, specifically the possession of a round, flattened face and large eyes, appealing because redolent of a human baby (Little, 2012; Bradshaw, 2017, Chapter 7), and exemplified by the brachycephalic breeds: the French bulldog, pug, and (British) bulldog are currently among the ten most popular breeds in the UK (Packer *et al.*, 2017), as are both bulldog breeds in the USA. This extreme distortion of the shape of the skull (brachycephalia) results in several congenital malformations that compromise the welfare of the dog. Although the bone supporting the airways is compressed, the associated soft tissue is not, and as a consequence these dogs have undersized openings to their nostrils, excessive folds of tissue within the nasal passages and on the larynx, and an oversized soft palate, tonsils, and tongue. Once they reach adulthood many can only breathe, inefficiently, through their mouths, and eventually the larynx may collapse, requiring surgery to prevent the dog from suffocating itself. Some are forced to sleep upright because their airways collapse whenever they lie down.

The problems experienced by brachycephalic dogs do not stop at difficulties with obtaining sufficient air. Their over-large ‘cute’ eyes, especially in the pug, are prone to injury and inflammation. They have insufficient space for their teeth in their foreshortened jaws, predisposing them to gum disease. In the UK at least, owners of such dogs appear to have disregarded all these potential welfare issues when choosing their dog, and may even perceive some of them – the ‘snuffly’ breathing, for example – as part of the inherent charm of the breed (Packer *et al.*, 2017).

Inherent welfare problems are by no means confined to breeds with flat faces. Loose-skinned breeds are prone to dermatitis, toy breeds to fractures of their delicate leg bones, breeds with deep chest cavities to gastric torsion; breeds with ‘corkscrew’ tails may suffer chronic spinal pain, and the mutations causing cosmetic hair ridges can lead to a predisposition to infection of the spinal cord (Rooney and Sargan, 2010).

All breeds, even those without any extremes of conformation, are prone to the deleterious effects of inbreeding: cross-breeds live longer than pedigree dogs. The insistence of the breed clubs that only ‘purebred’ dogs can be registered means that the effective gene pool within each breed is constantly shrinking, leading to an ever-increasing prevalence of inherited disorders, many of them caused by recessive genes. For example, another very popular companion breed, the Cavalier King Charles spaniel, suffers from several genetic diseases that can be ascribed to its very narrow genetic base, including mitral valve heart disease, and syringomyelia, a painful condition of the spinal cord in the neck that may affect up to 75% of older dogs. Despite the mounting evidence that inbreeding is progressively worsening the welfare of dogs, neither the breeders nor the dog-buying public seem to be sufficiently motivated to reverse this trend, which could be readily resolved by carefully planned outbreeding (merging of unrelated breeds).

14.4 Free-roaming Dogs

The welfare problems presented by inbreeding and selection for physical traits that cause inherent suffering are present around the world. However, the sight of dogs roaming freely on public property, a relatively rare occurrence in high-income countries, can be common elsewhere. Western visitors to developing countries may assume that a dog that is roaming without a visible owner must be an unowned dog. However, a review of literature reporting dog demographics in different countries noted that, in most cases, the proportion of ownerless dogs in these free-roaming populations is very low, with the highest proportions reported from South Asia (Davlin and Vonville, 2012). Norms for dog keeping vary between countries and, in many, confinement of owned dogs can be a minority practice, more similar to the keeping of pet cats in Europe where cat flaps and free ranging are the norm. For example: (i) in Ethiopia 72.6% of dogs in urban areas were allowed to roam during the day, and 89.2% in rural areas (Tschopp *et al.*, 2016); (ii) in Bolivia only 15% of dogs were reported to be confined at all times (Suzuki *et al.*, 2008); and (iii) in the rural villages surrounding the Serengeti, Tanzania, none of the owned dogs were reported to be confined by their owners, all being allowed to roam freely (Czupryna *et al.*, 2016) (Fig. 14.2).

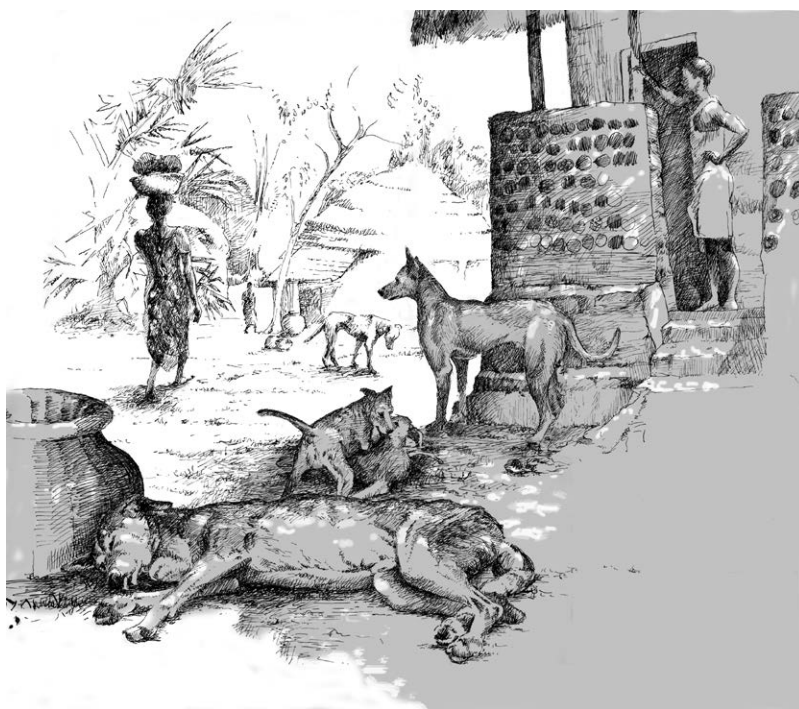


Fig. 14.2. Village dogs in Africa. (From Bradshaw, 2017; copyright Alan Peters, used with permission.)

Such variation between countries appears to be due to a combination of: (i) traditions of allowing dogs to free range; (ii) the need for dogs to supplement the food provided by their owners by foraging; and (iii) the logistical challenge of confinement where dog-proof fencing of private property is a rarity.

The free movement of owned dogs accounts for part of the free-roaming dog population, and in many countries, most of it. However, there are dogs that interact regularly with people without having a single referral household. Whereas the Western concept of dog ownership is dichotomous, a dog being either clearly owned by one household, or unowned, other cultures have a more liminal view of dogs, accepting a grey area between single household ownership and feral dogs that exist without direct reliance on humans (Arluke and Atema, 2016). Within this grey area exist those animals that can be termed ‘community dogs’. These are dogs that may be fed and cared for by more than one household; they are likely to be found on public property, foraging in garbage or receiving resources provided by sympathetic people. (A similar acceptance of ‘community’ ownership is also often seen with

domestic cats.) Such dogs may enjoy a reasonably reliable supply of food, provided there is tolerance for their presence. However, disease and misadventure is likely to cut their lives short, as provision of costly vet care is unlikely: one study of these dogs in Jaipur, India found an expected total lifespan of just 3.8 years for a spayed female (Reece *et al.*, 2008).

Truly feral dogs are at the extreme of the roaming dog population. These survive without reliance on purposeful resource provisioning by humans, although they may benefit from unintended resources such as discarded offal from slaughterhouses. Such dogs appear to be rare, and where they do occur, exist in relatively low numbers. Studies of these populations have also shown that their breeding is usually unsuccessful, with high mortality of both puppies and adults, their numbers instead being maintained by immigration from other subpopulations of dogs (Boitani *et al.*, 2016).

Breeding within community dog populations may be successful, providing a consistent source of the next generation of roaming dogs, although this is an understudied process and may be overestimated,

as pup mortality is also high (Pal *et al.*, 1998). An alternative source of roaming dogs is abandonment from the owned dog population. Reasons for abandonment of dogs to the streets may be similar to relinquishment of dogs to shelters in the UK, Australia and the USA; most commonly attributed to housing issues and owners' personal issues (Diesel *et al.*, 2010; Marston *et al.*, 2010; Weiss *et al.*, 2014, respectively). However, in Belgrade, Serbia, owners were more likely to cite financial issues (Vucinic *et al.*, 2009) and in Spain financial issues were joined by unwanted litters at the top of the list of reasons (Fatjó *et al.*, 2015). In the developing world, where reproduction control is very limited, it is presumed that unwanted litters play an even larger role in abandonment.

The welfare challenges facing roaming dogs can be very visible. Malnutrition, parasites and disease lead to thin dogs with visible skin problems; and obvious injuries may go untreated. These dogs can also pose a risk to public health through transfer of zoonotic diseases, bites, and involvement in road traffic accidents. As a result, there is usually a pressure to reduce their numbers. Unfortunately the control measures adopted may present their own welfare challenges. Culling of dogs in the streets may be done using methods such as shooting and strychnine poisoning; catching to remove dogs to a holding facility can involve methods that cause injury and distress, while the holding facilities themselves can lead to significant suffering and limited chances of rehoming.

Humane alternatives to these control methods try to focus on the sources of roaming dogs, as well as improving the welfare and reducing the risks presented by the current roaming population. Providing owners with access to spay/neuter services aims to limit unwanted litters and breeding behaviour. In locations where the presence of roaming dogs is well tolerated, these spay/neuter services are usually extended to include community dogs that are then released back to their community. Increasing the level of guardianship and care provided to owned and community dogs can improve their welfare and reduce their public health risk through vaccination and parasite treatment. Interventions may also target dog acquisition through controls on breeding and selling, and encouraging adoption, as well as trying to prevent abandonment.

Reproduction control through surgical sterilization is a vital part of humane dog population

management. There are many challenges to introducing this at the necessary scale and acceptable cost in the developing world, where companion animal veterinary services are novel and limited, exacerbated by the steep growth of dog ownership in emerging economies such as China and Brazil. The advent of new non-surgical options for fertility control in dogs is very welcome and this continues to be an active area of research (see Alliance for the Contraception of Cats and Dogs (n.d.) for updates on this field).

However, the ethical basis for the routine neutering of companion dogs, although undoubtedly extending lifespan (Hoffmann *et al.*, 2013), is becoming more ambiguous (Sandøe *et al.*, 2016). Where the boundaries of a household are sufficiently dog proof, and owners provide sufficient supervision outside of those boundaries, control of reproduction can be achieved by simple containment. In such a household, neutering may be carried out more for the benefit of the owner: bitches may be spayed to overcome the inconvenience of keeping the dog indoors when in season, and dogs castrated in the belief that it may make them less inclined to copulate with the legs of visitors to the household. From the dog's perspective, surgical sterilization is still an invasive procedure with associated discomfort, stress, and permanent physiological and behavioural alterations, and although spaying brings proven health benefits – through prevention of pyometra and uterine infections, castration may enhance the risk of several types of cancer and some diseases of the immune system in later life (Torres de la Riva *et al.*, 2013; Sundburg *et al.*, 2016).

14.5 Conclusions

We may presume that all dogs share the same capacity to suffer, and should be treated as sentient beings with the common capacity to feel a range of basic emotions from happiness through to fear. In assessing what circumstances are likely to trigger these emotions, it is reasonable to assume that dogs' cognitive capacities are also species-wide, even though historic breeding for behavioural traits may have led to some variation in their subjective priorities: for example, a Border collie may suffer more due to confinement than a Cavalier King Charles spaniel would. On these grounds, the welfare requirements of dogs should be similar whether that dog lives in a Western city or a village

in Africa. However, the most pressing needs for the improvement of their welfare will differ greatly depending on the circumstances the individual dog finds itself in.

Uniquely among domestic animals, dogs are exceptional in their ability to engage and bond with humans. This capacity produces significant benefits to their owners, both in making dogs trainable and thereby suited to a wide variety of tasks, and in providing companionship. Both in the past and to a large extent today, our perceptions of dogs have relied heavily on anthropomorphism. The recent strides made in the scientific understanding of dogs' cognitive and sensory capacities have opened up the possibility of a more direct comprehension of their welfare priorities. At the same time these have also helped to dispel some myths, including the misconceptions that have been used to justify the use of physical punishment in both formal and informal training of dogs.

In the West, where owners put considerable weight on the physical appearance of the dog when embarking upon ownership, breeders are inevitably driven to produce dogs that fit those expectations. However, they also have the responsibility to balance this with the welfare needs of dogs, which deserve a physicality that is fit for purpose and capable of providing a body able to carry a dog into old age.

What may initially appear to be a homogenous group of roaming dogs on public property turns out to consist of several subpopulations of dogs with differing relationships with people, although all reliant on resources that people provide, intentionally or otherwise. Humane management of these dogs requires an understanding of their varying sources. However, one common element is control of reproduction, to ensure that the numbers of the next generation of dogs are in balance with the homes and communities that can provide adequate guardianship. When applied alongside vaccination and parasite control to mitigate the risks dogs present to humans (and at the same time enhancing the dogs' welfare), a more harmonious relationship between people and dogs becomes possible. Where communities accept roaming dogs as part of their ecology, this harmony may be found even while dogs continue to roam. However, the capacity to provide adequate veterinary interventions varies considerably and hence tensions between roaming dogs and people still exist in many places.

References

- Alliance for the Contraception of Cats and Dogs (n.d.) Available at: www.acc-d.org (accessed 24 February 2018).
- Antonacopoulos, N.M.D. and Pychyl, T.A. (2008) An examination of the relations between social support, anthropomorphism and stress among dog owners. *Anthrozoös* 21, 139–152.
- Arluke, A. and Atema, K. (2016) Understanding and reducing cruelty toward roaming dogs. In: Brewster, M. and Reyes, C. (eds) *Animal Cruelty: A Multidisciplinary Approach to Understanding*. Carolina Academic Press; Durham, North Carolina, pp. 233–247.
- Ben-Aderet, T., Gallego-Abenza, M., Reby, D. and Mathevon, N. (2017) Dog-directed speech: why do we use it and do dogs pay attention to it? *Proceedings of the Royal Society B* 284, 20162429.
- Boitani, L., Francisci, F., Ciucci, P. and Andreoli, G. (2016) The ecology and behavior of feral dogs: a case study from central Italy. In: Serpell, J. (ed.) *The Domestic Dog: Its Evolution, Behavior and Interactions with People*. Cambridge University Press, Cambridge, pp. 342–368.
- Bradshaw, J.W.S. (2016) Sociality in cats: a comparative review. *Journal of Veterinary Behavior* 11, 113–124.
- Bradshaw, J.W.S. (2017) *The Animals Among Us: The New Science of Anthrozoology*. Allen Lane, London.
- Bradshaw, J.W.S., Blackwell, E.-J. and Casey, R.A. (2009) Dominance in domestic dogs – useful construct or bad habit? *Journal of Veterinary Behavior* 4, 135–144.
- Bradshaw, J.W.S., Blackwell, E.-J. and Casey, R.A. (2016) Dominance in domestic dogs: a response to Schilder *et al.* (2014). *Journal of Veterinary Behavior* 11, 102–108.
- Casey, R.A., Twells, C. and Blackwell, E.J. (2007) An investigation of the relationship between measures of consistency in owners and the occurrence of 'behavior problems' in the domestic dog. *Journal of Veterinary Behavior* 2, 83–84.
- Clutton-Brock, J. (2017) Origins of the dog: the archaeological evidence. In: Serpell, J. (ed.) *The Domestic Dog: Its Evolution, Behavior and Interactions With People*. Cambridge University Press, Cambridge, pp. 7–21.
- Czupryna, A.M., Brown, J.S., Bigambo, M.A., Whelan, C.J., Mehta, S.D. *et al.* (2016) Ecology and demography of free-roaming domestic dogs in rural villages near Serengeti National Park in Tanzania. *PLOS One* 11, e0167092.
- Davlin, S.L. and Vonville, H.M. (2012) Canine rabies vaccination and domestic dog population characteristics in the developing world: a systematic review. *Vaccine* 30, 3492–3502.

- Diesel, G., Brodbelt, D. and Pfeiffer, D.U. (2010) Characteristics of relinquished dogs and their owners at 14 rehoming centers in the United Kingdom. *Journal of Applied Animal Welfare Science* 13, 15–30.
- Dotson, M.J. and Hyatt, E.M. (2008) Understanding dog–human companionship. *Journal of Business Research* 61, 457–466.
- Fatjó, J., Bowen, J., García, E., Calvo, P., Rueda, S. *et al.* (2015) Epidemiology of dog and cat abandonment in Spain (2008–2013). *Animals* 5, 426–441.
- Freedman, A.H. and Wayne, R.K. (2017) Deciphering the origin of dogs: from fossils to genomes. *Annual Review of Animal Biosciences* 5, 281–307.
- Ghirlanda, S., Acerbi, A., Herzog, H. and Serpell, J.A. (2013) Fashion vs. function in cultural evolution: the case of dog breed popularity. *PLOS One* 9, e74770.
- Guéguen, N. and Ciccotti, S. (2008) Domestic dogs as facilitators in social interaction: an evaluation of helping and courtship behaviours. *Anthrozoös* 21, 339–349.
- Hirschman, E.C. (1994) Consumers and their animal companions. *Journal of Consumer Research* 20, 616–632.
- Hoffman, J.M., Creevy, K.E. and Promislow, D.E.L. (2013) Reproductive capability is associated with lifespan and cause of death in companion dogs. *PLOS One* 8, e61082.
- Horowitz, A. (2009) Disambiguating the ‘guilty look’: salient prompts to a familiar dog behaviour. *Behavioural Processes* 81, 447–452.
- Hughes, J. and Macdonald, D.W. (2013) A review of the interactions between free-roaming domestic dogs and wildlife. *Biological Conservation* 157, 341–351.
- Little, A. (2012) Manipulation of infant-like traits affects perceived cuteness of infant, adult and cat faces. *Ethology* 118, 775–782.
- Marston, L.C., Bennett, P.C. and Coleman, G.J. (2010) What happens to shelter dogs? An analysis of data for 1 year from three Australian shelters. *Journal of Applied Animal Welfare Science* 7, 27–47.
- Mech, L.D. (1999) Alpha status, dominance, and division of labor in wolf packs. *Canadian Journal of Zoology* 77, 1196–1203.
- Miller, S., Kennedy, C., DeVoe, D., Hickey, M., Nelson, T. and Kogan, L. (2009) An examination of changes in oxytocin levels in men and women before and after interaction with a bonded dog. *Anthrozoös* 22, 31–42.
- Morris, P.H., Doe, C. and Godsell, E. (2008) Secondary emotions in non-primate species? Behavioural reports and subjective claims by animal owners. *Cognition & Emotion* 22, 3–20.
- Odendaal, J. and Meintjes, R. (2003) Neurophysiological correlates of affiliative behaviour between humans and dogs. *The Veterinary Journal* 165, 296–301.
- Packer, R.M.A., Murphy, D. and Farnworth, M.J. (2017) Purchasing popular purebreds: investigating the influence of breed-type on pre-purchase motivations and behaviour of dog owners. *Animal Welfare* 26, 191–201.
- Pal, S.K., Ghosh, B. and Roy, S. (1998) Dispersal behaviour of free-ranging dogs *Canis familiaris* in relation to age, sex, season and dispersal distance. *Applied Animal Behaviour Science* 61, 123–132.
- Range, F. and Virányi, Z. (2017) Social cognition and emotions underlying dog behaviour. In: Serpell, J. (ed.) *The Domestic Dog: Its Evolution, Behavior and Interactions With People*. Cambridge University Press, Cambridge, pp. 182–209.
- Reece, J.F., Chawla, S.K., Hiby, E.F. and Hiby, L.R. (2008) Fecundity and longevity of roaming dogs in Jaipur, India. *BMC Veterinary Research* 4, 6. DOI: 10.1186/1746-6148-4-6
- Reisner, I. (2017) The learning dog: a discussion of training methods. In: Serpell, J. (ed.) *The Domestic Dog: Its Evolution, Behavior and Interactions With People*. Cambridge University Press, Cambridge, pp. 210–226.
- Rooney, N.J. and Bradshaw, J.W.S. (2014) Canine welfare science: an antidote to sentiment and myth. In: Horowitz, A. (ed.) *Domestic Dog Cognition and Behavior: The Scientific Study of Canis familiaris*. Springer, Berlin, Germany, pp. 241–274.
- Rooney, N.J. and Sargan, D.R. (2010) Welfare concerns associated with pedigree dog breeding in the UK. *Animal Welfare* 19(S1), 133–140.
- Rooney, N., Gaines, S. and Hiby, E. (2009) A practitioner’s guide to working dog welfare. *Journal of Veterinary Behavior* 4, 127–134.
- Sandøe, O., Corr, S. and Palmer, C. (2016) *Companion Animal Ethics*. Wiley, Chichester, UK.
- Serpell, J.A., Duffy, D.L. and Jagoe, J.A. (2017) Becoming a dog: early experience and the development of behaviour. In: Serpell, J. (ed.) *The Domestic Dog: Its Evolution, Behavior and Interactions With People*. Cambridge University Press, Cambridge, pp. 93–117.
- Smith, B.P., Browne, M. and Serpell, J.A. (2017) Owner-reported behavioural characteristics of dingoes (*Canis dingo*) living as companion animals: a comparison to ‘modern’ and ‘ancient’ dog breeds. *Applied Animal Behaviour Science* 187, 77–84.
- Steketee, G., Gibson, A., Frost, R.O., Alabiso, J., Arluke, A. and Patronek, G. (2011) Characteristics and antecedents of people who hoard animals: an exploratory comparative interview study. *Review of General Psychology* 15, 114–124.
- Sundburg, C.R., Belanger, J.M., Bannasch, D.L., Famula, T.R. and Oberbauer, A.M. (2016) Gonadectomy effects on the risk of immune disorders in the dog: a retrospective study. *BMC Veterinary Research* 12, 278.
- Suzuki, K., Pereira, J.A.C., Frías, L.A., López, R., Mutinelli, L.E. and Pons, E.R. (2008) Rabies-vaccination coverage and profiles of the owned-dog population in Santa Cruz de la Sierra, Bolivia. *Zoonoses and Public Health* 55, 177–183.

- Torres de la Riva, G., Hart, B.L., Farver, T.B., Oberbauer, A.M., Messam, L.L.M. *et al.* (2013) Neutering dogs: effects on joint disorders and cancers in golden retrievers. *PLOS One* 8(2), e55937.
- Tschopp, R., Bekele, S. and Aseffa, A. (2016) Dog demography, animal bite management and rabies knowledge – attitude and practices in the Awash Basin, Eastern Ethiopia. *PLOS Neglected Tropical Diseases* 10, e0004471.
- Tuber, B.S., Hennessy, M.B., Sanders, S. and Miller, J.A. (1996) Behavioral and glucocorticoid responses of adult domestic dogs (*Canis familiaris*) to companionship and social separation. *Journal of Comparative Psychology* 110, 103–108.
- Vucinic, M., Djordjevic, M., Teodorovi, R., Jankovi, L., Radenkovic-Damnjanovic, B. and Radisavljevic, K. (2009) Reasons for relinquishment of owned dogs in a municipal shelter in Belgrade. *Acta Veterinaria* 59, 309–317.
- Wayne, R.K. and vonHoldt, B.M. (2012) Evolutionary genomics of dog domestication. *Mammalian Genome* 23, 3–18.
- Weiss, E., Slater, M., Garrison, L., Drain, N., Dolan, E. *et al.* (2014) Large dog relinquishment to two municipal facilities in New York City and Washington, DC: identifying targets for intervention. *Animals* 4, 409–433.
- Wood, L., Martin, K., Christian, H., Nathan, A., Lauritsen, C. *et al.* (2015) The pet factor – companion animals as a conduit for getting to know people, friendship formation and social support. *PLOS One* 10(4), e0122085.

15 Animal Experience of Domestication

XAVIER BOIVIN

15.1 Introduction

The present period is fascinating for those who are interested in the human–animal relationships. Ethical debate is taking place in many organizations and governments about the many uses/abuses of animals; whether they produce food, clothes, or are used for work, company, or leisure. In recent years, animals have been legally defined as sentient beings in many national and transnational regulations. What does this change from a domestication perspective? Many of these animals in close contact with humans have come from a very long process of domestication where these ethical questions were very often disregarded. Through generations, domesticated species have been impacted by the various socio-historical contexts in which they live. As examples, most of the present breeds of dogs, horses, and cattle were created in the second half of the 19th century, alongside the development of modern conceptions in animal husbandry and controlled breeding practices. As with the production of other goods, animals were considered biological ‘machines’ for producing milk, meat, and so on, and with the great increase in human populations, the availability and economic issues of human food resources became more and more critical. However, at the same time, the present societal context more strongly questions animal status in our society and related welfare practices for animals which are now recognized for their sentience.

One important aspect to consider is how societal demands can affect the domestication process and, in detail, how this affects our domestic animals compared with their wild counterparts. This chapter tries to address this difficult, but important question. To do that, different ‘conceptions’ of domestication will be discussed. As the human–animal relationship is central to the domestication process, domestication from a modern ethological point of view will also be considered. The need to explore the animal perception of the human will be highlighted.

However, the main focus will be how domestication can affect the behavioural and experiential world of the animals compared with those in the wild. Finally, what this perspective could change in the way that animal domestication processes are considered will be discussed (Fig. 15.1).

15.2 How Should the Process of Animal Domestication Be Considered?

The definition of domestication is controversial. Among other points of view, Digard (2009) considered that the domestication process results from the insatiable motivation of humans to control and to use their natural environment to dominate what can be called ‘Nature’ for human profit. By contrast, Budiansky (1994) asked ‘who used whom?’, highlighting the mutual benefit humans and animals received from each other. Indeed, all ecosystems on earth are now strongly influenced by human activities. Many wild species live in close contact with humans without having been domesticated, such as the rat population – which has strongly developed today in megalopolises. Many imported species reared in captivity have escaped from human control, and now persistently affect surrounding ecosystems, such as possums in New Zealand, which now endanger the national symbol, the kiwi. From this point of view, domestic animals could be considered to have been proactive in their process of domestication, adapting and expanding beyond human control ‘after’ domestication. As with other animal populations in the wild, some specific animals were able to adapt to a new ecological niche, the ‘human niche’, thanks to predispositions to, for example: (i) a reduced fearfulness in early age; (ii) better sociability; and (iii) the capacity to live in large groups in captive conditions.

From a biological point of view, as discussed by Price (1999), it is important to consider domestication as an ongoing process of population adaptation to



Fig. 15.1. We can be blind to animal partnerships. (Image credit: Xavier Boivin.)

the human environment. It results from genetic selection in combination with individual adaptive changes recurring at each generation during the individual's life. The existence of sensitive periods during which an animal could more easily accept a human 'partnership' is of course very important in the domestication process. For example, recent research in cattle has demonstrated that avoidance distance and response to handling in the corner of a corral pen, or in the weighing scale raceway, have inherited determinism (Benhajali *et al.*, 2010). Interestingly, if responses to handling in different situations are genetically related, this does not seem to be the case with avoidance distance (Vénot *et al.*, 2015). This suggests that two distinct traits exist that are involved in what can be called animal docility: (i) the acceptance to be closely approached; and (ii) the reaction to strong constraints such as catching. Some cattle have strong active defences against predators, and to sources of disturbance. However, a strong genetic–environment interaction exists (Boivin *et al.*, 1994). These genetic predispositions can be totally masked by individual life history, until a favourable environment allows their expression. This is clearly the case, for example, for cattle that could be much more defensive towards humans when reared in outdoor conditions with a minimum level of human contact. If expressed, some of the domestic traits can be voluntarily biased by the human driver of the selection. However, as genetic selection processes include several traits, many others

may involuntarily be co-selected. These characteristics could also appear along successive generations, through genetic drift, and due to isolation from other populations of the species population.

15.3 Human–Animal Relationship: the Usefulness of an Ethological Definition

The different points of view about domestication have in common a tendency to question the nature of human–animal relationships, their definitions, their mechanisms of development, and their consequences for each partner of the relationship. From existing literature, Estep and Hetts (1992) discussed different classifications of these human–animal relationships from predator–prey to symbiotic relationships. These authors place an emphasis on the usefulness of retaining an ethological definition of human–animal relationship. Such a definition has, in the past, been based on the conceptual view of inter-individual relationships (Hinde, 1976): an inter-individual relationship results between different partners that regularly meet each other. From past experience, it becomes possible to predict the likely shape of the future interactions. This can be true for an observer who tries to describe and understand the developing 'domestication' relationship. This can also be particularly important for each partner of the relationship, as each may be able to anticipate and adapt its behaviour and communication to the other one.

The existence of emotions and consciousness in animals are now strongly discussed and argued in the scientific field (Low, 2012; Le Neindre *et al.*, 2017). Each interaction between humans and animals generates a functional perception of the other partner of the relationship. Of course, depending on the emotional and cognitive abilities of each individual, this representation is highly variable between, but also within species. This way to consider human–animal relationship is particularly useful when interacting with a different species. For example, it has been demonstrated that dogs are much more efficiently able to follow human gesture cues than wolves or chimps (Hare *et al.*, 2002). Dogs are particularly able to follow the human gaze. Oxytocin release, a hormone known to be strongly involved in bonding processes, is associated with this interaction process (Nagasawa *et al.*, 2015). According to these authors, this may have particularly strongly influenced the process of dog domestication. From our research at the Institut National de la Recherche Agronomique (INRA) research centre of Clermont-Ferrand, our group firmly believe that our understanding of human–animal relationships, and of domestication processes, can benefit strongly from considering not only the human point of view but also the animal point of view from an ethological perspective (Fig. 15.2).

15.4 Domestication, Animal Sentience and Animal Welfare

The central question of this chapter is how domestication can affect the behavioural and experiential world of domesticated animals when compared with those in the wild. And in a reverse question, how animal welfare considerations could influence the domestication process.

According to what was discussed in the previous part of this chapter, it is very difficult to describe domestication as a unitary phenomenon whatever the species being considered. The result of a domestication process will depend on several parameters: (i) the environment where domestication occurs; (ii) the predispositions of the animal population involved; (iii) the human population's needs; and (iv) the human skills available to successfully 'tame' the animals and manage their breeding and selection (Fig. 15.3). In addition, by contrast to what is commonly understood, domesticated animal populations are perpetually re-undergoing the process of domestication. Throughout human history and all over the world, the husbandry environment, and the human motivations to 'domesticate' animals were, and are still, changing. Any local conditions can affect the domestication process. One particularly important revolution in the last few decades



Fig. 15.2. We need to understand animal perception of 'the human'. (Image credit: Xavier Boivin.)

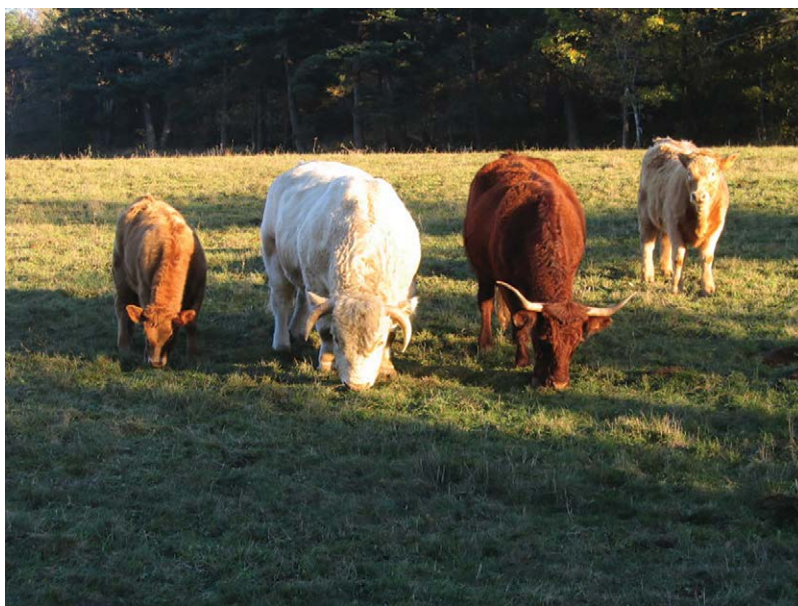


Fig. 15.3. There is great diversity among cattle breeds, and each has had a slightly different route of genetic selection, as the domestication process depends on several parameters (see text). (Image credit: Xavier Boivin.)

has been the potential to artificially control reproduction, even to the extent of cloning individuals, and then being able to facilitate the ‘reproduction’ process of the most interesting individual animals from a human point of view. This may give humans the impression that they ‘control’ the whole process, and favours the arguments of Digard (2009) about this very human tendency to satisfy the needs of power over ‘Nature’.

Domestic animals, for example laying hens in cage systems, are able to show high survival abilities, despite intensive farming conditions, in conditions very far from those seen by their ancestors. Considering the dynamic of population (high numbers of individuals), and fitness scores (‘fitness’ as defined by the number of animals ‘surviving’), it could be argued that domestic hen populations have a very high reproductive success compared with their wild ancestors. The same argument could be used for feedlot cattle, or for dairy farms, with thousands of cows or pigs or broiler chicken, with hundreds of thousands of animals. Even in outdoor conditions, flocks of hundreds of thousands of sheep exist, for example in Patagonia, very far from the usual herd size of their wild ancestors. So, from an ecological point of view, it could be considered that this process has offered a huge evolutionary

benefit and a measure of success for these populations. This could be considered a very significant benefit for the animal populations compared with wild ones, which have even sometimes disappeared and become extinct, such as the wild auroch (*Bos primigenius*). However, ecology and the study of population dynamics, until recently, did not consider the individual animal point of view, and the importance of individual animal sentience.

Applied ethologists, interested in animal individual perceptions, have observed what happens when domestic animals are placed into totally different environments from those they were selected for. For example, laboratory rodents have been selected to be very homogeneous in the genetic and morphological make-up so that they can be used in experiments around the world. These animals have been ‘standarized’ as materials for research, and are kept with the same food and physical environment. The Ratlife project from the University of Oxford (Ratlife, 2017) investigated how rats can adapt to a free-ranging and varied environment. Despite generations of selection, rats from different genetic lines were ready to express behaviours very similar to their conspecifics in the wild regarding food search, shelter, response to predators, etc. These findings were in line with many other observations

of domestic populations that have become feral after they have been lost (or abandoned), free from human control. Many of these animals have died in the wild, but those which survived, have shown adaptive behaviours towards their new environment. The conclusion of these observations has been that domestication does not completely delete many behavioural competencies, and that these characteristics can be revealed by changing animal environments, and when the animals test their ability to use them.

At this point, it is time to introduce animal welfare when considering animal domestication. The well-known five freedoms proposed by Brambell in 1965 (Brambell, 1965) and formalized by the UK Farm Animal Welfare Council identified an animal's primary welfare needs and fed into the creation of the World Organization for Animal Health (OIE) standards, influencing animal welfare at an international level. Good feeding, housing, and health were terms which, in general, received common agreement as to their value to animal lives. In contrast, the absence of fear or distress or the freedom to express normal patterns of behaviour remain more likely sources of debate and misunderstanding. Are avoidance of these (fear, distress) really primary welfare needs? Is it necessary to avoid any source of fear? What is 'normal'? Many scientists and citizens agreed that 'normal' has often been referenced to natural behaviours (Wechsler, 2007). However, Wechsler (2007) commented that in husbandry systems with artificial structures, behaviours towards this man-made environment cannot always be considered in reference to the natural repertoire of the species. In the same direction of thought, van de Weerd and Day (2009) stated that 'normal suggests behaviour that is not abnormal; stereotypic and other abnormal behaviours such as tail chewing are undesirable and a sign of poor welfare'. Regarding domestication processes which are central to this chapter, these last authors stated: 'Although domesticated farm animals usually retain the ability to show the natural behaviour of their progenitors, their behavioural needs and repertoire on a farm can differ markedly from those of their ancestors.' This is really a key aspect of the discussion here in this chapter and a major difficulty when considering animal welfare in relation to domestication. On the one hand, it is probably important to increase our knowledge from wild ancestors of our domestic species, as a source of understanding of what would be required to fulfil

domesticated animals' behavioural needs, and so to improve animal welfare. On the other hand, due to the important variability between individuals, and populations within the same species, it seems impossible to consider the behavioural repertoire of animals in a wild context as 'the gold standard'. In any case, behavioural needs are usually observed at an individual or group level by using animal-based criteria (behaviour, physiology, etc.) – deficiencies in these sometimes reflecting important deficiencies for the animal (Dawkins, 1988; Jensen and Toates, 1997; Jensen, 2000). Consequently, a huge literature now exists on the benefit of enriching domestic animal environments (Newberry, 1995; Boissy *et al.* 2007; van de Weerd and Day, 2009). Enrichment can be defined as a modification of the environment for the benefit of the animal, reducing inappropriate behaviour, stimulating positive emotional responses and cognitive functions, and increasing the complexity of the behavioural repertoire.

15.5 Animal Domestication, Human–Animal Relationships and Animal Welfare

As discussed earlier in this chapter, one important aspect of animal domestication relies on the development of human–animal relationships. The Farm Animal Welfare Council (1992) stated that good stockmanship is probably one of the major keystones to efficient improvements in animal welfare. Hemsworth and Coleman (2011) demonstrated that the stockperson–animal interaction can induce learned fear responses towards humans in farm animals, which can affect animal production, health and welfare. These authors also, importantly, identified that how the farmer interacts with his/her animals also affects work efficiency and job satisfaction (Fig. 15.4a and b). In the same vein of thought, David Fraser (2016) promotes the concept of 'One Welfare' inspired from the concept of 'One Health', noting that human welfare and animal welfare are very strongly interconnected in many activities.

In relation to animal domestication and animal welfare concerns, the idea that each stockperson is responsible for their own human–animal relationships could be defended. As with other production practices, they could and should develop what can be called 'relational practices' with their animals in order to work efficiently with them. They should



Fig. 15.4. Positive human–animal interaction occurs often (a and b). (Image credit: Xavier Boivin.)

take into account the fact that animals are sentient partners in the relationship, and that the humans need to ensure the animals' welfare. Farmers, and many other humans who work with animals, develop professional relationships with their animals. This means that humans 'work together with their animals', and this helps to ensure an income from their professional activities. In animal production, husbandry practices have been defined as 'voluntary strategies' including a succession of technical choices for a farm (and its animals) to reach their production objectives, such as milk or meat production (Landais *et al.*, 1986). Of course these choices depend on each farmer's outlook and approach, mixing personal and professional choices. The actual impact on the animals will depend on specific available resources, such as, for example, the competencies of the staff. Maybe a farmer working with animals needs to develop deliberate relational practices around the animals in order to build a meaningful relationship with them and to optimize the human–animal relationship.

Building relational practices would require, in our research group's opinion, reference to the ethological view of the human–animal relationship. From the products (domesticated animals) of the domestication process, it is clear that some animals have genetic predispositions to react more positively to humans and to their domestic environment. These animals should be carefully chosen, so that the 'domesticated' animals which continue to be farmed are those which most suit domestication. As farm sizes increase and the number of animals bred also increases, the number of animals cared for by each person also increases. There is an inherent

risk that the proximity of humans required to maintain 'domestication' can become eroded. The human–animal relationship is built from all interactions between the two partners through their whole life. Sensitive periods have been demonstrated during development, and also during particular periods of disturbance, such as the abrupt separation between young and their dams at weaning (for review see Boivin *et al.*, 2003). Both partners, humans and animals, express emotional responses associated with these interactions, and both have a functional representation of their partners that will allow them to predict the direction of future interactions (Waiblinger *et al.*, 2006; Hemsworth and Boivin, 2011). The ratio between positive and negative interactions should be largely in favour of 'rewarding ones' to promote what can be called 'positive animal representation of the human partner'. A number of studies in several species (horses, cattle, sheep) have provided evidence of a maternal or social influence from adult animals to young. This social context needs to be particularly considered with regard to domestication. Indicators of the quality of the relational practices can be found in classical production or health parameters, but also in animal responses to humans and handling, and in 'science-based' indicators of welfare found, for example in the Welfare Quality® programme. These relational practices are fully in line with the thoughts of Price (1999) where it is probably important to consider domestication as an 'ongoing process' of population adaptation, sensitive to failures of human understanding of this 'ongoing requirement' for a 'positive animal representation of the human partner'.

15.6 Conclusions

To conclude this chapter, our research group proposes a final idea which may be viewed as in contrast with many common views on the role of the human in an animal production system. We would support the idea that the domestication process could lead to a positive perception of the stockperson for farm animals, a source of enrichment, safety, and positive emotions for the animals rather than a source of disturbance. We have been studying the human–animal relationship for a long time, and we have commonly observed handling behaviours (forced herding, goading, movements based on fear responses) based on aversive interactions between humans and animals. However, we now strongly believe from our work, especially on artificially reared animals (for review see Hemsworth and Boivin, 2011; Nowak and Boivin, 2015), that it is possible to rear animals that would perceive the human presence as predictable and reassuring. Farm animals as sentient beings are able to anticipate the behaviours of their human partners. Genetic selection to improve animal predispositions, when combined with automatic monitoring, could actively reduce aversive human interactions and save time for increasingly positive stockperson–animal interactions. This spare time (spare human time) could be reinvested in relational practices, allowing durable reinforcement of the human–animal relationship. In the societal debate about animal welfare, farmers often say that they are responsible for their animals, and developing these positive relational practices for the ‘domesticated’ animals on which they depend, could help them to reinforce their image of responsibility.

References

- Benhajali, H., Boivin, X., Sapa, J., Pellegrini, P., Boulesteix, P. *et al.* (2010) Assessment of different on-farm measures of beef cattle temperament for use in genetic evaluation. *Journal of Animal Science* 88, 3529–3537.
- Boissy, A., Manteuffel, G., Jensen, M.B., Moe, R.O., Spruijt, B. *et al.* (2007) Assessment of positive emotions in animals to improve their welfare. *Physiology & Behavior* 92, 375–397.
- Boivin, X., Le Neindre, P., Garel, J.P. and Chupin, J.M. (1994) Influence of breed and rearing management on cattle reactions during human handling. *Applied Animal Behaviour Science* 39, 115–122.
- Boivin, X., Lensink, J., Tallet, C. and Veissier, I. (2003) Stockmanship and farm animal welfare. *Animal Welfare* 12, 479–492.
- Brambell, R. (1965) *Report of the Technical Committee to Enquire Into the Welfare of Animals Kept Under Intensive Livestock Husbandry Systems* (Great Britain. Parliament). Volume 2836 of Command papers. HMSO, London, pp. 1–84.
- Budiansky, S. (1994) *The Covenant of the Wild: Why Animals Chose Domestication*. Yale University Press, New Haven, Connecticut.
- Dawkins, M. (1988) Behavioural deprivation: a central problem in animal welfare. *Applied Animal Behaviour Science* 20, 209–225.
- Digard, J.-P. (2009) *L'Homme et les Animaux Domestiques : Anthropologie d'une Passion*. Fayard, Paris.
- Estep, D.Q. and Hetts, S. (1992) Interactions, relationships, and bonds: the conceptual basis for scientist–animal relations. In: Davis, H. and Balfour, D. (eds) *The Inevitable Bond: Examining Scientist–Animal Interactions*. Cambridge University Press, Cambridge, pp. 6–26.
- Farm Animal Welfare Council (1992) FAWC updates the five freedoms. *Veterinary Record* 17, 357.
- Fraser, D. (2016) Available at: <https://www.oie.int/fr/animal-welfare-conf2016/Abstracts/2.1.%20Fraser.pdf> (accessed 30 October 2017).
- Hare, B., Brown, M., Williamson, C. and Tomasello, M. (2002) The domestication of social cognition in dogs. *Science* 298, 1634–1636.
- Hemsworth, P.H. and Boivin, X. (2011) Human contact. In: Appleby, M.C., Mench, J.A., Olsson, I.A.S. and Hughes, B.O. (eds) *Animal Welfare*. CAB International, Wallingford, UK, pp. 246–262.
- Hemsworth, P.H. and Coleman, G.J. (2011) *Human–Livestock Interactions: the Stockperson and the Productivity and Welfare of Intensively Farmed Animals*, 2nd edn. CAB International, Wallingford, UK.
- Hinde, R.A. (1976) Describing relationships. *Journal of Child Psychology and Psychiatry and Allied Disciplines* 17(1), 1–19.
- Jensen, P. (2000) Natural Behaviour and Behavioural Needs of Farm Animals. Available at: <http://www.agriculture.de/acms1/conf6/ws5abehav.htm> (accessed 30 October 2017).
- Jensen, P. and Toates, F.M. (1997) Stress as a state of motivational systems. *Applied Animal Behavior Science* 53(1–2), 145–156.
- Landais, E., Lhoste, P. and Milleville, P. (1986) Points de vue sur la zootechnie et les systèmes d'élevage tropicaux. *Cahiers Des Sciences Humaines* 23, 421–437.
- Le Neindre, P., Bernard, E., Boissy, A., Boivin, X., Calandreau, L. *et al.* (2017) Animal consciousness. *EFSA Supporting Publications* 14(4), EN-1196. DOI: 10.2903/sp.efsa.2017.EN-1196
- Low, P. (2012) The Cambridge Declaration on Consciousness. *Francis Crick Memorial Conference on*

- Consciousness in Human and Non-human Animals*, 7 July 2012, Churchill College, University of Cambridge, Cambridge, 2 pp.
- Nagasawa, M., Mitsui, S., En, S., Ohtani, N., Ohta, M. *et al.* (2015) Oxytocin–gaze positive loop and the coevolution of human–dog bonds. *Science* 348(6232), 333–336.
- Newberry, R.C. (1995) Environmental enrichment: increasing the biological relevance of captive environments. *Applied Animal Behaviour Science* 44(2–4), 229–243.
- Nowak, R. and Boivin, X. (2015) Filial attachment in sheep: similarities and differences between ewe–lamb and human–lamb relationships. *Applied Animal Behaviour Science* 164, 12–28.
- Price, E.O. (1999) Behavioral development in animals undergoing domestication. *Applied Animal Behaviour Science* 65, 245–271.
- Ratlife (2017) The Laboratory Rat: a Natural History. Available at: <http://ratlife.org> (accessed 30 October 2017).
- van de Weerd, H.A. and Day, E.L. (2009) A review of environmental enrichment for pigs housed in intensive housing systems. *Applied Animal Behaviour Science* 116(1), 1–20.
- Vénot, E., Guerrier, J., Lajudie, P., Dufour, V., Leudet, O. *et al.* (2015) Mise en place d'une évaluation nationale du comportement des bovins allaitants à partir de données recueillies en ferme. In: *22èmes Rencontres Recherches Ruminants*. Rencontres autour des Recherches sur les Ruminants, Paris, pp. 107–110.
- Waiblinger, S., Boivin, X., Pedersen, V., Tosi, M.V., Janczak, A.M. *et al.* (2006) Assessing the human–animal relationship in farmed species: a critical review. *Applied Animal Behaviour Science* 101, 185–242.
- Wechsler, B. (2007) Normal behaviour as a basis for animal welfare assessment. *Animal Welfare* 16, 2.

16 Better to Have Lived and Lost – the Concept of a Life Worth Living

JAMES YEATES

16.1 Introduction

The concept of a ‘life worth living’ is not, in essence, a new one. But it has been suggested recently as a way to help us make decisions about how we treat animals (FAWC, 2009; Green and Mellor, 2011; Yeates, 2011; Whitham and Wielebnowski, 2013; Mellor, 2016). It may receive increasing attention (Walker *et al.*, 2014) and represents a shift from the previous focus on preventing unnecessary suffering (Lundmark *et al.*, 2014). In particular, it may help us decide what limits we should place on our treatment of animals when considering their own interests. How radical its implications might be will depend on the principles by which we apply the concept, and how we evaluate animals’ lives.

This chapter sketches out the key features of the concept as they have been recently discussed in the academic literature. It then tentatively suggests how they might be applied across animals in farm, companion, laboratory, and wild contexts. It considers possible ethical principles involved and ways to evaluate animals’ lives. Applying the latter suggests that many animals might not, in fact, have lives worth living. So the chapter finishes by considering how the concept might be used in policy.

16.2 The Basic Idea

16.2.1 The concept of a life worth living, and a life worth avoiding

The UK’s Farm Animal Welfare Council (FAWC) (FAWC, 2009) introduced the concept of a life worth living (LWL) in a report on the future of farm animal welfare. Since then, the key features of the concept have been analysed and partly adapted, in particular by Green and Mellor (2011) and myself (Yeates 2011, 2012).

Briefly, the value of an animal’s life can be considered in terms of the totality of its affective states during its life. We might call this the ‘quality’ of (that) life. An animal’s experiences might be pleasant/unpleasant or desired/undesired and these *qualia* of experiences determine the quality of the animal’s life. An animal’s life is worth living insofar as the animal experiences ‘more’ pleasant experiences (e.g. satisfaction, enjoyment of food or sex, pleasure from familial and social interactions, interest, the ‘joy’ of various forms of play, and experiences of achievement itself) and ‘less/fewer’ unpleasant experiences (e.g. frustration, fear, pain, distress, hunger, boredom, and loneliness).

Of course, few animals (if any) will have lives that include *only* states worth achieving or *only* states worth avoiding. Most animals’ lives (including our own) will probably include a mixture. We might define the quality of an animal’s life as the net value of all its affective states (Yeates, 2013). If the overall balance is positive, the animal has a LWL. If the overall balance is negative, the animal has a life worth avoiding (LWA). In practical terms, we might say that this is a matter of whether the total enjoyment outweighs the overall suffering, or vice versa. In this, we must take into account the frequency, intensity, and duration of all the animal’s experiences.

As a complicating factor, we might ask whether an animal’s life is a LWL in two ways (Yeates, 2011). The first is a retrospective question, in evaluating an animal’s past life (presumably once it is dead). The other is a prospective question, in evaluating whether an animal’s life is expected to be worth living or, more accurately, whether the ‘gamble’ of continued life is, for the animal, worth taking. This is a matter of not only the frequency, intensity, and duration of all the animal’s potential experiences, but also of the probability of each of them. This is a complicated assessment.

16.2.2 The value of the concept

The concept of a LWL and its antonyms has several advantages. The first is that it explicitly considers the value of the animal's life in terms of what matters for the animal. It may help us avoid being excessively swayed by other concerns such as the value of the animal's life for its owner, or as part of an ecosystem. The concept is, in essence, based on what the value is for the animal.

The concept is also understandable (at least conceptually) by non-scientists, such as owners, consumers, politicians, and lay committee members. The concept also provides a non-arbitrary threshold – the divide between a LWL and a LWA (unlike more arbitrary criteria commonly used to evaluate welfare such as 'severe' or 'unacceptable'). The concept is also directly morally relevant – an answer to whether a life is (or, more accurately, will be) worth living or worth avoiding implies a clear answer, all else being equal, to questions of whether an animal should be bred or not, or whether it should be euthanased or not.

However, the concept also has disadvantages, in particular that there is likely to be uncertainty and disagreement about whether particular animals have a LWL or LWA. It is also important to note that, while the concept is holistic in its assessment of the quality of each animal's life, it does not encompass all moral concerns or principles that we might wish to address in our ethical deliberations. For example, the FAWC suggested that having a LWL requires that any pain, suffering, distress, or lasting harm that an animal experiences must be necessary, proportionate, and minimal. But this is not true. So long as the pain is balanced by positive experiences, then an animal could still have a LWL despite experiencing pain that is unnecessary, disproportionate, or not minimal. For example, the deliberate abuse of a lamb early in its life would be all three, but if the lamb then goes on to have a life of great pleasure, then it may have a LWL. These other ethical concerns are important principles, but they are not part of the principle that every animal should have a LWL, and the concept should not be misused to include them. Any principle based on a LWL must be complemented with other principles.

16.2.3 The basic principles

The FAWC argued that every animal should have a LWL (FAWC, 2009). This is an admirable – and

ambitious – aim. It does, however, have some unexpected implications, in particular that it would imply we should be taking all efforts to keep all animals alive in order to have a LWL (Yeates, 2012). Instead, two less ambitious principles might be that:

- No animal should be deprived of having a LWL.
- No animal should have a LWA.

Both of these principles might be subject to some caveats. One might argue that these principles can apply only when we are able, in fact, to affect the outcome (e.g. we do not fail in our moral duties if we fail to prevent an animal having a LWA when to do so would be impossible). One could also, for example, constrain their application to any one animal by equivalent duties to another under the same principle (e.g. it might be legitimate to fail to prevent an animal having a LWA when the means to do so would cause other animals to have lives worth avoiding). One might argue that the former is subordinate to the latter, that is, it is worse to cause (or allow) an animal to have a LWA than for another not to exist (e.g. that it would not be appropriate to cause some animals a LWA for the benefit of those with a LWL).

Furthermore, one might apply these principles alongside other moral considerations. One might apply them in different ways depending on our agency (e.g. it would be wrong to *cause* one animal to have a LWA in order to *prevent* another – or perhaps even others – having a LWA). One might also say that there are other principles against which these principles should be balanced, or which might trump these responsibilities (e.g. it is right to deprive a non-human animal of a LWL in order to save a human or it is legitimate to cause an animal a LWL in order to save that animal's species). This chapter is not the place to discuss these other concerns (which would require a consideration of the whole of ethics). Rather, we can summarize whatever caveats we might apply by two slightly modified principles:

- No animal should be unreasonably deprived of having a LWL.
- No animal should be unreasonably caused (or allowed) to have a LWA.

16.3 Evaluating Animals' Lives?

Clearly, we cannot directly and categorically 'observe' whether a non-human animal's life is

worth living. Rather, we must infer this indirectly from other observations.

We might do this in a relatively informal and unstructured way, and probably we do. For example, owners and veterinary surgeons decide on whether an animal's life is worth living or worth avoiding in euthanasia consultations and decisions every day (albeit alongside other considerations). The concept of a LWL does not require us to use any particular methodology to evaluate the value of animals' lives. Nevertheless, we might try to structure our evaluation more systematically. Broadly, there are two ways we might approach evaluating an animal's life. We might try to evaluate the components of their lives and then aggregate those evaluations. Or we might try to characterize the animal's whole life and then holistically evaluate that life overall.

16.3.1 Aggregate all states

One approach is to: (i) determine all of the states that an animal experiences; (ii) evaluate each state; and (iii) aggregate these into an overall evaluation. We could try to measure the severity, duration, and number of each of an animal's (expected) experiences. This is no small undertaking.

We might legitimately question our ability to 'mind-read' others from observable characteristics (let alone predict them into the future). This is too deep a philosophical question for us to consider here. But the same questions raise a more specific difficulty. In order to 'add up' all an animal's experiences, we need to be able to place them on a ratio scale. A ratio scale needs a rational zero and regular intervals. The LWL concept does provide us with a conceptual zero: '0' represents the absence of any experience (and any equivalent combination of experiences or gambles). Relative to the zero point, experiences worth having can be scored as positive; experiences worth avoiding as negative. So far, so good.

What is less clear is how we find a trustworthy quantitative interval. We might have a stab at quantifying animals' experiences in terms of number and duration (albeit with some interesting questions about whether frequency and duration are of equivalent importance for different animals and/or types of experiences, and whether a doubled frequency or duration is actually twice as bad). But how do we place experience intensity or valence on a ratio scale? There is no SI unit of experience for

any type of feeling. I cannot meaningfully say that my distaste eating a bowl of sprouts is 6.2 times more intense as my enjoyment of reading Andrew Butterworth's latest article – let alone quantify the feelings of another animal.

One possible solution might be to *operationally* define the value placed on experiences in a way that predicates an underlying ratio scale. Specifically, we could evaluate experiences by assessing potential trade-offs between different experiences, varying their (quantifiable) number/duration or probability to determine their relative value. I might be indifferent to whether I have no experiences (e.g. am anaesthetized) or experiencing a mild headache and the enjoyment of a meal. Clearly such a method is fraught with questions and controversies.

One such question is *who* evaluates the trade-offs? We could do so, but this risks us under or overestimating animals' experiences (or misidentifying them completely). Alternatively, we could try to 'ask the animals', perhaps by assessing their preferences in a range of situations. But this would need a massive range of experiments to cover all the (common and significant) experiences an animal might be expected to face, and assumes the animals are making 'rational' welfare-focused choices. Nevertheless, the idea of aggregating all an animal's experiences may help us think about their lives, even if we accept that there will be errors. It may also be useful in cases where it seems clear that one experience is not outweighed, for example when an animal experiences long, severe suffering that would confidently outweigh its other experiences.

16.3.2 Aggregating periods

An alternative approach is to consider different periods within an animal's life, evaluate the quality of life (QOL) during that period and then aggregate those together (factored by their duration and, if necessary, likelihood). Again, this inevitably involves some subjective judgements by a human assessor, but this process might help to frame decision making and avoid an excessive focus on the short-term concerns or particular risks (Yeates and Corr, 2014).

16.3.3 Holistic life assessment

A very different alternative is to consider the animal's life as a holistic whole. While this cannot be particularly scientific, this approach might prove

helpful where we can get an intuitive idea about the value of an animal's life in a particular context or system. For example, one might consider that a battery chicken's life is overall worth avoiding, without having to identify and weigh each incidence of suffering and pleasure. However, this approach is clearly not going to satisfy everyone and might make conversations difficult where assessors disagree (insofar as it would be hard to break down and so defend the internal logic).

Perhaps, we might use measures that seem to represent the animal's total (or aggregated) experiences. Poor survival, growth, or reproduction might imply a LWA in some cases (although good survival, growth, or reproduction categorically does not imply a LWL). Evidence of some secondary physiological change or the development of particular mental health conditions or long-term moods might also give some indication of a LWA. Perhaps cognitive biases might give an evaluation of an animal's previous experiences. But none of these seem particularly likely to give us a clear and uncontroversial evaluation of an animal's life.

However, before giving up, it is worth recalling that we maybe do not need to be perfect in our assessments. We might think that we can judge some easier cases – of extreme or extended suffering or of prolonged joyous pleasure – without necessarily having a perfectly precise measurement for every case in the middle. We might be able to make many assessments perfectly well using our common sense – and should not get too hung up on how we deal with the grey area in the middle – and certainly not let that stop us ensuring animals have good lives where we are more confident.

16.4 Who Has a LWL?

16.4.1 General taxonomic considerations

A first question is the potential scope of the LWL concept's application. Conceptually, this is relatively simple. Only animals with the capacity for pleasant experiences or satisfied motivations can have a LWL. Only animals with the capacity for unpleasant experiences or frustrated motivations can have a LWA. Only animals with both these capacities can have a LWL or a LWA.

First, this means that insentient animals have neither a LWL nor a LWA – their lives are without experiences. Whether to produce animals who are incapable of any feelings is a philosophical question

that it seems is increasingly imminent as we learn more about how to genetically manipulate animals. An insentient animal *by definition* has, based on feelings, a life worth nothing. However, a note of caution is needed here given the lack of absolute confidence in our abilities to attribute mental states to others. Creating animals whom we *think* are insentient but who, in fact, only appear insentient would be catastrophic. We would presumably treat them as insentient and thus spare no regard for their experiences. This would probably mean they would be kept in ways that would cause them suffering – and to have, in fact, lives worth avoiding. Unless we can be perfectly sure that animals are insentient, we need to treat them with some respect. I cannot see that we can ever be that sure (and even some more advanced tissue cultures might throw up some doubts).

A similar logic applies to various species. There is a wide-ranging debate on the apparent sensibilities of invertebrate taxa (see most specifically Chapter 11, and less specifically Chapter 17, this volume). Generally, we assume plants, fungi, protists, archaea, and bacteria are insentient. For other animals, there is often some evidence both for and against. As such, they may have LWA or LWL. Interestingly, for prospective decisions (e.g. on whether to breed a particular animal for an experiment), our degree of *confidence* in their sentience might function in our decisions in the same way as *probabilities* of suffering, an existing function in decision making about tetrapod species.

There is also another possibility. If there are species (or perhaps we could create species) who can suffer but not enjoy experiences, then those animals can only have a LWA (and, vice versa, only have a LWL). I think it is interesting that many people would accept that reptiles and fish can suffer (see Chapter 17, this volume), but perhaps be less confident that they can have pleasurable experiences.¹ If that is the case, then all reptiles and fish have a LWA – with all the implications in breeding and euthanasia decisions.

16.4.2 Contingent analyses

Aside from such definitional points, we can only be (partially) subjective in our assessments of animals' lives.

At this point in time, I fear that many animals in our care have lives worth avoiding for two reasons. Some are given limited chances for positive experiences (e.g. including aspects such as exploration

and enjoyable social interactions), and significant risks of suffering (e.g. during management practices and transportation) so that the harms outweigh the positives. Some examples are:

- farm animals in conventional systems that severely limit their abilities to engage with their environment;
- research subjects housed in barren laboratory caging and used for unpleasant experiments;
- pets and horses kept isolated from human and animal company for extended periods of time;
- animals kept indefinitely in overcrowded or under-resourced shelters with 'no euthanasia' policies; and
- animals in circuses and zoological collections where their behavioural repertoire is severely limited.

Other animals may have a LWA because they experience suffering that cannot meaningfully be outweighed during those animals' relatively short (and sometimes generally unpleasant) lives including some:

- farm animals in systems involving severe mutilations or extended periods of unpleasant interactions (e.g. conventional foie gras production);
- research subjects used in experiments involving severe suffering;
- pets and horses subject to 'over-treatment' (instead of euthanasia);
- animals in circuses and zoological collections subject to fearful or harmful interactions (e.g. training methods); and
- animals bred to have a genotype or phenotype that causes severe suffering (e.g. some rodent models and pedigree dog lines).

However, I am also confident that there are animals who have lives worth living, where they are given sufficient opportunities for enjoyable interactions to outweigh the frustrations and harms that life throws up, including some:

- farm animals given more extensive space and also protected from major catastrophic management disturbances and major health problems or who are slaughtered at an early age while still with their mother;
- laboratory animals in some behavioural experiments that require giving them excellent accommodation;

- pets and horses kept by conscientious owners who allow them to fulfil their natural species' needs and have the right company; and
- animals kept in extensive 'collections' or national parks.

Wild animals present a separate category that makes them hard to assess. On the one hand, they probably avoid some of the severe chronic suffering that animals have in the more restrictive human exploitations. However, it is unclear whether their lives are generally worth avoiding or living. The traditional Hobbesian concept of wild existence as 'nasty, brutish and short' seems over-pessimistic. But a romantic idealization seems equally over-optimistic. Certainly some wildlife will have a LWL and others a LWA depending on their species and how they fare in the lottery of natural life. Conceptually, we might hypothesize what would be most adaptive, and assume that natural selection might have approximated phenotype so that wild animal existence, in general, tends toward a LWL.

On this basis, given that both the systems for positive and negative experiences are adaptive, one would expect animals to have both. And there seems no reason to think that one is more adaptive than another: natural selection favours the avoidance of harm, but also the achievement of feeding and sexual reproduction. Perhaps the most adaptive set-up would be equal propensities for both enjoyment and suffering, so that both have the greatest possible potential effectiveness. This would suggest animals have evolved to have – on average – a balance between pleasure and pain in their ecological niche. This would actually suggest their lives are on average (and assessed at their birth) neither worth living nor worth avoiding. However, this logic is entirely speculative, probably erroneous, and certainly at odds with my efforts to save (and to avoid accidentally ending) injured wild animals' lives.

Of course, once wild animals come under the control of humans (deliberately or accidentally) then I fear they may well be likely to experience a LWA. Their experiences in captivity will depend on their histories, and untamed or undomesticated animals can generally be expected to suffer, particularly from fear of humans and novel (and unpredictable) environments and from the unprecedented behavioural restrictions. Gregarious wild animals may well also be removed from the opportunities for pleasant experiences afforded by interactions with their social group. There seem few

legitimate reasons to take wild animals into captivity, but their expected lives is a strong reason against it.

16.5 Implications for Policy

16.5.1 Good care

The concept suggests two interacting aims: (i) ensuring animals do not have a LWA; and (ii) helping animals to have a LWL. In most cases, these aims coincide. We should try to give animals as many opportunities for enjoyment as reasonable, and limit the harms they experience as much as possible (or at least practicable). These two efforts will shift the balance of negative:positive in favour of positive experiences and thus, hopefully, over the threshold of a LWL. Giving animals a LWL will mean they do not have a LWA; while the best way to avoid a LWA is to ensure an animal has a LWL.

16.5.2 Veterinary treatment

An obvious application of the concepts is in making decisions on whether to extend or shorten an animal's life. We can (and many of us effectively already do, as veterinarians and animal owners) make euthanasia decisions based on the expected value of the life that the animal might otherwise have. This is a prospective decision, and thus must take into account the myriad possible future outcomes for the animal (one might say, its various potential future lives). But we can say that, at the point of the decision, the animal's future life is worth living (i.e. continuing) or worth avoiding (i.e. stopping). We can potentially avoid a LWA either through euthanasia or by improvements to a patient's QOL that mean he or she has a LWL. However, it is also important to consider that it is the animal's actual realistic expected life that is to be assessed – not the best life it could have if there were unlimited resources and good fortune.

Perhaps fewer people assess the value of ongoing treatment using these concepts. There is a danger in owners (or veterinary surgeons) trying treatments with a limited hope of success (and which might involve significant suffering). Perhaps the idea of a LWA would help to focus minds on ensuring the right risks are taken. First, the ideas of a LWL/LWA make clear that the value of extended life for the animal is entirely dependent only on his or her QOL: life itself is not valuable per se. Secondly, the

assessment of the value of the animal's future life might highlight the relative risks of causing or allowing an animal to have a future LWA, and, the sometimes slim chance of saving an animal's life, *and* for that life to be worth living.

A slight complexity in this decision making is created by the fact that an animal's life might be worth avoiding at a certain point, while his or her life is still expected to have a short period of overall enjoyment, as graphically represented in [Fig. 16.1](#). In this case, the animal has a LWA at time 0 but it would be better for the animal to wait until time '5' (the point at which the welfare trajectory drops below the neutral line '0'), so that he/she can enjoy that period of overall good welfare. Perhaps the best way to characterize the moral obligations here are to say that it is legitimate to euthanase at any time from 0 to 5, but better to wait if one can be certain that the euthanasia will then occur at or near the time when the overall welfare drops below the neutral point. There may be additional problems and complications when the overall welfare does not follow a linear pattern (e.g. when the patient's welfare fluctuates above and below the line) but these are more issues of precision of assessment which might be solved, for example, with using weighted aggregated evaluations over a time period either side.

16.5.3 Breeding

Another case where the concepts are useful could be when deciding what animals to breed. Put simply, animals should only be bred if their progeny are expected – based on their breed, parentage, and available genetic tests – to have a LWL. In practice, this may be best understood as ensuring they have 'a reasonable chance of having a LWL', since any animal may suffer misfortune unrelated to their genetics, and, within the philosophical literature, there are related arguments that creating a life is always a net harm (e.g. Benatar, 2009; cf. DeGrazia, 2010; Smuts, 2014).

Legislation often finds it difficult to consider how those breeding animals can be said to harm the animals bred, insofar as they are causing those harms before those animals exist and it would seem somewhat draconian to condemn anyone for any avoidable suffering in animals they breed, since any animal may suffer for reasons unconnected to the breeding and yet avoidable by the breeder insofar as they could simply not have bred that animal. The LWA concept gives one practical answer to this

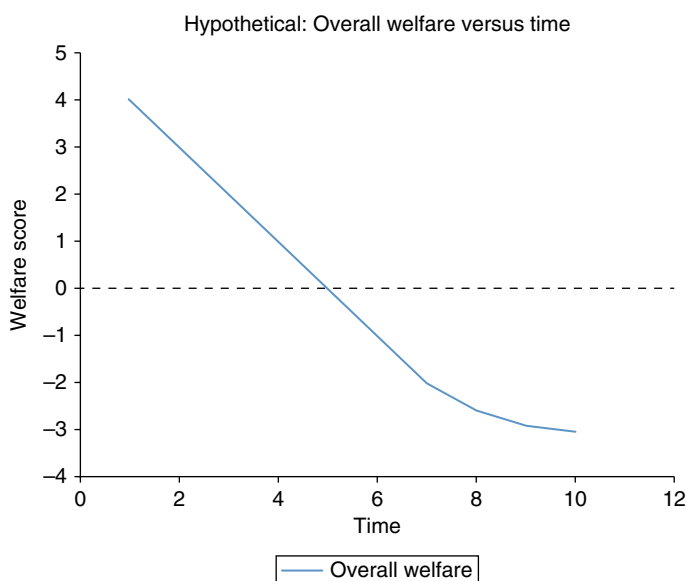


Fig. 16.1. Change in 'overall welfare' with time. (Image credit: James Yeates.)

conundrum. If animals are bred so that their lives are – at the point of birth – expected to be worth avoiding, then this seems to be a case in which the breeders harm the progeny. (Of course it is still additionally wrong to breed animals with lives worth living if they could have been 'bred better', i.e. the LWA/LWL obligation is still only part of our ethical landscape.)

16.5.4 Killing

Conversely, the principle that animals should not be unreasonably deprived of having a LWL implies that it is, all else being equal, wrong to kill an animal which otherwise would be expected to have a LWL (Yeates, 2009).

16.5.5 Justice (rights)

We can be faced with decisions about how to balance the interests of animals, for example whether it is acceptable to use some animals to feed others, or as research subjects to help others. The principle of avoiding a LWA can be helpful here. There is an argument made elsewhere (Yeates, 2010) based on the Rawlsian² idea that we should aim to better the lot of the worst off animals in our care – in other words to achieve the highest minimum standard of welfare we can. (This can be traced back to the

work of John Rawls, albeit with a very different application to his.) It seems logical that this highest minimum standard must be at least that of euthanasia – since any animals below that line could be euthanased (or never bred) and thus avoid the LWA (ignoring for now any practicalities of assessment and implementing those decisions). This suggests that we should never use animals when this use causes them to have a LWA and helps those with a LWL. (But this does not necessarily prohibit the use of animals with a LWA to improve the lot of those who also have a LWA).

The LWA/LWL framework also implies that animals should not be given an absolute right to life in their own interests, insofar as that may mean they are kept alive in cases where that life – for them – becomes worth avoiding. In other words, it seems ridiculous to afford animals a right that is contrary to their interests (and which they would rationally and self-interestedly waive). At the very least, the right should be modified to the right to a LWL – and ideally supplemented with a right to avoid a LWA where possible.

16.5.6 Compensation

A final idea that is worth considering is that when we do cause animals some unpleasant experiences in their lives – as we inevitably do – then we should

give them pleasant experiences to outweigh them, so that their lives are worth living overall. For example in a research context, animals might be used for experiments that cause minor or moderate suffering. If we want them to have a LWL then we need to ensure that their lives before (or in between) experiments are sufficiently positive that their net experiences are positive. In other words, we need to (over-)compensate those animals for the periods of suffering by ensuring periods of enjoyment.

This does not simply mean ensuring their lives in between are enriched above the normal standards where those normal standards give them a LWA (as I fear many common laboratory housing methods do): the enrichments need to be sufficient to make those intervening lives enjoyable overall. One might think this would require a big step up from the current 'enrichments' designed to minimize suffering. Furthermore, the worse the suffering in the experimental phase, the more enjoyment is needed to outweigh it (until experiments are so harmful that they cannot realistically be outweighed and should simply never be done).

16.6 Conclusions

The concept of a LWL/LWA is useful in its own way. It is relatively intuitive and gives us a way to evaluate philosophical concepts such as existence. In effect, it allows us to evaluate death by comparing it to life, and to evaluate life by comparing it to death. This logic is not circular insofar as we evaluate the life by assessing another concern: the quality of the animal's experiences.

However, notwithstanding the simplicity of the basic ideas, this concept does not avoid all the complexities of our decision making, not least because its applications require us to evaluate the whole (future) lives of animals, and because there are many other ethical concerns that might be applied alongside.

Notes

¹ For clarity, I am confident they are able to have both.

² John Bordley Rawls (1921–2002) was an American moral and political philosopher.

References

- Benatar, D. (2009) *Better Never to Have Been: the Harm of Coming into Existence*. Oxford University Press, New York.
- DeGrazia, D. (2010) Is it wrong to impose the harms of human life? A reply to Benatar. *Theoretical Medicine and Bioethics* 33(1), 317–331.
- FAWC (2009) *Farm Animal Welfare in Great Britain: Past, Present and Future*. Farm Animal Welfare Council (FAWC), London.
- Green, T.C. and Mellor, D.J. (2011) Extending ideas about animal welfare assessment to include 'quality of life' and related concepts. *New Zealand Veterinary Journal* 59(6), 263–271.
- Lundmark, F., Berg, C., Schmid, O., Behdadi, D. and Röcklinsberg, H. (2014) Intentions and values in animal welfare legislation and standards. *Journal of Agricultural and Environmental Ethics* 27(6), 991.
- Mellor, D.J. (2016) Updating animal welfare thinking: moving beyond the 'Five Freedoms' towards 'a Life Worth Living'. *Animals* 6(3), 21.
- Smuts, A. (2014) To be or never to have been: anti-natalism and a life worth living. *Ethical Theory and Moral Practice* 17(4), 711.
- Walker, M., Diez-Leon, M. and Mason, G. (2014) Animal welfare science: recent publication trends and future research priorities. *International Journal of Comparative Psychology* 27(1), 80–100.
- Whitham, J.C. and Wielebnowski, N. (2013) New directions for zoo animal welfare science. *Applied Animal Behaviour Science* 147(3), 247–260.
- Yeates, J. (2009) Death is a welfare issue. *Journal of Agricultural and Environmental Ethics* 23(3), 229–240.
- Yeates, J. (2010) The application of veterinary stem cell technologies to dogs and horses. In: Campbell, A.V. and Capps, B.C. (eds) *Bioethics and the Global Politics of Stem Cell Science: Medical Applications in a Pluralistic World*. Imperial College Press/World Scientific Publishing, London.
- Yeates, J. (2011) Is 'a life worth living' a concept worth having? *Animal Welfare* 20, 397–406.
- Yeates, J. (2012) Quality time: ethical approaches to the 'life worth living' concept in farm animal welfare. *Journal of Agricultural and Environmental Ethics* 25(4), 607–624.
- Yeates, J. (2013) *Animal Welfare in Veterinary Practice*. Universities Federation for Animal Welfare (UFAW)/Wiley-Blackwell, Hoboken, New Jersey.
- Yeates, J. and Corr, S. (2014) Use of a quantitative methodology to evaluate treatment options: methods and proof of principle example. *Journal of Animal Welfare Science, Ethics and Law* 18(1), 9–14.

17 If Fishes Feel Pain, What Should We Do?

VICTORIA A. BRAITHWAITE

17.1 Introduction

If we accept that fishes feel pain, and have a capacity for experiencing negative emotional and mood states, then, just as with other vertebrates, there is a need to consider when and how our interactions with fishes might have a negative effect on their well-being. A survey of how we use and interact with fishes and how we consider their welfare in different contexts reveals a number of inconsistencies. For example, fishes used in empirical research are typically protected because they are vertebrates, and experiments involving fishes require that licences and permits be approved before the fishes can become part of research projects. However, when we capture fishes at sea, remarkably little consideration is generally given to their welfare. So, for some human–fish interactions there is a reasonable degree of interest given to fish welfare, whereas for others, the concept of fish welfare seems to be largely absent.

In general, an interest in establishing what fish welfare means for different species in a range of settings has grown over the last two decades. From the fishes we farm, to those we keep as pets, people are increasingly asking questions about how best to maintain, house, and handle the fishes that are in our care, or that we capture for consumption or for sport. Interest in the welfare of fishes has grown alongside research that has revealed how several fish species have complex behavioural abilities. For example, fishes have diverse cognitive capacities: some species cooperate with one another, others will punish individuals that cheat, some learn to map their environment, and some species can even communicate their intentions to one another. Such skills have allowed fishes to radiate and colonize many different aquatic environments. All of which seems to be in contrast with the unjust caricature of fish as being slow, dim-witted creatures with a 3 s memory. Acknowledging just how behaviourally

sophisticated different species of fish are has helped to contribute to a current interest in determining what good welfare for fishes would look like.

The field of fish welfare encompasses a wide range of species with diverse welfare needs. From the millions of zebrafish used in research facilities around the world, to the fishes maintained for many years in large tanks as part of public aquaria displays; from the fishes we farm, to those kept as pets; and from the fishes we catch as part of commercial fisheries operations to those that are caught for sport – there is no single definition of fish welfare. Instead the species of fish, and the kind of human–fish interaction, will determine what factors promote good welfare and what can be done to avoid bad welfare situations.

As this is a relatively young field, this chapter will focus on areas where we have, by virtue of the numbers of animals involved, the greatest effect on fish welfare: aquaculture and wild capture fisheries. Developing appropriate welfare guidelines for the diversity of fishes that we interact with needs to be based on an understanding of the biology and requirements of different species. It is worth noting here that there are more than 30,000 species of fish, and yet we still use the term ‘fish welfare’ rather than discussing, for example, salmon welfare or cod welfare. Terrestrial species are not considered in this way. We do not talk about mammal welfare, but rather we recognize that the needs of a pig are likely to differ to those of a sheep or a cow. As the welfare issues facing fishes become more widely recognized greater attention will need to be given to identifying species-specific requirements. Below, I describe how the rapid growth of aquaculture has shaped an understanding of which factors are important for fish reared in captivity, and how some aspects of good practice are beginning to be adopted, to a small degree, in wild capture fisheries.

17.2 Farmed Fish Welfare

One of the first areas to attract attention with respect to fish welfare has been fin-fish aquaculture. Keeping fishes in captivity and growing them until they are ready to be consumed is something we have done for thousands of years: for example, references to rearing and harvesting fish can be found in ancient texts such as the Old Testament. The scale at which we now farm fish, however, has seen a remarkable transition. In the last few decades, aquaculture has rapidly expanded, and current estimates indicate that between 10 billion and 100 billion fishes are annually harvested by large-scale, global fish farming industries. Production of fishes on fish farms has grown exponentially; in the 1980s annual estimates of farmed fin-fish production were around

5 million t, however, 30 years later this figure was closer to 63 million t. And this figure continues to increase, with estimates from the Food and Agriculture Organization of the United Nations (FAO) that expansion of fish farming will continue into the foreseeable future. There is, therefore, an urgent need to understand and establish appropriate farmed-fish welfare metrics that allow us to assess and quantify well-being.

Identifying what farmed fishes need in terms of their welfare has been challenging. These animals spend virtually all their lives in an environment where it is difficult to see them (see Fig. 17.1). Systematic studies have helped identify biotic and abiotic factors that can impair farmed fishes' well-being, and it is important to remember that these



Fig. 17.1. An Atlantic salmon research farm in Norway. (Image credit: V. Braithwaite.)

can be species specific. Knowledge of what triggers welfare problems has therefore been used to create guidelines and regulations aimed at mitigating poor welfare and promoting best practice. When large numbers of fishes are kept in confined systems for many months, or even years, there are numerous ways in which their welfare can be affected. During early development, if the fish experience inappropriate temperatures, skeletal deformities can arise that can compromise future swimming performance, or the fishes can develop deformed jaws that prevent them from feeding and growing properly. It is now understood that finding ways to optimize the rearing environment can help to lower the rate at which such deformities develop.

Certain features of the way farmed fish are handled, or their environments are manipulated can induce acute stress responses. If these are short-lived and the fishes are in a reasonably good state, they will typically recover. But if too many stressful situations are encountered with little to no recovery time in between these events, then the fishes can become chronically stressed. A fish experiencing chronic stress generally has a decreased interest in food, and unrelieved stress can lead to immunosuppression that makes fishes more vulnerable to disease and infection. Designing facilities that are species appropriate and where husbandry practices are carefully managed can help to lower the frequency and duration of stressful situations, and thus help to mitigate negative welfare consequences.

Some kinds of stressor are unavoidable, for example handling of fishes for routine inspections, for size-grading, for vaccinations, or when they are harvested for slaughter, can induce fear and activate stress responses. Building appropriate recovery times into the husbandry routine can prevent acute stress responses from becoming chronic. Devising ways to decrease the amount of handling that is required can also help. One innovation that promotes this is a process known as passive grading. Rather than size-grading the fish manually, some farms now use flexible mesh walls that they introduce into a tank or a cage that only allows fishes of a certain size to fit through the mesh. The fishes therefore separate themselves into different size classes decreasing the need for handling.

In attempts to improve growth rate, changes to the rearing environment can include increasing the perceived day length by using underwater lighting rigs (see Fig. 17.2). Unexpected, or rapid sudden

transitions in the lighting protocol, such as changing from 24 h of light to a 12 h light/12 h dark cycle without any warning, can trigger stress responses that can take days to recover from. The effect can be lessened if the lighting regime is gradually changed over a series of days. This example illustrates how important predictability in the captive environment can be, and highlights how fishes, just like terrestrial vertebrates, are sensitive to interruptions or sudden changes of routine in day-to-day events.

Some of the biggest challenges currently facing fin-fish production are infectious diseases and parasites. A concerted effort to improve the health of farmed fish has seen the development of different vaccines to help protect the fishes from various diseases. Many fish vaccines have become more refined and do a better job at protecting large numbers of farmed fishes from certain forms of virulent and aggressive diseases. But the protection is not always complete, and diseases such as infectious pancreatic necrosis (IPN) virus that affects Atlantic salmon can still result in as much as 20% mortality even though the salmon have been vaccinated. It has been suggested that an unwanted side effect of using the vaccine is that it selects for an increase in the virulence of the virus because it is now more challenging for the virus to find hosts. Another significant welfare cost to consider is that diseases affecting fishes on farms can also spill over into wild populations that have had no protective vaccinations, and these wild populations are therefore likely to suffer high levels of mortality if there is an outbreak of IPN or other diseases.

A different health issue that continues to cause considerable problems in farmed salmon is infection by ectoparasitic sea lice. These small copepod crustacea attach themselves to the body of the fish, particularly around the head and on the back. The sea lice then feed on mucus, skin, and blood and can leave deep lesions that are prone to other infections. When sea lice infestations are bad, they can result in immune suppression and high levels of mortality. In 2015 it was estimated that the aquaculture industry spent more than US\$1 billion tackling sea lice problems. Many different attempts have been made to control sea lice, these include: (i) treatments with various kinds of drugs; (ii) using warm water baths to encourage the lice to detach; (iii) adding cleaner fish that remove ectoparasites from infected salmon in sea cages; and (iv) the use of physical barriers, such as developing completely



Fig. 17.2. Atlantic salmon sea cages artificially illuminated to improve growth rate of the fishes in Norway. (Image credit: I. Mayer.)

sealed containers, or using land-based facilities to rear salmon to prevent lice getting access to the fish. Sea lice infections are also highly contentious in terms of the damage that the sea lice appear to do to wild populations of fishes. This is another example of where the well-being of wild populations appears to be compromised because of problems that stem from fish farms. Welfare problems related to health and disease are clearly areas that continue to need attention.

Assays that can efficiently and accurately determine the welfare status of fishes maintained on farms have been hard to establish. Research targeting Atlantic salmon welfare has helped to develop welfare assessment models that combine multiple measures to produce a welfare index score. These systems, called the Salmon Welfare Index Models, or SWIM, combine multiple variables that are relatively easy for fish farm workers to score. One

model developed for on-farm use includes measures such as water temperature, salinity, oxygen saturation, water current, stocking density, lighting, disturbance, daily mortality rate, appetite, parasite load, nutritional state, vertebral deformation, maturation stage, stage of development, fin condition, and skin condition. Using a similar approach, other welfare determining models have been devised for use by fish health professionals. In these models, other kinds of information were relied on, for example cardiac condition, eye condition, pathologies of the abdominal organs, gills, opercula, skeletal muscles, vaccine-related pathology, aberrant fish (deformed), necropsy of the dead fish, and whether there was a need for active euthanasia on humane grounds. Both models use multiple factors and then use a system of weighting the different factors according to their importance for welfare. The result is an overall welfare index that can

inform the fish manager or the health professional about the welfare status of the fishes. In a fish farm context, these specific welfare models have the potential to provide welfare evaluation tools that can help to refine, or to diagnose, welfare issues that may be contributing to a low, or a high, SWIM index score (where a low index score corresponds to compromised welfare, and a high index score is indicative of good welfare).

Some changes in the way fishes are handled and slaughtered on farms have led to significant welfare improvements by means of more humane techniques. In some countries these improved methods are now the only acceptable way to kill farmed fishes. Research has shown that the most humane ways to kill farmed fishes such as salmon and trout is to swiftly stun them and then, while the fish is unconscious (stunned), the gill arch can be cut so that the fish bleeds out before recovery. Two kinds of stunning method have been devised: (i) percussive stunning – where a rapid hard blow is automatically delivered to the fish's head as it reaches the end of a channel that it is encouraged to swim into; and (ii) the fish is stunned using an electric shock. In the electric shock technique a fish is brought out of the water and put onto a metal grill that has an electric current passed through it, immediately rendering the fish unconscious.

The swift death that these two stunning methods and gill arch cutting can deliver is a substantial improvement on live chilling, where a fish is put on ice until it becomes so cold that it is unresponsive, allowing it to be handled. Neurophysiological studies have shown that there is still significant brain activity, and that the fishes are in an awake and alert state when their gill arches are cut if they are solely chilled on ice. An alternative, but popular way to kill farmed fishes has been to put them into tanks of water infused with carbon dioxide. Although this practice still continues in some countries, it is no longer considered to be a humane way to slaughter fish. When carbon dioxide is dissolved in water it creates an acidic solution (carbonic acid) and the fishes show a strongly aversive response the moment they enter water treated in this way. The acidity of the water presumably affects the sensitive tissues of the gills, which causes the fish to thrash around resulting in the carbon dioxide dissipating and at the same time the agitation to the water from the fishes results in re-oxygenation, making the whole process less effective at causing a loss of consciousness. This immersion in carbon dioxide-infused tanks of water

can take more than 30 min for the fishes to become calm enough to handle. It remains unclear, when the gill arches are cut, whether the fish are immobile because of exhaustion or because of a true loss of consciousness. By comparison, percussive and electrical stunning methods are faster, more effective, and more humane.

17.3 Welfare Implications of Wild Capture Fisheries

The extent to which humans interact with fishes is difficult to assess across the board, but the greatest effect in terms of the numbers of fish involved is through commercial fisheries that provide many of the fishes that we consume. Wild capture fisheries are estimated to catch 1 trillion fishes each year. This number is sobering when one considers the experiences that these fishes will go through when they are captured. However, it is important to acknowledge that, up until the time of capture, these fishes have led a natural life and have been free to swim and explore the ocean, or lake, or river, where they were caught. From a utilitarian ethical perspective, one could argue that the relatively short amount of time that these fishes may suffer at the point of capture may, therefore, be justified. On the other hand, the vast numbers of fishes that are involved with this form of fishing makes it hard not to be concerned about the degree of suffering that will occur.

Few fishes caught in wild capture fisheries are harvested and killed in ways that are considered humane. For fishes hauled up in nets, many experience severe barometric trauma associated with pressure changes as they are rapidly brought to the surface. The fishes begin to suffocate as they are raised out of the water and into the air, and fishes that are further down in the net are often crushed by the weight of the fishes above them. This kind of death is not swift. For fishes that are caught on long lines there can be many hours of delay from when a fish is first hooked to when the fishing vessel returns to check the lines and brings the catch in. Depending on the species and the market that the fishes are being fished for can affect what happens next. Most of the catch is typically left to suffocate on the deck of the vessel after the fishes have been unhooked from the lines. Sometimes, however, larger species, such as tuna and swordfish that are being harvested for sushi and sashimi markets, are killed more quickly. Here, a technique called

'ikijime' can be applied; this is where a spike is used to destroy the brain leading to a more rapid kill. This process is often done because of the benefit it has on the quality of the flesh of the fishes, rather than because a swifter death is considered to be more humane. Regardless of the motivation, ikijime does result in a swifter death than most long-line caught fishes experience.

A further welfare complication that arises from wild capture fisheries is the lack of specificity that most wild capture fishing techniques achieve. This generates unwanted by-catch that consists of other species that are not the target species, and although these are often other species of fish, by-catch problems can result in wild mammals, birds and reptiles being killed. Many nets have been redesigned in recent years to try and help unwanted by-catch, by allowing the non-target species to escape before the nets are brought out of the water. Although this does not always work, improved design can reduce the amount of by-catch, and fishes that escape this way have a much higher chance of survival than if they are brought onto the deck of the fishing vessel before being discarded back over the side of the boat.

Considering the large numbers and the kinds of death that wild captured fishes experience, the welfare implications of this form of fishing are not trivial. Particularly welcome then are the current efforts investigating modifications to existing fishing practices that aim to decrease the suffering associated with wild capture fisheries. Many of these are still at an experimental stage, but some commercial operators are switching to methods where the welfare of the fishes that they catch is a central concern. Some of the more promising techniques are borrowing ideas from the technology created for more humane ways of slaughtering fish on farms. These are then adapted for use on fishing vessels, for example it is possible to raise trawl nets more slowly so that the amount of barometric trauma is reduced. The fishes can also be kept submerged while they are pumped through wide-bore pipes into tanks within the hull of the boat. Shortly after this, electrical stunning equipment, similar to that used on fish farms, can be used to stun groups of fish before they are bled out while they are unconscious. These kinds of method are labour intensive, and this increases the cost of fish slaughtered this way; however, surveys have found that there are consumers willing to pay more for fishes that are harvested in these more humane ways.

It has been proposed that certification of these new fishing techniques, and labelling of fish caught using these new methods will allow consumers to identify and purchase fishes that have been harvested more humanely.

17.4 Summary

Although there are many ways in which humans interact with fishes, most of our existing knowledge on fish welfare comes from research that has addressed the welfare of farmed species. Tools have been developed to allow welfare indices of farmed fishes to be calculated through rapid, on-farm assessments. These measures take into account a wide range of factors that can influence the well-being of the captive fishes, and are providing practical methods for those who work closely with farmed fishes to recognize and take swift action when welfare issues arise. Significant improvements in the methods available for farmed fish harvesting include percussive stunning and electrical stunning. These techniques render the fish unconscious, before the fishes are handled and killed. A small number of studies are investigating whether the humane slaughter methods designed for use on farms can be modified for commercial fisheries vessels. Given the huge numbers of fish caught in wild capture fisheries, an opportunity to bring about a swifter, more humane death just after capture would certainly be an improvement for the welfare of these animals. Advances such as these are encouraging, but there is still more research needed to determine other ways in which to promote good fish welfare.

Bibliography

- Bovenkerk, B. and Braithwaite, V.A. (2016) Beneath the surface: killing of fish as a moral problem. In: Meijboom, F.L.B. and Stassen, E.N. (eds) *The End of Animal life: Ethical and Societal Considerations on Killing Animals*. Wageningen Academic Publishers, Wageningen, the Netherlands, pp. 227–249.
- Braithwaite, V.A. (2010) *Do Fish Feel Pain?* Oxford University Press, Oxford.
- Branson, E.J. (2008) *Fish Welfare*. Blackwell Publishing, Oxford.
- Huntingford, F.A. and Kadri, S. (2014) Defining, assessing and promoting the welfare of farmed fish. *Revue Scientifique et Technique OIE* 33, 233–244.
- Huntingford, F.A., Adams, C.E., Braithwaite, V.A., Kadri, S., Pottinger, T.G. *et al.* (2006) Current understanding on

- fish welfare: a broad overview. *Journal of Fish Biology* 68, 332–372.
- Lines, J.A. and Spence, J. (2014) Humane harvesting and slaughter of farmed fish. *Revue Scientifique et Technique OIE* 33, 255–264.
- Mood, A. (2010) Worse Things Happen at Sea: The Welfare of Wild-caught Fish, Summary Report. Available at: <http://www.fishcount.org.uk/published/standard/fishcountsummaryrptSR.pdf>. (accessed 23 November 2017).

18 Anthropomorphism: Faulty Thinking or Useful Tool?

CHARLES FOSTER

18.1 Introduction

Anthropomorphism is the unforgivable sin in the scientific world. It generates McCarthyite witch-hunts. A taste for Beatrix Potter can cost you tenure.

Yet when they come back from the laboratory, many professional biologists look meaningfully into the eyes of their dogs, not doubting that they (the biologists) can intuit something of what is going on in the dog's head, not doubting that they both share a real experience of the kitchen. The biologists' children attribute human qualities to teddy bears and share confidences with their hamsters.

These biologists learned about human biology from textbooks filled with information derived from experiments on and dissections of non-human animals. Their knowledge of human sodium and potassium channels comes from giant squid axons, and their understanding of the intrinsic contractility of myocardial cells comes from frogs. To a first degree of approximation, and at least if we exclude cognition, humans appear to work quite like molluscs, very like vertebrates and very, very like other mammals.

This is unsurprising. We only have to flip a few pages back in our family albums before we see furred, feathery, and scaly faces. Nothing very tectonic has happened in the history of basic physiology since mammals diverged from amphibians. There is, then, a strange irony in the daytime behaviour of those biologists – the 9 to 5 anti-anthropomorphists. All their work is governed by the neo-Darwinian paradigm, and yet their repudiation of anthropomorphism denies the essential Darwinian premise – that there is continuity between non-human animals and humans. The mutually inconsistent beliefs of the anti-anthropomorphist are not an argument against anthropomorphism, but it is interesting and enlightening.

Darwin's basic axiom was intuited long before Darwin or any of his Western scientific ancestors.

We see his axiom in the very oldest representational art executed by behaviourally modern humans. Possibly the earliest known representation of the human body is a carved ivory figure from Hohlenstein-Stadel, Germany (Fig. 18.1). It is dated at c.30,000 BCE (before the Current Era) – the man has a lion's head (Wynn *et al.*, 2009). In the Upper Palaeolithic (approximately 50,000 and 10,000 years ago) rock paintings of Europe and Africa there are frequent depictions of therianthropes: animal–human hybrids (Hancock, 2006).

When modern human consciousness ignited, and when humans, informed by that consciousness, first indicated their relationship to the non-human world, they asserted expressly that the boundary between the species was as porous as Darwin later demonstrated that it was (Lewis-Williams, 2004). This assertion governed much subsequent human behaviour. At the moments that humans were saying the most fundamental things about what they were and what they signified, they alluded to the fluid relationship between humans and non-humans. Shamans shuttled to and fro across the species boundary, bringing back knowledge from the animal world about how to thrive in the human world. Animals gave birth to men in many ancient creation stories. The Greek myths, in which humans sought to explain themselves to themselves, are populated by centaurs, sirens, satyrs, and gorgons, and many of the gods of the Egyptian pantheon are animal–human chimaeras. Millions of modern Hindus worship at the shrine of the elephant-headed god Ganesha. Even Christianity, which burned shamans for their trans-specific journeys, and insisted that humans were uniquely made in the image of God, acknowledged in the creation narrative in Genesis 1 that humans shared a birthday (the sixth day of creation) with all other terrestrial animals. One of Christianity's brightest



Fig. 18.1. Sketch of the carved ivory figure from Hohlenstein-Stadel, Germany, dated at 30,000 BCE (before Current Era) – the man has a lion's head. (Image credit: Eva Butterworth.)

stars, St Francis, spoke with pre-Darwinian prescience of 'Brother Ox'. In the Hebrew Bible, 1 Kings 5:13 relates that Solomon, the wisest of kings, spoke to 'beasts, and to the birds and to the creeping things and to the fishes'. He did, in other words, what those biologists never do in the laboratory, and always do at home.

Anthropomorphism, then, is a kind of Darwinian orthodoxy. It is ancient, ubiquitous, and apparently hardwired into human brains. In our scientific, religious, mythological, poetical, and philosophical attempts to make sense of the world we often refer to our close, defining relationships with non-human animals. Yet we should not overstate the case. A porous boundary is still a boundary – being able to travel to France doesn't make you French. The notion of a species, while not telling the whole truth about the fluidity of relationships within the natural world, is still useful. A cat cannot mate

with a fox and produce fertile (or any) offspring, but a dog may be able to mate with a fox (and perhaps create a hybrid – a dox – although this has not been verified). However, a dolphin can mate with a false killer whale (producing a wholphin), a sheep with a goat (shoat/geep), a horse with a donkey (hinny/mule). All of these examples cross boundaries between traditional taxonomic categories; there are many other examples of this potential for violation of the old conventions: see chapter 19 in this volume). And the caveat above ('at least if we exclude cognition') is massive: it threatens to disarm any defence of anthropomorphism. Cognition is plainly a huge part of what we are and what many non-human animals are not.

18.2 Objections to Anthropomorphism

If we exclude theology, there are broadly three objections to anthropomorphism. These are objections based on: (i) cognition; (ii) consciousness; and (iii) emotions. Although they are distinct, they are closely related, and for the purposes of the arguments in this chapter, nothing turns on the distinctions: to highlight the distinctions would make an already complex argument seem all the more convoluted. Very roughly, the argument based on each of these criteria, and any combination of these criteria, goes:

1. Humans are cognate/conscious/emotional.
 2. Non-human animals are not cognate/conscious/emotional.
 3. Cognition and/or consciousness and/or emotions are so fundamental to our make-up and/or our ability to relate to other creatures that, because non-human animals do not share these characteristics, no true comparison can be made between humans and non-human animals, and no real relationship can be established (since true relationship demands some degree of mutuality).
- Step 1 in the argument is unlikely to be controversial – although we might ask, how do we *know* that we are conscious? Isn't it consciousness itself which will always assert that consciousness is real? – a self-serving assertion if ever there was one.
 - Step 2 is contentious.
 - Step 3 needs to be evaluated in the light of a detailed assessment of the robustness of Step 2. Some philosophers, wary and contemptuous of grubby empiricism, might approach Step 2 in general terms. How, they might ask, do we know anything about the contents of the heads of *anyone* or

anything other than ourselves – whether human or animal? It is a perennial and powerful question, to which there is no very obvious, definitive answer. But most people will have little patience for such deep epistemological scepticism.

If it is possible, in theory, to know something other than the content of my own head, our immediate intuitions will insist that I have a better chance of working out what it is like to be my best human friend at any particular moment than it is to be a badger. After all, I share, or seem to share, more neurological hardware and software with my best human friend than I do with a badger, and my friend, unlike a badger, can use language to describe his emotional states and the way the world appears to him. Yet, there is a reasonable counter-argument that my best friend, being (apparently) a hugely more complex being than a badger, is consequently *less* accessible to me than a badger. I am more easily deceived by a sophisticated human fraudster than by a badger. A badger (unlike a human) is unlikely to be thinking on many levels at once, or to exhibit behaviour wholly inconsistent with its mental state.

18.3 Animal and Human Worlds

The very fact that humans are (presumably, according to Step 2, above) more *cognitive* than badgers is another reason to suspect that humans are uniquely inaccessible even to humans. If I look at a tree I get a visual image of the tree – and in registering ‘tree’, I more or less ignore other sensory modalities, such as hearing or smell (of which more later). But this visual impression itself is only momentary. My supposedly superior cognition gets immediately to work on the image, transmuting it into my thoughts about the tree. The resulting notion of the tree will bear very little relationship even to the visual data – it will be based on many things other than the data: (i) on memories of trees; (ii) on half-remembered scraps of poems about trees; and (iii) on all the other thoughts (probably entirely unconnected with trees at all) that I cannot stop streaming into my head. So when I say that I see the tree it is barely a half truth. My ‘tree’ is a creature of my own cognition. My world is incurably self-referential.

Badgers create worlds too, of course. That is the job of brains. But it is reasonable to suppose that fewer half-remembered poems distort the badger’s (primarily olfactory) picture of a tree. Badgers perceive trees far more as trees actually are than we do

(Fig. 18.2). If we could only learn to see trees as they are, we would have a fair chance of sharing more of a badger’s world than we do the world of another self-referential human.

Consciousness, in this context, of course means much more than merely *sensate*. It means, roughly, and for the purposes of the argument about anthropomorphism, *self-awareness*. And in this sense, consciousness seems to be very common indeed. We have historically been very bad at looking for consciousness. One of the main tools has been the mirror test, in which, if an animal recognizes itself in a mirror (for example by acknowledging the presence in its reflected image of a mark which it can see on its own body), it is deemed to have self-awareness, and hence consciousness. The mirror test was devised in the 1970s by Gordon Gallup, who observed that, ‘Self-awareness provides the ability to contemplate the past, to project into the future, and to speculate on what others are thinking’ (Gordon Gallup quoted in Tennesen, 2003). The American biologist Carl Safina trenchantly comments: ‘Try finding that in a mirror’ (Safina, 2015), and Safina, in the most accessible and devastating indictment of mirror tests in the literature, observes that:

A creature *lacking* self-concept would be unable to differentiate itself from anything, so it would *assume* that the reflected image is itself. But a mobile creature unable to differentiate itself from anything could hardly exist. It could not navigate the real world, escape, mate, or survive. Obviously many, many animals know the difference between themselves and the rest of the world. But very few recognize themselves in a mirror.

(Safina, 2015, pp. 186–187)



Fig. 18.2. The author and his son lived in a badger sett, and described their experiences in *Being a Beast* (Foster, 2016). (Image credit: Charles Foster.)

He continues:

When an individual ‘fails’ to recognize their reflection, all it proves is that they don’t understand reflection ... or simply don’t care [e.g. dogs – because they are so smell-oriented] ... Deciding whether a dog has self-awareness by whether it examines its mirror image is like a dog deciding that we lack a concept of self because we don’t linger to sniff our own ... shirt. When a bird *attacks* the mirror, it does so precisely because it believes the reflection is *another* individual: *not itself*. It demonstrates self-concept ... it clearly knows the difference between self and not-self ... Self-recognition is why a wolf eating an elk’s leg doesn’t bite into its own leg. A concept of ‘self’ is absolutely basic.

(Safina, 2015, pp. 276–278)

Even if mirror tests are useful in principle, there have been many experimental errors resulting from a casual, instinctive anthropocentrism. An example is: since humans indicate areas on their own bodies using their hands, it is easy, and foolish, to assume that cetaceans would indicate areas on their bodies in (e.g.) mirror tests, with their hand-analogues. But cetaceans do not use those analogues (flippers) analogously to hands at all.

Safina is right: self-awareness is a necessary consequence of individuation – at least in animals with a significant degree of encephalization, and individuation is the primary (and plainly correct) premise of Darwinian orthodoxy. It is not surprising that the better we get at looking for consciousness, the more we find it. Our planet seems to be a fertile garden for growing consciousness: it springs incontinently up throughout the biological world. Elephants have different selves than do humans, and so, no doubt, have a rather different awareness of those different selves, but, to deny them consciousness is an act of unscientific, dogmatic colonialism.

If consciousness is ubiquitous, it raises the possibility that emotions may be too. One can surely not have emotions without consciousness, but while consciousness might not necessitate emotions, it makes them highly likely. An awareness of self entails an awareness of oneself in relation to other individuals (or at least the world outside oneself) – and there one has the substrate of most, if not all, emotions. Even a pathologically self-obsessed, non-relational person has emotions (such as misanthropic disgruntlement) generated by the actual or perceived misalignment of the world outside his or her own head.

Emotions are more visible than consciousness. They will often be evidence of consciousness, and, in fact we see emotions – or what appear to be emotions – a very great deal, as Darwin himself knew: he wrote an entire book on the subject (Darwin, 1872). Traditional scientific attitudes towards animal emotion are merely traditional and may be profoundly unscientific. Zoologist David Macdonald describes how a fox he had been studying, and which he knew as ‘Wide Eyes’ was caught in a mower. Her leg was nearly severed, and that night she was euthanased by a vet. The following day, Wide Eyes’ sister, Big Ears, picked up a mouthful of food from a cache and ran off with it, whimpering, as she ran, ‘as foxes do when they are giving food to cubs’. Macdonald comments that it was more than a year since she had previously made that call. Big Ears took the food to the spot, still soaked with blood, where Wide Eyes had lain the previous day. ‘There, Big Ears whimpered the food-giving call, then she cached the food beneath the very blades of grass on which her injured sister had lain...’ (Macdonald, 1987). This looks emotional, it looks like compassionate sentiment, and the notions of kin selection or reciprocal altruism, however powerful they may be as explanations for the force that compelled Big Ears to do what she did, do not even begin to dilute the impression that this was an emotion-rich event. Big Ears, in circumstances in which we would be emotional, behaved in a way that we, driven by our emotions, might well behave. Is it more scientific to say that Big Ears was probably emotional, or that her reaction cannot be described as emotional at all? Surely the most parsimonious hypothesis is that she was emotional in something like the same way as we are (Foster, 2017).

‘Anthropomorphism’, says Safina, ‘is our best first guess at why animals are doing something ... when they are happy and having fun playing with one another and playing with their babies it’s because they are happy and having fun’ (Toomey, 2015). I agree.

So Step 2 (that non-human animals are not cognate/conscious/emotional), on the basis of the available evidence (rather than on the basis of mere philosophical argument) is looking increasingly dubious. So, therefore, is Step 3 (based on the premise that because non-human animals do not share these cognate/conscious/emotional characteristics, no true comparison can be made between humans and non-human animals).

18.4 Can We Ever Get the Whole Story About the Feelings of Any Other Creature?

Anthropomorphism, though the best first guess, is not the whole story. But then we can never get the whole story about the feelings of any other creature – even those of our spouses and close friends. If the arguments in this chapter fail to convince, consider something else. It will have failed because humans are massively different from non-human animals, and because the gulf between them cannot be bridged by observation or the intelligent use of imagination. It will have failed because of our cognition. We have already observed that our cognition, though we assume it is an advantage, might inhibit the flow of reliable information about the way the world is, or compromise our use of the information that does reach us for processing. It may be, then, that a positive effort to be anthropomorphic might enable more accurate perception. A fox (a superb sensory all-rounder) uses its eyes, its ears, its nose, its highly sensitive feet, and no doubt its taste buds, all at once, in a way that we rarely or never do. Its brain builds a much more accurate picture of the fox's environment than our brains do of ours. It lives more fully than we do; it pays more attention; it has fewer self-generated delusions. We would be more satisfactory and satisfied humans if we lived more fully, more epistemically accurately, and less delusionally. So strive to be anthropomorphic: it is a

useful tool not only for understanding animals, but also for understanding ourselves and understanding the worlds in which we live.

References

- Darwin, C. (1872) *The Expression of the Emotions in Man and Animals*, 1st edn. John Murray, London.
- Foster, C. (2016) *Being a Beast*, 1st edn. Profile Publishers, London.
- Foster, C. (2017) If you were an elephant. *The Guardian*, 19 January 2017. Available at: <https://www.theguardian.com/environment/2017/jan/19/if-you-were-an-elephant-> (accessed 26 June 2017).
- Hancock, G. (2006) *Supernatural: Meetings with the Ancient Teachers of Mankind*, 1st edn. Red Wheel Weiser, Newburyport, Massachusetts.
- Lewis-Williams, D. (2004) *The Mind in the Cave: Consciousness and the Origins of Art*, 1st edn. Thames & Hudson, London.
- Macdonald, D. (1987) *Running with the Fox*, 1st edn. Unwin Hyman, London, pp. 219–220.
- Safina, C. (2015) *Beyond Words: What Animals Think and Feel*, 1st edn. Souvenir Press, London.
- Tennesen, M. (2003) *Do Dolphins Have a Sense of Self?* National Wildlife Federation, Reston, Virginia.
- Toomey, D. (2015) Probing the Rich Inner Lives of the Planet's Wild Animals. Available at http://e360.yale.edu/features/probing_the_rich_inner_lives_of_the_planets_wild_animals (accessed 26 June 2017).
- Wynn, T., Coolidge, F. and Bright, M. (2009) Hohlenstein-Stadel and the evolution of human conceptual thought. *Cambridge Archaeological Journal* 19(1), 73–84.

19 Speciesism

STIJN BRUERS

19.1 Introduction

Imagine you're at your neighbor's barbeque. You taste a delicious new well-grilled sausage. You see the packaging and read: 'Delicious Dog. From our best quality golden retrievers. Free range. 100% organic'. Chances are high that you get a spontaneous emotional response of disgust. Why do we not have the same response in the supermarket, looking at a piece of pig meat? As psychologist Melanie Joy asked: 'Why do we love dogs, eat pigs and wear cows?' (Joy, 2009).

When it comes to our treatment of animals, we are very confused. We arbitrarily divide them into categories: wild versus domestic animals, edible versus inedible, pest animals, cute animals, disgusting animals, loyal animals. Looking at the domestic animals, all cultures have their food taboos: (i) the Hindus don't eat cows; (ii) the Muslims avoid eating pigs; and (iii) in the Anglo-Saxon world horses are considered inedible. Separating the wild animals into edible versus inedible animals becomes quite far-fetched: from dolphins to squirrels to pheasants, there is no obvious logic why people eat one but not the other, and the more we learn about animals, the messier it gets. In some countries, glue traps for mice and rats are allowed. This causes extreme suffering. In the meantime, scientists discover that rats and mice have complex cognitive and emotional capacities, and that they cannot only suffer themselves but can also feel kinds of empathy with the suffering of other individuals.

We are all familiar with optical illusions. The famous Müller-Lyer figure consists of two horizontal lines of equal length, one with outward pointing arrowheads at the ends, the other with inward pointing arrowheads (Fig. 19.1). This creates an illusion. One line appears to be longer than the other. Our senses cannot always be trusted. But what about our intuitions and judgements – can we always trust them? My claim is that there are moral illusions: spontaneous, intuitive moral judgements

that are very persistent, but they actually violate our deepest moral values (Bruers, 2015a), and they distract us away from a rational, authentic ethic.

One very dangerous moral illusion is discrimination. In this chapter I will focus on a very persistent kind of discrimination: speciesism, the judgement that members of some biological species are more important than other living beings. The term speciesism was first coined by psychologist Richard Ryder in the early 1970s and further popularized by philosopher Peter Singer as a prejudice, analogous to racism and sexism (Ryder, 1974; Singer, 1975). Like racism and sexism, in speciesism the treatment of individuals is based on a group membership or on morally irrelevant biological differences. Speciesism is most visible in its anthropocentric form: when it comes to granting rights and liberties, members of the human species are believed to deserve more, or stronger, rights than non-human animals.

We can use the Müller-Lyer optical illusion as a metaphor. The horizontal lines correspond with the moral values of two individuals, such as a dog and a pig, or a chicken and a child. The longer the line, the more value the subject has. This moral value represents, for example, the right not to be harmed or abused. The small arrowheads correspond with the morally irrelevant properties, such as bodily characteristics. It appears that a dog is more valuable than a pig, that a child is more valuable than a chicken, as if eating a child is worse than eating a chicken. But this is an illusion. How do we know this?

First, we can erase the arrowheads, the morally irrelevant properties. Now we see that both lines are equal. And what is left of the chicken and the child? Their morally relevant properties: their feelings and well-being. On that level, both individuals count equally. Chickens have emotional and cognitive capacities comparable to some humans such as toddlers or mentally disabled children (Marino, 2017). Having wings or arms is not morally relevant.

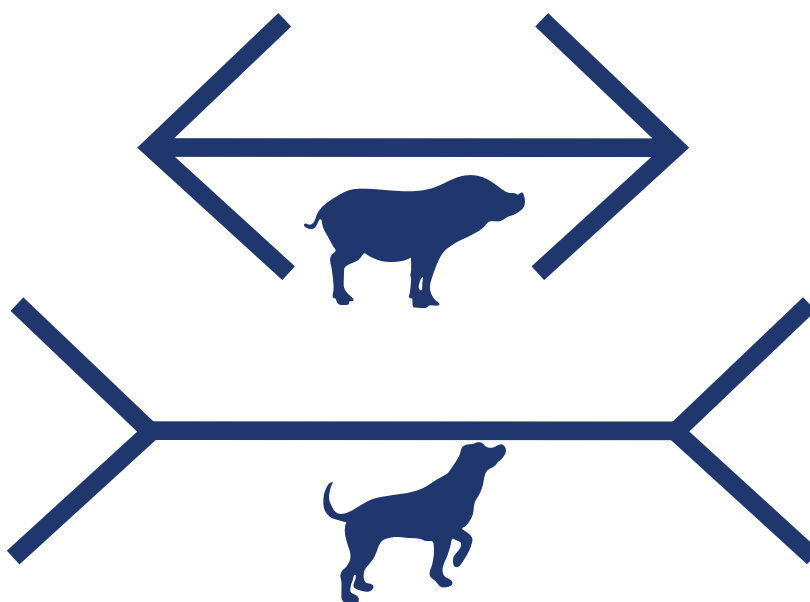


Fig. 19.1. The Müller-Lyer optical illusion as a metaphor for the moral values of a pig and a dog. (Image credit: Stijn Bruers.)

Or we can use another tool to demonstrate the equality of the two lines: we can shift a measuring stick from one line to the other. In ethics, we have a similar tool: empathy. This allows us to shift positions, to put ourselves in the position of someone else. Of course a good, reliable measuring stick is rigid and does not change its length when shifted. Similarly, when we put ourselves in the positions of other people, we cannot simply discount their feelings and preferences based on irrelevant properties. As a reliable measuring stick, our empathy could and should be impartial.

This brings us to an important clue about how to avoid moral illusions: we have to avoid all kinds of unjustified or unwanted arbitrariness.¹ The victims of discrimination do not want to be treated as a result of arbitrary exclusion. Why is speciesism arbitrary?

19.2 The Hierarchy of the Human Biological Classification

Let's look at the hierarchy of the human biological classification as a model. You can look at it as a cabinet with 12 drawers (Fig. 19.2). I can open the bottom drawer and say that I belong to the ethnic group of white Caucasian people. But I also belong

to the subspecies *Homo sapiens sapiens* in the drawer above, as well as to the species of humans, the genus *Homo*, the family of great apes, the infraorder of simians, the suborder of dry-nosed primates, the order of primates, the infraclass of eutheria, the class of mammals, the phylum of chordates and vertebrates, and in the top drawer the kingdom of animals. So why would we open this tenth drawer and point at this species of humans and say that only those individuals get rights? Why not point at other species or other categories such as the class of mammals? We are mammals as much as we are humans.

Speaking about human rights makes as much logical sense as speaking about, for example, simian rights. Yes, most humans have self-conscious, moral, and rational cognitive capacities: only a minority of babies, toddlers, and seriously mentally disabled humans lack mental capacities such as rationality. But the same goes for simians: there are about 8 billion simians, and the majority of them are rational, moral agents.

Speciesism is based on an arbitrary selection of one category in the vertical hierarchy of the biological classification. We see similar vertical hierarchies in other kinds of discrimination, such as nationalism and religious ethnocentrism. In the case of



Fig. 19.2. The 'biological classification'. (Image credit: Stijn Bruers.)

nationalism we have from top to bottom: the whole world, continents, supranational unions of states, countries, provinces, and municipalities. Preferring your own country is arbitrary: why is the nation more important than the family, the town, the province, the continent, or the whole world? In religious discrimination, we have from top to bottom: all religious believers, Abrahamists, Christians, Catholics, Roman Catholics, and Benedictines. If Christians want to discriminate Muslims, they have to argue why they picked the third layer from the top in this hierarchy. If Protestants fight Catholics, they have to argue why they discriminate on that level of the vertical hierarchy.

After arbitrarily selecting a level in the vertical hierarchy, discrimination requires an arbitrary selection of the 'in-group' (the 'preferred group', the positively discriminated group) defined at this level. Examples of this horizontal arbitrariness include: (i) picking the USA instead of another country; or (ii) picking the group of human animals (*Homo sapiens*) instead of another species. These kinds of discrimination involve a double arbitrariness: arbitrarily selecting a drawer (a level in the hierarchy) and then arbitrarily selecting a group in that drawer.

But it's worse. Defining the 'in-group' is often very difficult. Take an apparently simple question such as the difference in sex: how to define the

group of males? This might seem quite simple, but what about the different kinds of transsexuals and intersexuals (who have genital ambiguity or mixed chromosomal genotypes)? Such fuzzy boundaries disturb the self-evident appearance of an 'in-group' in a sexist culture. And even if we could give a complex set of characteristics to define males, its moral relevance would become increasingly far-fetched.

19.3 Fuzzy Species Boundaries

Racism can be criticized using the fact that it is basically impossible to clearly define and delineate a race. Here we see similarities between racism, sexism, and speciesism. Similarly, the idea of a species is not well defined either. There are many fuzzy boundaries. Consider hybrids: offspring resulting from cross-breeding between different species. Each cell in the body of a hybrid has the genome derived from two different species. The two species are defined as 'different' if most of the hybrids produced are infertile. It is not impossible that a human-chimpanzee hybrid (humanzee or chuman) could be created, up to 10% of mammal species can form interspecies hybrids. We have seen lion-leopards, lion-tigers, camel-lamas, dolphin-killer whales, sheep-goats, grizzly bear-polar bears,

horse–zebra, donkey–zebra (zebret, hebra, donkra), and humans routinely create horse–donkey hybrids (hinny, mule). If these are all possible, and if the genetic distance between humans and chimpanzees is not larger than the distance between those interbreeding species, it is not unlikely that humanzees can be born.

What would the moral status of this humanzee hybrid being be? Does it get human rights or not? Also here there is an arbitrariness, and there is likely to be more arbitrariness when we look at the possibility of human–animal chimeras. A human–animal chimera is an individual composed of genetically distinct cells that originate from human and animal zygotes. One part of the body of cells are human, the other are non-human. The bodies of chimeras can range from almost 100% human to almost 100% non-human. Recently, scientists were able to grow an embryo of a human–pig chimera: part of the embryo's body is pig, part is human. Where to draw the line of humanity? What would the moral status of such chimeric individuals be? There is no objective characteristic or indicator that scientists could use to determine whether such beings should be called human and should get a high moral status (as humans do).

One of the many definitions of species refers to the potential for interbreeding and production of fertile offspring. But how and why should this possibility influence moral status? It is too far-fetched to say that a being has a moral status if its close relatives² (parents) could have produced fertile offspring with some other morally relevant beings. It is unfair that an individual gets rights because his or her parents are able to reproduce with others. It is unjust to take a principle where non-human animals simply have the bad luck of having the wrong parents.

Even if human–animal hybrids and chimeras didn't exist, all the intermediates between you and a chicken actually once existed on this planet. Suppose I jump into a time travel machine and bring all our ancestors to the present, and I ask all these ancestors to line up in a long row. You are on the far left, then your mother, your grandmother, and so on. Moving further down the row, we see our ancestor who lived 400 million years ago. This is our great, great, great – and so on – grandmother. She is also the ancestor of all vertebrate land animals, including chickens. So we can extend the long row, moving up and down and across the branches of the phylogenetic tree all the way to a modern-day

chicken. You are on the far left, in the middle is a common ancestor of all vertebrate land animals, and on the far right is a chicken.

You are fully human so you get human rights. So are your mother and your grandmother. They all belong to the moral community, the group of individuals who get rights. But moving down the row, where does the moral community end? There is no sharp boundary between humans on the left and non-humans on the right. So our idea of human rights and our behaviour of eating chickens are based on an arbitrary fact that those intermediates between us and chickens no longer exist, and that at some point along the branches, human rights 'stop'.

According to evolutionary biology and genetics, scientists will never be able to tell – not even in principle – when they have collected 'all' the available information. This is the basis of the famous sorites paradox (sometimes known as the paradox of the heap): even if we have all information about the individual grains of sand, we still are not able to tell whether those grains should be called a heap. In other words: there are no non-arbitrary empirical facts that determine a sharp boundary between humans and non-humans. Moral status should not depend on the accidental non-existence of boundaries. In this sense, evolutionary biology undermines speciesism (Hull, 1986; Rachels, 1990; McMahan, 2005). If all human–animal intermediates (all our ancestors) still existed, the notion of *human* rights would more clearly appear to be arbitrary.

If we pick an arbitrary boundary around the human species, this boundary will refer to biological properties such as genes or appearances (bodily characteristics). But these are not morally relevant, because racism and sexism are also often based on genes or appearances and both anti-racism and anti-sexism are based on the premise that such a basis is not morally relevant. There is no 'interest in being alive gene' found only in humans; there is no specific gene that uniquely identifies any being as having 'interest to be alive', it is likely that all beings have 'interest to be alive'.

Where do speciesist, racist and sexist judgements come from? They are based on a cognitive bias called essentialism: the tendency to perceive hidden 'essences' that distinguish members of the in-group from members of the out-group. Essentialism means that there are characteristics that all elements of a specific set (e.g. a species) possess, and

elements that other sets don't possess. If there is an essence, all elements of that set can be accurately described and defined by the characteristics of that essence, the 'common essence'. That specific set therefore could have a definition.

Essentialism in biology is rooted in ancient philosophical thinking (e.g. Platonism), and described and articulated through major religions. In those religions, it is believed that there is something special to all, and only, humans: all humans, and only humans, have an eternal soul, or are created in the image of God. But since Darwin (*Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*, published on 24 November 1859), the scientific consensus indicates that there is nothing special about a species. A species can become an arbitrary abstract human-derived classification, with its own limits (and difficulties).

The above arguments about arbitrariness in hierarchies indicate that there are actually no readily defined essences related to subcategories. The fact that there is a tendency to think of species as essentialized groups does not mean that there is actually any real essence to a species. There is a cognitive bias that generates a moral illusion. A racist may think of races or ethnic groups as being essentialized natural groups, even though it is clear that there really is no essence related to an ethnic group or race. Several studies describe the phenomena that people rapidly (but incorrectly) tend to think in terms of essentialized groups (Gil-White, 2001; Gelman, 2003).

In the literature, essentialism can be recognized through use of expressions such as 'rational nature' (Lee and George, 2008), 'essential nature of a living kind' or 'a specific type of substantial nature' (Kumar, 2008). Philosophers who refer to 'essence', 'nature' or 'kind' include Finnis (1995, p. 48), Scruton (1998), Cohen (2001), Lee (2004), Scanlon (2008, p. 186) and Chappell (2011). The argument for specific 'kinds' has been criticized by, for example, Tanner (2006).

A property such as 'rationality' cannot be the essence of the human species, because some humans (e.g. mentally disabled children) have a level of rationality which is as high as some non-human animals. One could infer that mentally disabled humans have a 'rational nature' or a 'soul' as a hidden (not fully expressed) essence, but these properties are perhaps not readily (or scientifically) testable: we do not have a test to see whether a being that

lacks rationality still has a hidden rational nature. A soul cannot be detected, not even indirectly.

19.4 The Category 'Human'

Some argue that the category 'human' does not refer to the biological species concept currently favored by science but to a *folk* concept of 'human being' as a *kind* (as proposed by Chappell, 2011). However, this does not avoid the issues of arbitrariness and ambiguity. Each clarification of this notion of 'kind' results in the observation that there are many possible 'kinds'. If 'human being' is a kind, then, for example, 'primate', 'two-legged being' or 'Caucasian' can be kinds as well. It is not clear why the kind of human being is an exceptional kind of kind, compared with the many other possible kinds that one can think of. No unambiguous and specific natural 'kind' or 'essence' is related to the species *Homo sapiens*. We can compare species essentialism with letter essentialism. Consider the letter 'F': we can recognize and read a letter 'F' when we see it (at least in most cases), but this set of 'Fs' is very abstract and difficult to define. What do the letters 'F' in different fonts have in common? Some written letters 'F' look totally different from others. There is no essence behind the letter 'F'. But not only is a kind of letter difficult to define, there are also many other sets of letters, such as the sets of letters 'E' and 'L', as well as unified sets (e.g. a collection of fonts) of letters such as 'E, F and L'. This generates a whole hierarchy of letter categories. If it is meaningful to say that the letter 'F' is of a different kind than the letter 'O', then it is equally meaningful to say that 'F and E' are of a different kind than 'O and Q'. Introducing hybrid letters such as 'B, P and D' makes it even more complicated for letter essentialism.

Even after following the arguments as to why speciesism contains unwanted arbitrariness and how the cognitive bias of essentialism creates the moral illusion of speciesism, we often still automatically perceive humans as more valuable than non-human animals. Moral illusions like speciesism are very persistent. In optical illusions, this is known as cognitive impenetrability (Pylyshyn, 1999): even after measuring the lengths of the Müller-Lyer illusion, the lines will persist in appearing to be different, even to the observer who understands that they are measurably the same length. Speciesism has a similar kind of cognitive impenetrability: our spontaneous, intuitive judgements

regarding the moral status of humans versus animals reflect some degree of speciesism even after we engage with the logic of arguments against speciesism. In discussions with meat eaters, a lot of people remain speciesist even after they have engaged with, and agreed with the logical basis of the arguments described above. Many people will give inconsistent counterarguments to justify speciesism, and this can look like a moral dumbfounding (Haidt, 2001), where people have strong intuitive moral judgements but finally fail to express a rational principle which can explain their intuitive reactions.

Even some people with an animal rights perspective, or with a strong animal welfare concern, exhibit some aspects of speciesist language that reflects essentialistic thinking. For example, in discussions, animal rights activists often refer to the notion of humans. This might indicate that those anti-speciesist animal rights activists have difficulties in overcoming the moral illusion. My personal experience confirms this: I am an animal rights activist, but I am aware that I still have some intuitive speciesist judgements about the moral status of humans and animals. It takes some cognitive effort to overcome those intuitions.

A lot of animal welfare active people still exhibit some kind of speciesism, especially when it comes to the problem of wild animal suffering (Horta, 2010; Tomasik, 2015; Faria, 2016). These people may believe that suffering caused by humans is worse (more immoral) than suffering caused by non-human animals or nature. They may believe we have a stronger duty to prevent human-caused suffering, but the animals who suffer from non-human causes, don't care about who or what causes the suffering. Some animal rights activists believe, for example, that male lions kill the cubs of other males, because that's 'nature'. But are those lions allowed to kill human toddlers? And are humans allowed to kill those lion cubs? Neglecting, or giving low priority to wild animal suffering might be considered evidence that even people with strong animal welfare concerns have a persistent, speciesist bias.

19.5 What To Do?

So if species membership is not morally relevant, what to do? Traditionally, we start with the set of all-important rights, and then we ask the question: who gets those rights? Then we see an expanding

moral circle through history. We extended the range of our moral radar. First our fellow tribesmen became visible, then all white men, then all humans received rights (in principle, if not in practice). But we cannot arbitrarily (and illogically) stop at the group of humans. The moral circle could, and should logically expand further. Everyone and everything should be included, without arbitrary exceptions. So I propose to follow the other direction: we start with the condition that everyone and everything counts and will be included in the moral community, and then we figure out what rights we should give to everyone and everything.³

One of those rights could be the right not to be used as a means against one's will (Bruers, 2016). This is a right to bodily autonomy: your body belongs to you and no one else may use your body against your will as a means to an end. I use you as a means to my end if the presence of your body is necessary to reach my end. I use you *merely* as a means when this usage involves a treatment that you do not want, when you have to do or undergo things against your will. Everyone and everything should get this right to bodily autonomy, including plants, bacteria, and computers. There is no arbitrary exclusion or discrimination. But whatever we do, we cannot violate this right of a plant, because as far as we know a plant has no consciousness, no subjective sense of its own body and no will. Therefore, a plant cannot be used against its will. For stones, bacteria, plants, and computers, this right is always trivially satisfied, whatever we do. Those objects do not care about this right because they don't have the mental capacity to care about things. The right becomes only important when we are considering sentient beings, because they have a will and a sense of their own bodies. According to our scientific knowledge (and to a more inaccurate degree our empathy), most likely all vertebrates and possibly cephalopods and large crustaceans have a will. Having a will is morally relevant because you prefer that your will is taken into account by everyone. For example, you do not want to be killed (to be eaten) against your will, and in particular against a background of arbitrariness in regard to whether your will is considered or not.

For me, when I realized that I could not arbitrarily use the bodies of other sentient beings against their will, I adopted a vegan lifestyle (Bruers, 2015b, c). No animal products on my plate.

Overcoming my moral illusion of speciesism had far-reaching implications in my daily life, but it brought me into a sharp connection with my deepest moral values.

Notes

¹ Technically speaking, arbitrariness consists of picking an element or subset of a given set without using a rule (Bruers, 2015d). If you picked X, why did you pick X and not Y or Z? If you cannot answer this question by referring to a rule (that does not trivially select X), your choice for X was arbitrary. Arbitrariness is not unwanted if everyone can consistently want this arbitrariness and no one can consistently object to it. You can consistently want something if what you want is not in contradiction with a consistent set of all the most important things that you want or prefer, such as your strongest moral values. You can consistently object to something if what you want is incompatible with a consistent set of all the most important things that you want or prefer.

The unavoidable and innocent kinds of arbitrariness are kinds that anyone could consistently want. The culprit in ethics is the unwanted arbitrariness: the arbitrariness that not everyone can consistently want. The anti-arbitrariness principle in ethics states that all unwanted arbitrariness should be avoided. If one thing goes for X, then it must also apply to all Y and Z that are equal to X (in the sense of belonging to the same set as X) according to a rule, unless everyone can consistently want that it just applies for X. Arbitrariness is only allowed if it is not against anyone's will.

² I refer to its close relatives because the individual itself could be infertile.

³ More generally, our moral rules should apply to everyone and everything, without arbitrary exceptions (Bruers, 2015d). For everything you do, you have to be able to give a moral rule that justifies your act, and you must be able to consistently want that everyone follows that rule. If you cannot give such a rule, your act is not allowed. Or simply put: if you are allowed to do something, then so is everyone, because you are not special. You should not arbitrarily pick yourself from the set of all individuals and say that you are the only one who may do that thing. In ethics we try to avoid unwanted arbitrariness (see Note 1). Suppose that your moral rules contain unwanted arbitrariness. If you say that unwanted arbitrariness is permissible, then I may also follow arbitrary principles that you cannot consistently want. I am allowed to reject your arbitrary rule and impose my moral rules on you, and you cannot give reasons to complain. You are not able to give justified arguments against the imposition of my rules, because by following your arbitrary rules, you are acknowledging that unwanted arbitrariness is allowed. That means that it is also permissible to arbitrarily ignore someone else's moral views and rules. So I can say to you that your moral values and judgements are not valid.

And if you complain and say that your moral rules are valid, then I can reply that if you are allowed to arbitrarily exclude other moral views and make an ad hoc exception for your own ethical system, then so am I. So I may even make the exception that everyone's moral views should be respected, except yours. All your objections can easily be bounced back by saying: 'If you are allowed to arbitrarily do that, then so am I. What would make you so special that you are allowed to arbitrarily exclude others but I am not?'

References

- Bruers, S. (2015a) In search of moral illusions. *The Journal of Value Inquiry* 50(2), 283–303. DOI: 10.1007/s10790-015-9507-8
- Bruers, S. (2015b) The core argument for veganism. *Philosophia* 43(2), 271–290.
- Bruers, S. (2015c) In defense of eating vegan. *Journal of Agricultural and Environmental Ethics* 28(4), 705–717.
- Bruers, S. (2015d) Against arbitrariness. Available at: <https://stijnbruers.wordpress.com/2015/11/13/against-arbitrariness/> (accessed 6 December 2017).
- Bruers, S. (2016) Can Deontological Principles Be Unified? Reflections on the Mere Means Principle. *Philosophia* 44(2), 407–422.
- Chappell, T. (2011) On the very idea of criteria for personhood. *Southern Journal of Philosophy* 49(1), 1–27.
- Cohen, C. (2001) Why animals do not have rights. In: Cohen, C. and Regan, T. (eds) *The Animal Rights Debate*. Rowman & Littlefield, Lanham, Maryland, pp. 27–40.
- Faria, C. (2016) Animal ethics goes wild: the problem of wild animal suffering and intervention in nature. PhD thesis, Universitat Pompeu Fabra, Barcelona, Spain.
- Finnis, J. (1995) A philosophical case against euthanasia. In: Keown J. (ed.) *Euthanasia Examined*. Cambridge University Press, Cambridge, pp. 23–35.
- Gelman, S. (2003) *The Essential Child: Origins of Essentialism in Everyday Thought*. Oxford University Press, New York.
- Gil-White, F. (2001) Are ethnic groups biological 'species' to the human brain? Essentialism in our cognition of some social categories. *Current Anthropology* 42(4), 515–555.
- Haidt, J. (2001) The emotional dog and its rational tail: a social intuitionist approach to moral judgment. *Psychological Review* 108(4), 814–834.
- Horta, O. (2010) Debunking the idyllic view of natural processes: population dynamics and suffering in the wild. *Telos* 17(1), 73–88.
- Hull, D.L. (1986) On human nature. In: Fine, A. and Machamer, P.K. (eds) *PSA 1986: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, Volume 2. Philosophy of Science Association, East Lansing, Michigan, pp. 3–13.

- Joy, M. (2009) *Why We Love Dogs, Eat Pigs and Wear Cows: An Introduction to Carnism*. Conari Press, Newburyport, Massachusetts.
- Kumar, R. (2008) Permissible killing and the irrelevance of being human. *The Journal of Ethics* 12, 57–80.
- Lee, P. (2004) The pro-life argument from substantial identity: a defence. *Bioethics* 18(3), 249–263.
- Lee, P. and George, R. (2008) The nature and basis of human dignity. *Ratio Juris* 21(2), 173–193.
- Marino, L. (2017) Thinking chickens: a review of cognition, emotion, and behavior in the domestic chicken. *Animal Cognition* 20(2), 127–147.
- McMahan, J. (2005) Our fellow creatures. *The Journal of Ethics* 9, 353–380.
- Pylyshyn, Z. (1999) Is vision continuous with cognition? The case for cognitive impenetrability of visual perception. *Behavioural and Brain Science* 22, 341–365.
- Rachels, J. (1990). *Created From Animals: the Moral Implications of Darwinism*. Oxford University Press, Oxford.
- Ryder, R. (1974) *Speciesism: the Ethics of Vivisection*. Scottish Society for the Prevention of Vivisection, Edinburgh, UK.
- Scanlon, T.M. (2008) *Moral Dimensions*. Harvard University Press, Cambridge, Massachusetts.
- Scruton, R. (1998) *Animal Rights and Wrongs*. Demos Publishers, London.
- Singer, P. (1975) *Animal Liberation: a New Ethics for our Treatment of Animals*. HarperCollins, New York.
- Tanner, J. (2006) Marginal humans, the argument from kinds and the similarity argument. *Facta Universitas* 5(1), 47–63.
- Tomasik, B. (2015) The importance of wild-animal suffering. *Relations: Beyond Anthropocentrism* 3(2), 133–152.

20 Longevity and Brevity – Is Death a Welfare Issue?

ANDY BUTTERWORTH AND JAMES YEATES

20.1 Introduction

You've been born – the blood is flowing around your lungs, and you start to focus on the shapes of the world. You have a lot of potential from your genes and your development in the womb or the egg. Your cells continue to divide, and you are on track along an expected growth trajectory – infancy, youth, sexual maturity, adulthood, reproduction, the day-to-day business of survival, ageing, senescence, and death. You don't know it yet – and may never know it if you don't give it any thought – but you are an unlikely organized cellular energy packet in a world full of things that could disrupt the relative improbability of your existence. It doesn't matter if you are an eel, or an elephant, or an Emma – your time on the earth is probably particularly special to you, and may be your only chance for any of the things life brings. To have it cut down, shortened, or curtailed – without the full opportunity to have your full share of experience, existence, energy transfer, progeny, contribution to the life of your society (including animal society if you are a group living animal) – seems both a deprivation for you and somehow 'wasteful' in general.

If you die young, say through accident or disease, or if you are slaughtered for food as an adolescent animal, would this just be 'a pity', or 'a shame'? Or is it actually a more significant 'waste', in a number of meanings of the term 'waste' ('to consume, spend, or employ uselessly or without adequate return, to use to no avail or profit, squander, to fail or neglect to use, to miss an opportunity, to destroy or consume gradually, wear away' *Oxford English Dictionary*.)

This raises the uncomfortable question – is mankind wiping the experience slate of a huge mass of the world's animals 'clean' much too early, when the anatomical, physiological, and perhaps 'logical' extent of many animals' lives could be longer, wider, and richer?

We will explore this line of thought – but before we do that, we should consider that there will be many viewpoints on this, including:

- If an animal does not suffer at the time of its death, and it is unaware of its 'possible future life' (and its life expectancy), then surely it does not matter – each individual animal will be alive, then dead, and will not 'miss' what did not come next.
- If an animal can provide energy and protein for other life (and we might be particularly focused on the support of humans' lives), then surely this takes precedence over the energetic and experiential 'needs' of the farmed animal?
- The huge 'quantity' (i.e. number of farm animals in sum) may enable more 'animal experience' *in toto*. Even if farmed animal lives are short, there are lots and lots of lives – surely this compensates?
- Compared with, say, coral, or shrimp, or some fish, the number of 'wasted' lives in farmed animals is tiny – one cow may have ten calves in a lifetime (*K* selection, with high levels of care for individual offspring and an 'expectation' that many will survive). A broiler breeder chicken might produce 230 fertile eggs (still *K* selected, with, in the wild, high levels of maternal care, and in the farm, high levels of care by the human 'hatchery', and a high expectation of survival). But a shrimp might release 300,000 larval shrimp (*r* selection, with an 'expectation' that only a handful will survive), and a coral may release millions of eggs. So, does the consideration of loss of lifespan of a comparatively small number make any sense? Why ponder the 'lost life' of farmed animals when there is so much 'lost life' in the wild world?

We will try to explore these questions in the following text, but, even to be willing to consider whether 'quantity of life' is a topic worth discussion, we invite you, the reader, to allow some space

for discussion of the possibility that life duration is an element, and possibly even an important element, of an animal's life.

20.2 The Biological Investment in a Life

To get to the stage of being born requires a significant investment. Let's start by considering an egg. The nutritional content of an egg is well described – people build this information into nutritional plans, or into calorie-controlled diets. The composition of an egg is as follows:

- 290 kJ energy (carbon-rich molecules that can be metabolized as energy sources);
- 6.4 g protein (long chains of amino acids);
- 5.15 g fats (triglycerides);
- 1.7 g saturated fats (fatty acids with single bonds);
- 2.65 g monounsaturated fats (fatty acids with double bonds in the fatty acid chain);
- 0.85g polyunsaturated fats (fats with two or more carbon-carbon bonds);
- 0.2 g cholesterol (a sterol, a type of lipid);
- 0.7 g carbohydrates (molecules consisting of carbon, hydrogen and oxygen atoms, usually with a hydrogen:oxygen atom ratio of 2:1);
- 0.15 g sugars (molecules with carbon-oxygen double bonds, C=O); and
- 0.075 g sodium, 0.069 g potassium, 0.0065 g magnesium, 0.0245 g calcium, 0.104 g phosphorus, 0.0085 g iron and 'small amounts' (<0.001 g) of other trace elements.

The egg took a lot of energy to produce: (i) the energetic intake of the hen on the day the egg was laid and the energy cost of getting a hen to the point of lay; (ii) the maintenance energy cost; (iii) the actual energy content of the laid egg; and (iv) the energy content of the original egg from which the hen came. When an animal decides to produce offspring, it makes (probably unconsciously) 'life-history trade-offs' because reproduction entails both gains and costs. The gain is generally perceived to be an increase in reproductive fitness (offspring), and while increases in fitness may not be directly equated to 'pleasure' in any debate about the quality of life, the drive to reproduce is pretty much universal and self-sustaining. The costs may be difficult to quantify. Direct costs include: (i) the energy and nutrient demands of the reproductive event; (ii) the creation of the egg or the young; and (iii) the morphological and behavioural changes required to mate, fertilize,

grow, incubate, gestate, nurture, and rear young. There may also be less direct costs including 'compensatory costs' where the animal reduces investment in one area of growth or expenditure, to allow reallocation of resources to reproduction. In mammals, the costs of reproduction involve increased energy, protein and calcium uptake and deposition during pregnancy, and energetic and nutritional commitment during lactation. In birds and other egg-producing animals, the investment is in deposition of the egg, and then of nesting, brooding, rearing, protecting, and 'teaching' the young.

The reason to list the composition of an egg is this – much of an egg is already 'complex' – carbon- and oxygen-rich molecules which have been constructed and accumulated by the chicken, and have been arranged in the egg to provide all that is needed to make a chick. The egg is not really a 'bag of primary ingredients' for a chick, it is already a stockpile of biologically specialized molecules that can be reorganized by growing cells to make a living thing. In fact, a fertilized egg *is* a living thing – it is a respiring cell, which then divides into more cells using the prearranged packages of molecules prepared by the hen.

Why consider this? It is an example of 'potential' – we can assume that the molecular content of the chick which emerges from the egg will have approximately the same balance of oxygen, carbon, hydrogen, iron, sodium, potassium, calcium, and other atoms. But once it has been arranged into a chick something special has happened, something a bit improbable – all the molecular components have been arranged in a way that leads to a life. We all know this can happen, it happened to us all in the womb or in the egg – but because it happens 'all the time' does not diminish the complexity of what actually happened, the relative improbability of getting all the 'ingredients to line up' to make a life. We can, and do, boil an egg. We avoid boiling a chick, because we ascribe the potential for suffering to a chick. There is a transition from a bag of molecules, sugars, fats, and proteins, to a life, and that might be interpreted and considered 'evidence' of a biological commitment to the 'value' of the life. The process of this rearrangement is 'invested in' by the parent animal, in the long-term 'expectation' that the life created will in turn create more life, and as well as procreating, will also contribute to 'life experience' of the animals living out their lifespans on earth.

We can break down any animal into its constituent parts, even down to its molecular parts, but it is

not the ‘breaking down’ which is usually difficult (we do it to millions of animals every day as food), it is the ‘building up’ that is uniquely biological. Although farmers and animal breeders can stage manage this process, it is biological processes that control and enable this. Perhaps we could, or even should, consider with short, sharp clarity the biological parabola of a full life, and whether, by cutting almost all ‘farmed’ animals’ lives out while the animals are still on the ‘up-curve’ of their life arc, *we might be shifting the actual overall balance of biological functioning on earth.*

Hang on, that seems a bit sweeping! ‘We might be shifting the actual overall balance of biological functioning’ is too much! But is it? We will now explore this by considering various aspects of animal lives.

20.3 What ‘Quantity of Life’ Do Animals Get?

This seemingly simple question can be answered in different ways, depending on how and why we might think life to be valuable. Four possible ways immediately suggest themselves.

20.3.1 Has the animal had a long life in years?

We could simply measure how long, on average, animals live in years. This approach would assume that a year of life is equally valuable in any species. Let us first consider farm animals.

For beef cattle, approximately 20% (0.2) of animals are ‘breeding beef animals’ with an approximate lifespan of 2000 days (during which about four calves are born). The remaining 80% (0.8) are ‘fattening animals’ with fattening stock having an approximate lifespan of 550 days. So the combined ‘average’ lifespan of beef cattle (breeding and fattening together) is approximately $(0.2 \times 2000) + (0.8 \times 550) = 840$ days (2.3 years).

Among sheep, approximately 15% (0.15) of animals are ‘breeding ewes’ with an approximate lifespan of 1100 days. The remaining 85% (0.85) are ‘fattening animals’, sold as lambs, and during the lifespan of a breeding ewe about seven lambs are born on average, with lambs having an approximate lifespan of 120 days. So the combined ‘average’ lifespan of sheep (breeding ewes and lambs together) is approximately $(0.15 \times 1100) + (0.85 \times 120) = 267$ days (0.7 years).

Approximately 5% (0.05) of pigs are ‘breeding sows’ with a lifespan period of approximately 1100 days. The remaining 95% (0.95) are ‘fattening animals’, sold as young pigs. During the lifespan of a breeding sow about 25 piglets are weaned (some can produce more), with fattening pigs having an approximate lifespan of 150 days. So the combined ‘average’ lifespan of pigs (breeding sows and fattening pigs together) is approximately $(0.05 \times 1100) + (0.95 \times 150) = 197.5$ days (0.5 years).

It is surprisingly difficult to calculate accurate lifespans for pets. The average lifespan for a pet dog is about 12 years, and a cat is about 15 years (these can depend on breed). The lifespan of wild animals will vary enormously across species (and fortunes), but ‘average’ and maximum lifespans for wild animals have sometimes been calculated from studied populations. For example, in the wild, polar bears live an average of 15–18 years, and in captivity some long-lived bears reach their mid- to late 30s, and ‘Debby’, a captive bear in Canada, lived to be 42 (Polar Bears International, 2017).

However, we might consider that life is more valuable for different animals during different life stages. Some animals seem to ‘live quicker’ – physiologically and behaviourally – and die younger. Indeed, there is a well-known relationship between heart rate and natural longevity, suggesting that all animals who live natural lifespans have 10×10^8 (100,000,000) heart beats in total, spread over varying lengths of time (the species ‘average’ lifetime) (Levine, 1997). While the actual relationship between lifespan and heartbeat is likely to be more complex than this over-simplification of the theory of ‘rate of living’ suggests (particularly in making comparisons across dissimilar species), ageing may be related to metabolic processes and related to energy consumption and free-radical production.

20.3.2 Has the animal had a life of value?

An alternative view would be to consider an animal’s life in terms of value, weighted by some property of that animal’s life during that time, for example its ‘neurophysiological sensitivity’ or its ‘quality of life’. However, it is difficult enough to assess the value of parts of a single individual’s life (e.g. in Quality of Life assessments). There is no specific measure of ‘life-value’ that allows us to (confidently) compare lives between individuals, let alone across species. Perhaps we might legitimately differentiate sentient and insentient animals, affording

value to the lives of the former (if those lives are pleasant) and not to the latter (at least in terms of value for those animals – clearly the lives of insentient animals may have value for other sentient animals, for example as food). But that only defines the set of animals whose lives matter directly; it does not posit differential values for all of the periods of those animals' lives.

20.3.3 Has the animal had a fulfilling life?

We could consider whether an animal's life allows that animal to fulfil certain achievements (e.g. reproduction). A seemingly common motivation among humans is to 'leave something behind'. This might include passing on one's genes to one's children (and, less directly, supporting other kin). It might include passing on knowledge or resources, or it might simply involve having had a net beneficial effect on others who remain alive.

In commercial (i.e. non-subsistence/non-pastoral) farming systems, most pigs, chickens, sheep, and beef cattle (see the calculations above) do not live long enough to breed. Some other species, for example dairy cows and goats, do get to breed, because production of a calf or a kid is part of what is required to produce milk. However, although these animals do produce young, they may not have very long with their offspring, as the calves and kids are routinely removed from the mother and fed on artificial milk, while the 'natural milk' is fed to humans. Similarly, most pets and laboratory animals do not get to breed. Of course, it should also be noted that many wild animals also do not get to breed insofar as many die or are predated upon before reaching puberty.

20.3.4 What proportion of potential lifespan has been lived?

We might consider the proportion of a potential life that the animals live. In a similar way to an exploration of human lifespan, we can consider how long, for example, farmed animals live – and calculate: (i) the lifespan potential (L_p) of a farm animal; (ii) the life it usually actually has, i.e. the lifespan when farmed (L_F); and (iii) the 'actual percentage of potential life' ($A_{L\%}$) that a farmed animal lives. We can also calculate how many 'animal lifespans' for real farmed animals are squeezed into the potential life of an animal had it lived a 'potential life'. This allows us to see how many 'generations' of farmed

animals a farmer can squeeze into the time which would have been taken up if only one generation of animals offered a 'potential life' had been farmed (lifespan 'equivalents' (L_E) – the number of farmed lifespans which can occur in the potential lifespan). In this way, we can understand the economic and practical forces which prevent any farmer from keeping animals for the 'potential lifespan'.

Only breeding animals and a very small number of other individual farmed animals (perhaps 'pet' farm animals) ever reach 'old age'. The proportion is difficult to gauge, but, for example, a breeder chicken will be kept until it is about 100 weeks (maximum) of age (so about one-quarter through its potential life) and in that time the breeding bird may have produced up to 400 fertile eggs. This is, of course, an enormous 'multiplication' of biologic potential, but none of the young, nor the breeder bird itself, will ever reach its full potential lifespan – not in the commercial poultry world. So, the answer to the question, 'how many farmed animals reach their theoretical potential age?' is – *almost none*.

Does this matter? When an individual can produce a large number of offspring, but none of the offspring will reach 'old age'? And, it is likely that all of the offspring will not breed themselves. We will explore this in the next sections.

20.4 Death as a Deprivation

We could consider the value of an animal's life (or death) for that individual animal in terms of what it allows the animal to achieve (or avoid). One traditional view, at least within animal welfare science, has been that 'death is not a welfare issue', and this has been the thinking at the root of welfare legislation and policy in many countries. However, we might describe death as a welfare issue insofar as it leads to the exclusion of relevant welfare states. These states might be unpleasant or aversive, or they might be enjoyable or rewarding. As Yeates discusses in Chapter 16, this volume, sometimes an animal's whole (future) life might be deemed either 'worth living', or 'worth avoiding', based on the overall mix of positive and negative welfare states. In the former case, death deprives an animal of a positively valuable life. In the latter – which we might characterize as euthanasia – death allows an animal to avoid a net negative life.

To determine whether life would be good or bad overall for the animal, we could look to collect a representation of an animal's aggregated life experiences

with, as Yeates says (see Chapter 16), an acceptance that maybe we don't need to be 'perfect in our assessments'. We accept that a 'brushstroke' assessment of 'lifespan' when building a picture of an animal's whole life and considering whether it was a 'life worth living' is probably 'OK' and better than no consideration of 'lifespan' and cumulative life experience. In Chapter 16 Yeates also discusses the potential that an animal's life may contain elements of compensation – periods when unpleasant experiences can be weighed against (and compensated for) by periods when pleasant experiences exist – such that the animals' lives are 'worth living overall'. This may have particular resonance in the frame of a 'longer life' in which periods of illness, hunger, fear, stress or 'danger', immaturity, 'wrong decisions', infirmity, and old age can be considered in the overall life picture where pleasure, sex, procreation, feeding, light, sun, sleep, and the wide experiential portfolio of a longer life can be summated and combined – a 'full life' containing both positive and negative.

There are philosophical difficulties with assessing the value of death in this way. An animal's welfare is often characterized as 'the state of the animal'. This presents two problems. First, it is hard to describe non-existence as a state (we might call non-existence a state of potentiality prior to death but, unless we believe in metempsychosis/reincarnation, this seems less intuitively applicable after death when one might regard the potential as having been exhausted or frustrated). It seems odd to discuss whether an animal is 'healthy' or 'natural' post-mortem and a dead animal (as far as we know) experiences no suffering or enjoyment, so it is hard to talk of its welfare. Secondly, the animal itself does not exist, so arguably it is meaningless (at least from a scientific perspective) to talk about the animal at all (except in the past tense). To put it another way, for whom are we saying death is good/bad when the animal does not exist? Philosophically, these might be resolved by comparing lives of different lengths in multiple 'worlds' (i.e. modal reasoning). We can say that one life is better/worse than one of shorter/longer length. (Arguably we are making such modal comparisons when we consider any two alternatives for an animal's future.)

The idea that non-existence ('better not to have lived') can be beneficial or harmful raises another interesting possibility. If we can meaningfully describe an animal as being deprived by non-existence (relative to a counterfactual world in which it existed

for a given period), then is an animal similarly deprived by not being brought into existence in the first place? To put it another way, are we harming animals if we prevent them from being born? If so, this might suggest we have a duty to create all the animals we could (so long as they will have a life worth living). Such a conclusion places a very heavy burden on us. One way to avoid this issue is to consider we can only harm animals who *have* existed – they need to have a prior 'identity'. Another is to consider that we can have a negative duty not to harm animals by preventing their existence, but no positive duty to benefit them by creating them.

An alternative approach to considering the value of life/death is to consider the animal's own preferences. On this basis (all else being equal): (i) if an animal values continued life, then it is wrong to deprive that animal of the satisfaction of that preference (unreasonably); (ii) if an animal lacks that preference, then it is morally neutral (on these grounds) to kill it; and (iii) if an animal wants to die, then it is right to help it and wrong to prevent it fulfilling its desire.

Whether killing is right therefore depends partly on each individual's contingent preferences. More widely, it depends on whether the animal is *capable* of having such a preference. Having such a preference may be thought to need self-consciousness, an idea of self over time, and a concept of death (or at least of 'life' – as perhaps none of us really have an accurate concept of death). As an extension to this idea, we may argue that animals have a preference for continued life if they want outcomes that require life. If a pig is looking forward to its next meal or a cow to going back to pasture, then preventing those preferences from being satisfied seems wrong – whether that is through starvation/confinement or through death.

20.5 Life as a Narrative

This idea of a 'full life' has other resonances with how we think about death.

One idea is that life has value as a 'narrative'. It is a story that needs a beginning, a middle, and an end, rather than being cut off mid-chapter. But, again this idea is made more problematic by the thought that some stories do involve an abrupt end. Achilles, Hector, the hunchback of Notre-Dame, Macbeth, Jesus – did not die of natural old age. What would be the right narrative for animals? For

wild animals, many stories are cut short early on. For pets, perhaps there is a model story that involves their senescence. For farm animals it is unclear – being slaughtered is not a nice story, but it is the ‘expected narrative’ – a farm animal’s ‘conventional’ story is always short, and is only ‘cut shorter’ if they are killed before slaughter (e.g. in disease outbreak control).

Another idea relates to this connectivity through life, which is based on the concept of identity. We might consider that an animal’s identity is a matter of its body (or particular parts of its body, such as its brainstem). Alternatively, we might think of its identity as a mental construct. One famous exponent of the latter view is John Locke (John Locke, 1632–1704, was an English philosopher and physician, considered one of the most influential of the ‘Enlightenment’ thinkers), who argued that we are the same person due to the connections in our mental states – our memories, hopes, and continuity of thought (Locke, 1690). We might use this theory to help us decide when an animal has an identity to destroy (rather than merely being a bundle of bodily and/or cognitive functions) – thereby perhaps limiting our concern to sentient animals. But we might instead argue more directly that breaking this continuity is morally wrong, so that it is wrong to foreclose this connectivity’s extensions into the future. If so, then it is less bad to kill animals whose connections are non-existent or weaker. This might mean it is more acceptable to kill a carp than a cow.

20.6 Justifications for Killing

Even if we think that there are reasons not to kill (certain) animals, this does not mean that it is always wrong or that we should save every animal.

The first justification is euthanasia. Even if we wanted to afford animals a strong right to life, this right should not mean keeping them alive when their lives are worse for them than death.

A second justification might be when we have to trade-off quality and quantity of life. Sometimes we might need to risk surgery with limited chance of success, or provide toxic doses of painkillers, knowing that these may shorten an animal’s life, but reduce its suffering in the time it has remaining.

A third justification might be killing one animal to save a larger number of animals (e.g. culling infected animals in a disease outbreak) or killing

animals to protect human life (e.g. killing multiple chickens to save humans from highly pathogenic avian influenza). Whether this is acceptable will depend on *why* we think death is harmful. Of particular note is the idea that killing some animals on farm (or in wild stock) may be necessary to allow sufficient space or resources to allow others to live in that environment: for example, maintaining a population of wild animals at a stable size by culling, in a game park environment.

A fourth justification is also interesting. Many farm animals would not exist at all if they were not going to be killed (particularly those whose meat is eaten). If we were to conclude that it is always wrong to kill animals, then we would be effectively depriving large numbers of animals of the life they would have had up to slaughter. This may be a good thing if that life is one of suffering (a life worth avoiding), but it perhaps seems odd to avoid depriving an animal by depriving it *more*, even to the point of depriving it of ‘any’ life. Perhaps we could consider farming as a pseudo-contractual arrangement in which animals are given a ‘limited life’?

20.7 A Younger World?

Almost by definition the farm economic objective is to cut off a life when the animal reaches almost full size, but not too much after that. Farmers farm according to tradition, economic necessity, interest in the animals and the farm, and to satisfy society’s need for food at an acceptable price. Arguments about the longevity of individual animals are not likely to seem very meaningful to a farmer who is competing on price and productivity in a global food market. A conventional farmer who kept chickens until they were old before he/she sold them would be: (i) laughed at; (ii) produce a pretty strange food product – old, tough; and (iii) soon be out of the business.

Some fruitarians eat only what falls naturally from a plant but there is no equivalent for meat eaters – nobody chooses to eat animals after they have died of ‘old age’. In fact, many religious principles prevent the eating of meat derived from animals that have ‘died’ without slaughter – the original, and logical, argument being that eating the flesh of animals that had ‘died’, put human health at risk through transmission of disease.

In the lifespan of one chicken ($L_p = 8$ years, 3000 days) the farmer could produce over 50 ‘cycles’ of

commercial chicken, so it is obvious that the practical and economic basis for his/her farming life could not accommodate 'keeping animals until they are old'. This is the reality, but the discussion point may remain interesting and valid – by rearing and eating only young animals, humankind has shifted the whole 'age/experience' balance in the global animal population. There are almost no 'old farmed animals', and the concept of 'old age' (and the experiential life of old age – a lifetime's informed view of the world, a lifetime's experience of interactions and actions) does not really exist in the farm animal world.

If we produce such huge numbers of 'young only' animals, are we altering a biological norm, the balance of animal age profiles on the planet? If the experiential volume of animals in the world is dominated by young animals, with only a starting-point experience of life, does this matter? This may seem overtly philosophical – experience cannot be weighed; an older animal or person is not heavier through experience, as learning and exposure to life are changes held only within individual brains and manifest through experienced behaviours. So, there is no immediately apparent loss when the population is predominantly 'young' – and rapidly cycling. However, if you are willing to accept that 'experience and exposure' are elements of any life which follows a path through youth, middle age, and being elderly and old, then the total 'experiential mass' is much diminished in a global population of animals where the average age is low.

For some species, it is common for groups of young animals to be reared together in complete isolation from older animals of the same species. What this means is that there is *no* capacity for transfer of information between age groups or generations.

In the short term, this may not pose any practical problems – each group of juvenile animals (e.g. chicks or piglets) will be moved into a rearing area which, to them, is completely novel, and contains no guidance, or transfer of knowledge from older animals, so each group must make its own way, through novel exploration and use of inherent skills, but not through use of knowledge passed from other animals. This is actually an unusual situation as for many animals in 'natural mixed-age groupings', the transfer of experience, 'techniques', the 'rules of interaction', and even aspects including preferred group behaviour and hierarchical understanding will be moved between different age

groups. However, groups of juvenile animals reared away from older animals must make their own sets of rules and behaviours through 'naïve learning', and this must happen again and again as every 'crop' of young animals is introduced to the empty space of the rearing pen. The space is devoid of any transferred information. It's a bit like the crew of a space craft arriving at their destination to find that all the operating manuals for their new space home have been lost, and they must work out how everything works by experiment and innate knowledge alone. It could be that this is actually a great waste of effort and an 'ineffective' way of rearing animals. Further, as each group must explore its way through early growth with no 'guidance', it seems likely that (eventually) this would lead to the loss of the general capacity, and perhaps even the imperative, for parent animals to have the inherent capacity to 'teach' their young.

This teaching is not limited to vertical transmission from parents to offspring. Some teaching is between generations of children. Did you teach your children how to play the games which are marked out on the ground of the school playground? Probably not. I can't even remember the rules of hopscotch (a playground game in which players toss a small stone or coin into a pattern of rectangles outlined on the ground and then hop or jump through the marked spaces to retrieve the stone/coin) (Fig. 20.1).

The rules and behaviours of hopscotch are passed from children to children, in a pretty much closed transfer between age groups. Adults may see and acknowledge these games, and even arrange



Fig. 20.1. Knowledge transfer within a generation. Childhood games may be passed from young to young – sometimes with no direct adult input. (Image credit: Andy Butterworth.)



Fig. 20.2. Young turkeys and pigs. (a) Young turkeys have never ‘met’ their parent, or any older bird, and must ‘learn’ to move around the farm world from first-hand experience and innate skills. (b) Young pigs may have had some transfer of taught skills from the mother, but are soon placed in single age groups where no further learning from older animals takes place. (Image credits: Andy Butterworth.)

that the hopscotch board is marked on the ground – but they will not be the ‘trainers’. In the same way, young animals are likely to acquire some of their behavioural repertoire, and to have their group and social behaviours moulded and refined by contact with ‘more experienced’ (often older) individuals. This is completely unsurprising, and, when we see a parent animal steering their young to food, or away from hazards, or back into their zone of influence, this seems logical and fully appropriate. When this chain is broken, when complex animals such as birds and pigs are farmed in single age groups from very young ages, then almost none of this transfer can exist, and it would seem possible that ‘maternal/paternal’ care and guidance characteristics would eventually be lost from these species, as there would be no selection pressure to maintain them (Fig. 20.2). It may be that we would end up with reproductively capable, but behaviourally disinclined parent stock. In the short term, in systems where young animals always ‘find their own way’, this may not be a problem – but in any future, it would seem a risky disconnect if the breeding stock lost the genetic and behavioural capacity to be ‘effective parents’.

20.8 Summary

To consider that ‘duration of life’ should be a consideration in the life of the species that humans have control over is a challenge to the status quo. Farmers produce animals which are healthy and

young, and then kill them. Breeding stock may live longer lives than ‘fattening stock’, but will rarely live to be ‘old’. Pet and companion animals sometimes live into old age, and even into extreme old age – and then vets and owners are placed in a position where quality of life decisions around the physical and mental effects of senescence must be made.

Overall, the lives of huge numbers of animals which are farmed are ‘short’ – and it is possible that this has effects on the ‘mass of life experience’ held in the world farmed animals *in toto*, and may have long-term effects on the capacity of farmed animals to act as parents and ‘teachers’. There are difficult conceptual and philosophical questions which hang over discussion of ‘the importance of an animal following a life arc’. A rigid belief that ‘death is not a welfare issue’ seems to miss an opportunity to explore areas of animal science, and of philosophy and even of ‘responsible animal life consideration’ that may, in the long term, reflect a conscious avoidance of a difficult area of animal science, an area which is an established and unquestioned arena in human ethical debate.

Bibliography

- Balcombe, J. (2009) Animal pleasure and its moral significance. *Applied Animal Behaviour Science* 118, 208–216.
- Bartlett, K.S., McKeith, F.K., VandeHaar, M.J., Dahl, G.E. and Drackley, J.K. (2006) Growth and body composition

- of dairy calves fed milk replacers containing different amounts of protein at two feeding rates. *Journal of Animal Science* 84, 1454–1467.
- Bruijnis, M.R.N., Meijboom, F.L.B. and Stassen, E.N. (2013) Longevity as an animal welfare issue applied to the case of foot disorders in dairy cattle. *Journal of Agricultural and Environmental Ethics* 26, 191–205. DOI: 10.1007/s10806-012-9376-0
- Food and Agriculture Organization of the United Nations (FAO) (2015) *FAO Statistical Pocketbook*. FAO, Rome.
- Four Paws (2017) Farm Animal Life Expectancy. Available at: <http://www.four-paws.us/campaigns/farm-animals/farm-animal-life-expectancy/> (accessed 29 June 2017).
- Green, T.C. and Mellor, D.J. (2011) Extending ideas about animal welfare assessment to include 'quality of life' and related concepts. *New Zealand Veterinary Journal* 59(6), 263–271.
- Levine, H.J. (1997) Rest heart rate and life expectancy. *Journal of the American College of Cardiology* 30(4), 1104–1106.
- Locke, J. (1690) *The Works of John Locke*, Volume 1. *An Essay Concerning Human Understanding*, Part 1. Rivington, London.
- Murray, J. (2010) *Oxford English Dictionary*. Oxford University Press, Oxford.
- Polar Bears International (2017) What is the Lifespan of a Polar Bear? Available at: <https://polarbearsinternational.org/polar-bears/polar-bear-faq/> (accessed 18 July 2017).
- Regan, T. (1983) *The Case For Animal Rights*. University of California Press, Berkeley, California.
- Rollin, B.E. (2006) Euthanasia and quality of life. *Journal of the American Veterinary Medical Association* 228, 1014–1016.
- Speakman, J.R. (2008) The physiological costs of reproduction in small mammals. *Philosophical Transactions of the Royal Society London B Biological Science* 363(1490), 375–398. DOI: 10.1098/rstb.2007.2145
- United Nations, Department of Economic and Social Affairs, Population Division (2017) World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248. Available at: https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf (accessed 29 June 2017).
- Yeates, J. (2010) Death is a welfare issue. *Journal of Agricultural and Environmental Ethics* 23(3), 229–241. DOI: 10.1007/s10806-009-9199-9
- Yeates, J. (2011) Is 'a life worth living' a concept worth having? *Animal Welfare* 20, 397–406.
- Yeates, J. (2012) Quality time: ethical approaches to the 'life worth living' concept in farm animal welfare. *Journal of Agricultural and Environmental Ethics* 25(4), 607–624.

21 Promises and Challenges of Big Data Associated With Automated Dairy Cow Welfare Assessment

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AND MIEL HOSTENS

21.1 Introduction

Since the 1950s, computers have been used as a management tool in dairy farming (Lissemore, 1989). Over subsequent decades, dairy herd management software has evolved consistently and the personal computer has emerged as an important management tool to primarily monitor production, reproduction, and health (Gloy and Akridge, 2000). In the meantime, technologies to collect and store data have been evolving at a quicker pace compared with the speed at which new insights in dairy science have been discovered. The exponentially increased volume and speed at which data is created in the post-dotcom decade is commonly referred to as big data. Despite the fact that 'big data' became a new buzzword, there is no consistent definition of big data, nor detailed analysis of this new emerging technology. Most discussions until now have been taking place in the blogosphere, where active contributors have generally converged on the most important features and incentives of the big data. One of the drivers of excitement around big data has been the expectation that we will be able to discover new insights in order to support decision making as an ultimate goal. Machine learning is viewed as a key technology that will unlock such insights. Machine learning toolkits of varying quality and popularity are widely available (Domingos, 2012). A review paper by Rutten *et al.* (2013) documents the lack of integrated information and especially decision-making support tools in dairy research. It illustrates that while the technology has been widely accepted and published in dairy science, in actuality, effective implementation, validation, and valorization is often minimal. This chapter focuses on the authors' perspective of the current

challenges in data-intensive animal science based on experience of its use in dairy cow welfare.

21.2 The Definition of Data

'On the origin of information by means of data collection, or the preservation of favoured knowledge in the struggle for wisdom.'

(Charles Darwin)

With a wink to the title of one of the most illustrious articles of all time written by Charles Darwin (1859), this statement emphasizes the intrinsic value of data and the potential advantage of raising data to a higher level. It could be stated that data is the biggest and most powerful asset in modern dairy farming. This is supported by Ackoff's data, information, knowledge, and wisdom pyramid (Ackoff, 1989) (Fig. 21.1). However, data is not directly meaningful. Only when data are put in relation to each other, information arises and knowledge can be extracted from the collected information. Data only has value when transformed into information, and knowledge, which leads towards wisdom.

Reflecting upon the dairy sector, animals produce data which can be seen as a representation of their behaviors, characteristics, events, or environment. They are a product of observations made over time. Specifically at this level, technology has helped small data grow into big data. Due to rapid development of precision livestock farming (PLF) technologies and the availability of high-throughput information from sensors, large-scale massive data has become available on-farm. These PLF technologies have been proposed as a roadmap to aid researchers towards decision making in the 'Internet of things' (r)-evolution. As an example, milk

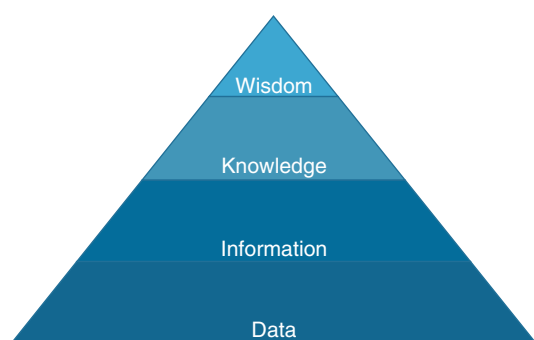


Fig. 21.1. Data, information, knowledge, and wisdom pyramid. (Image credit: Miel Hostens.)

robots, milk meters and automated concentrate feeders are collecting data around production parameters. Heat detection sensors such as pedometers and accelerometers attached to the front or hind legs and neck (Roelofs *et al.*, 2017) and more recently ears (Bikker *et al.*, 2014; Rutten *et al.*, 2017) are keeping track of cow movement and position (Roelofs *et al.*, 2005). New sensor technologies are collecting data around the metabolism and health status of the animals (Friggens *et al.*, 2007) such as ruminal and vaginal temperature loggers (Bewley *et al.*, 2008a), and automated weight scales and 3D-imaging technologies are now being used (Bewley *et al.*, 2008b).

So-called secondary off-farm data centers exist, mainly containing pedigree and milk-recording data, and high-dimensional genomic and diagnostics information are created in different countries across Europe, each containing a subset of data representing the real world of dairy cows (Spahr, 1993; Tomaszewski, 1993; Frost *et al.*, 1997; Pietersma *et al.*, 1998; Sun *et al.*, 2013; Egger-Danner *et al.*, 2015).

The **volume** (Fig. 21.2) or format of the data no longer presents a major constraint (as storage has become less costly); hence the total volume of cow-related data that is collected per day has increased rapidly. In 1984 it was estimated that a software program to manage 100 farms with 100 cows each, would need a storage capacity of about 6 megabytes (MB) on a yearly basis (Noordhuizen and Buurman, 1984). Canadian research in 2000 reported a need for 1.3 gigabytes (GB) of random access memory (RAM) to hold solutions and right-hand sides of mixed model equations during the iteration process of the test-day milkrecoRding model with nearly 2 million animals of the Holstein breed (cows with

records and ancestor dams and sires) and with 36 genetic regression coefficients per animal. To save solutions and diagonal blocks for all animals, as well as other information needed for the publication of results, a total of 16 GB of disk storage was required (Schaeffer *et al.*, 2000). Genomic evaluation of dairy cattle became available in the USA in 2008 (Wiggans *et al.*, 2011). Ever since, many researchers have discussed the storage and computational needs to include this new source of data in genetic evaluations (VanRaden, 2008; Wiggans *et al.*, 2012). In 2013, a computer memory of 256 GB RAM was reported insufficient to manage a mating program for 230,000 cows (Sun *et al.*, 2013).

The **velocity** or rate at which data gets collected has increased in recent years, following a similar pattern to that of the volume. This aspect becomes important when handling streams of data coming from the aforementioned PLF technologies. Technically, researchers will be challenged as both batch and stream processing requires a different high-level computer architecture when compared with traditional data storage (relational database management system or RDBMS). Multiple distributed and parallel storage and processing architectures have been proposed to address both problems (Garber, 2012; Carbone *et al.*, 2015; Marz and Warren, 2015). For different research purposes, one could, and should, design different and appropriate architectures at the beginning of data analysis.

One of the characteristics that follows from both volume and velocity is the data **volatility**. This refers to how long data remains valid and how long it should be stored. In a world of near real-time data, one needs to determine at what point the raw, non-aggregated data is not relevant to the analysis. This leads towards optimization of the cost of data storage. In contrast, failure to store data from welfare or behavioral studies in dairy cows has a big cost as well. Study results are often based on cohort analysis at a point in time within its specific condition. A large opportunity for dairy researchers lies in the re-usage of the growing amount of data collected from dairy behavioral studies. Nowadays, however, the likelihood for such data to get lost is high. It has been estimated that 80% of research data is lost within 20 years (Vines *et al.*, 2014). As a result, meta-analyses have become popular over the past years in dairy science due to the possibility to reuse aggregated study results (Rabiee *et al.*, 2004, 2005; Lean *et al.*, 2009, 2012). In contrast to bioinformatics, publishing of the raw data from

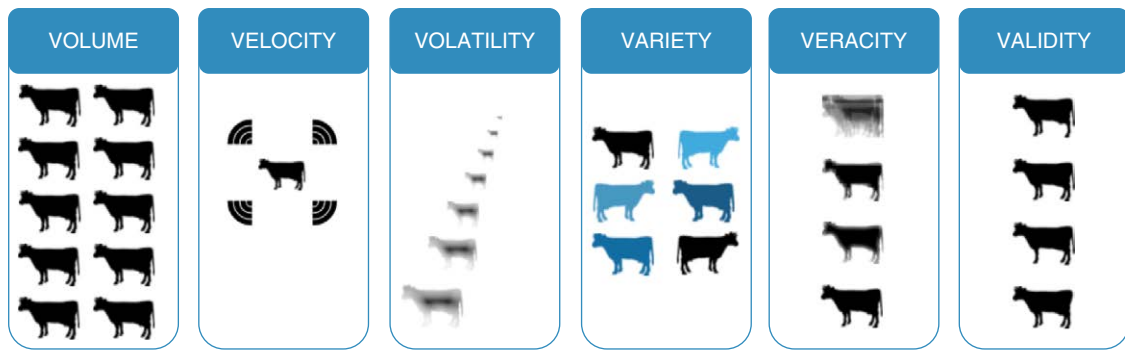


Fig. 21.2. Visual illustration of characteristics of big data applied to dairy cows. (Image credit: Miel Hostens.)

studies in open repositories is far from common. This practice builds transparency as it has the potential to identify mistakes, deliberate or otherwise, more rapidly. It stops duplication of research efforts which would be particularly beneficial when that research involves living animals. This approach is often referred to as ‘open data’. Multiple steps have been identified to reach full open data (Molloy, 2011; Reichman *et al.*, 2011). Journals such as *Evolution* and those published by the Public Library of Science (PLOS) have recently improved their data policy by asking authors to report where the data supporting their findings are deposited (Fairbairn, 2011; Bloom *et al.*, 2014).

However, structural file format or database heterogeneity, syntax heterogeneity, implementation heterogeneity, and semantic heterogeneity can restrict proper reuse of the data. To tackle this **variety** issue, publishing data with proper syntax annotation and linkage towards other similar data sources is commonly referred to as an ultimate data sharing policy. An essential but extremely complex component in the analysis of big data is the standardization of data. The use of ontologies (i.e. controlled vocabularies) is a means to make scientific descriptions more comparable (Hughes *et al.*, 2008). Animal behavior ontologies have been described, but most uses seem discontinuous at this moment (Martins, 2004; Gkoutos *et al.*, 2015). In dairy cows, most ontologies and trait definitions originate from milk recording organizations. At present, 30–40 traits are commonly recorded in dairy cattle and used in selection schemes implemented in many developed countries. Over the last decades, fertility and health-related phenotypes have been implemented with varying success as comprehensively discussed by Boichard and Brochard (2012). The main reason

is that many of these traits often cannot be easily captured in a canonical form which is the preferred notation that encapsulates all equivalent forms of the same concept (e.g. disease or health event) (Cios and Moore, 2002). Many of these newer traits could be captured through PLF technology with marginal extra effort. Within computer sciences, the semantic web provides a common framework that allows data to be shared and reused across canonical form, application, enterprise, and community boundaries (Molloy, 2011; Reichman *et al.*, 2011; Hitzler and Janowicz, 2013; Lehmann *et al.*, 2015). Efforts within the dairy science welfare and behavior community are needed before the semantic web can grow from a conceptual framework in animal health management towards an applied framework.

It is especially the variety that induces **veracity** and **validity** issues. These refer to the biases, noise and abnormality in data. As technology has become more accessible, publishing incorrect data and spreading incorrect information across multiple sources becomes more likely. Finding the single truth or even multiple truths from conflicting values has been a hot topic for data scientists using high volume (Liu *et al.*, 2011), dynamic (Dong *et al.*, 2009) and varying data (Guo *et al.*, 2010). As recently reported by Hermans *et al.* (2017), although electronic records could be a source of valuable information in dairy cows, the source of data needs to be checked before one can interpret the data. These researchers found multiple issues in common dairy herd management system software and stressed the need for prompt data cleaning before one can analyse data. A generally accepted approach for defining data quality is the concept of fitness for use, emphasizing the perspective of the end users. At the individual animal level, Hermans

et al. (2017) suggested that a correct physiological occurrence of events should be the minimum data quality standard. At herd level, historical records should be analysed with care. Furthermore, these authors observed the lowest data quality in older records, which may be caused by the process of switching from handwritten records to electronic records. More recently, a lack of interface between different software systems available at the farm can induce 'dual data input' which is often associated with data quality issues. Data quality problems are present in every aspect of cattle farming. A literature review was performed by Hermans *et al.* (unpublished results) in order to find papers mentioning dirty data in dairy farming which complied with the dirty data types described by Li *et al.* (2014). In total 24 articles were selected published between 1900 and 2014. Four articles were published prior to the year 2000, whereas half of the articles were published recently between 2010 and 2014. Within the selected articles, 15 out of 24 (63%) described data quality issues in the domain of disease data. As disease monitoring and prediction is often mentioned as one of the main goals of PLF technology, higher data quality, especially in disease data, is needed before one can successfully implement and validate these technologies in dairy cows.

21.3 Challenges Concerning Data Governance, Privacy and Exchange

The challenge of data-intensive dairy science nowadays continues beyond technical dilemmas. Data ownership, privacy, security, and data exchange challenges become equally important. The European Union recently released new guidance on how companies operating in Europe should protect their customers' data. In less than 2 years, all organizations will have to comply with this General Data Protection Regulation (GDPR). Several guidelines have been published with regard to the processing of personal data (European Union, 2016). Although mainly applicable to personal data in humans, such privacy discussions will have a spill-over effect on the awareness around data privacy of animal data as well. Historically, the scientists who developed the hypothesis, designed the experiments, and analysed the outcomes have been considered the owners of the data. When introducing producer-collected records, laboratory diagnoses, or even data created with newer PLF technologies, such ownership of course becomes more ambiguous.

So, in all this chaos of data generation, where does true ownership lie (Fig. 21.3)? Often the answer to this question is found in truth, veracity, and therefore verifiability. The producer of the data who can verify this data, and confirm the veracity of the information, is the true owner of the data. From this approach, it seems most obvious that the ownership of the data mainly resides with the dairy farmer when using herd records and PLF technology. The term data ownership is likely to get more attention when research and business commingle. As discussed by Al-Khouri (2012), the private sector will continue to use data as a source of information to support competition and growth. Advocates of data use will always justify their practices in that this contributes to productivity, innovation, and competitiveness of entire sectors and economies (Manyika *et al.*, 2011). Moreover, data ownership is often confused with *delegated* ownership and data access rights (Fig. 21.3). As cloud-based datacentres and cloud-based PLF technology have emerged over the last years, data is more likely to be stored online instead of locally on hardware installed at the dairy farm. This requires a new layer of data privacy, agreements on delegated ownership, and access rights. So far, research and business struggle to move towards a so-called, farm-centric digital ecosystem. More concrete implementation of such data-intensive projects is needed to gradually move towards fully integrated data analysis in dairy science.

21.4 Research Challenges Associated with Automated Dairy Cow Welfare

One of the drivers of excitement around big data has been the expectation that we will be able to discover new insights from use of the data. Effectively tackling the aforementioned challenges will create a huge opportunity for innovative approaches to dairy cow welfare assessment through real-time monitoring (streaming data analysis) and risk factor analysis or predictive modelling (batch data analysis). In the scenario where all the aforementioned technical challenges are addressed, we illustrate a potential data pipeline for automated welfare monitoring and prediction using a real-world example with four sources of data flowing from a dairy farm (see Fig. 21.3):

- Animal identification, reproductive records and free-text health events stored on the farm, in the farm management software.

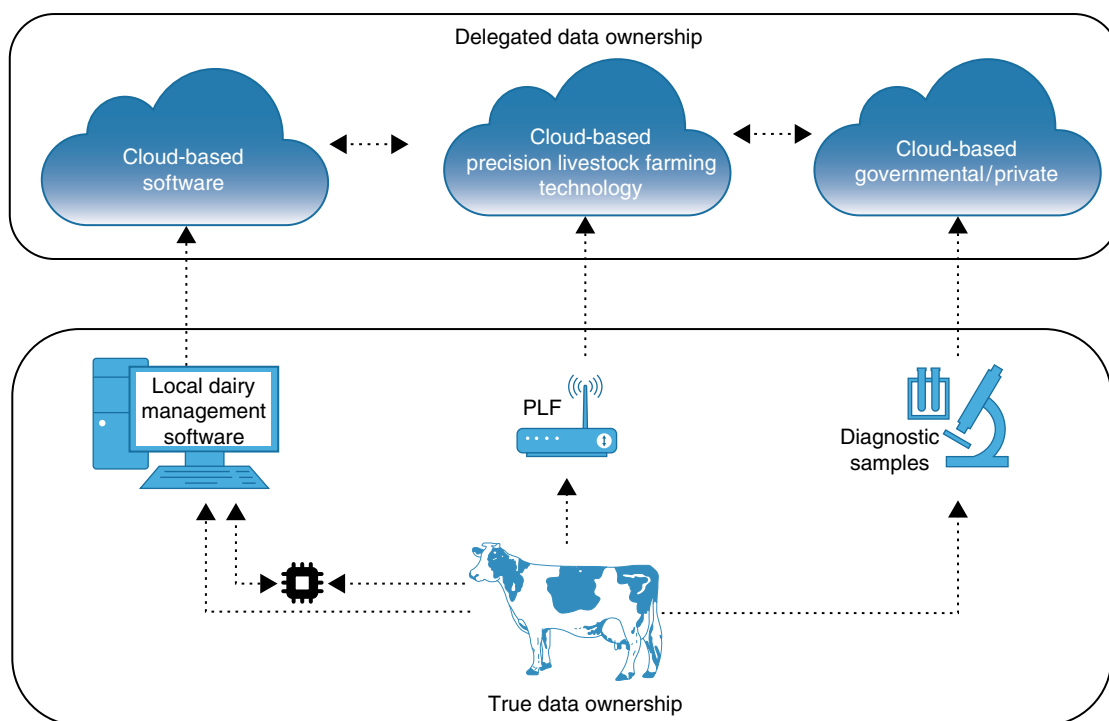


Fig. 21.3. Data ownership and delegated ownership in dairy cows. (Image credit: Miel Hostens.)

- Milk yields stored on farm through the milk parlor process computer.
- Milk recording data stored by cloud-based milk recording organization.
- A novel PLF sensor that captures laying behavior, stored in a cloud-based resource, through a third-party technology provider.

Although the aforementioned structure seems obvious, four essential steps need to be implemented before we can start building specific prediction algorithms and monitoring or visualization tools applied to the domain of dairy cow welfare. We would need to:

1. Clean and effectively join multiple data sources holding information from the same animals (= **data matching**).
2. Incorporate real-time data with historical data (= **data fusion**).
3. Extract information from unstructured text data (= **feature extraction**).
4. Identify the relevant parts in the big data (= **feature selection**).

21.4.1 Data matching

Although unique cow identifiers seem obvious in Europe, and despite having an obligatory official ear tag (EG 911/2004 //EG1760/2000), farmers are used to the official ear tag number but rarely use it for daily identification. The official ear tag number is a long and complex number, prone to data entry errors and therefore not easy to use. One would expect identification to be error free, however, one of the biggest problems in large animal research is positive repeatable identification (Dziuk, 2003; Gu *et al.*, 2003). These characteristics make record linkage particularly challenging. Data matching refers to the task of identifying records that refer to the same logical entity (e.g. the same cow) across different data sources, especially when an individual animal may, or may not, share a common unique identifier (Elmagarmid *et al.*, 2007; Larsen, 2008). Due to the large volume of dairy-related data, the need for an automated solution is high, but not yet described in dairy science.

Two frequently described methodologies in record linkage are: (i) deterministic record linkage;

and (ii) probabilistic record linkage. In the deterministic approach, all, or a predefined subset, of linking variables have to agree (corresponding values on a linking variable are the same within a pair to consider a pair as a link) (Maizlish and Herrera, 2005; O'Reilly *et al.*, 2008). In probabilistic record linkage, weights for agreement or disagreement are estimated for each variable based on the difference in probability, such that a variable agrees among matches and non-matches (Jaro, 1995).

21.4.2 Data fusion

Automated dairy cow welfare monitoring would involve the collection of many activity patterns from a diverse range of dairy cows over time, and associated together with risk factors known from literature to influence those patterns. From these, a summarizing behavior model can be developed which holds the standardized 'normal' behavior for dairy cows given the dataset until that moment in time. Data fusion is the integration of historical and live data towards the same application, to allow comparison of new activity patterns flowing in real time against the 'normal' model (Stonebraker *et al.*, 2005; Casado and Younas, 2015). Once the new activity pattern is processed and potential deviations are flagged, this set of data could be used to re-train the 'normal' model, a process which can be executed upon arrival of new data streams.

21.4.3 Feature extraction

Analysis of behavioral patterns could be of tremendous help in predicting disease and increasing understanding of animal welfare. Before being able to create predictive models, a large dataset of correctly annotated disease cases is needed. In contrast with most other sources of data, disease records are difficult to capture. They are mainly recorded in an unstructured, user-dependent and hence non-standardized format. Although the need for a standardized disease data input has been recognized for a long time (Kelton *et al.*, 1998), effective implementation in current software is lacking (Wenz and Giebel, 2012). Natural language processing consists of multiple computational techniques to process language in a human-like form, from machine-readable unstructured texts. This has been successfully applied in human medicine (Liao *et al.*, 2015; Ford *et al.*, 2016), but not yet in dairy science to our knowledge. With these techniques, one can extract useful

information from unstructured records, and create a structured dataset holding disease information. This dataset subsequently can be matched to other data sources.

21.4.4 Feature selection

After joining the different datasets, 'feature selection' becomes necessary to select the features with the greatest impact on dairy cow welfare (Chandrashekar and Sahin, 2014; Sheikhpour *et al.*, 2017). The main objective is to select a subset of the most relevant and non-redundant features in the data available from the herd data sources by specifically removing irrelevant and redundant features in a (semi-) automated way.

In the case of predictive modelling, feature selection mainly helps to avoid over-fitting and improve model performance, to provide faster and more cost-effective models, and to gain a deeper insight into the underlying processes that generated the data (Saeys *et al.*, 2007), and most important, to improve the model interpretability (Kashyap *et al.*, 2015). With sensor-driven time series and other longitudinal data streams from dairy cows, 'features' are highly auto-correlated. Because of the high dimensionality and rank deficiency, normal statistical methods will over-fit on this data. Feature selection methods can improve this by applying supervised learning (classification) where class labels are known beforehand, or by permitting unsupervised learning (clustering; Saeys *et al.*, 2007). Among the large number of models reported in the literature, linear and non-linear density-based classifiers, decision trees, naive Bayes, support vector machines, wavelet analysis, neural networks, k-nearest neighbor and k-means are the most frequently used methods in many applications (Kashyap *et al.*, 2015). However, these methods applied to feature selection have not been published on real-time and large-scale datasets in dairy science to our knowledge.

21.5 Conclusions

The potential of using big data in dairy cow welfare monitoring and predictive modelling is extremely large, given the amount of data collected on dairy farms. Besides acknowledging the typical properties and pitfalls of big data, questions of data ownership and some research challenges need to be addressed by dairy scientists in strong collaboration

with technology providers. Successful collaboration is essential to the industry before it will be possible to fully validate and valorize automated welfare monitoring and prediction tools in the real world of dairy farming.

References

- Ackoff, R.L. (1989) From data to wisdom. *Journal of Applied Systems Analysis* 16, 3–9.
- Al-Khouri, A.M. (2012) Data ownership: who owns 'my data'? *International Journal of Information Technology and Management* 2, 1–8.
- Bewley, J.M., Einstein, M.E., Grott, M.W. and Schutz, M.M. (2008a) Comparison of reticular and rectal core body temperatures in lactating dairy cows. *Journal of Dairy Science* 91, 4661–4672.
- Bewley, J.M., Peacock, A.M., Lewis, O., Boyce, R.E., Roberts, D.J. *et al.* (2008b) Potential for estimation of body condition scores in dairy cattle from digital images. *Journal of Dairy Science* 91, 3439–3453.
- Bikker, J.P., van Laar, H., Rump, P., Doorenbos, J., van Meurs, K. *et al.* (2014) Technical note: evaluation of an ear-attached movement sensor to record cow feeding behavior and activity. *Journal of Dairy Science* 97, 2974–2979.
- Bloom, T., Ganley, E. and Winker, M. (2014) Data access for the open access literature: PLOS's data policy. *PLoS Biology* 12, e1001797.
- Boichard, D. and Brochard, M. (2012) New phenotypes for new breeding goals in dairy cattle. *Animal* 6, 544–550.
- Carbone, P., Katsifodimos, A., Ewen, S., Markl, V., Haridi, S. and Tzoumas, K. (2015) Apache flink: stream and batch processing in a single engine. *Bulletin of the IEEE Computer Society Technical Committee on Data Engineering* 36(4), 28–38.
- Casado, R. and Younas, M. (2015) Emerging trends and technologies in big data processing. *Concurrency and Computation: Practice and Experience* 27, 2078–2091.
- Chandrashekar, G. and Sahin, F. (2014) A survey on feature selection methods. *Computers & Electrical Engineering* 40, 16–28.
- Cios, K.J. and Moore, G.W. (2002) Uniqueness of medical data mining. *Artificial Intelligence in Medicine* 26, 1–24.
- Darwin, C. (1859) *On the Origin of the Species by Means of Natural Selection*. John Murray, London.
- Domingos, P. (2012) A few useful things to know about machine learning. *Communications of the ACM (Association for Computing Machinery)* 55, 78–87.
- Dong, X.L., Berti-Equille, L. and Srivastava, D. (2009) Truth discovery and copying detection in a dynamic world. *Proceedings of the VLDB Endowment* 2, 562–573.
- Dziuk, P. (2003) Positive, accurate animal identification. *Animal Reproduction Science* 79, 319–323.
- Egger-Danner, C., Cole, J.B., Pryce, J.E., Gengler, N., Heringstad, B. *et al.* (2015) Invited review: overview of new traits and phenotyping strategies in dairy cattle with a focus on functional traits. *Animal* 9, 191–207.
- Elmagarmid, A.K., Ipeirotis, P.G. and Verykios, V.S. (2007) Duplicate record detection: a survey. *IEEE Transactions on Knowledge and Data Engineering* 19, 1–16.
- European Union (2016) General Data Protection Regulation (GDPR) Portal. Available at: <http://www.eugdpr.org/> (accessed 8 March 2018).
- Fairbairn, D.J. (2011) The advent of mandatory data archiving. *Evolution* 65, 1–2.
- Ford, E., Carroll, J.A., Smith, H.E., Scott, D. and Cassell, J.A. (2016) Extracting information from the text of electronic medical records to improve case detection: a systematic review. *Journal of the American Medical Informatics Association* 23, 1007–1015.
- Friggens, N.C., Chagunda, M.G.G., Bjerring, M., Ridder, C., Hojsgaard, S. and Larsen, T. (2007) Estimating degree of mastitis from time-series measurements in milk: a test of a model based on lactate dehydrogenase measurements. *Journal of Dairy Science* 90, 5415–5427.
- Frost, A.R., Schofield, C.P., Beaulah, S.A., Mottram, T.T., Lines, J.A. and Wathes, C.M. (1997) A review of livestock monitoring and the need for integrated systems. *Computers and Electronics in Agriculture* 17, 139–159.
- Garber, L. (2012) Using in-memory analytics to quickly crunch big data. *Computer* 45, 16–18.
- Gkoutos, G.V., Hoehndorf, R., Tsaprouni, L. and Schofield, P.N. (2015) Best behaviour? Ontologies and the formal description of animal behaviour. *Mammalian Genome* 26, 540–547.
- Gloy, B.A. and Akridge, J.T. (2000) Computer and internet adoption on large US farms. *The International Food and Agribusiness Management Review* 3, 323–338.
- Gu, L., Baxter, R., Vickers, D. and Rainsford, C. (2003) Record linkage: current practice and future directions. *CSIRO Mathematical and Information Sciences Technical Report* 3, 83.
- Guo, S., Dong, X.L., Srivastava, D. and Zajac, R. (2010) Record linkage with uniqueness constraints and erroneous values. *Proceedings of the VLDB Endowment* 3, 417–428.
- Hermans, K., Waegeman, W., Opsomer, G., Van Ranst, B., De Koster, J. *et al.* (2017) Novel approaches to assess the quality of fertility data stored in dairy herd management software. *Journal of Dairy Science* 100, 4078–4089.
- Hitzler, P. and Janowicz, K. (2013) Linked data, big data, and the 4th paradigm. *Semantic Web* 4, 233–235.
- Hughes, L.M., Bao, J., Hu, Z.L., Honavar, V. and Reecy, J.M. (2008) Animal trait ontology: the importance and usefulness of a unified trait vocabulary for animal species. *Journal of Animal Science* 86, 1485–1491.

- Jaro, M.A. (1995) Probabilistic linkage of large public-health data files. *Statistics in Medicine* 14, 491–498.
- Kashyap, H., Ahmed, H.A., Hoque, N., Roy, S. and Bhattacharyya, D.K. (2015) Big data analytics in bioinformatics: a machine learning perspective. *arXiv pre-print arXiv 1506.05101*, 1–20.
- Kelton, D.F., Lissemore, K.D. and Martin, R.E. (1998) Recommendations for recording and calculating the incidence of selected clinical diseases of dairy cattle. *Journal of Dairy Science* 81, 2502–2509.
- Larsen, M.D. (2008) Data quality and record linkage techniques. *Journal of Official Statistics* 24, 327–330.
- Lean, I.J., Rabiee, A.R., Duffield, T.F. and Dohoo, I.R. (2009) Invited review: use of meta-analysis in animal health and reproduction: methods and applications. *Journal of Dairy Science* 92, 3545–3565.
- Lean, I.J., Celi, P., Raadsma, H., McNamara, J. and Rabiee, A.R. (2012) Effects of dietary crude protein on fertility: meta-analysis and meta-regression. *Animal Feed Science and Technology* 171, 31–42.
- Lehmann, J., Isele, R., Jakob, M., Jentzsch, A., Kontokostas, D. et al. (2015) DBpedia – a large-scale, multilingual knowledge base extracted from Wikipedia. *Semantic Web* 6, 167–195.
- Li, L., Peng, T. and Kennedy, J. (2014) A rule based taxonomy of dirty data. *GSTF International Journal on Computing* 1, 140–148.
- Liao, K.P., Cai, T.X., Savova, G.K., Murphy, S.N., Karlson, E.W. et al. (2015) Development of phenotype algorithms using electronic medical records and incorporating natural language processing. *British Medical Journal* 350, h1885.
- Lissemore, K.D. (1989) The use of computers in dairy-herd health-programs—a review. *Canadian Veterinary Journal* 30, 631–636.
- Liu, X., Dong, X.L., Ooi, B.C. and Srivastava, D. (2011) Online data fusion. *Proceedings of the VLDB Endowment* 4, 932–943.
- Maizlish, N.A. and Herrera, L. (2005) A record linkage protocol for a diabetes registry at ethnically diverse community health centers. *Journal of the American Medical Informatics Association* 12, 331–337.
- Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R. et al. (2011) Big data: the next frontier for innovation, competition, and productivity. Report by McKinsey Global Institute. McKinsey & Company, New York.
- Martins, E.P. (2004) EthoSource: storing, sharing, and combining behavioral data. *AIBS Bulletin* 54, 886–887.
- Marz, N. and Warren, J. (2015) *Big Data: Principles and Best Practices of Scalable Realtime Data*. Manning Publications, New York.
- Molloy, J.C. (2011) The open knowledge foundation: open data means better science. *PLoS Biology* 9, e1001195.
- Noordhuizen, J.P. and Buurman, J. (1984) VAMPP: a veterinary automated management and production control programme for dairy farms (the application of MUMPS for data processing). *Veterinary Quarterly* 6, 66–72.
- O'Reilly, D., Rosato, M. and Connolly, S. (2008) Unlinked vital events in census-based longitudinal studies can bias subsequent analysis. *Journal of Clinical Epidemiology* 61, 380–385.
- Pietersma, D., Lacroix, R. and Wade, K.M. (1998) A framework for the development of computerized management and control systems for use in dairy farming. *Journal of Dairy Science* 81, 2962–2972.
- Rabiee, A.R., Lean, I.J. and Stevenson, M.A. (2004) A Bayesian meta-analysis of the effects of administering an intra-vaginal (CIDR) device in combination with other hormones on the reproductive performance of cycling, anoestrous and inseminated cows. *New Zealand Veterinary Journal* 52, 384–393.
- Rabiee, A.R., Lean, I.J. and Stevenson, M.A. (2005) Efficacy of Ovsynch program on reproductive performance in dairy cattle: a meta-analysis. *Journal of Dairy Science* 88, 2754–2770.
- Reichman, O.J., Jones, M.B. and Schildhauer, M.P. (2011) Challenges and opportunities of open data in ecology. *Science* 331, 703–705.
- Roelofs, J.B., van Eerdenburg, F.J.C.M., Soede, N.M. and Kemp, B. (2005) Pedometer readings for estrous detection and as predictor for time of ovulation in dairy cattle. *Theriogenology* 64, 1690–1703.
- Roelofs, J.B., Krijnen, C. and van Erp-van der Kooij, E. (2017) The effect of housing condition on the performance of two types of activity meters to detect estrus in dairy cows. *Theriogenology* 93, 12–15.
- Rutten, C.J., Velthuis, A.G.J., Steeneveld, W. and Hogeveen, H. (2013) Invited review: sensors to support health management on dairy farms. *Journal of Dairy Science* 96, 1928–1952.
- Rutten, C.J., Kamphuis, C., Hogeveen, H., Huijps, K., Nielen, M. and Steeneveld, W. (2017) Sensor data on cow activity, rumination, and ear temperature improve prediction of the start of calving in dairy cows. *Computers and Electronics in Agriculture* 132, 108–118.
- Saeys, Y., Inza, I. and Larranaga, P. (2007) A review of feature selection techniques in bioinformatics. *Bioinformatics* 23, 2507–2517.
- Schaeffer, L.R., Jamrozik, J., Kistemaker, G.J. and Van Doormaal, B.J. (2000) Experience with a test-day model. *Journal of Dairy Science* 83, 1135–1144.
- Sheikhpour, R., Sarram, M.A., Gharaghani, S. and Chahooki, M.A.Z. (2017) A survey on semi-supervised feature selection methods. *Pattern Recognition* 64, 141–158.
- Spahr, S.L. (1993) New technologies and decision-making in high producing herds. *Journal of Dairy Science* 76, 3269–3277.
- Stonebraker, M., Cetintemel, U. and Zdonik, S. (2005) The 8 requirements of real-time stream processing. *Sigmod Record* 34, 42–47.

- Sun, C., VanRaden, P.M., O'Connell, J.R., Weigel, K.A. and Gianola, D. (2013) Mating programs including genomic relationships and dominance effects. *Journal of Dairy Science* 96, 8014–8023.
- Tomaszewski, M.A. (1993) Record-keeping systems and control of data-flow and information-retrieval to manage large high producing herds. *Journal of Dairy Science* 76, 3188–3194.
- VanRaden, P.M. (2008) Efficient methods to compute genomic predictions. *Journal of Dairy Science* 91, 4414–4423.
- Vines, T.H., Albert, A.Y., Andrew, R.L., Debarre, F., Bock, D.G. *et al.* (2014) The availability of research data declines rapidly with article age. *Current Biology* 24, 94–97.
- Wenz, J.R. and Giebel, S.K. (2012) Retrospective evaluation of health event data recording on 50 dairies using Dairy Comp 305. *Journal of Dairy Science* 95, 4699–4706.
- Wiggans, G.R., VanRaden, P.M. and Cooper, T.A. (2011) The genomic evaluation system in the United States: past, present, future. *Journal of Dairy Science* 94, 3202–3211.
- Wiggans, G.R., Cooper, T.A., VanRaden, P.M., Olson, K.M. and Tooker, M.E. (2012) Use of the Illumina Bovine3K BeadChip in dairy genomic evaluation. *Journal of Dairy Science* 95, 1552–1558.

22 Animal Welfare: Information in a Changing World

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22.1 Introduction to Animal Welfare and Society

Animal farming has undergone major changes from the 1950s onwards. Housing conditions, especially for pigs and poultry, changed profoundly where low-density systems (often outdoor) were replaced by housing systems (often indoor) characterized by high animal density with minimal living space for the individual and a very barren environment (Blokhuys, 1999). These systems allowed a high degree of mechanization, such as automatic manure removal, egg collection, climatic control, etc. thereby decreasing the labour requirement and allowing for larger (and fewer) farms. This mechanization and rationalization resulted in reduction of labour per livestock unit. The latter contributed to an enormous decrease in the workforce employed. For example, in the European Union (EU) (12 member states) labour in agriculture fell from 13.5% to 5.5% between 1970 and 1994 (Grant, 1997). Thus animal, production intensified enormously, both as total production worldwide and in terms of animal units per farm and farmer, production units per animal, and capital investments (Miele *et al.*, 2013). This intensification not only enabled a large increase in production volume but also increased food security/independence in Europe and other industrialized countries.

The barren housing conditions, high production levels, and profound mechanization also caused fierce societal debate regarding the welfare of the animals involved. The activities of consumer groups, animal protectionists, welfare scientists and, more recently, the publicity around crises such as swine fever, bovine spongiform encephalopathy (BSE), foot-and-mouth disease, avian influenza, and increased resistance of bacteria to antibiotics (antimicrobial resistance, AMR) led to increased public awareness that animal production needs to be more than just an industry. Indeed, public concern for animal welfare is widespread and growing. Thus, the

recently published special Eurobarometer survey on the attitudes of Europeans towards animal welfare (European Commission, 2016) shows that more than nine in ten EU citizens believe it is important to protect the welfare of farmed animals (94%). This is just one indicator among others showing that citizens are having an interest in animal production and related animal welfare standards.

Increasingly the interconnections between animal health and welfare and human health and welfare and their relationship with environmental factors (climate change, biodiversity) is recognized, as shown by the emergence of the 'One Welfare' concept (Pinillos, *et al.*, 2016). 'One Welfare' extends the approach of (and partially overlaps with) the One Health theme used for human and animal health (Monath *et al.*, 2010).

Thinking in terms of One Welfare can stimulate a holistic approach, and does not only integrate the many facets affecting animal welfare but also helps us to analyse and understand the effects and benefits of animal welfare improvement on humans and the environment. This is illustrated in [Fig. 22.1](#) where different issues are gathered under the umbrella of the One Welfare concept, addressing animal welfare, human well-being, and environmental conservation.

Knowledge of animal farming can shape opinion about animal welfare issues (Miele and Evans, 2010; Evans and Miele, 2012). Such knowledge and concern are often associated with personal experience with companion animals, but the media, market adverts, animal advocacy groups, radio, newspapers, friends, etc. are also very influential. Television is the most cited source of information, followed by the Internet and newspapers with most animal welfare information coming from mass media images and reports, particularly when reporting on negative issues such as disease outbreaks (European Commission, 2007b).

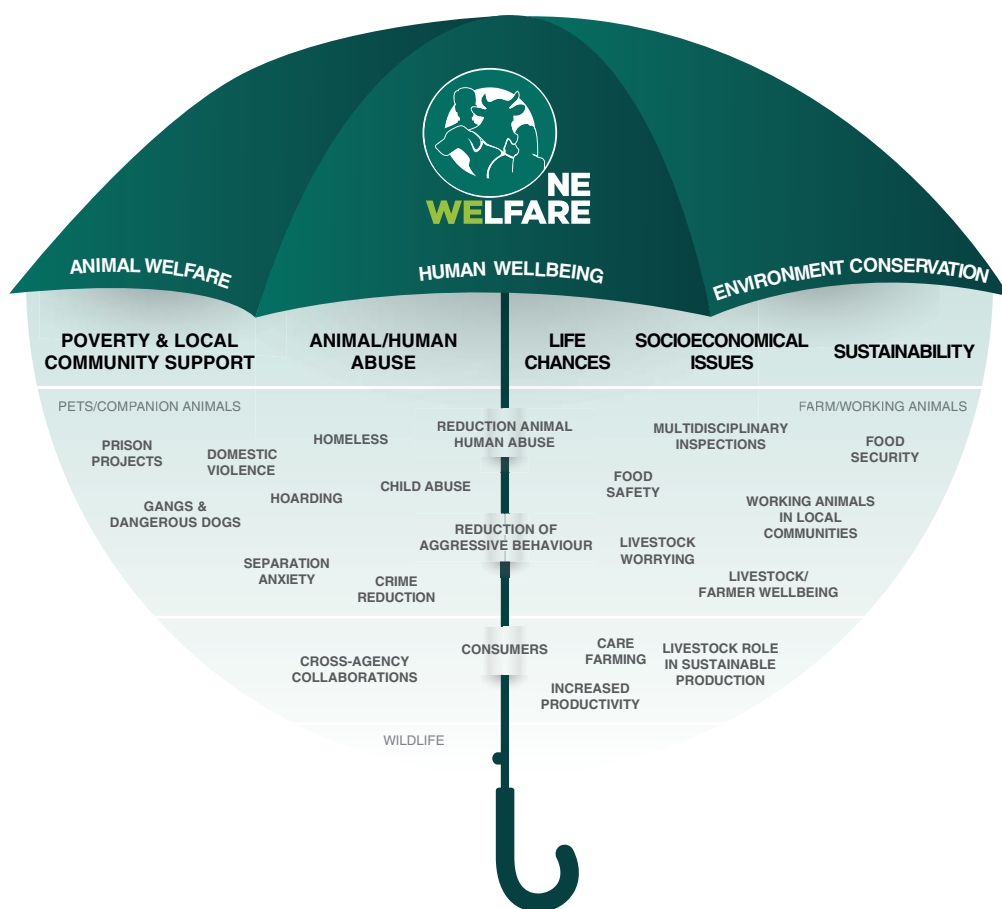


Fig. 22.1. Illustration of the One Welfare approach. (From Pinillos *et al.*, 2016.)

General knowledge about the way animals are kept is not always very high with citizens (in a European survey, more than 30% of respondents had never visited a farm with animals; European Commission, 2007a). However, there does seem to be a clear demand for more information about the way agricultural animals are kept (European Commission, 2016).

22.2 Retail and Consumers

Welfare is becoming increasingly recognized as an important quality aspect of the product (Blokhuys *et al.*, 2003). Although there are clear differences between countries, more than half of the consumers in Europe (59%) indicate that they are prepared to pay more for products sourced from animal welfare-friendly production systems (European Commission, 2016). More than a third of respondents

(35%) are prepared to pay up to 5% more, but only a small minority (3%) are ready to pay more than 20%. However, although the Eurobarometer study indicates a willingness to pay for animal welfare, it is not always clear how much of what is expressed by consumers is also practised in everyday life. Consumers do not always value welfare attributes and shopping choices based on price are often prioritized (Kjaernes and Lavik, 2008).

Actual shopping behaviour in relation to animal welfare is difficult to evaluate, because purchasing decisions are influenced by many factors and the specific role of animal welfare is difficult to measure. However, growing trends in the size of the market share of animal friendly products such as organically produced products (Meredith and Willer, 2016), non-cage eggs, and various welfare-labelled products (e.g. 'Beter Leven'; Beter Leven, 2017) and 'RSPCA

Assured' (previously 'Freedom Food') (RSPCA Assured, 2017) illustrate that animal welfare plays an increasing role in affecting the production and consumption of animal products. Maybe the increase in the number of people that follow a vegetarian or vegan lifestyle can also be interpreted as such. For example, from a recent survey in Sweden it appeared that 10% of Sweden's population is now vegetarian or vegan, where it was 6% 5 years before (Djurens Rätt, 2014). Retailers and fast food chains play a major role in this progression towards animal friendly production. For example, a number of major retail companies have announced that they will shift to selling cage-free eggs only, most promising to do this by the year 2025.

Today, companies use so-called 'shared value strategies' to create measurable business value by identifying and addressing societal issues that intersect with their business (Porter and Kramer, 2011). Farm animal welfare is such a 'shared value' in that it benefits: (i) the animal (healthy, happy); (ii) the producer (lower costs, increased profits); (iii) the consumer (ethical food production, better food quality and safety); and (iv) the overall food supply chain (increased public acceptability and sustainability).

Importantly, consumer choice is related to the product information that is provided. When EU citizens were asked whether they would like to have more information about the conditions under which farmed animals are kept, almost two-thirds of the respondents (64%) indicated they would like to have more information (European Commission, 2016). This was an increase of six percentage points compared with the survey carried out 10 years earlier (European Commission, 2007b). However, such information may be delivered in various forms, such as general information, campaigns, or specific labelling of animal products. In connection with segmentation in the market, Buller (2013) identifies a number of approaches:

- explicit welfare labelling: where a product is labelled according to the welfare criteria applied to the system of production over and above regulatory minima;
- quality assurance labelling: where a product is labelled as conforming to an existing assurance or quality scheme for which higher welfare standards are claimed;
- conformity labelling: where a product is labelled as having certain characteristics that might be assumed to be in conformity with regulatory welfare requirements;

- omni-labelling: where a range of ethical considerations are brought together into a composite label or scheme;
- production system labelling: a product is labelled according to the type of production system and according to an established and defined range of systems;
- criteria labelling: where a label might refer to a single criterion that is either specifically focused on welfare or assumes some welfare advantage; and
- branding: where a product is labelled as being part of a brand to which certain welfare conditions are specified (but are not necessarily presented on the packet itself).

These are applied in different countries and markets depending on local/national circumstances or preferences and marketing strategies (Kjaernes and Lavik, 2008).

As pointed out by Miele *et al.* (2013), a key issue for any information that is provided regarding the welfare status of farmed animals is the trustworthiness of the information. Therefore, reliable welfare monitoring and assessment systems that guarantee a certain level of welfare and make it possible to convey information about animal welfare to the consumer are required.

22.3 Farmers

It is widely recognized that poor welfare, with disease as an important component, negatively affects production and specific quality aspects, and this clearly has the potential to jeopardize profitability (Hemsworth and Coleman, 2011; Blokhuis *et al.*, 2013). In Europe farmers generally consider animal welfare to be an important aspect of farming (Bock, 2009) and they are very motivated to provide good care for their animals within the limits set by the need to ensure the economic profitability of their enterprises.

There is a lot of scientific and practical knowledge about the needs and requirements of different species and related consequences for animal welfare when these needs are not fulfilled. Examples of needs are laying nests for hens and rooting substrate for pigs. But it is also clear that resource needs may vary, for instance, for different breeds of animals or animals in various stages of life. A chick has different requirements to a hen, and a calf has other needs than a cow. In groups of animals, social structures and related behaviours may prevent equal access to resources for all individuals (e.g. dominant cows

may prevent subordinates gaining access to a feeding place or cubicle). Moreover, climatological conditions may affect what resources are needed or are adequate. One can think about shade for cows on hot sunny days or additional heating for young animals.

Farmers are also very much aware that they are operating in a competitive market where they have to comply with food retailers' standards if they want to have access to the market. Indeed, animal welfare credentials, above legal requirements, are increasingly required by retailers in order to strengthen their brand image (Kjaernes *et al.*, 2009).

Maintaining a good state of animal welfare depends largely on the quality of resources: for

instance, the type of housing system, available space, feed type, and quality of transport vehicles and slaughter equipment. However, animal welfare is not only affected by the resources as such, but also by how these resources are applied and managed and how accurate, and at what stage of development, welfare problems are recognized. This very much depends on the knowledge and skills of farmers, veterinarians, drivers, handlers, etc. and education and training are essential here.

Animal production in the EU has to comply with quite extensive legislation on animal protection (see Box for explanation of the relationship between animal welfare and animal protection).

BOX: Animal welfare and animal protection

Several descriptions/definitions of animal welfare include two dimensions: (i) aspects of animal welfare; and (ii) how to achieve them. A first example is the five freedoms, where the first part of each sentence describes dimensions of welfare and the second part of the sentence describes how to achieve them:

1. Freedom from Hunger and Thirst – by ready access to fresh water and a diet to maintain full health and vigour.
2. Freedom from Discomfort – by providing an appropriate environment including shelter and a comfortable resting area.
3. Freedom from Pain, Injury or Disease – by prevention or rapid diagnosis and treatment.
4. Freedom to Express Normal Behaviour – by providing sufficient space, proper facilities and company of the animal's own kind.
5. Freedom from Fear and Distress – by ensuring conditions and treatment which avoid mental suffering.

(Anonymous, 2012)

Similarly, the definition by the World Organization for Animal Health (OIE) describes first what good animal welfare means and in the second paragraph the requirements for good animal welfare.

Animal welfare means how an animal is coping with the conditions in which it lives. An animal is in a good state of welfare if (as indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behaviour, and if it is not suffering from unpleasant states such as pain, fear, and distress.

Good animal welfare requires disease prevention and appropriate veterinary treatment, shelter, management and nutrition, humane

handling and humane slaughter or killing. Animal welfare refers to the state of the animal; the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, and humane treatment.

(OIE, 2016)

These two dimensions can be called 'animal welfare' and 'animal protection', respectively.

They also relate to different types of variables. On the one hand variables to measure the welfare state of the animal, and on the other hand variables to describe what we do ('management') and what we provide ('resources') to protect the welfare of the animals and to prevent welfare risks. These two types of variables are also called 'input variables' (management and resources) and 'output variables' (actual animal welfare). Of course, these two types are closely related since the actual welfare status of the animals depends on how well welfare is protected in terms of: (i) the quality of available resources; (ii) how these resources are applied and managed; and (iii) a timely and adequate response to resolve welfare problems when they occur. To a certain extent, input variables can be relatively easily defined and assessed (especially resources) and thus also regulated through legislation. That is why most requirements in welfare regulations refer to this type of variable. Output variables refer to aspects of the animal and generally are measured at/on the animal (e.g. wounds, lameness, fearfulness, etc.). Animal welfare science has provided the theoretical basis and practical approaches to measure animal welfare (Blokhuys *et al.*, 2008) and also developed various methods to assess welfare on farm (Blokhuys *et al.*, 2010).

The first EU legislation on farm animals concerned the protection of laying hens and was adopted in 1986, followed in 1991 by Council Directives on the protection of calves and pigs. In 1998, Council Directive 98/58/EC on the protection of animals kept for farming purposes gave general rules for the protection of animals of all species kept for farming purposes (Council of the European Union, 1998). Legislation has been further developed since that time to progressively improve the welfare status of farmed animals and to set standards for their transport and conditions at the time of stunning and slaughter. The member states in the EU transpose this legislation into national laws. Some countries (e.g. Sweden) have additional requirements in their national legislation above the EU requirements.

Intensification, and a general trend towards larger farm sizes, results in more animals per caretaker, reducing the time available to monitor the welfare status of animals in the herd/flock, and this complicates the management of the welfare of issues. Technological developments in the area of precision livestock farming (PLF) can help a farmer to continuously monitor welfare aspects of his/her animals and to alert the farmer in case of (potential) welfare problems (Berckmans, 2014). Such sensing technology can, for instance, automatically detect lameness in dairy cows by applying image analysis techniques that recognize the deviating back posture in lame cows (Viazzi *et al.*, 2013). PLF can use sound analysis to identify coughing of pigs as an indicator of a respiratory problem (Guarino *et al.*, 2008).

Such systems can greatly support the management of welfare but can of course not replace a farmer. The farmer still has to make decisions and take action and remain the most important factor to achieve good animal welfare. The technology can support the farmer's eyes and ears and help them focus on those animals or situations that need attention. PLF systems are currently not yet widely implemented. This may partly be a result of the state of development of the technology and the related costs. Not all systems have reached the 'plug and play' state (i.e. work as soon as they are connected) and the economical added value of improved management when using these systems is still not convincingly shown.

Notwithstanding the awareness of farmers, animal protection legislation, increased attention for animal welfare in the market, and development of technology support, there are still major welfare

issues in virtually all types of animal production. These include: (i) barren housing conditions; (ii) limited space in which to, for example, express natural behaviour; (iii) amputations; (iv) lameness; (v) injurious behaviours; and (vi) poor transport and slaughter conditions.

22.4 Information on Animal Welfare

In the above sections, references were made to various forms of information related to the welfare status of animals. To respond to societal concerns, facilitate the related effects in the market, provide farmers with welfare management tools and to regulate and check compliance with legislation, information about animal welfare is needed. The information takes different forms depending on who is going to use it and what for. Five broad groups or categories of information demand may be distinguished:

1. To inform society about the welfare status of farm animals.
2. To give food retailers/restaurants the opportunity to brand products or their corporate identity.
3. To allow consumers to purchase products from animals with assured welfare.
4. To provide farmers and other chain actors (transporters, slaughterhouses) with data to manage and improve animal welfare.
5. To regulate animal protection and to check compliance with legislation.

For these various aims different types of information or indicators are needed. Some brief indications are outlined here.

22.4.1 Information needs – category 1

Information about animal welfare provided for citizens could include the extent to which different types of housing systems are used for different species in a specific country. Since citizens' general knowledge about the way animals are kept is not always very good, information could include descriptions or videos illustrating different housing practices. Apart from data and illustrations of housing systems the information could also include scientists' assessment of the pros and cons of these systems. Information on current legislation and data about (non-) compliance with existing regulations could also be included.

To reach different groups of citizens, different routes of communication should be used. A large

majority (87%) of Europeans agree that information campaigns are a good way to positively influence the attitudes of younger people towards animals. Obviously, specifically for this group, the information should also be made available through websites and social media.

22.4.2 Information needs – category 2

The information needed in this category may vary a lot depending on the claims a company or organization wants to make. The information should be directly related to these claims. Some branding may be very specific, referring to one or a few welfare-related aspects of production (generally resource-based information – such as ‘non-cage eggs’, ‘grazing milk’) while other types of branding may be more holistic. The first type needs only reliable information about specific resources (input variables) of suppliers, whereas the second type needs detailed information on various aspects of production also based on output parameters. Both require certification schemes, including (third party) assessments, that relate to the claims made and provide assurance to consumers on these aspects of animal welfare. A best practice framework was proposed for such schemes (Main *et al.*, 2014) and the International Organization for Standardization (ISO) published a Technical Specification (ISO, 2016) to support the implementation of relevant practices to ensure animal welfare in livestock production systems. Taking an integrated approach, the Welfare Quality® project (Blokhuis *et al.*, 2013) was instrumental in providing a sound scientific basis for the European harmonization of assessment and information systems.

22.4.3 Information needs – category 3

Consumers who wish to make an informed choice and buy ‘animal friendly’ products could use two different categories of information (which include the approaches mentioned by Buller (2013) and quoted above): (i) information directly related to the product, with some kind of labelling; or (ii) information related to the point of sale where the shop or the restaurant only sells products that meet a certain welfare standard. Which type of information is preferred varies between countries and market conditions (Kjaernes and Lavik, 2008). In shops and supermarkets, consumers have difficulty in finding information on products sourced from animal-welfare-friendly production systems (European

Commission, 2007b). In a study in six European countries, Roe and Marsden (2007) found that many animal-based product types carry welfare claims (16% of pork products, 23% of eggs, 32% of dairy products, 33% of beef products, and 15% of chicken products). However, the information regarding animal welfare was not very specific, and often confusing and not harmonized between chains or countries. Moreover, the animal welfare claims were often bundled with other product attributes such as environmentally friendly, human health, or taste.

22.4.4 Information needs – category 4

In order to manage animal welfare, farmers or other actors (e.g. transporters and slaughterhouses) need information on the actual welfare state of the animal. The type of information needed depends on the welfare issue to be managed. For example, to manage lameness in dairy cows, a daily assessment may be adequate, while effective detection of respiratory problems in pigs may require continuous monitoring (cf. Guarino *et al.*, 2008). To evaluate design parameters, for example, the size of cubicles in a dairy barn or the length of available perches for laying hens, and a yearly verification visit and ‘inspection’ may be enough. In a welfare management plan these distinctions should be clearly made and related routines should be defined.

Clearly, managers of animal welfare need to know how specific welfare aspects depend on input variables in order to correct the situation if welfare is affected. As mentioned before, even if technology can assist the manager, he or she is still the most important factor and influence in detecting and solving welfare problems. Training and education is therefore important for caretakers (also to allow correct interpretation of PLF data) to maintain a high quality of welfare monitoring and management, and to deliver high levels of welfare.

22.4.5 Information needs – category 5

To regulate animal protection, legislators need information that describes how ‘what we do’ (‘management’) and ‘what we provide’ (‘resources’) affects the welfare of the animals and how we can prevent or reduce welfare risks. The provision of adequate feed, suitable flooring, space, litter material, comfortable resting places, etc. is of course relevant for animals, for instance to be able to express their behavioural needs, to remain healthy

and to prevent wounds and other damage. Legislation cannot possibly define, in detail, the multitude of necessary requirements for all animal types and breeds, housing circumstances, climatological conditions, group structures, and life phases, etc. Legislative requirements have to be limited to those resources that are valid in all situations. The latter includes bans of those systems and practices that are shown to have a negative impact on animal welfare (e.g. battery cages for laying hens, stalls for pregnant sows, tail docking, etc.).

Following the very brief comments above, it becomes clear that different categories of information are needed for the different purposes. However, it is also clear that the basis of all information is the same: the welfare status of the individual animal. This was also recognized by the Welfare Quality® project and was the basis of its approach to provide a harmonized assessment and information system as the basis for animal welfare management, communication, marketing, and legislation (Blokhuys *et al.*, 2010). This is illustrated in the diagram in Fig. 22.2.

However, the Welfare Quality® project focused on systems that assess animal welfare at the farm level with rather long intervals between assessments (months to years). Such intervals may be suitable for most of the goals mentioned above, but they are of limited value for daily on-farm management. Modern technology allows for more continuous monitoring of relevant welfare parameters and is therefore more applicable as a management tool.

Obviously, such technology would also generate data to support welfare assessments for other purposes.

22.5 Future Developments

The basic needs of our domestic animals are very much the same as their wild ancestors. The challenge is to accommodate these needs in a production environment in a way that allows efficient and sustainable production and is accepted by society. Reliable information on the animals' welfare status is crucial to respond to this challenge and further research and development of assessment measures and technologies to automate such measures is paramount. In this context, it is interesting to note that technologies that generate basic data can be applied in the context of welfare as well as production. For instance, real-time localization systems in dairy cows support location of cows in a large herd and alert the farmer when cows are in oestrus, but these data can potentially also provide information about health issues, aggression, comfort around resting, etc. (Richard *et al.*, 2015). Thus, it seems likely that increasingly 'welfare' measures will overlap with 'production' measures and form an integrated part of the total production management.

In an ideal world, good animal welfare (and sustainability of production) would be valued in the market as a quality aspect of animal products and the animal production sector would deliver this quality. However, as mentioned above, there are

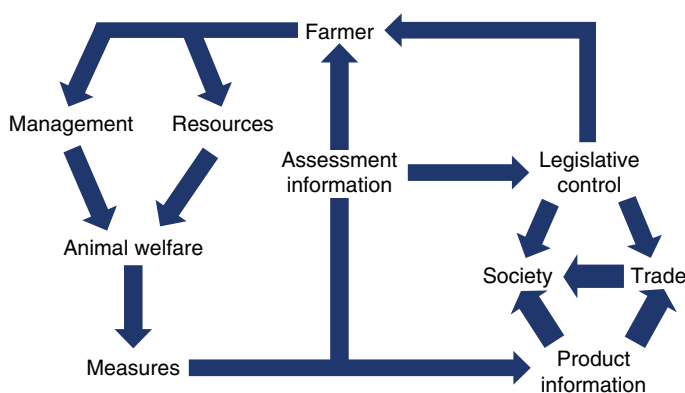


Fig. 22.2. Diagrammatic representation of the use of assessment information (Blokhuys *et al.*, 2010). Primary measures of animal welfare are processed and used for different purposes: (i) to manage/improve animal welfare by the farmer; (ii) to define products in trade; (iii) to inform society and consumers; and (iv) to check compliance with legislation. (Image credit: Harry Blokhuys.)

still major welfare issues in virtually all types of animal production (e.g. barren housing conditions, limited space, difficulties for animals to express natural behaviour, amputations, lameness, injurious behaviours, poor transport, and slaughter conditions, etc.). Although the market share of products from animals with higher welfare has increased, current markets/consumers do not always value these attributes, and low price is often prioritized. There is a role for industry to focus on innovative changes in farm housed environments and husbandry practices to combine good animal welfare and efficient production. Such innovations could also include partnerships with retailers to stimulate consumer awareness and willingness to pay. An example of such an innovative approach is the development of the Roundel in the Netherlands, a housing and marketing concept for laying hens (Groot Koerkamp and Bos, 2008).

At the EU level it has been stated that the European Commission will consider the feasibility and the appropriateness of introducing science-based indicators of animal welfare outcomes, as opposed to welfare inputs as has been used so far (European Commission, 2012). Such an approach could simply define minimum acceptable levels for the welfare indicators that are gathered on farm and could also be used for welfare management and assurance for market purposes.

References

- Anonymous (2012) Five Freedoms. The National Archives, Farm Animal Welfare Committee. Available at: <http://webarchive.nationalarchives.gov.uk/20121007104210/http://www.fawc.org.uk/freedoms.htm> (accessed 18 September 2017).
- Berckmans, D. (2014) Precision livestock farming technologies for welfare management in intensive livestock systems. *Revue Scientifique et Technique (International Office of Epizootics)* 33(1), 189–196.
- Beter Leven (2017) Available at: <https://beterleven.dierenbescherming.nl/> (accessed 17 September 2017).
- Blokhuys, H.J. (1999) Integration of animal welfare in intensive animal production. In: Wensing, Th. (ed.) *Production Diseases in Farm Animals*. Wageningen Press, Wageningen, the Netherlands, pp. 222–229.
- Blokhuys, H.J., Jones, R.B., Geers, R., Miele, M. and Veissier, I. (2003) Measuring and monitoring animal welfare: transparency in the food product quality chain. *Animal Welfare* 12, 445–455.
- Blokhuys, H.J., Keeling, L.J., Gavinelli, A. and Serratos, J. (2008) Animal welfare's impact on the food chain. *Trends in Food Science and Technology* 19, 75–83.
- Blokhuys, H.J., Veissier, I., Miele, M. and Jones, R.B. (2010) The Welfare Quality® project and beyond: safeguarding farm animal well-being. *Acta Agriculturae Scandinavica A, Animal Science* 60, 129–140.
- Blokhuys, H.J., Veissier, I., Jones, R.B. and Miele, M. (2013) The Welfare Quality® vision. In: Blokhuys, H.J., Jones, R.B., Veissier, I. and Miele, M. (eds) *Improving Farm Animal Welfare. Science and Society Working Together: the Welfare Quality Approach*. Wageningen Academic Publishers, Wageningen, the Netherlands, pp. 71–89.
- Bock, B.B. (2009) Farmers' perspectives. In: Butterworth, A., Blokhuys, H.J., Jones, B. and Veissier, I. (eds) *Conference Proceedings, Delivering Animal Welfare and Quality: Transparency in the Food Production Chain* (including the final results of the Welfare Quality® project), 8–9 October 2009, Uppsala, Sweden. Project Office of Welfare Quality®, Lelystad, the Netherlands, pp. 73–75.
- Buller, H. (2013) Animal welfare: from production to consumption. In: Blokhuys, H.J., Jones, R.B., Veissier, I. and Miele, M. (eds) *Improving Farm Animal Welfare. Science and Society Working Together: the Welfare Quality Approach*. Wageningen Academic Publishers, Wageningen, the Netherlands, pp. 49–69.
- Council of the European Union (1998) Council Directive 98/58/EC of 20 July 1998 concerning the protection of animals kept for farming purposes. *Official Journal L* 221, 23–27.
- Djurens Rätt (2014) Allmänheten om vegetarisk mat. Report. Demoskop, Stockholm, 7 pp.
- European Commission (2007a) Attitudes of consumers towards the welfare of farmed animals. *Special Eurobarometer* 229(2). Eurobarometer, Brussels, 53 pp.
- European Commission (2007b) Attitudes of EU citizens towards animal welfare. *Special Eurobarometer* 270. Eurobarometer, Brussels, 82 pp.
- European Commission (2012) *Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee on the European Union Strategy for the Protection and Welfare of Animals 2012–2015*. European Commission, Brussels, 12 pp.
- European Commission (2016) Attitudes of Europeans towards Animal Welfare. *Special Eurobarometer* 442. Eurobarometer, Brussels, 86 pp.
- Evans, A. and Miele, M. (2012) Between food and flesh: how animals are made to matter (and not to matter) within food consumption practices. *Environment and Planning D – Society and Space* 30(2), 298–314.
- Grant, W. (1997) *The Common Agricultural Policy*. Macmillan, London, 256 pp.
- Groot Koerkamp, P.W.G. and Bos, A.P. (2008) Designing complex and sustainable production systems: an integrated and reflexive approach for the case of table egg production in the Netherlands. *Netherlands Journal of Agricultural Science* 55(2), 113–138.

- Guarino, M., Jans, P., Costa, A., Aerts, J.-M. and Berckmans, D. (2008) Field test of algorithm for automatic cough detection in pig houses. *Computers and Electronics in Agriculture* 6(2), 22–28.
- Hemsworth, P.H. and Coleman, G.J. (2011) *Human–Livestock Interactions*. CAB International, Wallingford, UK, 194 pp.
- ISO (2016) *Animal Welfare Management – General Requirements and Guidance for Organisations in the Food Supply Chain*. Technical Specification ISO/TS 34700. International Organization for Standardization (ISO), Geneva, Switzerland, 8 pp.
- Kjaernes, U. and Lavik, R. (2008) Opinions on animal welfare and food consumption in seven European countries. In: Kjaernes, U., Bock, B.B., Roe, E. and Roex, J. (eds) *Consumption, Distribution and Production of Farm Animal Welfare Opinions and Practices Within the Supply Chain*. Welfare Quality Reports No. 7. Cardiff University/Welfare Quality, Cardiff, pp. 1–117.
- Kjaernes, U., Bock, B., Higgin, M. and Roex, J. (eds) (2009) *Farm Animal Welfare Within the Supply Chain: Regulation, Agriculture, and Geography*. Welfare Quality Reports No. 8. Cardiff University/Welfare Quality, Cardiff, 280 pp.
- Main, D.C.J., Mullan, S., Atkinson, C., Cooper, M., Wrathall, J.H.M. and Blokhuis, H.J. (2014) Best practice framework for animal welfare certification schemes. *Trends in Food Science & Technology* 37, 127–136.
- Meredith, S. and Willer, H. (eds) (2016) *Organic in Europe. Prospects and Developments 2016*. International Federation of Organic Agriculture Movements (IFOAM) European Union Group, Brussels, Belgium, 85 pp.
- Miele, M. and Evans, A. (2010) When foods become animals, ruminations on ethics and responsibility in care-full spaces of consumption. *Ethics, Policy and Environment* 13, 171–190.
- Miele, M., Blokhuis, H.J., Bennett, R. and Bock, B. (2013) Changes in farming and in stakeholder concern for animal welfare. In: Blokhuis, H.J., Jones, R.B., Veissier, I. and Miele, M. (eds) *Improving Farm Animal Welfare. Science and Society Working Together: the Welfare Quality Approach*. Wageningen Academic Publishers, Wageningen, the Netherlands, pp. 19–47.
- Monath, T.P., Kahn, L.H. and Haplan, B. (2010) Introduction: One Health perspective. *ILAR Journal* 51(3), 193–198.
- OIE (2016) *Terrestrial Animal Health Code*. World Organisation for Animal Health (OIE). Available at: <http://www.oie.int/international-standard-setting/terrestrial-code/access-online/> (accessed 18 September 2017).
- Pinillos, R.G., Appleby, M.C., Manteca, X., Scott-Park, F., Smith, C. and Velarde, A. (2016) One Welfare – a platform for improving human and animal welfare. *The Veterinary Record* 179(16), 412–413.
- Porter, E. and Kramer, M.R. (2011) Creating shared value. How to reinvent capitalism – and unleash a wave of innovation and growth. *Harvard Business Review* 89(1/2), 62–77.
- Richard, M.M., Sloth, K.H. and Veissier, I. (2015) Real time positioning to detect early signs of welfare problems in cows. EC-PLF (European Conference on Precision Livestock Farming), September 2015, Milan, Italy, 4 pp.
- Roe, E. and Marsden, T. (2007) Analysis of the retail survey of products that carry welfare claims and of non-retailer led assurance schemes whose logos accompany welfare claims. In: Kjaernes, U., Miele, M. and Roex, J. (eds) *Attitudes of Consumers, Retailers and Producers to Farm Animal Welfare*. Welfare Quality Report No. 2. Cardiff University/Welfare Quality, Cardiff, pp. 33–69.
- RSPCA Assured (2017) RSPCA Assured. Royal Society for the Prevention of Cruelty to Animals (RSPCA), London. Available at: <https://www.berspcaassured.org.uk/> (accessed 18 September 2017).
- Viazzi, S., Van Hertem, T., Romanini, C.E.B., Bahr, C., Halachmi, I. et al. (2013) Automatic back posture evaluation in dairy cows using 3D camera. In: Berckmans, D. and Vandermeulen, J. (eds) *Precision Livestock Farming '13*. KU (Katholieke Universiteit) Leuven, Leuven, Belgium, 968 pp.

23 Licensed to Harm

REBECCA ALDWORTH

23.1 Introduction

In August 2016, the Washington Post and other leading news agencies reported on a video posted on social media, showing an American trophy hunter, Josh Bowmar, mortally wounding a black bear with a homemade spear in Alberta, Canada. Mr Bowmar lured the bear to the kill site with bait, a practice that is outlawed in two Canadian territories (Porter, 2016) and is illegal or severely restricted in the overwhelming majority of US States (Lucky Buck, 2016), and killed the animal during the spring season when mothers are nursing cubs and vulnerable bears are emerging from hibernation.

In the video, Mr Bowmar states that he threw the spear, which was outfitted with a camera, from a distance of 12 to 15 yards. He noted that there were ‘no shotguns within miles’, revealing that he had no method of humanely dispatching the animal should he fail to deliver an immediate death.

The bear was not immediately killed by the spear and the video shows the wounded animal running away from Mr Bowmar, into the trees. The video reveals that Mr Bowmar then left the scene for at least 16 hours before returning to retrieve the animal. When Mr Bowmar returned, parts of the black bear’s intestines were wrapped around low branches along the ground and the dead, disemboweled animal was found ‘60 to 70 yards’ away from where it was first struck.

Notably, the day before this controversial hunt took place, Mr Bowmar’s wife Sarah had killed another bear, and a video of her kill was also posted on social media. Ms Bowmar used a bow and arrow to wound the bear, which was visibly alive and conscious after being struck. Yet Ms Bowmar also left the scene overnight, returning only the next day to retrieve the animal. The video shows Ms Bowmar following the intestines of the bear along the ground and locating the dead animal many meters away.

In the video of Mr Bowmar’s spear hunt, the husband and wife are shown ecstatically celebrating the death of the bear. However, the public reacted quite differently. Within three months, the video had achieved over 200,000 views, and many outraged comments were posted from around the world. One commenter asked, ‘Surely there are laws against this kind of hunting? It’s not even hunting — it’s animal cruelty, pure and simple.’ Relevant management authorities also weighed in, with Alberta Ministry of Environment and Parks spokesperson Kyle Ferguson stating, ‘The type of archaic hunting seen in the recently posted video of a hunter spearing a black bear in Alberta is unacceptable.’ A hunter commented on the popular American hunting website, Outdoorhub, ‘I’ve been hunting for 56 years and this video was disgusting... if you want to take an animal humanely (which you obviously could care less about) then shoot it with a rifle’. Under Armour, an American company that manufactures footwear, sports, and athletic wear, ended its endorsement deal with Sarah Bowmar in August 2016 in response to the public outcry (the couple wore the company’s clothing in the hunting video).

The case illustrates a clear disconnect between public views on animal welfare as it pertains to wildlife hunts and what actually occurs and is permitted in recreational hunts in the wild. While the public, the corporate sector, and management authorities were clearly shocked by the method of killing depicted in the video, Mr Bowmar was not charged with any wrongdoing because his method of killing was, in fact, legal under provincial hunting regulations.

23.2 What is a Humane Death?

Social regard for animal welfare is reflected in a proliferation of animal welfare science as well as

changing government, corporate, and trade policies (Leary *et al.*, 2013). This regard is also signaled by the generally accepted principle that if we kill an animal for our own purposes, we should do so in a humane fashion, involving a minimum of pain, fear, and distress for the animal. This, in turn, has been reflected in the establishment of humane slaughter standards which, in most developed nations, include: minimizing distress prior to and during stunning, rendering the animal unconscious and insensitive to pain without the need to repeat the stunning process, delivering death rapidly through an accepted method, confirming unconsciousness, and ensuring unconsciousness persists until death occurs (Butterworth and Richardson, 2013).

Given these standards, it is perhaps to be expected that reputable veterinary authorities do not sanction the use of a free-thrown spear on a free-ranging animal to achieve 'euthanasia' ('a good death'). However, the public might be more surprised to learn that the more commonly used killing methods in recreational hunting also fail to adhere to accepted criteria for euthanasia.

23.3 Wild Animals, Trophy Hunting, and Humane Killing

Canada is the largest source of trophies from wildlife hunts, accounting for 33% of the global supply (IFAW, 2016) (See also Chapter 5 - Trophy Hunting). Yet, while 81% Canadians support eating animals (killing domestic animals for food), only 9% are in support of trophy hunting of wild animals (Insights West, 2017) and only 8% of Canadians participate in hunting or trapping (Federal, Provincial and Territorial Governments of Canada, 2012). The difference in Canadian attitudes towards killing farmed animals for food and recreational hunting of wildlife is clear in survey polling data. Given the significantly lower tolerance for killing animals for sport, it might be logical to assume a stronger, or at least equal, legal standard of animal welfare protections for wild animals in Canada, yet a review of the relevant legislation reveals the opposite.

In most developed nations, regulations and codes of practice pertaining to slaughter of food animals outline the permitted methods of (and implements used for) stunning and killing, which generally adhere to veterinary guidelines on humane killing. Training is supposed to be provided for workers and there is some oversight of the slaughter process

by managers and third-party inspectors. In federally inspected slaughterhouses in Canada, with exceptions granted only for religious purposes, the Meat Inspection Act (Government of Canada, 1985) requires that animals be stunned prior to slaughter with a minimum of fear, pain, and distress and an approved method of slaughter must be implemented rapidly following confirmation of unconsciousness. Methods of handling animals, stunning, and killing are described in detail in the regulations. In contrast, in wildlife hunts, these standards are, for the most part, lacking, and provincial wildlife hunting regulations fail absolutely to proscribe humane killing methods.

A large number of factors influence the welfare outcomes in hunting of wildlife. These include but are not limited to: the skill and alertness of the marksman, the distance of the shooter, visibility, motion of the target, and environmental conditions such as temperature and wind speed (Butterworth and Richardson, 2013). In the wild, hunters target free-ranging animals, often from long distances, which poses significant challenges to accuracy, for even the most highly skilled marksman. Yet provincial wildlife regulations allow for hunting in conditions that add considerably to the existing obstacles to humane killing. For example, most provincial and federal hunting regulations specifically permit animals to be targeted in dim lighting conditions, in the half hour before dawn and the half hour after sunset (as well as during the day). A number of Canadian provinces also allow rifle hunting at night, in the dark, for some animals (see [Table 23.1](#)).

Though shooting accuracy impairment has been reported in low temperature (winter) shooting conditions (Grebot and Burtheret, 2007), provincial hunting regulations do not limit hunting during extreme low temperatures. Similarly, there are no prohibitions on hunting in extreme low visibility situations caused by weather elements such as dense fog, heavy snow or freezing rain, or in high wind conditions.

23.4 A Lower Standard of Welfare for Wild Animals

A growing societal concern for animal welfare has inspired scrutiny of practices applied in the management of wildlife (Leary *et al.*, 2013) and to receive public support, wildlife killing methods should be shown to be humane (Hampton *et al.*, 2014). Paquet and Darimont (2010) conclude that,

Table 23.1. Provincial wildlife hunting regulations compared to federal slaughter regulations

Indicator	Provincial wildlife hunting regulations	Federal slaughter regulations
Stunning required prior to slaughter	NO	YES, exception for ritual slaughter
Minimize pain, fear, and distress prior to stunning	NO	YES
Permitted slaughter methods described	NO	YES
Monitoring for consciousness following stunning	NO	YES
Restun if signs of consciousness exhibited	NO	YES
Monitoring for consciousness prior to dressing	NO	YES
Training of slaughterer	NO	YES
Supervision of slaughterer	NO	YES
Third party inspection	NO	YES

‘the suffering wildlife endures because of humans is a collective responsibility that presents a moral imperative for animal welfarists and conservationists alike.’

Yet even in recognized euthanasia guidelines, a lower standard of welfare is often applied to the killing of wild animals. For example, the American Veterinary Medical Association’s (AVMA) Guidelines for the Euthanasia of Animals (Leary *et al.*, 2013) state, ‘Gunshot is acceptable with conditions for euthanasia of free-ranging, captured, or confined wildlife, provided that bullet placement is to the head (targeted to destroy the brain).’ The Guidelines note that a gunshot to the chest or neck may not result in rapid death or immediately render an animal unconscious, and presents challenges for accurate placement. Bateson and Bradshaw (2000), in their studies on hunted deer, found that, ‘the activities of muscle enzymes, creatine kinase, aspartate amino transferase, and lactate dehydrogenase, were markedly higher in the plasma of deer shot in the chest as compared with those shot in the head or neck’. The AVMA Guidelines go on to qualify that,

‘it may, however, not be possible or appropriate to target the head when killing is attempted from large distances’ and that a gunshot to the heart, chest or neck ‘may be the best option for free-ranging or other settings where close approach is not possible.’

In other words, to be a ‘good death,’ the bullet placement should be to the head. However, the challenges of shooting free-ranging animals from long distances are presented as justification to remove this requirement and replace it with a less humane method that allows for the animal to suffer. While there are situations in which a less humane method might be justifiable, when a gunshot to the head is not possible (euthanizing a fatally wounded, suffering animal from a distance, for example), it is questionable whether the public would support a lowering of welfare standards to facilitate recreational hunting activities. Leary *et al.* (2013) also notes that, ‘When the most appropriate firearm is being chosen for the purpose of euthanasia, there are several factors to be considered, including caliber of the firearm, type of bullet or shotshell, distance from the target, age of the animal (aged animals have harder skulls), sex of the animal (bull or cow), and accuracy of aim.’ Yet few of these factors are addressed from a welfare standpoint in provincial hunting regulations.

23.5 Common Recreational Hunting Weapons

There is a notable sparsity of current scientific literature on welfare implications of even the most common weapons and killing methods permitted in recreational and other forms of hunting. In itself, this could speak to a lack of emphasis which stakeholders have placed on the welfare of wild animals during slaughter, or to a lack of (i) agreement of which hunting could or should be ‘researched’ and (ii) support for research in this area despite the large numbers of animals affected. Moreover, the studies that do exist rely on contradictory definitions of the indicators used to evaluate welfare outcomes. Regardless, many of these studies do indicate high wounding rates and other negative welfare outcomes that would not be accepted in commercial slaughter operations.

23.5.1 Rifles/shotguns

Some research has reflected public concerns about animal welfare in the shooting of wildlife (Bateson

and Bradshaw, 1997; Butterworth and Richardson, 2013) and the importance of positive animal welfare in wildlife management (Mellor and Littin, 2004; Warburton and Norton, 2009; Littin, 2010; Warburton *et al.*, 2012). Yet there are few quantitative data on shooting methods for wild animals, making it difficult for stakeholders to determine the welfare outcomes associated with wildlife shooting. Veterinary and other studies of wildlife shooting programs rely on different criteria to measure effectiveness and welfare outcomes, while definitions of welfare criteria such as wounding rates differ from study to study (Hampton *et al.*, 2015). Despite these challenges, a number of studies have attempted to rank wildlife culling methods based on welfare outcomes (Sharp & Saunders, 2011; Beausoleil & Mellor, 2014; Littin *et al.*, 2014). These studies have underscored the need for measurable, standardized parameters to facilitate ranking the humaneness of various wildlife killing methods.

The non-lethal wounding of animals is an almost inevitable outcome of a shooting program conducted in field conditions (Knudsen, 2005). From an animal welfare perspective, the escape of a wounded animal is one of the worst of all possible outcomes because it involves a potentially protracted, but unquantifiable, duration of suffering (Bateson and Bradshaw, 2000). Bateson and Bradshaw (2000) recorded negative welfare outcomes when studying hunting of red deer in Southwest England. They found that 11% of deer required two or more shots to be killed, 7% took 2–15 min to die, and 2% escaped wounded. Aebischer *et al.*, (2014) identified a number of factors that reduced the probability of hitting the target including uncomfortable firing positions, rushed shooting, freehand shooting, obscured targets, and lack of skill of the shooter. Notably, there are no Canadian regulations that prohibit any of these elements in rifle hunts. Comparisons between published wounding rates are difficult due to differing methodologies. Hampton *et al.* (2015) attempted to establish a baseline of welfare criteria against which terrestrial wildlife hunts could be measured, using several parameters applied to cetacean hunts. The authors studied a controlled rabbit shooting program that took place on a livestock grazing property near Melbourne, Australia. Out of 141 animals shot at by hunters, 127 were hit. Of those that were hit, 27% had to be shot more than one time after the initial strike to achieve death. 12% of these animals

were wounded and escaped, which could lead to a slow and painful death from infections, starvation, and other related conditions. Only 53% of the rabbits that were hit were killed with one bullet. 25% were shot at multiple times before being hit or escaping unwounded, which would have caused significant fear and distress to the animals. Post mortem analysis revealed bullet wound trauma in the abdomen in 35% of cases, limbs in 30% of cases, and cervical spine in 30% of cases. Only in 6% of cases were the rabbits shot in the cranium.

Shooting of game using shotguns inevitably leads to wounding, yet this issue has attracted less attention from the scientific community than hunting issues related to conservation (Noer *et al.*, 2007). Numerous studies have revealed that large numbers of birds are wounded by shotgun pellets during their lifespans. In some species of geese and ducks, up to 62% of the birds examined were found to have embedded shot (Elder, 1955a,b; Grieb, 1970; Norman, 1976; Jönsson *et al.*, 1985; Noer and Madsen, 1996; Noer *et al.*, 1996; Hicklin & Barrow, 2004; Falk *et al.*, 2006).

Seal hunting, a commercial activity, has been the subject of scrutiny for several decades (Butterworth and Richardson, 2013). Shooting by rifle or shotgun is one of two permitted methods of killing seals in the commercial seal hunt and, as such, has been somewhat studied. As is the case in recreational hunting studies, differing welfare criteria and methodologies have hindered comparative analyses. Yet a number of studies reveal high wounding rates and prolonged suffering (Burdon *et al.*, 2001; Daoust *et al.*, 2002; Butterworth *et al.*, 2007) (Figures 23.1, 23.2). Malouf (1986) explained the high wounding rates as a product of the environment



Fig 23.1. A three-week old seal pup is shot and wounded and crawls across the ice before being gaffed onto a sealing vessel on April 21, 2015. (Image credit: Humane Society International/Michael Bernard).



Fig 23.2. A seal that has been shot and wounded crawls across the ice, swims to a second ice pan and then struggles onto it before a sealer arrives to club the seal on April 8, 2010. (Image credit: Humane Society International/ Gray Mitchell).

in which the commercial seal hunt occurs: ‘Many Canadian hunts take place, or have taken place, under conditions which make it impossible to obtain an acceptably high proportion of kills with head shots...The causes include long-range shooting, shooting from moving boats, and shooting at seals in the water.’

EFSA (2007) observes that there are varying interpretations of the same data in studies on the welfare outcomes of commercial sealing. Upon investigation, this phenomenon appears to result from differing welfare criteria applied by the experts evaluating the data (Butterworth and Richardson, 2013). The lack of adherence to a common, accepted standard definition of humane slaughter in evaluation of welfare outcomes of commercial sealing is partially explained in Smith (2005), who explained that ‘hunting standards’ aim to, ‘produce recommendations that are realistic in the context of the hunt’ and stated that, ‘there needs to be a realistic balance between ideal procedure and methodology, and what is practical and achievable.’ In other words, it would appear that a lower standard of welfare is accepted for wild animals than would be for domestic species, because of the

practical considerations of killing free ranging animals in a field setting.

23.5.2 Bowhunting

Pedersen et al. (2008) evaluated shot accuracy of bowhunters who used modern archery equipment in a managed white-tailed deer-hunting program that had been carried out for more than 18 years in Maryland, USA. The authors used data sheet summaries from the 1989–2006 hunting seasons to produce their calculations, and every bowhunter who submitted a data sheet was assumed to have hunted during that season. Despite the fact that the bowhunters were required to have carried out an International Bowhunter Education Program and to have passed an annual pre-season shooting proficiency test, the study recorded an 18% loss rate, defined as wounded animals not recovered within 24 hours, as well as an apparent failure to hit their targets at all in 35% of cases. Specifically, of the 161 bowhunters who participated in the hunting program during 1989–2006, 104 bowhunters (65%) hit 908 deer and recovered only 746 of them within 24 hours.

Ditchkoff *et al.* (1998) studied white-tailed deer hunting with traditional archery equipment (recurve and longbows) in Oklahoma during 1995–1997. The authors captured and affixed radio collars to 80 male white-tailed deer to ascertain wounding rates. Of the 22 deer that were hit, 50% were wounded (defined as animals struck with an arrow and not retrieved) (Figure 23.3). Two of the shot deer died within 24 hours of wounding, but a third deer survived 7 days before succumbing to his wounds. This study noted that the 50% wounding rate found was similar to findings of other studies including the 50% wounding rate reported in Downing (1971) and Boydston and Gore (1987) in Georgia and Texas respectively. Other studies also report high wounding rates, including 44% in Georgia (Croft, 1963), 58% in Indiana (Stormer *et al.*, 1979), 55% in New Jersey (Lohfield, 1980), 31–37% in Wisconsin (Herron, 1984), 48% in South Dakota (McPhillips *et al.*, 1985) and 43% in Michigan (Langenau, 1986). Krueger (1995) interviewed more than 6000 hunters who took part in two-day archery deer hunts in Minnesota in 1992 and 1993. The hunters were asked the location of their hunt, whether they had shot any deer, if they had hit but not recovered deer, and how many wounded deer they had seen. The study reveals a staggering 27.7% ‘struck and lost’ rate (hunters that shot deer but did not personally retrieve them).

In 2016, staff of Humane Society International/Canada reviewed videos posted on YouTube of bear hunting in Alberta and retrieved video material,



Fig 23.3. A deer with an arrow embedded in its face was spotted in New Jersey for more than a week in November 2013 before receiving help from Fish and Wildlife officials. (Image credit: Susan Darrah).

through use of search terms including ‘bear hunt Alberta’, ‘trophy hunt black bears Alberta’ and ‘crossbow bear hunt Alberta.’ The 100 videos analysed showed 136 bear kills, of which 40 of the animals were killed with rifles, one animal was killed with a spear and 95 were killed using crossbows or bows and arrows. In 134 cases (98.5% of animals struck), the animal was wounded and did not die instantly. Many of these wounded animals were left for extended periods of time (overnight in a number of cases) and most were found dozens of meters or more from the site of impact. In just two cases, the animal collapsed without further movement and, in both cases, the animals were killed with rifles. However, no tests for unconsciousness were performed on camera in either case so there is no way to determine if the animal was indeed rendered unconscious or dead. The fact that hunters voluntarily posted these videos for public viewing suggests they did not view their hunting methods negatively.

23.6 Evolving Societal Views on Recreational Hunting

In July 2015, an American trophy hunter named Walter Palmer killed a beloved 13-year-old lion known as Cecil, who lived in the Hwange National Park in Zimbabwe. Mr Palmer, a dentist from Minnesota, reportedly paid \$54,000 USD for the privilege of bow-hunting the lion. He hit Cecil with an arrow on a farm located outside the park and then tracked the animal for 11 hours before ‘finishing him off’. The story of Cecil’s death was reported around the world, sparking vocal public outrage and condemnation of Mr Palmer. In response to public pressure, some nations took measures to restrict trade in lion trophies, the United States (the largest importer of lion trophies) added new protection for lions, and dozens of international airlines prohibited transport of trophies from lions, rhino, elephants, leopards, and Cape buffalo (Actman, 2016).

Perhaps the most significant outcome of this tragedy was the public discourse that resulted on the practice of trophy hunting. As the global debate on the ethics of hunting animals for sport continued, public support for the practice appears to have waned. Public opinion polls conducted in the United States and Canada in the wake of the killing of Cecil showed high levels of opposition to recreational hunting, with a strong majority of

Americans (86%) specifically opposing big game hunting (Marist, 2015). Surveys in Canada showed even higher levels of opposition to recreational/trophy hunting, with 91% of residents in British Columbia and 84% of Albertans disapproving of the practice (Insights West, 2015).

Historically, any perceived negative impact of recreational hunts has been viewed almost exclusively in terms of conservation. However, mounting evidence of animal suffering in wildlife hunts, paired with the advent of social media platforms that are driving global scrutiny of the topic, has created a public dialogue about the impacts of sport hunting on individual animals. Indeed, there is evidence that a broad cross-section of people now question whether wild animals should be hunted at all for sport.

It is likely that shifting social views on wildlife hunting will result in more regulatory restrictions on trophy hunts and certain practices in trophy hunts that are generally condemned. At the very least, it should serve as the basis for more objective study of the welfare outcomes of wildlife hunts, including standardized metrics for evaluation. Moreover, as a matter of urgency, wildlife hunting regulations should be enhanced to include humane killing requirements that reflect recognized veterinary and welfare science and the physiological characteristics of the animals rather than the convenience of the individuals targeting the animals for sport.

Bibliography

- Actman, J. (2016) Cecil the Lion Died One Year Ago—Here's What's Happened Since. Available at: <http://news.nationalgeographic.com/2016/06/cecil-african-lion-anniversary-death-trophy-hunting-zimbabwe/> (accessed 24 October 2017).
- Aebischer, N.J., Wheatley, C.J. and Rose, H.R. (2014) Factors associated with shooting accuracy and wounding rate of four managed wild deer species in the UK, based on anonymous field records from deer stalkers. *PLOS ONE*, 9(10), e109698. DOI:10.1371/journal.pone.0109698
- Bateson, P. and Brandshaw, E.L. (1997) Physiological effects of hunting red deer (*Cervus elaphus*). *Proceedings of the Royal Society of London B* 264: 1707–1714.
- Bateson, P. and Bradshaw, E.L. (2000) The effect of wound site and blood collection method on biochemical measures obtained from wild, free-ranging red deer (*Cervus elaphus*) shot by rifle. *Journal of Zoology (London)* 252:285–292.
- Beausoleil, N.J. and Mellor, D.J. (2014) Advantages and limitations of the Five Domains model for assessing welfare impacts associated with vertebrate pest control. *New Zealand Veterinary Journal* 62: 1–17.
- Boydston, G.A. and Gore, H. (1987) Archery wounding rates: a synopsis. Page 77 in: Harlow, R.F. and Guynn, D.C. Jr (eds). *Southeast Deer Study Group Annotated Bibliography, 1977 to 1990*. The Samuel Roberts Noble Foundation, Ardmore, Oklahoma.
- Burdon, R.L., Gripper, J., Longair, J.A., Robinson, I., Ruehlmann, D. (2001) Veterinary report Canadian Commercial Seal Hunt Prince Edward Island. Available at: https://www.harpseals.org/about_the_hunt/ifaw_vet_report_2001.pdf (accessed 27 July 2018).
- Butterworth, A. and Richardson, M. (2013) A review of animal welfare implications of the Canadian commercial seal hunt. *Marine Policy* 38, 457–469. DOI:10.1016/j.marpol.2012.07.006
- Butterworth, A., Gallego, P., Gregory, N., Harris, S. and Soulsbury, C. (2007) Welfare aspects of the Canadian seal hunt: preliminary report, 30 p. and final report, 45 p. Document submitted to the EFSA Panel on Animal Health and Welfare and cited in <http://www.efsa.europa.eu/en/scdocs/doc/610.pdf> (accessed 9 June 2018).
- Croft, R.L. (1963) A survey of Georgia bowhunters. *Proceedings of the Southeast Association of Game and Fish Commissioners* 17, 155–163.
- Daoust, P.Y., Crook, A., Trent, K., Bollinger, T.K., Campbell, K.G. and Wong, J. (2002) Animal welfare and the harp seal hunt in Atlantic Canada. *Canadian Veterinary Journal* 43, 687–94.
- Ditchkoff, S.S., Welch, E.R. Jr., Lochmiller, R.L., Masters, R.E. Starry, W.R. and Dinkines, W.C. (1998) Wounding rates of white-tailed deer with traditional archery equipment. *Proceedings of the Southeastern Association of Fish and Wildlife Agencies* 52, 244–248.
- Downing, R.L. (1971) Comparison of crippling rates of white-tailed deer caused by archery, buckshot, and shotgun slugs. *Proceedings of the Annual Conference of the Southeast. Association of the Game and Fish Commissioners* 25, 77–82.
- EFSA (2007) Scientific Opinion of the Panel on Animal Health and Welfare on a request from the Commission on the Animal Welfare aspects of the killing and skinning of seals. *The EFSA Journal* (2007) 610, 1–122. Available at: <http://www.efsa.europa.eu/en/scdocs/doc/610.pdf> (accessed 1 March 2018).
- Elder, W.H. (1955a) Fluoroscopic measurements of shooting pressure on Pink-footed and Greylag geese. *Wildfowl Trust Annual Report* 7, 123–126.
- Elder, W.H. (1955b) Fluoroscopic measures of hunting pressure in Europe and North America. *Transactions of the 20th North American Wildlife Conference*, March 1955, Montreal, 298–321.
- Falk, K., Merkel, F., Kampp, K. and Jamieson, S.E. (2006) Embedded lead shot and infliction rates in common eiders (*Somateria mollissima*) and king

- eiders (*S. spectabilis*) wintering in Southwest Greenland. *Wildlife Biology* 12, 257–265.
- Federal, Provincial, and Territorial Governments of Canada. (2012) 2012 Canadian Nature Survey: Awareness, participation and expenditures in nature-based recreation, conservation, and subsistence activities. Available at: http://www.biodivcanada.ca/2A0569A9-77BE-4E16-B2A4-C0A64C2B9843/2012_Canadian_Nature_Survey_Report%28accessible_opt%29.pdf Page 30 (accessed 9 June 2018).
- Grebot, C., Burtheret, A.J. (2007) Effects of temperature changes on the mechanical and ballistic responses in biathlon shooting. *Journal of Applied Mechanics* 74, 1037. Available at: <http://dx.doi.org/10.1115/1.2712229> (accessed 9 June 2018).
- Grieb, J.R. (1970) The shortgrass prairie Canada goose population. *Wildlife Monographs* 22, 1–47.
- Government of Canada. (1985) Meat Inspection Act (R.S.C., 1985, c. 25 (1st Supp.)). Available at: <http://laws-lois.justice.gc.ca/eng/acts/M-3.2/> (accessed 1 March 2018)
- Hampton *et al.* (2014) Quantitative analysis of animal-welfare outcomes in helicopter shooting: a case study with feral dromedary camels (*Camelus dromedarius*). *Wildlife Research* 41 (2), 127–135.
- Hampton, J.O., Forsyth, D.M. and Mackenzie, D.I. (2015) A simple quantitative method for assessing animal welfare outcomes in terrestrial wildlife shooting: the European rabbit as a case study. *Animal Welfare* 24(3), 307–17.
- Herron, J.S.C. (1984) Deer harvest and wounding loss associated with bowhunting whitetailed deer. M.S. Thesis, Univ. Wise, Madison. 35pp.
- Hicklin, P.W. and Barrow, W.R. (2004) The incidence of embedded shot in waterfowl in Atlantic Canada and Hudson strait. *Waterbirds* 27, 41–45.
- IFAW (2016) Trophy Hunting. Available at: https://s3.amazonaws.com/ifaw-pantheon/sites/default/files/legacy/IFAW_TrophyHuntingReport_US_v2.pdf (accessed 27 July 2018).
- Insights West (2015) British Columbians and Albertans Condemn Trophy Hunting. Available at: <http://insightswest.com/news/british-columbians-and-albertans-condemn-trophy-hunting/> (accessed 24 October 2017).
- Insights West (2017) Survey on Trophy Hunting in Canada – February 15, 2017. Available at: http://www.insightswest.com/wp-content/uploads/2017/02/BTH_Canada_Tables.pdf. (accessed 24 October 2017).
- Jönsson, B., Karlsson, J. and Svensson, S. (1985) Incidence of lead shot in tissues of the bean goose (*Anser fabalis*) wintering in South Sweden. *Swedish Wildlife Research*, 13, 259–271.
- Knudsen, S.K. (2005) A review of the criteria used to assess insensibility and death in hunted whales compared to other species. *Veterinary Journal* 169, 42–59. DOI:10.1016/j.tvjl.2004.02.007
- Krueger W.J. (1995) *Aspects of Wounding of White-tailed Deer by Bowhunters*. West Virginia University Press, Morgantown, pp236.
- Langenau, E.E., Jr. (1986) Factors associated with hunter retrieval of deer hit by arrows and shotgun slugs. *Leisure Science* 8, 417–438.
- Leary, S., Underwood, W., Anthony, R., Cartner, S., Corey, D. *et al.* (2013) *AVMA Guidelines for the Euthanasia of Animals*, 2013 Edition. American Veterinary Medical Association, Schaumburg, Illinois.
- Littin K.E. (2010) Animal welfare and pest control: Meeting both conservation and animal welfare goals, *Animal Welfare*, vol. 19, No. 2 (pp. 171–176).
- Littin, K., Fisher, P., Beausoleil, N.J. and Sharp, T. (2014) Welfare aspects of vertebrate pest control and culling: ranking control techniques for humaneness. *Revue Scientifique et Technique International Office of Epizootics* 33, 281–9.
- Lohfield, M.L. (1980) Crippling losses and illegal kill of white-tailed deer (*Odocoileus virginianus*) during a controlled hunt in a New Jersey state park. M.S. Thesis, Rutgers University, New Brunswick, New Jersey 25pp.
- Lucky Buck (2016) State Deer Baiting Regulations. Available at: <http://lucky-buck.com/state-regulation-list-baiting-feeding> (accessed 1 March 2018).
- Malouf, A. (1986) *Seals and Sealing in Canada. Report of the Royal Commission*. Canadian Government Publication Centre, Ottawa, Canada. 27pp.
- Marist Poll (2015) Sport Hunting. Available at: <http://marist-poll.marist.edu/1124-americans-oppose-big-game-hunting-more-than-six-in-ten-favor-legal-ban/> (accessed 27 July 2018).
- McPhillips, K.B., Linder, R.L. and Wentz, W.A. (1985) Nonreporting, success, and wounding by South Dakota deer bowhunters - 1981. *Wildlife Society Bulletin* 13, 395–398.
- Mellor, D.J. and Littin, K.E. (2004) Using science to support ethical decisions promoting humane livestock slaughter and vertebrate pest control. *Animal Welfare* 13 (Supplement), 127–32.
- Noer, H. and Madsen, J. (1996) Shotgun pellet loads and infliction rates in pink-footed goose (*Anser brachyrhynchus*). *Wildlife Biology* 2, 65–73.
- Noer, H., Madsen, J., Strandgaard, H. and Hartmann, P. (1996) *Anskydning Af Vildt* [Wounding of Game]. NERI Thematic Report no. 8. National Environmental Research Institute, Rønde, Denmark.
- Noer, H., Madsen, J. and Hartmann, P. (2007) Reducing wounding of game by shotgun hunting: effects of a Danish action plan on pink-footed geese. *Journal of Applied Ecology* 44, 653–662. DOI:10.1111/j.1365-2664.2007.01293.x
- Norman, F.I. (1976) The incidence of lead shotgun pellets in waterfowl (Anatidae and Rallidae) examined in South-Eastern Australia between 1957 and 1973. *Australian Wildlife Research* 3, 61–71.

- Paquet, P.C. and Darimont, C.T. (2010) Wildlife conservation and animal welfare: two sides of the same coin? *Animal Welfare* 19, 177–190.
- Pedersen, M.A., Bossart J.C. and Berry S.M. (2008) Wounding rates of whitetailed deer with modern archery equipment. *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies* 62, 31–34.
- Porter, L. (2016) Porter: Baiting for Bears Falls Within Code of Ethics July 30, 2016. Available at: http://www.omaha.com/outdoors/porter-baiting-for-bears-falls-within-code-of-ethics/article_a619fcdc-0b12-557c-84bc-50b575056905.html (accessed 01 March 2018).
- Sharp, T. and Saunders, G. (2011). *A Model for Assessing the Relative Humaneness of Pest Animal Control Methods*, Second Edition. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia.
- Smith, B.L. (2005) Improving Humane Practice at the Canadian Harp Seal Hunt: a Report of the Independent Veterinarians' Working Group on the Canadian Harp Seal Hunt. Available at: <http://www.thesealfishery.com/files/IWVGReportAug2005.pdf>. (accessed 01 March 2018).
- Stormer, F.A., Kirkpatrick, C.M. and Hoekstra, T.W. (1979) Hunter inflicted wounding of white-tailed deer. *Wildlife Society Bulletin* 7, 10–16.
- Warburton, B. and Norton, B.G. (2009) Towards a knowledge-based ethic for lethal control of nuisance wildlife. *Journal of Wildlife Management* 71, 158–164.
- Warburton, B., Tompkins, D., Choquenot, D. and Cowan, P. (2012) Minimising number killed in long-term vertebrate pest management programmes, and associated economic incentives. *Animal Welfare* 2012, 21(S1), 141–9.

24 Animal Watching in Tourism

TARYN GLASS AND DAVID A. FENNELL

24.1 Introduction

Tourism is a multibillion-dollar industry with global reach. It has impacts on the lives of local people, foreign tourists, land, landscape, and animals. It was not until the 1990s that ethics in tourism started to become a more prominent field (Fennell, 2006). This emerging field – tourism ethics – is a sign of hope for more ethical practices to become commonplace in the future. Animal welfare theory is commonly used to regulate animals in tourism because it posits that using animals for human enjoyment is acceptable. There is, however, still concern over an animal's quality of life (Fennell, 2013a). It is generally accepted that animals are sentient beings and thus should not be subjected to unnecessary suffering. This principle probably also serves the tourism sector well if it means that the animals are in good shape because tourists do not like seeing unhealthy animals (Fennell, 2013a).

Viewing animals as a tourism attraction occurs in a variety of settings, and Cohen (2012, pp. 194–195) proposes four classifications of wildlife tourism:

- **fully natural settings**, such as wilderness, jungles, or deserts, which are unframed, and in which animals are in no way restrained;
- **semi-natural settings**, such as national parks and wildlife sanctuaries, which are regulated and bounded to various degrees by the authorities, thus separated from the flow of ordinary life; but the animals remain unrestrained within their context;
- **semi-contrived settings**, such as zoos, aquariums, and animal theme parks, in which at least nominally wild but captured animals are kept in framed, contrived surroundings; while some simulate the animals' natural habitats, in others the animals are confined to narrow, restraining habitation which significantly constrains their ability to reproduce their natural behavior patterns; and
- **fully contrived settings**, such as establishments featuring animal performances and shows, in which captured animals, though they might remain wild, are trained, tamed, or humanized to varying degrees, mostly to enact behaviors which are not part of their natural repertoire.

These classifications will be referenced throughout the chapter in order to classify particular industries within tourism and how they treat animals.

The living conditions of animals are only one aspect of their welfare. Animals almost certainly need enrichment, some need companionship, others need solitude, and some can thrive within captivity while others do very poorly (Fig. 24.1). Welfare can be generalized across species in terms of the five freedoms: (i) freedom from hunger and thirst; (ii) freedom from discomfort; (iii) freedom from pain, injury, and disease; (iv) freedom from fear and distress; and (v) freedom to express natural behaviors. However, welfare also differs between species. For example, the welfare needs of killer whales are very different from the welfare needs of armadillos. Killer whales need companionship and without it their welfare appears to decrease. This has been the case for Kiska, a killer whale in solitude at Marineland in Niagara Falls, Canada. Armadillos need to be able to burrow, and without this Baird *et al.* (2016) found they often showed signs of poor welfare.

Viewing animals as a tourist destination takes many forms. Animals can be viewed in zoos, through ecotourism ventures, where contact with the animals can be advertised as 'up close and personal', and through thrill-seeking tourism. All of these provide tourists with a different experience of the animals they come into contact with. The effects on the animals also differ greatly across the multiple tourism sectors. This chapter is by no means a comprehensive overview of animals in tourism but seeks to inform readers of the multiple ways their actions affect animals used in the industry by discussing examples of animal use in

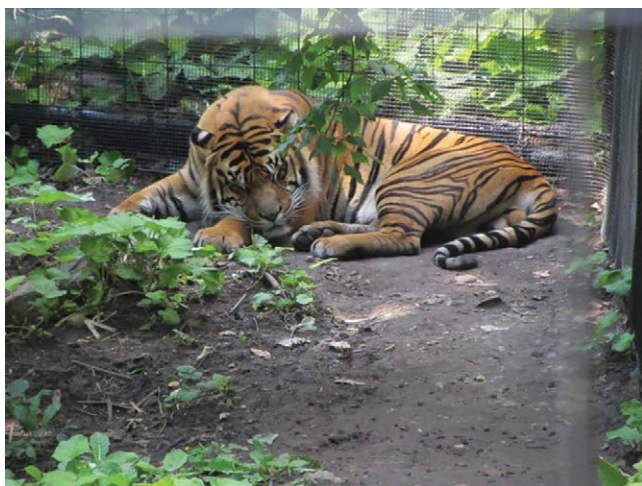


Fig. 24.1. Tiger sleeping in its cage at the Toronto Zoo, Canada. (Image credit: David Fennell.)

tourism (for a more comprehensive overview see Fennell, 2012b).

24.2 Zoos

The concept of confining wild animals for human enjoyment has existed for thousands of years. Chinese and Aztec emperors held private menageries since the 15th century BCE (Fennell, 2012b, p. 70), and keeping animals as a personal collection was a sign of high status and power (Jamieson, 1985; Agoramoorthy and Hsu, 2005; Fennell, 2012b). These menageries were usually for personal enjoyment and were not used as educational venues until the 16th century when the emperor of the Zhou dynasty opened up his personal collection to the public (Fennell, 2012b). The modern zoo has become a popular tourist attraction all around the world. According to the Association of Zoos and Aquariums (2017) their 230 institutions are visited by more than 183 million people every year.

The capture of animals for zoos is ethically questionable. In the late 19th century the most cost-effective way to obtain animals was to shoot the adults and round up the young. The loss of multiple individual lives for the accumulation of a few was acceptable because the animals were only thought of as a 'collective species' where the capacity to view a small number of animals overwhelmed concerns over those lost in the process (Chrulaw, 2011). Capturing animals and removing them from their natural habitat undoubtedly causes them a lot of stress (Keulartz, 2015). International animal dealer, Jean-Yves Domalain estimated that only around

one in ten wild-caught animals survived to make it to the zoo (Fennell, 2012b, p. 73). More recently, transport standards created by the World Association of Zoos and Aquariums and Convention on International Trade in Endangered Species of Wild Fauna and Flora aim to ensure that welfare standards are being met during capture and transport (these can be found on their websites: www.waza.org and www.cites.org ; both accessed 9 March 2018).

Capturing and holding animals in an unnatural captive environment for the sake of human pleasure and education have multiple dimensions, and are viewed in different ways by different people. Zoos pride themselves as being places for learning, building empathy towards animals, and conservation, and visitors are able to view species from all around the world. Ryan and Saward (2004) found that most tourists went to the zoo as a family outing, not specifically for educational purposes. But how educational is viewing an animal in its unnatural habitat? Animals in zoos sometimes display unnatural stereotypic behaviors (Cohen, 2012). Sometimes they are even forced to perform in shows doing tricks for the audience (Agoramoorthy and Hsu, 2005; Cohen, 2012; Laidlaw, 2014; Markwell, 2015). Most of the education comes from reading plaques outside cages or talking to a park employee. However, when researching what features of zoos were important to tourists, educational signs were ranked 25 out of 38 in a listing of features of zoos (Ryan and Saward, 2004). Looking at the animal in this environment will not teach you about much more than their appearance, and allow you to see some of their behaviors.

Captive breeding programs are a part of zoos' contribution to conservation efforts, although these efforts have sometimes been controversial. Critics have argued that the large sums of money spent on captive breeding programs could and should go towards preservation of natural habitat instead (Cohn, 1988; Gippoliti and Carpaneto, 1997). Others have pointed out that only a select few of the possible large number of endangered species are selected for breeding programs, and that many of the animals that are successfully bred in zoos, remain in zoos. However, there have been some success stories with captive breeding. The bearded vulture (Gippoliti and Carpaneto, 1997, p. 807), fallow deer (Braverman, 2013), Mongolian wild horse and European bison (Jamieson, 1985) have all been saved from elimination in the wild.

Zoo animals are subjected to constant human gaze. Their enclosures are usually designed for maximum human-viewing pleasure and offer few, if any, hiding spaces for the animals. Swaisgood found that 'startle or defense response, avoidance, suppression of feeding and sexual behavior, aggression, stereotypic behavior, lack of responsiveness or apathy, decreased complexity of behavior, and the time required to resume normal activity after a stressor' were all signs of stress in zoo animals resulting in poor welfare (Swaisgood, 2007, p. 141). This can be very unsettling, and for animals that become ill or hurt while at the zoo, this constant human gaze may cost them their life. Stemming out of evolutionary pressures, injured or sick animals will mask illness, and not allow any potential predators to know they are weak or compromised (Hill and Broom, 2009). Hill and Broom found that multiple veterinarians and zookeepers knew of animals that appeared healthy one day and were dead the next (Hill and Broom, 2009, p. 535). This evolutionary trait of hiding and masking pain or sickness may benefit an animal in the wild, but in the zoo, animal behavior cannot always be trusted as the only sign of good health or welfare. Barber (2009) suggests that just as we look for the negative signs of welfare, we should also look for the positive. This could be exhibited in frequent play behavior, sexual behavior, and sociality – although Barber warns that these signs have yet to be scientifically proven as the best signs for positive animal welfare (Barber, 2009, pp. 525–526).

Stereotypic behavior can develop among zoo animals and is a sign of poor welfare. Stereotypies can include pacing, bar licking, swaying, head

nodding, wind sucking, repetitive cycles of climbing (Fig. 24.2), spinning, and other repetitive behavior (Clubb and Mason, 2003; Swaisgood, 2007; Cohen, 2012; Fennell, 2012a, b; Whitham and Wielebnowski, 2013; Laidlaw, 2014; Keulartz, 2015; Markwell, 2015; Baird *et al.*, 2016). According to Clubb and Mason (2003) carnivorous animals who naturally have a large home range were most likely to exhibit stereotypies within zoos. Their findings show that animals with a large home range are more likely to suffer the effects of restriction within captivity. To get an idea of how small the average zoo enclosures are compared with a natural home range, a polar bear's minimum home-range size is 1 million times larger than its typical zoo enclosure (Clubb and Mason, 2003, p. 473). Small enclosure sizes, lack of enrichment, inescapable negative interactions between other animals in the enclosure, and environmental stressors can all contribute to poor welfare for zoo animals.

24.3 Ecotourism

Ecotourism developed as an alternative to mass tourism with a focus on sustainability and appreciation for the environment. Fennell (2015) found that its origins are difficult to pinpoint as it may have first developed as a 'concept' within the literature before its practice by tourism operators, and so the 'inception' of this term is debated within the field. Despite its uncertain origins, this form of tourism has many defining features. There is a continuum within ecotourism that encompasses both soft and hard forms. Soft ecotourism has a utilitarian



Fig. 24.2. Monkey holding onto cage bars at 'Zooz', Canada. (Image credit: David Fennell.)

reasoning, and is business oriented. Hard ecotourism is focused on sustainability, responsible tourism and conservation of nature (Fennell, 2015). Hard ecotourism is cognizant of its impacts on the environment and is designed to have the least amount of negative impact possible in order to preserve ecosystems, benefit local communities, and ethically utilize natural resources. Tourists who choose to participate in ecotourism have diverse backgrounds and may be travelling for the specific purpose of being an ecotourist or may just happenstance become one while travelling. Their motivations will determine how they value and respect the environment they are in.

Wildlife viewing is a very popular form of ecotourism and according to Gallagher *et al.* it is one of the most profitable (Gallagher *et al.*, 2015, p. 366). Tourism ventures such as whale watching, gorilla trekking, birdwatching, and other non-invasive practices are

not usually associated with negative welfare concerns; however, unfortunately tourism almost always has some sort of repercussions. Whale watching is a popular ecotourism activity with 119 countries and territories offering it in 2008 and 13 million people participating (O'Connor *et al.*, 2009, p. 23). The industry has, to some degree, developed as a profitable alternative to whaling. According to Fennell an increase in boat activity and boat noise has led to an increase in whales beaching on shore (Fennell, 2012b, p. 210). Ecotourism, along with the tourism industry as a whole, is continually changing due to new research on animal ethics.

The popularity of safari parks in Africa, and to a lesser extent Asia, has grown significantly since they were first opened up as a tourist destination. Tourists are taken out in jeeps or buses and driven around the park in hopes of seeing some of the large and charismatic animals (Fig. 24.3) – the African



Fig. 24.3. An elephant being watched by tourists in jeeps on a safari at Lake Manyara National Park, Tanzania. (Image credit: David Fennell.)

‘big five’ (African lion, African elephant, Cape buffalo, African leopard, rhinoceros), and the sometimes listed equivalent, the Asian ‘big five’ (Bengal tiger, Asiatic lion, Indian elephant, one-horned rhinoceros, water buffalo). Unfortunately, some game parks have come under public scrutiny for allowing so many tourists to be on the ground at once. In Asia, when a tiger is spotted within a park, jeeps often swarm the animal causing unneeded stress and altered behavior (Cohen, 2012, p. 197). In one case this resulted in a tourist getting seriously injured in a tiger attack (Cohen, 2012, p. 198). There have also been reports of tourism operators baiting the wildlife and fitting them with trackers to ensure tourists get to see all the animals (Cohen, 2012, p. 197; Hayward *et al.*, 2012). Operators have also been accused of taking tourists on illegal night safaris (Cohen, 2012). Night-time is normally a period of high activity for predators and principles of ethical management would support the view they are not to be disturbed while hunting. These locations may make claims to support conservation first and tourism second, but, as with any form of tourism, if this is not properly monitored it can become unsustainable, damaging both the animal and the human experience, and have negative consequences for animal well-being.

Operating within the neo-liberal capitalist system that is spreading through globalization, ecotourism serves as an alternative way to profit from unique ecosystems, nature, and animals. The two aspects of ecotourism can work in tandem – producing profit, while also working alongside conservationists to conserve and preserve the environment. Although ecotourism has proven to have some negative impacts on animal welfare, this alternative form of tourism may be better for animal welfare when compared with more mainstream and mass-tourism forms. Perhaps a defining characteristic of a true ‘ecotourist’ destination would be that each animal has the ability to leave any interaction on its own terms, and at any time (Fennell, 2013b). This could be used as a ‘prime principle’ and as a defining criterion for animal welfare and animal–human interactions in ecotourist destinations.

24.4 Intimate Animal Attractions

Tourists may gain tremendous satisfaction by having the opportunity to interact closely with animals. How ‘close animal interaction’ interfaces with a tourist’s personal moral code is a question of some

significance. ‘Once in a lifetime’ opportunities are capitalized on by tourism business, and it is only after a period of self-reflection that the tourist may revisit what they have done or seen, and questions *may* emerge about the moral praiseworthiness of these actions (Curtin and Wilkes, 2007).

Some interactions with animals can be detrimental to an animal’s well-being. Animals used as ‘photo opportunity’ models for tourists can be victims of coercive techniques such as full or partial sedation, physical restraint, physical abuse, and withholding food to control behavior (Agoramoorthy and Hsu, 2005; Cohen, 2012, 2013). Many animals are forced to entertain people by performing unnatural tricks. This can even happen within licensed environments such as zoos and parks, or in informal environments like on the street or at coffee shops or restaurants. It can be dangerous for animals to be used in this ‘ad hoc’ way as entertainment with no oversight by the government or animal welfare agencies. This was of concern to Agoramoorthy and Hsu who found that the numbers of non-human primates being used for entertainment in South-east Asia by private owners were on the rise (Agoramoorthy and Hsu, 2005, p. 142). However, a licensed environment does not necessarily ensure better welfare conditions for the animals being used. Many zoos, aquariums, and animal attractions have been sites of abuse despite having welfare standards in place (Agoramoorthy and Hsu, 2005). The infamous Tiger Temple in Thailand has been under scrutiny for a number of years about alleged cruelty and sedation of their tigers during photo opportunities and visitor interaction despite being run by Buddhist monks (Cohen, 2012, 2013). Public pressure, often resulting from public attention and journalistic interest in specific animal cases, has proven to be an instrumental tool which has resulted in animal attractions progressively adopting better welfare standards, and also a mechanism which has resulted in legislative change, or more attentive action to enforce existing regulations.

Swimming with dolphins is a popular tourist attraction that is available in both contrived, and also in natural settings. Swimming with dolphins in a fully or partially contrived environment is predominantly done at zoos, aquariums, and resorts where the dolphins are housed (Fig. 24.4). Dolphins in this setting are often trained to entertain the tourists by posing for pictures, performing tricks, and giving tourists rides in the pool. These animals are, in general, not performing natural behaviors as



Fig. 24.4. Dolphins performing a rehearsed routine with their trainer for the audience at Marineland, Canada. (Image credit: David Fennell.)

part of the ‘swim with dolphin’ activity, and carry out this activity as part of their confinement. In natural settings tourists take boat rides in hopes of finding dolphins in the ocean. If tourists are able to find dolphins in their natural habitat, they suit up in wetsuits and swim alongside them (Besio *et al.*, 2008). In such cases, the dolphins are able to remove themselves from the interaction if they wish to do so, or they can interact with the tourists while swimming. In both cases tourists are able to swim and interact in close quarters with dolphins.

For swimming with dolphins in an ecotourism destination the focus is on using the animals in a sustainable way with the least amount of negative impact. However, some operators offer tourists the chance to hand-feed wild dolphins which, in the long term, has many negative impacts on their well-being by introducing a degree of human dependency, and increased boat activity and disturbance (Orams, 2002; Garrod and Fennell, 2004; Bulbeck, 2005; Bach and Burton, 2017). Bach and Burton found that hand-feeding dolphins caused changes in vocalization, feeding and resting patterns, social behavior, foraging behaviors, a decrease in calf survival rates, aggression, and increased dependence (Bach and Burton, 2017, p. 182). Even with a lack of provisioned feeding, the interaction between

humans and dolphins may also decrease dolphin well-being through interruption of established patterns of behavior (Macbeth, 2012; Wiener, 2015). It may therefore be important for tourists to know the potential repercussions their actions may have on the species they choose to ‘interact closely’ with.

Interacting with animals can be a rewarding and authentic experience if the animal’s welfare is considered. When an animal is forced to perform for the entertainment of humans in a fully contrived setting it can cause unneeded harm to the animal. In light of this, fully natural tourism ventures, where the animals can live freely and disengage with tourists at any time, allow for the animals to make decisions based on their own needs. There are, of course, adverse effects still associated with this kind of tourism but it is generally accepted that ecotourism, where animals are ‘as a prime driver’ given the ‘option to disengage’, is more likely to be humane than mass-tourism destinations.

24.5 Thrill-seeking Tourism – Shark Diving

Thrill seeking is one of the four main categories of sensation-seeking tourism according to Zuckerman’s Sensation Seeking Scale (Gibson, 1996). Tourists

travel to destinations and partake in activities that elevate fear and novelty. Shark diving is an example of thrill-seeking tourism as tourists are taken to within close proximity of species of shark that could kill the tourist if safety measures failed. Sharks have become associated with danger, with, for example, the famous movie *Jaws* (Spielberg, 1975) cementing this narrative (Dobson, 2006). It is of no surprise that shark diving has become a popular tourism attraction for thrill seekers.

Shark diving occurs in roughly 85 countries and attracts half a million tourists each year (Gallagher *et al.*, 2015). Huveneers *et al.* (2013) researched the effects of shark cage-diving operators that use provisioning (feeding, use of ‘chum’ – food) in the Neptune Islands off the coast of Australia on great white shark (*Carcharodon carcharias*) behavior and space use. They found that sharks swam at slower speeds, stayed in a smaller area, and swam closer to the surface when shark cage-diving operators were present. This could result in decreased ‘survival fitness’ of the sharks as they foraged less since they had access to food from the operators – although legally the operators must remove the food before the shark eats it, sometimes the operators are not fast enough. However, these findings do not speak for all great white sharks, as some individuals consistently stayed far away from the ‘cage-diving’ operation. Gallagher *et al.* (2015) found that scuba-diving tourists caused resting sharks stress when at a distance of 3 m. Some tour operators put sharks into a state of ‘tonic immobility’ for tourists by rubbing the shark’s snout, where sensory pores are located, but there is speculation that this has adverse effects on the shark, thus the authors argue for the practice to stop until more research has been done.

There are, conversely, some positive aspects of shark-diving tourism that contribute to conservation efforts. Kathy Xu (www.thedorsaleffect.com; accessed 9 March 2018) created The Dorsal Effect, an ecotourism activity and social enterprise that turns shark-fishing boats into shark-diving boats. Xu recognized the need to help shark conservation efforts and the need for locals to generate an income. This project married the two enterprises together (fishing boat activity, but with a new focus on shark diving), and this also had an effect on shark conservation by decreasing the number of fishermen selling shark fins (Tan, 2014). Huveneers *et al.* (2013) argue that dangerous animals may benefit more from wildlife tourism because it helps

to de-stigmatize these animals. This is further supported by Gore *et al.* (2011) who cited public misconception of a species as a major factor inhibiting their conservation. In light of this, Gallagher *et al.* (2015) argued that ecotourism sites create a de facto conservation area for sharks since the activity generates so much income, and so there is motivation to protect (and so conserve) the animals in this area. However, there is a hidden risk for any area in which rare or valuable animals are known to present – illegal fishermen, who know that sharks frequent the area, may target shark tourism locations.

24.6 Conclusions

Animals are used in a myriad of ways within tourism whether directly or indirectly. They are showcased in fully contrived, semi-contrived, semi-natural, and fully natural settings. All of these different forms of viewing animals can have impacts on animal welfare. Some impacts are more significant and noticeable, particularly in zoos and aquariums where the effects may be more immediately apparent, whereas, for example, in destinations or activities which aim to represent ecotourism, these effects may be more subtle. Whenever animals are being used or may be affected, tourism operators should be knowledgeable about their welfare needs. Many authors have found that there was no code of ethics for the animals used within the sectors they reported on (Fennell, 2012b, 2014; Gallagher *et al.*, 2015). A code of ethics would outline the welfare concerns for the species in question and give operators guidelines on how to proceed with their operations. Moving forward, there almost certainly needs to be more research done on animal welfare within tourism studies to help create substantive, species-specific codes of ethics for the industry.

Tourism, like any other business sector, is an industry that seeks to make profit. Shani and Pizam (2008) encourage tourism operators to adopt an open and transparent policy for operations concerning animals. Local legislation, public pressure, and continued research on animal welfare requirements and outcomes are needed to help the tourism sector make informed decisions and there are signs of the industry slowly changing. Trip Advisor announced in 2016 they would stop selling tickets to inhumane animal attractions (Bale, 2016). The Ringling Brothers and Barnum & Bailey, a popular circus operator in the USA, announced in 2015

they would stop using elephants in their shows by 2018, but, by 2017 they have already retired the elephants to the Center for Elephant Conservation owned by their parent company (Grush, 2016). Matador Network listed animal welfare as one of the criteria for choosing the top ten ethical destinations of 2017 (Hershberger, 2017). Stimulated by such changes, new theories, approaches, and practices are required to educate tourists, service providers, and governments about the specific welfare needs of the animals in their spheres of influence.

References

- Agoramoorthy, G. and Hsu, M.J. (2005) Use of nonhuman primates in entertainment in Southeast Asia. *Journal of Applied Animal Welfare Science* 8(2), 141–149.
- Association of Zoos and Aquariums (2017) About Us. Available at: <https://www.aza.org/about-us> (accessed 30 May 2017).
- Bach, L. and Burton, M. (2017) Proximity and animal welfare in the context of tourist interactions with habituated dolphins. *Journal of Sustainable Tourism* 25(2), 181–197.
- Baird, B.A., Kuhar, C.W., Lukas, K.E., Amendolagine, L.A., Fuller, G.A. et al. (2016) Program animal welfare: using behavioral and physiological measures to assess the well-being of animals used for education programs in zoos. *Applied Animal Behaviour Science* 176, 150–162.
- Bale, R. (2016) Trip Advisor Halts Ticket Sales to Cruel Wildlife Attractions. Available at: <http://news.nationalgeographic.com/2016/10/wildlife-watch-tripadvisor-animal-tourism-ticket-sales/> (accessed 30 May 2017).
- Barber, J.C.E. (2009) Programmatic approaches to assessing and improving animal welfare in zoos and aquariums. *Zoo Biology* 28, 519–530.
- Besio, K., Johnston, L. and Longhurst, R. (2008) Sexy beasts and devoted mums: narrating nature through dolphin tourism. *Environment and Planning* 40, 1219–1234.
- Braverman, I. (2013) Animal frontiers: a tale of three zoos in Israel/Palestine. *Cultural Critique* 85, 122–162.
- Bulbeck, C. (2005) *Facing the Wild: Ecotourism, Conservation and Animal Encounters*. Earthscan, London.
- Chrulew, M. (2011) Managing love and death at the zoo: the biopolitics of endangered species preservation. *Australian Humanities Review* 50, 137–157.
- Clubb, R. and Mason, G. (2003) Captivity effects on wide-ranging carnivores: animals that roam over a large territory in the wild do not take kindly to being confined. *Nature* 425, 473–474.
- Cohen, E. (2012) Tiger tourism: from shooting to petting. *Tourism Recreation Research* 37(3), 193–204.
- Cohen, E. (2013) 'Buddhist compassion' and 'animal abuse' in Thailand's Tiger Temple. *Society & Animals* 21, 266–283.
- Cohn, J.P. (1988) Captive breeding for conservation. *BioScience* 38(5), 312–316.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (n.d.) Available at: www.cites.org (accessed 9 March 2018).
- Curtin, S. and Wilkes, K. (2007) Swimming with captive dolphins: current debates and post-experience dissonance. *International Journal of Tourism Research* 9(2), 131–146.
- Dobson, J. (2006) Sharks, wildlife tourism, and state regulation. *Tourism in Marine Environments* 3(1), 15–23.
- Fennell, D.A. (2006) *Tourism Ethics*. Channel View Publications, Bristol, UK.
- Fennell, D.A. (2012a) Tourism, animals and utilitarianism. *Tourism Recreation Research* 37(3), 239–249.
- Fennell, D.A. (2012b) *Contemporary Geographies of Leisure, Tourism and Mobility: Tourism and Animal Ethics*. Routledge, New York.
- Fennell, D.A. (2013a) Tourism and animal welfare. *Tourism Recreation Research* 38(3), 1–16.
- Fennell, D.A. (2013b) Contesting the zoo as a setting for ecotourism, and the design of a first principle. *Journal of Ecotourism* 12(1), 1–14.
- Fennell, D.A. (2014) Exploring the boundaries of a new moral order for tourism's global code of ethics: an opinion piece on the position of animals in the tourism industry. *Journal of Sustainable Tourism* 22(7), 983–996.
- Fennell, D.A. (2015) *Ecotourism*, 4th edn. Routledge, New York.
- Gallagher, A.J., Vianna, G.M.S., Papastamatiou, Y.P., Macdonald, C., Guttridge, T.L. and Hammerschlag, N. (2015) Biological effects, conservation potential, and research priorities of shark diving tourism. *Biological Conservation* 184, 365–379.
- Garrod, B. and Fennell, D.A. (2004) An analysis of whalewatching codes of conduct. *Annals of Tourism Research* 30(2), 334–352.
- Gibson, H.J. (1996) Thrill seeking vacations: a life span perspective. *Society and Leisure* 19(2), 439–458.
- Gippoliti, S. and Carpaneto, G.M. (1997) Captive breeding, zoos, and good sense. *Conservation Biology* 11(3), 806–807.
- Gore, M.L., Muter, B.A., Lapinski, M.K., Neuberger, L. and Van Der Heide, B. (2011) Risk frames on shark diving websites: implications for global shark conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems* 21, 165–172.
- Grush, L. (2016) Ringling Brothers' Elephants Are Headed for Early Retirement. Available at: <http://www.theverge.com/2016/1/11/10750390/circus-elephants-retire-conservation-center-cancer-research> (accessed 30 May 2017).

- Hayward, M.W., Somers, M.J., Kerley, G.I.H., Perrin, M.R., Bester, M.N. *et al.* (2012) Animal ethics and ecotourism. *South African Journal of Wildlife Research* 42(2), iii–v.
- Hershberger, M. (2017) These Are Your Most Ethical Travel Destinations for 2017. Available at: <https://matadornetwork.com/change/ethical-travel-destinations-2017> (accessed 30 May 2017).
- Hill, S.P. and Broom, D.M. (2009) Measuring zoo animal welfare: theory and practice. *Zoo Biology* 28, 531–544.
- Huveneers, C., Rogers, P.J., Beckmann, C., Semmens, J.M., Bruce, B.D. and Seuront, L. (2013) The effects of cage-diving activities on the fine-scale swimming behaviour and space use of white sharks. *Marine Biology* 60(11), 2863–2875.
- Jamieson, D. (1985) Against zoos. In: Singer, P. (ed.) *In Defense of Animals*. Blackwell Publishing, Malden, Massachusetts, pp. 132–143.
- Keulartz, J. (2015) Captivity for conservation? Zoos at a crossroads. *Journal of Agricultural and Environmental Ethics* 28, 335–351.
- Laidlaw, R. (2014) Looking at fragments of nature: a perspective on zoo and aquarium captivity. In: Sorenson, J. (ed.) *Critical Animal Studies: Thinking the Unthinkable*. Canadian Scholars' Press Inc., Toronto, Canada, pp. 137–153.
- Macbeth, J. (2012) Not all fun and games: the missing ethics of animals in tourism. *The Conversation*. Available at: <http://theconversation.com/not-all-fun-and-games-the-missing-ethics-of-animals-in-tourism-8986> (accessed 30 May 2017).
- Markwell, K. (ed.) (2015) *Animals and Tourism: Understanding Diverse Relationships*. Channel View Publications, Bristol, UK.
- O'Connor, S., Campbell, R., Cortez, H. and Knowles, T. (2009) Whale watching worldwide: tourism numbers, expenditures and expanding economic benefits. A special report from the International Fund for Animal Welfare, Yarmouth, Massachusetts, prepared by Economists at Large.
- Orams, M.B. (2002) Feeding wildlife as a tourism attraction: a review of issues and impacts. *Tourism Management* 23, 281–293.
- Ryan, C. and Seward, J. (2004) The zoo as ecotourism attraction – visitor reactions, perceptions and management implications: the case of Hamilton Zoo, New Zealand. *Journal of Sustainable Tourism* 12(3), 245–266.
- Shani, A. and Pizam, A. (2008) Towards an ethical framework for animal-based attractions. *International Journal of Contemporary Hospitality Management* 20(6), 679–693.
- Spielberg, S. (director) (1975) *Jaws*. Universal Pictures, Universal City, California.
- Swaisgood, R.R. (2007) Current status and future directions of applied behavioral research for animal welfare and conservation. *Applied Animal Behaviour* 102, 139–162.
- Tan, T. (2014) Swimming with sharks. *Alumnus* 96, 22–23.
- The Dorsal Effect (n.d.) Available at: www.thedorsaleffect.com (accessed 9 March 2018).
- Whitham, J.C. and Wielebnowski, N. (2013) New directions for zoo animal welfare science. *Applied Animal Behaviour Science* 147, 247–260.
- Wiener, C.S. (2015) Dolphin tourism and human perceptions: social considerations to assessing the human–dolphin interface. In: Markwell, K. (ed.) *Animals and Tourism: Understanding Diverse Relationships*. Channel View Publications, Bristol, UK, pp. 146–162.

25 The Rise of the Inclusive Approach to Change in Animal Welfare

PHILIP LYMBERY

25.1 Introduction

Midnight under a starlit summer sky, the North Carolina countryside was alive with the buzz of cicadas and distant bullfrogs. I was in a Chevrolet four-wheel drive parked unobtrusively among some sheds on a poultry farm. We waited into the early hours for the catching gang to arrive, keeping out of sight so we wouldn't be spotted. Yet, despite the subversive feel, there was no fear of being caught by an angry farm owner; he was sitting right beside me in the driving seat.

I had met the farm owner, Craig Watts, by invitation, earlier that day to get a rare glimpse inside America's poultry industry. It's big business in North Carolina, a broiler-chicken state that churns out 785 million birds, worth \$3 billion, a year. I arrived with Compassion in World Farming's (CIWF's) US director, Leah Garcés, to find Watts aboard a bright orange mower cutting the grass around his white clapboard homestead. His family has farmed here since the 1700s. Ruggedly handsome in dungarees, with a thatch of greying hair and engaging brown eyes, he was welcoming and jovial.

Watts married his childhood sweetheart Amelia in his 20s. He went into farming chickens because he wanted to be his own boss, and soon found out he was anything but. Now with two young sons and a daughter, the 48-year-old was farming chickens on a large scale. His contract was with Perdue, one of the biggest poultry-processing companies in the USA. Like an army of so-called contract growers across the country, he saw himself as running to stand still on the debt treadmill, beholden to a processing company he felt held all the cards.

He had invested around half a million dollars in four state-of-the-art buildings; like long, low-slung warehouses for raising meat chickens. Watts provided the sheds, the land and labour; Perdue provided the chicks, the feed, and specified how they should be reared. After 22 years of raising chickens, at

breaking point, and concerned about the way cheap chicken was being advertised to the public, he decided to blow the whistle. He contacted CIWF and invited us to film his farm and tell his story. He chose us after careful research, because he felt we would be willing to listen and not just blame the farmer for what was going on. It was a unique chance to see the kind of conditions that all too often lie behind labels like 'all natural' in grocery stores across the USA and around the world.

Inside the windowless sheds the motionless white birds covered every available inch of what seemed like a 2000 m² (over 20,000 ft²) corridor with whirling giant fans at the end (Figs 25.1 and 25.2). The flock, a sea of white, was a miserable sight. Most birds were squatting and panting. Even the ones in better shape looked unsteady with bloated bodies that tottered hopelessly on weak legs. Watts estimated that each bird had about the same amount of floor space as a standard sheet of typing paper. If it weren't for his contract, he said he'd do away with the solid walls and let in sunshine and fresh air, 'Number one, the birds would love it, and number two, it would be better for me,' he said. I asked him what he saw as the future of the industry: 'I think it's almost going to have to be a start over. I think we're past the rewind button here. I think this has gone too far' Watts replied with a sigh.

When CIWF released Watts' story to the media in a feature by Nicolas Kristof in the *New York Times*, millions soon saw it. The story, and the accompanying video, soon went global. Kristof commented: 'Torture a single chicken and you risk arrest. Abuse hundreds of thousands of chickens for their entire lives? That's agribusiness' (Kristof, 2014).

Perdue Farms' first response to the story was to initiate an audit of the farm, suggesting that Watts had failed to follow their guidelines on rearing and animal welfare. It was an accusation that infuriated Watts, who was adamant he had followed their



Fig. 25.1. Broiler chickens: Craig Watts (left) and Leah Garcés of Compassion in World Farming (CIWF) walking through a ‘sea of white’. (Image credit: CIWF.)



Fig. 25.2. Broiler chickens reared for meat on a typical intensive farm. (Image credit: CIWF.)

guidelines meticulously. However, not too long after, having shone a light inside America’s chicken sheds, Perdue Farms shared publicly its quest to find better ways to keep its chickens. By July 2015 Jim Perdue was being quoted in the *New York Times* saying, ‘We need happier birds’ (Strom, 2015).

A year later in July 2016, Perdue Farms was making a huge announcement: it was to be the first major chicken company in the USA to publish a detailed policy on animal welfare aiming to create an environment where chickens have the ‘freedom to express normal patterns of behavior’ (Perdue

Farms, 2016). Then in July 2017 executives from Perdue Farms welcomed advocates from animal welfare organizations, including the Humane Society of the United States, Mercy for Animals and CIWF, to poultry sheds in Frankfort, Delaware where they were to see the company’s vision of the chicken house of the future (Charles, 2017). CIWF’s Leah Garcés was among the group, riding with Jim Perdue himself. She was impressed, commenting:

It’s a big difference from current conditions for chickens. The environment has been enriched with straw bales, perches, and boxes. Windows are letting

in natural light. The chickens are running around, climbing on things, pecking and perching. Importantly Perdue is not just looking at housing, but also considering changing to slower growing chickens, and planning to introduce more humane slaughter.

(L. Garcés, Atlanta, Georgia, 2017, personal communication)

In the space of just 3 years, since that first day when I met Craig Watts, Perdue had moved further than I could ever have envisaged. Many millions of sentient creatures a year – chickens – would now be given better lives. So what led to such dramatic change?

Well, Perdue put it down to the need for greater support for farmers in terms of improving husbandry methods, as well as consumer interest in how animals are raised for food (Perdue Farms, 2016). The company also cited a desire to produce more tender meat – they noted that active chickens produce a higher quality product (Charles, 2017).

My view is that the issue of animal welfare has come of age.

This dramatic result didn't happen in isolation. Innovative as the approach was, in teaming up with a factory farmer to tell the story of the need for change, it came against a backdrop of three decades or more of an animal welfare movement gathering steam. Countless scientists have worked on building the evidence base. Practitioners have developed viable alternatives. Advocates have built public support for animal welfare, which was first consolidated into political backing, and then taken into the corporate arena more than a decade ago, where it has started to gain major traction.

At the vanguard of the movement was Ruth Harrison, whose 1964 book, *Animal Machines*, first exposed the factory farm machine in the UK, leading to a government enquiry which led to a report to Parliament on the subject.

Among the pioneers was Peter Roberts, a former dairy farmer from the south of England, who took a local monastery to court for keeping calves in tiny veal crates, where the calves couldn't turn around. It was the mid-1980s and he lost the case. However, the resulting publicity catapulted the issue into headlines across the nation, making 'veal' a dirty word and sparking off perhaps the UK's most successful consumer boycott of all time. The wave of public concern resulted in the British government banning veal crates from 1990.

In Europe, a major breakthrough came in 1997 when the European Union (EU) not only agreed to

ban veal crates throughout all member states of the EU, but also gave legal recognition to animals as sentient beings. Animal welfare had finally arrived. The requirement to pay full regard to the welfare of animals as living creatures, capable of feeling pain and suffering, was now written into law. At a stroke, it stripped away the scope for those who would try to justify poor practice on the basis of animals being little more than unfeeling objects, or just 'goods'.

Public and political awareness of the issues continued to grow in Europe, resulting in a suite of new EU legislation; outlawing some of the worst systems and practices, including the use of barren battery cages for laying hens and the prolonged use of gestation crates for pregnant pigs. This awareness was fueled by countless undercover investigations, and has since been accelerated by the digital age, which has brought with it unprecedented opportunity to place graphic images of animal cruelty in front of consumers via the Internet and social media.

As the issue of farm animal welfare has gained increased visibility, public support, and legislative credence, so the corporate world has opened up to the need to embrace animal welfare as part of their corporate and social responsibility agenda. With more and more companies willing to commit to policies that would see whole swathes of poor welfare products, like cage-free eggs, taken off the shelves, a new era of inclusive animal welfare was heralded. It brought with it exciting opportunities for animal welfare advocates, corporates, and industry to work together to solve previously intractable problems.

More recently, pressure from investors has added to consumer pressure, leading to a groundswell of new corporate animal welfare policies and the adoption of credible and auditable welfare assurance schemes. At the heart of this new inclusive approach, particularly in the last decade, has been collaboration between animal advocates and food businesses engaging with companies in the role of 'critical friend' to encourage new policies that lead to an upward shift in baseline animal welfare standards.

25.2 Driving Progress with Food Companies

One of the big drivers of progress in animal welfare over the past decade has come from the food businesses that I have come to view as 'super-consumers' – supermarkets, food service companies, and food manufacturers. They have increasingly

broken new ground, with wholesale policy switches to only cage-free eggs, higher welfare chicken meat, or pasture-based dairy.

Why ‘super-consumers’? Well, because they buy vast quantities of produce from farm businesses. These super-consumers seldom have a vested interest in the actual business of farming, and so are not wedded to a particular system or way of doing things. This gives them scope to shift supply in line with their latest decisions on ethics, good practice, and consumer demand. And in so doing, they create new markets for higher welfare produce, providing compelling demand for the products of those producers who are willing to adopt higher welfare standards. As the number of higher welfare pledges by super-consumer companies has rocketed, so leading advocates have shifted their perception away from companies being slavish purveyors of the ‘cheapest’ products in pursuit of profit-at-any-cost, to one where they are seen as powerful partners in driving progress for animal welfare.

And positive progress is catching.

A good example can be seen in the world of mayonnaise brands. A few years ago, almost all major manufacturers of mayonnaise used eggs from caged hens as an ingredient. Most supermarket shelves were stocked with boxes of cage-reared eggs too. CIWF launched a new-style engagement campaign to persuade major food companies to think about the food on their shelves and the ingredients they select. Thanks to that work, and similar forays by organizations such as the Royal Society for the Prevention of Cruelty to Animals (RSPCA), some of the big supermarkets started to avoid battery eggs. They began exclusively stocking eggs from cage-free hens.

Around the same time, CIWF worked with Unilever to switch the flagship Hellmann’s mayonnaises and sauces across Europe to free-range eggs. When the campaign came off, it felt like a massive victory. A switch like this can mean hundreds of thousands, sometimes millions of hens a year living free-range lives instead of cooped up in a cage. Since then, other mayonnaise brands of all sorts have made the switch to cage-free egg ingredient. The pace of change in this new era of inclusive advocacy has been dramatic.

25.3 The Power of Positive Recognition

One of the hallmarks of the inclusive approach to animal welfare has been the willingness of leading

welfare organizations to give public recognition to companies that make significantly higher welfare pledges. One of the key tools developed to help incentivise corporate moves to higher welfare was the idea to offer awards to companies that agree to move a whole category of product, like eggs, to a new welfare benchmark, thereby shifting the baseline upwards. Perhaps the most successful awards scheme was created a decade ago, when farmer Roland Bonney met with CIWF for lunch in The Farmer’s Club in London. That lunch spawned the idea of a new way of incentivizing change within the corporate community, by offering a ‘Good Egg’ award. It was a simple idea. It folded political imperative – the need to get corporates to support incoming legislation banning barren battery cages by implementing change early – with good old recognition. This simple approach of providing an award-based incentive helped focus corporate minds on making positive change. Also, by having a suite of awards covering different species, categories or sectors of supply, it has given companies a clear pathway of progression for continuous improvement. A company making a commitment on eggs might, next, eye up the opportunity to make a further pledge on chicken meat, for example, thereby qualifying for more recognition and an increased ‘halo’ effect.

I remember giving my first opening address at our inaugural ‘Good Egg Awards’ ceremony in the House of Commons in 2007. Since then, we have recognized more than 800 companies as having made serious commitments to improving the animal welfare standards of the food they sell. Companies such as Subway, Starbucks, Sainsbury’s, Unilever and the world’s largest restaurant chain, McDonald’s, have all taken pledges to use cage-free eggs in the UK and/or Europe. ASDA, the Co-op and the ice-cream manufacturer Ben & Jerry’s have been recognized for pledges to source milk from cows allowed to graze on grass, instead of being locked indoors, during the grazing season. CIWF also gives an award to the overall ‘most compassionate’ supermarket in the UK, a title that has passed back and forth between Waitrose and Marks & Spencer for over a decade. The suite of awards include the Good Egg Awards, Good Chicken Awards, Good Dairy Awards, Good Pig Awards, and Good Rabbit Awards, and the 5 star Good Producer Awards for higher welfare egg, chicken, and pig production in China. The Retailer Awards recognize supermarkets that are leading

the way in farm animal welfare innovation, marketing and performance. These awards now have a global reach with companies from China, the USA, Australia, and Europe accepting accolades, including a first full Good Chicken Award in China, awards for Dodu Rotisserie Francais, 14 awards to retailers, and 12 to the food manufacturing sector. Additionally, 29 Chinese producers have been awarded their own 5 star Good Pig, Good Egg, and Good Chicken Production Awards (Fig. 25.3).

The 2017 award winners alone are calculated to positively impact the lives of nearly 100 million animals each year. Together with previous awards winners, other partnership projects, and more recently, a groundswell of corporate pledges around the world, more than a billion farm animals are set to benefit from better welfare every year.

Instead of pitching animal advocacy as a straight ‘David versus Goliath’-style battle, the movement has been reframed and is now working with some of the most influential ‘Goliaths’ on the planet. I remember being asked to speak at a screening of the US film, *Food Inc* (Kenner, 2008), which explores what it calls the ‘highly mechanized underbelly’ of the industrial farming system in the USA. It’s a shocking exposé, but watching it, I could see that it was more than a critique of the system. There was also a message of hope, with examples of companies and producers switching to more humane and sustainable ways of farming. One interviewee in the film described how the sustainable food movement needs to move beyond being David, and become Goliath; it needs to be championed by some of the biggest companies in the world.



Fig. 25.3. The power of positive recognition: CIWF's Good Farm Animal Welfare Awards. (Image credit: CIWF.)

It is a sentiment that lies at the heart of the new inclusive approach to animal welfare: the idea that, for real success, the issue of animal welfare needs to be embraced and championed by some of the world food industry's greatest ‘Goliaths’.

25.4 A Chicken Welfare Revolution

While policy commitments to go cage free on eggs have become the standard entry point for companies looking to upgrade their animal welfare standards, pledges to move to higher welfare chicken meat across the board have become the subject of the latest ripple effect. A recent wave of farm animal welfare progress has been co-created with advocates working with major food service sector companies in the USA. Compass Group, the world's biggest food service sector company, has made a ground-breaking commitment to move its entire US chicken meat supply to higher welfare by 2024. Other food service giants such as Sodexo, Aramark, Delaware North, and Centreplate in the USA have followed suit. These company pledges are based on a commitment to purchase only from sources that guarantee chickens a better life as defined by the standards of the US-based farm assurance scheme, the Global Animal Partnership (GAP) (Compass Group, 2016). GAP was originally developed by Whole Foods Market (WFM) and comprises a 5-Step® animal welfare labelling system. It starts with Step 1 – no cages, crates or crowding – and goes up to Step 5 and 5+ – equivalent to European organic standards or higher. Products are available through retailers and food service in the USA and Canada. The 5-Step® ratings were launched in every WFM store in the USA and Canada in 2011.



Fig. 25.4. Going global: the author investigating the use of sow stalls in China. (Image credit: CIWF.)

In 2016, GAP made a ground-breaking commitment to tackle the welfare of broiler chickens by announcing that by 2024 it would work 'to replace 100 percent of fast-growing chicken breeds with slower growing breeds for all levels of its 5-Step® Rating Program' (Global Animal Partnership, 2017). GAP's move towards slower growing chicken breeds is the first major, specific, time-bound commitment to address the negative effects of fast growth on chicken health and welfare in the USA. Collaborative working has played a huge role in driving this progress. US-based animal welfare organizations, including the Humane Society of the United States and CIWF, have worked with WFM and GAP for nearly a decade. They have participated in board-level discussions on GAP's animal welfare standards and strategy across all species.

The subsequent ripple effect on the chicken meat market in the USA came hot on the heels of incredible progress in persuading companies to eliminate the use of battery-caged eggs. It was sparked by a 2015 announcement from McDonald's in the USA that it would phase out the use of cage-produced eggs. Within just a few months, over 130 companies had joined them in the pledge. Barely a week goes by now without a major food business making another welcome announcement on farm animal welfare.

25.5 Investing in Change

In the last few years, a new and particularly influential stakeholder has entered the farm animal welfare arena: the investor. The voice of the investment community emerged forcefully as part of the inclusive approach to animal welfare around the time of the horsemeat scandal in the UK and Europe. The crisis in 2013 saw beef being exchanged for horsemeat, leaving the horse-loving nation of Britain stunned and distrustful. Keen to avoid taint from the torrent of revelations, the then UK Prime Minister, David Cameron, blamed supermarkets, who blamed their suppliers, who pointed to distant traders in faraway lands. Consumers were left baffled and angry. Consumer confidence and company share prices were hit hard.

The scandal drove home the message that the world of business now had to take account of interdependencies, be they societal, ecological, or animal welfare. Writ large was the need to take the integrity of supply chains seriously if company bosses wanted to sleep at night. Integrity doesn't stop at

the basics: knowing where products come from and what they contain. It also requires being sure of the quality of products, be they meat, milk, or fish, so that there are no nasty surprises or questionable ethics lurking within, and waiting to be found out. It is something that leading businesses are increasingly coming to recognize.

I saw this first-hand when I was part of the launch of a new league table of food companies aimed at investors: the Business Benchmark on Farm Animal Welfare (BBFAW). This listing is based on how seriously companies take farm animal welfare. As I rose to my feet to talk in the heart of London's financial district, I wondered whether hard-nosed financial types would 'get it'. Would they not ask what animal welfare has got to do with good investment decisions? I needn't have worried. Riding on the back of 'Horsegate', no one in the room needed convincing. They could see the danger in not addressing serious issues of public interest and transparency. The launch of the league table made headline news in the UK's *Financial Times* newspaper. Minds had been alerted to the perils of cutting corners.

BBFAW is a project collaboration between Collier Capital, World Animal Protection and CIWF, and consists of an annual review of how about a hundred of the world's leading food companies are managing risks and opportunities associated with farm animal welfare (The Business Benchmark on Farm Animal Welfare, 2016). It has provided a tool for the investment community, establishing farm animal welfare as a serious emerging issue, one that is set to become as important as carbon, water, and waste. In 2012, 46% of companies assessed by BBFAW had published farm animal welfare policies. In 2016 it had increased to 73%. According to BBFAW Advisor, Rory Sullivan:

The Benchmark shows that investors are key agents of change. They are sending a clear signal to companies that they expect food companies to effectively manage the systemic risks and opportunities posed by farm animal welfare, and it is clear that companies are responding to these expectations.

(R. Sullivan, London, 2016, BBFAW press release)

As a spin-off from BBFAW, 2017 saw 19 institutional investors, spanning Europe, the USA, Canada, and Australia, announcing participation in an international collaboration on farm animal welfare. The participating investors had a total of £1.5 trillion in

assets under management, and include Aviva, BMO Global Asset Management, Collier Capital, Rathbone Greenbank Investments, Triodos Bank, and Walden Asset Management. Together, using BBFAW as their benchmarking tool, they wrote to company bosses, providing direct encouragement to major global food companies to continue to strengthen their approach, management systems, and processes on farm animal welfare.

25.6 A Model for Change – the UK Calf Forum Initiative

Perhaps one of the earliest and most effective initiatives spawned by the emerging inclusive approach to animal welfare progress has been the ‘Beyond Calf Exports Stakeholder Forum’, which operated in the UK from 2006 to 2013. UK male dairy calves were considered the unfortunate by-product of the dairy industry. With no market in the UK, many were shot at birth or exported to continental veal systems often operating to standards illegal in the UK.

After the lifting of the 10-year ban on live calf exports from the UK, imposed during the BSE (bovine spongiform encephalopathy) crisis, advocates faced the prospect of returning to the protests at the docks, or to finding another way of solving this seemingly intractable problem. Working with the RSPCA and Ben Bradshaw, the government minister responsible for animal welfare, CIWF decided to bring stakeholders together to find realistic and economically viable solutions to keep male dairy calves in the UK supply chain and founded the Calf Forum along with the RSPCA.

A wide range of stakeholders were invited to take part, including representatives from the beef and dairy industry, processors, veterinary organizations, academics, government, farm assurance schemes, retailers, farming unions, breeding companies, livestock auctioneers, and trading standards organizations. The Forum launched a series of round-table meetings at which stakeholders were encouraged to participate in joint problem-solving discussions, and to report on progress made against common objectives. The objectives themselves were hammered out following discussions by a number of working groups, and were adopted by the Forum to achieve:

- an increase in the uptake of male dairy calves into the beef chain;

- a reduction in the number of male dairy calves killed on farm; and
- a reduction in the number of male dairy calves exported live for further fattening.

To achieve progress, the Forum agreed that members would need to work to support and encourage the development of economically viable outlets for the domestic rearing and finishing of male dairy calves. It was also seen as important to develop potential domestic and export market opportunities for home-produced beef from male dairy calves. The encouragement of high welfare standards for calf rearers in the UK and across Europe was also adopted as a key cornerstone of the work of this multi-stakeholder group. The Forum established a website (www.calfforum.org.uk), held biannual meetings, and cooperated to produce annual progress reports, as well as scientific reports on key issues. In 2013, the Calf Forum published its final report, ‘The modern solution to the export of calves: working in black and white’.

It was humbling to see just how much had been achieved by leaders from the UK dairy and beef industries, the retail and food sectors, veterinarians, and academics working together. Together, they had kick-started an attitudinal shift in the UK, generating economic value for male dairy calves, where before there was none. It was a collective effort that resulted in a reduction in the number of calves killed on farm and a 90% reduction in the number of calves being exported live for further fattening, to less than 8000 calves. This was clear, measurable progress, delivered by an extraordinary array of stakeholders throughout the industry.

The reduction in live calf exports to the continent was a remarkable achievement, particularly when contrasted with the truly dark days of the early 1990s, when half a million calves were exported every year to the most wretched lives in continental veal crates. One of the keynote speakers at the final report launch, Professor John Webster, Emeritus Professor of Animal Husbandry at the University of Bristol, said:

Despite the title of the Forum, it is not about exports as such, it's about alternatives. Every animal should have a decent quality of life and a gentle death. The Forum has found new markets such as promoting higher welfare, and British rosé veal.

(J. Webster, London, 2013, launch of Calf Forum final report)

The approach taken by the Calf Forum presents a model for overcoming seemingly intractable

problems and is a commendable model for addressing other major issues affecting animal welfare.

25.7 Looking Forward

Animal welfare is increasingly being seen, not only as a major issue in itself, but as a key indicator of the wider health of our food system (Fig. 25.5). Factory farming – the grain-feeding of confined animals – is responsible for serious public health problems, including the rise of antibiotic-resistant bacteria, deadly viruses such as highly pathogenic swine flu, and food poisoning bacteria (e.g. *Salmonella*). Intensive farming also causes huge environmental problems, not least the decline of pollinating insects, like bees, that are vital for pollinating a third of all crops on the planet.

Industrial-style farming also undermines our soils, leading to erosion and loss of soil fertility; the United Nations warns that, if we don't do something, the world's soils may be gone in just 60 years from now. And then what do we do for food? On top of that, factory farming is also a major driver of deforestation and climate change.

All in all, factory farming is undermining the very ecosystem that we as a species rely on for our survival. It's as simple as that. It also wastes the very thing it is said to produce: food.

Vast acreages of arable land are devoted to growing feed for industrially reared animals. If we put all of those feed crops worldwide into one field, that field would cover an area equivalent to the entire land surface of the EU. Put another way, if we restored the farm animals to the land, to the

pastures, and used that arable land to feed people, that crop could feed an extra 4 billion people.

Yet, factory farmers will have us believe that wasting enough food for more than half the human inhabitants on the planet is somehow 'efficient', a 'necessary evil'. Well, the current food system, which is not yet dominated across the world by intensive agriculture, produces enough to feed 16 billion people; more than enough food for everyone today and in the foreseeable future. If only we didn't waste so much of it, not least by feeding it to factory farms.

The future of farm animals, our food and the environment, are inextricably linked. To ensure a bright future for society, a far-reaching and collaborative approach will be needed to move away from the kind of systems and practices that cause poor welfare and damage the environment. A major meeting of minds by multiple stakeholders has the potential to deliver a food system where farm animals are kept on rotational free-range farms, pasture-fed, or organic.

An inclusive approach, rather than marginalizing polarity, holds the key to unlocking the kind of change that society will need, not only to meet the interlinked demands of decent food and animal welfare, but also to safeguard the planet for future generations. Animal advocates working together, inclusively, with corporate 'Goliaths' and other stakeholders will be essential if we are to truly unlock the wide-ranging benefits which flow from properly meeting the welfare of animals.

Bibliography

- Business Benchmark on Farm Animal Welfare (2016) Available at: <https://www.bbfaw.com/media/1450/bbfaw-2016-report.pdf> (accessed 27 July 2018).
- Calf Forum (2013) The Modern Solution to the Export of Calves: Working in Black and White. Final report on progress. Compassion in World Farming, London. Available at: <https://www.ciwf.org.uk/media/3756108/Calf-Forum-Report.pdf> (accessed 14 March 2018).
- Charles, D. (2017) Perdue Farms Signs Up for a Chicken Welfare Revolution. *WBAA News*. Available at: <http://wbaa.org/post/perdue-farms-signs-chicken-welfare-revolution#stream/0> (accessed 21 August 2017).
- Compass Group (2016) Compass Group USA Becomes First Foodservice Company to Commit to 100% Healthier, Slower Growing Chicken by 2024 through Landmark Global Animal Partnership Agreement. Available at: <http://www.compass-usa.com/compass->



Fig. 25.5. High animal welfare is increasingly being seen as a 'must-have' component of sustainability. (Image credit: CIWF.)

- group-usa-becomes-first-food-service-company-commit-100-healthier-slower-growing-chicken-2024-landmark-global-animal-partnership-agreement/ (accessed 21 August 2017).
- Global Animal Partnership (2017) Our Commitment to Improving Bird Welfare with 100% Slower Growing Chicken Breeds. Available at: <https://globalanimalpartnership.org/about/news/post/our-commitment-to-improving-bird-welfare-with-100-slower-growing-chicken-breeds/> (accessed 21 August 2017).
- Harrison, R. (1964) *Animal Machines: The New Factory Farming Industry*. Vincent Stuart, London.
- Kenner, R. (director) (2008) *Food Inc*. Participant Media/ River Road Entertainment, Beverly Hills/Los Angeles, California.
- Kristof, N. (2014) Abusing Chickens We Eat. *New York Times*. Available at: <https://www.nytimes.com/2014/12/04/opinion/nicholas-kristof-abusing-chickens-we-eat.html> (accessed 21 August 2017).
- Lymbery, P. (2017) *Dead Zone: Where the Wild Things Were*. Bloomsbury Publishing, London.
- Lymbery, P. and Oakeshott, I. (2017) *Farmageddon: the True Cost of Cheap Meat*. Bloomsbury Publishing, London.
- Perdue Farms (2016) Perdue Foods Commitments to Animal Care 2016 and Beyond. Available at: <http://www.perdufarm.com/media/1002/perdue-foods-animal-care-2016-beyond.pdf> (accessed 21 August 2017).
- Strom, S. (2015) Perdue Sharply Cuts Antibiotic Use in Chickens and Jabs at Its Rivals. *New York Times*. Available at: <https://www.nytimes.com/2015/08/01/business/perdue-and-the-race-to-end-antibiotic-use-in-chickens.html> (accessed 21 August 2017).

26 Animal Welfare Protection in the Face of Shrinking Public Resource

SOPHIA HEPPLÉ

26.1 Introduction

This chapter considers how animals can (and historically have been) protected with limited or even no public resource, and indeed with limited or no animal protection laws. Many governments and non-governmental organizations (NGOs) actively contributed significant resources during the 20th century to research in animal welfare science and in protecting animal welfare through both education and enforcement. These contributions have been fundamental in developing and driving forward minimum welfare standards through all stages of an animal's life, not only at a regional or country level but also on a global scale. These same governments and NGOs are now facing cuts in available funds and resources to protect animal welfare during the 21st century. Governments are increasingly focused on risk-based inspections to manage the worst offenders while charitable organizations involved in animal protection have to think more 'smartly' about generating income and carefully prioritize how they spend their donated funds. In developed countries there continues to be a need to improve standards to reflect our increasing understanding of animal sentience and cognition, meanwhile improvements in basic animal welfare standards in developing countries are still needed. There have been some innovative approaches to achieving these changes. Encouraging human behaviour change, sometimes in the face of culture, custom or habit, is a fundamental part of this process (Fig. 26.1).

26.2 Early Days – Enforcement without Public Resource

If we consider animal protection law as it relates to the welfare impact or feelings (unnecessary suffering) of the animal rather than the wilful act carried

out by a perpetrator against an animal, it was not until the mid-19th century that the UK Government started to consider any form of social responsibility for ensuring animal protection. This was around the same time that human social care and protection, particularly within the workplace, started to be a subject for government legislation, and much later, active intervention.

However, legislation in itself does not protect animals, nor drive up minimum standards of acceptable care. It is the appropriate and proportionate enforcement of the law, and bringing such unacceptable actions to the attention and education of the wider public or 'society', that drives improvement in animal welfare and helps change the accepted moral compass of the masses.

At the start of this process, there was no public resource available to enforce early animal protection laws. This is not peculiar to animal protection, because at this time enforcement of criminal law in the UK would usually require the victim (or relatives of a victim, if dead or incapacitated) to bring a private prosecution against the offender(s). The 'policing' of unlawful activity was very much down to local communities and local funding, but by 1800 the City of Glasgow had established the first 'professional' full-time, paid police force. Similar development of a police force did not occur in London until 1829, and even then, the newly formed Metropolitan Police did not include the City of London, which incorporated Smithfield market, a key target for early animal protection law enforcement at this time.

In the early days, enforcement of animal protection laws therefore relied on private funding to monitor and, where necessary, prosecute offenders. This was provided by individuals, such as Richard Martin or 'Humanity Dick', Member of Parliament for Galway, and responsible for sponsoring the first successful Bill leading to 'An Act to Prevent the



Fig. 26.1. (a, b) Protecting animal welfare while animals are under human care. Increasing knowledge of animal sentience and understanding of their behavioural needs means we are constantly learning better ways of providing a 'life worth living' or 'Beter Leven' or maybe even a 'good life' for the animals for which we are responsible. (Image credits: Sophia Hepple.)

Cruel and Improper Treatment of Cattle' (1822) as well as numerous Bills thereafter, which failed to be enacted in law in Martin's lifetime but ultimately found their way into later laws. He actively brought private prosecutions against individuals and employed an agent to monitor activity at the markets and in the streets.

Alternatively, a charitable organization, the then Society for Prevention of Cruelty to Animals (SPCA), set up with a remit to protect animals in 1824, and with Richard Martin as a founder member, could fulfil such a role. There were two clear remits for the SPCA (addressed by separate committees):

- **education** – including influencing public opinion, which incorporated strong and successful political lobbying at that time; and
- **enforcement** – through monitoring markets (Fig. 26.2) and shows (Fig. 26.3), streets and slaughterhouses to ensure that the law was being complied with and, where necessary, prosecuting offenders.

Martin observed that prosecution alone would not work in eliciting change. However, 149 successful prosecutions were carried out by the SPCA in its first year of operation; and by the end of the 19th century the total number of prosecutions for animal welfare infringements carried out by the RSPCA (now endorsed with the 'Royal' prefix and proactive royal patronage) was over 150,000.

The development of animal welfare law and its successful enforcement without public resource during the 19th century in the UK was ultimately down to a small group of enthusiasts, who suffered parliamentary and media ridicule and were considered

'eccentric' by many at the time. Arthur Broome, a key founder member of the SPCA, was imprisoned when the society went into debt within 3 years of its establishment. Yet this group of eccentrics' commitment to 'mitigating the suffering of' and 'promoting the practice of humanity towards' animals, turned the society around and not only made it a successful charitable organization but ultimately a global influencer in the field of animal welfare as it is today.

26.3 Is Our Scope Protection from Unnecessary Suffering or Ensuring Animal Well-being?

Before going any further in this chapter on 'protecting animal welfare' it is perhaps appropriate to discuss what we are seeking to 'protect'. Traditionally, and into the mid- to late 20th century, 'animal protection' in what we now describe as 'developed' or 'Westernized' countries focused on avoidance of animal suffering, caused through either:

- **cruelty** – a positive act to deliberately cause unnecessary suffering of an animal; or
- **negligence** – an action or lack of action (through ignorance or lack of competence) that unintentionally results in unnecessary suffering.

Certainly, in English law this is judged by the standards of a 'reasonable' member or citizen of a chosen 'society'. As an example, for farmed animals, a 'case' would be judged by the standards of how we would expect a reasonably competent stockperson rearing livestock in England to act, whereas for a pet owner the bar (standard) might

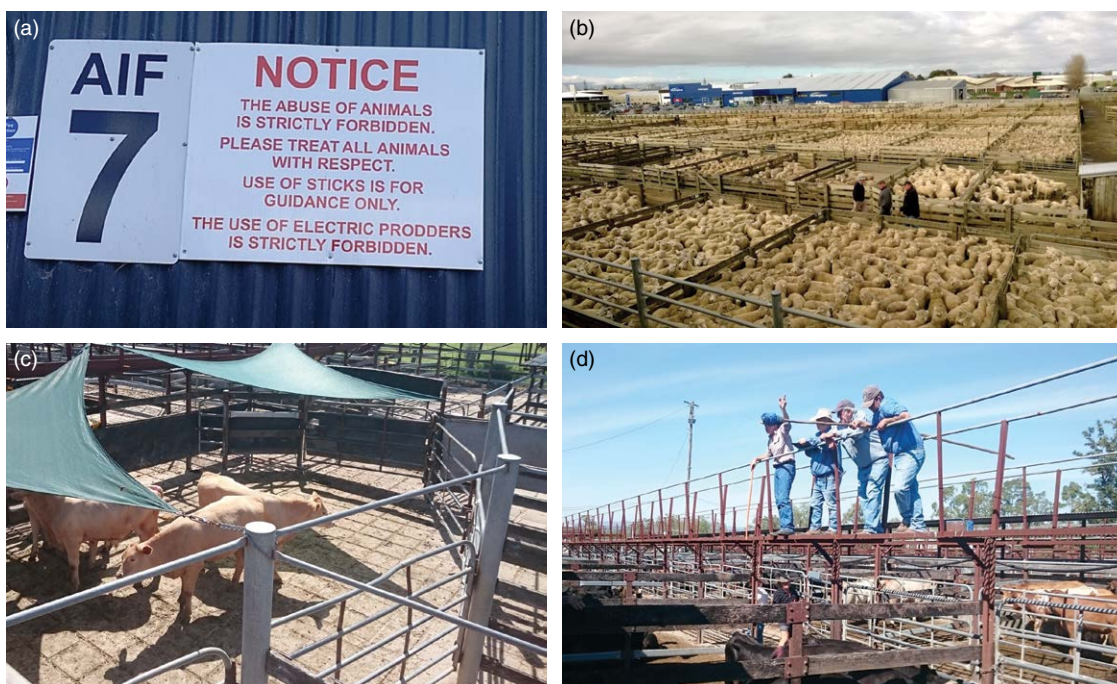


Fig. 26.2. John Lawrence (1796) strongly believed education was key to improving welfare standards and that people working with animals, particularly drovers taking animals to market and for slaughter, needed a particular empathy and patience with animals at such a stressful time. He also believed an inspector should be permanently placed at Smithfield market in London. Today, markets and collection centres continue to be a key part of farming life in many countries: (a) drovers are still reminded of the need to treat animals with respect in a collection centre in Ireland; (b) sheep gathered at Feilding market, New Zealand, one of the largest markets in the southern hemisphere; (c) beef stock are provided with shade in the heat of the summer in New South Wales, Australia; (d) bidding for livestock gets under way in New South Wales, Australia. (Image credits: Sophia Hepple.)

be set somewhat lower regarding the expected level of knowledge. Therefore we were, and still are, dealing with the negative extreme of an animal's welfare experience as the limits of what is 'reasonable', and this might be considered the basis of the concept of a '**life not worth living**' if standards fall below a certain level (FAWC, 2009) (also, see Chapter 16, this volume).

By the late 1960s, following the Brambell Committee report (Brambell, 1965), the focus in the UK was on setting minimum standards of acceptable care for farmed animals, in other words promoting more positive welfare experiences than negative ones such that, certainly for animals in the farming sector, they could experience '**a life worth living**' (FAWC, 2009) (Fig. 26.4).

It wasn't until 2006 in the UK that all other animals under human care, such as pets, reached equal parity to farmed animals, with a section in

the new animal welfare legislation that required responsible persons to have a duty of care to meet an animal's basic needs, enshrined in law, and essentially encompassing all elements of the Farm Animal Welfare Council's (FAWC) five freedoms that we are familiar with for farmed animals (Fig. 26.5).

It seems surprising that it had taken so long (2006) for *all* animals under human care to be considered for minimum standards to meet their well-being. However, it was only 2 years earlier that **child well-being** (rather than just **child protection**) was incorporated into the Children's Act 1989 in the UK and it wasn't until 2008 (in the Children and Young Persons Act 2008) that English law acknowledged government responsibility to ensure this occurred through 'a general duty of the Secretary of State to promote the well-being of children in England'.



Fig. 26.3. (a, b) Abraham Lincoln expounded on the value of agricultural shows in his address to Winsconsin State Agricultural Society in 1859, a year before he became president of the USA and 2 years before agreeing to set up the US Department of Agriculture:

the chief use of agricultural fairs is to aid in improving the great calling of agriculture, in all its departments, and minute divisions – to make mutual exchange of agricultural discovery, information, and knowledge; so that, at the end, all may know everything, which may have been known to but one, or to but a few, at the beginning – to bring together especially all which is supposed to not be generally known, because of recent discovery, or invention

Agricultural shows continue to attract large crowds and opportunity is always taken to educate the wider public about farmed animals, this is particularly important as more of society becomes disengaged from the origins of where their food comes from. (Image credits: Sophia Hepple.)

26.4 Case Study 1: The Problems with ‘Protection’ vs ‘Ensuring Well-Being’ and the Issue of ‘Drift in the System’ – Parallels Between Animal and Child Protection

In the aftermath of the Victoria Climbié death in the UK, Lord Laming (2003) reported that child protection could not be separated from policies to improve children’s lives as a whole (i.e. well-being) and that a shift in focus needed to be on universal services provided for *all children* in addition to the clear targeted [protection] services for *children at risk* of harm. The result was *Every Child Matters* (UK Government, 2003), for the first time defining basic needs of all children to be healthy, stay safe, to enjoy [life] and achieve, and make a positive contribution to society [by not engaging in anti-social behaviour] and to have economic well-being. The Children’s Act 2004 incorporated these elements into legislation making it incumbent on children’s services to ensure for all children: (i) physical and mental health and emotional well-being; (ii) protection from harm and neglect; (iii) education, training, and recreation; (iv) the contribution made by them to society; and (v) social and economic well-being. However, were lessons learnt?

Child protection as opposed to well-being continued to be the primary focus and a second Laming report (2009) following the death of Baby P in 2008 and the Munro report (2011) all focused on managing high-risk children where the focus was on ‘children who are suffering or who are likely to suffer significant harm’. The Children’s Act 1989 distinguished between the ‘child in need’ category and a ‘child protection’ category which mirror the difference between animals not having their needs met (section 9 of the Animal Welfare Act 2006) from those subject to unnecessary suffering (section 4 of the Animal Welfare Act 2006). It has been suggested that pressure on public resources has encouraged the placing of children into a ‘child in need’ category rather than a ‘child protection’ category (Kirk and Duschinsky, 2017) to avoid the additional resource required to manage a child protection case. Kirk explained in an interview with the website *Community Care* (2016): ‘If they’re in the child protection category then they are serious and we need to do something about them, if they’re a child in need, they’re not.’ This is the risk with a two-tier categorization of welfare. Despite the introduction of minimum standards, shrinking public resources mean the focus continues to stay with the worst



Fig. 26.4. Setting minimum standards of care in the farming sector. Ruth Harrison's *Animal Machines* (1964) and the Brambell report (1965) paved the way for a change in focus from a 'life not worth living' to ensure farmed animals at least had a 'life worth living'. (a) A feather-pecked end-of-lay former caged hen, provided with a better 'later' life experience on North Island, New Zealand as she starts to regrow her feathers (2013); (b) Laying hens on a new free range unit on South Island, New Zealand back out enjoying the early winter sunshine just a week after severe snow drifts (2013); (c) Dairy-cross offspring on a dairy unit in the UK to which the owner was subject to prosecution (2004), a criminal record, financial penalty, and finally a disqualification from keeping cattle (2005); (d) An example of a UK retailer's ethical sourcing policy – rosé veal calves being reared to high welfare standards under a guaranteed retailer-buy-back scheme for unwanted male dairy cattle from dairy farms contracted to supply the retailer with their milk (2014). (Image credits: Sophia Hepple.)

cases. Those cases falling just below this will 'drift in the system' while still being at risk, since most child deaths reported as a result of abuse or neglect had not crossed the threshold of the child protection category (Brandon *et al.*, 2008). It wasn't really until the starvation case of Daniel Pelka in 2012 led to a re-emergence of the concept that every child matters and a commitment by the UK Government to provide all children in their first 3 years of school (school year ages 5–7 years) with free school meals from September 2014. Many schools were already providing free healthy fruit snacks and milk at break time, regardless of family income, to this age group, but this was extended to include 'hot' dinners at lunch time. Further, options to provide free breakfast club or

after-school places to a 'child in need' have provided further opportunities to directly provide breakfast and tea-time snacks to those children not quite falling into the child protection category.

26.5 Are We Currently Dealing With Animal Well-being or Merely Animal Protection?

The answer to the question posed in this section about whether we are dealing with ensuring animal well-being or merely animal protection (against unnecessary suffering or, in the context of wild animal conservation, protection from extinction) is dependent on some key factors.



Fig. 26.5. The duty of care under the Animal Welfare Act 2006 extended legal requirements in England and Wales, to meet a duty of care for all animals that came under human care, not just farmed animals. (a) Street artists have risked their lives for art in Bogotá, Colombia, a 16-year-old graffiti artist was shot dead by police in 2011 while painting on an underpass. Time has moved on and in 2013 Justin Bieber, a famous American singer, was protected by police as he produced his own art on an underpass in Bogotá. (b) Despite the country's history of political unrest we find that the Farm Animal Welfare Council's five freedoms, originally written for farmed animals, are portrayed by street artist Lesivo Bestial and have been extended to all animals. The five freedoms are written in Spanish within this 'Five Freedoms' artwork. (c) A few blocks away street dogs scavenge on the streets in La Candelaria district (2016). (d) In local communities of Colombia, government funding provides free rabies vaccinations to 'owners' of street dogs. Children and adults alike are encouraged to bring their feral 'pets' to be checked and vaccinated to protect both animals and humans, where children are the main human risk group for rabies. (Image credits: Sophia Hepple.)

First, is society aware about the sentience of animals, in agreement that animals have basic needs and that we all have a responsibility to ensure the welfare of animals under our care, and maybe even agreeable that we have duties to meet the needs of wild animals and support their ecosystems in the wider environment?

Secondly, does society have both the capacity and the ability to provide well-being for animals, whether these animals are under our direct care or part of some conservation programme (Fig. 26.6)? If the answer to these questions is yes, then this certainly justifies defining minimum standards to ensure that the majority of animals have a life worth living and some even enjoy a good life.

However, John Webster pointed out:

It is easy to ride the philosophical cable car to fashionable areas of the moral high ground (third-world poverty, animal welfare) and make impeccable judgements without losing a bead of metaphorical sweat when these are made at little or no cost to ourselves. (Webster, 2005)

Webster was referring specifically to the example of the farmed livestock sector, expected to meet retailer demands for increasing standards (and often, but not always, increased costs) of animal welfare, while still making a profit so as to have a life worth living for the human family looking after the animals. However, this position could be equally applied to a



Fig. 26.6. (a, b) What can society afford with regards to meeting animal needs? If we define laws in a society then the people must have the capacity to meet these needs and society must have the means to enforce them. If the society, at both central and local community level cannot realistically do this then we need to find ways of working with animal owners to improve animal welfare standards. (Image credits: Sophia Hepple.)

country, society, or local community's ability to pay for higher welfare standards and further, how much that society can afford to enforce any standards it sets for animal welfare (Fig. 26.7).

26.6 Do Governments Still Need to Take Responsibility for Animal Welfare, and If We Agree That They Do, How Can They Achieve This?

Clearly ensuring child well-being, not just child protection, is considered by most societies today as a key government responsibility, despite it taking a long time to acknowledge that 'every child matters' and even longer to enact this. So, should government still be taking responsibility for animal welfare? Monitoring and enforcing animal welfare standards can be an expensive business. If animals are taken into local authority care while a prosecution takes its rather slow course through the judicial process, the significant public costs of a single case could be brought into question when considering other local government priorities such as funding public healthcare, education, and policing.

Hepple and Gibbens (2012) observed that the legal recognition of animal sentience did not mean that the public and its government must recognize any animal rights or that their interests must be considered equally to that of humans, but that government is required to provide transparent evidence of the ethical basis for policy decisions that impact on animal welfare. The legal recognition of animal sentience is reflected in the explanatory notes to the

Animal Welfare Act 2006, by the European Union (EU) and a number of other countries worldwide.

Hepple and Gibbens (2012) also stated that the Animal Welfare Act 2006 infers a policy position with respect to the higher regard for human interest over that of animals. For example, the suffering of a police horse might be deemed acceptable when protecting property. This reflects Garner's (2008) commentary that while legal recognition by society that animals are sentient means that we (society) have direct moral obligations towards them, the same society also considers that humans are morally superior to animals. Garner stated that this, in effect, means we are not entitled to inflict suffering on animals unless the human benefit requires this outcome. However, this same argument can also be expanded to ensuring minimum standards for animals. If we know that animals require certain needs to be met to have a life worth living, then those responsible for animals should ensure these needs are met as a minimum. As long as circumstances at the time do not put human lives at risk, then this should be the bottom line (below which society will not tolerate, perhaps the 'legal minimum') in our society because we don't want to see an animal reach the point of unnecessary suffering before action can be taken to resolve the situation.

26.7 Case Study 2: Should Society Expect Government to Take Responsibility?

Society expects government to take responsibility for ensuring animal welfare standards are acceptable

throughout life and up to the point of humane slaughter. How those minimum standards are set is often influenced by prevailing cultures and accepted practices, even in developed societies. For example, for nearly the last 30 years, UK calves: (i) cannot be presented at a market before 7 days of age and until their navel is healed; (ii) cannot be brought to market more than once in 28 days; (iii) must be well bedded at all times; and (iv) must be transported from the market or collection centre within 4 h of sale of the last calf (Fig. 26.8). Under EU law they

cannot be transported at less than 10 days old unless the journey is under 100 km. In Australia, Prevention of Cruelty to Animals (Land Transport of Livestock) Standards 2013 (No. 2) state that calves must not be presented at market until they are at least 5 days old but can be transported direct to another farm at less than 5 days old if they meet specific requirements, including deep bedding provision. They must be provided with milk, or milk replacer, within 6 h of transport if they are less than 30 days old, which would mean provision of milk



Fig. 26.7. In societies which can afford it, animal protection may include funding to support conservation of habitats to support wild animal survival but where society cannot afford this then smarter solutions may need to be sought to protect animal welfare. (a) In Colombia, Fundacion Bioethos, an NGO, supports protection of endangered wild animals by encouraging indigenous people to make figures of the endangered species for sale to tourists. There is a QR (Quick Response) bar code on the bottom of each animal, which the tourist can click on with a smartphone to find out about the animal at risk. The local people earn money from this and are then less likely to kill those endangered animals themselves and encourage protection at a local level. (b) At the other end of the spectrum, the Animal Welfare Act (2006) includes a duty of care by all people with 'temporary responsibility', for example when a wild or feral animal is taken into care. For the most part wildlife rehabilitators do not need monitoring, providing they have a clearly defined humane culling or care policy for animals that are not fit to rehabilitate and release. However, a new and emerging welfare issue in developed societies is that of the animal 'hoarder', where the consequences of human mental health problems directly impact on the welfare of 'rescued' animals – and other humans, including children – in the family affected. (Image credits: Sophia Hepple.)



Fig. 26.8. Setting standards – (a) a calf for sale at a market in New South Wales, Australia; and (b) calves in a collection centre in the Republic of Ireland. (Image credits: Sophia Hepple.)

must be provided at the market, or their complete journey from farm, to market, to the new destination has taken less than 6 h. There are guidelines to provide bedding and ensure the navel is healed at market but these are not minimum legal standards in Australia and so will not always be followed.

26.8 Law and Guidance Should Ensure That Society is Clear About What is Acceptable

Hepple and Gibbens (2012) state that any law and guidance that accompanies an agreed government policy should ensure that society is clear about what is acceptable. The law provides for judgement and punishment of those who break the rules; the detail of the law is selected on the basis of a human judgement of what is considered right at the time of making them, together with the consequences of those rules. However, where the focus at the time of passing those laws was on judging and punishing unnecessary suffering and a 'life not worth living' then this can be difficult to translate across to punishing the failure to meet minimum standards – where unnecessary

suffering is not detected but clearly welfare may have been compromised for some or all animals subject to less than the minimum care that society expects. Additionally, penalties must be 'dissuasive enough' to ensure compliance and prevent recurrence.

A government can make as many laws as it wants around animal welfare but if some or all of that legislation is not enforced, or if the enforcement carries little disincentive (or effective punishment), those laws, or elements of it, become ineffective. Most in society would agree that enforcing action for unnecessary suffering and wilful cruelty deserves a criminal prosecution with convictions that include high monetary penalties, imprisonment and banning individuals from ownership and care of animals (Fig. 26.9).

In 2017 the revisions to guidance on sentencing and penalties relating to the key sections of the Animal Welfare Act 2006 in England and Wales came into force. These include:

- **level of culpability** demonstrated, for example, by differentiating deliberate or gratuitous acts to cause suffering from well-intentioned but incompetent care; and



Fig. 26.9. Most people agree that causing unnecessary suffering is a crime that must be punished, including custodial sentences, seizure of animals, and banning orders on the future keeping of animals. (a) Sick and untreated calf, (b) reindeer, (c) pig. (Image credits: Sophia Hepple.)

- **degree of harm** caused, differentiating death and serious injury/unnecessary suffering from other lesser harms causing welfare compromise to the animal(s).

Based on a combination of these two assessments, the sentencing panel is guided on levels of custodial sentence, community orders, and financial penalty to apply on conviction.

The panel is then required to take into account:

- **aggravating factors** – such as previous conviction or ignoring of previous professional advice; and
- **mitigating factors** – including remorse, previous good character, voluntary surrender of animals to authorities.

This process should ensure that the punishment does fit the crime and should result in custodial sentences and higher financial penalties being applied where there has been high culpability and unnecessary suffering has been caused.

However, applying such criminal penalties for ‘putting animals at risk by failing to meet minimum defined standards’ is not so easily justified or supported when applying the public interest test. A criminal conviction has serious consequences for the individual concerned and may be considered too much of a ‘sledgehammer to crack a nut’. However, there should be a simple, clear, and proportionate way to ensure we can achieve this without criminalizing those responsible when less serious offences are

disclosed. This means that, for example, in those countries with only criminal prosecution available, it may be necessary to consider additional civil penalty routes when welfare is at risk of being compromised by failure to meet minimum standards.

During New Zealand’s recent review of its 1999 animal welfare legislation this was acknowledged, and civil penalties will be introduced from 2018 to support the enforcement of minimum standards with clear monetary penalties for specific failings within different animal sectors.

26.9 Case Study 3: Enforcement Action That Does Not Work

In 2011 the European Commission reported on audit findings during 2008–2010 across a number of EU countries relating to enforcement of laying hens kept in unenriched cages (prior to the 2012-wide EU ban on such cages). This review revealed examples of enforcement action that did not work. Preventing eggs from being marketed as table eggs in Belgium had no disincentive if the farmers could still make a substantial profit marketing them as processed eggs (Fig. 26.10). Fines for overstocking in Italy, Bulgaria, Latvia, and Poland were not dissuasive when the profits on the excess birds far outweighed the penalties for non-compliance. In Bulgaria, for instance, one example of an initial overstocking infringement penalty was the equivalent of €150 in 2008 and the repeat infringement disclosed



Fig. 26.10. If the civil penalty route for infringements of animal protection law is to work then it must be financially dissuasive. Financial penalties must be greater than the profits made from breaking the law. (Image credits: Sophia Hepple.)

on the same farm in 2009 was €300; the disincentive to comply was clear when one worked out the 28,000 illegally overstocked birds on the unit were bringing in approximately €2250 per day for the producer! Prompt follow-up action to ensure compliance was also raised as a key element of enforcement – allowing a full year to follow up non-compliances was not considered effective in such circumstances.

26.10 Enforcement, What ‘Should’ It Do?

Enforcement action should ensure that:

- The consequences of enforcement action on non-compliance must be *financially dissuasive*:
 - financial penalties must be applied swiftly and appropriately; and
 - where restriction occurs (e.g. on sale or marketing of animals or products) until compliance occurs, the financial costs to the producer need to outweigh the profits made on non-compliance.
- The enforcement ‘body’ needs a clear process for following up on non-compliances to *ensure compliance occurs quickly*.
- There is a clear process for appropriate follow-up *enforcement action for continued non-compliances*.
- The *criminal prosecution* route, including, where necessary, actions to remove animals at risk and ban individuals from owning, keeping, or caring for animals, should remain part of the enforcement process.
- Where *serious offences* are disclosed at the outset, where the culpability and degree of harm is high without any mitigating factors, then criminal prosecution should be considered the primary route of enforcement at the outset.

In summary, civil penalties and further enforcement action must be applied in such a way that compliance can be quickly achieved for the individual and clear messages are communicated to the wider animal-keeping community about expectations on meeting minimum standards (including the penalties for non-compliance) in animal welfare (Fig. 26.11). Where offences are so serious that they justify immediate action to protect animals, the criminal prosecution route should not be delayed by any civil penalty processes which have been put in place.

However, does government have to be responsible for some, any, or all of this process? And how much,

if any, of the public purse should be paying for all of this?

In instances where an industry is making profit from the use of animals, society could quite easily argue that the industry should pay for some, if not all, of the policing costs of this, and that penalties derived from the process should be directly invested back into paying for the inspection and enforcement process.

26.11 How Much Do Those Profiting from Animal Use Need to Take Responsibility and Pay for Monitoring Standards in Animal Welfare?

Police, at all times, should maintain a relationship with the public that gives reality to the historic tradition that the *police are the public and the public are the police*; the police being only members of the public who are paid to give full-time attention to *duties which are incumbent upon every citizen in the interests of community welfare and existence*.

(Seventh Principle of Law Enforcement, Metropolitan Police, 1829 (italics added for emphasis); UK Government, 2012)

The nine principles of law enforcement were written into the instructions booklet given to each police officer enrolled into the Metropolitan Police, and thereafter other police forces, from 1829. This seventh principle was based upon the concept of police officers being ordinary members of the public, but being paid to do full time what is every citizen’s obligation to do in daily life to keep the local community safe and stable. The power of policing in the UK, and other countries following a similar approach, is carried out with public agreement, or the general ‘public will’, rather than through the powers of the state. This is known as ‘policing by consent’. Most of our public and society comply with the laws of the land and expect others to comply with the laws too, and it is expected that the public will (or would) support compliance with the law by reporting on non-compliances to the appropriate enforcement body. In the same way, there is a general expectation by the public that people with responsibility for animals, whether as companion, zoo, or farmed animals, will care for them, and that for wild sentient animals, people will not seek to deliberately harm them. Hunting of wild animals is an issue not yet addressed by the majority of developed societies where there is no essential need to hunt (see Chapters 5 and 23, this volume).



Fig. 26.11. Pyramid of enforcement tools proposed by the UK Government's (2011) report of the independent Farming Regulation Task Force. This sets out the future expectations on enforcement in the farming sector but should be equally applicable to other areas of animal welfare enforcement. (Image credits: Sophia Hepple.)

In situations where animals are being reared for a human purpose to provide food, milk, fibre or to assist in human work such as draught animals and assistance dogs, there does appear to be a greater expectation that governments will ensure those involved in their care discharge their duties correctly. Similarly, where wild animals are impacted by human actions or policies intended for a human benefit, there is an expectation that the government will ensure their needs are accounted for in addition to other environmental impacts. This is covered in more detail by Hepple and Gibbens (2012). However, the government, by acknowledging its responsibility in safeguarding animal welfare generally, does not absolve those involved in and profiting from animal care to take responsibility for themselves and execute self-regulation.

Paying for policing is not a new idea. The principle of publicly funding the police service in the UK (through a combination of funds from the UK tax payer and from local community taxing of households) is intended for the benefit of the public at large and specifically the local community, covered by the relevant local police service. However, where

the requirement for policing is as a consequence of a small sector present in the community (and some not normally resident in the local community) benefiting from the policing, for example at football matches and at music festivals (Fig. 26.12), then the police can charge events' organizers for their services. In the UK police can legitimately charge private businesses, such as football stadiums and music festivals, for policing events which are not of benefit to the public at large; however, they can only charge for services on the private premises. The wider implications of policing beyond the perimeter of the main event will impact the wider general public and so must still come from the public's pockets. However, more local communities are paying for additional private policing where government cuts have reduced police support, particularly in rural areas. Is it therefore reasonable to expect primary producers who make a profit from animals to pay towards policing animal welfare checks to assure the wider public of their care? Or is ensuring the provision of animal welfare seen as a public good that all society gains a moral benefit from, even those not directly consuming or using



Fig. 26.12. (a, b) UK police can legitimately charge private businesses, such as football stadiums and music festivals, for policing events which are not of benefit to the public at large. Is ensuring the provision of animal welfare seen as a public good that all society gains a moral benefit from, even those not directly consuming or using the end products, and that therefore government should continue to take some, or even all, of the responsibility? (Image credits: Sophia Hepple.)

the end products, and that therefore government should continue to take some, or even all, of the responsibility? However, many local councils have opted to pay for additional routine policing of local communities, which have been impacted in recent years by cuts to police funding. This has particularly affected rural communities where the low numbers of residents cannot justify full-time policing. In 2015, 20 of 43 police forces released figures under freedom of information laws, which showed that 1120 police officers were privately funded to the tune of more than £20 million in the UK police (*The Telegraph*, 2016).

Food business operators (FBOs) already contribute to the direct costs of inspections carried out by government inspectors in slaughterhouses across the UK to monitor and enforce animal welfare at the time of killing, in addition to checks to ensure that the food produced is safe to eat. However, these payments do not cover the full operational and indirect costs associated with inspection, checking, testing, and enforcement associated with killing animals at slaughterhouses.

These two examples are not really ‘self-regulation’ but the private sector paying, in effect, the government regulator for its own costs of regulation. However, the change to charging for policing has led to a shift change in how police are used, for example in football grounds. Rather than pay for the (more expensive) police to exert crowd control at pitch level, football associations or music festivals may pay for their own private security staff to do this, using and paying for the police in a more

targeted fashion, thus reducing the costs of policing. This is in effect self-regulation, but it works because for the most part security staff are there as a deterrent and when things go really wrong the private sector want the police support there as backup!

So, while the concept of self-regulation appears to be the cheapest solution in the face of reduced public resource, can it really work in businesses where profit is being made from animal use? Those involved in a particular food-producing industry, for example, will have a reputation to uphold and should not want to cover up or protect those not doing the job properly. For those industries with a global reputation this should strengthen the argument for self-regulation being a key solution. Yet, when citizens were asked about this, they appeared to be uncomfortable with this particular aspect of the Food Standards Agency’s (FSA) (England and Wales) five principles of regulation (TNS BMRB Research (for the FSA), 2016). The five principles state:

1. Businesses are responsible for producing food that is safe and what it says it is, and should be able to demonstrate that they do so. Consumers have a **right to information** to help them make informed choices about the food they buy – businesses have a **responsibility to be transparent** and honest in their provision of that information.
2. Businesses should **meet the costs of regulation**, which should be no more than they need to be.
3. Businesses **doing the right thing for consumers should be recognised**; action will be taken against those that do not.

4. FSA and regulatory partners' decisions should be tailored, proportionate and based on a clear picture of UK food businesses.
5. The regulator should take into account all available sources of information.

(TNS BMRB Research, 2016)

While the participants in the research agreed with the proposed five principles, particularly with the elements of industry taking responsibility and being transparent, they seemed less supportive of proposed changes towards self-certification, changes to the way regulation was to be funded and the potential introduction of multiple inspection providers:

As trust in food business was fragile, participants were unconvinced that a system that relied wholly or significantly on self-certification, in the absence of inspections, could be effective, and were strongly against this. Participants were sceptical that businesses could be induced to report any negative incident, and felt that self-assessment could encourage businesses to become dishonest or complacent. Participants felt strongly that inspections were the cornerstone of effective regulation, and provided a key mechanism for keeping businesses compliant.

(TNS BMRB Research, 2016)

Further, it was reported there was some concern about the credibility of privatization of any regulation of food businesses, which included the following:

- change in accountability of inspection provider from public to share-holder accountability;
- competition between different inspection providers and a focus on profit could reduce standards in inspection putting the public at increased risk (in relation to food safety); and
- increased risk of collusion between private regulators and FBOs.

Citizens appear to feel more secure with an independent 'government' regulator accountable to the public than with those contracted to carry out the work privately, whose primary obligations are to private shareholders. The policing model example discussed earlier appears to be the more trusted approach – making industry fund a government regulator's costs. Alternatively, an independent not-for-profit body with no shareholder or industry interest could be considered equivalent to a government regulator's independency as long as that independent body's visions and objectives are aligned with those of the general public. However, are there

any self-certification schemes that do work, and do the public trust them?

Currently in the UK and other countries there are 'farm assurance' schemes, which in effect are self-certifying compliance with an agreed set of standards. These assess against the minimum legislation across a range of relevant domestic laws and in some cases go beyond legislative requirements. Industry reputation is key, and so the meeting of such standards is then translated into the concept of producing high quality food from animals reared to a high standard: 'from paddock to plate', 'from stable to table' and 'from farm to fork'. While initially focusing on food safety assurance for the consumer, assurance has rapidly expanded to encompass many elements of food production that now include animal welfare during rearing, transport, and killing practices. There are some welfare-specific assurance schemes such as 'RSPCA Assured' (UK), 'Beter Leven' (the Netherlands, Dutch Society for the Protection of Animals) and 'Blue Tick' (New Zealand, Society for Prevention of Cruelty to Animals), to name a few (Fig. 26.13).

Most assurance schemes are usually independently accredited so that there is some third-party evaluation of the scheme to assure the public and the scheme members of the credibility of the assurance scheme. Generally the membership of such assurance schemes means that inspectors inspect all of the farms in the scheme, depending on the scheme type, between one and four times in every 12–18 month period. This coverage is far better than that able to be achieved by government inspectors focused on principally risk-based inspections (i.e. visiting those farms more likely to have non-compliances). However, trust in such private assurance schemes is tested every time there is a new media exposé on an assured farm revealing poor welfare, particularly if that farm has recently been inspected and found to be compliant. Most inspections are carried out on an 'announced' basis allowing farmers to get themselves organized (including gathering animals/getting extra staff in and gathering documentation for inspection) and to be available for inspections that often need some preparation if inspectors are to evaluate all elements covered under the assurance scheme. Further, the definition of an 'unannounced' inspection seems fairly elastic, with examples found on social media suggesting that farmers are given some notice (e.g. the night before) even for unannounced inspections. While welfare issues such as lack of



Fig. 26.13. Welfare branding and retailer claims on provenance. (a) More welfare-specific assurance labels such as 'RSPCA Assured' are now being used in the livestock product sector in addition to a basic assurance level. (b) 'Beter Leven' means 'better life' and the descriptor with the hand is 'animal protection'. (Image credits: Sophia Hepple.)

appropriate nutrition cannot be covered up overnight, other elements of welfare can be, which leads to loss of credibility, whether this is an inspection by a private assurance scheme inspector or a government inspector.

However, evidence does suggest that those farmers participating in farm assurance schemes do have a higher level of welfare compliance when assessed by government inspectors (Kilbride *et al.*, 2012). The latest evidence suggests that the more voluntary assurance and health schemes that a farm is signed up to then the greater the likelihood of compliance with animal welfare standards (Clark *et al.*, 2016). Of course this does not suggest a causal relationship, but this can be helpful when prioritizing inspections where public resources are limited. This link (between assurance and reduced risk) also suggests opportunities for industry to take more responsibility. This is particularly the case for those farms which have minor non-compliances and are encouraged to comply, the ultimate incentive to improve being removal of membership from the assured scheme, which can affect the producer's retailer supply contract and therefore their immediate source of income. This will probably have a far greater financial impact than prosecuting the farmer for failing to meet animal needs. Further, any earned recognition under risk-based government inspection systems may also be negated by removal from the scheme. However, this does rely on the various schemes aligning with the government on interpretation of what welfare compliance means. While for some elements of welfare legislation this is apparent, for other standards this is not so clear. When non-compliances are detected, there

needs to be a clear protocol for managing resolution quickly and effectively.

While most assurance schemes are operated on a country basis, and within-country each sector may have its own dedicated scheme, what about global assurance standards? In countries where there may not be the infrastructure or public resources to set standards and monitor welfare, then should industry and private companies investing in livestock operations abroad be ethically responsible in setting minimum standards in animal welfare that are recognized globally?

26.12 Case Study 4: Free Access in Cattle

Free-access cubicle systems are the norm in many European countries for dairy cows during winter periods when pasture cannot be accessed, and for some herds throughout all of lactation. They are provided with bedding in the cubicles, feed access in a separate location and often provided with enrichment devices such as grooming brushes (Fig. 26.14). Tie-stalls and tethers, while prohibited for calves, can still be used legally for adult cattle but their use is less common and very country specific. During a visit by the author to a pre-accession country, expected to join the EU within the next decade, there were some large tie-stall systems where dairy cows spent the whole of lactation confined to their cubicles. They were milked where they stood using a mobile milking system and if they became lame were treated in the same cubicle. This was a highly resource-intensive process and cows were only freed from their chains when dried off in preparation for



Fig. 26.14. (a, b) Free-access cubicle systems are the norm in many European countries for dairy cows during winter periods; however, in pre-accession countries, expected to join the EU within the next decade, large tie-stall systems exist where dairy cows spend the whole of lactation confined (tethered) in their cubicles. (Image credits: Sophia Hepple.)

calving. The heifers' experience in rearing did involve close individual confinement in the first 8 weeks of life but thereafter experienced open-fronted straw barns and in some cases pasture access until they entered the dairy herd between 2 and 3 years of age. This means that most of their early life experience was that of an animal with free movement and able to interact with other cows in the herd. As soon as they had their first calf they would enter the tether/chain cubicles. One very large farm was owned and run by an Irish farmer. When questioned about their principles in continuing to use such a system when free-access cubicles were the norm 'back home', the manager admitted that in Ireland they would not do this as it wasn't deemed acceptable but in this country it was. While the company hinted that in the future they would move to free-access cubicles because mobile milking was expensive in labour costs compared with using a milking parlour, it was concerning to find that a European company investing in livestock rearing abroad was willing to lower welfare standards to a local level of acceptability rather than attempt to drive up minimum standards to those used in the home country.

26.13 The Difficulty in Taking Responsibility for Protecting Welfare and Standard-setting at a Global Level

While global standards for animal disease control have been in place for nearly 100 years through the original agreement of 28 countries under the Office International des Epizooties (OIE) in 1924, it took another 80 years for the OIE to include animal welfare, and to consider setting global welfare standards.

The Brambell report (Brambell, 1965) acknowledged: 'Historically the evolution of our society has been marked by increasing concern for the welfare of animals . . . and that conditions which appear to us tolerable today may come to be considered intolerable in the future.'

As we improve our knowledge of animal cognition and different species' behavioural needs our attitudes to what is considered acceptable practice changes. With this in mind, the UK banned the long-term confinement of pregnant sows and gilts in stalls and tethers in 1999 and in Europe this was banned in 2013 (although in Europe sows can still be kept confined in stalls up to 4 weeks after service). However, most sows reared indoors commercially on a global level are kept in stalls throughout their life. UK breeding sow numbers in 2016 were just under 0.5 million (at 490,000), with the figure for total EU sows being just over 12 million (Eurostat), so realistically the direct impact that the UK laws have on the welfare of breeding sows is probably less than 1% (very approximately (!) calculated from known global meat production) of the total global breeding sow population. Note, however, that UK retailers may have a wider sphere of influence since UK legal requirements may be demanded for imported pig meat.

The setting of global standards, or at the very least global animal welfare principles, hopefully allows some lines to be drawn in the sand regarding level of acceptability. However, when we look at the current OIE welfare chapters (available at: <http://www.oie.int/> (accessed 15 March 2018)) we find that the focus is on welfare outcome indicators with no clear stance on minimum resource access (such as space requirements and limits on confinement

and access to bedding or enrichment materials). This means they are somewhat lacking in their global influence on lessons learned in the livestock-rearing sectors. Ideally the guidance should reflect on the unsuitability of certain rearing methods which unnecessarily isolate and confine animals, or which require painful intervention such as tail-docking, castration, teeth-clipping, and beak trimming, to avoid undesirable injurious behaviours which are seen in some rearing environments.

26.14 Case Study 5: The Confinement Crate

For years the indoor farrowing sow has been moved into a farrowing crate prior to giving birth, unable to turn around (Fig. 26.15). She remains in the crate until after she has weaned her piglets at 4 weeks of age, or longer if she is then used as a foster sow. The aim is to prevent the unfortunate, but regular, accidental deaths of piglets by the sow crushing them or the occasional savaging of an entire litter by a young sow. This is a case of compromising the welfare of the mother to optimize the survival and well-being of her offspring. While 40% of breeding sows farrow outdoors in the UK and do not face such confinement, most of the remaining indoor sows do and what was considered acceptable in the best interests of the piglets is now no longer considered by most in society as acceptable for the welfare of the sow. The UK Government funded a large-scale project, 'PigSAFE', to redesign a farrowing environment from first principles to seek an optimum free farrowing design that optimized both sow and piglet welfare

(Baxter *et al.*, 2012). Other similar projects were underway across Europe and most studies reached similar conclusions. These were that a farrowing environment allowing free movement of the sow and permitting her to nest-build could be achieved if appropriate safety measures were put in place for the piglets, and the nesting area designed and bedded in a way to encourage the sow to farrow and nurse her piglets in the right location of the pen. Norway, Sweden, and Switzerland have already banned the farrowing crate. FAWC (2015a) noted that Brambell's (1965) observation that sows were confined for only a few days after farrowing had been extended to the full lactation over the years since this report (1965) and concluded that only the first 72 h of life were critical to piglet survival. FAWC recommended 'continued development of commercial free farrowing systems with the aim of replacing farrowing crates' and to review the adoption of free farrowing systems in 2020. Denmark aims to have 10% of its breeding sows out of traditional farrowing crates by 2022 and Austria plans to phase them out by 2033. Unfortunately, developing countries are now adopting 'Western society'-rearing methods and the issue of the sow confined in the farrowing crate, and indeed throughout gestation in gestation crates, could continue on a far greater global scale as China now has the biggest breeding sow population in the world. So how much responsibility do the rest of society, and specifically global industry, private companies, and retailers investing and profiting from 'cheap meat' production need to take to ensure avoidable welfare problems are not translocated to countries with lower welfare standards?



Fig. 26.15. (a) Indoor farrowing sow in a farrowing crate, unable to turn around. She remains in the crate until after she has weaned her piglets at 4 weeks of age, or longer if she is then used as a foster sow. (b) A free farrowing system in which the sow can turn around and in which bedding is provided for nesting. (Image credits: Sophia Hepple.)

26.15 Part of a Global Conglomerate

So, we understand that we do not just live life in our little cocoon of a British island, European Community, or Australasian continent. We are part of a global conglomerate of a number of distinct societies with different values and views towards animals. These different societies have varied abilities to ensure that welfare needs are met and that animals are protected. Not all societies are currently able to set what one society might consider are the minimum requirements – such as daily access to appropriate food, water (Fig. 26.16), and veterinary supplies (Fig. 26.17), when the human society caring for those animals does not have such access for themselves. Furthermore, some countries do not have the necessary regulatory frameworks or veterinary services to set standards or provide ongoing support and advice to local communities.

It has been mainly the work of international charities working in countries to initially provide direct support in the form of treatment, and then support training owners to provide basic care for their animals. The issues dealt with in these countries are akin to the issues raised in the late 18th and early 19th century in the UK and Europe. In other words, dealing with unnecessary suffering caused either wilfully or through ignorance, as a result of traditional practices or custom, or human necessity (because continued use of the animal is necessary for family income). This starts to explain in some way, when you consider the current 180 country membership of the OIE, why the OIE welfare chapters have to be pragmatic in the guidance that they provide on animal welfare.

Any global standards in animal welfare need to be realistic and recognize that many countries may



Fig. 26.16. Setting minimum standards at a global level can be difficult: (a) while wholesome daily water provision for animals under our care is really a ‘no-brainer’ as a minimum welfare standard (and possible to achieve in many developed countries), (b) in countries where the human population may struggle to attain this for themselves then this may be practically unattainable for some. (Image credits: Sophia Hepple.)



Fig. 26.17. (a) Access to the right veterinary advice and appropriate treatments in developing countries are part of a holistic ‘One Health’ concept, but a key element is preventive healthcare for animals. (b) This includes education of the primary care-givers and in many instances requires significant human behaviour change for this to work. (Image credits: Sophia Hepple.)

need ongoing support and effective knowledge transfer at a local community level.

26.16 Conclusions

We have two parallel elements running on the theme of protecting animal welfare in the face of shrinking public resource:

- thinking more smartly about capacity building through effective but economic knowledge transfer and eliciting human behaviour change in developing countries; and
- ensuring that those emerging countries entering the more intensive livestock-rearing sector are imparted with our lessons learned (including our own mistakes) about intensive livestock husbandry over the last 70 years.

As we face the issues of food security to feed 9 billion by 2050, climate change mitigation strategies, and sustainable livestock intensification, animal welfare must not be compromised by this. FAWC's report on sustainable agriculture (2015b) proposed the following three key principles:

1. Agriculture cannot be considered sustainable if it is achieved at an unacceptable cost to animal welfare.
2. Sustainable agriculture must take account of the fact that farmed animals are sentient individuals.
3. Sustainable agriculture must include a duty of care for the physical and mental needs and natures of farmed animals, and should not depend on prolonged or routine use of pharmaceuticals, or on mutilations.

In summary, we must not lose the valuable evidence we have already learned and applied in some countries for providing suitable rearing environments for animals, whether they are companion, farmed livestock, or wild animals. We need to embed minimum standards of animal welfare as part of our global focus on food security and environmental/agricultural sustainability with governments, NGOs, retailers and major industry players – each taking responsibility for ensuring this in the face of ongoing shrinking public resources.

Bibliography

Baxter, E.M., Lawrence, A.B. and Edwards, S.A. (2012) Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs. *Animal* 6(1), 96–117.

- Brambell, F.W.R. (1965) *Report of the Technical Committee to Enquire into the Welfare of Animals Kept Under Intensive Livestock Husbandry Systems* (also known as the Brambell Committee report). HMSO, London.
- Brandon, M., Belderson, P., Warren, C., Gardner, R., Howe, D. *et al.* (2008) The preoccupation with thresholds in cases of child death or serious injury through abuse and neglect. *Child Abuse Review* 17(5), 313–330.
- Clark, C.C.A., Crump, R., KilBride, A.L. and Green, L.E. (2016) Farm membership of voluntary welfare schemes results in better compliance with animal welfare legislation in Great Britain. *Animal Welfare* 25, 461–469.
- Community Care (2016) *Child in need or child protection? The never-ending issue of thresholds*. Available at: <http://www.communitycare.co.uk/2016/10/11/child-in-need-child-protection-never-ending-issue-thresholds/> (accessed 27 July 2018).
- European Commission (2011) *General Report of Findings from Missions 2008–2010 on Enforcement of Animal Welfare Standards for Laying Hens Kept in Unenriched Cages*. The Food and Veterinary Office of the European Commission's Health and Consumer Directorate. Ref. Ares(2011)382892 – 06/04/2011. Available at: http://ec.europa.eu/food/fvo/specialreports/2011_8814_en.pdf (accessed 23 August 2017).
- Farm Animal Welfare Committee (2015a) *Farm Animal Welfare Committee (FAWC) Opinion on Free Farrowing Systems*. Department for Environment, Food and Rural Affairs (Defra), London. Available at: <https://www.gov.uk/government/publications/farm-animal-welfare-committee-fawc-opinion-on-free-farrowing-systems> (accessed 23 August 2017).
- Farm Animal Welfare Committee (2015b) *Farm Animal Welfare Committee (FAWC) Independent Report on Sustainable Agriculture and Farm Animal Welfare*. Department for Environment, Food and Rural Affairs (Defra), London. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/593479/Advice_about_sustainable_agriculture_and_farm_animal_welfare_-_final_2016.pdf (accessed 23 August 2017).
- Farm Animal Welfare Council (FAWC) (2009) *FAWC Report on Farm Animal Welfare in Great Britain: Past, Present and Future*. Department for Environment, Food and Rural Affairs (Defra), London. Available at: <https://www.gov.uk/government/publications/fawc-report-on-farm-animal-welfare-in-great-britain-past-present-and-future> (accessed 23 August 2017).
- Garner, R. (2008) The politics of animal rights. *British Politics* 3, 110–119.
- Harrison, R. (1964) *Animal Machines: The New Factory Farming Industry*. Vincent Stuart Publishers, London.
- Hepple, S. and Gibbens, N. (2012) Animal ethics and government's policy: 'to guard and protect'. In: *Veterinary and Animal Ethics: Proceedings of the First International Conference on Veterinary and*

- Animal Ethics*, September 2011. Wiley, London, pp. 229–244.
- Kilbride, A.L., Mason, S.A., Honeyman, P.C., Pritchard, D.G., Hepple, S. and Green, L.E. (2012) Associations between membership of farm assurance and organic certification schemes and compliance with animal welfare legislation. *Veterinary Record* 170, 6.
- Kirk, G. and Duschinsky, R. (2017) On the margins of the child protection system: creating space for relational social work practice. *Child & Family Social Work* 22, 963–971. DOI: 10.1111/cfs.12316
- Lawrence, J. (1796) The rights of beasts. In: *A Philosophical and Practical Treatise on Horses: And on the Moral Duties of Man Towards the Brute Creation*. Longman, London, pp. 117–163.
- Lord Laming (2003) *The Victoria Climbié Inquiry*. The Stationery Office, London, 432 pp.
- Lord Laming (2009) *The Protection of Children in England: A Progress Report*. The Stationery Office, London.
- Munro, E. (2011) *The Munro Review of Child Protection: Final Report. A Child-centred System*. The Stationery Office, London.
- Onion, A.K. (2014) Humane education in an early childhood science education curriculum. In: Jalongo, M.R. (ed.) *Teaching Compassion: Humane Education in Childhood*. Springer, Dordrecht, the Netherlands, pp. 213–226. DOI: 10.1007/978-94-007-6922-9
- The Telegraph* (2016) Revealed: Britain's Privately-funded Police Force. 3 January. Available at: <https://www.telegraph.co.uk/news/uknews/law-and-order/12064205/Revealed-Britains-privately-funded-police-force.html> (accessed 15 March 2018).
- TNS BMRB Research (2016) Food Standards Agency – Regulating our Future: Research with the Public. Previously Available at: <https://www.food.gov.uk/sites/default/files/rofresearchwiththepublic.pdf> (accessed 23 August 2017).
- UK Government (1989) The Children's Act 1989. Available at: <https://www.legislation.gov.uk/ukpga/1989/41/contents> (accessed 15 March 2018).
- UK Government (2003) *Every Child Matters*. The Stationery Office, London, 112 pp.
- UK Government (2006) The Animal Welfare Act 2006. Available at: http://www.legislation.gov.uk/ukpga/2006/45/pdfs/ukpga_20060045_en.pdf (accessed 15 March 2018).
- UK Government (2008) Children and Young Persons Act 2008. Available at: <https://www.legislation.gov.uk/ukpga/2008/23/part/2> (accessed 15 March 2018).
- UK Government (2011) Independent Farming Regulation Task Force report. Available at: <https://www.gov.uk/government/publications/independent-farming-regulation-task-force-report> (accessed 27th July 2018).
- UK Government (2012) Definition of Policing by Consent. Home Office freedom of information release, 10 December 2012. Available at: <https://www.gov.uk/government/publications/policing-by-consent> (accessed 15 March 2018).
- Webster, A.J.F. (2005) *Animal Welfare: Limping Towards Eden*. Wiley-Blackwell, London.

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Animal Welfare in a Changing World

Edited by **Andy Butterworth**

Contemporary and challenging, this thought-provoking book outlines a number of the key dilemmas in animal welfare for today's, and tomorrow's, world. The issues discussed range from the welfare of hunted animals, to debates around intensive farming versus sustainability, and the effects of climate and environmental change. The book explores the effects of fences on wild animals and human impacts on carrion animals; the impacts of tourism on animal welfare; philosophical questions about speciesism; and the quality and quantity of animal lives. The welfare impacts of human-animal interactions are explored, including human impacts on marine mammals, fish, wildlife, and companion and farm animals.

Animal Welfare in a Changing World provides:

- Concise, opinion-based views on important issues in animal welfare by world experts and key opinion leaders.
- Pieces based on experience, which balance evidence-based approaches and the welfare impacts of direct engagement through training, campaigning and education.
- A wide-ranging collection of examples and descriptions of animal welfare topics which outline dilemmas in the real world, that are sometimes challenging, and not always comfortable reading.

This is a 'must-read' book for animal and veterinary scientists, ethologists, policy and opinion leaders, NGOs, conservation biologists and anyone who feels passionately about the welfare of animals.