

WILDLIFE ECOTOURISM IN PROTECTED AREAS OF THE LOWER NEGRO RIVER, BRAZILIAN AMAZON: CHARACTERIZATION, CHALLENGES, AND POTENTIALS

ECOTURISMO COM FAUNA SILVESTRE EM ÁREAS PROTEGIDAS DO BAIXO RIO NEGRO, AMAZÔNIA BRASILEIRA: CARACTERIZAÇÃO, DESAFIOS E POTENCIALIDADES

ECOTURISMO CON FAUNA SILVESTRE EN ÁREAS PROTEGIDAS DEL BAJO RÍO NEGRO, AMAZONÍA BRASILEÑA: CARACTERIZACIÓN, DESAFÍOS Y POTENCIALIDADES

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Abstract: In the last few decades, tourist interactions involving wildlife, one of the activities that distinguishes ecotourism, have attracted many fans in various regions of the world. This article maps, characterizes, and presents the challenges and potentials of wildlife ecotourism in protected areas of the Lower Negro River, in the Brazilian Amazon. Through data collection in the field, seven enterprises were visited and tourist interactions with twelve different species of wildlife were recorded. The activities that visitors engage in vary according to the species they are interacting with, but include watching the animals, offering food, physical contact (petting or holding the animals), and getting into the water with them. The recorded species include the Amazon River dolphin (*Inia geoffrensis*), the Woolly monkey (*Lagothrix lagotricha*), and the Bald uakari (*Cacajao calvus*), which are on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Despite the negative impacts of these activities, they help create income for the host communities, increase the public use of protected areas, and raise awareness among visitors regarding the conservation of species and their habitats.

Keywords: negative impacts; tourist interactions; threatened species; visitation.

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Resumo: Nas últimas décadas, interações turísticas com espécies da fauna silvestre, uma das atividades desenvolvidas no ecoturismo, têm agregado adeptos em várias regiões do mundo. Este artigo apresenta o mapeamento, a caracterização e os desafios e potencialidades do ecoturismo com fauna silvestre em áreas protegidas do Baixo Rio Negro, na Amazônia brasileira. Através de coleta de dados em campo, foram visitados sete empreendimentos e registradas interações turísticas com 12 espécies. As atividades desenvolvidas pelos visitantes variam de acordo com a espécie foco e incluem a observação dos animais, oferta alimentar, contato físico (tocar ou segurar nas mãos) e entrada na água. Dentre as espécies registradas, destacam-se o boto-vermelho (*Inia geoffrensis*), o macaco-barrigudo (*Lagothrix lagotricha*) e o uacari-branco (*Cacajao calvus*), presentes na lista vermelha de espécies ameaçadas da União Internacional para Conservação da Natureza. Apesar dos impactos negativos, a atividade contribui para a geração de renda nas comunidades receptoras, uso público nas áreas protegidas, e sensibilização dos visitantes para a conservação das espécies e seus habitats.

Palavras-chave: impactos negativos; interação turística; espécie ameaçada; visitação.

Resumen: En las últimas décadas, las interacciones turísticas con especies de fauna silvestre, una de las actividades desarrolladas en el ecoturismo, han sumado muchos adeptos en diversas regiones del mundo. Este artículo presenta el mapeo, caracterización y desafíos y potencialidades del ecoturismo con fauna silvestre en áreas protegidas del Bajo Río Negro, en la Amazonía brasileña. A través de la recolección de datos de campo, se visitaron siete empresas y se registraron las interacciones turísticas con 12 especies. Las actividades que realizan los visitantes varían según las especies de interés e incluyen observar a los animales, ofrecer comida, contacto físico (tocarse o tomarse de la mano) y entrar al agua. Entre las especies registradas destacan el bufeo (*Inia geoffrensis*), el mono choro (*Lagothrix lagotricha*) y el uakari blanco (*Cacajao calvus*), presentes en la lista roja de especies amenazadas de la Unión Internacional para la Conservación de la Naturaleza. A pesar de los impactos negativos, la actividad contribuye a la generación de ingresos en las comunidades anfitrionas, el uso público en las áreas protegidas y la concientización de los visitantes para la conservación de las especies y sus habitats.

Palabras clave: impactos negativos; interacción turística; especie en peligro de extinción; visitación.

INTRODUCTION

Tourism plays a key role in the sociocultural transformation of the nations, while being one of the fastest-developing industries in the World. It also contributes to economic growth by creating vocational opportunities (Geary, 2018; Sharif, 2020). Tourism has become an important economic activity and is considered one of the main sources of income, with some parts of the world relying almost exclusively on tourism activities (Santos & Santos, 2011). However, with global growth in per capita income, numbers of tourists have grown exponentially, and this growth has led to environmental degradation (Tang, 2018).

Among the various segments of the tourism industry, ecotourism is based on sustainable relationships with nature and the host communities, which are committed to conservation, Environmental Education, and socioeconomic development (Brazil, 2010). Ecotourism has specific principles, in particular, an interest in nature, contribution to environmental conservation in protected or largely untouched areas, educational and sustainable components, and the ethical nature of ecotourism experiences (Fennel, 2002; Wearing & Neil, 2014).

The rapid and uncontrolled urban growth observed in many countries, including Brazil, has contributed to a growing search for ecotourism, which has led to the promotion of alternative forms of touristic practices (Roe *et al.*, 1997; Ruschmann, 2001). Within this context, wildlife is an important tourist attraction and a valuable endogenous resource for the regions where it is present (Dias, 2011).

In the past decade, interaction between tourists and wildlife species, one of the activities developed in ecotourism, has attracted fans in various regions of the world (Vidal *et al.*, 2022), prompting tourists to travel great distances in order to see, touch, feed, or swim with wildlife species at the locations visited (Orams, 2002; Nakamura & Nishida, 2009; Molina, 2011; Puhakka *et al.*, 2011; Mustika *et al.*, 2012; Silva-Jr, 2017; Vidal *et al.*, 2017).

In the United States alone, over eighty-six million people have sought some form of interaction with wildlife, spending around seventy-six billion dollars on such activities in 2016 (USFWS, 2017). Whale watching, which consists not only of watching whales and dolphins but also feeding and swimming with the animals (Parsons *et al.*, 2003; Scarpaci & Dayanthi, 2003), attracts over 13 million visitors in 119 countries (O'Connor *et al.*, 2009). Another fast-growing activity is birdwatching, especially in the United States, the United Kingdom and the Netherlands. Globally, around three million international trips are made each year for the purpose of birdwatching (CBI, 2021).

Ecotourism involving interaction with wildlife in its natural environment has been considered a potential means of conservation. Provided it is properly planned, it can be positive; direct contact with animals attracts people's curiosity and encourages them to become more environmentally responsible, since tourism activities involving interaction with animals generally include elements of environmental education and interpretation (Orams, 1996; Newsome *et al.*, 2005; Vidal *et al.*, 2022). However, when this type of tourism is carried out without the due planning, monitoring or controls, it can have significant negative impacts, resulting in drastic changes in the behaviour of the wildlife and posing a threat to the well-being and conservation of the species (Orams, 1996; Moorhouse *et al.*, 2016).

Studies have documented changes in animal behaviour during tourist activities such as walking, diving, and boat riding. Many of these changes are related to activities that are crucial for the species, such as oviposition in sea turtles, rest and breastfeeding in sea manatees (*Trichechus manatus*), vigilance in polar bears (*Ursus maritimus*) and sea lions (*Zalophus californianus*), and socialization in dolphins (Dyck & Baydack, 2003; King & Heinen, 2003; Meletis & Harrison, 2010; Alves *et al.*, 2013; Díaz-Maestre, 2020).

Considering that there have been few studies in Brazil that diagnose and evaluate the positive and negative impacts of ecotourism, the questions arise: What are the characteristics of ecotourism focused on interaction with wildlife? and What are the challenges and potentials inherent to this tourism model? To answer these questions, this article aims to map, characterize and discuss the challenges and potential of wildlife ecotourism in the mosaic of protected areas of the Lower Negro River, in the Brazilian Amazon.

Based on field data collection and secondary data extracted from documentary sources, the article provides information that can help raise awareness among environmental managers, tourism operators and visitors, so that they can properly plan this model of interaction with the fauna in a way that contributes to visitor satisfaction, income creation for the host communities, and conservation of the species that is the focus of the tourist activities.

THEORETICAL REVIEW

The rapid growth of ecotourism places growing pressure on wildlife in areas that have been historically isolated and/or protected (Giannecchini, 1993). However, many conservationists have embraced ecotourism as an economic and social incentive for the protection of species and ecosystems, especially in developing countries, considering it as an activity that enables local economies to transition from direct or unsustainable use of wildlife (e.g. hunting and capture) to more sustainable indirect uses (e.g. watching or interacting with the animals) (Graham, 2004).

Activities involving tourist interaction with wildlife, such as watching the moment turtle eggs hatch and the hatchlings make their way to the sea, or looking for monkeys in forests, or feeding sharks and stingrays, or watching birds in their natural habitat, are highly sought-after (Nakamura & Nishida, 2009; Meletis & Harrison, 2010; Maljković & Côté, 2011; Puhakka *et al.*, 2011), and many of them are carried out in protected natural areas. Brazil distinguishes itself in this sense; the country has areas of approximately 2.5 million km² allocated to the conservation of biodiversity, preservation of natural landscapes of notable scenic beauty, sustainable use of natural resources and valorization of cultural diversity, This figure is far higher than in other countries. Around 30% of the Brazilian continental territory is covered by protected areas, whereas worldwide, only 15.8% of continental areas are under legal protection (WDPA, 2023).

Brazil is also a megadiverse country, with the highest biodiversity on the planet (ICMBIO, 2018) and with high potential for wildlife ecotourism. Strengthening the Brazilian potential, the Amazon has the largest block of contiguous rainforests and the biggest river basin in the world, characteristics that, along with its cultural wealth and diverse habitats and species, make it one of the most sought destinations for visitors from many different places of origin (Oliveira *et al.*, 2010; Macedo & Castello, 2015; Valsecchi *et al.*, 2017).

METHODOLOGY

Characterization of the studied area

The study was conducted in the mosaic of protected areas of the Lower Negro River, in the Brazilian Amazon, a region that includes two National Parks, two State Parks, three Environmental Protection Areas, one Extractive Reserve, and four Sustainable Development Reserves. In total, it covers 7,316,799 hectares, comprising one of the biggest blocks of protected areas in the world (ICMBio, 2017).

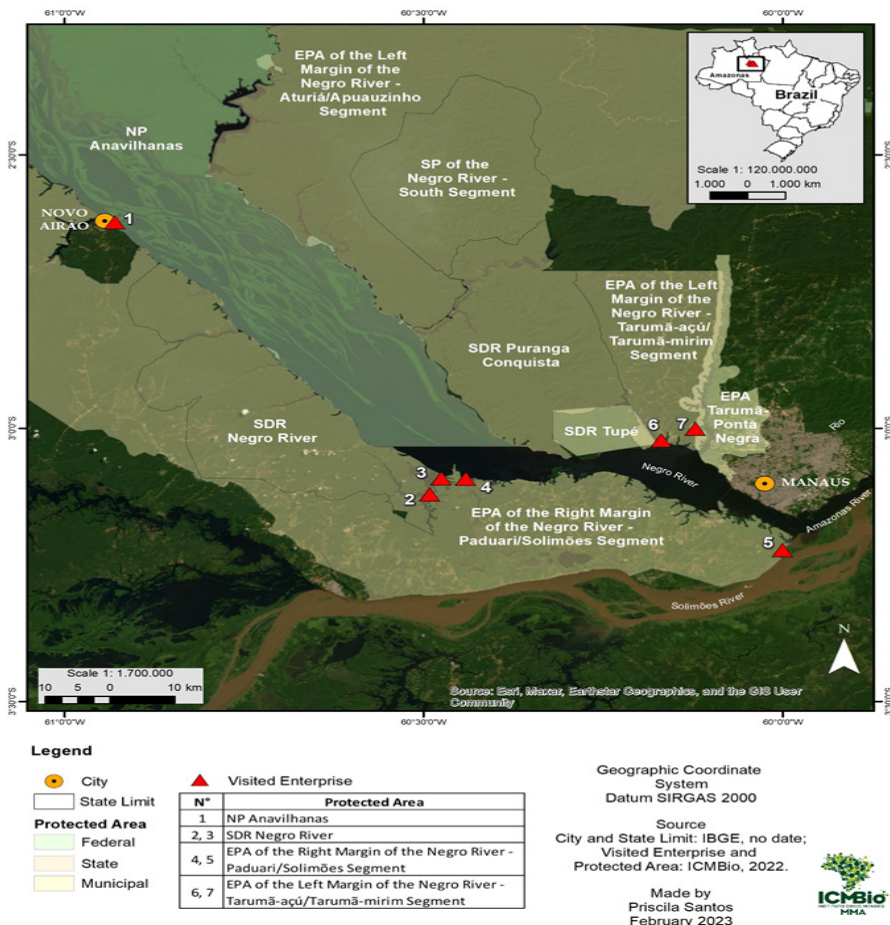
The average annual temperature in the regions is 25° C, and annual rainfall is around 2,500 mm, unevenly distributed throughout the year, with a rainy season from November to May (Cintra et al., 2007). The climate is tropical rainforest – Af, according to the Köppen classification (ICMBio, 2017).

The most representative forest formations of the region are meadows (*campinaranas* and *campinas*), the upland (*terra-firme*) and backwater-flooded forests (*igapó*), an ecosystem that is highly dynamic due to the seasonal variation in the level of black waters, rich in humic acids that give the water its dark colour (Oliveira & Daly, 2001; Pezzuti et al., 2010; ICMBio, 2017).

Data collection

Primary data was collected through field visits to seven enterprises previously identified as offering visitors activities in which they can interact with wildlife, within the mosaic of protected areas of the Lower Negro River. Of the visited enterprises, one is located within the Anavilhanas National Park, a federal integral protection area, and six are located in State sustainable use protected areas, the Environmental Protection Area of the Right Bank of the Negro River – Paduari/Solimões Segment, the Negro River Sustainable Development Reserve, and the Environmental Protection Area of the Left Bank of the Negro River – Tarumã-açu/Tarumã-mirim Segment (Figure 1).

Figure 1 - Visited enterprises and their locations in protected areas of the Lower Negro River, Brazilian Amazon.
Legend: NP=National Park; EPA= Environmental Protection Area; SDR= Sustainable Development Reserve.



Source: Prepared by the authors.

Considering criteria present in other research involving ecotourism with wildlife (Doan, 2013; D’Cruze *et al.*, 2017; Ramón & Mooser, 2018), during the visits to the enterprises, information was collected on the following categories: the animals that are focus of the touristic interactions (species, number of tourists interacting with each species, activities carried out with the species), characterization of the enterprises (protected area, environment in which it is situated, primary purpose of operation), and challenges (deforestation, pollution, use of non-native species, risk of accidents during interactions) and potential benefits (strategies for mitigating impacts, environmental education and awareness-raising activities) related to the species that are the focus of tourist interactions and to visitors. These data, entered in a field notebook and accompanied by photographic records, were obtained through informal talks with the people responsible for the enterprises and through the direct observation of the environment and the interaction dynamics between visitors and wildlife.

For all the species recorded, their taxonomic classes were identified (mammals, birds, reptiles, amphibians, fish) and their conservation statuses obtained by consulting the red list of threatened species of the International Union for the Conservation of Nature – IUCN.

After collecting the data in the field, the results were analysed and interpreted. This consisted of organizing the material following the respondents’ statements, classifying the qualitative and quantitative data, drawing up tables and graphs, and analysing them alongside the theoretical references. The primary data were also complemented with secondary data extracted from document sources (ordinances, normative instructions) made available by the institutions that manage state protected areas (Secretary of State for the Environment –SEMA), as well as federal ones (Chico Mendes Institute for Biodiversity Conservation – ICMBio) where the study was conducted.

RESULTS

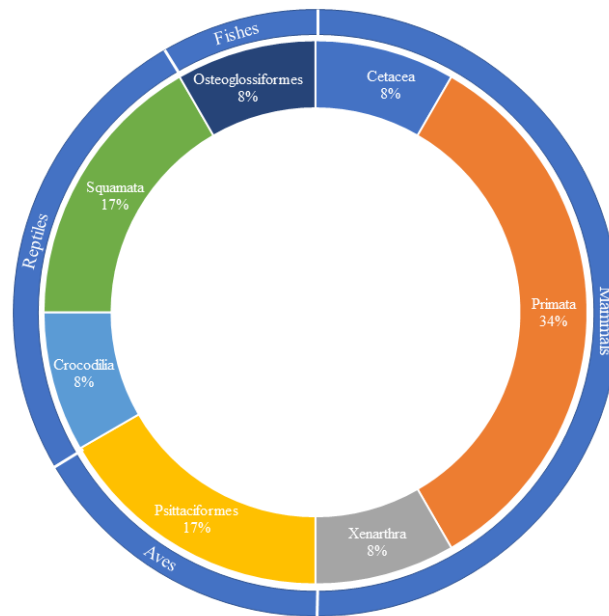
Characterization of the species that are focus of touristic interactions

In the seven enterprises visited, tourist interactions with twelve wildlife species were recorded (Table 1). These were distributed into seven orders (Figure 2) belonging to the classes of mammals, birds, reptiles, and fish. The visitors’ activities varied, depending on the species of focus, and included watching, feeding, touching or stoking, and getting into the water with the animals. Among the recorded species, we highlight the Amazon River dolphin (*Inia geoffrensis*), the Woolly monkey (*Lagothrix lagotricha*), and the Bald uakari (*Cacajao calvus*), included in the IUCN red list of threatened species (da Silva *et al.*, 2018; Stevenson *et al.*, 2021; Aquino *et al.*, 2022).

Table 1 - Species focus of wildlife ecotourism in protected areas of the Lower Negro River, Brazilian Amazon.

Common name	Species	Type of interaction	Conservation status
Amazon River dolphin	<i>Inia geoffrensis</i>	Watching, feeding, physical contact, getting into the water	EN
Woolly monkey	<i>Lagothrix lagotricha</i>	Watching, feeding, physical contact	VU
Bald uakari	<i>Cacajao calvus</i>	Watching, feeding, Watching, feeding, physical contact	VU
Squirrel monkey	<i>Saimiri sciureus</i>	Watching, feeding, Watching, feeding,	NT
White-fronted capuchin	<i>Cebus albifrons</i>	Watching, feeding, offering food,	NT
Three-toed sloths	<i>Bradypus variegatus</i>	Watching, feeding, offering food,	NT
Pirarucu	<i>Arapaima gigas</i>	Watching, feeding,	NT
Red-macaw	<i>Ara chloropterus</i>	Watching, physical contact	NT
Caninde-macaw	<i>Ara ararauna</i>	Watching, physical contact	NT
Common caiman	<i>Caiman crocodilus</i>	Watching, physical contact	NT
Jiboia	<i>Boa constrictor</i>	Watching, physical contact	NT
Green anaconda	<i>Eunectes murinus</i>	Watching, physical contact	NT

Legend: EN=Endangered; VU=Vulnerable; NT=Non-threatened. Source: Prepared by the authors.

Figure 2 - Classes and orders of species focus of wildlife ecotourism in protected areas of the Lower Negro River, Brazilian Amazon.

Source: Prepared by the authors.

The Amazon River dolphin was the species used in most of the enterprises, with all five saying they used this species. This was also the species with most individuals involved in touristic interactions, 69 in total (Table 2).

Table 2 - Number of individuals per species and enterprises that uses the species in wildlife ecotourism in protected areas of the Lower Negro River, Brazilian Amazon.

Species	Enterprises using the species	Number of individuals recorded
<i>Inia geoffrensis</i>	1, 2, 3, 4, 6	69
<i>Lagothrix lagotricha</i>	7	32
<i>Cacajao calvus</i>	7	1
<i>Saimiri sciureus</i>	4	7
<i>Cebus albifrons</i>	4	7
<i>Bradypus variegatus</i>	5	1
<i>Ara chloropterus</i>	5	1
<i>Ara ararauna</i>	7	1
<i>Caiman crocodilus</i>	5	1
<i>Boa constrictor</i>	5	1
<i>Eunectes murinus</i>	5	1
<i>Arapaima gigas</i>	2	7

Source: Prepared by the authors.

Characterization of enterprises, challenges and potentials

In the Anavilhanas National Park, in municipality of Novo Airão, there is an enterprise that promotes interaction with the Amazon River dolphin. According to the owner of the enterprise, interactions with the dolphins first began here in 1998, when her daughter started to feed one of the animals that frequented the waters around her floating restaurant, which is moored on the right bank of the Negro River, alongside the main urban beach of the city of Novo Airão. Since then, the interactions with dolphins have become very popular, and the enterprise has become one of the main tourist attractions of the city.

Every day, except Mondays, eight sessions are conducted when food is offered to the dolphins and visitors can watch and touch the animals (Figure 3). Visitors are not allowed to get into the water, and only the employees of the enterprise can feed the dolphins, reducing the risk of accidents involving porpoises (bites and other injuries, or transmission of zoonoses). The interactions are preceded by a lecture, which gives the visitors information about the biology of the Amazon River

dolphins, beliefs related to these animals, and the main threats to the species. Since it is located in the urban area of Novo Airão, accessible by both river and road, the enterprise is close to potential sources of negative impacts for the dolphins, such as the high traffic of boats and effluents discharged into the water.

Figure 3 - Visitors watch as food is offered to Amazon River dolphins in enterprise located in the Anavilhanas National Park.



Photo: Vidal, M. D.

In the Negro River Sustainable Development Reserve, on the right bank of the Negro River, in the municipality of Iranduba, there are two other enterprises that offer opportunities to interact with the Amazon River dolphin. One of these enterprises is a floating house located at the mouth of the Acajatuba River (a region locally known as the Lago de Acajatuba, or Acajatuba Lake), a tributary of the Negro River, where visitors can watch the dolphins being fed, touch the animals, and get into the dark waters of the Negro River alongside them. Running since 2006, the enterprise modelled its activities based on the floating dolphin interaction that operates in Anavilhanas National Park. In this enterprise, we also registered touristic interaction with pirarucus kept in captivity. During this activity, the visitors “fish” for the pirarucus, which are kept within a floating tank, continuously filled by water from the Negro River. Small fish are tied to end of a string attached to a wooden rod (no hooks are used to tie the bait). The rod is then thrown into the water to attract the pirarucu, a predator fish, which bites on the bait and is hauled out of the water so that the visitor can see it (Figure 4). According to the owner, the pirarucus were legally acquired for commercial breeding, and the agency responsible for administering the protected area is aware of the tourist activities carried out there. The visitors are not given any information about the biology or conservation aspects of the pirarucu.

Figure 4 - Visitor's interactions with pirarucu at an enterprise located in the Negro River Sustainable Development Reserve.



Photo: Vidal, M. D.

The second enterprise in the Sustainable Development Reserve is also a floating house, but it is located on the bank Negro River. According to the owner, the tourist activities of interaction with Amazon River dolphins began in 2006, and techni-

cians of the National Institute of Amazon Research – INPA go there regularly to monitor the dolphins, reporting back to the owner and his family with information about the animals

Both enterprises located in the Sustainable Development Reserve of the Negro River provide information on the biology and conservation of dolphins for visitors. However, because visitors are allowed to enter the water when offering food to the dolphins, there is a risk of transmission of zoonosis, dolphin bites, and injuries caused by impacts with these animals. Due to their proximity to small urban centres (rural communities), there are potential threats of dolphins becoming caught in fishing nets. Access to both enterprises is by river only.

Within the Environmental Protection Area of the Right Bank of the Negro River – Paduari/Solimões Segment, which covers part of the municipalities of Iranduba, Manacapuru, and Novo Airão, we visited a sizable hotel in the middle of the forest. Since 2005, visitors to the hotel have been able to watch food being offered to the Amazon River dolphins, touch the animals, and get into the water with them. This activity takes place from a floating platform located at the mouth of the Ariaú River, a tributary of the right bank of the Negro River. Visitors and hotel guests can also have direct contact with squirrel monkeys and white-fronted capuchins, that frequent different areas of the enterprise. Despite the signs asking people not to feed the animals, it was common to see the monkeys eating food offered by guests or visitors. Direct contact with the animals increases the risk of transmission of zoonosis, bites, and injuries caused by impact with these animals. The enterprise is located far from potential sources of impact to the animals, and is accessible only by river.

Also in the Environmental Protection Area of the Right Bank of the Negro River – Paduari/Solimões Segment, there is a group of floating houses within Januari lake, in the municipality of Iranduba, close to the meeting of the waters from the Negro and Solimões rivers. While visiting one of these houses, we saw animals being kept in captivity to be shown to visitors (Figure 5). Visitors could also hold the animals and, depending on the species, feed them, as in the case of the three-toed sloths. This direct contact between wild animals and visitors exposes both to the risk of transmitting pathogenic microorganisms. The enterprise is accessible by river only, and due to the densification of the surrounding floating houses, the water environment is suffering the impact of untreated wastewaters.

Figure 5 - Visitor's interactions with (A) jiboia, (B) common caiman, and (C) three-toed sloth in enterprise located in the Environmental Protection Area of the Right Margin of the Negro River – Paduari/Solimões Segment.



Photo: Núñez, L.

In the Environmental Protection Area of the Left Bank of the Negro River – Tarumã-açú/Tarumã-Mirim Segment, in the municipality of Manaus, two enterprises were visited. The first was a floating house located on the left bank of the Tarumã-Mirim River, where visitors can feed the Amazon River dolphins, touch them, and get into the water with them. No information about the biology or conservation of the dolphins was given for visitors when interacting with the animals. According to the owner of the enterprise, the interactions with dolphins first started in 2009, after observing the experience of the enterprise at Novo Airão. Access to the enterprise is by river only, and due to its proximity to small urban centres (rural communities), there is the potential threat of dolphins becoming caught in fishing nets.

The second enterprise is a hotel, set in the forest on the right bank of the Tarumã-açu River. Connected to the hotel since 1991, there is a space known as the “monkey forest”. Here, the monkeys are fed twice a day, and guests and visitors can take photos, pet the monkeys, and offer them fruits and vegetables (Figure 6). Information on the biology and conservation of the species is provided for the visitors. The monkey forest also has areas where it takes in and treats animals brought in by people and institutions, including government environmental bodies, such as the Brazilian Institute for the Environment and Renewable Natural Resources – IBAMA. Due to its location, close to the urban expansion area of the city of Manaus, deforestation and hunting pose potential threats to the animals.

Figure 6 - Visitor's interaction with woolly monkey in enterprise located in the Environmental Protection Area of the Left Margin of the Negro River – Tarumã-açu/Tarumã-Mirim Segment.



Photo: Vidal, M. D.

DISCUSSION

Feeding animals

The activities of interactive tourism with Amazon River dolphins were first organized in the Anavilhanas National Park in 2010 and since then, have been monitored by the ICMBio. The active administration of tourism focused on feeding dolphins has reduced the negative effects of this model of tourism significantly, and it has been creating important information for the administration of public use in this protected area (Vidal *et al.*, 2017).

However, the promotion of tourism with Amazon River dolphins in Anavilhanas triggered the creation and establishment of five other similar enterprises in the Lower Negro River, all located within state protected areas (Vidal *et al.*, 2021a). Despite the publication, in 2018, of Resolution no. 28 of the State Environment Council, which established guidelines and procedures to be observed during the authorization and development of interactive tourism with dolphins in the state of Amazonas (Vidal *et al.*, 2021a), what is seen in practice is an excess of enterprises offering tourist interactions with dolphins in the state protected areas of the Lower Negro River. Some of these enterprises disregard the norms established for this model of wildlife tourism, putting the wellbeing of dolphins and the safety of visitors at risk, as there have been frequent reports of bites and other related accidents, with too many people interacting with the dolphins and a disregard to the amount of food offered, which should be no more than 1 kg/day/animal

Another issue is the close proximity between enterprises 2, 3 and 4, of which offer interaction ecotourism with Amazon River dolphins, and are all located within 3 kilometers of each other. As a result, some of the dolphins frequent more than one enterprise, resulting in excessive food intake and a probable overestimation of the total number of animals that frequent these enterprises. Around two years after the collection of data for this study, enterprise 4 ceased its activities. The same happened with enterprise 6, the only one located on the left bank of the Negro River that offered activities of interaction with Amazon River dolphins to visitors.

The other interactions between visitors and wild animals (pirarucus, monkeys, and three-toed sloths) that involve feeding followed no specific guidelines to monitor and ensure the animals' wellbeing, the improvement of the services provided, or the safety of the visitors in the regions of the Lower Negro River.

In the specific case of touristic interactions with pirarucu, besides the use of the fish for tourism purposes, despite having obtained authorization for commercial breeding, there is a risk of injury both for visitors and the fish. For the pirarucus, there may be injuries caused by the forced return of the bait from its stomach and by ingesting part of the rope, which could lead to injuries of the stomach and pharynx; while for visitors, there is a risk of potentially serious injuries from the wooden fishing rods, especially if they break due to the strength needed to haul the fish out of the water (Paschoalini & Barbosa, 2016). Another aspect indicated by studies related to the catch-and-release practice (Petreire Jr., 2014; Alves Junior et al., 2020), and with calls for more in-depth analysis, with lines of the discussion under two perspectives, (i) the pragmatic one, which assesses whether, and how the activity compromises the health of the fish and the propagation of their genes; and (ii) the ethical one, whereby the wellbeing of the fish depends on the lack of pain.

The planning and administration of tourism should consider commercial intentions and studies on the biological impacts of the activity with the wildlife, besides creating guidelines and norms that are coherent with the principles of sustainability (Brumatti, 2013). In the state of São Paulo, Decree FF/DE no. 324/2020 regulates the practice of primate watching within the protected areas administered by the Forest Foundation. Likewise, watching medium and large mammals in the wild in the state of Mato Grosso do Sul is regulated by Resolution no. 08/2015. In all these normative instruments, it is forbidden to offer food for the purpose of attracting the animals or increasing the chances of spotting them, or to encourage them to remain in a certain locality.

In the Iguazu National Park, in the South of Brazil, for many years visitors offered food to coatis (*Nasua nasua*). The foods offered were very diverse (bread, biscuits, popsicles) and were not part of the natural diet of the coatis, posing risks for the animals' health and a danger for visitors, which ended up being bitten by the coatis (G1-PR, 2016). In response, the ICMBio, the administering body of the National Park, prohibited feeding the animals. Even so, it is still common to see coatis being fed by visitors, or even coatis snatching food from visitor's hands or bags.

Potential transmission of diseases

In the protected areas of the Lower Negro River, close encounters between humans and wild animals, such as feeding, stroking and even hugging the animals, expose both animals and visitors to the risk of contamination by viruses, fungi and bacteria, some of which can be fatal.

Amazon River dolphins are commonly affected by a bacterial disease known as "golf ball disease", which causes dermatitis and panniculitis in the animal, affecting several organs, especially the lungs (Song et al., 2017). Despite there being no records of transmission of these bacteria from the dolphins back into humans, it is an important issue from the point of view of public health and the animals' wellbeing, and further studies are needed on this theme. The dolphins are also susceptible to respiratory tract infections, including pneumonia. Thus, contact with humans can pose a risk of contamination for these animals, leading to population decline (Rodrigues et al., 2018).

Herpes, caused by the HHV-1 virus, is a benign condition for humans but it can be lethal for primates, especially small ones (Casagrande et al., 2014). In Africa, one of the most concerning negative impacts of ecotourism involving interactions with large primates is the potential transmission of diseases from humans (Boesch, 2008).

Conversely, diseases can also be transmitted from wild animals to humans. Covid-19, the illness caused by the new coronavirus (SARS-CoV-2) led to a great number of hospitalizations and deaths (Freedman & Wilder-Smith, 2020; Hui et al., 2020). It is believed that SARS-CoV-2 virus was initially transmitted to humans who had handled and consumed pangolins and bats (Neupane, 2020). Similarly, the Middle East Respiratory Syndrome (MERS), a zoonotic disease that can be lethal for humans, is transmitted through contact with camels (Azhar et al., 2019). Hepatitis A, another viral disease, infects primates naturally, without any apparent clinical signs (Andrade, 2002), but it causes significant harm in humans.

In the metropolitan region of Manaus, the most populated area of the Lower Negro River, infection by cytomegalovirus, a micro-organism present in many wildlife species (Staczek, 1990), tends to be more common than in other Brazilian contexts (Santos, 2017). Although in most immunocompetent people, the cytomegalovirus is responsible for asymptomatic infection, in immunocompromised patients the infection represents an important cause of morbidity and mortality (Mendrone Júnior, 2010).

Introduction of non-native species

The situation of the Woolly Monkey (*L. lagotricha*) and Bald Uakari (*C. calvus*) recorded at the enterprise located in the Environmental Protection Area of the Left Bank of the Negro River – Tarumã-açú/Tarumã-mirim Segment is concerning. The geographical distribution of these two primate species does not include the left bank of the Negro River, these being species that have been inappropriately introduced to the area of the enterprise. The presence of these non-native primates in the locality, with their consequent reproduction and dispersion to nearby areas, poses an imminent risk to other naturally occurring species in the region, including the pied tamarin (*Saguinus bicolor*), classified as Critically Threatened by the IUCN red list (Gordo *et al.*, 2021). Among the risks, we highlight the competition for food, potential spread of diseases, and local exclusion due to the competition for habitat, factors that have been identified in studies on other primate species (Boesch, 2008; Sobroza *et al.*, 2021).

Within this context, the most notable case in Brazil includes the non-native common marmoset (*Callithrix jacchus*), which, after decades of illegal trafficking, now inhabits almost all the urban and rural areas of the country's Southeast, leading to a significant impact on prey populations, especially birds (Cunha *et al.*, 2006). There is also a very high risk of hybridization with native species, as also occurred with the introduction of *C. jacchus* in the Brazilian Southeast. By creating fertile hybrids with the black-tufted marmoset, *C. penicillata* (Malukiewicz *et al.*, 2015), they threaten native marmoset and tamarin populations, such as the golden lion tamarin (*Leontopithecus rosalia*). Therefore, there is legitimate concern with sheltering non-native species from one area of the Amazon in another area, which can lead to introductions with high risk of hybridization for native primate populations.

Illegal capture and keeping in captivity of fauna

One of the destinations most offered by tourism agencies for visitors at the Lower Negro River is the Janauari Lake. About an hour far from the city of Manaus, the capital of Amazonas, the Janauari is located close to part of the Amazon river where the waters of the Negro and Solimões rivers come together. In this area, many species of fauna are illegally captured by local inhabitants and kept in captivity without authorization from the responsible environmental agencies (D'Cruze *et al.*, 2017), in order to be exhibited to visitors. Many of these animals are subjected to many hours of handling by tour guides and visitors (Vidal *et al.*, 2022).

Most tourists who travel to the Amazon region expect and hope to see an abundance of wildlife in the places they visit, and are often disappointed to discover that certain species are difficult to spot (Charity & Ferreira, 2020) due to the dense forest, the low numbers of large animals, and the scarcity of some species. Therefore, keeping wild animals in captivity to be shown to visitors, despite being illegal, is a common activity at Janauari Lake. The disregard for environmental laws and the degrading situation of the animals go back many years. In 2016, IBAMA imposed fines during inspection actions in the region, and seized wild animals kept in captivity (IBAMA, 2016). In 2018, the non-governmental organization World Animal Protection filed complaints with the Amazonas Federal Public Ministry regarding the irregular keeping in captivity and abuse of animals involved in tourist interactions in Manaus and the surrounding areas, including the Janauari Lake. The complaints were discussed at a public hearing, which led to a series of recommendations for companies and governmental agencies to fit ecotourism into the environmental legislation, including prohibiting tourism operators from promoting physical contact with wild animals, under penalty of a daily fine (Fonseca, 2018).

Even though in the Brazilian Amazon live animals (especially parrots and many primate species) are often captured and kept as pets (locally known as "xerimbabos"), a cultural tradition inherited from indigenous peoples (Charity & Ferreira, 2020), the capture and keeping in captivity of wildlife in the Janauari region may be also contributing to the illegal sale of these animals, acting as a source of income for the local inhabitants. It is known that the illegal sale of wild animals is a criminal activity that takes place in many countries around the world, but it is especially rife in vulnerable rural communities (Destro *et al.*, 2019), like those in the Janauari region.

Potential benefits of wildlife ecotourism in the Lower Negro River

Ecotourism through interaction with wildlife has huge potential to increase public use in protected areas, promote the creation of jobs and income, and raise visitors' awareness for the conservation of species and their habitats. Provided they are properly planned and monitored, touristic interactions with wildlife in the mosaic of protected areas of the Lower Negro River can be positive, as direct contact with animals attracts people's curiosity and increases their knowledge, making it an important tool for environmental awareness. Many animals that are the focus of tourism, such as the Amazon River dolphins, and monkeys, are also charismatic and can potentially be used as flagship species, contributing to the conservation of less charismatic species, or those with less emotional appeal (Vidal et al., 2017). By interacting with these charismatic animals, visitors may present emotional responses, such as a concern for their conservation, especially of those threatened with extinction, encouraging financial and political support for their conservation (Vidal et al., 2022).

In protected areas of South Africa, charismatic wildlife species improve the touristic experience, the most sought after species by visitors being lions (*Panthera leo*), leopards (*Panthera pardus*), and African elephants (*Loxodonta africana*) (Cousins et al., 2008; Maciejewski & Kerley, 2014). In Tanzania and Uganda, watching chimpanzees (*Pan troglodytes*) and gorillas (*Gorilla sp.*) used to human presence is one of the main activities of the ecotourism in protected areas (Nakamura & Nishida, 2009; Van Der Duim et al., 2014). This form of interaction with wildlife is considered positive, as it provides an alternative income for local inhabitants who would otherwise use forests for agriculture, logging, and to hunt wildlife species for feeding, including large-sized monkeys (Nakamura & Nishida, 2009). In Kenya, lions, elephants, and giraffes (*Giraffa camelopardalis*) attract millions of tourists each year, creating employment and income (Morand, 1994). In Africa, the economic gains from ecotourism provide an important source of resources, benefitting local inhabitants (Nakamura & Nishida, 2009) and helping combat animal trafficking, restore habitats, and reduce the harm caused by wildlife species (Mossaz et al., 2015). Something similar occurs in Indian national parks, where tiger-watching (*Panthera tigris*) ecotourism is one of the main motivations for tourist visits and an important source of resources for the conservation of these cats (Karanth et al., 2012).

In Brazil, some protected areas are renowned destinations for those seeking to interact with wildlife. Abrolhos National Park receives thousands of visitors each year, hoping to see the migration of the humpback whale (*Megaptera novaeangliae*) for reproduction, and at Fernando de Noronha National Park, spinner dolphins (*Stenella longirostris*) and different species of sea turtles can be observed (Vidal et al., 2021b). In these areas, the awareness promoted by responsible and conscientious visitation contributes to the conservation of the species. In the Brazilian Pantanal (wetlands), both inside and outside the protected areas, wildlife-watching tourism combines its activities with the local culture, considering that it is an income alternative that adds value to rural properties and creates employment, income, and qualification, especially for women (Tortato et al., 2021).

FINAL CONSIDERATIONS

Recognizing and valuing the environmental, social, and biological characteristics of each region through activities in which tourists can interact with wildlife can help creating income, raise awareness among local inhabitants and visitors, and protect the species and their habitats.

Several negative factors were identified in the wildlife-interacting ecotourism in the mosaic of protected areas in the Lower Negro River, notably, the spread of enterprises offering wildlife interactions based on feeding, illegal capture and keeping in captivity of wildlife, the transportation of non-native species, and the associated risks for the indigenous fauna, such as viral, fungal, and bacterial zoonosis, which are still understudied. Actions of organization and monitoring are therefore needed, to mitigate these negative factors. However, regulating measures must consider the fact of not imposing inadequate restrictions on the non-extractive use of wildlife by ecotourism, under the risk of reversion to lethal (hunting) or degrading uses (irregular captivity, animal trafficking).

Despite the existence of a growing demand for wildlife ecotourism in protected areas over the last years, and the high potential for this tourism model in the Amazon, this theme is still little discussed or addressed in the academic and scientific spheres, or by public policies. There is still a great need for proper planning, execution, monitoring, and administration of interactions between tourists and fauna, in order to mitigate significant negative impacts and maximize the benefits of this tourism model. Therefore, it is imperative to conduct deeper, more participative, and long-term studies that will contribute to the administration of protected areas, the wellbeing of wildlife, the satisfaction of visitors and the creation of income in the host communities.

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