The Predominance of Wild-Animal Suffering over Happiness: An Open Problem

Abstract

I present evidence supporting the position that wild animals, taken as a whole, experience more suffering than happiness. This seems particularly true if, as is possible if not very likely, insects[1] can suffer, since insects have lifespans of only a few weeks and are orders of magnitude more preponderate than other animals.

I do not know what should be done about this problem, but I propose that further work on the subject might include

- Continued study of whether insects are sentient,
- Investigation of the effects (negative and positive) of various types of environmental destruction on wild-animal welfare, and
- Research on ways to alleviate the pain endured by animals in the wild, especially that of insects and other small animals.

Of course, even if wild-animal lives are generally worth living, efforts to reduce their suffering may still be worthwhile.

I encourage readers to contact me with any insights into these issues: webmaster ["at"] utilitarian-essays.com

1 Introduction

> The fact that in nature one creature may cause pain to another, and even deal with it instinctively in the most cruel way, is a harsh mystery that weighs upon us as long as we live. One who has reached the point where he does not suffer ever again because of this has ceased to be a man.
>
> —Albert Schweitzer [31, Ch. 3]

Many advocates of animal welfare assume that animals in the wild are, on the whole, happy. For instance, the site utilitarian.org includes a proposal to create a wildlife reserve, the main "Utility value" of which would come from "The value of life over death for the animals who will live there" [62].

The assumption of wild-animal happiness is also implicit in the arguments that animal welfarists make against interfering with nature. When asked whether we should prevent lions from eating gazelles, Peter Singer replied:

[1] Throughout this piece, I use "insects" as shorthand for "higher-level arthropods," including spiders, millipedes, crabs, and others, in addition to members of the class *Insecta*.

> [. . .] for practical purposes I am fairly sure, judging from man's past record of attempts to mold nature to his own aims, that we would be more likely to increase the net amount of animal suffering if we interfered with wildlife, than to decrease it. Lions play a role in the ecology of their habitat, and we cannot be sure what the long-term consequences would be if we were to prevent them from killing gazelles. [. . .] So, in practice, I would definitely say that wildlife should be left alone. [74]

Jennifer Everett mentions a similar idea:

> [. . .] if propagation of the fittest genes contributes to the integrity of both predator and prey species, which is good for the predator/prey balance in the ecosystem, which in turn is good for the organisms living in it, and so on, then the very ecological relationships that holistic environmentalists regard as intrinsically valuable will be valued by animal welfarists because they conduce ultimately, albeit indirectly and via complex causal chains, to the well-being of individual animals. [27, p. 48]

But is it true that wild animal lives are worth living? In rest of this piece, I present arguments against this view. Note, however, that even if wild-animal lives *are*, on balance, positive, it may still be worthwhile to undertake efforts to alleviate their suffering.

2 Life and Death in the Wild

2.1 A Neglected Topic

> Preoccupied with the [. . .] task of countering those forms of more-than-human, and potentially avoidable, suffering that have their genesis not in nature, but in society, ecophilosophers and ecopolitical theorists have tended to be silent on the dire realities of pain, predation, disease and death that seem to be inseparable from organismic life in general.
>
> —Kate Rigby, "Minding (about) Matter: On the Eros and Anguish of Earthly Encounter" [65]

Many humans look at nature from an aesthetic perspective and think in terms of biodiversity and the health of ecosystems, but forget that the animals that inhabit these ecosystems are individuals and have their own needs. Disease, starvation, predation, ostracism, and sexual frustration are endemic in so-called healthy ecosystems. The great taboo in the animal rights movement is that most suffering is due to natural causes.

—Albert, in Nick Bostrom's "Golden" [9]

People who are appalled by the indiscriminate killing of wildlife by mechanisms such as leg-hold traps should recognize that the pain and suffering caused by cat predation is not dissimilar and the impacts of cat predation dwarf the impacts of trapping.

—Audubon Society of Portland [15]

It is often assumed that wild animals live in a kind of natural paradise and that it is only the appearance and intervention of human agencies that bring about suffering. This essentially Rousseauian view is at odds with the wealth of information derived from field studies of animal populations. Scarcity of food and water, predation, disease and intraspecific aggression are some of the factors which have been identified as normal parts of a wild environment which cause suffering in wild animals on a regular basis.

—"Captivity and Suffering," *UCLA Animal Care and Use Training Manual* [13]

2.2 Are Animals Less Sensitive?

Alfred Russel Wallace wrote in 1910:

> [. . . S]maller birds and mammals [. . .] are all so wonderfully adjusted to their environments, that, in a state of nature, they can hardly suffer at all from what we term accidents. Birds, mice, squirrels, and the like, do not get limbs broken by falls, as we do. They learn so quickly and certainly not to go beyond their powers in climbing, jumping, or flying, that they are probably never injured except by rare natural causes, such as lightning, hail, forest-fires, etc., or by fighting among themselves; and those who are injured without being killed by these various causes form such a minute fraction of the whole as to be reasonably negligible. The wounds received in fighting seem to be rarely serious, and the rapidity with which such wounds heal in a state of nature shows that whatever pain exists is not long-continued. [. . .]
>
> Our whole tendency to transfer our sensations of pain to all other animals is grossly misleading. The probability is, that there is as great a gap between man and the lower animals in sensitiveness to pain as there is in their intellectual and moral faculties; and as a concomitant of those higher faculties. We require to be more sensitive to pain because of our bare skin with no protective armour or thick pads of hair to ward off blows, or to guard against scratches and wounds from the many spiny or prickly plants that abound in every part of the world;

> [...] it is this specially developed sensibility that we, most illogically, transfer to the animal-world in our wholly exaggerated and often quite mistaken views as to the cruelty of nature! [81, p. 376, 377, 379]

I do not pretend to give a full refutation of Wallace's naive claim, but consider the following point. It may provide insight into why Wallace and some of his contemporaries concluded that animals are less sensitive.

1. Sick and injured members of a prey species are the easiest to catch, so predators have evolved such that they deliberately target these individuals.
2. As a consequence, those prey that appear sick or injured will be the ones killed most often. Thus, evolutionary pressure pushes prey species to avoid drawing attention to their suffering and to pretend as though nothing is wrong [56, Ch. 4.12].
3. Humans may interpret this "apparent stoicism" as evidence that animals are relatively insensitive to pain [10]. However, this inference has been shown to be false [10].

2.3 Hunger, Thirst, and Cold

- Many animals die of thirst during times of drought [54].
- "Starvation and malnutrition occur in several wildlife species and routinely eliminates the young, old, weak, and sick animals. [...] Historically, in Michigan the number of species diagnosed at the Laboratory as dying from malnutrition and starvation are second only to those dying from traumatic injuries" [48].
- Stages of starvation [48]:
  1. Within a few hours, carbohydrate glycogen in the liver is used up.
  2. Next, fat deposits are consumed.
  3. Finally, the body resorts to protein stored in the cytoplasm of cells.
  4. Eventually, the cells stop functioning. Too little glucose reaches the brain, triggering shock followed by death [48].
- Hunger is particularly severe during the winter, due to greater energy requirements and the reduced availability of food [48]. Deer are sometimes unable to reach shoots buried below ice [35], and adult deer can lose 25% to 30% of their body weight over a severe winter [48]. During a particularly long period of cold in the Czech Republic in 2006, some deer blinded themselves by eating rape root, the only green plant they could find [49].

- 2006 was also a harsh year on bats in Placerville, California:

  > "You can see their ribs, their backbones, and (the area) where the intestine and the stomach are is completely sunk through to the back," said Dharma Webber, founder of the California Native Bat Conservancy. [...]
  >
  > She said emerging mosquitoes aren't enough to feed the creatures.
  >
  > "It would be like us eating a little piece of popcorn here or there," she said. [18]

- "Birds unable to find a sheltered perch during the storm may have their feet frozen to a branch or their wings covered in ice making them unable to fly. Grouse buried in snow drifts are often encased by the ice layer and suffocate" [35].

2.4 Examples of Diseases and Parasites

Roundworms: These parasites are some of the most common in the world [67]. While generally innocuous, they can sometimes cause hemorrhages, tissue damage, and pneumonia—especially in young or infirm animals [67].

Stomach worm: This parasite inhabits many common birds, including the crow, blue jay, and American robin [63]. Stomach worm can make its hosts lethargic (hence, more easily caught by predators) and can reduce their immune defenses against other diseases. Additionally, if the worms build up too much "thick, white, slimy mucous and sloughed stomach epithelial tissue" while enlarging part of the stomach, they can entirely block the entrance of food—causing the host to starve to death [63].

Rabies: This disease is found on every continent except Australia and Antarctica [64]. It's 100% fatal and has highly erratic symptoms. An animal with "dumb rabies" simply becomes paralyzed and succumbs to death. One with "furious rabies" becomes excited and violent for a few days, after which it develops tremors, convulsions, paralysis, and then dies [64].

Salmonellosis: Caused by *Salmonella* bacteria, this disease affects fish, reptiles, amphibians, birds, and mammals all over the world [68]. In birds,

> Signs range from sudden death to gradual onset of depression over 1 to 3 days, accompanied by huddling of the birds, fluffed-up feathers, unsteadiness, shivering, loss of appetite, markedly increased or absence of thirst, rapid loss of weight, accelerated respiration and watery yellow, green or blood-tinged droppings. The vent feathers become matted with excreta, the eyes begin to close and, immediately before death, some birds show apparent blindness, incoordination, staggering, tremors, convulsions or other nervous signs. [68]

Verminous Hemorrhagic Ulcerative Enteritis: In waterfoul, the disease produces "weakness, limber neck, wing droop, listlessness, lack of fear of humans, anorexia, and blood stained feathers around the vent" [80]. Ingestion of as few as 20 trematode "flukes" will cause death, usually within 3-8 days. Flukes attach to intestinal mucous and produce hemorrhagic ulcers; severe blood loss often kills the birds as a result of shock [80].

2.5 Predation

> Accidents and predators take some. Only occasional accidents cause quick relatively painless death. [F]requently severe bruising and bone breakage results from accidents; pain certainly accompanies this. Predators may or may not be efficient. Often hide and flesh may be torn or displaced, prey may be killed or escape with several wounds to die later or recover.
>
> —"Hunting: Kindness or Cruelty?" [37]

> To believe in the carnivorous reptiles of geologic times is hard for our imagination—they seem too much like mere museum specimens. Yet there is no tooth in any one of those museum-skulls that did not daily through long years of the foretime hold fast to the body struggling in despair of some fated living victim. Forms of horror just as dreadful to the victims, if on a smaller spatial scale, fill the world about us to-day. Here on our very hearths and in our gardens the infernal cat plays with the panting mouse, or holds the hot bird fluttering in her jaws. Crocodiles and rattlesnakes and pythons are at this moment vessels of life as real as we are; their loathsome existence fills every minute of every day that drags its length along; and whenever they or other wild beasts clutch their living prey, the deadly horror which an agitated melancholiac feels is the literally right reaction on the situation.
>
> —William James, *The Varieties of Religious Experience* [42, pp. 161-62]

In the following table, all information in a given row came from the source in the far-right column unless I include a citation elsewhere in the table, in which case only the cited portion came from a different source. Some entries in the table reference notes that appear subsequently. Note 1 is referenced by (1), etc.

Predator	Examples of Prey	Means of killing	Duration of killing (minutes)	Source
lions	wildebeest, zebra, ungulates	suffocation (1)	5-6 [50, p. 13]	[1]
cheetahs	gazelles	suffocation (occasionally 2-3 times)	often 5-15, sometimes 25	[17]
spotted hyenas	ungulates	biting off chunks of flesh	1 to 13	[43]
wild dogs	ungulates	disembowelment (2)		[50, p. 18-22]
coyotes	rabbits, rodents, reptiles, amphibians, fish	may stalk prey for 20-30 minutes until prey is exhausted		[20]
heron	fish	swallow whole	≤ 2 to swallow	[22]
piranha	fish, cattle, "anything"	tear apart while alive		[61]
constrictor snakes	rodents (3), mammals	prevent prey from inhaling (4)	1 [86]	[30]
small snakes	fish, frogs	swallow and digest alive (5)		[30]
venomous snakes	rodents, birds, reptiles	internal bleeding, paralysis (6)	a few minutes	[50, p. 49]
crocodiles	birds, fish, reptiles, ungulates	grabbing in jaws, drowning (7)		[50, p. 43]

Notes:

1. [50, p. 12-13] vividly describes the capture of a zebra by a lioness:

    > The lioness sinks her scimitar talons into the zebra's rump. They rip through the tough hide and anchor deep into the muscle. The startled animal lets out a loud bellow as its body hits the ground. An instant later the lioness releases her claws from its buttocks and sinks her teeth into the zebra's throat, choking off the sound of terror. Her canine teeth are long and sharp, but an animal as large as a zebra has a massive neck, with a thick layer of muscle beneath the skin, so although the teeth puncture the hide they are too short to reach any major blood vessels. She must therefore kill the zebra by asphyxiation, clamping her powerful jaws around its trachea (windpipe), cutting off the air to its lungs. It is a slow death. If this had been a small animal, say a Thompson's gazelle (*Gazella thomsoni*) the size of a large dog, she would have bitten it through the nape of the neck; her canine teeth would then have probably crushed the vertebrae or the base of the skull, causing instant death. As it is, the zebra's death throes will last five or six minutes.

2. Describing a fictional wild-dog hunt, [50, p. 22] writes:

    > Two dogs converge on the [wildebeest] calf, causing it to veer away from the other wildebeests, still accompanied by its mother. The two wildebeests are still galloping at a fair speed, but the calf is beginning to tire. Three other dogs fall in behind the two pursuers. The lead dog closes with the calf and launches itself at one of its hind legs. Its sharp teeth make contact, and the jaws lock tight, bringing the calf to a faltering stop. A second dog

grabs it by the nose. Two more tear at its underbelly, ripping it open and pulling out its gut. Its helpless mother looks on.

3. "Live mice will fight for their lives when they are seized, and will bite, kick and scratch for as long as they can" [30].

4. "Small (and maybe large) constrictors seem to kill their prey by causing high blood pressure, heart attacks and strokes before suffocation" [78].

5. "The snake drenches the prey with saliva and eventually pulls it into the esophagus. From there, it uses its muscles to simultaneously crush the food and push it deeper into the digestive tract, where it is broken down for nutrients" [60]. Prey animals often do not die immediately after being swallowed; this is illustrated by the fact that some poisonous newts, after being swallowed, use their toxins to kill their captor snake so that they can crawl back out of its mouth [50, p. 59].

6. [50, p. 50] tells of a colleague who was bitten by a rattlesnake: "The pain, which he likened to holding his hand on a hot stove, lasted for four days."

7. Another fictional narrative from [50, p. 43]:

    > A herd of wildebeests approaches a placid lake in the middle of a hot afternoon. [...] Suddenly one of the crocodiles [in the lake] explodes from the water, clamping its massive jaws on the first thing it contacts. Bluntly pointed teeth splinter through bone, locking fast on a startled wildebeest's leg. The impact throws the wildebeest onto its side in the shallows. [...] The crocodile gives an enormous tug, dragging the wildebeest into deeper water. With hooves threshing and eyes popping, it lets out a terrified bellow. The next instant its head is jerked beneath the surface. Choking water sears down its throat and floods its lungs. The wildebeest struggles violently to get its head above the water but does not stand a chance against such brute strength.

2.5.1 Endorphins:

In some cases, death by predation may not be quite as bad as it seems. Upon capture by predators, some animals release endorphins—the same chemicals that our brains produce when we exercise [33, Question 2]. Endorphins can have a pronounced effect:

> LORD SOULSBY: [...I]s there any other situation where we can at least get evidence of death being either very painful, animal welfare or not—and I am talking about other predator situations, when it is known endorphins reach a very high level just at the end of a hunt when gazelle are attacked by a large

cat? Is that a realistic argument to use that, in fact, in the prey predator situations that might also occur?

MR WISE: Lord Soulsby, [...] I have in front of me an article from a *Sunday Telegraph* a couple of years ago. It is entitled, "I was eaten by a hyena." It relates to a woman who suffered extremely serious injuries when she went into a cage in a wildlife centre. What she said was: "The mind, I found, is strange. It shut off during the attack while my body continued to act without thought or even sight. I do not remember him sinking his teeth into my arm, although I heard, the little grating noise as his teeth chewed into the bone. Everything was black and slow and exploding in my stomach. Vision returned gradually, like an ancient black and white television," et cetera, et cetera. It goes on. Throughout this account, that is two pages, she constantly reiterates that she never experienced any pain whatsoever. Interestingly, she experienced anxiety, but not to the extent of her wound. But her sandals were pulled off during the attack, and she was worrying about mundane everyday things like the fact she would burn her feet on the sand. At the same time she was being destroyed by this hyena, which was an extraordinary thing. She also heard herself screaming, but was quite unaware of having screamed. [72]

2.5.2 Fear of Predators

Not all predation attempts are successful. When hunting alone, lions capture a meal only 14% to 32% of the time, although this figure doubles when they hunt in groups of at least two [70]. Hunting dogs and cheetahs capture prey roughly 70% of the time [70].

Since predators are not always successful, some prey endure the experience of fleeing from a predator even before the end of their lives. I didn't find literature that discussed how stressful these experiences might be, but I did find a study in which researchers traumatized mice by putting them in the presence of a cat [26]. The exposed mice exhibited short- and long-term "behavioral and neurochemical changes consisting of acute increased anxiety associated with posttraumatic stress disorders" that mirrored the DSM-IV criteria [26, p. 1-3].

2.6 Lifespans

Type of Animal	Lifespan (years)
Deer	10 [25]
Squirrels	6 [11]
Cats	4 [14]
Raccoons	3.5 [51]
Reptiles and amphibians	≈ 3 [12, 32]
Opossums	1.5 [57]
Dogs	1.5 [52]
Birds	1 to 2 [44, 36]
Rats	1 [41]

3 A Bug's Life

There seems generally to be a negative correlation between an animal's height on the ecological food pyramid and its level of welfare: Smaller prey animals tend to have shorter lifespans and more offspring that will not survive to maturity. Unfortunately, there is also a negative association between an animal's height on the pyramid and its preponderance, meaning that the animals that suffer more tend to have larger populations.

Near the bottom of the animal food pyramid are insects (which I define to include spiders, crabs, and other higher-level arthropods). Judging from their short lifespans, these animals—if they are sentient—probably have some the worst lives of all.

Type of Insect	Lifespan (weeks)
Horn fly	2 [58]
Trichogramma Wasps	2 [6]
Stable fly	3 [58]
Black fly	≈ 3 to ≈ 20 [7]
Mosquito	3 to ≈ 150 [7]
Damselflies	3 to 4 [40]
Drosophila	6 [79]
Dragonflies	6 to 8 [40]
Green lacewings	12 [6]
Ladybird beetles	48 [6]

The sources that I used for this table were not specific about whether the "average lifespans" that they reported included the large number of insects that die shortly after birth. I imagine that most of these figures only give the average lifespan of those individuals that

make it past the first few days or weeks of age. Thus, these figures probably severely *understate* how soon after birth most insects die.

3.1 But Are Insects Sentient?

I review the matter in more detail in another piece, "Can Insects Feel Pain?"[2] In this piece, I merely include an extended quotation from another paper—Jane A. Smith's "A Question of Pain in Invertebrates" [75]—which nicely summarizes the main points of the debate. In addition to the sources cited in Smith's article (which I do *not* list in my own bibliography, since the references are available online), I recommend [47, 45] as sources that support the possibility of insect sentience.

> Quite apart from philosophical considerations, practical and scientific evidence may lead us to assume that all mammals can experience something analogous to (though most likely qualitatively and quantitatively different from) the human experience of pain. Humans, after all, are mammals; and although the details may differ, we share our basic physiology with other mammalian species. There is also a reasonableness, it seems, in extending this view to include other members of the Vertebrata. The further we move away from the mammalian plan, the more difficult it becomes to infer pain in other species. But vertebrates, at least, have similarities in basic anatomy and physiology, including similarities in nervous organization, which are especially important in this context.
>
> What, however, of the 95 percent of species in the Animal Kingdom that do not possess a backbone—the heterogeneous assemblage of animals, organized very differently from the vertebrate plan, which we call "invertebrates"? [...]
>
> Most, if not all, invertebrates have the capacity to detect and respond to noxious or aversive stimuli. That is, like vertebrates, they are capable of "nociception." Examples of aversive stimuli include changes in temperature beyond the animal's normal range, contact with noxious chemicals, mechanical interference, or electric shock. Under certain conditions, all of these might be expected to cause pain in humans. In general, invertebrates, like vertebrates, respond to such stimuli by withdrawing or escaping so as to reduce the likelihood that they will be damaged by the noxious conditions. [...]
>
> However, in humans, at least, there is a distinction to be made between the "registering" of a noxious stimulus and the "experience" of pain. [...] Experiments on decorticate mammals have shown that complex, though stereotyped, motor responses to noxious stimuli may occur in the absence of consciousness and, therefore, of pain (Iggo, 1984). Thus, it is possible that invertebrates' responses

[2]http://www.utilitarian-essays.com/insect-pain.html

to noxious stimuli (and modifications of these responses) could be simple reflexes, occurring without the animals being aware of experiencing something unpleasant, that is, without "suffering" something akin to what humans call pain.

The "relatively simple organization" of the insect central nervous system, Elsemann et al. argue, "raises the question of whether any experience akin to human pain could be generated" in these animals (and by implication in other invertebrates with a similar or less complex nervous organization). On the analysis of Gould and Gould (1982), the answer to such a question would be "no," for these authors can find no evidence for conscious experience in insects. Certainly, on the limited amount of evidence presented here, it seems very difficult to imagine that insects and the other simpler invertebrates mentioned above can "suffer" pain in anything like the vertebrate sense. Nevertheless, the issue certainly is not closed, and further questions should be asked.

Perhaps such a view simply reflects a paucity of (human) imagination. Griffin (1984) surely would urge us to maintain an open mind on the issue, having provided behavioral evidence which, he argues, should challenge "the widespread belief that an insect, for example, "is too small and its central nervous system too differently organized from ours to be capable of conscious thinking and planning or subjective feelings." Indeed, to take a more radical view, perhaps "it is presumptuous for us to assume that because our suffering involves self-awareness, this should also be true of other species" (McFarland, 1989).

Alternatively, perhaps, as Mather (1989) suggests, we should simply accept that these animals "are different from us, and wait for more data." [...]

Clearly, in all this, there is the danger of adopting an uncritical anthropomorphic (or, in this context, perhaps a "vertebromorphic") approach, which could lead to incorrect conclusions about the experiences of invertebrates (see Morton et al., 1990). Thus, it might be inferred, incorrectly, that certain invertebrates experience pain simply because they bear a (superficial) resemblance to vertebrates—the animals with which humans can identify with most clearly. Equally, pain might incorrectly be denied in certain invertebrates simply because they are so different from us and because we cannot imagine pain experienced in anything other than the vertebrate or, specifically, human sense.

This limitation should be borne in mind when considering the practical implications of the tentative conclusions drawn from the evidence presented above. Although pain might seem less likely in the more "simple" invertebrates, than in the most "complex" invertebrates, such as the cephalopod mollusks (and, perhaps, decapod crustaceans such as crabs and lobsters, not considered here),

> this certainly does not mean that the more "simple" invertebrates ought not to be afforded respect.
>
> A principle of respect should lead those who use invertebrates in research (or display them in zoos, rear them for food, and so on) to try to maintain the highest possible standards of husbandry and care, so as to promote the animals' general "well-being" and, whenever practicable, to give the animals the benefit of the doubt where questions of pain and suffering are concerned.
>
> The well-being of invertebrates used for research is being taken increasingly seriously. Wigglesworth (1980), for example, has suggested that for practical purposes it should be assumed that insects feel pain and that they should, therefore, be narcotized in procedures that have the potential to cause pain. Cooper (1990) has identified several practical ways in which the well-being of invertebrates might be promoted. These include:
>
> - providing husbandry conditions that match, as closely as possible, those preferred by the species in the wild;
> - assuring high standards of care, provided by staff with an interest in invertebrates;
> - avoiding unnecessary or insensitive handling or restraint;
> - narcotizing the animals for any invasive or disruptive procedures and during prolonged restraint [...].
>
> To this list might be added:
>
> - attempting to kill invertebrates by the most humane methods possible and;
> - providing suitable guidance and training for all involved in the care and use of these animals.

Giving insects the benefit of the doubt is a far more radical approach than I propose. Rather, I favor coming up with a rough subjective probability that insects can feel pain and then discounting the potential suffering that we cause them by that factor. I think a probability of 0.001 for insect sentience is conservative.[3] At any given moment, the

[3] In Shakespeare's *Measure for Measure*, Isabella tells Claudio:

> The poor beetle, that we tread upon
> In corporal sufferance finds a pang as great
> As when a giant dies. [73, Act 3, Scene 1]

I am making a far weaker claim. I assert merely that, on balance of expectation, a giant's death entails as much suffering as stepping on 1,000 beetles.

earth supports 10^{18} insects [77]. This number becomes 10^{15} when we discount by a 0.001 probability of sentience.

3.2 Insect Predation

Unfortunately, insects endure many of the same hardships as higher animals, including predation and parasitism.

Some insects become trapped in spider webs. Venemous spiders bite their prey, wrap them in silk, and dissolve them in digestive fluid [46]. Even less fortunate are victims of the Amazonian *Allomerus decemarticulatus* worker-ants, which build a trap out of plant fibers to catch passers-by [28]. The device has been dubbed a "torture rack" because captured insects are stretched out on the fibers while they wait to be paralyzed by a sting from the ants. Some larger victims stay caught in the trap for up to 12 hours. Fortunately, only one other related species is known to build such traps [28].

The ichneumon wasps are a group of insect parasites that feed on their hosts in a particularly gruesome way. Sometimes called the "farmer's friends," these creatures are used as biological control agents because of their success at eating caterpillars and larvae of pest insects [83]. Stephen Jay Gould describes the process by which some ichneumon wasps parasitize their hosts:

> The free-flying females locate an appropriate host and then convert it into a food factory for their own young. Parasitologists speak of ectoparasitism when the uninvited guest lives on the surface of its host, and endoparasitism when the parasite dwells within. Among endoparasitic ichneumons, adult females pierce the host with their ovipositor and deposit eggs within. (The ovipositor, a thin tube extending backward from the wasp's rear end, may be many times as long as the body itself.) Usually, the host is not otherwise inconvenienced for the moment, at least until the eggs hatch and the ichneumon larvae begin their grim work of interior excavation.
>
> Among ectoparasites, however, many females lay their eggs directly upon the host's body. Since an active host would easily dislodge the egg, the ichneumon mother often simultaneously injects a toxin that paralyzes the caterpillar or other victim. The paralysis may be permanent, and the caterpillar lies, alive but immobile, with the agent of its future destruction secure on its belly. The egg hatches, the helpless caterpillar twitches, the wasp larvae pierces and begins its grisly feast.
>
> Since a dead and decaying caterpillar will do the wasp larvae no good, it eats in a pattern that cannot help but recall, in our inappropriate anthropocentric

> interpretation, the ancient English penalty for treason drawing and quartering, with its explicit object of extracting as much torment as possible by keeping the victim alive and sentient. As the king's executioner drew out and burned his client's entrails, so does the ichneumon larvae eat fat bodies and digestive organs first, keeping the caterpillar alive by preserving intact the essential heart and central nervous system. Finally, the larvae completes its work and kills its victim, leaving behind the caterpillar's empty shell. [34]

Unlike the relatively rare torture-rack ants, the ichneumonoidea are very common. This made the phenomenon of live parasitism especially troubling for natural theologians, as Gould notes:

> The ichneumonoidea are a group of wasps, not flies, that include more species than all the vertebrates combined (wasp, with ants and bees, constitute the order Hymenoptera; flies, with their two wings—wasps have four—form the order Diptera). In addition, many non-ichneumonoid wasps of similar habits were often cited for the same grisly details. Thus, the famous story did not merely implicate a single aberrant species (perhaps a perverse leakage from Satan's realm), but hundreds of thousands—a large chunk of what could only be God's creation. [34]

4 An Energy-Cost Argument

In his 1995 paper "Towards Welfare Biology," Yew-Kwang Ng constructs a theoretical description of animal motivation, a theorem of which is that the total amount of suffering in the wild exceeds the total amount of happiness [55]. I attempt a restatement of his argument in this section, though I do not know if my presentation correctly interprets Ng's original ideas. I welcome comments and corrections.

Assumption 1: For the sake of simplicity, suppose that an organism's life can have one of two possible outcomes

- "Winning": the organism survives, mates successfully, and has children, or
- "Losing": the organism dies at a young age and fails to mate.

Definition: Consider a given species. Let n be the ratio of the number of organisms of that species that "lose" to the number of organisms of that species that "win." For instance, if 2 organisms win and 4 lose, $n = \frac{4}{2} = 2$.

Assumption 2: In terms of energy use and tissue maintenance, it's more costly for the body to produce states of strong emotion than states of hedonic neutrality [55, p. 271]. The stronger the emotion, the greater the cost.

Definition: Let c be a real number representing the magnitude of cost that an organism expends in producing an emotional state. Define $c = 0$ for the cost of producing a regular equilibrium emotional state. Define $E(c)$ to be the magnitude of enjoyment that results when cost c is applied toward producing happiness. Let $S(c)$ represent the corresponding magnitude for suffering. Even though suffering is a "negative" emotion, let the magnitude of S be ≥ 0.

Assumption 3: E and S are both differentiable functions of c and both have the same shape.

Assumption 4: As cost increases, it takes more and more cost to produce the same magnitude of change in emotional experience. In other words, E and S are concave.

Assumption 5: The hedonic value of being in a state of relative equilibrium is essentially neutral; *i.e.*, $E(0) = 0$ and $S(0) = 0$ [55, p. 271].

Definition: Let w be the value of c such that $E(w)$ represents the enjoyment associated with "winning." Let ℓ be the value of c such that $S(\ell)$ represents the suffering associated with "losing." The difference in the utility of winning and losing is then $E(w)+S(\ell)$.

Assumption 6: Organisms are motivated to survive and reproduce because they seek the happiness of winning and hope to avoid the suffering of losing. In particular, the bigger is $E(w) + S(\ell)$, the more motivated organisms will be.

Assumption 7: Organisms with greater motivation are more likely to survive. Hence, in the long run, organisms will develop hedonic mechanisms that maximize $E(w) + S(\ell)$ subject to the constraint of having a fixed amount of resources available for producing strong emotional states.

Result: These assumptions are sufficient to establish what Ng calls the "Buddhist premise"—that for species with $n > 1$, the overall amount of suffering is greater than the overall amount of happiness [55, p. 272].

Illustration: To take an example, let $k > 0$ be a constant, and suppose that $E(c) = S(c) = k \ln(c + 1)$ for $c \geq 0$. As Ng suggests [55, p. 282], this seems consistent with the Weber-Fechner law in psychology, which states that the perceived magnitude of a stimulus is a logarithmic function of its actual magnitude [82].

Assumption 7 tells us to maximize $E(w) + S(\ell)$ subject to the constraint $bw + nb\ell =$ constant, where b is the number of winning organisms in the species [55, p. 277]. This gives the solution $w = n\ell + n - 1$.[4] If ℓ equals some amount ℓ_0, so that $w = n\ell_0 + n - 1$,

[4] To see this, use the method of Lagrange multipliers. Maximize $f(w, \ell) := E(w) + S(\ell) = k \ln(w + 1) +$

what is the balance of suffering to happiness?

$$\begin{aligned} nbS(\ell_0) - bE(n\ell_0 + n - 1) &= nbk\ln(\ell_0 + 1) - bk\ln(n\ell_0 + n) \\ &= bk\Big[n\ln(\ell_0 + 1) - \ln n - \ln(\ell_0 + 1)\Big] \\ &= bk\Big[(n-1)\ln(\ell_0 + 1) - \ln n\Big]. \end{aligned}$$

Assuming $b = k = \ell_0 = 1$, this equation reduces to

$$\text{amount by which suffering exceeds happiness} = (n-1)\ln 2 - \ln n,$$

which I plot in the following figure.

The labels in these figures are roughly based off of data from [76, p. 37], which Ng includes in a table in his piece [55, p. 270]. These data gave typical values for the number of offspring produced by a female during a mating season. For instance, the bullfrog (*Rana catesbeiana*) lays between 6,000 and 20,000 eggs per brood. To incorporate this number into Figure 2, I did the following:

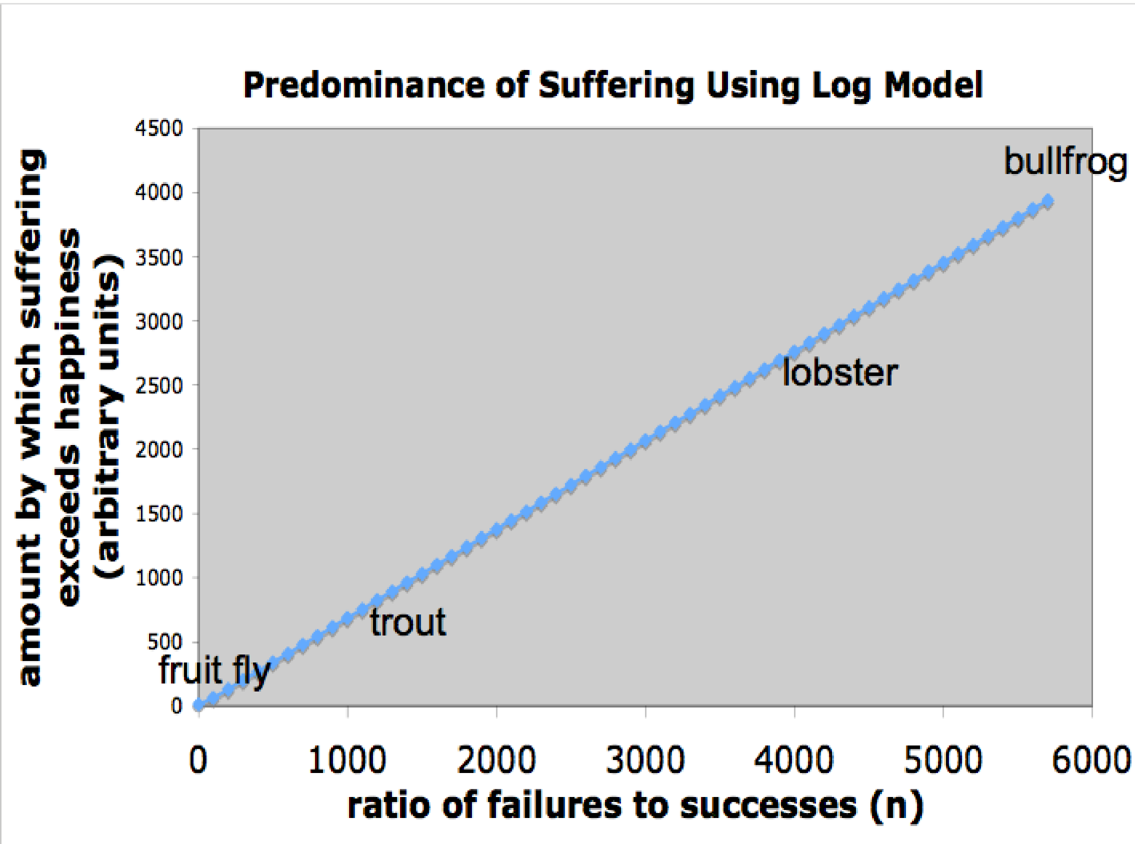
- Take the average of the range: 13,000.
- Assume (conservatively) that a bullfrog has only one mating cycle in its lifetime. Hence, a single female produces on average 13,000 eggs.
- In a stable population, two of those eggs, on average, will survive to maturity, while the rest will die early. Hence, $n = \frac{13{,}000-2}{2} \approx 6,500$.
- In using this figure, I'm implicitly assuming that all of the other 13,000 - 2 organisms fell into the "failure" group. If the reader finds this unrealistic, he or she may use a larger number of successes—say 50. Then $n = \frac{13{,}000-50}{50} = 259$, which is still considerable.
- I'm also implicitly assuming that all of the 13,000 eggs develop into a form capable of feeling pain before they die. In fact, many of the eggs are probably eaten before

$k\ln(\ell + 1)$ subject to $g(w, \ell) := bw + nb\ell =$ constant. For some λ,

$$\begin{aligned} \nabla f &= \lambda \nabla g \\ \left(\frac{k}{w+1}, \frac{k}{\ell+1}\right) &= \lambda(b, nb) \end{aligned}$$

so that

$$\begin{aligned} w + 1 = \frac{k}{\lambda b} \quad \text{and} \quad \ell + 1 &= \frac{1}{n}\frac{k}{\lambda b} \\ w + 1 &= n(\ell + 1) \\ w &= n\ell + n - 1. \end{aligned}$$



Predominance of Suffering Using Log Model
amount by which suffering exceeds happiness (arbitrary units)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
bullfrog
lobster
trout
fruit fly
0
1000
2000
3000
4000
5000
6000
ratio of failures to successes (n)

they hatch, while others fail to hatch altogether; if the eggs themselves feel no pain, this does not cause suffering.

5 Emotional and Cognitive Biases

In this section, I suggest some biases that may affect our assessments of wild-animal suffering.

5.1 Availability Heuristic

The *availability heuristic* refers to the tendency of people to overestimate the probability or prevalence of an outcome or feature of the world that they can readily imagine [4]. For instance, people often assess the risks of airplane crashes, natural disasters, shark attacks, and terrorism [4] as higher than they actually are because mental images of these events are more available than images of, say, workplace injury.

The images of wild animals most readily available to many people are probably those from movies, zoos, and backyard birdfeeders. Even when people walk through a forest, they remark about the song of birds, the croaking of frogs, and the chirping of katydids. They fail to notice the thousands of arthropods upon which they are stepping[5] or the sick and dying frogs and birds that suffer in quiet misery.

5.2 Selection Bias

Selection bias happens when a researcher draws conclusions about a population on the basis of a statistically unrepresentative sample [71]. In this context, I intend the term to refer to a slightly different concept: the idea that, as is often said, "History is written by the winners." Or in other words, the organisms who study wild animals and appraise their welfare are usually well-off human beings (not sick or marginalized members of human

[5] An article called "Basic Facts: Insect Numbers" reports:

> A person steps upon thousands of insects whenever walking outdoors. In an oak forest in Pennsylvania, researchers counted the number of arthropods in leaf litter and soil in samples that were one foot square and three inches deep. They found an average of 9,759 arthropods per square foot. Based on these counts, the researchers estimated that there were more than 425 million soil and litter arthropods per acre (43,560 square feet) of forest. [...] In this study, mites (Class Arachnida) were the most abundant kind of animal, averaging more than 294 million per acre. Springtails (Class Hexapoda, Order Collembola), which are closely related to insects, averaged 119 million. Insects and other arthropods averaged 11 million per acre. [5]

society, nor rabbits, tadpoles, or flies). Many people in Western societies have never been tortured, have never been chased by predators, and have never gone without food, water, and warmth for days on end. Even if we were (hypothetically) to ask other animals in the wild for their opinions, we would still be sampling "the winners" of the group; we would miss out on the large numbers of babies that died shortly after being born.

Selection bias also applies to emotional states. If you were in a state of severe agony, you wouldn't be reading this paper right now. Most of your important moral and practical decisions you probably make in a relatively "euthymic state"—one in which you have your basic needs satisfied and feel mildly content. This is probably a good thing, since severe pain makes us irrational.[6] But it is important that we do not become complacent to suffering. We musn't blindly assume that other organisms share our emotional state, and we must remind ourselves of what it's like to suffer.

5.3 Wishful Thinking

Wishful thinking refers to the tendency of people to predict better outcomes than rationality would dictate [84]. Related is the fallacy of *rosy retrospection*, in which people tend to remember well the better parts of an experience (such as a vacation) and ignore the irritating or unpleasant aspects of it [66]. At the same time, depressed people may be more down to earth. At least, that's the hypothesis of *depressive realism*, which claims that people with depression tend to have more accurate perceptions than happy people, especially as regards their own abilities [24].

The types of psychological mechanisms described above seem generally helpful in allowing people to succeed in society, since those who don't dwell on negative thoughts will presumably be more motivated, productive, and healthy. Of course, this analysis is slightly complicated by the fact that positive delusions themselves actually make people happier, so that those who think that their lives are better *actually do* have better lives, *ceteris paribus*. But when we are examining the amount of suffering experienced by wild animals, we should aim for accuracy, rather than the conclusion that will make us feel good about the world. The sick gazelle that lies helpless on the ground, waiting to be torn apart by predators, is not helped by our desire to paint rosy Potemkin villages of nature.

[6] In George Orwell's *1984*, O'Brien makes this point in its most extreme form:

> [...F]or everyone there is something unendurable—something that cannot be contemplated. Courage and cowardice are not involved. If you are falling from a height it is not cowardly to clutch at a rope. If you have come up from deep water it is not cowardly to fill your lungs with air. It is merely an instinct which cannot be destroyed. [59]

5.4 Reverence for Nature

People feel a wonderful sense of awe when they spend time in nature.

> [. . .] He is insensibly subdued
> To settled quiet: he is one by whom
> All effort seems forgotten; one to whom
> Long patience hath such mild composure given,
> That patience now doth seem a thing of which
> He hath no need. He is by nature led
> To peace [. . .] [85]

Thomas Huxley remarked:

> The vast and varied procession of events, which we call Nature, affords a sublime spectacle and an inexhaustible wealth of attractive problems to the speculative observer. If we confine our attention to that aspect which engages the attention of the intellect, nature appears a beautiful and harmonious whole, the incarnation of a faultless logical process, from certain premisses in the past to an inevitable conclusion in [the] future. But if it be regarded from a less elevated, though more human, point of view; if our moral sympathies are allowed to influence our judgment, and we permit ourselves to criticise our great mother as we criticise one another; then our verdict, at least so far as sentient nature is concerned, can hardly be so favourable.
>
> In sober truth, to those who have made a study of the phenomena of life as they exhibited by the higher forms of the animal world, the optimistic dogma, that this is the best of all possible worlds, will seem little better than a libel upon possibility. [39, p. 195-96]

Huxley went on to compare the natural world with "a gladiator's show":

> The creatures are [. . .] set to fight—whereby the strongest, the swiftest, and the cunningest live to fight another day. The spectator has no need to turn his thumbs down, as no quarter is given. He must admit that the skill and training displayed are wonderful. But he must shut his eyes if he would not see that more or less enduring suffering is the meed of both vanquished and victor. And [. . .] the great game is going on in every corner of the world, thousands of times a minute; [. . .] were our ears sharp enough, we need not descend to the gates of hell to hear
>
> > sospiri, pianti, ed alti guai.
> >
> > . . .

Voci alte e floche, e suon di man con elle[.[7]]

[39, p. 200]

Nature doesn't care if the survivors are miserable; it only cares that they survive.[8] [8]

6 What Should Be Done?

To this question, I don't have a good answer. I hope that readers more knowledgeable about the subject than I am will contact me with ideas.

Further research into the degree of wild-animal suffering may be cost-effective. In particular, it would be helpful to have a better assessment of the probability of insect sentience. If further study changes our subjective probability from, say, 0.03 to 0.3, then the problem of wild-animal suffering will have become nearly ten times as urgent.

Also important is the question of whether it would be possible to intervene in nature to reduce animal suffering. A few philosophers have raised the question of whether such intervention is morally obligatory [69, 53, 29, 19], though as the quotations in the Introduction noted, such intervention should aim to avoid causing more harm than good. Are there or might it be possible to develop technologies that could, say, ease the painfulness of wild-animal deaths? Would such techniques be applicable to insects and other small animals that account for nearly all of the expected suffering in the wild? I look forward to investigating this topic further.

[7]This passage from Dante's *Divine Comedy* translates as follows:

Languages diverse, horrible dialects,
Accents of anger, words of agony,
And voices high and hoarse, with sound of hands,

Made up a tumult that goes whirling on
For ever in that air for ever black,
Even as the sand doth, when the whirlwind breathes. [21, Inferno: Canto III]

[8]There may be some evolutionary argument for the hypothesis that, before animals mature, their lives are not brutally awful most of the time, for if their lives were, the animals might find it harder to reproduce. (In fact, this is one of many arguments against pain in plants: if plants did suffer, it would only induce stress and would yield no survival benefit, since they wouldn't be able to run away.) Once animals enter old age, though, there's no evolutionary influence to counteract terrible suffering; for instance, there's no evolutionary benefit for having a mechanism to palliate the pain of death, since such a mechanism could not enhance the organism's ability to propagate children [23].

In addition, this analysis ignores the vast majority of animals that *don't* make it to reproductive age. These individuals may very well suffer horribly as they die from hunger, disease, and predation. Indeed, in this case, there's an evolutionary argument for the hypothesis that most animals which fail to reproduce and die young have miserable lives [55, 16]. In many species, fitness is enhanced by overproducing offspring so that only those best adapted survive. "Most children left behind" could be the motto of this process.

The challenge of wild-animal suffering is difficult, but it is also highly important. Between 50 and 100 million animals are killed each year in laboratory experiments, according to sources in [2]. A conservative figure for the number of land-based farm animals killed for food each year around the world is 55 billion, according to the UN Food and Agriculture Organization (see [3]). But there are 10^{18} insects in the world [77], and a few more non-insect wild animals. As serious as animal pain due to experiments and agriculture may be, the number of wild animals that suffer in preventable ways is probably far higher. It seems that there ought to be a cost-effective way of relieving at least some of this suffering.

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