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The study of tourism in Costa Rica from the perspective of Recreational Ecology

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ABSTRACT. **Introduction:** Tourism in protected areas has grown globally, boosting conservation and the economy but also generating negative ecological impacts. Recreational Ecology studies these effects, addressing challenges such as habitat degradation and carrying capacity to promote sustainable management strategies. **Objective:** To identify key themes in Costa Rica's recreational ecology, including ecological impacts and sustainable management. **Methods**: We systematically reviewed the literature and carefully selected 15 out of 39 relevant documents, focusing specifically on experimental studies of ecological impacts. **Results**: Over the last decade, most research has examined the effects of tourism on wildlife. Our analysis reveals significant impacts, including alterations in animal behavior, intensified soil erosion, and elevated CO_2 emissions, all driven by the increasing presence of tourists in natural habitats. **Conclusion:** As tourism grows, its ecological consequences become more severe, necessitating urgent strategies for sustainable tourism in protected areas of Costa Rica.

Keywords: ecotourism, recreational activities, protected areas, sustainable development, ecological impacts.

RESUMEN. "El estudio del turismo en Costa Rica desde la perspectiva de la Ecología Recreativa". **Introducción:** El turismo en áreas protegidas ha crecido globalmente, impulsando la conservación y la economía, pero también generando impactos ecológicos negativos. La *Ecología Recreativa* estudia estos efectos, abordando desafíos como la degradación del hábitat y la capacidad de carga para promover estrategias de manejo sostenible. **Objetivo:** Identificar temas claves en la ecología recreacional costarricense, incluyendo efectos ecológicos y administración sostenible. **Métodos:** Revisamos sistemáticamente la literatura y seleccionamos 15 de 39 documentos relevantes, enfocándonos en estudios experimentales sobre impactos ecológicos. **Resultados:** En la última década, la mayoría de las investigaciones han examinado los efectos del turismo sobre la fauna. Nuestro análisis revela impactos significativos, como alteraciones en el comportamiento animal, mayor erosión del suelo y aumento de emisiones de CO_2, impulsados por la creciente presencia de turistas en hábitats naturales. **Conclusión:** A medida que el turismo crece, sus consecuencias ecológicas se agravan, lo que exige estrategias urgentes para un turismo sostenible en áreas protegidas de Costa Rica.

Palabras clave: ecoturismo, actividades recreativas, áreas protegidas, desarrollo sostenible, impactos ecológicos.

Globally, participation in tourism and recreational activities within protected areas has seen a significant increase (Revollo-Fernández et al., 2024). This growth aligns with a broader global trend where tourism plays a crucial role in both conservation and economic development, particularly in countries with high biodiversity and extensive protected areas, which attract a significant number of visitors and generate substantial economic benefit (Balmford et al., 2015). While these activities provide substantial socioeconomic benefits, they also introduce negative externalities, such as the disruption of biophysical conditions, which can undermine in-situ conservation efforts (Vargas, 2009).

Within this context, recreational ecology—defined as the scientific study of the effects of outdoor recreation and tourism on natural and semi-natural environments—serves as a crucial framework for understanding and managing these impacts (Hammitt & Cole, 1998). This field assesses ecological changes associated with visitor activities, accounting for various factors that can either exacerbate or alleviate such impacts (Leung et al., 2008). In recent decades, research in recreational ecology has expanded significantly, with studies focusing on key challenges such as visitor carrying capacity, habitat degradation, and species behavioral changes in high-traffic areas (Marion et al., 2016). By offering insights into the ecological consequences of increased tourism, recreational ecology supports the development of management strategies aimed at minimizing potential ecological damage and enhancing the sustainability of conservation efforts (Monz et al., 2013).

In Costa Rica, ecotourism is a cornerstone of the national economy (Krüger, 2005; Weaver, 1999). The country's protected areas have become increasingly popular among diverse tourist groups, leading to a notable rise in visitation (ICT, 2024). However, despite this growth, the field of recreational ecology has received limited attention, resulting in critical gaps in our understanding of the ecological impacts of tourism in Costa Rica's protected areas and the necessary management responses.

This study aims to address these gaps by examining the specific themes and categories within recreational ecology that have been explored in Costa Rica's context. It provides a systematic review of scientific literature that identifies the negative implications of tourism while also highlighting research gaps and emerging trends structured perspective aligns with the principles of recreational ecology and offers guidance for future research and the development of sustainable management practices in this field.

MATERIALS AND METHODS

This study employs a quantitative approach through a systematic literature review to uncover the negative ecological impacts of tourism in protected areas (Pickering & Byrne, 2014). Between January and May 2024, we reviewed studies in both Spanish and English, focused on experimental ecological impacts within Costa Rica. The inclusion criteria included peer-reviewed articles, experimental methodologies, and publications addressing the effects of tourism.

We searched databases such as Web of Science, Scopus, ScienceDirect, and Google Scholar using keywords in both languages. From an initial set of 39 documents, 14 met the inclusion criteria. We categorized the studies by publication year, site, ecological components, objectives, methodologies, impact findings, and management implications. To ensure quality, we evaluated the articles based on their experimental methods. This approach provides a detailed perspective on the effects of tourism and supports the development of sustainable management strategies.

RESULTS

The reviewed publications span from 1990 to 2024. Most of the fieldwork was conducted in 1987 and 1998, and each year produced two papers. The peak year for publications was 2014 (n=3), while the decade from 2010 to 2020 recorded the highest output, with a total of five works. On average, there was a 4,47-year lag (SD = 4,10) between fieldwork and publication. Research primarily addressed topics in primatology, tropical biology, conservation, ecotourism, and management. Among the 45 researchers involved in work conducted in Costa Rica, 71,11% were foreign, and 14 articles appeared in English. Gender representation among authors was nearly balanced, with 46,67% male and 53,33% female. Research locations varied, with Manuel Antonio National Park leading in research activity (n=5), followed by Tortuguero National Park (n=3).

The studies focused on three primary ecological components: soil and vegetation, wildlife, and air. Investigations into soil and vegetation explored issues such as erosion, trail conditions, and the effects of trampling. Wildlife, representing the majority (73,33%) of the work, predominantly analyzed the behavior of species such as the White-faced Monkey (Cebus *imitator)*, and the Howler Monkey (*Alouatta palliata* (n=7), alongside raccoons (*Procyon lotor* and *Procyon cancrivorus*), water anoles (*Anolis aquaticus*), and tropical spotted dolphins (*Stenella attenuate*). Additionally, one study examined CO_2 emissions resulting from tourist boat activities. Research was conducted in areas with different types of governance, all engaged in tourism (Table 1). In state-managed PA, all studies were carried out in sites classified under IUCN management categories I and II.

TABLE 1

Study locations and frequency of tourism research in Costa Rica categorized by governance

Governance	Locations
Private	La Selva Biological Station (1), Monteverde Cloud Forest Biological Reserve (1), Las Cruces Biological Station (1), Lapa Ríos Rainforest Ecolodge (1), Loma Linda State (1).
State	Tortuguero National Park (3), Braulio Carrillo National Park (1), Manuel Antonio National Park (5), Poás Volcano National Park (1), Cabo Blanco Abolute Natural Reserve (1).
Mixed*	Curú National Wildlife Refuge (2).
Uncertain	Between Drake Bay and Isla del Caño Biological Reserve (Marine area).

*Refers to areas managed through a combination of private and state governance.

Thirteen studies were conducted in terrestrial ecosystems, whereas only two focused on marine or aquatic ecosystems, such as canals (Fig. 1). This imbalance highlights a notable research gap in understanding the impacts of tourism on aquatic environments.

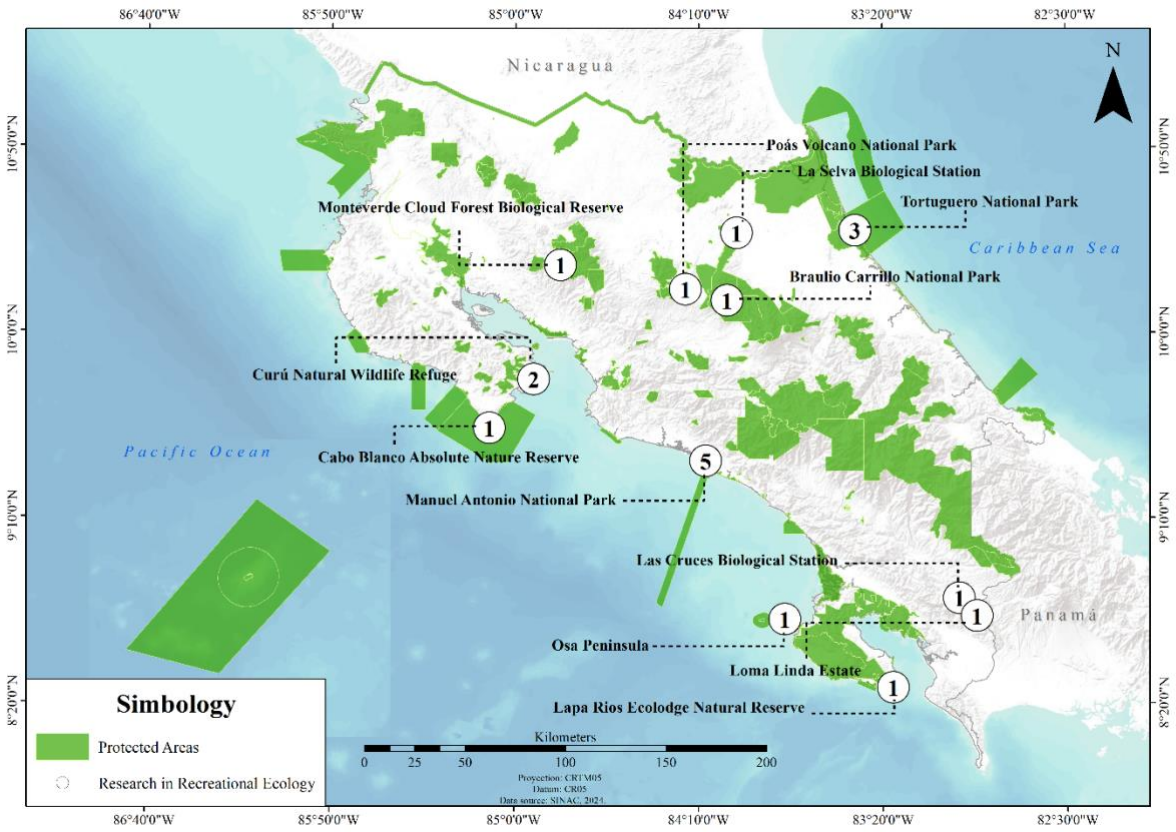

Fig. 1. Locations of research sites for studies on tourism impacts in Costa Rica. GIS based on data from SINAC (2024).

Methodologies of studies on tourism impacts: Approaches varied from non-intrusive observations to more invasive procedures, such as species capture and trail simulation (Table 2). Despite the diversity of methods (n=15), only one study reported minimal negative impacts of tourism on wildlife, while the others highlighted significant behavioral and habitat disturbances.

TABLE 2

Objectives and methods applied on tourism studies impacts

Ecological component	Methods applied*	Objective
Soil and vegetation	Simulation of rainfall on the trail and adjacent surfaces	Quantify infiltration and soil particle detachment
	Interviews with protected areas administrators	Identify and qualitatively assess trail conditions
	Trail monitoring	Compare vegetation change and recovery
	Instantaneous sampling focal/cluster census	Direct observation, troop tracking, and data collection
	Ethnoprimatology	Quantitative assessment of primate behavior

Wildlife	Night census	Quantify successful turtle nests, false nests, and failed nesting activity
	Captures by traps and placement of radio transmitters	Follow-up of individual mobility
	Captures (samples) of individuals with different clothing colors	Determine the probability of capture
	Visitor interviews	Assess visitor attitudes towards monkeys
	Use of camera traps	Monitor mammals and birds in various locations
	Instantaneous sampling every two minutes along a strip transect	Study dolphin sighting density and behavior in the presence of tourist boats
	Recording of interactions between wildlife and tourists	Record site, time, date, interaction type, and species involved
Air	Vessel registration and various parameters for CO_2 calculations	Obtain vessel information (type, owner, engine size), tour frequency, and calculate emissions

* The methods described in this table were based on the following sources, listed in chronological order: Lippold (1990); Boucher et al., (1991); Carrillo & Vaughan (1993); Jacobson & López (1994); Wallin & Harden (1996); Farrell & Marion (2001); Montero & Lobo (2010); Alvarado-Van der Laat (2014); Webb & McCoy (2014); McKinney (2014); Kauffman (2014); López et al., (2019); Fondren et al., (2020); Schulte et al., (2020); Porras et al., (2022).

Key impacts identified: The main impacts identified include significant soil erosion and vegetation degradation. Trails showed increased runoff and detachment of soil particles (Farrell & Marion, 2001). Additionally, uncontrolled foot traffic has contributed to the formation of unauthorized trails, leading to habitat fragmentation and a decline in plant regeneration rates. Compacted soil further reduces water infiltration, increasing surface runoff and sedimentation in nearby aquatic ecosystems (Wallin & Harden, 1996).

Research on wildlife studies highlighted diverse responses to tourism (Webb & McCoy, 2014; McKinney, 2014; Schulte et al., 2020; Kauffman, 2014; Porras et al., 2022). Species such as White-faced Monkey and Howler Monkey showed greater interaction with visitors (McKinney, 2014), while other species exhibited avoidance behaviors that led to habitat shifts (Lippold, 1990). In some cases, species displacement has resulted in increased competition for resources in adjacent habitats, affecting biodiversity and ecosystem stability. Nocturnal species such as Procyon lotor and *Procyon cancrivorus,* have also altered their daily activity patterns due to human presence, becoming increasingly dependent on anthropogenic food sources (Carrillo & Vaughan, 1993; Porras et al., 2022).

In Manuel Antonio, tourism influenced White-faced Monkeys and two raccoon species (North American racoon and Crab-eating raccoon) altering their feeding habits and activity patterns (Carrillo & Vaughan, 1993; Porras et al., 2022). Frequent interactions between tourists and wildlife have led to behavioral conditioning, where animals actively seek human food, increasing the risk of malnutrition, disease transmission, and aggressive encounters.

Furthermore, air pollution from tourist boats raised environmental concerns in Tortuguero, impacting both air and water quality. The accumulation of boat emissions and fuel residues in aquatic ecosystems can affect water pH, harm aquatic life, and contribute to long-term habitat degradation (Alvarado, 2014).

DISCUSSION

As of May 2024, only 15 publications on recreational ecology in Costa Rica have been produced, underscoring the limited scientific interest and the early stage of research dissemination in this field. This aligns with Sumanalapa & Wolf (2019) observation regarding low scientific output in developing countries. Notably, none of these publications explicitly refer to the term 'recreational ecology,' even though 71% of the authors were foreign.

The Manuel Antonio National Park stands out with the highest number of publications, likely due to its status as the most visited protected area in the region, rendering it more vulnerable to negative impacts and thus a key site for study (Marion et al., 2016). Visitor numbers emerged as the primary variable negatively affecting wildlife behavior (Carrillo & Vaughan, 1993; Porras et al., 2022), with peak visitation times correlating with increased human-wildlife interactions. This pattern aligns with global trends, where popular protected areas often experience greater ecological pressure, emphasizing the urgent need for adaptive management strategies (Newsome et al., 2012).

Most research has focused on ecology and general biology, with particular emphasis on species such as monkeys and raccoons, primarily using observational methods. This narrow focus underscores the need for interdisciplinary approaches that incorporate innovative methodologies and technologies (Marion et al., 2016), as well as greater attention to *non-charismatic species*—those that typically receive less public interest due to their appearance, behavior, or lack of media presence. Unlike charismatic species, such as large mammals or colorful birds, non-charismatic species (e.g., insects, plants, and small vertebrates) often play critical ecological roles yet remain underrepresented in conservation and ecological studies (Monz et al., 2013). Additionally, significant research gaps persist in marine ecosystems, with only one study addressing this area, while topics such as birdwatching and trekking remain largely unexplored.The lack of research in aquatic environments mirrors a broader gap in recreational ecology, where terrestrial impacts are more frequently documented, despite growing concerns over the effects of tourism on marine biodiversity (Davenport & Davenport, 2006).

From a theoretical perspective, this research enhances the field of recreational ecology by providing a systematic review of specific environmental impacts of tourism in Costa Rica's PA. This study consolidates experimental evidence and fills critical gaps in the literature, acting as a foundational reference for future research and management efforts in recreational ecology. These findings emphasize essential areas for targeted intervention and ongoing monitoring, which support the development of sustainable tourism strategies grounded in ecological science. Future research should also explore the socio-ecological dimension of tourism, integrating community perspectives and participatory conservation approaches.

To address emerging trends in recreation and tourism, it is essential to develop robust strategies for research, evaluation, and monitoring that inform effective management decisions. The protection of the health and integrity of natural resources is crucial for the delivery of high-quality visitor experiences and the promotion of sustainable tourism development in protected areas (Marion et al., 2016). This requires stronger collaboration between policymakers, researchers, and local stakeholders to ensure that conservation goals align with economic and social sustainability (Eagles, 2014).

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REFERENCES

Alvarado-Van der Laat, I. (2014). Tortuguero National Park, Costa Rica: Baseline CO_2 Emissions from Boat Tours into the Channels System. *Low Carbon Economy*, *05*(01), 19–25. https://doi.org/10.4236/lce.2014.51003

Balmford, A., Green, J. M. H., Anderson, M., Beresford, J., Huang, C., Naidoo, R., Walpole, M., & Manica, A. (2015). Walk on the wild side: Estimating the global magnitude of visits to protected areas. *PLoS Biology, 13*(2), e1002074. https://doi.org/10.1371/journal.pbio.1002074

Boucher, D. H., Aviles, J., Chepote, R., Domínguez Gil, O. E., & Vilchez, B. (1991). Recovery of trailside vegetation from trampling in a tropical rain forest. *Environmental Management*, *15*(2), 257–262. https://doi.org/10.1007/bf02393857

Carrillo, E., & Vaughan, E. (1993). Variación en el comportamiento de Procyon spp. (Carnivora: Procyonidae) por la presencia de turistas en un área silvestre de Costa Rica. *Revista de Biología Tropical*, *41*(3B), 843–848. https://revistas.ucr.ac.cr/index.php/rbt/article/view/24113

Davenport, J., & Davenport, J. L. (2006). The impact of tourism and personal leisure transport on coastal environments: A review. *Estuarine, Coastal and Shelf Science, 67*(1-2), 280-292. https://doi.org/10.1016/j.ecss.2005.11.026

Eagles, P. F. J. (2014). Research priorities in park tourism. *Journal of Sustainable Tourism, 22*(4), 528-549. https://doi.org/10.1080/09669582.2013.785554

Farrell, T. A., & Marion, J. L. (2001). Identifying and assessing ecotourism visitor impacts at eight protected areas in Costa Rica and Belize. *Environmental Conservation*, *28*(3), 215–225. https://doi.org/10.1017/s0376892901000224

Fondren, A., Swierk, L., & Putman, B. J. (2020). Clothing color mediates lizard responses to humans in a tropical forest. *Biotropica*, *52*(1), 172–181. https://doi.org/10.1111/btp.12744

Hammitt, W. E., & Cole, D. N. (1998). *Wildland recreation: Ecology and management* (2nd ed.). John Wiley & Sons.

ICT (Instituto Costarricense de Turismo). (2024). *Visitas de residentes y no residentes a las áreas silvestres protegidas*. https://www.ict.go.cr/es/documentos-institucionales/estad%C3%ADsticas/cifras-tur%C3%ADsticas/visita-a-las-%C3%A1reas-silvestres-protegidas-sinac/2668-visitas-areas-protegidas-1990-2023/file.html

Jacobson, S. K., & López, A. F. (1994). Biological impacts of ecotourism - Tourists and nesting turtles in Tortuguero National Park, Costa Rica. *Wildlife Society Bulletin*, *22*(3), 414–419. https://doi.org/10.2307/3783383

Kauffman, L. (2014). Interactions between tourists and white-faced monkeys (*Cebus capucinus*) at Manuel Antonio National Park, Quepos, Costa Rica. *Primate Tourism* (pp. 230–244). Cambridge University Press. https://doi.org/10.1017/CBO9781139087407.017

Krüger, O. (2005). The role of ecotourism in conservation: Panacea or Pandora's box? *Biodiversity and Conservation*, *14*(3), 579–600. https://doi.org/10.1007/s10531-004-3917-4

Leung, Y.-F., Marion, J. L., & Farrell, T. A. (2008). Recreation ecology in sustainable tourism and ecotourism: A strengthening role. In S. F. McCool & R. N. Moisey (Eds.), *Tourism, recreation and sustainability: Linking culture and the environment* (2nd ed., pp. 19–37). CABI.

Lippold, L. K. (1990). Primate population decline at Cabo Blanco Absolute Nature Reserve, Costa Rica. *Brenesia*, *34*, 145–152. http://biblioteca.museocostarica.go.cr/articulo.aspx?id=2511&art=8603

López, B., Almeyda, A. M., Mulder, G., Ols, C., Dirzo, R., Almeyda, S. L., Quispe, C. A., Cruz, J. C., Álvarez, D., Valdelomar, V., Villareal, E., Sanchez, A., Quiros, A., Stein, T. V., Lewis, K., & Broadbent, E. N. (2019). Ecotourism: the 'human shield' for wildlife conservation in the Osa Peninsula, Costa Rica. *Journal of Ecotourism*, *19*(3), 197–216. https://doi.org/10.1080/14724049.2019.1686006

Newsome, D., Moore, S. A., & Dowling, R. K. (2012). *Natural area tourism: Ecology, impacts and management* (2nd ed.). Channel View Publications.

Marion, J. L., Leung, Y.-F., Eagleston, H., & Burroughs, K. (2016*)*. A review and synthesis of recreation ecology research findings on visitor impacts to wilderness and protected natural areas. *Journal of Forestry*, *114*(3), 352-362. https://doi.org/10.5849/jof.15-498

McKinney, T. (2014). Species-Specific Responses to Tourist Interactions by White-Faced Capuchins (*Cebus imitator*) and Mantled Howlers (*Alouatta palliata*) in a Costa Rican Wildlife Refuge. *International Journal of Primatology*, *35*(2), 573–589. https://doi.org/10.1007/s10764-014-9769-1

Montero, A., & Lobo, J. (2010). Effect of tourist vessels on the behaviour of the pantropical spotted dolphin, *Stenella attenuata*, in Drake Bay and Caño Island, Costa Rica. *Journal of Cetacean Research and Management*, *11*(3), 285–291.

Monz, C. A., Pickering, C. M., & Hadwen, W. L. (2013). Recent advances in recreation ecology and the implications of different relationships between recreation use and ecological impacts. *Frontiers in Ecology and the Environment*, *11*(8), 441446. https://doi.org/10.1890/120358

Pickering, C., & Byrne, J. (2014). The benefits of publishing systematic quantitative literature reviews for PhD candidates and other early-career researchers. *Higher Education Research & Development, 33(3)*, 534–548. https://doi.org/10.1080/07294360.2013.841651

Porras, L. P., Wong, G., & Chacón, I. S. (2022). Human-wildlife interactions in a major tourist destination: Manuel Antonio National Park, Costa Rica. *Biodiversitas Journal of Biological Diversity*, *23*(5). https://doi.org/10.13057/biodiv/d230520

Revollo-Fernández, D. A., Lithgow, D., Von Thaden, J. J., Salazar-Vargas, M. del P., & Rodríguez de los Santos, A. (2024). Unlocking local and regional development through tourism: Exploring the potential of agroforestry and regenerative livestock farming in Mexico. *Economies, 12(*6), 137. https://doi.org/10.3390/economies12060137

Schulte, M., Gutiérrez, G., & Lynch, J. (2020). Human-monkey interaction dynamics and their dietary impacts on central american white-faced capuchins (*Cebus imitator*) at Manuel Antonio National Park, Costa Rica. *Neotropical Primates*, *26*(1)*,* 1–9. https://doi.org/10.62015/np.2020.v26.73

Sumanapala, D., & Wolf. I (2019). Recreational ecology: A review of research and gap analysis. *Environments*, *6*(7), 81. https://doi.org/10.3390/environments6070081

Vargas, G. (2009). Turismo y Espacios Naturales Protegidos en Costa Rica: Enfrentamiento o Concertación. *Revista de Ciencias Sociales, 123-124*, 49-78. https://revistacienciassociales.ucr.ac.cr/images/revistas/RCS123_124/04VARGAS.pdf

Wallin, T. R., & Harden, C. P. (1996). Estimating trail-related soil erosion in the humid tropics: Jatun Sacha, Ecuador, and La Selva, Costa Rica. *Ambio*, *25*(8), 517–522. https://doi.org/10.2307/4314532

Weaver, D. B. (1999). Magnitude of ecotourism in Costa Rica and Kenya. *Annals of Tourism Research*, *26*(4), 792-816. https://doi.org/10.1016/s0160-7383(99)00044-4

Webb, S. E., & McCoy, M. B. (2014). Ecotourism and primate habituation: Behavioral variation in two groups of white-faced capuchins (*Cebus capucinus*) from Costa Rica. *Revista de Biología Tropical*, *62*(3), 909–918. https://doi.org/10.15517/rbt.v62i3.14064