Best Practices Toward Sustainable Ecotourism

10

Diogo S.M. Samia, Lisa M. Angeloni, Maddalena Bearzi, Eduardo Bessa, Kevin R. Crooks, Marcello D'Amico, Ursula Ellenberg, Benjamin Geffroy, Courtney L. Larson, Rafael Loyola, Anders Pape Møller, Sarah E. Reed, Bastien Sadoul, Graeme Shannon, Zulima Tablado, Daniel Zacarias, and Daniel T. Blumstein

Fig. 10.0 Burrowing owls (*Athene cunicularia*), found throughout North and South America, are often quite tolerant of humans. Photo credit Diogo S. M. Samia

D.S.M. Samia (✉)
Department of Ecology, University of São Paulo, São Paulo, Brazil
e-mail: diogosamia@gmail.com

D.T. Blumstein et al. (eds.), *Ecotourism's Promise and Peril*,
DOI 10.1007/978-3-319-58331-0_10

L.M. Angeloni
Department of Biology, Colorado State University, Fort Collins, CO, USA
e-mail: angeloni@colostate.edu

M. Bearzi
Ocean Conservation Society, Los Angeles, CA, USA
e-mail: mbearzi@earthlink.net

E. Bessa
Graduate Program in Ecology, and Life and Earth Sciences Department, University of Brasília, Brasilia, Distrito Federal, Brazil
e-mail: edu_bessa@yahoo.com

K.R. Crooks
Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO, USA
e-mail: kevin.crooks@colostate.edu

M.D'Amico
CIBIO-InBIO, University of Porto, Lisbon, Portugal

CEABN-InBIO, University of Lisbon, Lisbon, Portugal
e-mail: damico@cibio.up.pt

U. Ellenberg
Department of Ecology, Environment and Evolution, La Trobe University, Melbourne, Australia
e-mail: u.ellengerg@latrobe.edu.au

B. Geffroy • B. Sadoul
Ifremer, UMR MARBEC, Marine Biodiversity, Exploitation and Conservation, Laboratory of Adaptation and Adaptability of Animals and Systems, Palavas-les-Flots, France
e-mail: bgeffroy@ifremer.fr; bsadoul@ifremer.fr

C.L. Larson
Graduate Program in Ecology, Colorado State University, Fort Collins, CO, USA
e-mail: courtney.larson@colostate.edu

R. Loyola
Conservation Biogeography Lab, Departamento de Ecologia, Universidade Federal de Goiás, Goiânia, Goiás, Brazil

Centro Nacional de Conservação da Flora, Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, Rio de Janeiro, RJ, Brazil
e-mail: rdiasloyola@gmail.com

A.P. Møller
Ecologie Systématique Evolution, Université Paris-Sud, CNRS, AgroParisTech, Université Paris-Saclay, Orsay Cedex, France
e-mail: anders.moller@u-psud.fr

S.E. Reed
Wildlife Conservation Society and Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO, USA
e-mail: sreed@wcs.org

G. Shannon
School of Biological Sciences, Bangor University, Bangor, UK
e-mail: g.shannon@bangor.ac.uk

Z. Tablado
Swiss Ornithological Institute, Sempach, Switzerland
e-mail: zulima.tablado@vogelwarte.ch

D. Zacarias
Programa de Pós-graduação em Ecologia e Evolução and Conservation Biogeography Lab, Departamento de Ecologia, Universidade Federal de Goiás, Goiânia, Goiás, Brazil

Programa de Graduação Ciência para Desenvolvimento (PGCD), Instituto Gulbenkian de Ciência, Oeiras, Portugal

Universidade Eduardo Mondlane/Escola Superior de Hotelaria e Turismo de Inhambane, Maputo, Mozambique
e-mail: daniel.zacarias15@gmail.com

D.T. Blumstein
Department of Ecology and Evolutionary Biology, and The Institute of the Environment and Sustainability, University of California Los Angeles, Los Angeles, CA, USA
e-mail: marmots@ucla.edu

10.1 Introduction

When entering a natural environment, ecotourists and wildlife operators must be aware they are entering habitats that are home to millions of individual organisms. Ecotourists are guests in these environments where residents must acquire resources, avoid predation and parasitism, and safely rest and reproduce. Each of these basic activities has been honed to efficiency by generations of natural selection to work well in that specific environment. Changes in the environment, such as those caused by human visitation and tourism activities, can create mismatches between what the organisms are adapted to and the environment, creating novel challenges for the organisms that call it home.

Often when we think about an ecotourist destination, we immediately think of the charismatic species—the large terrestrial and aquatic vertebrates that are commonly featured in photographs and in the public media [1]. However, these species usually represent just a tiny portion of any ecological community [2–4]. Most of the species richness and abundance in an ecosystem is composed of small vertebrates (e.g., small rodents, amphibians, fishes), invertebrates (e.g., arthropods, mollusks, worms), plants, fungi, bacteria, and viruses—all of which play vital roles in ecosystem functioning.

The species in an ecosystem are connected by a complex and dynamic interaction network [5], which includes fundamental ecological processes such as predation (some species eat others), competition (species which compete for access to resources), parasitism (some species benefit at the expense of others), and mutualism (species that work together to create mutual benefits). This interdependence implies that fluctuation in populations of one or more species (e.g., through extinction of a parasite or of a top predator) can trigger a cascade of effects that may compromise other species [6, 7], change the structure and dynamics of the ecological community [8, 9], or even threaten ecosystem functions, processes, and environmental services [10–12].

Importantly, these intricate and interdependent processes are all around us when we are hiking, biking, snorkeling, whale watching, or just sitting on a boulder enjoying the sunset. The uniquely new thing in remote parks and protected areas is often us, humans, along with our set of novel accessories. We bring with us new stimuli (motor noises, lights, etc.) that animals may have no ecological or evolutionary experience with because, unlike the ecosystems that we encounter in our backyards and cities, many of these species and their interactions have not evolved with human activity. Thus, in these places, even seemingly benign activities can have considerable impacts.

For some species, human activities create a sudden disturbance from which animals flee to avoid potentially detrimental effects. Other species may appear unaffected, ignoring or seemingly tolerating human activity. However, it is important to remember that even species that appear tolerant of humans may still experience subtle physiological or ecological changes, as many examples in previous chapters have illustrated. And, while subtle changes in behavior and physiology do not always alter the structure and dynamics of natural populations and communities or ecosystem health, they may indicate that human activity is not entirely

benign. Indeed, ecotourism may be the additional stressor that, when combined with other stressors (habitat degradation, climate change, etc.), triggers harmful effects on biodiversity and environments. Thus, we should adopt the precautionary principle, and our goal should be to limit potentially deleterious effects of ecotourism and, by doing so, support population viability and ecological sustainability.

How can we reduce potentially negative effects while maintaining the beneficial outcomes of ecotourism for conservation and human community development? This is a key question. Well-managed ecotourism can prevent destruction of wildlife and their habitats by deterring illegal hunting, illegal logging, and urban development while promoting education and pro-environmental behavior in the tourists. Ecotourism can also benefit human local communities by preserving their cultures and providing revenue and thus incentives for nature conservation. By doing so we may ultimately transform human communities from consumers to stewards of their natural environment. The challenge is getting the balance right, and the key to this is developing and applying best practices that reduce any negative impacts of tourist activities.

In this chapter, most of the book's authors worked together to suggest a number of best practices for ecotourism (Table 10.1). We tried to combine our insights from writing the other chapters to provide scientifically sound recommendations to better meet the three pillars of ecotourism—environmental, economic, and social [13, 14]. Because this book focuses on the evaluation of biological ecotourism impacts, we have placed a greater emphasis on recommendations related to the environmental dimension of ecotourism. However, we also considered the economic and social aspects of ecotourism, as shown by the first category of recommended best practices of our list (see Table 10.1).

This list is clearly not exhaustive. Other lists and other discussions of best practices can be found elsewhere (e.g., [15–20]), and we encourage ecotourists and ecotourism managers and operators to become familiar with them. Here, however, we provide updated recommendations based on the latest scientific knowledge of ecotourism impacts. The list comprises best practices to integrate the local human populations with ecotourism development and maintenance, to advance ecotourism management that draws upon multidisciplinary scientific knowledge, and to design policy and practices that reduce impacts on wildlife while promoting long-term ecosystem sustainability.

Table 10.1 Best practices for ecotourism

Recommended best practice	Reasons for recommendation	Empirical examples of reasons for recommendation
1. Encourage community-based tourism as the preferred form of ecotourism	Integrating local communities in the design and maintenance of an ecotourism project ensures more socially sustainable practices Promotes a more stable and sustainable relationship between local people and tour operators Creates employment opportunities for local communities (e.g., building, maintenance and operation of hotels, and the supply of goods and services) and promotes a sense of belonging in the local population From the range of opportunities created by ecotourism, direct payments to local communities have been identified as one of the most important Reduces the chances of wealth stratification in which local leaders receive more benefits than the remaining members of the community	A survey of community-based ecotourism projects in Thailand indicated that local communities were involved running businesses under the auspices of local institutions, serving as guides and porters, providing food and accommodation, and replacing private operators [21] In the Tchuma-Tchato project of Mozambique, 33% of tax revenue was shared between all stakeholders and was directed to local communities [22]. This changed the perspective of citizens and transformed local communities from resource users to resource protectors [22–24]
2. Reduce the likelihood that local communities become financially overdependent on ecotourism	Fluctuations in climate, currency exchange rate, and political and social conditions can influence ecotourist visitation rates Reduces the economic impact on a local community caused by some industries monopolizing aspects of ecotourism (e.g., hotels and airlines at some destinations) Local communities with certified bio-cultural products can have greater profits and be more effective in natural resource conservation [25, 26]	Human local communities in cold polar regions, an extremely threatened area because of global warming, are increasingly dependent on the jobs, income, and income generated by ecotourism, especially marine mammal tourism. For example, the polar bear tourism industry in Churchill, Canada, has rapidly grown into a $2 million/year industry since the 1970s [27] In Southeastern Tanzania, mismanagement and inequitable harvesting of timber stocks penalized local communities. This led to the implementation of a group certification scheme that yielded more than US$100,000 per year and extensive community management against illegal and private loggers [28], which in turn resulted in an increase in wildlife sightings and an increase in ecotourism activities Beyond creating revenue for a local community, bio-cultural certification has indirectly contributed to the reduction of the CO_2 footprint associated with tourism [29–31]

3. Promote partnerships with a multidisciplinary body of scientists, integrating them in all stages of an ecotourism project	Acquisition of updated and scientifically sound knowledge concerning the environmental, economic, and social impacts of ecotourism and how to mitigate them should help to design low-impact, sustainable practices Monitoring of wildlife and local human populations permits a dynamic decision-making process Minimizes labor costs because scientists and students often have other sources of support Trains students and volunteers and creates skilled labor in the local population Increases the chances of developing public policies to protect the area as new scientific evidence is accumulated	A cost-benefit analysis of a three-way partnership between conservation biologists (the Tambopata Macaw Project, Peru), an ecotourism operator (Rainforest Expeditions), and a volunteer-recruiting NGO (the Earthwatch Institute) was conducted [32]. Researchers provided training, volunteers, and supervision and offered research presentations to ecotourists. In turn, researchers received funding, transportation, food, lodging, and volunteers to help with gathering data. At the end, all partners benefited financially from this association and by protecting the clay lick that provided key resources for macaws [32]. The project enhanced the sustainability of the ecotourism site
4. Promote partnerships between the ecotourism project and eco-friendly and socially responsible companies	Some consider ecotourism as an oxymoron [33, 34] because ecotourists usually have to travel long distances with transportation that contaminates the environments and contributes to global climate change and because ecotourists often have to stay in eco-unfriendly hotels and resorts [35]	It is estimated that tourism (transport and activities) accounted for 5% of global anthropogenic CO_2 emissions in 2005 [36] Only 47% of ecotourism travel companies licensed by Galápagos National Park purchases carbon offsets or engages in carbon neutral policies [37] Many tourist camps in the Okavango Delta depend on borehole water, and their waste water and sewage sludge contaminate the groundwater [38]

(continued)

Table 10.1 (continued)

Recommended best practice	Reasons for recommendation	Empirical examples of reasons for recommendation
5. Promote "ecological network thinking" in all stakeholders, from decision-makers to ecotourists, through environmental education and integrated planning of all ecotourism activities	Organisms in an ecosystem are connected by a complex and dynamic network of ecological interactions (e.g., the trophic relationships between predators and prey and the relationships between pollinators and plants) [39, 40] Many studies show how disturbance of a few species, interactions, or resources can trigger cascading effects across species leading to extinctions of other species. Thus, minor disturbance events may affect the entire community or ecosystem, particularly if such disturbance impacts keystone species or keystone interactions [11, 41, 42]	The eradication of gray wolves (*Canis lupus*) from Yellowstone National Park by the mid-1920s led to an increase in elk (*Cervus elaphus*) which grazed in the open areas close to rivers, an area previously avoided because of the greater vulnerability to wolf attacks [43]. The consequence was that elk overgrazed the vegetation along the rivers, which triggered a cascade of events such as changes in species composition and abundance, which led to visible and biologically important landscape modifications [43, 44]. Consumption of Pacific salmon (*Oncorhynchus* spp.) by brown bears (*Ursus arctos*) is responsible for up to 24% of the nitrogen influx in riparian ecosystems in southwestern Alaska—an iconic example of keystone interaction [45] A theoretical model validated with data of a natural food web found that 80% of the extinctions in a community did not occur in the species in which the mortality rate was manipulated but rather in another species directly or indirectly connected to it [46]
6. Encourage national accreditation of the natural area tourism based on international standards while respecting idiosyncrasies of each region or country	Not all tourism in natural environments is ecotourism Many recreational companies operating in natural places are accused of marketing their tourism as "eco" while not meeting the environmental, economic, and social responsibilities required for an ecotourism activity (this is sometimes referred to as "greenwashing") While many accreditation programs for ecotourism exist worldwide, with at least two attempts to create international standards by consensus [47, 48], ecotourism in many countries still lacks regulation, or participating in certification programs is not mandatory Idiosyncrasies should be respected because, among other reasons, some impactful ecotourism practices might be more acceptable in developing than developed countries	An evaluation of the websites of tour operators from the UK, the USA, and Ecuador selling "ecotourism" to Galápagos Islands reported considerable variation in how ecotourism principles were followed between countries and operators [37] For an enterprise be marketed as ecotourism in the Ngorongoro Conservation Area (NCA; Tanzania), the economic benefits should be culturally appropriate, they should be socially and politically acceptable to the local community, and they must respect the community's land tenure and its ability to make decisions over it [49]

7. Continuously monitor wildlife and the environment, preferably with taxonomic and environment specialists, but always with a holistic view of the ecosystem's functions and processes	Populations, communities, and ecosystems are dynamic entities, and a myriad of known and unknown factors, as well as rare events (e.g., wildfires or oil spills), can change—sometimes dramatically—their structure and stability Early detection of threats, such as proliferation of diseases and the introduction of alien species, increases the chances of a successful mitigation Exposure to chronic stressors will make individuals more susceptible to disease and reduce reproductive success and life expectancy. Thus, stress levels in wildlife must be monitored regularly Idiosyncrasies in a species' biology/ecology or a unique habitat feature may require species-specific or environment-specific mitigation. Identifying these idiosyncrasies may help design more effective management strategies	Only 1% of the extinctions predicted for the forest-dependent vertebrates from the Brazilian Amazonian have so far taken place, and 80% are expected to by 2050 [50]. Knowing the areas that are likely to be vulnerable and the estimated time delay involved offers an opportunity to concentrate management efforts, for example, through habitat restoration or species translocation [50, 51] Elevated stress levels in ring-tailed lemurs (*Lemur catta*) were directly related to increased mortality over a subsequent 2-year period. One of the key reasons for the observed effect was greater susceptibility to infectious disease as a result of suppressed immunity [52]. Early detection may have helped reduce lemur mortality The monitoring, over several months, of water quality and nutrient inputs throughout several Australian lakes allowed the detection of planktonic algae [53]. Such a perturbation, linked to tourism, would have been missed without intensive sampling
8. Rely on multiple biological indicators to monitor stress in wildlife	The lack of behavioral reaction does not necessarily mean that wildlife is not stressed by tourists. Even in the absence of a behavioral response, encounters with humans may trigger physiological responses, such as increases in heart rates, body temperature, and stress hormone production Because exposures to chronic stressors can result in exhaustion or downregulation of the stress response system, a low baseline level of stress hormones may be misleading, thus requiring additional tests of the capacity to respond to a second stressor or a hormonal challenge (e.g., activation of the HPA axis) to evaluate coping abilities	Despite showing no obvious behavioral reaction, heart rates of Bighorn sheep (*Ovis canadensis*) in the Sheep River Wildlife Sanctuary increased when encountering humans [54] The lack of behavioral responses to visitors in colonial birds on the Galápagos Islands was misinterpreted in the past as tameness. However, later studies monitoring heart rates found that internally they were experiencing physiological stress [55] Chronically stressed European starlings (*Sturnus vulgaris*) had low basal corticosteroid levels. By studying the response to a secondary stressor, reduced responses were identified, suggesting that birds had exhausted their ability to respond to stressors [56]

(continued)

Table 10.1 (continued)

Recommended best practice	Reasons for recommendation	Empirical examples of reasons for recommendation
9. Conduct rigorous controlled studies of wildlife physiology, behavior, reproductive success, and survival, before and after the introduction of artificial sources of resources, significant habitat alterations, or when introducing non-native species	Artificial resources (e.g., water holes, salt licks) may increase the abundance or density of local species which, in turn, may affect behavior, increase injury among conspecifics and heterospecifics, and modify habitat structure [57, 58] There is a large literature on the effects of non-native species introduced to control pests on the survivorship and health of native species [59, 60]	The establishment of artificial water holes in Hwange National Park (Zimbabwe) led to extremely high density of some species [58]. These unsustainable densities damaged local vegetation, altered animal communities, and favored especially aggressive individuals and species [58, 61] Animals aggregating at feeders, which occur throughout the world, may facilitate the spread of pathogens and advance the timing of annual events (e.g., migration, reproduction, and dispersal) because such events are affected by body condition, which in turn is determined by food intake [62]. Feeders may also increase the rate of reproduction and survival with consequences for population density [62] Cane toads (*Rhinella marina*) introduced into Australia to control mosquitoes have had a devastating effect on Australian biodiversity [63] as have rats and chickens introduced into Hawaii [64]
10. Apply mechanistic knowledge concerning animal physiology, behavior, ecology, and evolution to mitigate impacts or designing low-impact ecotourism activities	The main senses used to perceive the environment differ among species (e.g., vision for many birds and olfaction for many mammals). By understanding sensory abilities, we can design effective mitigation actions for target species Animals evolved to avoid predation. By identifying how animals assess risk, novel and effective ways to reduce risks can be used to reduce the negative impacts associated with human presence Species have limitations to adapt to human visitation based on their historical experience interacting with humans and other predators	Set vehicle speeds based on a fundamental understanding of mechanisms that animals use to assess approaching risks; species that have not evolved with rapidly approaching vehicles may be unprepared to successfully avoid them [65, 66] The use of hides and visual shields at bird-watching sites and water holes in Africa helps reduce animal stress since they are unable to see tourists and thus do not activate their physiological stress response [67, 68] Elephants (*Loxodonta africana*) are able to discriminate between language and voice characteristics of humans to correctly identify the most threatening individuals based on their ethnicity, gender, and age [69]. This highlights the benefits of identifying the mechanisms underlying patterns because this could be potentially applied to solve specific wildlife management problems (e.g., avoid poaching) The fact of flight initiation distance (FID) of zebras (*Equus quagga*) is substantially larger than the FID of horses (*Equus caballus ferus*)—both from areas with low frequency of interactions with humans—may be partially explained by a long history of humans hunting zebras, compared to a relatively brief period of humans hunting horses (since the last glacial cycle) [70]

11. Stimulate research on "compassionate conservation," animal emotions, and animal cognition for species usually observed in the protected and ecotourism areas	The recognition of animal emotions and cognitive abilities has generated empathy in humans and sensitized people to conservation needs and the well-being of other species [71, 72]	Scientists have begun to recognize animals as cognitive beings with personalities and emotions [73, 74]. As a result of this deepening "animal-human bond," the number of people feeling empathy and compassion toward animals is growing, as is the interest in experiencing wildlife firsthand
12. Collect data on ecotourist visitation to understand current levels of use and as a baseline for future mitigation strategies	Knowledge of the frequency and type of disturbance on a natural area is key to evaluate present impacts as well as to determine targets for future restoration If visitation increases rapidly, new mitigation measures or regulations may have to be implemented	The number and behavior of ecotourists influence the effects of ecotourism and thus must be known to develop effective mitigation plans [75, 76] After an increase in visitor frequency to some areas of the Sinharaja Forest Reserve, Sri Lanka, researchers used a data-informed GIS model to plan new trails to mitigate human-created stresses [77]
13. Conduct social research to understand how different ecotourism activities improve visitors' scientific literacy and increase their engagement in conservation activities	Ecotourist's participation in interpretation programs enhances their understanding of ecological processes [78, 79], because the more senses that are stimulated, the more likely they are to be engaged [78–80] Citizen science is on the rise, but how people are engaged and the associated benefits are still not well understood [81] Help ecotourism providers to design more effective interpretation programs that lead to pro-environmental behavior [82]	A study of tourists visiting the Galápagos Islands found that after a guide-run interpretation program, tourists got 10% more correct answers about biodiversity and evolutionary processes [83] A study conducted in Tangalooma, Australia, found that after interacting with dolphins, tourists increased their desire to change their behavior and act in more environmentally responsible ways [84]
14. Provide environmental education services to the ecotourists, preferentially using guides	Guided interpretation programs can manage tourist behavior to reduce impacts, provide participants with realistic expectations, increase the value of more wild and natural experiences, and promote tourism of less crowded areas and less known wildlife beyond charismatic species [68] Guides improve environmental education of ecotourists, enrich ecotourist's experiences, and enforce regulations designed to protect wildlife and natural resources The use of local guides creates financial incentives for conservation and, by employing locals, may increase satisfaction through the recognition of the value of their resources and knowledge	Evidence has shown that educational programs in outdoor settings have positive impacts in shaping their attitudes and perception of conservation needs and goals [85] Yankari Game Reserve (Nigeria) [86] and the Galápagos National Park [87] only permit guided tours where guides or rangers control the distribution and conduct of tourists Guides in the Masai Mara National Reserve, Kenya, were trained to deliver information, not only about the popular species but also about the entire park to inspire tourists to visit other park areas and reduce high concentration of tourists in specific sites, which would generate impacts [88]

(continued)

Table 10.1 (continued)

Recommended best practice	Reasons for recommendation	Empirical examples of reasons for recommendation
15. Establish clear guidelines for human access in the ecotourism area, making it more or less restrictive according to season, conservation status, and sensitivities of species and environments to human disturbance	Human-wildlife contact should be controlled because animals may become more tolerant to human presence, which can increase human-wildlife conflict and disease transmission from humans, increase mortality by vehicular collisions, and increase susceptibility to poaching Reacting behaviorally or physiologically to an encounter with humans is energetically costly for wildlife and may reduce their body condition, reproductive output, and survival. It may be particularly costly when disturbances occur during energetically demanding periods, like breeding or migration seasons Species' sensitiveness to human disturbance is mostly species-specific and also varies according to age, sex, breeding stage, time of the day, number of humans approaching, directness of approach, etc. [89, 90]. Areas with human-limited access should take these variables into account to design effective buffer zones Stresses caused by repeated human disturbance may reduce physiological capacity to respond to a stressor, such as responding to a sudden change in the environment or the presence of real predators Some individuals become bolder as a function of human contact and evidence shows that bold individuals can suffer higher mortality than shy individuals in challenging, unstable environments [91] Escape or panic reactions from encountering ecotourists may lead to self-injury or damage to offspring, eggs, or conspecifics [33]. This impact might be aggravated in tourist visits to breeding-bird colonies due to the high density of individuals Making human behavior predictable, such as by walking and driving on existing trails, helps to reduce animal stress and prevents animals from engaging in costly antipredator behavior [92, 93]	Gorillas (*Gorilla beringei beringei*) habituated to humans in the Bwindi Impenetrable Forest, Uganda, have sometimes ventured outside the park, damaging nearby crops and becoming aggressive toward humans trying to chase them out of the fields [94] Primates habituated for tourist viewing are at greater risk from poaching than non-habituated individuals [95] Tourist presence is associated with reduced body mass, a key indicator of survival in fledgling yellow-eyed penguins (*Megadyptes antipodes*) [96] Common wall lizards (*Podarcis muralis*) from tourist-exposed areas had relatively lower body masses in summer, the season with most human-animal interactions, compared to animals not exposed to tourists [97]. Similarly, juvenile hoatzin chicks (*Opisthocomus hoazin*) in tourist-exposed areas are smaller than undisturbed juveniles [98] Adélie penguins (*Pygoscelis adeliae*) tending older chicks later in the season will flee when approached to within ~6 m, whereas when the chicks are young, parents will tolerate approach to within ~1 m [99], because young chicks are unable to maintain their body heat and require the presence of their parent for survival Stingrays (*Dasyatis americana*) have worse health indicators at dive sites. In addition, rays at tourist sites have more injuries and parasites than animals studied at non-dive sites [100] Polar bears (*Ursus maritimus*) from Manitoba, in Canada, are prevented from resting during a key period of the year when they are unable to hunt because of the continued presence of specialized ecotourism vehicles [101] The approach of tourists to Nile crocodile (*C. niloticus*) in Murchison Falls National Park, Uganda, caused females to escape into the water, leaving their nests unattended and making them likely to be predated by lizards and baboons (*Papio* spp.) [102]. Studies have shown that some predators even specialize on attacking temporarily unattended prey and may follow humans around to profit from their disturbance [103, 104] Western capercaillie grouse (*Tetrao urogallus*) avoid suitable habitat in response to human visitors in a similar way to how they respond to predators [92]

16. Avoid physical contact with and very close approach to wild animals	Physical contact increases boldness, aggressiveness, the likelihood of disease transmission, and injuries in animals and humans Close contact may drive habituation, which in turn can increase human-wildlife conflicts and disease transmission, increase mortality by vehicular collision, and increase susceptibility to poaching Close interaction with wildlife may push shy individuals away. The resulting displacement of certain animals can degrade the tourism experience and will alter species population structure with potential consequences to population viability	Operators delivering food to sharks or stimulating tonic immobility have an increased risk of bite injuries, create stress in animals, and disrupt normal physiological/biochemical process [105] Increased exposure to humans during swim-with-dolphin programs and food-provisioned encounters at sea intensifies the risk of disease transfer in both directions [106] African penguins (*Spheniscus demersus*) had varying levels of tolerance to human presence depending upon the overall level of activity and proximity of tourists. The authors noted that careful management is required to ensure undisturbed areas that can be used by shy individuals [107]
17. Avoid feeding wildlife, particularly with nonnatural and non-native food	Feeding may increase boldness, aggressiveness, disease transmission, and injuries among conspecifics and humans Feeding can promote change in species abundance and distribution, change the social structure of a population, and cause environmental changes Feeding with non-native prey items may facilitate biological invasion (e.g., non-native seeds and non-native prey species) At a physiological level, a shift from a natural to an artificial diet can affect an animals' body condition and other traits essential for population survival Feeding can create an ecological trap in which food-conditioned individuals are easily killed by poachers Animals being fed may become dependent on artificial sources of food and lose the capacity to find natural food [61, 108]	Brown and black bears (*U. arctos and U. americanus*) have habituated to human presence, particularly in situations where they have access to readily available food resources (e.g., garbage). This sometimes results in a serious human-wildlife conflict with associated risks to people, property, and ultimately the animals [109] Unregulated feeding of sea lions (*Zalophus californianus*) at haul-out sites in the USA has led to a number of attacks on tourists, likely driven by an increase in boldness and aggression at the population level [61] The use of salt to attract wildlife in Aberdare National Park, Kenya, caused leaching of salt into the soil and led to vegetation death in a nearby water hole [58] At tourist-fed sites, usually solitary southern stingrays (*Dasyatis americana*) aggregate at high densities where they have more parasites, have reduced body condition, and have more injuries. These aggregation-related problems may impact their survival and long-term reproductive success [110] Regularly provisioned southern stingrays have different blood fatty acid profiles when compared to unfed animals [111]. Similarly, carnivorous fish become hyperglycemic because they could not control the increased blood glucose induced by eating bread [112, 113] Wildlife poachers in the Democratic Republic of the Congo stated that gorillas (*Gorilla gorilla*) that were habituated are more easily killed than non-habituated ones [95]

(continued)

Table 10.1 (continued)

Recommended best practice	Reasons for recommendation	Empirical examples of reasons for recommendation
18. Prioritize the use of noninvasive techniques, to the extent possible, when studying or monitoring wildlife populations within ecotourism and protected areas	Contact with humans disturbs animal behavior and physiology (e.g., by increasing stress), which can make individuals either sensitize or habituate to humans Invasive techniques (e.g., toe amputation, handling) can cause stress and infections and can affect chemical cues of recognition among conspecifics Some modern and noninvasive techniques have been shown to be as effective, or more effective, than invasive techniques (e.g., measuring metabolites through animal feces, hair, feathers, etc.)	Human handling influences physiological stress responses in little blue penguins (*Eudyptula minor*) [114] Evidence shows that blood sampling in cliff swallows (*Petrochelidon pyrrhonota*) reduces their survival rate [115], although blood sampling had no effect on survivorship of barn swallows (*Hirundo rustica*; A. P. Møller unpublished data), and surprisingly, there was a positive association between breeding success and disturbance in yellow-eyed penguin (*Megadyptes antipodes*) [116] The stress caused by tourism has been successfully examined by measuring stress hormones in feces of European pine martens (*Martes martes*) in the Natural Park Montes do Invernadero, Spain [71]. This has also been done for emblematic species such as African lions (*Panthera leo*) [117] Avian heart rates can be monitored with noninvasive techniques such as dummy eggs within nests that contain infrared or acoustic sensors [118, 119]

19. Implement rigorous practices to prevent biological invasions and disease transmission	The abundance and richness of non-native species is significantly higher in tourist than non-tourist areas, both in terrestrial and aquatic habitats [120] The majority of invasive species transferred via tourism are plants that have been moved inadvertently as seeds in or on belongings, on shoes, or on clothing. Therefore, sanitizing belongings before visiting protected areas is highly recommended Detrimental effects of biological invasions and diseases may cause rapid decline in small populations because generally there is insufficient time for effective mitigation The introduction of domesticated, non-native animals, such as cats and dogs, has impacted native wildlife worldwide because they are highly effective predators and vectors of diseases to a number of species [121] Limited previous exposure to pathogens, due to geographical isolation, makes indigenous tribes and some species immunologically naïve to diseases such as influenza and salmonella Due to their close evolutionary relationships, humans and other primates are susceptible to similar diseases, making the use of surgical or respirator masks, strict hygiene protocols, information on avoiding visitation when sick, and vaccination requirements for humans highly recommended	Heavily used trails in Central California had much higher numbers of *Phytophthora ramorum*—a pathogen that causes sudden oak death—in the soil compared with areas that were off the trail, suggesting that the dispersal of the pathogen was driven by human activity [122] Viable seeds of diverse non-native plants were found in the footwear of tourists visiting Svalbard in the high Arctic [123]. Whereas, Arctic species such as chickweed (*Stellaria media*) and yellow bog sedge (*Carex* sp.) were found on the clothing of tourists and researchers visiting Antarctica [124]. Some tour operators in the Antarctic use "local" footwear to avoid introducing microorganisms on boots Originally from Russia, the invasive zebra mussel (*Dreissena polymorpha*) spread through waterways in North American and Western European protected areas. Recreational boating was implicated as a key vector of rapid spread [120]. Their voracious feeding reduces the number of microorganisms available to other aquatic species that rely on this food source, and they attach themselves to other native mussel species (i.e., biofouling), exacerbating susceptibility to environmental stressors Feral cats in Australia are implicated in the decline of endemic mammals and birds [125, 126] A number of diseases (e.g., influenza, common cold, pneumonia, measles, and intestinal parasites) have been transmitted from humans to chimpanzees (*Pan troglodytes*) and gorillas (*Gorilla gorilla*), especially to those that are habituated to human presence [127, 128] The chimpanzees studied as part of the Taï research project in the Ivory Coast experienced five distinct outbreaks of human respiratory diseases over a period of 7 years with mortality rates of the affected groups reaching 19% [128]

(continued)

Table 10.1 (continued)

Recommended best practice	Reasons for recommendation	Empirical examples of reasons for recommendation
20. Implement rigorous practices to prevent environmental pollution, including light and noise pollution	Beyond those well-known sources of chemical pollution (e.g., oil and heavy metal contamination), there are some nonobvious sources such as those caused by sunscreen in water bodies, which can affect fish homeostasis and health [129] Light and noise pollution can generate what is called ecological or evolutionary traps by attracting animals to suboptimal habitats [130], as well as interfere with intra- and interspecific communication among animals [131] Artificial noise and lights can physiologically stress animals and increases mortality [132, 133]	The presence of sunscreen in water bodies stimulates early egg hatching, reduces digestive enzyme action [129], as well as interferes with gonadal functioning in fishes [134] The sounds and vibrations caused by vehicles driving off-roads have been interpreted by Western American spadefoot toads (*Scaphiopus couchii*) as heavy rain, causing them to emerge from their burrows during the wrong season in the Californian deserts [135], thus exposing them to unnecessarily hot dry weather and to predators [135] Increased whale-watching traffic in the St. Lawrence appears to be contributing to the death of baby belugas (*Delphinapterus leucas*) because vessel noise affects the calves' ability to communicate with their mothers [136] Artificial light can negatively affect populations by disorienting animals, such as hatchling sea turtles that are lured away from the sea by artificial lights on land [137] Light pollution can "trap" nocturnally migrating birds that only travel in the dark and can reduce the reproduction of nocturnally mating animals (e.g., frogs [130, 138])
21. Spatially cluster ecotourism infrastructure in order to maintain larger blocks of contiguous habitat	Roads increase habitat fragmentation, interfere with species dispersion, and affect community structure [139–141] Scattered ecotourism infrastructure associated with electricity, water supply, and waste disposal may increase the extent of human impacts	A meta-analysis shows that mammal and bird population density tends to decline with proximity to infrastructures, affecting the populations within a range of 1 to 5 km radius [141] Both dik-diks (*Madoqua guentheri*) and mule deer (*Odocoileus hemionus*) are more tolerant of humans within 500 m of human buildings and settlements (even temporary ones) than farther away [142, 143]. These results suggest that scattered development further increases the negative impacts of development

22. Plan and manage roads and trail placement to avoid vehicular collisions and habitat fragmentation and to direct tourists to areas where humans are allowed	Vehicular collisions are responsible for the deaths of millions of animals within and outside ecotourism areas annually, both in terrestrial and aquatic environments [144, 145] Roads increase habitat fragmentation, interfere with species dispersion, and affect community structure [139–141] Establishment of speed limits, improvement of signage, and building of fences and wildlife crossing structures have helped to decrease wildlife mortality by vehicular collisions [92, 146] Making human behavior predictable, such as walking and driving in existing trails, helps to reduce animal stress and avoid animals to elicit costly antipredator behavior [92, 93]	Over 2000 road-killed vertebrates were recorded in 1 year on the roads of the Doñana Biosphere Reserve, Spain. Yet, almost 2000 vertebrates were killed in a year on a single road of Biebrza National Park, Poland [147]. In about 2 years, almost 700 birds and mammals were killed by vehicles in Banff National Park, Canada [148] Mortality by vehicle collision in the Lake St. Clair National Park, Tasmania, was so high that eastern quoll (*Dasyurus viverrinus*) became locally extinct and had to be reintroduced following successful efforts to reduce vehicle collisions [149] Collisions with vessels accounted for about 25% of the manatee mortality in Florida from 1974 to 1998 [150] In endangered urban forests in Australia, the level of fragmentation caused by recreational trails was similar to that caused by urban development itself [151] Fences placed along roads, combined with wildlife road-crossing structures, helped to decrease risk of vehicle collision in Banff National Park, Canada [152, 153] After the improvement of a road in Cradle Mountain-Lake St. Sinclair National Park, Australia, the resident population of Tasmanian devils (*Sarcophilus harrisii*) declined by 50%, and the local population of eastern quolls (*Dasyurus viverrinus*) went extinct because of vehicular collisions. By reducing traffic velocity and educating park visitors, vehicular mortality was reduced and populations increased [149]

(continued)

Table 10.1 (continued)

Recommended best practice	Reasons for recommendation	Empirical examples of reasons for recommendation
23. Ecotourism best practices should be adaptable to the specific ecological, geographical, and sociological contexts	Ecological and evolutionary patterns and their drivers are not homogeneous across space and time (e.g., species richness decreases as latitude increases [154] and species-area relationships varies according by the ecoregion and other environmental factors [155])	Birds in tropical habitats are less tolerant of human presence than conspecific or congeneric populations from temperate zones [157], a pattern expected from life history theory. This occurs because animals in the tropics have low reproductive rates and high annual adult survival rates, while this is the opposite in the temperate climatic zones [157]
	Trade-offs between conservation and socioeconomic goals usually depend on whether ecotourism occurs in developed or developing countries (e.g., North-South debate [156])	Certification programs, especially in developing countries, are value dominated, where the economic-conservation paradigm often overrides the sociocultural paradigm [158]
	Guidelines for protecting wildlife should certainly be stricter in areas where ecotourism does not benefit a local human community or in places where there are no human residents	Rules for penguin ecotourism in Antarctica should be very strict. By contrast, in places where there may be benefits to human local communities, such as inhabited areas of Australia, New Zealand, South Africa, and South America, there may, at times, be valid reasons to have less strict regulations
24. Ecotourism best practices should be updated based on new scientific evidence and with new environmental problems	New evidence can help us regulate management practices to correct mistaken past practices	Recreational fishing was considered a reasonable practice until the amount of fish harvested and population fluctuations showed it is a dangerous practice. This led to a call for the widespread adoption of catch and release fishing. However, recent evidence is showing that catch and release is also deleterious [159]
	It is essential to develop a culture of continuous evaluation so that emerging threats can be identified in time for effective mitigation	

10.2 The Recommended Best Practices

Below we list 24 recommendations that comprise our suggested best practices for ecotourism. They are divided into four categories, although some recommended best practices could fit perfectly well into more than one category. We emphasize that the order in which the recommended best practices are presented here does not reflect their relative importance. And, as we noted before, there are other previously published lists of best practices for ecotourism. Thus, our list is necessarily incomplete but does focus on many of the issues discussed in previous chapters regarding the biological and social dimensions of ecotourism. Table 10.1 details the reasons for these recommendations and examples of empirical evidence supporting them.

Aspects Related to Socioeconomic Outcomes:

1. Encourage community-based tourism as the preferred form of ecotourism.
2. Reduce the likelihood that local communities become financially overdependent on ecotourism.
3. Promote partnerships with a multidisciplinary body of scientists, integrating them in all stages of an ecotourism project.
4. Promote partnerships between the ecotourism project and eco-friendly and socially responsible companies.
5. Promote "ecological network thinking" in all stakeholders, from decision-makers to ecotourists, through environmental education and integrated planning of all ecotourism activities.
6. Encourage national accreditation of the natural area tourism based on international standards while respecting idiosyncrasies of each region or country.

Improving Knowledge on Conservation Topics Related to Ecotourism:

7. Continuously monitor wildlife and the environment, preferably with taxonomic and environment specialists, but always with a holistic view of the ecosystem's functions and processes.
8. Rely on multiple biological indicators to monitor stress in wildlife.
9. Conduct rigorous controlled studies of wildlife physiology, behavior, reproductive success, and survival, before and after the introduction of artificial sources of resources, significant habitat alterations, or when introducing non-native species.
10. Apply mechanistic knowledge concerning animal physiology, behavior, ecology, and evolution to mitigate impacts or designing low-impact ecotourism activities.
11. Stimulate research on "compassionate conservation," animal emotions, and animal cognition for species usually observed in the protected and ecotourism areas.
12. Collect data on ecotourist visitation to understand current levels of use and as a baseline for future mitigation strategies.
13. Conduct social research to understand how different ecotourism activities improve visitors' scientific literacy and increase their engagement in conservation activities.

Aspects Directly Related to Animal Well-Being and Population Sustainability:

14. Provide environmental education services to the ecotourists, preferentially using guides.
15. Establish clear guidelines for human access in the ecotourism area, making it more or less restrictive according to season, conservation status, and sensitivities of species and environments to human disturbance.
16. Avoid physical contact with and very close approach to wild animals.
17. Avoid feeding wildlife, particularly with nonnatural and non-native food.
18. Prioritize the use of noninvasive techniques, to the extent possible, when studying or monitoring wildlife populations within ecotourism and protected areas.
19. Implement rigorous practices to prevent biological invasions and disease transmission.
20. Implement rigorous practices to prevent environmental pollution, including light and noise pollution.
21. Spatially cluster ecotourism infrastructure in order to maintain larger blocks of contiguous habitat.
22. Plan and manage roads and trail placement to avoid vehicular collisions and habitat fragmentation and to direct tourists to areas where humans are allowed.

Context Dependence of the Best Practices:

23. Ecotourism best practices should be adaptable to the specific ecological, geographical, and sociological contexts.
24. Ecotourism best practices should be updated based on new scientific evidence and with new environmental problems.

References

1. Ducarme F, Luque GM, Courchamp F (2013) What are "charismatic species" for conservation biologists? Biosci Master Rev 1:1–8
2. Boakes EH, McGowan PJK, Fuller RA et al (2010) Distorted views of biodiversity: spatial and temporal bias in species occurrence data. PLoS Biol 8:e1000385
3. Cohen JE, Jonsson T, Carpenter SR (2003) Ecological community description using the food web, species abundance, and body size. Proc Natl Acad Sci U S A 100:1781–1786
4. May RM (1988) How many species are there on Earth? Science 241:1441–1449
5. Bascompte J (2010) Structure and dynamics of ecological networks. Science 329:765–766
6. Brodie JF, Aslan CE, Rogers HS et al (2014) Secondary extinctions of biodiversity. Trends Ecol Evol 29:664–672
7. Colwell RK, Dunn RR, Harris NC (2012) Coextinction and persistence of dependent species in a changing world. Annu Rev Ecol Evol Syst 43:183–203
8. Fowler MS (2010) Extinction cascades and the distribution of species interactions. Oikos 119:864–873
9. Paine RT (1966) Food web complexity and species diversity. Am Nat 100:65–75
10. Muradian R, Corbera E, Pascual U et al (2010) Reconciling theory and practice: an alternative conceptual framework for understanding payments for environmental services. Ecol Econ 69:1202–1208
11. Valiente-Banuet A, Aizen MA, Alcántara JM et al (2014) Beyond species loss: the extinction of ecological interactions in a changing world. Funct Ecol 29:299–307
12. Knight TM, McCoy MW, Chase JM et al (2005) Trophic cascades across ecosystems. Nature 437:880–883

13. Sharpley R (2006) Ecotourism: a consumption perspective. J Ecotourism 5:7–22
14. Hansmann R, Mieg HA, Frischknecht P (2012) Principal sustainability components: empirical analysis of synergies between the three pillars of sustainability. Int J Sustain Dev World Ecol 19:451–459
15. Trevelin AC, Pivatto MAC, Leite V (2012) Benchmarking e o ecoturismo no Brasil. In: Sabino J (ed) Ecoturismo: nas trilhas da biodiversidade brasileira. Natureza em Foco, Campo Grande, pp 149–157
16. Drumm A, Moore A (2002) Ecotourism development: a manual series for conservation planners and managers. The Nature Conservancy, Arlington
17. Tapper R (2006) Wildlife watching and tourism: a study on the benefits and risks of a fast growing tourism activity and its impacts on species. UNEP/Earthprint, Bonn
18. Wood ME (1993) Ecotourism guidelines for nature tour operators. The Ecotourism Society, North Bennington
19. Newsome D, Moore SA, Dowling RK (2012) Natural area tourism: ecology, impacts and management. Channel View Publications, Bristol
20. Wearing S, Neil J (2009) Ecotourism: impacts, potentials and possibilities, 2nd edn. Routledge, Abingdon
21. Leksakundilok A (2004) Community participation in ecotourism development in Thailand. University of Sydney
22. Filimão E, Mansur E, Namanha L (1999) Tchuma Tchato: an evolving experience of community-based natural resource management in Mozambique. In: Proceedings of the International Workshop on Community Forestry in Africa: "Participatory forest management: a strategy for sustainable forest management in Africa." Banjul, pp 145–152
23. Johnson S (2004) The Tchuma-Tchato project in Mozambique: community-based natural resource management in transition. In: Fabricius C, Koch E, Magome H, Turner S (eds) Rights, resources and rural development: community-based natural resource management in Southern Africa. Earthscan, London, pp 210–222
24. Suich H (2013) Evaluating the household level outcomes of community based natural resource management: the Tchuma Tchato Project and Kwandu Conservancy. Ecol Soc 18:25
25. Hamden M, Low KCP (2015) Ecotourism development in Brunei Darussalam. Transnatl Corp Rev 6:248–272
26. Poyyamoli G (2015) Eco-cultural tourism for biodiversity conservation and sustainable development of remote ecosystems in the third world. In: Kumar S, Dhiman MC, Dahiya A (eds) International tourism and hospitality in the digital age. IGI Global, Hershey, pp 34–55
27. Lemelin RH, Wiersma EC (2007) Perceptions of polar bear tourists: a qualitative analysis. Hum Dimens Wildl 12:45–52
28. Ball J (2010) Sustainable forest management. Commonwealth Forests 2010:32–53
29. Gössling S, Garrod B, Aall C et al (2011) Food management in tourism: reducing tourism's carbon "foodprint". Tour Manag 32:534–543
30. Munday M, Turner K, Jones C (2013) Accounting for the carbon associated with regional tourism consumption. Tour Manag 36:35–44
31. Sun Y-Y (2014) A framework to account for the tourism carbon footprint at island destinations. Tour Manag 45:16–27
32. Brightsmith DJ, Stronza A, Holle K (2008) Ecotourism, conservation biology, and volunteer tourism: a mutually beneficial triumvirate. Biol Conserv 141:2832–2842
33. Higgins-Desbiolles F (2011) Death by a thousand cuts: governance and environmental trade-offs in ecotourism development at Kangaroo Island, South Australia. J Sustain Tour 19:553–570
34. Place S (1995) Ecotourism for sustainable development: oxymoron or plausible strategy? GeoJournal 35:161–173
35. Simmons DG, Becken S (2004) The cost of getting there: impacts of travel to ecotourism destinations. In: Buckley R (ed) Environmental impacts of ecotourism. CABI Publishing, Wallingford, pp 15–23
36. Scott D, Amelung B, Becken S et al (2008) Climate change and tourism: responding to global challenges. World Tourism Organization, Madrid

37. Self RM, Self DR, Bell-Haynes J (2010) Marketing tourism in the Galapagos Islands: ecotourism or greenwashing? Int Bus Econ Res J 9:111–125
38. McCarthy TS, Ellery WN, Gieske A (1994) Possible ground water pollution by Sewage effluent at camps in the Okavango Delta: suggestions for its prevention. Botsw Notes Rec 26:129–138
39. Bascompte J (2009) Disentangling the web of life. Science 325:416–419
40. Bascompte J (2007) Networks in ecology. Basic Appl Ecol 8:485–490
41. Jordán F (2009) Keystone species and food webs. Philos Trans R Soc B 364:1733–1741
42. Ebenman B, Jonsson T (2005) Using community viability analysis to identify fragile systems and keystone species. Trends Ecol Evol 20:568–575
43. Ripple WJ, Beschta RL (2012) Trophic cascades in Yellowstone: the first 15 years after wolf reintroduction. Biol Conserv 145:205–213
44. Soulé ME, Estes JA, Miller B, Honnold DL (2005) Strongly interacting species: conservation policy, management, and ethics. Bioscience 55:168
45. Helfield JM, Naiman RJ (2006) Keystone interactions: Salmon and bear in riparian forests of Alaska. Ecosystems 9:167–180
46. Säterberg T, Sellman S, Ebenman B (2013) High frequency of functional extinctions in ecological networks. Nature 499:468–470
47. Alliance R (2011) Mohonk Agreement: proposal for an international certification program for sustainable tourism and ecotourism. pp 97–100
48. Green Globe (2017.) https://greenglobe.com. Accessed 18 Mar 2017
49. Charnley S (2005) From nature tourim to ecotourism? The case of the Ngorongoro Conservation Area, Tanzania. Hum Organ 64:75–88
50. Wearn OR, Reuman DC, Ewers RM (2012) Extinction debt and windows of conservation opportunity in the Brazilian Amazon. Science 337:228–232
51. Kuussaari M, Bommarco R, Heikkinen RK et al (2009) Extinction debt: a challenge for biodiversity conservation. Trends Ecol Evol 24:564–571
52. Pride RE (2005) High faecal glucocorticoid levels predict mortality in ring-tailed lemurs (*Lemur catta*). Biol Lett 1:60–63
53. Hadwen WL, Bunn SE, Arthington AH, Mosisch TD (2005) Within-lake detection of the effects of tourist activities in the littoral zone of oligotrophic dune lakes. Aquat Ecosyst Health Manag 8:159–173
54. MacArthur RA, Geist V, Johnston RH (1982) Cardiac and behavioral responses of mountain sheep to human disturbance. J Wildl Manage 46:351–358
55. Jungius H, Hirsch U (1979) Herzfrequenzänderungen bei brutvögeln in Galapagos als folge von störungen durch besucher. J Ornithol 120:299–310
56. Rich EL, Romero LM (2005) Exposure to chronic stress downregulates corticosterone responses to acute stressors. Am J Physiol Regul Integr Comp Physiol 288:R1628–R1636
57. Gaylard A, Owen-Smith N, Redfern J (2003) Surface water availability: implications for heterogeneity and ecosystem processes. In: Du Toit JT, Biggs HC, Rogers KH (eds) The Kruger experience: ecology and management of savanna heterogeneity. Island Press, New York, pp 171–188
58. Roe D, Leader-Williams N, Dalal-Clayton DB (1997) Take only photographs, leave only footprints: the environmental impacts of wildlife tourism. IIED, London
59. Simberloff D, Stiling P (1996) How risky is biological control? Ecology 77:1965–1974
60. Myers JH, Cory JS (2017) Biological control agents: invasive species or valuable solutions? In: Vilá M, Hulme PE (eds) Impact of biological invasions on ecosystem services. Springer, Switzerland, pp 191–202
61. Orams MB (2002) Feeding wildlife as a tourism attraction: a review of issues and impacts. Tour Manag 23:281–293
62. Robb GN, McDonald RA, Chamberlain DE, Bearhop S (2008) Food for thought: supplementary feeding as a driver of ecological change in avian populations. Front Ecol Environ 6:476–484

63. Shine R (2010) The ecological impact of invasive cane toads (*Bufo marinus*) in Australia. Q Rev Biol 85:253–291
64. van Riper C, van Riper S, Goff M, Laird M (1986) The epizootiology and ecological significance of malaria in Hawaiian land birds. Ecol Monogr 56:327–344
65. Lima SL, Blackwell BF, DeVault TL, Fernández-Juricic E (2014) Animal reactions to oncoming vehicles: a conceptual review. Biol Rev 90:60–76
66. Devault TL, Blackwell BF, Seamans TW et al (2015) Speed kills: ineffective avian escape responses to oncoming vehicles. Proc R Soc B 282:20142188
67. Knight J (2009) Making wildlife viewable: habituation and attraction. Soc Anim 17:167–184
68. Green RJ, Giese M (2004) Negative effects of wildlife tourism on wildlife. In: Higginbottom K (ed) Wildlife tourism: impacts, management and planning. Common Ground Publishing/CRC for Sustainable Tourism, Altona, pp 81–97
69. McComb K, Shannon G, Sayialel KN, Moss C (2014) Elephants can determine ethnicity, gender, and age from acoustic cues in human voices. Proc Natl Acad Sci U S A 111:5433–5438
70. Brubaker AS, Coss RG (2015) Evolutionary constraints on equid domestication: comparison of flight initiation distances of wild horses (*Equus caballus ferus*) and plains zebras (*Equus quagga*). J Comp Psychol 129:366–376
71. Vining J (2003) The connection to other animals and caring for nature. Hum Ecol Rev 10:87–99
72. Berenguer J (2010) The effect of empathy in environmental moral reasoning. Environ Behav 42:110–134
73. Gosling SD (2008) Personality in non-human animals. Soc Personal Psychol Compass 2:985–1001
74. Bearzi M, Stanford C (2008) Beautiful minds: the parallel lives of great apes and dolphins. Harvard University Press, Cambridge
75. Pizzitutti F, Walsh SJ, Rindfuss RR et al (2016) Scenario planning for tourism management: a participatory and system dynamics model applied to the Galapagos Islands of Ecuador. J Sustain Tour 2016:1–21
76. Bessa E, Gonçalves-de-Freitas E (2014) How does tourist monitoring alter fish behavior in underwater trails? Tour Manag 45:253–259
77. Boers B, Cottrell S (2007) Sustainable tourism infrastructure planning: a GIS-supported approach. Tour Geogr 9:1–21
78. Galbraith M (2013) Public and ecology – the role of volunteers on Tiritiri Matangi Island. NZ. J Ecol 37:266–271
79. Higham J, Carr A (2002) Ecotourism visitor experiences in Aotearoa/New Zealand: challenging the environmental values of visitors in pursuit of pro-environmental behaviour. J Sustain Tour 10:277–294
80. Liem A (2005) Promoting science literacy by engaging the public. PLoS Biol 3:e427
81. Cooper CB, Dickinson J, Phillips T, Bonney R (2007) Citizen science as a tool for conservation in residential ecosystems. Ecol Soc 12:11
82. Staus NL, Falk JH (2013) The role of emotions in ecotourism experiences. In: Ballantyne R, Packer J (eds) International handbook on ecotourism. Edward Elgar Publishing Limited, Cheltenham, pp 178–191
83. Powell RB, Ham SH (2008) Can ecotourism interpretation really lead to pro-conservation knowledge, attitudes and behaviour? Evidence from the Galapagos Islands. J Sustain Tour 16:467–489
84. Orams MB (1997) The effectiveness of environmental education: can we turn tourists into "greenies". Prog Tour Hosp Res 3:295–306
85. Rattan JK, Eagles PFJ, Mair HL (2012) Volunteer tourism: its role in creating conservation awareness. J Ecotourism 11:1–15
86. Olokesusi F (1990) Assessment of the Yankari game reserve, Nigeria: problems and prospects. Tour Manag 11:153–163
87. Galapagos Conservancy (2017.) http://www.galapagos.org/travel/travel/park-rules/. Accessed 17 Mar 2017

88. Gakahu C (1992) Tourist attitudes and use impacts in the Maasai Mara National Reserve. Wildlife Conservation International, Nairobi
89. Samia DSM, Blumstein DT, Stankowich T, Cooper WE Jr (2016) Fifty years of chasing lizards: new insights advance optimal escape theory. Biol Rev 91:349–366
90. Cooper WE Jr, Blumstein DT (2015) Escaping from predators: an integrative view of escape decisions. Cambridge University Press, New York
91. Smith BR, Blumstein DT (2008) Fitness consequences of personality: a meta-analysis. Behav Ecol 19:448–455
92. Rösner S, Mussard-Forster E, Lorenc T, Müller J (2014) Recreation shapes a "landscape of fear" for a threatened forest bird species in Central Europe. Landsc Ecol 29:55–66
93. Ikuta LA, Blumstein DT (2003) Do fences protect birds from human disturbance? Biol Conserv 112:447–452
94. Goldsmith M (2005) Impacts of habituation for ecotourism on the gorillas of Nkuringo. Gorilla J 30:11–14
95. Kasereka B, Muhigwa J-BB, Shalukoma C, Kahekwa JM (2006) Vulnerability of habituated Grauer's gorilla to poaching in the Kahuzi-Biega National Park, DRC. Afr Study Monogr 27:15–26
96. McClung MR, Seddon PJ, Massaro M, Setiawan AN (2004) Nature-based tourism impacts on yellow-eyed penguins *Megadyptes antipodes*: does unregulated visitor access affect fledging weight and juvenile survival? Biol Conserv 119:279–285
97. Amo L, López P, Martín J (2006) Nature-based tourism as a form of predation risk affects body condition and health state of *Podarcis muralis* lizards. Biol Conserv 131:402–409
98. Müllner A, Linsenmair KE, Wikelski M (2004) Exposure to ecotourism reduces survival and affects stress response in hoatzin chicks (*Opisthocomus hoazin*). Biol Conserv 118:549–558
99. Wilson RP, Culik B, Danfeld R, Adelung D (1991) People in Antarctica – how much do Adélie penguins *Pygoscelis adeliae* care? Polar Biol 11:363–370
100. Houghton J, Holt MM, Giles DA et al (2015) The relationship between vessel traffic and noise levels received by killer whales (*Orcinus orca*). PLoS One 10:e0140119
101. Dyck MG, Baydack RK (2004) Vigilance behaviour of polar bears (*Ursus maritimus*) in the context of wildlife-viewing activities at Churchill, Manitoba, Canada. Biol Conserv 116:343–350
102. Cott M (1969) Tourists and crocodiles in Uganda. Oryx 10:153–160
103. Knight RL, Cole DN (1995) Wildlife responses to recreationists. In: Knight RL, Gutzwiller KJ (eds) Wildlife and recreationists: coexistence through management and research. Island Press, Washington, pp 51–69
104. Strang CA (1980) Incidence of avian predators near people searching for waterfowl nests. J Wildl Manage 44:220–222
105. Gallagher AJ, Vianna GMS, Papastamatiou YP et al (2015) Biological effects, conservation potential, and research priorities of shark diving tourism. Biol Conserv 184:365–379
106. Munro A, Scott A, Lam T (1990) Reproductive seasonality in teleosts: environmental influences. CRC Press, Boca Raton
107. Pichegru L, Edwards TB, Dilley BJ et al (2016) African penguin tolerance to humans depends on historical exposure at colony level. Bird Conserv Int:1–16
108. Boo E (1990) Ecotourism: the potentials and pitfalls. World Wildlife Fund, Washington, DC
109. Elfström M, Zedrosser A, Støen OG, Swenson JE (2014) Ultimate and proximate mechanisms underlying the occurrence of bears close to human settlements: review and management implications. Mamm Rev 44:5–18
110. Semeniuk CAD, Rothley KD (2008) Costs of group-living for a normally solitary forager: effects of provisioning tourism on southern stingrays *Dasyatis americana*. Mar Ecol Prog Ser 357:271–282
111. Semeniuk CAD, Speers-Roesch B, Rothley KD (2007) Using fatty-acid profile analysis as an ecologic indicator in the management of tourist impacts on marine wildlife: a case of stingray-feeding in the Caribbean. Environ Manage 40:665–677
112. Cowey C, Knox D, Walton M, Adron J (1977) The regulation of gluconeogenesis by diet and insulin in rainbow trout (*Salmo gairdneri*). Br J Nutr 38:463–470

113. Moon TW (2001) Glucose intolerance in teleost fish: fact or fiction? Comp Biochem Physiol Part B 129:243–249
114. Carroll G, Turner E, Dann P, Harcourt R (2016) Prior exposure to capture heightens the corticosterone and behavioural responses of little penguins (*Eudyptula minor*) to acute stress. Conserv Physiol 4:1–11
115. Brown MB, Brown CR (2009) Blood sampling reduces annual survival in cliff swallows (Petrochelidon Pyrronota). Auk 126:853–861
116. Stein A, Young MJ, Seddon PJ et al (2017) Investigator disturbance does not reduce annual breeding success or lifetime reproductive success in a vulnerable long-lived species, the yellow-eyed penguin. Biol Conserv 207:80–89
117. Creel S, Christianson D, Schuette P (2013) Glucocorticoid stress responses of lions in relationship to group composition, human land use, and proximity to people. Conserv Physiol 1:1–9
118. Tarlow EM, Blumstein DT (2007) Evaluating methods to quantify anthropogenic stressors on wild animals. Appl Anim Behav Sci 102:429–451
119. Ellenberg U, Mattern T, Seddon PJ (2013) Heart rate responses provide an objective evaluation of human disturbance stimuli in breeding birds. Conserv Physiol 1:1–11
120. Anderson LG, Rocliffe S, Haddaway NR, Dunn AM (2015) The role of tourism and recreation in the spread of non-native species: a systematic review and meta-analysis. PLoS One 10:e0140833
121. Young JK, Olson KA, Reading RP et al (2011) Is wildlife going to the dogs? Impacts of feral and free-roaming dogs on wildlife populations. Biosci 61:125–132
122. Cushman JH, Meentemeyer RK (2008) Multi-scale patterns of human activity and the incidence of an exotic forest pathogen. J Ecol 96:766–776
123. Ware C, Bergstrom DM, Müller E, Alsos IG (2012) Humans introduce viable seeds to the Arctic on footwear. Biol Invasions 14:567–577
124. Chown SL, Huiskes AHL, Gremmen NJM et al (2012) Continent-wide risk assessment for the establishment of nonindigenous species in Antarctica. Proc Natl Acad Sci U S A 109:4938–4943
125. Woinarski J, Burbidge A, Harrison P (2014) The action plan for Australian mammals 2012. CSIRO Publishing, Clayton
126. Garnett S, Szabo J, Dutson G (2011) The action plan for Australian birds 2010. CSIRO Publishing, Clayton
127. Woodford MH, Butynski TM, Karesh WB (2002) Habituating the great apes: the disease risks. Oryx 36:153–160
128. Könden S, Kühl H, N'Goran PK et al (2008) Pandemic human viruses cause decline of endangered great apes. Curr Biol 18:260–264
129. Fouqueray M, Noury P, Dherret L et al (2013) Exposure of juvenile *Danio rerio* to aged TiO_2 nanomaterial from sunscreen. Environ Sci Pollut Res 20:3340–3350
130. Schlaepfer MA, Runge MC, Sherman PW (2002) Ecological and evolutionary traps. Trends Ecol Evol 17:474–480
131. Swaddle JP, Francis CD, Barber JR et al (2015) A framework to assess evolutionary responses to anthropogenic light and sound. Trends Ecol Evol 30:550–560
132. Whitfield AK, Becker A (2014) Impacts of recreational motorboats on fishes: a review. Mar Pollut Bull 83:24–31
133. Simpson SD, Radford AN, Nedelec SL et al (2016) Anthropogenic noise increases fish mortality by predation. Nat Commun 7:10544
134. Weisbrod CJ, Kunz PY, Zenker AK, Fent K (2007) Effects of the UV filter benzophenone-2 on reproduction in fish. Toxicol Appl Pharmacol 225:255–266
135. Brattstrom B, Bondello M (1983) Effects of off-road vehicle noise on desert vertebrates. In: Webb RH, Wilshire HG (eds) Environmental effects of off-road vehicles: impacts and management in arid regions. Springer, New York, pp 167–206
136. Groc I (2016) Crying to be heard. New Sci 230:38–41
137. Witherington BE, Bjorndal KA (1991) Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles *Caretta caretta*. Biol Conserv 55:139–149
138. Longcore T, Rich C (2004) Ecological light pollution. Front Ecol Environ 2:191–198

139. Forman RTT, Alexander LE (1998) Roads and their major ecological effects. Annu Rev Ecol Syst 29:207–231
140. Keller I, Largiadèr CR (2003) Recent habitat fragmentation caused by major roads leads to reduction of gene flow and loss of genetic variability in ground beetles. Proc R Soc B 270:417–423
141. Benítez-López A, Alkemade R, Verweij PA (2010) The impacts of roads and other infrastructure on mammal and bird populations: a meta-analysis. Biol Conserv 143:1307–1316
142. Coleman A, Richardson D, Schechter R, Blumstein DT (2008) Does habituation to humans influence predator discrimination in Gunther's dik-diks (*Madoqua guentheri*)? Biol Lett 4:250–252
143. Price MV, Strombom EH, Blumstein DT (2014) Human activity affects the perception of risk by mule deer. Curr Zool 60:693–699
144. Seiler A, Helldin JO (2006) Mortality in wildlife due to transportation. In: Davenport J, Davenport J (eds) Ecology of transportation: managing mobility for the environment. Springer, Dordrecht, pp 165–189
145. Erritzoe J, Mazgajski TD, Rejt Ł (2003) Bird casualties on European roads – a review. Acta Ornithol 38:77–93
146. Farmer RG, Brooks RJ (2012) Integrated risk factors for vertebrate roadkill in southern Ontario. J Wildl Manage 76:1215–1224
147. Gryz J, Krauze D (2008) Mortality of vertebrates on a road crossing the Biebrza Valley (NE Poland). Eur J Wildl Res 54:709–714
148. Clevenger AP, Chruszcz B, Gunson KE (2003) Spatial patterns and factors influencing small vertebrate fauna road-kill aggregations. Biol Conserv 109:15–26
149. Jones ME (2000) Road upgrade, road mortality and remedial measures: impacts on a population of eastern quolls and Tasmanian devils. Wildl Res 27:289–296
150. Reynolds J III, Powell J (2002) Manatees. In: Perrin W, Würsig B, Thewissen J (eds) Encyclopedia of marine mammals. Academic Press, New York, pp 709–720
151. Ballantyne M, Gudes O, Pickering CM (2014) Recreational trails are an important cause of fragmentation in endangered urban forests: a case-study from Australia. Landsc Urban Plan 130:112–124
152. D'Amico M, Román J, de los Reyes L, Revilla E (2015) Vertebrate road-kill patterns in Mediterranean habitats: who, when and where. Biol Conserv 191:234–242
153. Clevenger AP, Chruszcz B, Gunson KE (2001) Highway mitigation fencing reduces wildlife-vehicle collisions. Wildl Soc Bull 29:646–653
154. Mittelbach GG, Schemske DW, Cornell HV et al (2007) Evolution and the latitudinal diversity gradient: speciation, extinction and biogeography. Ecol Lett 10:315–331
155. Guilhaumon F, Gimenez O, Gaston KJ, Mouillot D (2008) Taxonomic and regional uncertainty in species-area relationships and the identification of richness hotspots. Proc Natl Acad Sci U S A 105:15458–15463
156. Beyerlin U (2006) Bridging the North-South divide in international environmental law. ZaöRV 66:259–296
157. Møller AP, Liang W (2013) Tropical birds take small risks. Behav Ecol 24:267–272
158. Jamal T, Borges M, Stronza A (2006) The institutionalisation of ecotourism: certification, cultural equity and praxis. J Ecotourism 5:145–175
159. Arlinghaus R, Cooke SJ, Lyman J et al (2007) Understanding the complexity of catch-and-release in recreational fishing: An integrative synthesis of global knowledge from historical, ethical, social, and biological perspectives. Rev Fish Sci 15:75–167