20
NON-DOMESTICATED TERRESTRIAL SPECIES

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Introduction

Wildlife can be defined as "living things and especially mammals, birds, and fishes that are neither human nor domesticated" (Merriam-Webster 2021). The number of non-domesticated terrestrial species far exceeds the number of domesticated animals. And yet, we still know very little about their well-being. Animal welfare science has traditionally focused on domesticated animals or non-domesticated animals in zoos (Freire and Nicol 2019), whereas wildlife have been the concern of biological conservation, with little attention paid to their welfare until the late 20th century (e.g., Broom 1999). Since the term "wildlife" encompasses a vast range of species, there is a large diversity in behaviour, physiology, and signs of pain. It is, therefore, very difficult to make any generalisations about how poor wildlife welfare manifests. Furthermore, the uncertainty about sentience in some species adds another layer of complexity (Soryl et al., 2021).

With the growth and expansion of human populations over the last centuries, wildlife have been increasingly influenced by human activities. Fraser and MacRae (2011) listed four types of human impact: 1) keeping animals in captivity; 2) causing deliberate harm, e.g., through hunting or pest management; 3) causing direct but unintended harm, e.g., by vehicle collisions, a harvest of agricultural products, or oil spills; and 4) causing indirect harm, e.g., through environmental pollution, loss of habitat, or climate change. Some of these impacts are discussed in the other chapters of this book. This chapter aims at highlighting potential animal welfare issues experienced by non-domesticated terrestrial species in the wild, through wildlife rehabilitation, reintroduction programmes, wildlife research, and the exotic pet trade.

Non-domesticated animals in the wild

In contrast to popular belief, the lives of animals living in the wild can be far from idyllic (Horta 2017). Their well-being may be compromised through starvation, disease, or injury, and the majority of animals die well before reaching their maximum lifespan. Richard Dawkins described the situation in the wild in his book River Out of Eden with the following words (Dawkins 1995, pp. 131–132):

> The total amount of suffering per year in the natural world is beyond all decent contemplation. During the minute that it takes me to compose this sentence, thousands

DOI: 10.4324/9781003182351-24

> of animals are being eaten alive; others are running for their lives, whimpering with fear; others are being slowly devoured from within by rasping parasites; thousands of all kinds are dying of starvation, thirst and disease.

Indeed, it could be considered that most of the wildlife suffering might be a consequence of 'natural' causes, such as resource scarcity limited by the carrying capacity of the ecosystem, droughts, or floods. These factors are, however, exacerbated by human activities. The increasing human population puts immense pressure on ecosystems through the building of infrastructure, pollution, and demand for food resources, and with it associated land use and anthropogenic climate change (Chapter 23). Many practices in forestry, agriculture, or pest control have a significant impact on wildlife welfare.

That humans are responsible for the well-being of animals under their care is a widespread societal view that is often embedded in animal welfare legislation. When it comes to wildlife, there are opposing opinions on whether humans have the duty or even right to manage or assist these animals. Some philosophers have argued that we do not have a moral obligation to intervene in nature because (most) animals would not be considered moral agents (Sapontzis 1984), or because the autonomy and sovereignty of animals should be honoured (Nussbaum 2006). Others have reasoned that we need to expand our circle of moral concern beyond domesticated animals and try to alleviate the suffering of non-domesticated animals living in the wild, i.e., living in natural conditions without human control (Horta 2017). Several forms of assistance to wildlife have been proposed, for instance, the provision of medical care to sick animals, vaccination to prevent diseases, or contraception to control population size and dynamics (Horta 2017; Soryl et al., 2021). One specific approach to help wildlife is wildlife rehabilitation.

Wildlife rehabilitation

The aim of wildlife rehabilitation is to provide care to injured, sick, or orphaned animals so that they could be returned to their natural habitats. Among the reasons for admission are, for example, car strikes, dog and cat attacks, or entanglements (Taylor-Brown et al., 2019). While the primary benefit of wildlife rehabilitation is to help and alleviate the suffering of an individual animal, there are several other advantages, including the improvement of diagnostic and therapeutic practices for wildlife, replenishment of local populations, education, or disease surveillance (Tribe and Orr 2019). Moreover, data from wildlife rehabilitation centres are of great value for species conservation, providing insights into natural and anthropogenic threats for wildlife (Taylor-Brown et al., 2019).

Nevertheless, there are also risks associated with the rehabilitation practice, such as improper medical interventions resulting in poor animal welfare, risk of disease transferred from the rehabilitated and released individual into the population of animals living in the wild, or risks of zoonoses for employees and volunteers of rehabilitation centres (Tribe and Orr 2019). Furthermore, the hazards of the release stage are often underestimated, with the potential for high losses. Hence, post-release monitoring of the released animals is essential to evaluate the success of the rehabilitation program (Mullineaux 2014).

Wildlife rehabilitation requires balancing the well-meaning altruism of people trying to help non-domesticated animals, against the aim of avoiding unnecessary suffering of animals brought into captivity (Mullineaux 2014). As the flight response to humans is a vital survival trait for all wildlife species, every effort must be made to keep human contact to the minimum to prevent the habituation and taming of the animals. Unfortunately, sometimes people bring wild animals to a rescue or rehabilitation facility who do not actually need saving. For instance, Robertson and Harris (1995) radio tracked foxes after release and reported that many 'orphaned' fox cubs were not in fact orphans.

The rehabilitation of non-native, invasive species is a contentious issue, which is handled differently based on local legislation. For instance, the National Wildlife Rehabilitators Association based in the USA defines rehabilitation as "the treatment and temporary care of injured, diseased, and displaced *indigenous* animals, and the subsequent release of healthy animals to appropriate habitat in the wild" (Miller, 2012; emphasis added). Consequently, injured or orphaned individuals that are classified as invasive species might get rejected by most rehabilitation centres. In many countries, it is illegal to release an invasive species into the wild. Therefore, even if the animals receive veterinary care, they have to be either euthanised or stay in captivity. Captivity often leads to substantial animal welfare issues, e.g., due to inappropriate housing conditions or stress caused by the presence of people and other animals (Rivera et al., 2021).

Repatriation to the wild

Animal reintroductions are defined by the IUCN as "the intentional movement and release of an organism inside its indigenous range from which it has disappeared" (IUCN 2013). More generally, they refer to an attempt to restore a population of extirpated species or to increase abundance within a population, in the area that is a part of the species' current or historical range. Species reintroduction programmes are now commonly used to aid conservation efforts across the globe. One example of success is the recovery of the Californian condor (*Gymnogyps californianus*). In 1982, there were only 22 Californian condors left in the wild, as a consequence of habitat loss and pollution. The remaining individuals were brought into captivity and used in a breeding program in 1987. Even though the species remains critically endangered, breeding and reintroduction have been effective and a small population is now thriving in the wild (Wilcove 2000).

However, despite the wide implementation of reintroductions, the success rate of reintroduction programmes varies greatly for different species, environments, and scenarios. Specifically, the success might be influenced by predation risk, habitat quality, number of released individuals, and behavioural traits. Unfortunately, many translocations and reintroductions fail shortly after the release of animals. After release, welfare risks include potential human persecution (especially for large carnivores), injury, hunger, and in social species, the need to re-establish a social structure (Goddard 2020). Harrington et al. (2013) evaluated 199 reintroduction projects and found that two-thirds reported one or more animal welfare issues. Mortality rates of more than half of the released animals were described in 23% of the projects. Furthermore, captive-bred animals often experience more difficulties with coping in the wild after release than wild-caught animals, and have a higher mortality rate (Harrington et al., 2013). For wild-caught animals used in breeding and reintroduction programmes, it is also crucial to consider the welfare implications for the individuals within the source populations. The capture of animals from the wild might have negative consequences in species with complex social structures if key individuals are removed (Goddard 2020). The original populations might be also left genetically depauperate.

Reintroduction of captive-bred predators in particular into their natural ecosystem carries many difficulties, as the ability of the animals to recognise, catch, and kill their prey can be compromised. Many large carnivores come into conflict with people, which sometimes escalates into their persecution (Goddard 2020). On the other hand, there are also issues with the reintroduction of prey species that are naïve to the predator's presence. Associative learning might teach naïve animals about predators and enable them to identify and appropriately respond to them (Clayton et al., 2014). However, whether this training improves the success of reintroduction is not clear. So far, several studies have reported no improvement in the survival rate after release, or have assessed only short-term survival. The welfare of resident wildlife needs to be considered

as well. They might be displaced by the reintroduced species, have to compete for resources, or become prey to introduced carnivores (Goddard 2020).

It is important that reintroductions adhere to the internationally accepted standards for animal welfare, and that stress or suffering is minimised. The IUCN Guidelines for Reintroductions and Other Conservation Translocations outline a framework for deciding when a translocation is an acceptable option, on planning a translocation, the feasibility and design, risk assessment, release, monitoring, and dissemination of information (IUCN 2013). Repatriation should be implemented only after a careful consideration of harms and benefits, and conservation goals should not supersede the individual animal's welfare.

Wildlife research

Ecosystems across the globe are experiencing a dramatic extinction process. To fully understand and possibly counter this trend, ecologists, conservation biologists, and wildlife researchers collect data on species distribution, population sizes, or gene flow, all of which are necessary information for effective management. Wildlife research is often glamorised by the media, focusing on charismatic species and on saving their populations. But historically, there has not been enough consideration for the welfare of individual animals. In the seminal work defining the field of conservation biology, Michael Soulé wrote (Soulé, 1985, p. 731):

> It may seem logical to extend the aversion of anthropogenic extinction of populations to the suffering and untimely deaths of individuals because populations are composed of individuals. I do not believe this step is necessary or desirable for conservation biology. Although disease and suffering in animals are unpleasant and, perhaps, regrettable, biologists recognize that conservation is engaged in the protection of the integrity and continuity of natural processes, not the welfare of individuals.

Even today, research in conservation biology is often conducted under the assumption that it has an insignificant impact on the studied wild animals or that any impact is outweighed by the potential benefits to the population or species. Such assumptions however raise concerns for animal welfare (Zemanova 2019, 2020, 2021b). Many research methods traditionally implemented in wildlife research are invasive (i.e., penetrating the skin barrier) or stressful, thus negatively impacting the animal used in research. Our understanding of how research practices affect animal welfare is hindered by the fact that some of the research methods might have delayed consequences, and in many cases, animal welfare implications are simply not known. It is imperative to exercise the precautionary principle, and when in doubt, to always design the study to have the least potential impact (Zemanova 2020). Examples of research activities that have been shown to influence animal welfare are capture, marking, blood and tissue sampling, or attachment of radio transmitters.

Marking of wildlife species is often used to obtain data on behaviour, survival rate, or population size estimation. Practically all marking techniques require capture and some of them include tissue damage through hot- or freeze-branding, or mutilation of limbs with toe-clipping. Toe-clipping is still a commonly used method for marking small species such as amphibians, lizards, and rodents, even though several studies have reported its negative impact on the animal's survival rate and locomotion. Another marking approach is the use of tags or bands. However, these can increase the energetic costs of swimming due to drag in semi-aquatic animals such as seals or penguins (reviewed in Zemanova 2020).

Blood and tissue sampling are commonly used for DNA collection, physiological assessment, or ecotoxicological studies. Although generally considered safe, blood sampling has been

linked to a lower survival rate in American cliff swallows (*Petrochelidon pyrrhonota*) (Brown and Brown 2009). Tissue sampling often requires lethal means, causing obvious harm to the individual animal.

To track animal movement, wildlife researchers use GPS collars and harnesses or radio transmitters glued to the skin or implanted into body cavities. There have been several animal welfare issues identified with their use. For example, birds carrying a radio transmitter can get entangled with vegetation and have a lower survival rate. GPS collars on large herbivores have been shown to affect grazing behaviour and decrease the survival rate. If the radio transmitter is attached to the skin, the glue can cause abrasions and lesions. Implanted radio transmitters seem to be particularly problematic, as several cases of mortality have been reported for a range of wildlife species, e.g., brown bear (*Ursus arctos*), European lynx (*Lynx lynx*), or American badger (*Taxidea taxus*) (reviewed in Zemanova 2020).

Even capture alone can be extremely stressful for an animal living in the wild that is not accustomed to being handled by humans. The stress of capture can be reflected in increased cortisol levels, which might skew the results of physiological assessments. In extreme cases, this stress can lead to capture myopathy, which is a metabolic disease often resulting in death. Furthermore, capture can lead to a deteriorated body condition, reduced movement, or a lower survival rate. Traps can also cause injuries, ranging from skin abrasions to broken limbs.

Poor animal welfare is, however, not only an issue for the individual animals affected by wildlife research. It can also result in public outrage and affect the soundness of study results (Zemanova 2021a). Pain leads to behavioural, physiological, and neurobiological changes (Sneddon 2017). Since rigorous science is a prerequisite for good management decisions, it is crucial that the impact of wildlife research on animal welfare is minimised. Unfortunately, there seems to be a lack of education in ethics and animal welfare that could provide basic guidance on how to deal with ethical dilemmas encountered in wildlife research (Zemanova 2017, 2021a). Moreover, the legislation in some countries distinguishes whether a permit is required to conduct the same procedure, e.g., blood sampling, depending on whether its purpose is classified as wildlife research or wildlife management (Lindsjo et al., 2019).

An important milestone in promoting animal welfare in research was achieved in 1959 when Russell and Burch proposed the 3Rs principles (Russell and Burch, 1959). These principles state that scientists should Replace animals with alternative methods whenever possible, Reduce the number of animals in experiments to the minimum, and Refine or limit the pain and distress that animals might be experiencing as a result of the experiment or laboratory housing. The 3Rs principles are nowadays an integral part of legislation in many countries. Even though they were originally proposed and designed for work with laboratory animals – mostly rodents – they are applicable to wildlife research as well – with a few caveats. While laboratory research might use animals as models for human diseases and physiology, the object of wildlife research is the animal itself. Therefore, it would not be possible to use a cell culture – a common replacement approach in laboratory research – to study, for instance, gene flow among kangaroo populations. Furthermore, wildlife is a term encompassing a broad range of species with different ecological and physiological characteristics, making generalisations of guidelines challenging.

Nevertheless, one of the most straightforward strategies to implement the 3Rs is to use non-invasive research methods, but other strategies, such as calculation of the minimum sample size, sharing data and resources, or using anaesthesia and tranquilisation, are also important for good animal welfare (Figure 20.1). Unfortunately, the use of invasive and lethal methods persists. For instance, a recent assessment revealed that on average, only 22% of wildlife genetics studies published between 2017 and 2018 made use of an available non-invasive DNA sampling technique (Zemanova 2019). Even though this review may have not captured all published studies, the

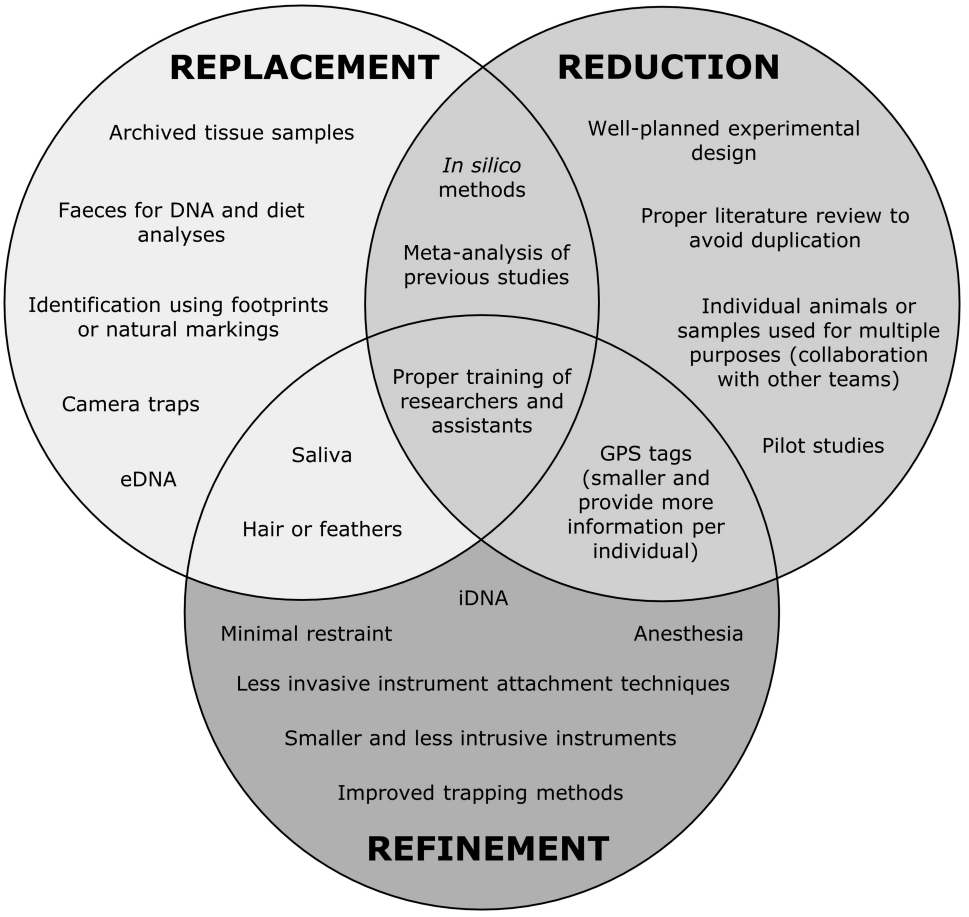

Figure 20.1 Strategies for the implementation of the 3Rs principles (Replacement, Reduction, Refinement) in wildlife research. Overlapping methods for replacement and refinement depend on whether the animal has to be captured or not. Source: Zemanova (2020).

findings indicate that wildlife researchers might struggle to implement non-invasive methods into their work. Sadly, the application of the 3Rs principles to wildlife research has been rather slow. For example, Field et al. (2019) reviewed animal care policies in 206 biodiversity- and wildlife-related journals and found that only 6% required authors to adopt the 3Rs principles in their research. One of the main reasons for the low implementation rate might be a lack of awareness (Zemanova 2021a). The lack of awareness will hopefully be ameliorated with the emergence of the 3Rs guidelines and databases designed specifically for researchers working with wildlife (e.g., https://3RsWildlife.info; Zemanova 2021b).

Exotic pet trade

Most of us are fascinated with wildlife. But for some it is not enough to watch animals in the wild; they want to be able to touch them, cuddle with them, or just flaunt them as status symbols. This desire is reflected in the increasing demand for exotic, i.e., relatively rare or unusual, non-domesticated pets. It was estimated that in the USA, 19.4 million households owned an

exotic species in 2013 (Micheli 2014), and in the UK, the exotic pet population amounted to 42 million in 2014 (PFMA 2014). Keeping exotic pets is, however, not limited to the developed countries. For instance, Jepson and Ladle (2005) found that in Indonesia, one is more likely to find an exotic pet in a household than a common domesticated animal, such as a cat or a dog.

Wildlife trade is one of the most prominent contributors to biodiversity loss and a major hindrance to species conservation (Baker et al., 2013). The majority of countries protect threatened and endangered animals through the agreement implemented within the Convention on the International Trade in Endangered Species (CITES). The convention currently lists approximately 5,950 animal species that are prohibited from trading without a license from the authorities (CITES, 2021). Yet, animals traded under the CITES represent only a small proportion of the species bought and sold as exotic pets. Furthermore, the international market in exotic pets is not limited to legal means of supply, and constitutes a significant proportion of the illegal wildlife trade, mostly of birds, amphibians, reptiles, and fish (Schuppli et al., 2014). Illegally traded animals are often smuggled across borders under abhorrent conditions. Small species may be crammed in large numbers into small, airtight containers, resulting in death due to asphyxiation during transport (BBC, 2014). This trend is not easy to combat, because the illegal wildlife trade has become one of the largest sources of income for organised crime. In 2012, it was valued at around 19 billion US dollars a year (WWF and Dalberg, 2012).

Animal welfare issues associated with exotic pet trade are still understudied. Baker et al. (2013) assessed the literature on wildlife trade and found that only 13–25% of the studies reported the impact on animal welfare. In the following, some of the known issues are discussed.

Wild capture versus captive breeding

Any live capture of wildlife poses a risk – not only for the person capturing an animal, who might get scratched or bitten, or acquire a zoonotic disease, but there is a risk of injury also for the captured animal. Natusch and Lyons reported that large numbers of wild-caught reptiles in New Guinea are unsuitable for export due to injury or death (Natusch and Lyons 2012). Since many animals also die in transit, due to dehydration, starvation, crushing, or asphyxiation, many more individuals need to be captured than the number that actually ends up being traded on the market (Baker et al., 2013).

Captive breeding might reduce the pressure on wild populations of favoured exotic species. However, the financial costs of wild capture tend to be much lower than the costs of captive breeding (Burivalova et al., 2017). Additionally, breeding farms can be used to launder illegally caught wildlife. Lyons and Natusch (2011) assessed the trade of the green python (*Morelia viridis*) in Indonesia and were able to trace over 4,000 illegally caught green pythons to a breeding farm. They estimated that a minimum of 80% of the green pythons exported from Indonesia are illegally captured from the wild. Furthermore, some species are difficult to breed. While 90% of freshwater ornamental fish are easily bred in captivity (Andrews 1990), 90% of marine ornamental fish are still wild-caught (Cato and Brown 2008).

Husbandry concerns

The domestication of dogs or cats took thousands of years of artificial selection that resulted in them being well adapted to life as human companions. Conversely, captive-bred, non-domes-

ticated animals have the same needs as their counterparts living in the wild. There is plenty of information about the proper care for domestic animals, such as dogs and cats, and veterinary practices are well versed in treating them. In contrast, there is a lack of specialised veterinary care for exotic animals and such pets may not be easy to care for. For instance, reptiles and amphibians have very specific physiological and behavioural requirements that many owners may not be aware of or do not have the facilities to cater for. Furthermore, these animals may not exhibit stress indicators common in other species (Hernandez-Divers 2001).

Keeping animals in suboptimal settings is a threat to their welfare. Ashley et al. (2014) reported on an investigation at a large international wildlife wholesaler conducted by veterinarians and biologists under the auspices of the Texas state authorities. The investigators found and confiscated over 26,000 animals across 171 species. Sick, injured, or dead animals constituted 80% of the animals on site. The authors identified poor hygiene, inadequate or inappropriate supply of water, food, or heat, and high levels of stress, as the factors contributing to high disease and mortality rates (Ashley et al., 2014). Within households, it has been estimated that the vast majority of pet reptiles are kept under unsuitable conditions, and up to 75% die within a year of purchase (Toland et al., 2021). Cases of incorrect husbandry with dire consequences for animal welfare have been reported also for other types of animals. For example, parrots are one of the most intelligent birds, making them prone to developing stereotypies, i.e., abnormal, repetitive, and seemingly functionless behaviours that are one of the indicators of poor animal welfare (Engebretson 2006). Improper care or lack of attention from cohabiting humans can result in stress – manifested as self-mutilation or feather plucking, injuries from inappropriate housing or poor handling, and lack of vitamins in the diet can lead to metabolic bone disease. Some of the larger species also have a lifespan of up to 80 years (e.g. green-winged macaw), which means that they might need repeated rehoming during their lives (Engebretson 2006).

Zoonoses

Exotic pets can constitute a health risk to other wild animals, domestic animals, and humans. Wildlife is considered to be the source of more than 70% of all zoonotic emerging infectious diseases (Jones et al., 2008), with wildlife trade enabling the spread of initially localised pathogens across the globe. For instance, the vast majority of cases of avian chlamydiosis, a disease that can be transmitted through the air from birds to humans, are the result of exposure to pet birds (Balsamo et al., 2017). The import of wild-caught animals, mixing of species from different regions, often stored together in crowded and stressful conditions, increases the risks of zoonotic outbreaks.

Abandonment or escape

The exotic pet trade facilitates the introduction of non-native species to new regions. Many of the released or escaped exotic species can establish colonies, sometimes with dire consequences for ecosystems. In amphibians and reptiles, the exotic pet trade has contributed the largest number of established non-native species (Lockwood et al., 2019). For example, in Florida, USA, there are at least 140 species of non-native reptiles and amphibians, of which almost 85% originated from the exotic pet trade (Krysko et al., 2011). Exotic bird pets that escape from cages are the main source of avian invasions. It has been estimated that a minimum of 25 exotic parrot species have already established breeding populations in the USA (Uehling et al., 2019).

The reasons owners release their exotic pets into the wild have not been broadly documented, but may include difficulty in taking care of old, large, or aggressive individuals (Lockwood et al.,

2019). Unfortunately, there are limited options for rehoming exotic pets. Specialised sanctuaries have limited capacities, and zoos are often unable to accept animals. This is an important point to make: not all species are suitable to be kept as pets. In summary, according to Schuppli and Fraser (2000), we should always consider: 1) the welfare of the animal, defined as a range of factors captured in the "five freedoms" (Farm Animal Welfare Council 1992); 2) the welfare of others – humans or other animals; and 3) risks to the environment, either in the source region, or in case of introduction of exotic species to new ecosystems.

Conclusions

Consideration of the well-being of wildlife has been a neglected field within animal welfare science. Wildlife welfare has finally been recognised in recent years, driven by the expectations of the general public for humane treatment of wildlife, application of legislation to species living in the wild, and the recognition of wildlife researchers that good welfare of animals used in studies is a prerequisite for robust scientific results. In this chapter, I have highlighted some of the recognised animal welfare issues faced by non-domesticated terrestrial species. While there are still many unknowns when it comes to wildlife welfare, it is clear that we need to be cognisant of the risk that our fascination with wildlife, and our desire to help animals, might be detrimental to their well-being.

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