

Refining the Ecosystems Services Model: Integrating Animal Behavior into Ecotourism Management

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Abstract

As life on Earth has entered a sixth mass extinction driven by pervasive human impacts, there is a growing need for research that effectively identifies and resolves potential conflicts between wildlife and humans. While developing solutions on how to mitigate adverse interactions between humans and wildlife is of critical importance, there is notably less research on the impact of animal behavior shifts on the quality of ecosystem services that humans benefit from, such as those derived from ecotourism activities, that are fundamentally based on people's ability to witness natural animal behaviors. These human-wildlife interactions can lead to valuable contributions to conservation and economic opportunities for local communities. However, studies have revealed that drastic behavior changes occur when wildlife populations are subjected to high levels of anthropogenic disturbance. Building on the understanding that human and animal behaviors are strongly linked through complex social-ecological feedback systems and utilizing the existing ecosystem frameworks, this chapter highlights the need for better understanding of the current wildlife-based ecotourism models and how they might become better adapted into the future. The year-long COVID-19 pandemic provided a unique opportunity for the current practices to be adapted, and emerging questions about the on-going relationship between humans and wildlife need to be investigated to establish more effective ecosystem management interventions.

Introduction

The ecosystem services (ES) framework was established to map the relationship between human well-being and the services derived from natural systems (Daily, 2000). The use of this model to provide estimates of the value of ecosystems is relevant to the creation of policies related to wildlife conservation, human welfare, and sustainable development. However, most theory relating ES to animal ecology focuses on how changes in wildlife population size affect the value of an individual animal (i.e., the value of a marginal population increase), with only relatively recent work considering population structure and dynamics (Gerber, 2006). The term "ecosystem services" was first codified in the Millennium Ecosystem Assessment (MEA) in 2005 and resulted in the creation of several standardization frameworks such as the Common International Classification of Ecosystem Services (CICES) in 2018 and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in 2016.

The IPBES is the most comprehensive framework to date that directly connects nature-derived ES with human benefits. In addition to the direct material and economic benefits derived from nature, the IPBES also acknowledges the social services that should be included in decision-making, such as recreational benefits, and the overall contributions these activities make to cultural conservation. Meanwhile, the Economics of Ecosystems and Biodiversity (TEEB), published in 2011, attempted to provide an estimate of the global cost of biodiversity loss, and ultimately highlighted the need for increased financial investment in conservation initiatives. Despite animal behavior existing within a complex feedback loop that contributes to overall ecosystem function and health, as well as tourist satisfaction and the economic sustainability of local communities, the specific value that behavior plays in provisioning ES has not yet been thoroughly evaluated or explicitly included in any of these existing models. In this chapter, we review how changes in animal behaviors influence the recreational services that result from the interactions between tourists and wildlife, (e.g., economic benefits to local communities, increased cultural knowledge and value for wildlife conservation) and provide suggestions for how this research could be explored and integrated more thoroughly into existing science paradigms.

Animal behavior is a critical metric to consider when studying human-wildlife interactions. This is especially true when evaluating the impacts of animal behavior on the quality of human experiences derived from ecotourism activities, which are fundamentally based on tourists' ability to witness natural animal behaviors. Generally, ecotourists favor experiences that bring

them close to wild species, and these encounters can result in an increase of pro-environment attitudes and financial support towards both local and global conservation efforts from tourists. Additionally, these activities are often heralded as beneficial alternatives to more consumption-based relationships with nature (e.g., hunting, whaling, poaching). However, the automatic adoption of this assumption may unintentionally gloss over some of the more adverse impacts on wildlife.

Chronic exposure to high levels of anthropogenic activity alters animal behavioral responses to human presence and can increase stress levels in the organisms being observed. Ultimately, this can change human-wildlife interactions and thus the net ES provided through these interactions (Fig. 1). Many studies show how increased stress responses in wildlife can lead to negative effects on health and survival, potentially impacting the survival of individuals (Mullner et al., 2004; Ellenberg et al., 2007). A consequential decline in population and stress-induced suppression of critical behaviors (e.g., feeding, resting, or caring for offspring), could reduce the ability of wildlife to provide the desired ES to tourists (e.g., more charismatic, or “photogenic” behaviors), resulting in decreased satisfaction and future conservation contributions. However, critical research on these potential feedbacks is currently lacking, and therefore we propose a framework that incorporates understanding of the dynamic changes in both animal and human behavior into a new combined “biosocial” system. This framework can help us understand when activities such as wildlife tourism are beneficial or detrimental to humans and nature and will hopefully contribute to the establishment of more effective conservation management strategies (Fig. 3).

Prior to the global halt of tourism due to the COVID-19 pandemic, the level of worldwide ecotourism activity was accelerating at an ever-growing rate, primarily due to increasing human populations, urban development, and societal interest in outdoor recreation and exploration. This demand was facilitated by easier planning and travel capabilities (Newsome, 2020), and the commensurate increased demand for ecotourism infrastructure has raised concerns about the potential over-exploitation of natural spaces, especially in locations where tourist activity was relatively unmanaged or unregulated (Newsome, 2020). High levels of human-induced disturbance can have both direct and indirect impacts on wildlife, through heightened stress responses and behavior modification, pollution, habitat modification, and climate change, all of which can potentially affect our on-going interactions with nature and the myriad of benefits they provide. This unprecedented pause of human activity has provided researchers with a unique opportunity to evaluate the past and present relationship between humans and wildlife and assess ways it can be improved (Newsome, 2020).

We begin this chapter by summarizing the established ES benefits that wildlife-based ecotourism provides, which include educational, cultural, and financial contributions to local and global communities, and we discuss how these may be influenced through shifts in animal behavior. We then synthesize information on the established impacts that tourism can have on wildlife behavior and the role the pandemic has played. Finally, we propose how this relatively unexplored perspective could be applied to considerations about the future of wildlife-based tourism. The drastic changes that occurred to the global tourism industry in the past year spawned many important questions regarding the robustness and sustainability of tourism operations, and how considerations of animal and human behavior feedbacks might potentially shift the existing mindset and practice towards a less impactful and mutually beneficial system. Many conservation programs rely extensively on the income provided from tourism revenue and the evaporation of this funding source has led to a rise in illegal poaching and bush-meat harvesting activity, as many wildlife protection measures (e.g., hiring of rangers, presence of tourist groups) have been reduced or cut entirely, casting a cloud of uncertainty around the fate of many already-endangered species populations. This new area of research could make significant contributions to the studies of animal behavior, ecosystem conservation, wildlife policy and management and help ensure that the benefits of wildlife-based tourism continue into the future.

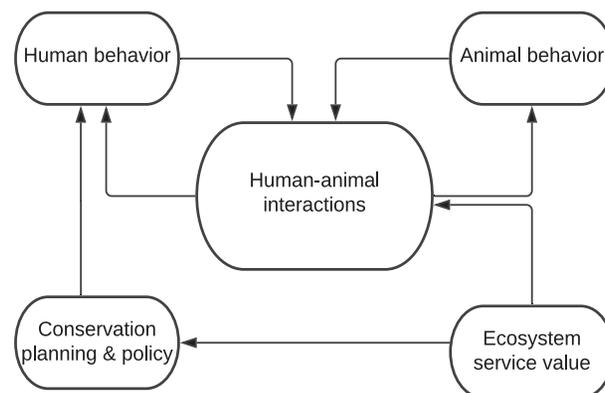


Fig. 1 Conceptual model of the link between animal and human behaviors, ecosystem service values, and conservation policy.

The ES paradigm

The ES paradigm helps identify the net benefits provided by ecosystems and wildlife populations to human well-being and elucidates the relationship between human activities and ecosystem management interventions. Traditionally, ES are defined by the benefits derived from ecosystems, both directly through goods (e.g., timber, food) and processes (e.g., carbon filtration, pollination), as well as indirectly through aesthetic purposes (e.g., cultural and recreational activities). There is also value to be found in the conservation contributions of a system, such as the genetic diversity it hosts and the vital support it provides to other, interconnected biological systems. However, as the flow of these services that occur both between and within systems are not fully understood at this time, it is challenging to ascertain their value (Daily, 2000).

We believe there is a need for a better understanding of the feedback loops that exist between the various parts of the system and how shifts in the consumption rate of an ES can potentially affect the benefits derived (Fig. 1). For example, wildlife-based tourism, one of the most popular forms of global tourism today, is entirely dependent on the visual, recreational, and intrinsic values a tourist derives from the interaction they have with wildlife. Subsequently, when unregulated, a constant human presence can have drastic effects not only on the occurrence of wildlife species, but also their long-term behavior and population dynamics. For example, a stressed animal may spend more time fleeing rather than other necessary survival behaviors such as feeding or caring for offspring (Mullner et al., 2004), and if individual animals or even whole populations start to exhibit undesirable behaviors (e.g., fleeing, hiding, aggression) at higher frequencies, or even abandon a traditional habitat all together, this could cause a decline in visitor satisfaction and future visitation rate.

Conversely, if wildlife tourism is appropriately managed from the onset (e.g., through capacity limits and guide and operator training on proper viewing-procedure), then wildlife will likely continue to exhibit both natural and charismatic behaviors and remain visible for longer periods of time. Both can contribute to overall tourist satisfaction as it allows for more interactive and immersive experiences, which can lead to greater financial contributions to conservation issues as well as overall elevated awareness of both local and global environmental issues (Tapper, 2006). If animals are given the opportunity to exhibit their natural behaviors, their presence can provide humans with the chance to enhance their own appreciation for the natural world, potentially motivating them to want to conserve it. This could create a positive feedback cycle through the further development of responsible and sustainable tourism operations. The relationship between wildlife tourism and the ES value is complex and impacts on larger landscape scale systems can vary substantially, however, as tourism and development continue to expand increasingly into areas shared with wildlife, there are and will be many situations where a fuller appreciation and understanding of animal behavior might be crucial to avoiding negative conflicts and interactions.

ES benefits of wildlife-based tourism

Wildlife tourism is an attractive and growing industry due to the wide range of socioeconomic benefits that it provides. The tourism sector itself is arguably the largest market-based contributor to the financing of protected areas (Twining-Ward et al., 2018, pp. 5), and many national parks and protected areas receive the majority of their funding from donations and admissions fees from visitors, providing the salaries for their rangers and guides as well as contributions to conservation research efforts. In Namibia, tourist dollars contributed significantly to both local conservation efforts as well as approximately \$488 million US dollars to net national income, (see Twining-Ward et al., 2018). Even “theoretical” financial motivation can be derived from ecotourism experiences. At two popular tourist locations in Australia, a whale-watching site and a sea turtle observation tour, 80–98% of surveyed participants were convinced that more action should be taken to protect these two species (Wilson and Tisdell, 2003). Approximately 87% of respondents at Mon Repos said that their experience inspired them to make more personal contributions to sea turtle conservation efforts, which equates to an estimated AUS \$250,000 dollars in the 1999–2000 tourist season. Overall, the study found that the educational experiences derived at both locations prompted both an increased compassion for the wildlife and a willingness to pay to support conservation efforts, which could theoretically contribute to conservation goals.

Wildlife tourism can also support many cultural services and provide local communities with both increased public engagement and more sustainable livelihoods. A community that can create jobs based on wildlife tourism will theoretically have more incentive to protect their local ecosystem from degradation and is subsequently more likely to develop a collective pro-conservation mindset. A conservation ethic that motivates people to care for their local and often endemic flora and fauna could also establish a sense of unity, empowering individuals with a sense of nationalistic pride or “place” that can carry over into other cultural and spiritual traditions and practices. Cultural benefits are often directly connected to both economic and conservation contributions, as many locals are employed by the tourism industry either working as staff or as natural guides, with some individuals being recruited specifically for their knowledge of the local biodiversity. The presence of an educational guide has also been shown to result in higher likelihood that participating tourists will donate to conservation projects, due to visitors’ opportunities to develop a deeper sense of empathy towards the wildlife they view (Wilson and Tisdell, 2003; Zeppel and Muloin, 2008).

Increased investment and prioritization of wildlife tourism also provides an alternative and more stable source of income for local peoples, thereby diminishing reliance on poaching and bushmeat markets (Twining-Ward et al., 2018). In the Okavango Delta in Northern Botswana, tourism activities generated enough income to build homes, provide scholarships, and fund social services in

the community while simultaneously reducing poaching (Twining-Ward et al., 2018). However, management strategies involving multiple external stakeholders can sometimes present challenges and limitations to local communities. Unequal wealth distribution can cause conflict between communities and surrounding nature preserves, as some communities are better suited to host tourism than others (Twining-Ward et al., 2018). Failure to address existing tensions that stem from systemic social inequities and policy failure can exacerbate any attempt at conservation intervention as this may cause further schisms between scientists, government, and the local community. Conversely, when communities are provided equal opportunities and are actively involved in decision-making, they can directly experience the benefits of tourism. One example is the Sanctuary at Ol Lentille, Laikipia in Kenya, where profits went towards community healthcare and education in addition to conservation projects (Twining-Ward et al., 2018). Identifying the ways wildlife and humans can coexist and contribute to each other's well-being should be the goal of sustainable conservation and ecotourism, (Tapper, 2006). Human agency to participate in conservation efforts can take a variety of forms, whether through donations to conservation organizations, adopting sustainable habits, or even volunteering. These increased contributions, both physical and financial, can provide positive feedback for the ongoing protection of wildlife, ensuring the opportunity of these interactions for future generations.

Detrimental impacts of wildlife-based tourism

Without proper management, ecotourism activities can notably affect animal behavior via several ecological, behavioral, and biological pathways. On a broad scale, changes in any one of these domains (i.e., ecology, behavior, or physiology) can drastically alter the downstream consequences to other parts of an ecosystem. Even benign forms of anthropogenic use can be impactful: driving or walking along paths can compact soil and reduce nutrient cycling. Humans often track debris, fungi, trash, or foreign plants into protected areas, which can pollute and even destroy systems through the introduction of invasive, non-native species or pathogens (Shannon et al., 2017). On a broader scale, many of the charismatic megafauna that are integral to the ecotourism industry are also key contributors to local and landscape-level ecosystem functioning. For example, African elephants (*Loxodonta africana*) are both popular tourist attractions and landscape architects, affecting vegetation structure and food availability for other species. If these key species are forced out of their habitat or stressed to the point where their population viability is threatened, it may cause potentially unpredictable ecological feedbacks (Shannon et al., 2017), such as a loss of ES like fertilization from elephant droppings or creation of new water holes.

Anthropogenic presence can also influence prey and predator abundance in an area by causing startle responses in prey, disrupting the hunting of predators, or in extreme cases, causing increased mortality risk (e.g., higher rates of vehicle collisions), (Shannon et al., 2017). Shifts to prey/predator dynamics can have significant consequences on ecosystem health, altering food chains and causing negative trophic cascades. In the Molokini Marine Life Conservation District, Hawaii, schools of Bluefin trevally (*Caranx melampygus*) are regularly displaced by tourist boats despite establishment of the area as a Marine Protected Area (Filous et al., 2017). As Bluefin are key predators in the area, their absence and the resulting disruption of their typical ranging patterns threatens other critical ecosystem functions, which might cause long-term irreparable ecological shifts if management strategies are not implemented for this species. There is also evidence that high tourism levels can induce increased levels of aggression, either towards members of the same species (conspecifics) or towards humans. In a troop of heavily visited Barbary macaques (*Macaca sylvanus*), rates of in-group aggression were observed at much higher rates when tourist groups were present than when not present (Maréchal et al., 2016). As Barbary macaques are critically endangered, any perturbation to natural behaviors could impact their overall survival rates, proving detrimental to global conservation efforts. In another study, Hawksbill sea turtles (*Eretmochelys imbricata*), another critically endangered species, spent notably less time eating, investigating their surroundings, and breathing when approached by recreational divers (Hayes et al., 2016).

Shifts in wildlife behavior can be important indicators for how species might respond to increased levels of disturbance overall, and clearly within some systems, tourism can be a direct cause of increased aggression and behavioral changes that may also decrease the quality or the sustainability of the tourist attraction. It is not yet known if these interactions can have long-term effects on the health of these wildlife populations, however any behavioral change should still be noted, studied, and considered when making decisions regarding the balance between conservation strategies and ecotourism. Without thoughtful management strategies that prioritize the effects of animal behavior on larger conservation and economic goals, many benefits from these species stand to be lost.

Connecting human and wildlife behavior

Despite all the existing literature on the impacts that anthropogenic tourist activities have on wildlife, there remains a surprising lack of research that directly examines how the role of behavior is tied into the ES animals provide for ecotourism. Greggor et al. (2019) highlighted the lack of understanding about animal behavior found within conservation management approaches, and suggested this as the reason for the limited success of many conservation efforts. A similar argument could be made for attempts to develop robust, non-impactful tourism activities that foster mutually beneficial interactions between humans and wildlife. While there are many studies that highlight the negative impacts of anthropogenic activity on animal behavior, there are others that demonstrate the lack of relationship or identify disturbance occurring only in select situations. Additionally, the data does not yet currently exist for longer-lived species, on the effects of chronic disturbance on survival and reproduction rate.

While this chapter reviews only some of the current knowledge that exists on the intersection between animal behavior and ES, it is our belief that much more research is required—in both human and animal behavior science—for us to fully realize the potential value these two combined fields will bring to conservation and management. It is imperative that these future investigations consider how the ES benefits of human-wildlife interactions can simultaneously contribute to both education as well as conservation, protecting animals and habitat from harm or alterations to their natural states. Individuals in the fields of wildlife management, ecotourism, animal behavior, and conservation biology would do well to develop and make use of an integrative coupled human-nature framework that both maximizes the benefits of animal behavior as an ecosystem service and minimizes the cost to both humans and wildlife. While specific case studies such as the ones highlighted in this paper (Mullner et al., 2004; Hayes et al., 2016) are notable, we recommend research efforts be expanded to include less-charismatic species that may be just as endangered or are important keystone species in a particular ecosystem.

In addition to researching the impacts of anthropogenic disturbance on wildlife, it is critical to examine how communities feel towards their local species as it not only provides a better understanding of in-situ cultural beliefs but provides a framework for how to move forward in conservation efforts with community support. As ecotourism has the potential to be a source of livelihood for an entire community, there are important synergies to be considered between the economic value of ES to people, and the biological value of conserving the species as a whole. Each group of relevant stakeholders may have differing motivations and interests, which all must be considered (Tapper, 2006). Conducting focus groups in these communities, establishing citizen science efforts, and involving local scientists and leaders in decision-making will help ensure that there is regional support for both conservation efforts and development regulation. Moreover, such efforts contribute to mitigating the level of undesired outside intervention. It is important that the endeavors to protect animal behavior be both transparent and act in tandem with the goals of the community, so that the needs of tourists are not put ahead of the well-being of locals. One of the most important tools will be education opportunities, for both local communities and for visitors. There are currently some existing wildlife programs that offer certification for ecotourism businesses, but it is not always clear if these certifications are valued by the tourists themselves and therefore these businesses are deliberately sought out (i.e., it is unclear whether the public is aware of what these certifications represent). In order to better protect wildlife and preserve natural behaviors as best as possible, action initiatives need to come from both the consumers and providers of ecosystem services.

Impacts of COVID on the future of wildlife-based tourism

The year-long pause in human movement and tourism caused by the COVID-19 pandemic has provided natural systems with the chance to recover from years of over-utilization, as exponential increases in visitor numbers over the past few years resulted in varying levels of environmental damage to the local ecosystems at many popular tourist destinations. Already society has observed ways wildlife behavior can shift in the absence of human visitation, with populations returning to previously abandoned habitats, exploiting new territory, or exhibiting hitherto unobserved behaviors. However, as the world starts to reopen and resume pre-pandemic operation levels, the ecotourism industry will need to be patient as wildlife begins to acclimate to human presence once again. The pandemic has forced us to consider how as a society our relationships with outdoor environments may have been changed. Nature is no longer something that we take for granted but has become appreciated and treasured as a chance for physical escape from the confinement of our own rooms and houses. The necessity of adhering to social-distance requirements has led to visitors needing to seek out less-frequented, or previously untouched natural spaces, bringing them into even closer contact with wildlife. Unfortunately, the ability to access nature is not a luxury utilized equally by all members of society. Travel to exotic and remote places on the planet was already something typically enjoyed by those in the traditionally middle and upper classes: those with the resources to travel and time for vacations. As the tourism industry remains constrained by added safety and health protocols (e.g., visitor limits, extra cleaning and sanitization efforts, higher quality requirements), these added costs can potentially be transferred onto visitors, making tourism travel potentially even more restricted to just the wealthy. The events that have transpired in the United States surrounding the concept of racial justice and discrimination, have also brought up serious questions regarding the access to nature and the outdoors, (e.g., Ahmaud Arbery, Christian Cooper), and whether there are other demographic barriers that preclude some members of society from receiving the benefits of these experiences.

Alternatively, we might consider whether the increasing digitization of the world has opened up new potential mediums that could make travel more widely accessible and immersive for a wider range of audiences. Advanced technology such as drones or UAS (unmanned aerial systems) may enable both researchers and tourists to view wildlife from new and innovative perspectives, providing more observational capacity than traditional viewing platforms. As recent studies have revealed a notable lack of response from wildlife to the presence of the UAS, drone technology could arguably make significant contributions to the potential discovery and recording of hitherto unknown wildlife behavior with minimal impact on the study subjects. This is just the beginning of our relationship with this technology, and while more studies are needed to ascertain the potential impacts such innovations may have on different wildlife species, it is worth considering whether these types of technological innovations could successfully be used in the ecotourism industry as well. Just as researchers can gain access to novel behaviors, this media could also enhance viewing opportunities for tourists. For example, most whale watchers will never be able to view more than the arch of whale's back as it dives or the spout from an occasional blowhole hundreds of meters away. Even in a close encounter, either from a whale or dolphin voluntarily approaching the boat, (or the boat illegally getting close to the animal), the size of the animal and the angle of the boat preclude a full appreciation for any exhibited behavior. The bird's-eye perspective offered by drones could provide a more

comprehensive viewing experience, which could lead to more educational opportunities, as well as more appreciative and satisfied visitors. Visitors can still derive an emotional experience from going out on the boat to search for whales, but such technologies might enable guests to get a closer view once they have been located, without having to physically bring tourists closer to the animals and thereby respecting their rights and well-being. As this technology continues to make its way into the tourism industry, we hope more studies will explore tourism satisfaction that is derived from viewing wildlife through this new lens, to provide conclusive evidence on the efficacy of novel viewing apparatuses as a suitable alternative to traditional wildlife viewing.

Recommendations

Due to the relative absence of studies that evaluate how ES benefits may be impacted by changes in wildlife behavior, we advocate for the development of a multilayered, feedback-based framework that incorporates these various fields of study (Fig. 2). As outlined previously, there are many established benefits to tourism activities, and therefore we do not advocate for the eradication of wildlife-based tourism altogether. However, in our desire to obtain these benefits, it is imperative to remain cognizant of the often-overlooked intricacies of animal behavior and to ensure the activities of human tourists do not cause undue stress on these wildlife populations. Berger-Tal et al. (2011) hypothesizes that animal behavior and conservation could be directly linked through a new discipline called “conservation behavior,” and proposes that future research be focused on three major themes: behavioral indicators, human-wildlife behavioral feedback loops, and behavior-based management. Through this integration of animal behavior into existing ES framework, scientists, conservationists, eco-tourism vendors and patrons, and wildlife itself, all stand to benefit (Berger-Tal et al., 2011).

Thus, we propose the establishment of “behavior-based” ecotourism management systems and the inclusion of animal behavior in general conservation management and policy decisions, and we make the following recommendations for how this could be achieved (Table 1). The first is increasing interdisciplinary collaborations and education opportunities. Animal behavior studies would benefit from not remaining firmly embedded within the single lens of biological sciences, but ought to be expanded to include perspectives from other branches of science (e.g., ecology, sustainability, landscape ecology, conservation management, human psychology). It is also important to respect the sovereignty of the local areas where ecotourism businesses and research are conducted (Tapper, 2006), and involves making sure ecotourism operators work in tandem with the local governments to respect local sovereignty and work to balance the boundaries of the species being utilized for ecotourism. Other on-the-ground options include the establishment of business partnerships between tourism operations and local nature reserves to provide tourists with more information about wildlife in more controlled settings. It will also be important to place capacity limits on tourism operations, which may be of even higher priority depending on the habitat and species in question (i.e., when the tourism is centered on endangered species). Regulating and establishing capacity limits on tourism activity will ultimately increase the quality of ecotourism experiences for tourists, by providing wildlife with the space to exhibit normal behaviors (Tapper, 2006).

Second, it will be imperative that both tourism and conservation management practices develop a more thorough understanding about the motivations of visitors when it comes to participation in wildlife-based tourism activities. According to Tapper (2006), many tourists desire more than just photos of animals and want a truly immersive experience where they can observe wildlife exhibiting natural behaviors, even if that means limited viewing opportunities for the public. However, many tour operators may be under the opposing impression that tourists are only motivated by a desire to get as close to animals as possible, which could lead to higher frequencies of disregard for existing policies and regulations. Providing training opportunities for tour operators to enable them to convey important conservation messages to visitors will help ensure that both the educational and conservation benefits of

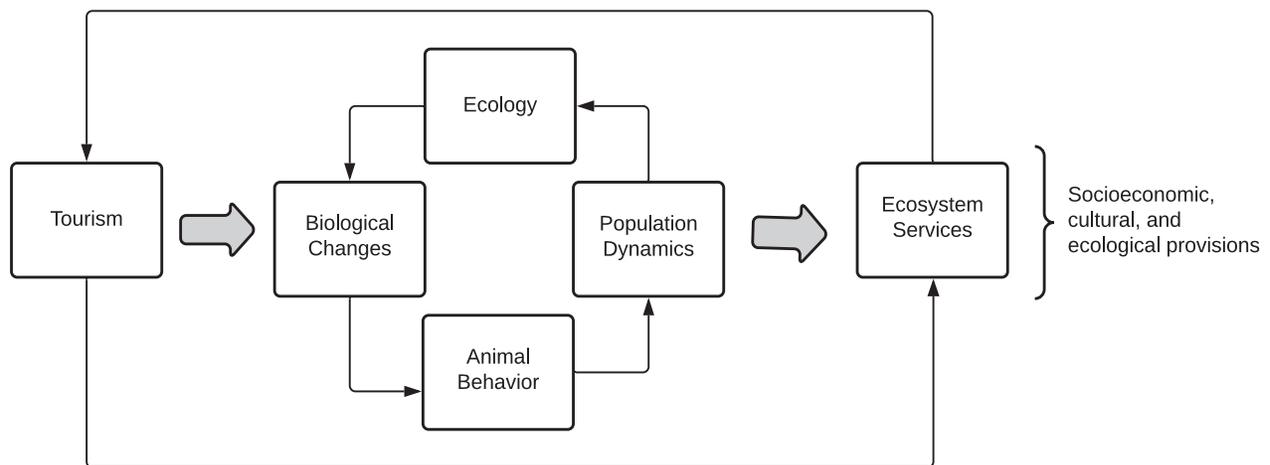


Fig. 2 Visual representation of how the feedback loop of changes in behavior, ecological and physiology of wildlife, caused by anthropogenic disturbance, can be incorporated into the broader ES framework. Rather than viewing each of these elements as.

Table 1 A brief list of several of the key problems within the ecotourism system, recommendations for how they could be rectified, the main stakeholder(s) involved that will be required to address it, and examples/case studies of what these problems and solutions can look like.

<i>Problem</i>	<i>Recommendation</i>	<i>Responsible Party</i>	<i>Example</i>
Lack of knowledge of anthropogenic impacts to wildlife due to tourism	Increase in research on intersections between human and wildlife behavior	Scientists	Expanding on studies and funding for research on behavioral responses to tourism in local communities, as well as involving local scientists and expanding on citizen science efforts; (Tapper, 2006).
Unequal distribution of profit/benefits that adversely affects the surrounding communities involved in wildlife tourism.	Interdisciplinary collaborations	All	By forming community trusts, like the Chobe Enclave Conservation Trust in Okavango Delta, income from wildlife tourism has funded households and community projects as well as social services such as providing homes and scholarships (Twining-Ward et al., 2018)
Physiological stress responses by animals to tourism/ anthropogenic disturbance	Limits on capacity of tourism	Tourism operators, scientists, policy makers	The hormonal stress responses and survival rate of Hoatzin chicks living in ecotourism hotspots was found to be drastically affected by unregulated tourism levels, (Mullner et al., 2004). It was suggested that tourism operators and managers should operate with an understanding of the vulnerable stages of the wildlife being observed.
Lack of adherence to existing regulations	Enforcement of existing policies and regulations, offering incentives when necessary (provided the benefits are actually those desired by the stakeholders)	Government (both local and national level)	Incorporate a system to monitor local ecotourism businesses to ensure that policies and regulations are being followed. This could include checking for permits and certifications, requiring annual recertification and re-trainings.
A business-oriented wildlife tourism attraction, neglecting the long term conservation value the experience could provide	Research on values and motivations of tourists	Scientists, in collaboration with tourism operators	Provision of an educational and guided tour can foster pro-environmental attitudes that lasts even after visiting the attraction, especially by establishing an emotional response to wildlife and a desire to protect wildlife, (Zeppel and Muloin, 2008)
Tourists have general lack of knowledge/awareness about wildlife they want to have an experience with and how their activities are contributing to adverse effects	Increase in educational opportunities	Tourism operators and tourists, local government	Provide training programs in which ecotourism operators are certified in educating tourists about wildlife; incorporate more educational activities for tourists in ecotourism activities. Also create public awareness campaigns that teach tourists about consumer responsibility and patronizing environmentally conscious tourism companies.
Exponential and unregulated expansion of tourism industry	Establishment of development guidelines that are aligned with conservation goals and limits on number of operators/ businesses in specific areas (e.g., licensing or permit requirements)	Government (local and national level)	Increased communication strategies and information sharing, that allow government officials and decision-makers to have access to the most recent and up to date science. As previously mentioned, decision making would greatly benefit from the inclusion of stakeholders from many diverse backgrounds, and perspectives to encompass all socioeconomic and biological needs, (Tapper, 2006).

tourism activities are achieved. In this way, the corresponding desire of conservationists to minimize the physiological stress responses (and harm) to species can also serve to maximize the positive experiences of tourists with wildlife, thereby satisfying the needs of all stakeholders with respect to the biological limits of wildlife. By shifting the emphasis to focus on the quality of ecotourism experiences rather than quantity, we can better ensure that the interactions between human tourists and wildlife remain meaningful and significant, potentially contributing to long-term sustainability goals.

Conclusion

The onset of the COVID pandemic, despite its global devastation, has offered respite for much of the natural world, and a chance for humans to re-evaluate our relationship with nature. As we take a step back from our role as active environment influencers, we can instead allow nature to “take the lead,” by learning how to adapt our systems to be more integrated with natural cycles, maximizing the benefits for all species (humans included). Just as we humans changed our behaviors to accommodate the shifts in our environment (e.g., COVID), it will be necessary for successful conservation efforts to embrace this more novel concept of “behavior-based” management to ensure that future development does not cause irreparable harm or drastic alterations to the sustainability of important ecosystem functions. In conclusion, we propose one potential “expanded” version of the traditional ES model, that is integrated with the feedback loops found within the ecotourism system (Fig. 3) which could be used for future research and management planning. Additional exploration will be needed that focuses on coupled systems in all forms—interspecies relationships, local and international interests, effects of crashing climate—ultimately establishing a novel approach to explicitly integrate animal behavioral ecology into conservation planning.

The recommendations laid out in this paper are just some of the potential lenses through which we can view the intersection of conservation behavior and the ES paradigm. Numerous studies have outlined the impactful role that anthropogenic activity can have on wildlife behavior, with many revealing the negative results that can emerge. As a species, humans have always had a fascination with our environment, and it is only natural that we would want to cultivate meaningful and significant interactions with the other species we share it with. However, without proper management, our desire to connect with wildlife has the potential to drastically change the behavior and potentially survival rate of the species we cherish, resulting in a negative feedback loop that can reduce the opportunities for others to enjoy these activities in the future. Wildlife-based tourism is part of a complex bio-social system that encompasses local culture, economics, and conservation ethics, and is ultimately dependent on the ongoing survival and stability of wildlife populations. Thus, we ought to consider the coupled-dynamics of both the biological field of animal behavior and social-economic systems, and advocate for the development of a new biosocial model that is considered in its entirety.

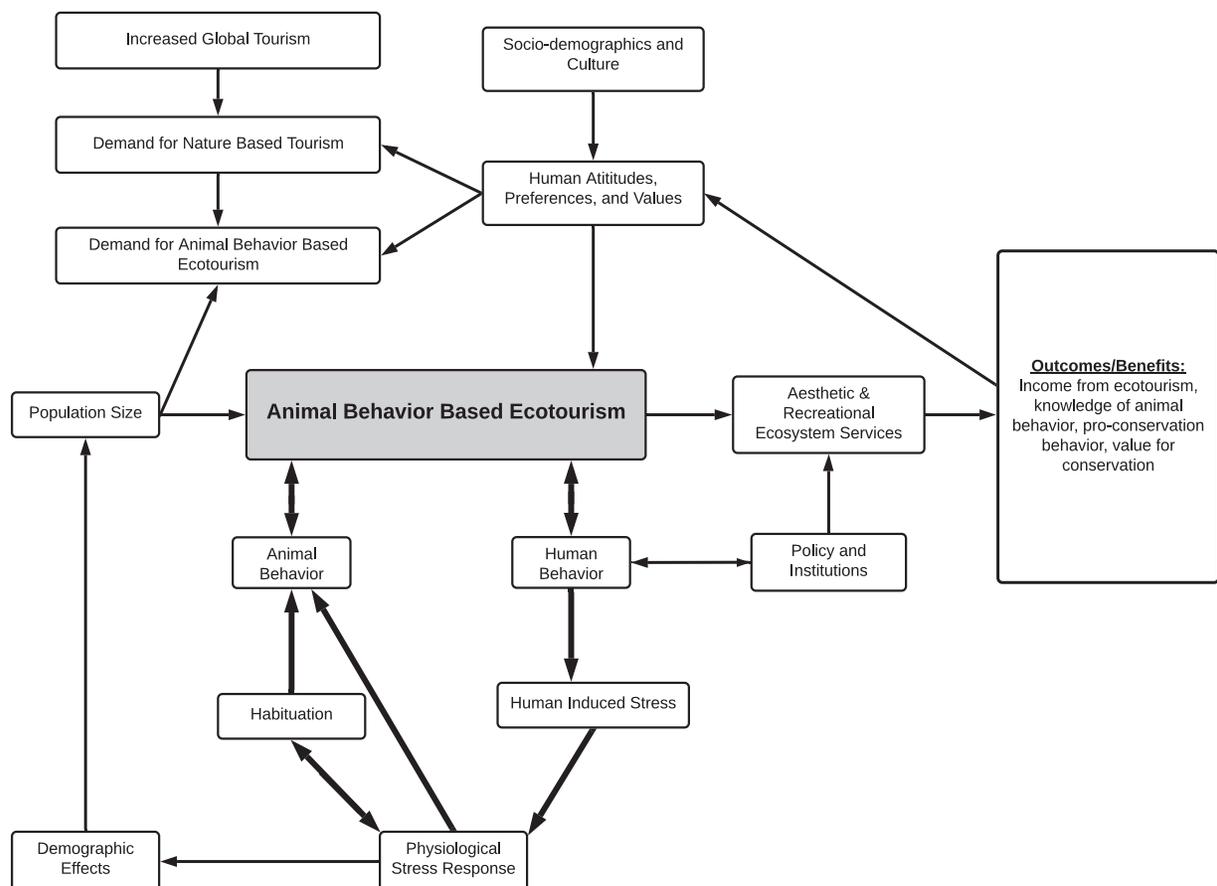


Fig. 3 An expanded version of the ecosystem services framework that incorporates the feedback loop of the animal-behavior based ecotourism system.

To our knowledge, a formal evaluation of the value of animal behavior within the traditional ES model has never been formally proposed or studied, and we hope that this paper can provide the launching point for more integrative studies in the future. The ultimate goal would be the development and management of wildlife-based ecotourism in a less-impactful, more mindful way, where the needs of both wildlife and humans are mutually respected and appreciated.

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