**Limited aggregation for resolving human-wildlife conflicts**

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Abstract:

Human-wildlife interactions frequently lead to conflicts – about the fair use of natural resources, for example. Various principled accounts have been proposed to resolve such interspecies conflicts. However, the existing frameworks are often inadequate to the complexities of real-life scenarios. In particular, they frequently fail because they do not adequately take account of the qualitative importance of individual interests, their relative importance, and the number of individuals affected. This article presents a limited aggregation account designed to overcome these shortcomings and thus to facilitate decision-making in real-world human-wildlife conflicts.

Keywords: interspecies conflicts; wildlife management; limited aggregation; animal ethics; interspecies distributive justice; zoonotic disease control; human-wildlife conflicts

# 1. Introduction

Humans intervene in nature in many ways. For example, humans extend their territory to land inhabited by wild animals, which inevitably leads to conflicts about the fair use of land and natural resources. Furthermore, humans frequently adapt, modify, and destroy ecosystems and wildlife. Examples include infectious disease control among wild animals (which may involve culling) to avoid disease transmission to livestock and population control of certain wild animals (for example, invasive species) to protect the local flora and fauna. These interventions often negatively affect sentient nonhuman animals (hereinafter, “animals”); indeed, they may be detrimental to their well-being and even result in their deaths.

At the same time, wild animals can be a nuisance to humans’ property and well-being, or even a danger to human lives. Examples include wild animals eating human resources (such as crops), animals occupying and defecating on human land (such as golf courses and public beaches), wolves killing sheep, and animals attacking and killing humans (Snijders et al. 2019). The wide range of interactions among humans and wild animals inevitably leads to conflicts, where the interests of one party can, in many cases, only be satisfied by frustrating the interests of the other party.

These human-wildlife conflicts give rise to ethical questions. We assume here that sentient animals count morally for their own sake – that they are, to use Kenneth Goodpaster’s words, *morally considerable* (1978). However, in cases of conflicts, we must decide on their relative *moral significance* (Goodpaster 1978). That is, we have to determine which frustrations of humans’ and animals’ interests in conflict situations are justified from an ethical perspective, and which ones are not. However, in many human-wildlife conflicts, it is unclear how to fairly weigh the respective interests of humans and animals and how to act best.

The aim of this article is to propose a formalized account which facilitates decision-making in real-world human-animal conflicts, as they arise in the field of wildlife management and beyond. To be sure, this endeavour is not entirely new. Many philosophers have suggested *principled accounts* to resolve conflicts between the interests of humans, animals, and sometimes even nature (Callicot 2005; Donoso 2017; Sterba 2005; VanDeVeer 1979, etc.). While these contributions are valuable, we will show in section 2 that these principled frameworks are often of limited use in practice because they underestimate the complexities of real-world cases. In addition, they only provide guidance for a limited number of cases, as they primarily address conflicts between the interests of different categories, such as *trivial* human interests and *basic* animal interests. Yet, when it comes to conflicts of interests of similar strength – i.e., basic human interests versus basic animal interests, or trivial human interests versus trivial animal interests, some of these accounts turn out to be of limited practical use. In section 3, we will argue that existing principled accounts often neglect the importance of the *number* of individuals affected and the *qualitative importance* of the interests at stake (including the interest in continued existence).

To overcome the shortcomings of the existing frameworks, we build in section 4 on the literature in moral philosophy about limited aggregation and we argue that it enables a better comparison and weighing of interspecies interests. We focus on *limited aggregation* (i.e., the view that the aggregation of interests is not absolute, but rather limited in some cases), as it allows us to develop a more nuanced account to resolve human-wildlife conflicts. Whether aggregation is limited depends on the *quality* of each of the individual interests, on their *importance relative to each other*, and on the *number of individuals affected*. That is, we will use insights and developments from the limited-aggregation literature in moral philosophy and transfer them to the ethics of human-animal relationships in general and to wildlife management in particular. Thus, the novelty of our approach consists in extending the core ideas of limited aggregation to conflicts *between humans and animals*.

We defend the following claim: if one appropriately takes the quality of interests, their relative importance, and the number of affected individuals into account when it comes to the human-wildlife conflicts, this will significantly change the way we are allowed to act towards wild animals. In particular, properly weighing these different factors entails that we should often attribute wild animals’ interests *more* moral significance than we commonly do in practice. Hence, we have to fundamentally rethink how we address and resolve human-wildlife conflicts.

This conclusion, we argue, is even valid if we take a hierarchical view of moral status as a starting point. Indeed, for the sake of argument, we begin this article from the premise that sentient wild animals matter morally for their own sake, albeit less than humans. This can be considered a *hierarchical view of moral status* (for a defence, see, for example Shelly Kagan (Kagan 2019). In other words, we deny both the principle of equal consideration (Singer 2009, 2011) – i.e., the view that interests of animals matter as much as similar interests of humans – as well as the view that animals have fundamental and inviolable rights (Regan 2004; Cochrane 2012). Consequently, we accept a certain degree of speciesism – i.e., discrimination based on species membership.

The reasons for this choice of premise are chiefly pragmatic. While a large body of literature in the field of animal ethics has argued in favour of giving equal consideration to nonhuman animals’ interests or recognizing fundamental animal rights (see, for example, Regan 2004; Cochrane 2012, Singer 2009 and 2011), this view is not yet widely accepted in the field of wildlife management. Consequently, we chose a premise regarding the moral status of animals which would be acceptable to members of this field. After all, if we started from premises about the moral status of animals that were unacceptable from the outset to biologists, ecologists, conservationists, and wildlife-managers, then our proposed account would be of little practical use for these fields.[[1]](#footnote-1) We outline the implications of our account for an equal moral standing of humans and animals at the end of this article (section 6).

In what follows, we focus on human-wildlife interactions which affect specifically the lives of *sentient* nonhuman animals. That is, we set aside the interventions’ impact on nature itself and on non-sentient animals. There are several reasons for this choice. First, we start from the premise that sentient animals – like humans – matter for their own sake. After all, sentient animals have an *experiential well-being*. Their life can fare better or worse for them and they care about their life (they prefer it to go better than worse). This is a difference from other natural entities, such as plants, trees, the biosphere, and whole ecosystems. We start here from the assumption that these organisms and systems do *not* have experiential well-being – i.e., they are not consciously aware of what is happening to them.

A second reason for restricting ourselves to conflicts between sentient humans and non-human animals is pragmatic: it allows us to focus our argument to develop a basic account for human-animal conflicts. As we show, the conflicts between humans and wild animals are often more complex than the literature assumes. In section 5, our aim is to present a formalized account that takes these complexities of real-world scenarios seriously. Adding conflicts with nature would over-complicate matters, for present purposes. Nonetheless, in section 6, we briefly discuss the implications of our account for animals with uncertain sentience (for example, insects and shrimps) and ecological issues, such as the protection of endangered species, and we outline what other types of human-animal conflicts our account can be applied to.

# 2. Principled Accounts for Resolving Human-Wildlife Conflicts and their Shortcomings

Several principled accounts have been proposed for weighing conflicting human and animal interests. In this section, we briefly present the accounts of Baird Callicott (2005), James Sterba (2005) and Donald VanDeVeer (1979), as they deal particularly well with some forms of human-wildlife conflicts.[[2]](#footnote-2) However, they all have significant shortcomings, as we will show.

James Sterba has proposed four non-anthropocentric principles to resolve conflicts when humans’ and animals’ interests collide: human preservation, disproportionality, human self-defence, and rectification (Sterba 2005). The principle of human preservation allows humans to satisfy their *basic* needs (such as for food), even if this may involve harming nature or aggressing against animals’ basic needs. The principle of disproportionality restricts the kinds of aggressions against nature which humans are allowed to perpetrate: it prohibits aggressions against the *basic* needs of plants and animals if such aggressions take place in pursuit of *non-basic* human needs. The principle of human self-defence allows humans to defend their lives against the attacks of animals, even if this may involve harming or killing an animal. Finally, the principle of rectification requires compensation and reparation when these principles have been violated. Thus, if humans violate animals’ basic interests for trivial human purposes, this principle would demand redress and rectification.

We believe Sterba’s four principles (2005) capture important intuitions and provide a promising starting-point to address conflicts between the interests of humans and those of wild animals. In particular, we deem the principles of disproportionality and self-defence particularly useful and ethically justified: humans should not be forced to sacrifice their life if attacked by an animal; moreover, even from a hierarchical understanding of the moral status of animals, it is morally unjustified to sacrifice animals’ basic needs for trivial human interests.

One problem with Sterba’s account, however, is that it does not provide guidance in situations where *humans’ trivial interests* conflict with *animals’ trivial interests* (for example, wild animals occupying and polluting human spaces like beaches or playgrounds). Another problem concerns conflicts between humans’ and animals’ *basic* interests. According to Sterba’s account, actions necessary for meeting basic human needs are justified even if they have negative effects on the basic needs of animals (principle of human preservation). That is, humans are always justified in aggressing against animals’ basic needs if the action supports humans’ basic needs. However, such an account lacks nuances, because it neglects the importance of animal interests (including animals’ death) along with the number of individuals affected. As we will argue later on, the category of non-basic needs and interests must be refined with an eye to giving more consideration to wild animals’ lives and their continued existence as well as to the number of individuals affected.[[3]](#footnote-3)

Other noteworthy principled accounts intended to resolve human-wildlife conflicts have been proposed by Baird Callicot (2005) and Donald VanDeVeer (1979). Callicott developed an ecocentric account based on Aldo Leopold’s land ethics (1949). According to Callicott’s first second-order principle (SOP-1), obligations generated by membership in more venerable and intimate communities take precedence over those obligations generated by more recent and impersonal communities. According to his second second-order principle (SOP-2), stronger interests take precedence over duties generated by weaker interests, thus potentially trumping SOP-1 (Callicott 2005). In practice, this means that according to SOP-1, obligations towards humans are generally stronger than obligations towards nature and animals. At the same time, according to SOP-2, flora and fauna should not be destroyed for trivial human purposes.

Donald VanDeVeer’s two-factor egalitarianism (1979) bears a similarity to Callicott’s second second-order principle (SOP-2). According to the former account, peripheral or trivial human interests should not trump basic and vital animal interests. However, when basic human and basic animal interests conflict, the humans’ interests should prevail because “the interests of beings with more complex psychological capacities deserve greater weight than those with lesser capacities” (VanDeVeer 1979, p. 70).

Sterba’s, Callicott’s and VanDeVeer’s accounts have the advantage of grasping the intuition that it is morally wrong to sacrifice animals’ basic interests for trivial human purposes. However, these frameworks have important limitations, because many real-world cases are more complex than these accounts assume. First, these principled accounts are not adequately equipped to consider the *number of individuals affected.* That is, they generally seem to presuppose either that conflicts arise between a similar number of humans and animals, or that the number of beings affected does not matter. But in our view, always giving fundamental human interests lexical priority over similar animal interests *irrespective* of the number of animals affected represents an unjustified devaluation of animal interests. Second, these principled accounts overlook important nuances when it comes to the *quality of the interests at stake and their relative importance*. That is, they do not sufficiently differentiate among the relevant interests. Finally, these accounts do not give enough attention to animal death as an ultimate and irreversible harm. We develop these considerations more in depth in the following sections.

**3. Why Welfare Quality, Numbers, and Death Matter**

Convincing approaches to tackling human-wildlife conflicts need, so we claim, to be able to account for: i) the qualitative importance of interests; ii) different numbers of individuals affected; and iii) the harm incurred by animals’ deaths. Yet, existing accounts often fail to account for these factors *sufficiently*.

First, most accounts dealing with human-animal conflicts usually distinguish between two broad categories of interests, namely, trivial (or non-basic) versus non-trivial (or basic) interests (or needs).[[4]](#footnote-4) Basic interests are considered stronger than trivial interests and thus outweigh them. However, in many cases this distinction is too simplistic and of limited practical use. It lacks important nuances which are needed to address real-world human-wildlife conflicts. After all, human and animal welfare exists on a *spectrum* that contains several distinct categories, often of different weights. For example, not losing a limb or not catching an infectious disease that negatively affects one’s well-being (for instance, by being bedridden for a week) fall into the category of basic interests. Nonetheless, they are *qualitatively* different: most would judge that losing a limb is worse than suffering from a heavy flu for a week. Their difference is not only based on the amount of harm and suffering they cause, but also in the ways they affect our lives beyond pain and suffering. Losing a leg restricts our abilities and possibilities in life in ways a mild headache or being bedridden for a week will never do.

But let us put these complexities aside for a moment and assume, for the sake of argument, a scenario in which human and animal interests of *equal* strength are in conflict. Here, existing frameworks often give lexical priority to human interests, *irrespective of the number of individuals affected*. That is, most existing principled frameworks either assume that human life (or death, respectively) *eo* *ipso* outweighs animals’ basic interests and life, no matter how large the group of animals concerned, or they remain silent on the question of what to do if the numbers of individuals affected in each group vary substantially. This is problematic, as in many real-life situations, the interests of a *few* humans conflict with theinterests of *many* more animals (and *vice versa*). That is, an action-guiding and practical framework for addressing human-wildlife conflicts should be able to deal with *different numbers of humans and animals affected*, especially if the number of individuals affected in one group is much larger than the other.

Finally, existing principled accounts do not give due importance to death, in particular *animals’ deaths*. We should acknowledge – as we do with humans – the moral importance of death to animals, insofar as death forecloses all possibilities of experiential welfare. That is, death is the ultimate form of harm by deprivation, for both humans and animals. Conflicts among humans and animals which may involve the death of one party thus require special attention and consideration. As outlined earlier, we accept, for the sake of argument, the premise that humans matter more than animals from a moral perspective. This implies that a human’s life and death matter more than the life and death of an animal. Nevertheless, various accounts in the philosophical literature have attempted to show why animal death is bad and matters from a moral perspective. The most prominent one is probably the *deprivation account*, according to which death deprives animals from valuable future experiences (DeGrazia 1996; Regan 2004; Sapontzis 1987) or frustrates future-related desires and preferences (Singer 2011). McMahan’s *time-relative interest account* (McMahan 2003) is a particularly nuanced deprivation account: the more potential life-time a being loses, so McMahan, the worse death is for him or her. However, to avoid the implausible conclusion that death is worse for a foetus than for a 10-year-old, McMahan argues that death is worse in proportion to how much more one is connected via time-relative interests with one’s own future. Since most humans are more connected with their own future than animals are – for example, humans anticipate and plan for the long-term future – death is worse for them:

The Time-Relative Interest Account offers an explanation of why the killing of animals is less seriously objectionable than the killing of persons. Because the psychological capacities of animals are significantly less well developed than those of persons, the range of goods accessible to them is narrower and the degree of psychological unity within their lives is less. They therefore have a weaker time-relative interest in continuing to live than a person normally does. For not only do they lose less good in dying, but the relations that ground their time-relative interest in the goods they might have had are weaker; thus the loss of those goods matters less in an egoistic way than the loss of a comparable amount of good would matter in the life of a person. (p. 204)

We deem McMahan’s account the most appropriate one for the present purpose, since it allows for a hierarchical understanding of moral status and views premature death as a greater evil for humans than for animals.

In conclusion, an account that would truly be of practical use for real-world human-animal conflicts would have to be able to consider a much wider and more complicated range of interests than generally assumed and covered by existing frameworks. In particular, it needs to be able to discriminate among nuances in *qualitatively different interests*, as the extant distinction between the two broad categories of basic and trivial interests is insufficient. Furthermore, the account would have to factor in differing numbers of humans and animals affected. Finally, it would have to recognize the importance of animal death as an ultimate harm, even within a hierarchical understanding of moral status.

As we will show in what follows, the philosophical literature on aggregation can consider the qualitative importance of interests (including death) and the number of beings affected. Therefore, by relying on this literature, we can overcome the shortcomings of the principled accounts discussed above. Importantly, insights from this literature have not yet been extended to *inter-species* conflicts. Nonetheless, as we will show below, they can provide useful guidance when it comes to decision-making in interspecies contexts.

# 4. Aggregation and Its Limits

The literature on aggregation in moral philosophy contains a rich debate about whom to prioritize in situations where interests of different strengths conflict and where the sizes of the affected groups vary substantially.[[5]](#footnote-5) This literature starts from the premise that the aggregation of interests is justified – and even required – in conflict situations. Aggregation, in this context, means that we *sum* the *numerical value* of competing interests to decide which action will lead to the best outcome. The discussion often revolves around paradigmatic thought experiments such as the following:

“Case 1: You can save one person from death or some larger number of people, N1, from paralysis.

Case 2: You can save one person from death or some larger number of people, N2, from a mild headache” (Tomlin 2017, p.1).

Aggregationists calculate the strength of the interests of all the individuals affected to decide whether it is ethically justifiable to accept the death of one person to save many individuals from minor or major ailments. In the scenarios above, proponents of *unlimited* *aggregation* claim that you ought to save the large number of individuals from paralysis and headaches (Halstead 2016; Norcross 1997; Norcross 2009). That is, on unlimited aggregation accounts, headaches, paraplegia, and death are not categorically different from one another and thus can be aggregated and weighted. In practice, this means that sometimes the life of one or even several individuals can be sacrificed to avoid pain and suffering for the many.

Some philosophers oppose the view that *death* can be aggregated against “lesser” harms, such as headaches, paraplegia, and broken limbs. Death should never be aggregated, in their view, because it represents a harm categorically different from all other harms (i.e., non-aggregation of death) (Kamm 2007).

*Limited aggregation accounts* represent a middle-ground between these two options. On such accounts, one ought to save the one person from death in case 2. That is, one should not sacrifice the life of one person to spare thousands or even millions of individuals from a mild headache. In case 1, however, one ought to save the larger number from paralysis.The reason is that death can be aggregated, *but only against other basic or non-trivial interests of the many* (Lefkowitz 2008; Voorhoeve 2014; Voorhoeve 2015).

In our view, such *limited aggregation* accounts correctly recognize the importance of *the quality of the interests* at stake and the *number of individuals affected,* as outlined in the last section*.* In addition, when interests are in conflict, it matters for limited aggregationists whether these interests are *relevant to each other*. As Scanlon (1998) notes:

[I]t seems that our intuitive moral thinking is best understood in terms of a relation of “relevance” between harms. If one harm, though not as serious as another, is nonetheless serious enough to be morally “relevant” to it, then it is appropriate, in deciding whether to prevent more serious harms at the cost of not being able to prevent a greater number of less serious ones, to take into account the number of harms involved on each side. But if one harm is not only less serious than, but not even “relevant to,” some greater one, then we do not need to take the number of people who would suffer these two harms into account in deciding which to prevent, but should always prevent the more serious harm. (Scanlon 1998, p. 240)

Based on similar reasoning, Alex Voorhoeve (2014, 2015) developed an aggregation of relevant claims account. It has the advantage of combining an unlimited form of aggregation (i.e., “you ought to save a larger number of individuals from disability than one from premature death” (Voorhoeve 2014, p. 65)) with a limited form of non-aggregation (“there is a harm small enough such that no number of such very minor harms to people who will in any case have good lives can outweigh curing one young person’s terminal illness” (Voorhoeve 2014, p. 65)). A sore throat, for example, is such a minor harm in comparison to a lost limb that it does not have a serious impact on the quality of life of the affected individual (Voorhoeve 2015). A broken limb, paraplegia or death, on the other hand, are much more significant harms for each individual, and the latter’s losses in well-being, abilities and possibilities are much more important. Since the subjective and individual experience of a sore throat is a negligible nuisance in comparison to severe harms, it should *not* be aggregated against broken limbs and paraplegia. At the same time, broken limbs, paraplegia and death are all non-trivial harms. On a one-to-one comparison of these claims, one can see that they are *relevant* *to each other* and hence can and should be aggregated and weighted.

Admittedly, limited aggregation accounts are not uncontested.[[6]](#footnote-6) Two prominent arguments against limited aggregation are the “continuity” and “transitivity” problems. The continuity problem holds that for every harm X, there is a harm Y which is slightly less bad than X, and which can trump X when the number of people n suffering from Y is large enough (nY \* Y > X). Because of this, aggregationists argue that it is implausible to postulate a threshold or demarcation line between two relevantly similar harms (Lefkowitz 2008).

The transitivity problem holds that if some harm M is more important (after aggregation) than some harm A, and another harm Z is bigger than harm M, then Z has to be bigger than A. Now imagine the following cases:

Case 3: You can save one person from paralysis (harm A) or 1,000 persons from breaking a leg (harm M).

Case 4: You can save 1,000 persons from breaking a leg (harm M) or 1,000,000 from having a migraine (harm Z).

Case 5: You can save one person from paralysis (harm A) or 1,000,000 from having a migraine (harm Z).

On limited aggregation accounts, you should probably choose M over A in case 3, Z over M in case 4, and A over Z in case 5. However, the result (M > A > Z > M) violates transitivity.

In response to this criticism, Lefkowitz (2008) developed an orbital conception of relevant harms that, in our opinion, successfully addresses these two problems. On his account, harms that fall within an “orbit” are harms that are morally relevant to each other and thus should be aggregated, while all other harms outside of an orbit are not relevant to each other and thus should not be aggregated. That is, in graph 1, orbital 1 contains harms A to M, orbital 2 contains harms D to S, and orbital 3 contains harms K to Z. Only harms *within* orbitals are relevant to each other. In orbital 1, A is relevant to B, C, D, E, …, K, L and M; in orbital 2, D is relevant to E, F, …, K, L, M, …, P, Q, R and S, and in orbital 3, K, L, M and all other harms sharing an orbital with Z (e.g., P, Q, R, S, …, Y) are relevant to Z. However, S, as part of orbital 2, does not share an orbital with harms A, B or C, and thus is not relevant to them.

Graph 1: Orbital model of relevant harms. Each letter represents a harm. Each harm belongs to specific orbitals of relevant harms.

This means that M and A can be aggregated, while aggregation between A and Z is precluded. This is because harm Z is not relevant to harm A and thus should not be aggregated and weighted against A. This allows for transitivity *between relevant harms* (i.e., harms within an orbital), but denies transitivity between harms that do not share an orbital. Importantly, such an account treats harms that differ very little from one another as morally relevant to each other – hence, continuity is not violated. Empirical data suggests that the moral intuition of the majority of people is in agreement with a limited aggregation account (Cowell et al. 2010). Accordingly, we believe that limited aggregation is ethically justifiable and convincing when it comes to inter-human conflicts as well as interspecies conflicts, as we will now show.

# 5. A More Nuanced Account for Resolving Human-Wildlife Conflicts

As we have demonstrated, three factors – i.e., the qualitative importance of individual interests, their relative importance to conflicting interests, and the number of individuals affected – have already been recognized for *interhuman* conflicts. The aggregated numerical value of *relevant* harms and interests can be calculated by multiplying the qualitative importance of interests with the number of individuals affected. For *non-relevant* harms and interests, aggregation is precluded (i.e., calculation is not needed).

The insights from the limited aggregation literature can be fruitfully extended to *interspecies* conflicts. Let us accept, for the sake of argument, that animals matter morally, but humans matter more. In this case, we can attribute different numerical values to the same harm X (for example, an injury or disease) experienced by both humans (XH) and animals (XA). That is, the same harm X would have a slightly higher value in the case of humans than in the case of animals (XH > XA).[[7]](#footnote-7)

First, we outline the advantages of our account when assessing conflicts of interests belonging to the same category affecting different numbers of individuals on each side. Second, we discuss conflicts between human and animal interests belonging to different categories (that is, trivial versus non-trivial interests); in such cases, our account mostly comes to conclusions similar to those of the principled accounts outlined earlier (Callicott 2005, Sterba 2005, VanDeVeer 1979). We will employ the following abbreviations for our formalized account: I = Interest; n = numbers affected; A = animal; H = human; t = trivial; nt = non-trivial; d = death.

***5.1 Trivial Human Interests versus Trivial Animal Interests***

Humans and wild animals share habitats, often negatively affecting each other. For example, wild animals occupy and pollute human beaches or golf courses, or humans take a stroll in the forest and frighten deer and birds. To be sure, these actions often have only minor effects on the well-being of the affected individuals (i.e., trivial human versus trivial animal interests).

Example 1: humans go for a forest hike and, in so doing, startle and scare away wild animals. The animals will flee but can return to a relaxed state shortly afterwards. Is it ethically permissible to disturb wild animals in their habitats for such a leisurely purpose?

Sterba’s four principles are only concerned with conflicts between different categories – i.e., trivial human interests versus non-trivial animal ones, or vice versa. Hence, they do not offer any guidance about conflicts between conflicting *trivial* interests. According to our understanding of VanDeVeer’s two-factor egalitarianism, in situations of conflicting similar interests held by both humans and animals, priority is *eo* *ipso* given to human interests if the animals lack significant psychological capacities which humans possess, irrespective of the number of individuals affected (VanDeVeer, 1979, p. 73). That is, even for conflicts where the number of humans affected is much smaller than the number of animals affected (nH <<< nA), priority is nonetheless given to human interests in virtue of humans’ superior cognitive capacities.

On Callicott’s account, SOP-2 (which claims that stronger interests take precedence over duties generated by weaker interests) does not play a role, because the interests in question are qualitatively similar. However, according to SOP-1, precedence should still be given to human interests on account of their membership in a more intimate and venerable community than the community between humans and animals. Hence, in conflicts of trivial human and animal interests, human interests will prevail.

Similarly, hierarchical accounts of limited aggregation will give preference to trivial human interests over trivial animal interests when the number of humans is higher, similar, or even often smaller than the number of animals affected:

HIt > AIt for nH ≅ nA or nH > nA or nH << nA

However, even on the assumption that relevantly similar human interests are more important than animal interests in a one-to-one comparison, if animal interests are actually morally relevant, this requires that *the number of affected animals be taken into consideration*. Hence, there must be a threshold at which animal interests will eventually trump trivial human interests (nH <<<< nA => HI < AI). In practice, this may mean that activities such as a few (say 1-10) humans taking a stroll in the forest must be critically re-evaluated, according to the account presented here, if they negatively affect the well-being of *many* animals (say several hundreds to thousands of animals).[[8]](#footnote-8)

In addition, note that not all interests in the *trivial* category are equally important, and an aggregative framework can better account for this difference than non-aggregative frameworks. By attributing numerical values to different human and animal interests, one can more easily assess whether a disruptive human activity can be justified from an ethical point of view (for example, an activity which creates a certain amount of pleasure for a few humans while temporarily distressing many animals).

Moreover, an aggregation calculus of this sort may be also useful in other contexts. For example, in recent years, the question of how to fairly use and distribute habitat spaces amongst humans and animals has received considerable attention in the animal ethics literature (Blattner et al. 2020; Bradshaw 2020; Cooke 2017; Donaldson und Kymlicka 2011; Hadley 2015; Kianpour 2020; Milburn 2017; Nussbaum 2006). These accounts have mostly focused on property rights and animal sovereignty. Our proposed account here can usefully complement these propositions, as it allows for a calculation of the respective human and animal interests when they are in conflict – for example, allocating a limited space among humans and animals, using forests for human leisure activities, or extending human space to areas inhabited by many animals. Our account can show why in some cases a shared use of territory may be ethically justified, while in rare cases (with many more animals and more important animal interests affected) it may be problematic from an ethical perspective.

**5.2 Non-Trivial Human Interests versus Non-Trivial Animal Interests**

In this section, we wish to address human-wildlife conflicts involving *non-trivial interests*. This is probably both the most prevalent and most challenging category, as decisions in this context frequently concern human and animal health, well-being, and death. A first example is wild-animal population control, for example to stop the expansion of what are often called ‘invasive’ species to protect the local flora and fauna, or to limit the number of predators (such as wolves) who may pose a threat to humans and domesticated animals such as dogs and sheep. A second example is the control of infectious-disease outbreaks among wild animals (which may involve culling) to avoid disease transmission to livestock and humans. The transmission of such zoonotic diseases from animals to humans causes disease in billions of individuals and millions of deaths every year (Morens et al. 2004; Maudlin et al. 2009) and is thus a problem of particular importance. Zoonotic outbreaks such as Ebola and SARS as well as the ongoing COVID-19 pandemic are only the most recent examples (Santana 2020). Because of their threat to public health, such outbreaks often result in the mass culling of thousands (and sometimes even millions) of wild and domesticated animals (such as civet cats and poultry chicken) (Degeling et al. 2016; Parry 2004)). For example, in 2020, it was discovered that minks are susceptible to SARS-COV-2 and thus could potentially spread the virus to humans. As a consequence, millions of minks destined for the fur industry were culled (Lesté-Lasserre 2020). For illustrative purposes, we therefore focus here on the following scenario:

Example 2: Imagine a zoonotic disease that causes severe symptoms in animals (for example, severe shortness of breath with potentially deadly consequences) and in humans (for example, strong fever, severe immune reaction, and death). Is it ethically permissible to kill animals to prevent the transmission of this disease amongst animals and eventually humans?

On Callicott’s ecocentric account and VanDeVeer’s two-factor egalitarianism, human interests are to be prioritised if the conflicting interests are both non-trivial. For Callicott, the reason is that we have stronger obligations to more intimate and venerable communities (such as the human species). For VanDeVeer, the reason is that “the interests of beings with more complex psychological capacities deserve greater weight than those with lesser capacities” (VanDeVeer 1979, p. 70). That is, if human wellbeing is significantly in danger or there is a high risk of human death, then human interests trump similar animal interests. This means that the culling of millions of animals (both sick and healthy) may be ethically justified to protect human interests tied to health, life, and well-being.

On Sterba’s account, the principle of self-preservation allows for actions that are necessary to meet one’s basic interests, even if this aggresses against the basic needs of animals. Again, lexical priority is given to human interests, while both aggregation and weighting are precluded. Importantly, this is the case irrespective of the qualitative and relative importance of the interests at stake and the number of individuals affected.

By contrast, we claim that our example highlights the shortcomings of these three accounts. In cases of conflicting non-trivial interests that are relevant to each other, greater significance ought to be given to the interests of animals *if they outnumber humans by far* (for example, a ratio of 1000:1). We agree with the three accounts mentioned above that if animals matter less than humans, then in situations where the number of humans is similar or larger than the number of animals (nH ≅nA , nH> nA), the human interests should prevail. Even in situations where the number of humans is slightly or moderately smaller than the number of animals (e.g., a ratio of 8:10), human interests (for example, avoiding severe bodily impairment (nt) or death (d)) will often prevail because, on a one-to-one comparison, the human interests should be considered more important than the animal interest:

HInt > AInt and HId > AId and HInt > AId for nh ≅ na or nh > na or nh < na

However, on our account of limited interspecies aggregation, animal interests can trump human interests (even in bodily integrity and continued existence) if the individual and collective interests are relevant and if the number of affected animals is much larger than the number of affected humans:

HInt < AInt for nH << nA, HId < AId for nH << nA and HId < AInt for nH <<< nA

This is not what usually happens in practice. The risk of animal-borne diseases has usually been seen as a reason to eliminate wildlife rather than to protect it (for example, culling bats, civet cats, rodents, and wild ungulates (Santana 2020)), regardless of their number. According to our account, however, it is questionable whether it is always justified – on ethical grounds – to pre-emptively cull very large numbers of both infectious and healthy animals as a measure for zoonotic disease control to safeguard public health, if the number of animals far outnumber the humans who stand to be affected.[[9]](#footnote-9)

In addition, an important yet neglected aspect in decisions concerning infectious zoonotic disease outbreaks is that other human practices are often underlying causes and drivers for zoonotic occurrences. For example, human land use, poaching, and animal production systems increase the risk of zoonotic diseases (Jones et al. 2013; Magouras et al. 2020; Santana 2020). This calls for a comprehensive re-evaluation of the anthropogenic practices which underlie and increase zoonosis risks, of the ethical permissibility of pre-emptive measures which include the killing of healthy animals, and of alternatives to massively culling infected animals (isolation, treatment, etc.).

In a next step, we will turn to conflicts between trivial and non-trivial interests of humans and animals, for which our account comes to similar conclusions as the accounts of Sterba, Callicot and VanDeVeer.

***5.3 Trivial Animal Interests versus Non-Trivial Human Interests***

Wild animals often intrude into human spaces, for example to profit from human garbage for nesting opportunities, as a source of food, or to simply use human land. In doing so, however, they may be a nuisance for humans. Consider the following example:

Example 3: Wild hog babies joyfully play in a field of crops that farmers grow for their own subsistence. Are the farmers allowed to scare the animals off?

According to Sterba’s principles of self-defence and preservation (2005) along with Callicott’s (2005) and VanDeVeer’s (1979) and our own account, humans are allowed to defend themselves and their basic interests when their well-being and lives are in danger. Assuming that the wild hogs could easily find other places to play than the farmers’ crops, the hogs’ interests (i.e., animal interest = AI) to play and consequently destroy the crops are trivial (t) compared to the non-trivial interest of the farmers who earn their livelihood with the crops (HInt > AIt). Hence, it is permissible for the farmer to scare off the hogs, irrespective of the number of individuals involved. That is, humans’ non-trivial interests (HI) outweigh the animals’ trivial interests (AI) in this case. Since the farmers and the hogs’ interests are significantly different, aggregation is precluded:

HI > AI for nH ≅ nA; nH > nA; nH < nA

***5.4 Trivial Human Interests versus Non-Trivial Animal Interests***

Humans sometimes engage in practices that satisfy their own trivial interests while exacting a major toll on the wellbeing of wild animals. An example is leisure hunting – i.e. hunting which is necessary neither for the hunter’s economic survival nor for wild animal population control.

Example 4: Humans hunt animals (for example, foxes) as a leisure activity. The animals experience substantial distress due to this activity and often lose their lives. Can such an activity be ethically justified, even assuming that animals count less than humans?

The accounts of Sterba, Callicott, and VanDeVeer concur that the satisfaction of trivial human interests by aggressing against basic animal interests is morally impermissible. Although they remain silent on the question of whether the number of individuals affected matters, we can assume they would agree that such practices are ethically problematic irrespective of the number of individuals affected:

HIt < AInt, for nH ≅ nA; nH > nA; nH < nA

This assessment holds for severely injuring animals as well as for killing them for trivial human purposes. Again, we agree with this conclusion. According to our own account, trivial and non-trivial interests ought not to be aggregated and weighted, because they fall into categories of interests that are not relevant to each other. In practice, however, trivial human interests often are given priority over non-trivial animal interests.

**6. Conclusion and Outlook**

We have argued that existing principled frameworks for resolving human-animal conflicts have important limitations. In particular, these principled accounts fail when it comes to conflicts between relevantly similar interests. That is, they are ill-equipped to address conflicts between trivial human and animal interests as well as conflicts between non-trivial human and animal interests. Callicott and VanDeVeer give lexical priority to human interests in both cases. Sterba’s account cannot address trivial human versus trivial animal interests, and his account also always gives priority to non-trivial human interests when they are in conflict with non-trivial animal interests. However, we reject this lexical priority and have argued that even if we assume that animals count less than humans, humans should often rethink how they treat wild animals in human-wildlife conflicts.

We have presented a limited aggregation account to resolve human-wildlife conflicts when interests of similar relevance clash. Our account can provide guidance for real-world human-wildlife conflicts, for example when it comes to the fair use of shared territory, animal population control, and the management of infectious disease outbreaks. According to our framework, more attention should be paid to the qualitative importance of individual interests, to the relative importance of interests compared with other conflicting interests, and to the number of individuals affected. We outlined what this looks like in practice, and we concluded that human health, well-being, and life should not always to be prioritised over animals’ health, well-being, and life. That is, we claim that there are conflicts in which the basic interests of animals, when properly aggregated, can potentially outweigh basic human interests. This has far-reaching implications for human-animal relations in general and wildlife management specifically.

In what follows, we will shortly mention some further aspects that may warrant consideration in limited aggregation accounts, namely, risk, invertebrate sentience and non-individual harms such as structural and historical injustices. In this article, we limited our argumentation to *determinate* cases with known outcomes. However, wildlife managers are often confronted with problems of *indeterminate* outcomes. For example, there can be cases in which there is a *low to high probability* of animals’ spreading an infectious disease to humans with a *mild, moderate or catastrophic* *outcome* in case the incidence actually occurs. These various likelihoods must be evaluated differently. We cannot discuss in detail here the implications of risk considerations in interspecies conflicts. Note, though, that the limited aggregation literature for interhuman conflicts has recently turned to the importance of risk considerations (see, for example, Lazar 2018). We are confident that these insights can provide useful guidance also for interspecies conflicts in the future.

A related question concerns the implications of our account for animals with uncertain sentience. We restricted ourselves here to wild animals that are considered sentient, such as bears, wolves, wild hogs, birds, fish, cephalopods, and decapods (for a discussion of the sentience of the last three species, see Birch et al. 2021; Culum 2015; Sneddon 2019). However, it is still uncertain whether other animals, such as shrimps and insects, are sentient (Adamo 2016; Birch 2022; Birch et al. 2021; Crump et al. 2022; Groening et al. 2017). One may contend that this provides our limited aggregation account with a particular challenge. Animals with uncertain sentience outnumber humans by far. If their likelihood of being sentient is larger than zero, does this imply that, in cases of conflicts between humans and insects, for example, insect interests always trump human interests? This is not the case. The first reason is that we assumed here a hierarchical understanding of moral status. Therefore, insects likely would be very low in the hierarchy, and their interests would have a comparatively low numerical value. The second reason is that even if we assume for the sake of the argument that insects are sentient, we would still need to determine whether their interests are qualitatively and relatively similar to the interests of humans and other animals (and hence, whether insect interests ought to be aggregated against interests of humans and other animals).

We have also left aside considerations about structural and historical injustices. That is, we did not discuss whether animals should be compensated for past wrongs, such as for example habitat pollution and destruction. However, limited aggregation accounts could, in theory, address past injustices. They could assign the interests of animals who were previously wronged a higher numerical value. Therefore, a claim for reparation may in some cases increase the importance of animal interests.

Similar considerations apply in the case of non-individual harm. The question of how much the life of an individual sentient animal counts compared to the survival of a species is a key conflict between animal and environmental ethicists and has been debated for decades (Callicott 1980; Faria & Paez 2019; Sagoff 1984). For our argumentation, we primarily focused on harms caused to *individuals*, not groups. However, in theory, our account could accommodate non-individual harms. In this case, the interests of animals of endangered species could be assigned a substantially higher numerical value.

Furthermore, note that we only developed here the *basics* of limited aggregation accounts for resolving interspecies conflicts. In future research, the numerical values of different interests and the extent and limits of aggregation of relevant interests need to be determined in interdisciplinary collaborations.

Moreover, we restricted our discussion here to conflicts between humans and wild animals. However, we want to emphasize that our formalized account can of course be applied beyond human-wildlife conflicts. One example is the use of animals in research. Here, aggregation would involve weighing the purpose of the experiment and its potential gain for humans (quality of life improved and number of humans benefiting from the research), but also the negative impact on the individual animal as well as the number of animals affected. Furthermore, in veterinary medicine and in public health, our framework can help take animal well-being and life properly into consideration for situations of disease outbreaks amongst domesticated animals, such as agricultural farms (Eggel and Martin 2022).

Finally, our framework can also provide guidance in situations where the interests of *several groups of humans and animals* are in conflict. An example is conflicts between humans, domesticated animals (such as sheep or chicken), and wild animals (such as wolves or foxes): predatory animals, such as wolves and foxes, may hunt for domesticated animals, such as chicken, sheep, and rabbits, who, in turn, belong to humans who use them for their economic subsistence. In such cases, one can determine the number of beings affected in each group and the strengths of their relevant interests, in order to determine what kind of intervention (for example, scaring away the predators) or protective measures (for example, temporarily locking up domesticated animals for their own benefit) are ethically justified. That is, aggregating relevantly similar interests can also be useful in situations where the interests of several groups clash.

The account presented here is based on a hierarchical understanding of moral status. That is, human interests are considered more important than similar animal interests. However, our account is also useful from a non-speciesist and non-hierarchical point-of-view. If ever the attitudes of the general public and welfare managers about the moral status of sentient animals were to change (i.e., if similar interests of humans and animals counted equally), then our limited aggregation account could be adapted accordingly. In turn, this would imply that humans would have to significantly change the way in which they treat and interact with (wild) animals.

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1. The notion that animals count morally, albeit less than humans, seems to be intuitively shared by many humans (Fischer et al. 2021). This is important for our purposes, insofar as we aim to develop an account that is acceptable for most people. Correspondingly, we cannot build our argument on premises that most people intuitively reject. [↑](#footnote-ref-1)
2. There are other principled accounts in the literature that deal with what we owe to animals, for example Fraser (2012) and Fischer et al. (2021). We exclude them from the discussion here because they do not provide guidance regarding what to do when the interests of humans and animals are *in conflict*. [↑](#footnote-ref-2)
3. For further criticism of Sterba’s principles, see Donoso (2017). [↑](#footnote-ref-3)
4. Non-trivial or basic interests are here understood as interests that concern crucial or essential needs, such as being free from hunger and thirst, bodily integrity, well-being, and being free from pain and suffering. This category encompasses interests that have a significant impact on one’s life and welfare. Non-basic or trivial interests are interests that are not crucial for one’s welfare and survival. Their fulfillment would be nice to have, but one’s welfare is not significantly affected by their frustration (examples are a reduced range of food choices, being interrupted in entertainment activities, and the like). [↑](#footnote-ref-4)
5. Some authors in the aggregation literature refer to ‘claims’ (an example being Voorhoeve (2014)), while others talk about ‘interests’ (for example, Norcross (2009)). For our present purpose, we use the language of ‘interests’, as it is uncontroversial that sentient animals have interests, while it is more controversial that they have ‘claims’, i.e., morally protected interests. [↑](#footnote-ref-5)
6. For criticisms of limited aggregation, see Broome (2004), Norcross (1997), Parfit (2003), and Tomlin (2017). [↑](#footnote-ref-6)
7. How much a harm or interest X of humans matters more than the harm or interest X of animals depends on the specific animal species. The reason is that we endorse here a hierarchical understanding of moral status. While the harm or interest X of humans counts likely only slightly more than the harm or interest X of primates, the same harm or human interest X counts more than the harm or interest X of fish. The exact numerical value of human interests and interests of different animal species has to be determined elsewhere, though. [↑](#footnote-ref-7)
8. We acknowledge that it would be desirable to provide the exact numbers for all sorts of human-animal conflicts. However, we cannot provide these numbers here, as their determination is a project on its own. In addition, most seminal articles in the aggregation literature do not provide exact numbers either (yet). Hence, we can only provide rough numbers for illustrative purposes here. We thank an anonymous reviewer for urging us to clarify this point. [↑](#footnote-ref-8)
9. Admittedly, whether culling is justified also depends on the spill-over risk and on the severity of disease in humans and animals. We discuss the role of risk more in detail in section 6. [↑](#footnote-ref-9)