Introduction

This chapter introduces some of the ways that human beings compromise the welfare of wild animals. In particular, it focuses on welfare compromises that are due to three broad and overlapping categories of human action: (1) those that affect the environment, such as climate change and habitat fragmentation; (2) human–wildlife conflicts, especially where humans manage wild animals who they view as either threats or nuisances; and (3) species introductions, where humans either intentionally or unintentionally add species to ecosystems.

This task is complicated by two factors. First, the focus here is on individual welfare, though much of the available data is on human impacts on populations and species. While there are, of course, reasons to be concerned directly about biodiversity loss generally and extinction events specifically, those phenomena are of indirect interest in this context; they are relevant insofar as they bear on the welfare of individuals. While it is possible to make some general predictions about the welfare implications of population declines – such as increased difficulty finding mates – it is often impossible to assess the welfare implications of particular population declines without more information about the case. Consider, for instance, the introduced rodents on Gough Island, some 2,700 km west of Cape Town in the South Atlantic. The mice eat the young of the critically endangered Tristan albatross (RSPB 2021). The main welfare impact is probably on the chicks who are predated (though there are surely impacts on the adult albatrosses too). A different species introduction case, however, might involve a different pattern of welfare impacts – say, where predation is not the issue, but instead the members of the native species are starving because they are losing in the competition for a scarce food resource. This is the plight of the Coqui, a small tree frog, which is being outcompeted by invasive iguanas on the island of Puerto Rico (Platenberg 2007). So, while impacts on populations and species are generally relevant to individual welfare, they only reveal that there are some welfare impacts – not necessarily what the specific welfare consequences are.

The second complicating factor relates to the organisation of the chapter itself. While the division between environmental impacts, human–wildlife conflicts, and species introductions is useful for arranging much of the material that follows, it obscures the fact that these actions have shared drivers. Insofar as the ultimate aim is to consider how humans might reduce negative impacts on wildlife, it is important to consider the underlying factors that lead humans to...
act in such harmful ways. So, the chapter begins with a general orientation to human–wildlife relations. After that, the chapter offers a bit more detail about the impacts associated with each category of action. It concludes with a brief discussion of practical recommendations.

Human–wildlife relations: The big picture

The big picture of human–wildlife relations can be broken into two parts. The first is human population growth. At one point, of course, humans were a relatively small group of primates mostly located in East Africa; now, there are roughly 7.8 billion humans on the planet, a number that is twice what it was in 1970 (The World Bank 2019b). The second is humans’ historical tendency to advance their interests with an anthropocentric and relatively short-term view of the costs and benefits. In other words, throughout much of human history, humans have largely tried to achieve their goals without much consideration for the impacts of their actions on animals and without giving much weight to the long-term consequences of those actions. So, as the human population grew, human beings (1) expanded their physical reach around the globe; (2) extracted more resources for human use; and (3) created more resources for human use in ways that have largely had negative consequences for wild animals. (What’s more, human beings became far more effective resource extractors and creators: per capita gross domestic product has risen dramatically since the Industrial Revolution, climbing by a factor of 13 just in the last 50 years (The World Bank 2019a).

These three activities are interrelated in complex ways, but it is possible to disentangle some of their implications for wild animals. Human expansion involves the development of the infrastructure required to move and house both people and resources, including cities and suburbs, roadways, oil and gas pipelines, submarine communication cables, shipping lanes, and much else. This process has meant that many wild animals have had their habitats destroyed, fragmented, and generally degraded. Moreover, it has meant that many animals have been classified as pests (e.g., elephants who cause crop damage) or threats (e.g., the systematic elimination of big cats in North America and elsewhere). It has also meant that human beings have moved species around the globe, sometimes intentionally (as when, in 1500s, Spanish explorers brought wild pigs to what’s now the southeastern US (Mayer & Brisbin 1991) but often unintentionally (as when boats move zebra mussels from one body of water to another (US Department of the Interior Bureau of Reclamation, n.d.)). As a result, many animals face new and particularly fierce competition.

Resource extraction includes everything from the lumber industry to deep-sea drilling; resource creation includes activities like farming, fishing, and energy production. These activities have also meant that many wild animals have had their habitats destroyed, fragmented, and generally degraded as noted. Likewise, they have meant that many animals have been classified as pests or threats. Additionally and crucially, though, these activities have led to climate change, which threatens to radically alter the prospects for many wild animals. Climate change does this directly by making animals vulnerable to conditions for which they are not well adapted (e.g., polar bears who can no longer reach adequate prey because the sea ice forms later and melts earlier each season (NASA Earth Observatory 2020)). Climate change does this indirectly via several mechanisms, including forcing some animals to migrate to new regions where they have to compete with native species, as well as forcing humans to migrate to new regions, which means yet more habitat destruction, fragmentation, and degradation.

Of course, the consequences of human action on wildlife are not uniform. While a certain form of resource extraction, for instance, is likely to harm many wild animals, it is also likely to create opportunities for others. Deer, for instance, sometimes flourish in the wake of forests being clearcut, as clearcutting benefits the shrubs and grasses that deer like to eat (US Department of Agriculture 2003). However, these opportunities tend to be fleeting. When animals benefit from
human action, their populations often grow dramatically. And when these increased populations move into regions or use resources that humans value, humans often categorise those animals as pests. In such circumstances, lethal wildlife “management” campaigns regularly follow – a euphemism for killing, exclusion from habitat, and other welfare-compromising actions. So, it is important to evaluate the consequences of human action on wildlife holistically, which generally reveals negative consequences indeed.

There is a simple lesson here: namely, that it would be a mistake to see the issues discussed below as independent events that can be addressed separately. The environmental changes that humans have wrought, the many sources of human–wildlife conflict, and the persistent issue of species introductions, are linked in complex ways by their underlying causes and interventions aimed to mitigate their impacts on wildlife need to be sensitive to these factors. In any case, it is now time to explore these three categories of human action in more detail.

Environment-affecting actions

It is difficult to overstate the extent to which human beings have altered the environment. In the US, for instance, only 6% of virgin forests remain and less than half the wetlands that Europeans first found when they came to America’s shores (National Council for Science and the Environment 2008). This is not simply an American phenomenon: more than one-third of the world’s land surface is now devoted to agriculture. Moreover, agriculture now claims almost 75% of freshwater resources (UN Report: Nature’s Dangerous Decline 2019). The rate of global groundwater stock loss has more than doubled in the last 60 years (American Geophysical Union 2010), and while total global supply remains unknown, it is clear that this rate is unsustainable in many places. Several major aquifers, such as the Ogallala Aquifer in the High Plains states of the US, are projected to go dry in the next 100 years even if users significantly reduce how much they pump (Scott 2019).

Water is not simply being used at unsustainable rates; it is being polluted as well. In developing countries, it is estimated that some 90% of sewage is discharged directly into local water bodies without prior treatment (UN World Water Development Report 2015), and even in the US, nearly half of rivers and lakes are considered polluted (United States Environmental Protection Agency 2000). Indeed, it may be the case that as much as a third of global biodiversity loss is attributable to pollution in freshwater ecosystems (United Nations Water 2015). There are similar concerns about ocean water, with increasing attention devoted to plastic pollution. Humans create some 300 million tonnes of plastic each year, of which at least 8 million tonnes wind up in the ocean (International Union for Conservation of Nature 2018). These plastics break down slowly into microplastics, which slowly build up in the bodies of marine life and the animals – including humans – who eat marine life.

Environmental change takes many other forms, and human activity is now responsible for significantly altering 75% of terrestrial and 66% of marine environments via the kinds of direct impacts just described (United Nations 2019). However, climate change might be the most dramatic way that humans have affected the planet – and, as a result, animal welfare. On average, the global annual temperature has gone up 0.07°C (0.13°F) per decade since 1880. Since 1981, it has gone up at double that rate. Unsurprisingly, then, new temperature records have been set roughly every 13.5 years from 1900 to 1980; in the last 40 years, those records have been set every 3 years. The five warmest years since 1880 have all occurred after 2015 (Lindsey & Dahlman 2020). (Figure 23.1).

Moreover, there is every reason to think that these trends will continue. Different climate models indicate that Earth’s average temperature will be between 2.0–9.7°F (1.1–5.4°C) warmer
in 2100 even if significant mitigation efforts are taken, with the precise amount of warming dependent on global energy choices over the next several years (Herring 2012).

Animal agriculture is partially responsible for climate change. Xu et al. (2021) provided explicit estimates of greenhouse gas (GHG) emissions worldwide from plant- and animal-based human food circa 2010. They found that emissions from food systems are responsible for at least 35% of global total anthropogenic GHG emissions and that 57% of food-related emissions were themselves attributable to the production of animal-based food (including livestock feed). Hence, the production of animal-based food appears responsible for at least 20% of anthropogenic GHG emissions. With increased consumption of livestock produce since 2010, a conservative estimate using current production and consumption data could be even higher.

Hayek et al. (2021) argued that a global switch to plant-based diets would itself be sufficient to hit international greenhouse gas reduction targets that are designed to limit global warming to 1.5°C. Much of animal agriculture’s impact is due to enteric fermentation – that is, the digestive process that creates methane in ruminants. Feed quality and composition has a significant impact on methane production, and although there is no way to eliminate it, the FAO estimates that it could be reduced by more than 50%. Three other factors account for most of the remaining emissions: the decomposition of manure (which releases both methane and nitrous oxide), feed production (which involves CO2 emissions at several stages, but most notably the conversion of forest into farmland for feed crops and fertiliser and pesticide production), and the energy consumption associated with the rest of the supply chain (including housing, transporting, slaughtering, and processing animals into retail products).

Demand for such products is expected to increase by roughly 70% by 2050. At that rate of growth, livestock production would still account for a substantial percentage of global greenhouse gas emissions even if the various industries were to pursue aggressive emissions mitigation efforts. If current dietary trends continue, then relative to 1995 levels, methane and nitrous oxide emissions would more than double by 2055 (Popp et al., 2010). As Harwatt (2019) argues, it is difficult to see how current climate change targets can be achieved without shifting towards alternative proteins.

Obviously, animal agriculture is itself a source of extensive animal welfare concerns, though other chapters have those issues as their foci. This chapter attends to the dramatic implications that climate change has had for a wide range of ecosystems.
For instance, arctic sea ice is at its minimum at the end of each summer and that minimum is currently dropping at a rate of 13.1% per decade (NASA 2021a). Likewise, satellite imagery shows that the land ice in Antarctica has been losing mass annually since that study began in 2002. Between melting ice and seawater expanding as it warms, global average sea level has risen roughly 7 inches in the last 100 years (NASA 2021b). This has had devastating effects on coastal ecosystems as they are now experiencing much higher rates of erosion than ever before. Indeed, some island nations, such as the Maldives, are likely to disappear forever – and with them all their native wildlife (Nurse et al., 2014).

Climate change threatens wildlife in several other ways. For instance, climate change can threaten habitat by simply altering a synergy on which a particular species depends. Northern Michigan’s Kirtland’s Warbler, for instance, nests on the ground under jack pines. Jack pines grow in sandy soil that allows water to drain away rapidly. But climate change is pushing the jack pines further north into less sandy soil that drains more slowly. If, as is predicted, the birds follow the jack pines, they will soon be nesting on ground that will flood periodically before their young can fledge, which means that in 30 to 60 years, the warbler may be extinct (Schneider, Root, & Van Putten 2013).

Because climate change incentivises migration, it can also mean that non-migrating wildlife become vulnerable to new parasites and pathogens that had not previously occupied a particular region. However, it can also impose burdens on migratory species. In some circumstances, climate change can also make existing seasonal migrations more metabolically taxing, as animals are exposed to temperatures that they did not previously encounter. In other cases, climate change can reduce the incentive to migrate, resulting in sedentary populations that are vulnerable to increased rates of infection—a problem that has, for instance, had serious effects on monarch butterfly populations (World Wildlife Fund).

Warren et al. (2013) show that if greenhouse gas emissions continue on their present trajectory, more than half of plant species and over one-third of animal species are likely to lose more than half of their current climatic range in the next 60 years. If emissions were to peak in 2030, then that loss could be reduced by as much as 40%, although that is looking increasingly unlikely given global trends. As a result, it is reasonable to expect a substantial loss of global biodiversity over the course of this century.

**Human–wildlife conflict**

Climate change harms wild animals in ways that may not always be obvious. Human–wildlife conflicts, however, are far more visible. Perhaps the most obvious examples of human–wildlife conflicts relate to agriculture. Humans actively cull many big cats, wolves, coyotes, foxes, and other predators to prevent them from killing agricultural animals (and pets), effectively extirpating them in many regions. Moreover, species that feed on crops are actively culled as well, including European starlings, sparrows, deer, and mice, through some combination of trapping, hunting, and poisoning (Nyhus 2016). Some of these population control measures have drastically negative impacts on animal welfare, such as using anticoagulant poisons as lethal population management against mice. These chemicals cause internal bleeding that can take hours or days to be fatal (Meerburg, Brom, & Kijlstra 2008), during which the animal suffers considerably.

In all these cases, animals are categorised as nuisances or pests—terms that are typically defined in terms of conflict with human interests. In principle, any species can be so categorised. Tigers, for instance, were long considered pests in China due to the frequency of their attacks on people. In fact, Mao Zedong called for tigers to be slaughtered across China to address this problem, essentially exterminating tigers in the country (Pomfret 2010). Now, of course, many conservationists reject these classifications, insisting that the tiger is a valuable species that ought
to be preserved and promoted. Cecil the Lion provides another interesting example of this phenomenon. Cecil was killed by an American trophy hunter in 2015, and when the photos of the kill went viral, there was an immediate and intense public outcry. The hunter became the subject of intense public scrutiny, received death threats, and ultimately had to close his business. By contrast, Goodwell Nzou, a native Zimbabwean, wrote an op-ed in the New York Times where he wrote that: “When I turned on the news and discovered that the messages were about a lion killed by an American dentist, the village boy inside me instinctively cheered: One lion fewer to menace families like mine” (Nzou 2015). As this case illustrates, vantage point clearly matters. Where lions are symbols, they are often beloved; where lions are threats, they are far less popular.

Many conservationists hoped that the creation of protected lands would ease tensions between humans and wildlife. However, neither humans nor wildlife appear to respect the boundaries of protected lands. Humans enter those protected lands to poach wildlife; wildlife leave the protected lands in search of food and mates. Moreover, the status of protected lands is constantly contested, as humans have a persistent interest in converting many of those lands for agricultural use (Extent of Human Encroachment 2019).

There are, of course, many cases where humans are not trying to kill wildlife, yet wildlife die all the same. One familiar example is roadkill. Wildlife habitat is fragmented by roadway construction, which itself has negative impacts on wildlife populations, and vehicle strikes are the main anthropogenic cause of death for many vertebrate species. Indeed, it is estimated that a million or more vertebrates are killed on US roads alone each day (Schwartz, Shilling, & Perkins 2020). There is a similar problem of unintentional killing in the case of energy production. This is not simply a problem with oil and natural gas extraction: wind turbines kill somewhere between 140,000–328,000 birds each year in the contiguous United States (Loss, Will, & Marra 2013) and solar energy production kills between 37,800 and 138,600 birds annually in the same region. (The mechanism is not entirely clear in the case of solar energy production, but one possibility is various parts of solar farms reflect polarised light in a way that makes them appear as waterbodies to birds, who then collide with them (Walston Jr. et al., 2016).)

Species introductions

Humans have also had enormous impacts on wildlife by moving animals to new locations, whether intentionally or unintentionally. Domestication, for instance, led to massive animal translocations. Alfred W Crosby, a professor of history and geography, once wrote that:

If the Europeans had arrived in the New World and Australasia with twentieth-century technology in hand, but no animals, they would not have made as great a change as they did by arriving with horses, cattle, pigs, goats, sheep, asses, chickens, cats, and so forth. Because these animals are self-replicators, the efficiency and speed with which they can alter environments, even continental environments, are superior to those for any machine we have thus far devised.

(Crosby 2015)

Whether or not Crosby is correct about the counterfactual, it is true that Europeans radically altered the landscape of the lands they colonised. Europeans brought hogs to North America that quickly went feral, steadily spreading across what are now the southern US states, out-competing many native species; Europeans brought hogs to Australia, where they turned into razorbacks after a few generations; and Europeans left hogs on any number of islands in between home and their destinations, just to ensure that they would have ample food when they came
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back through. Given the rate at which they breed, these animals quickly put pressure on many species that had never had to compete with such omnivores.

Europeans also brought cattle with them. From the 16th to the 19th century, the majority of the cattle in the Americas were likely feral, and Félix de Azara, an 18th-century Spanish military officer, estimated that there were some 48 million feral cattle in the Americas (Azara 1847/2018) – nearly as many the buffalo on the Great Plains, though obviously spread out over a larger region. (They were so common that, during the 1800s in Argentina, people built the walls surrounding plantations out of the skulls of cattle – each property using hundreds of thousands of them.) This obviously placed enormous pressure on other grazers.

In addition to all the species that humans introduced intentionally, there were also the ones that they introduced unintentionally. Rats stowed away on ships and quickly made their way to shore whenever the opportunity arose. They were so plentiful that they actually threatened some colonial aspirations. Jamestown, Virginia was nearly lost to rats in 1609, as thousands of them ate the food stores that the colonists needed to get them through the winter. According to one report from Garcilaso de la Vega, a 16th-century Spanish soldier, rats in Peru “bred in infinite numbers, overran the land, and destroyed the crops and standing plants, such as fruit trees, by gnawing the bark from the ground to the shoots” (Crosby 2015). As with all the other species that humans introduced, rats remade the landscapes they inhabited, provided plenty of food for certain predators, and were devastation for some of their direct competitors.

However, species introductions are not simply a historical phenomenon. The pet trade moves animals around the world, resulting in the presence of “exotic” animals in ecosystems when they escape or their owners release them (e.g., pet fish being released into waterways). In some cases, these animals flourish in their new environs, rapidly challenging the animals who previously occupied that territory (e.g., Burmese pythons in Florida, which have effectively eliminated foxes and two species of rabbits in the Everglades and seriously reduced the numbers of several other mammalian species (McLeroy et al., 2015)). Moreover, international shipping continues to move aquatic and terrestrial animals around the world, as aquatic organisms can be trapped in ships’ ballast water and insects and other small animals can hide in cargo. In all these cases, animals can find themselves vulnerable to novel pressures for which they are not well adapted, resulting in significant population declines.

Population declines, extirpations, and extinctions

The collective impact of all these actions – those affecting the environment, human–wildlife conflicts, and species introductions – has been dramatic. This is one of the reasons why many scientists now describe the present era as the “Anthropocene”, a period beginning with the Neolithic Revolution (some 12,000–15,000 years ago), when humans transitioned from being hunter/gathers to agriculturalists. One of the hallmarks of the Anthropocene is the radical loss of species, often described as the “sixth mass extinction”. Each of the earlier mass extinctions involved the loss of 70 – 95% of the species diversity extant at that time, and while current species losses are estimated to be much lower – perhaps around 7% (Régnier et al., 2015) – the rate of species extinctions is thought to be at least 100 times higher than the base rate (Ceballos et al., 2015). Now, roughly 1 million animal and plant species are considered at risk of extinction, many of which are expected to be extinct within the next few decades, including some 40% of amphibian species, over 33% of all marine mammals, and 10% of insect species (UN Report: Nature’s Dangerous Decline 2019). To give just a few specific examples, all 11 great shark species have suffered population declines over the last 35 years (Myers et al., 2007), approximately 75% of non-human primate species populations are in decline and 60% are at risk of going extinct.
(Estrada et al., 2017), and elephant populations are declining at 8% per year across Africa, mostly due to poaching (Chase et al., 2016).

As discussed earlier, the focus here is on individual welfare, not biodiversity. However, species loss implies that all members of the species have died. These deaths, of course, are explained by a wide range of factors, many of which have been identified here: starvation due to lost food sources, predation from introduced species, toxicity from pollution, plastic entanglement or ingestion, and many others. Insofar as these deaths can be attributed to such causes, it seems that humans are responsible for compromising the welfare of an extraordinary number of wild animals.

**Conclusions and recommendations**

It would be a mistake to adopt too rosy a view of “pristine” ecosystems, untouched by human hands. Healthy, untrammelled ecosystems are not necessarily high welfare ecosystems. That is, for any set of metrics used to assess ecosystem health, an ecosystem may score well on those metrics while still containing extensive animal suffering. This is because the welfare of many wild animals is regularly compromised by hunger, thirst, extremes of heat and cold, parasites, predators, stress from the threat of predation, inability to find mates, the loss of young, disease, injury, and any number of other factors. This suffering is not anthropogenic; animals do not experience it because of climate change, habitat fragmentation, or pollution. Instead, this suffering occurs because insofar as natural selection maximises anything, it maximises fitness, not the welfare of individuals. If, for instance, animals are more likely to pass on their genes by having large numbers of offspring, then that may well be (and in fact often is) the reproductive strategy that natural selection prefers. This is true even when the number of offspring is far more than can be sustained by the resources in the local environment, which means that many of those offspring will starve; it is true even when the offspring are highly vulnerable to predation, which means that many of those offspring will be consumed by other animals.

At the same time, however, it is crucial to recognise that human beings can further compromise the welfare of wild animals, making already-difficult lives even harder. What can be done about this? As suggested earlier, negative impacts on wildlife are ultimately traceable to human population growth combined with humans’ tendency to advance their interests with an anthropocentric and relatively short-term view of the costs and benefits of their actions. There is no realistic and all-things-considered desirable scenario in which population growth is radically checked in the next few decades, and it seems doubtful that much can be done to alter central aspects of human decision-making. In such circumstances, and given the pressing nature of the problem, it is difficult to see how any bottom-up, populist solution is feasible.

Instead, top-down, regulatory strategies are the ones to pursue. In particular, it will be important to create regulations that change the system of incentives for various actors such that it is more burdensome to harm wildlife than the alternative. Insofar as climate change is part of the problem, this will probably involve a weighty carbon tax. A carbon tax, of course, is a way of forcing actors to internalise a cost of their activity. Likewise, governments might consider pricing other ways that humans harm wildlife. Imagine an arrangement where harms to any species are taxable events, with periodic environmental studies setting costs each year based on the degree to which species are threatened. In principle, this could allow all harms to wildlife to have some price — since all wildlife is, in principle, vulnerable to anthropogenic extinction.

There are practical challenges to this proposal. The main hurdle may well be measuring individual causal contributions, not least because such an approach would need to factor in indirect impacts as well (via, e.g., habitat destruction/degradation, air pollution, etc.). In principle, the
measurement burden could be pushed onto the organisations being taxed. Underreporting is an obvious concern, but that could be mitigated by periodic audits with steep penalties for failures to disclose wildlife impacts. In any case, it does not matter whether the system catches all bad actors; it only matters that the system disincentivises harm to wildlife long before animals would be eligible for protection under the current model.

Granted, such a strategy may seem far-fetched in current regulatory environments. However, given the nature, scope, and immediacy of the crisis facing wildlife – and the incentives to which humans reliably respond – regulators must find ways to make it far more costly to harm wildlife. It is, of course, an open question whether the carbon tax model is a viable strategy, but it is clear that current strategies are not working. More radical proposals should be explored.

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