

body of work is that large carnivores are dangerous for livestock and themselves in danger from humans guarding livestock. Studies of domestication do not substantiate speculation that tameness in wild populations is a heritable trait that would have a strong enough selective advantage to oppose selection for antipredator traits. The transfer-of-habituation model predicts that domestic animals should be particularly susceptible to predators because they have been bred for tameness. In reality, the converse is well known: feralization can occur in recently released individuals and feral domestic species from guppies to dogs to goats to hogs [8–10] rapidly acquire wild-type antipredator behaviors. Thus, the more plausible scenario is that once the human shield is gone, tameness and boldness should also rapidly go away in wildlife.

The converse of the Geffroy *et al.* [1] model is supported by research: tourism is a proven incentive to protect habitats and large populations of wildlife from hunting. When hunting pressure is released, animals made wary from hunting regain less secretive activity patterns [11]. Depressed populations rebound and wildlife in general is more viewable. Flight initiation distance (FID) is less in areas with tourism because of lack of hunting pressure, not because animals are so habituated they are on their way to domestication.

Geffroy *et al.* [1] reiterate the important point that in some instances animals suffer from badly managed interactions with tourists. The almost standard recommendation, long implemented all over the world, is to restrict tourist activity to a small proportion of wild animal populations and discourage habituation [11,12]. At the scales where conservation is most needed, the negative effects of tourism are less severe than bushmeat hunting, the wildlife trade, logging, invasive species, and habitat conversion for agriculture, roads, and dams. The conservation shield that ecotourism creates is not a panacea, but it remains an effective

tool among many for protecting wildlife and ecosystems all over the world.

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<http://dx.doi.org/10.1016/j.tree.2015.11.002>

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## Letter

# Nature-Based Tourism and Prey Vulnerability to Predators: A Reply to Fitzgerald and Stronza

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In a recent review [1] we developed a framework to identify potential ecological consequences of long-term benign interactions between humans and animals and to highlight potential deleterious effects of non-threatening wildlife viewing by tourists. Fitzgerald and Stronza [2] questioned our hypothesis stating that ‘It sends a countervailing, mixed message to conservation stakeholders about the real importance of tourism for protecting wildlife’ and claimed that we focused on negative points while ecotourism could bring many more benefits than costs to endangered animals. We fully agree that ecotourism, and more generally nature-based tourism, may provide net benefits that might outweigh the potential costs we have identified. However, to identify the trade-offs that might result from nature-based tourism, it is essential to identify all potential costs to properly evaluate the net benefits. Besides this main point, we believe that other aspects of our position were slightly mis-stated by Fitzgerald and Stronza [2] and we aim to correct these below.

Nature-based tourism should have net benefits; thus, we focused on a potentially unanticipated deleterious outcome from it. We did not state that negative outcomes are certain in all situations. Rather, we emphasized a highly plausible scenario where these negative outcomes could occur. Our review, like many other *TREE* reviews, should help guide future studies that will produce a more comprehensive understanding of the conditions under which nature-based tourism increases predation risk.

Fitzgerald and Stronza [2] asserted that, to date, there is no conclusive evidence regarding a transfer of habituation to the suite of predators in nature. We agree that this has not been properly tested in the wild and emphasized this in our review [1]. Nevertheless, the idea that individuals that

are bold around humans are also bold around genuine predators and has some empirical support. In addition to the fox squirrel study we reported [3], a more recent experiment on pigeons revealed that those individuals that were bolder and more docile toward humans were also more susceptible to raptor predation [4]. Personality traits are, by definition, repeatable across time and context [5]. Therefore, we expect individuals that have 'positive' early experiences when approaching humans (e.g., obtaining food, passive protection) to develop a boldness syndrome, which may result in bold individuals being more susceptible to predation when exposed to their real predators. Current evidence prevents us from rejecting this plausible outcome. Yet, more research is needed to better understand the conditions under which it is likely.

The positive socioeconomic impacts of nature-based tourism or ecotourism have already been exhaustively discussed in the literature (e.g., [6,7]) and were thus not the focus of our review. We think that it is too simple to say that tourism protects animals from illegal hunting. While providing alternative sources of income for the subsistence of hunters and fishers could permit them to not hunt or fish, we know that highly human-habituated individuals are more vulnerable to human hunters (e.g., [8]). Fitzgerald and Stronza [2] stated that 'Flight initiation distance (FID) is less in areas with tourism because of lack of hunting pressure, not because animals are so habituated they are on their way to domestication'. However, available data do not support this claim. Indeed, many studies have shown reduced FID in areas with more humans than in areas where humans are absent (or less common) even when there is no hunting pressure (reviewed in [9]).

Developing synergies between environmental and socioeconomic objectives depends on many factors, among which is the size of the site. Recent work has shown that bigger attractions (in terms of

number of animals) create fewer concerns for both conservation and animal welfare [10]. In addition, wild attractions (e.g., dolphin interactions, gorilla trekking, gibbon watching, polar bear sightseeing) were not only conservation neutral but also significantly decreased animal welfare [10]. Hence, while the socioeconomic benefits for the local human population might be high [11], there is currently no consensus on the environmental impacts of these activities, which might be detrimental [11].

Not all nature-based tourism is ecotourism, but there are three pillars of ecotourism: it should be socially, economically, and environmentally relevant. Our framework focuses exclusively on the environmental relevance. We hope that our study, combined with a recent review [12], will stimulate more research that will permit a better accounting of environmental costs so that the net benefits of eco- and nature-based tourism can be properly identified. In many cases, even with documented environmental costs, we believe that the net benefits will support properly designed tourism. In this sense, there are some likely useful practices to minimize potentially harmful effects of tourism on wildlife<sup>i</sup>. We hope that the framework we developed [1] helps improve nature-based tourism so that the benefits are maximized and the costs to the animals are reduced.

#### Resource

<sup>i</sup> <http://theconversation.com/ecotourism-could-be-making-animals-less-scared-and-easier-to-eat-49196>

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#### Forum

### Sex, Mitochondria, and Genetic Rescue

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Genetic rescue is a potentially effective management tool to offset the effects of reduced genetic diversity in imperiled populations. However, implementation requires complex choices. Here we address the consequences of introducing males versus females, highlighting the possibility that introduced females might lead to maladapted mitonuclear genomes and reduced offspring fitness.