Opinion

Explicit value trade-offs in conservation: integrating animal welfare

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Conservation is an evolving discipline, with its values changing over time. Animal welfare is gaining attention, but can conflict with other conservation values. We illustrate how different management decisions arise from prioritizing different values, and show how these conflicts can depend on value prioritization, as well as how values such as animal welfare are defined. This includes the limits (type of welfare states), scope (range of species), and timescales considered. Since small changes in value articulation and prioritization can lead to major changes in management decisions, we argue for making values and trade-offs explicit. An established structured decision-making (SDM) framework can enhance transparency, reducing misunderstanding in conservation controversies and helping maintain public trust in science.

Evolving values in conservation and wildlife management

Multiple values underpin decisions about **conservation** (see Glossary) and the management of **wildlife**. While society is generally supportive of conservation, many decisions remain controversial because they involve trade-offs between competing values [1]. These trade-offs occur between, for example, **wildness**, **cultural values**, economic values, **biodiversity**, and **animal welfare**. Failure to articulate these trade-offs and explain value prioritization can lead to conflict between stakeholders and erode trust in decision makers, and in the science (and scientists) that inform them [2]. Indeed, a common source of conflict in conservation decision making is 'lack of trust, transparency or communication' ([3], p. 2).

Understanding the outcomes associated with prioritizing specific values can assist conservation decision making and advance conservation practice. Conservation science is an evolving discipline. It has involved a succession of goals that have changed over time and hence changed how conservation is practiced (Box 1). Each successive paradigm was raised as a challenge and then incorporated into conservation practice as an additional consideration (rather than superseding the one that came before) [4]. This has shifted the focus of conservationists across several decades; however, many still aim to preserve the core elements of previous movements (see Figure I in Box 1). For example, the emerging emphasis on animal welfare has been explicitly considered in conservation for over 60 years [5], but recently it has been espoused as a critical value, sometimes suggested to supersede all others [6]. Rather than superseding all other conservation priorities, we believe that animal welfare can be incorporated as a competing or complementary value within the larger value set (Figure 1).

Wildlife management has been employed as a conservation strategy in a variety of contexts, although the objectives of conservation and wildlife management do not always overlap. Here

Highlights

Animal welfare has been given increasing attention in conservation contexts, but exactly how to include it in management decisions remains controversial.

Animal welfare can both complement and conflict with the traditional management values of wildness, biodiversity, economics, and human wellbeing and culture.

Value conflicts can depend on how concepts such as animal welfare are defined and assessed. Transparently articulating values and their corresponding measures is a key and overlooked issue in understanding conservation conflicts.

Using formal structured decision making can help to integrate animal welfare in conservation decision making by evaluating its limits, scope, and scale, and how it interacts with other conservation values.

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we draw on the historical development of Western wildlife management paradigms to build a ty-pology of values included in decision making (Box 1). We highlight animal welfare as a value that can be considered explicitly within **structured decision-making (SDM)** frameworks to address contemporary societal expectations (Box 2). The primary focus of this Opinion is to highlight how animal welfare could be better integrated into conservation decision making by more clearly artic-ulating the **limits**, **scope**, and **scale** of animal welfare and the potential conflicts and alignment of animal welfare with other conservation values. A secondary aim is to illustrate how making implicit values explicit can provide increased transparency about conservation decision making, which may mitigate stakeholder conflicts and prevent erosion of trust in the underpinning science.

Valuing animal welfare

Values tell us what we care about, in contrast to ethical theories, which guide action. In this Opinion we take a broadly **consequentialist** perspective; decisions are guided by conse-quences with the aim of maximizing the values we care about [5,7]. This is currently the dominant ethical paradigm in conservation, although there are alternative ethical approaches [8].

Animal welfare is commonly defined as the state of an animal as it attempts to cope with its en-vironment [9]. This includes consideration of an animal's affective state (its feelings), which can be inferred through both behavioral and cognitive indicators, and its physiological state (its health and biological functioning), often assessed through physiological indicators [10,11]. When animal welfare is valued, it is the lives of individual animals that are considered [12]. The integration of animal welfare science, which uses a range of markers to assess an animal's welfare state, into wildlife management spans at least 60 years [13] and has been applied to a broad range of activities (e.g., [14,15]).

In conservation settings, an increased focus on animal welfare has been used to compare the humaneness of various methods [16], as well as advocate for alternatives to traditional lethal con-servation practices [17], such as behavioral modification [18] and fertility control [19]. Such prac-tice changes are argued to promote animal welfare in wild populations, but are often costlier than other alternatives, limiting the degree to which other conservation goals can be achieved [20]. They also often fail to account for known indirect and unintentional harms, which would encom-pass a wider limit on what is considered a relevant animal welfare outcome [18,21].

Traditionally, animal welfare has focused on captive animals, where welfare concerns are borne out of direct human intervention [22]. Recent work has used these concepts to explore a wider limit: wild animal welfare. Where wild animal welfare considerations were historically restricted to the outcomes of intentional **anthropogenic** impacts [23], more recent concerns have wid-ened to encompass natural (non-anthropogenic) processes, such as predation, competition, and disease or parasitism, in wild animals living outside the direct influence of humans [24,25]. This has led a minority to suggest that we are morally obligated to intervene in the lives of such animals, ranging from providing food during shortages [25] to genetically engineering carnivores to become herbivorous [26]. These suggestions have faced harsh criticism by conservationists [27], animal welfare scientists, and ethicists [28], suggesting that more work is needed address-ing the limits of animal welfare concerns in conservation and how animal welfare is considered and prioritized alongside other values in a conservation context (see Outstanding questions).

Recent research has not only increased our capacity to measure animal welfare [29], but has also attempted to establish whether a species is considered sentient – presently an eligibility threshold for many welfare considerations [30]. This development has broadened the scope of concern for animal welfare [31]. As a result, there is increasing attention given to invertebrate taxa in animal

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welfare considerations, including calls from scientists and philosophers to include some invertebrates in animal welfare legislation ([32], but see also [33]). An overall evaluation of the scope of animal welfare requires estimating welfare impacts for different species and developing methods to compare these impacts across species, an area of inquiry that animal welfare scientists and philosophers are only just beginning to explore [34,35].

Conservation efforts targeting one animal often also affect multiple non-target animals from different populations, species, and/or ecosystems (see case studies later). Such indirect effects highlight the need to determine limits and scope, as well as scale. In some cases, animal welfare is compromised or sacrificed in the short term and/or for a few animals to promote longer-term and/or more taxonomically comprehensive welfare outcomes [36].

Value trade-offs matter

Here we outline four case studies where differences in animal welfare prioritization generated different management decisions. For each case study, we speculate how outcomes may have differed if value priorities had changed and/or if some aspects of the animal welfare concept considered (limits, scope, and scale) had been different.

Wildness trumps animal welfare: wolves in Yellowstone National Park

Grey wolves (*Canis lupus*) were reintroduced to the greater Yellowstone ecosystem in the USA in 1995 to restore a previously extirpated apex predator [37]. This initiative was driven by a desire to restore a degree of wildness and biodiversity to the world's first national park [38]. It was an ecological success, given that the wolf population grew rapidly, beyond expectations. This recovery correlated with a cascade of direct and indirect ecological effects, such as reduced ungulate populations, recovery of riparian habitats, and increases in avian diversity ([39], cf. [40]). However, wolf recovery has arguably come at an animal welfare cost. Restoration of predation imposed significant negative welfare costs on prey species and mesopredators since they experience a heightened risk of injury and stress from predation, as well as increased mortality [26] (for a discussion of death as an animal welfare issue, see [41]; cf. [42]). Large numbers of ungulates and other prey were killed by wolves, including some domestic animals. This often occurs in ways involving considerable suffering [24–26]. However, as noted above, how much weight to attribute this suffering depends on the limits of the animal welfare concept employed. For some conservationists, 'naturally' occurring suffering such as predation harm lie beyond the limits of animal welfare in a conservation context [27], even when humans facilitated the harm by reintroducing wolves.

There were also welfare costs to the translocated wolves themselves [43,44], and some were killed by humans. Had animal welfare considerations been prioritized over wildness or biodiversity recovery, the proposal to reintroduce wolves may not have progressed [24].

Animal welfare trumps wildness: bushfires in Australia

The 2019–2020 Australian bushfire season, dubbed the 'Black Summer' fires [45], saw 18 million ha severely burned, with an estimated 2.5 billion vertebrate animals displaced, injured, or killed [46], alongside countless invertebrates [47]. The immediate management response was unusual for its focus on individual animal welfare and included the temporary establishment of *in situ* veterinary triage centers, deployment of wildlife care teams, supplementary provisioning of wild animals [48], the *ex situ* management of affected native mammals in zoos and sanctuaries [45], and the broadscale lethal control of invasive predators. Much of this work was facilitated by the rapid commitment of unprecedented government funding [49] and an outpouring of public support. The scope of animal welfare considerations was mostly limited to vertebrates, with a particular focus on marsupials [50]. Had wildness taken precedence as a guiding value instead of animal

Glossary

Animal welfare: the health of an animal along with the subjective affective state experienced by an animal. Together, this comprises physical and mental wellbeing, and weighing up negative subjective states (suffering and pain) and positive subjective (pleasure and happiness).

Anthropogenic: any process originating in human activity.

Biodiversity: the number, variability, and variety of living organisms in a place; can emphasize different aspects such as species, genetic, phylogenetic, or functional diversity.

Consequentialism: the evaluation of the rightness or wrongness of actions based solely on their outcomes or consequences.

Conservation: a paradigm prioritizing the preservation of organisms.

Cultural values: values associated with the maintenance of ideas, practices, customs, and social behaviors.

Ecosystem services: benefits provided to humans from ecosystems; includes, but not limited to, clean water, clean air, health, recreation, and pollination.

Intrinsic value: the inherent worth of an entity or property, which is recognized as valuable for its own sake regardless of its utility.

Limits: which animal welfare states and outcomes are considered relevant in a conservation setting. For instance, wild animal suffering caused by direct human impacts may be considered within the limits of a relevant welfare state, whereas wild animal suffering caused by natural predation may not.

Scale: the timescales over which animal welfare outcomes are considered; that is, are the welfare consequences of an intervention evaluated over the short term (a single generation) or longer term (multiple generations)?

Scope: the range of species considered when evaluating animal welfare.

Sentience: The capacity of an animal to experience different feelings such as suffering or pleasure.

Structured decision making (SDM): an organized approach to identifying and evaluating creative options and making informed and transparent choices in complex decision situations.

Wildlife: all organisms (animals, plants, and fungi) living in natural environments

welfare, as it has in nearly every previous Australian bushfire, very few resources would have been directed towards this event. In other words, this strongly interventionist response would have been eschewed in favor of respecting the autonomy and continuity of affected ecosystems, with a direct trade-off being increased suffering for fire-affected wildlife.

Biodiversity trumps animal welfare: rodent eradication on Lord Howe Island

Lord Howe Island is a small volcanic island in the Tasman Sea, approximately 600 km from Australia's east coast. It is a World Heritage Site recognized for its numerous endemic species and unique biodiversity. A rodent eradication program was implemented in 2019 to support the reintroduction of captive populations of endangered Lord Howe Island stick insects (*Dryococelus australis*) that had previously been extirpated by non-native rats [51]. Here, the biodiversity value of the island took priority over welfare concerns for the rodents who would suffer

without direct human intervention or domestication.
Wildlife management: a strategy of actively manipulating wildlife populations to achieve specific objectives (e.g., controlling numbers of individuals, eradicating species).
Wildness: a property of places that are relatively unaffected from industrialized human design and management, with historical continuity.

Box 1. Values in conservation

The past 70 years have seen shifting priorities in conservation goals and values [59]. While often initially raised as a rejection of previous practices, new conservation goals more often become incorporated into conservation decision making as competing goals (Figure I). The defining aim of conservation as a practice initially was the preservation of wilderness. Given that wilderness was ill defined and misused to exclude Indigenous peoples, we will refer to the value of wildness [60]. Wildness involves two goals: maintaining ecosystem autonomy from human influence and preserving the historical continuity of ecological entities, including preventing extinction [61,62]. The more scientific concept of biodiversity extended the focus of conservation from preserving species to preserving diversity at multiple levels of the biological hierarchy [63]. In the 1990s, there was a desire to connect the conservation of biodiversity to economic interests [64,65]. **Ecosystem services**, the good and services nature produces for humanity, emerged as a semi-competing framework for conservation. In the 2000s into the 2010s, human wellbeing was centered more explicitly, including radical visions that argued conservation should be a science of using nature for economic development [66,67]. Others aimed to incorporate cultural factors by drawing on the social sciences and democratic participation, and particularly by recognizing Indigenous perspectives and knowledge [2,58]. Animal welfare has been discussed in wildlife management since the 1970s [13], but only much more recently has it been considered as a central value to be considered in conservation [17].
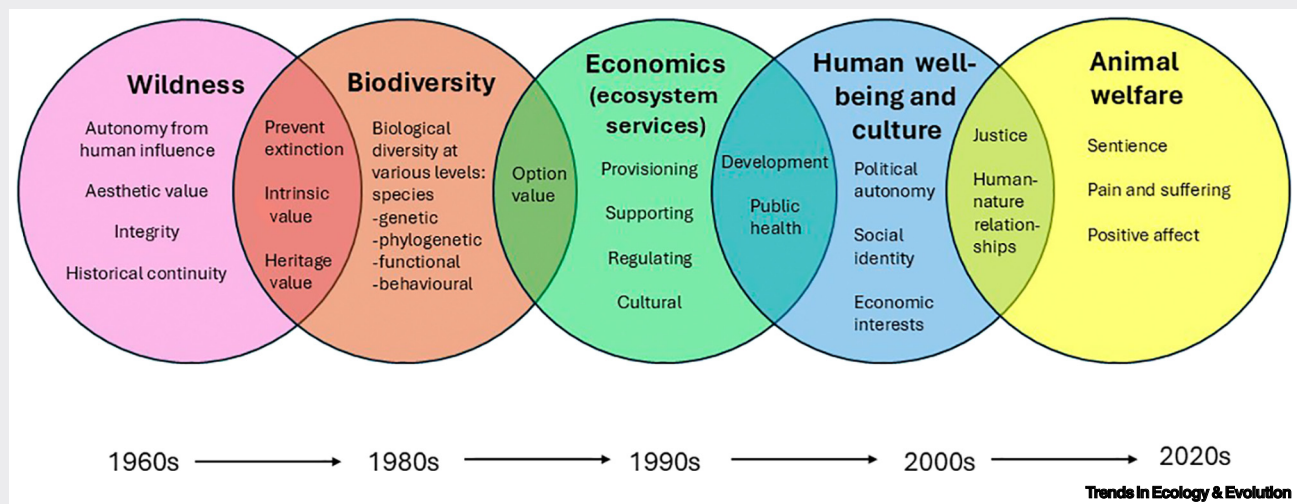
Figure I. Five phases of goals in the modern conservation movement. These goals are driven by different values and often were present in conservation practice before being emphasized in Western conservation theory. Wildness emerged through an appreciation of nature for its autonomy, heritage, and esthetic impact on the individual experiencing it. The wildness of a system incorporated a desire to preserve the system including the ongoing existence of species, designating them of **intrinsic value**. Biodiversity developed from this biocentric focus to the value of the diversity of life at all levels of biological hierarchy, emphasizing its contribution to humanity and intrinsic value. Further future uses were emphasized, with conserving biological diversity being associated with preserving options for unexpected or undiscovered future uses. Ecosystem services explained the anthropocentric utility of preserving natural systems and diversity, with economic, health, and recreational benefits. Human wellbeing was considered as its own goal, with consideration of how to develop nature for anthropocentric interests and support political autonomy and democratic decision making for nature. This centered human interests in nature outside the act of preserving these systems, including restoration according to local needs. Human cultural considerations incorporate social justice and traditional practices into conservation. Critically, this has involved centering Indigenous authority including cultural, spiritual, and management practices for the natural world. In line with concurrent social justice movements, wellbeing considerations have been extended to consider animal welfare, with efforts to ameliorate suffering, protect sources of positive welfare, and consider quality and length of life.

	Wildness	Biodiversity	Economics	Human wellbeing	Culture	Animal welfare
Wildness	Continuity of history versus absence of humans	Limited negative human impact	Ecosystem services (e.g., nutrient cycling)	Reduced frequency of zoonotic spill-over	Preservation of cultural places and species	Reduced anthropogenic stressors
Biodiversity	Reduced opportunity for intervention to promote biodiversity	Different definitions of biodiversity	Ecosystem services (e.g., resource extraction)	Mental health benefits of nature	Preservation of cultural places and species	Enhanced welfare improves survival and reproduction
Economics	Lost opportunities for utilizing natural resources	Land use conflict	Who benefits? Choice of actions	Provisional ecosystem services	Cultural ecosystem services	Ecotourism
Human wellbeing	Human displacement and Nature-deficit disorder	Large predator attacks on humans	Social inequality	Which public?	Connection to a community	Reduced infectious disease transmission
Culture	Disconnection to Country	Harvesting threatened species	Over-exploitation	Traditional food practices leading to zoonosis	Whose culture?	Protection & care of culturally important species
Animal welfare	Prolonged suffering due to natural causes	Introduced species culling	Trophy hunting	Culling diseased populations to protect human health	Traditional hunting practices	Whose welfare? (e.g., predators or prey)

Trends in Ecology & Evolution

Figure 1. Selected examples of conflicts and synergies between values. Boxes with green text above the diagonal illustrate synergistic positive interactions between values. Boxes with red text below the diagonal illustrate negative interactions between values. Black boxes along the diagonal illustrate competing trade-offs present in a single value. Note that in many cases there can be competing trade-offs among multiple values, and that these trade-offs are dependent on limits, scale, and scope (see Outstanding questions).

from ingestion of baits containing a slow-acting anticoagulant poison [52]. Additionally, the potential collateral welfare impacts of baiting on native wildlife species had to be considered and managed [e.g., capture and temporary captive holding of endangered Lord Howe woodhens (*Hypotaenidia sylvestris*) during the baiting process], as did opposition from some of the island's

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Box 2. Incorporating animal welfare into formal decision making

Animal welfare is an emerging consideration for conservation decision making. Although considered explicitly in some high-profile examples [e.g., lethal control of feral horses (*Equus caballus*)] [23], animal welfare considerations are more often implicit or lack transparency [68]. Structured decision analysis provides a framework through which animal welfare can be explicitly considered in conservation decision making, and tools to assist with key decision elements such as objective setting, estimating decision consequences, and managing trade-offs between competing values [1].

Many conservation decision makers already use structured decision analysis tools (or SDM) to tackle decisions with multiple competing objectives and values, especially under high uncertainty and potentially irreversible consequences [1]. For instance, funding allocation to support the USA's National Fish Habitat Action Plan, which was originally allocated based on the size of partner organizations, was aided by SDM by identifying the long-term objectives of the plan such as enduring ecological health, leveraging opportunity for future investments, and cost-effectiveness [69]. Examples of SDM application include reserve design, resource allocation, disease prevention, and reintroductions [68]. Incorporating animal welfare is an obvious next step; it requires that decision makers can clearly define animal welfare objectives, including the limits, scope, and scale of animal welfare considered, and identify measures for its assessment (e.g., [70]).

SDM does not seek consensus or to provide the 'right' answer; decision outcomes vary based on how different values are weighted and depend on who is consulted or empowered in decisions. It does offer a transparent and reproducible process for conservation decisions by guiding and making transparent the values, procedures, and weights applied by the decision maker(s), and fosters more productive debates by making explicit the crux of disagreements [71]. The addition of animal welfare objectives and methods – for instance, by incorporating recent work on interspecies welfare comparisons – could provide a promising new way of using SDM in conservation contexts, and offers a complementary approach to articulating the limits, scope, and scale of animal welfare considerations.

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human inhabitants over the use of poison baits [53]. If those other values – including the welfare of different native and non-native species – had been prioritized differently, the rodent eradication program may not have proceeded. In this case, short-term welfare costs were accepted to prioritize the long-term restoration of unique biodiversity.

Animal welfare trumps Indigenous culture: harp seals in Canada

Harp seals (*Pagophilus groenlandicus*) have been commercially and sustainably harvested in Atlantic Canada for over 200 years, and by Indigenous peoples for much longer [54]. In recent decades, perceptions of poor animal welfare outcomes led to aggressive opposition from advocacy groups and a strong public sentiment against seal harvesting [53]. This loss of 'social license' for seal harvesting by non-Indigenous Canadians culminated in prohibitions on the importation of seal products from several of Canada's trading partners and the virtual collapse of the industry [55]. The declining commercial harvest in Canada illustrates how animal welfare concerns can erode social license and decimate even ecologically sustainable wildlife-use enterprises. Animal welfare was prioritized as the most important value in this context in the 2000s, at least in the deliberations of the EU. However, societal changes since then have seen a notable rise in the importance afforded to the interests of Indigenous peoples who wish to retain seal harvesting as a cultural practice [56], and the EU is now reconsidering seal product imports [57]. If the anthropocentric value of Indigenous cultural continuity rises above animal welfare, support for the Canadian seal harvesting industry may be restored.

The preceding examples are certainly not exhaustive, but illustrate that conservation values often conflict. In conservation decision making, value trade-offs must be made either implicitly or explicitly (Figure 1 and Box 2). We recommend the latter to transparently integrate value prioritization into formal conservation decision making.

Concluding remarks

Prioritizing different values in decision making can profoundly affect conservation practices, outcomes and perceptions. How animal welfare is conceptualized, considered, and assessed has real-world impacts for animals, humans, and ecosystems, often in counterintuitive ways. While

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Outstanding questions

Animal welfare science has developed from a focus on captive animal welfare. How can these existing approaches be modified to better evaluate wild animal welfare and facilitate the incorporation of welfare into more integrative decision making?

How do we define the limits and scope of welfare considerations in conservation and management? For instance, should the predation harm to prey be considered when reintroducing predators?

How do we define the timescales over which welfare and other values are assessed? For instance, should we prioritize the welfare of animals in the short term (i.e., the current generation) over the welfare of animals in the long term? How far into the long term do we need to consider the consequences of conservation actions? Do we care about two generations, ten generations? More?

Which animals' welfare should we care about? Should invertebrates be considered? Relatedly, what kind of evidence is required or sufficient for considering the welfare of an animal taxon?

When addressing the welfare of different species, how to deal with cross-species comparisons? Are the welfare impacts on all animals equally important or do we care about some more than others?

How can we apply SDM to better understand successes and failures and articulate how precisely welfare considerations may improve outcomes?

Given that values have shifted over the past, can we predict which existing management practices are likely to change in the future? Which values are currently being overlooked?

Is SDM the best way to incorporate animal welfare into conservation decisions? How do the outcomes change when it is?

there have been increasing calls for consideration of animal welfare in conservation decision making, how to best understand and assess welfare and how to effectively make those decisions both require further work. Researchers wanting to address animal welfare concerns must articulate where the limits of animal welfare considerations lie, decide on the scope of animal welfare considerations across the animal kingdom, define the timescale(s) at which they wish to assess welfare impacts, and address interspecies welfare comparisons (see Outstanding questions).

Policy makers should be wary of the allure of 'win–win' or 'listen to the science' narratives when tackling contentious issues that require value trade-offs. Instead, being explicit with the values being traded off allows transparent decision processes. SDM has proved successful in a range of conservation contexts [58]. By encouraging articulation of clearly conceptualized, measurable values and making explicit values trade-offs, SDM enables greater transparency in decision making. Stakeholders who disagree with management decisions must make their case on the basis of the relative importance of competing values without the need to contest underlying scientific evidence. Greater transparency in this context is thus likely to prevent the further erosion of public trust in science. SDM is already an established tool in conservation and we are confident that it can reduce conflict and improve conservation outcomes when animal welfare is considered.

Declaration of interests

No interests are declared.

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