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Understanding visitors' experiences in Protected Areas through Social Media posts in Brazil

Entendendo as experiências dos visitantes em Áreas Protegidas por meio de publicações em Mídias Sociais no Brasil

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ABSTRACT: Social media is used as a tool to monitor and manage visitor use in Protected Areas (PAs). While PAs are primarily designed to conserve ecosystems, they also play an important role in promoting human well-being through ecotourism in areas that allow visitation. The objective of this study was to analyze the provision of cultural ecosystems services (CES) carried out by Brazilian PAs, through content analysis of social media photos and videos. In total, 2,147 posts were analyzed, 1,001 on Instagram and 1,146 on Facebook. The most frequently recorded attractions were landscapes (47.1%) and water bodies (27%). Although there were differences among biomes: in the Amazon and Cerrado, water bodies were more prominent (40.5% and 40.4% of posts, respectively), whereas in the Pantanal and Pampa, animal species received greater attention (49.0% and 28.0%, respectively). Sixteen types of sports activities were identified, with hiking and cycling standing out in almost all biomes. Most visitors preferred to share individual photos or videos (40.2%), while posts featuring children (5.6%) or traditional populations (0.5%) were relatively rare. Our findings highlight patterns in visitor interests and contribute to a broader understanding of human-nature interactions, providing a basis for future research on the use of protected areas.

KEYWORDS: Conservation Culturomics; Cultural Ecosystem Services; Ecotourism; iEcology; Parks.

RESUMO: As mídias sociais são utilizadas como uma ferramenta para monitorar e gerir o uso público em Unidades de Conservação (UCs). Embora as UCs sejam projetadas principalmente para conservar ecossistemas, elas também desempenham um papel importante na promoção do bem-estar humano por meio do ecoturismo nas áreas que permitem visitação. O objetivo deste estudo foi analisar a oferta de serviços ecossistêmicos culturais (SEC) realizados pelas UCs brasileiras, por meio da análise de conteúdo de fotos e vídeos publicados nas redes sociais. Ao todo, foram analisadas 2.147 publicações, sendo 1.001 no Instagram e 1.146 no Facebook. As atrações mais frequentemente registradas foram paisagens (47,1%) e corpos d'água (27%). No entanto, houve diferenças entre os biomas: na Amazônia e no Cerrado, os corpos d'água foram mais proeminentes (40,5% e 40,4% das postagens, respectivamente), enquanto no Pantanal e no Pampa as espécies animais receberam maior destaque (49,0% e 28,0%, respectivamente). Foram identificados dezesseis tipos de atividades esportivas, com destaque para trilhas e ciclismo em praticamente todos os biomas. A maioria dos visitantes preferiu compartilhar fotos ou vídeos individuais (40,2%), enquanto postagens com crianças (5,6%) ou populações tradicionais (0,5%) foram relativamente raras. Nossas descobertas destacam padrões nos interesses dos visitantes e contribuem para uma compreensão mais ampla das interações entre humanos e natureza, fornecendo uma base para futuras pesquisas sobre o uso de áreas protegidas.

PALAVRAS-CHAVE: Culturomia da Conservação; Serviços Ecossistêmicos Culturais; Ecoturismo; iEcologia; Parques.

Introduction

Protected Areas (PAs) are designated territorial spaces (including their natural resources and jurisdictional waters), legally established to ensure the protection and maintenance of biological diversity. Their primary goal is to promote the recognition, preservation, and conservation of natural resources, ecosystems, and the biodiversity of different species and habitats (Brasil, 2000). In Brazil, PAs are classified into two main groups: Full Protection and Sustainable Use. Full Protection areas aim to guarantee the complete preservation of nature, where the consumption, collection, or destruction of natural resources and species is prohibited. Sustainable Use PAs, in contrast, seek to reconcile nature conservation with the responsible use of certain natural resources (Brasil, 2000).

Reconciling biodiversity conservation with human well-being remains one of the greatest global challenges (Halffter 2005; Ott; Bordin 2021; Schleicher, 2018). Human well-being is understood as material, physical, social, and psychological conditions, as well as autonomy and fulfillment, sustained by ecosystem services that meet basic needs (King; Renó; Novo, 2014). PAs are among the most effective strategies to safeguard ecosystems, species, and ecosystem services, while also generating multiple social and

economic benefits (Hermoso *et al*., 2016; Oldekop *et al*., 2015; Whitelaw; King; Tolkach, 2014). In addition to their role in conserving biodiversity, PAs contribute to human well-being by providing mental health benefits, opportunities for recreation, and socioeconomic gains for local communities (Buckley *et al*., 2019; Faleiro; Loyola, 2013; Naidoo *et al*., 2019). These combined functions underscore the dual importance of PAs as tools for both conservation and sustainable development.

In this context, ecotourism within PAs has grown steadily, offering unique opportunities for people to connect with nature and fostering broader support for conservation (Carvache-Franco *et al*., 2020; Castro; Galvão; Binfaré, 2018; Köhler; Digiampietri, 2021). Visitor satisfaction is often linked to factors such as scenic beauty, biodiversity, cultural features, and adequate infrastructure, while the revenues generated contribute to local and national economies (Balmford *et al*., 2015; Hermoso *et al*., 2016; Souza *et al*., 2019). Interaction with nature in PAs has been linked to positive outcomes across emotional, physical, spiritual, and social dimensions for visitors (Cunha *et al*., 2022; Haybron 2011; Sandifer; Sutton-Grier; Ward, 2015). These benefits highlight the importance of maintaining and expanding visitation opportunities, as well as integrating conservation objectives with sustainable use strategies. Therefore, PAs not only protect ecosystems but also function as spaces that enhance human well-being and drive sustainable economic development.

Brazil hosts one of the largest and most diverse networks of PAs in the world, covering 16.8% of the national territory (Brasil, 2000; Jenkins *et al*., 2015; Oliveira *et al*., 2017). These areas are distributed across six terrestrial biomes - Amazon, Atlantic Forest, Caatinga, Cerrado, Pantanal, and Pampa - each with distinct ecological features and varying degrees of protection. While the Amazon stands out with 26.4% of its area protected, other biomes, such as the Pampa, have less than 3% (Jenkins *et al*., 2015; Overbeck *et al*., 2007; Ribeiro *et al*., 2021). Despite uneven coverage, PAs in Brazil are highly effective in reducing habitat loss and safeguarding biodiversity, protecting approximately 60% of the country's vertebrate, arthropod, and angiosperm lineages (Bernardes, 2022; Carranza *et al*., 2014 Oliveira *et al*., 2017). Importantly, even small PAs play a crucial role in maintaining vulnerable mammal populations (Bissa *et al*., 2020).

In recent years, social media has become a powerful tool for monitoring human–nature interactions, giving rise to emerging approaches such as "digital conservation" or "iEcology" (Barros *et al*., 2022; Van der Wal; Arts, 2015; Wilkins; Wood; Smith, 2021). Studies have demonstrated that metrics derived from social media can serve as reliable proxies for visitation data (Levin; Kark; Crandall, 2015; Souza *et al*., 2023; Tenkanen *et al*., 2017;). Photo-based platforms have been used to identify charismatic species driving ecotourism in Africa (Willemen *et al*., 2015). Additionally, issues such as mismanagement have been identified through social media data (Hausmann *et al*., 2017). In Brazil, social media has already revealed evidence of visitation in PAs with no official records (Borges, 2022), underscoring its potential to complement traditional monitoring and inform management (Barros *et al*., 2022; Correia *et al*., 2018).

Building on this perspective, our study investigates the Cultural Ecosystem Services (CES), defined as the non-material benefits obtained from ecosystems that contribute to human well-being, including mental, physical, and spiritual health (Brasil, 2026), provided by Brazilian PAs through the analysis of social media content. Specifically, we focus on aesthetic, spiritual, educational, and recreational dimensions by examining 2,147 photos and videos posted on Facebook and Instagram. We assess the natural and anthropic features that attract visitors, such as landscapes, water bodies, biodiversity, roads, and buildings, as well as the social dimension of visitation, including group composition and sports activities. By analyzing what people post when visiting PAs, we aim to generate insights that can support management strategies, foster public engagement, and strengthen the role of cultural ecosystem services in conservation.

Materials and Methods

In this study, we adopt the official classification used by the Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of the Environment and Climate Change (MMA), which recognize six terrestrial biomes in Brazil: Amazon Forest, Atlantic Forest, Caatinga, Cerrado, Pampa and Pantanal. These biomes are characterized by great heterogeneity in terms of soils, vegetation and water bodies, which result in the development of the biological richness and diversity present in these ecosystems (Arruda *et al*., 2017).

We selected the 10 most popular PAs in each Brazilian biome, according to (Borges, 2022). These researchers analysed the popularity of all Brazilian PAs located on terrestrial biomes by counting the number of Facebook check-ins and Google reviews each PA had. This research was conducted in 2022 and can be used as proxies for visitor flow, thereby serving as a surrogate to identify the most visited and the most popular PAs within Brazilian biomes. As we have six biomes, at the end we selected 60 PAs.

While Borges (2022) used Facebook and Google reviews, we focused on photos and videos posted on Facebook and Instagram. We chose these platforms because Instagram has become one of the most popular social media platforms in recent years and, together with Facebook, represents one of the two largest platforms worldwide (Fuciu, 2019). Within Brazil, Instagram and Facebook are among the most widely used social media platforms. At the beginning of 2023, Instagram ranked second with approximately 113.5 million users, while Facebook ranked third with around 109.1 million users (Kemp, 2023).

Additionally, Google reviews were not analyzed because most of them lack photos or videos, limiting their usefulness for our objectives. Similarly, Flickr was not included because it is characterized by a user profile that prefers less charismatic and naturalistic biodiversity, with less representation of people and recreational activities (Hausmann *et al*., 2018). Furthermore, studies indicate that Instagram has significantly higher usage rates than Flickr, reinforcing its broader representativeness for this type of analysis (Tenkanen *et al*., 2017).

For each PA, thirty posts (photos or videos) were selected on Instagram and thirty on Facebook, without considering more than two posts from the same user. When the first two posts from the same user were very similar to each other, the second was replaced with a later, more distinct post. On Facebook, we searched for each PA's name in Portuguese using the "Places" filter and verified that each page corresponded to the correct PAs. On Instagram, we searched for the PA's name and selected the corresponding hashtag, as hashtags on this platform are used to group posts about the same subject or place. Additional hashtags were created based on the name of the PAs, tourist attractions, or trails within the area (Supplementary Material).

All posts were collected manually and analyzed individually in chronological order (from the most recent to older posts). Each photo or video was classified according to the defined variables (Supplementary Material) using a binary system: presence = 1 and absence = 0. Thus, when a publication displayed a certain characteristic (e.g., fauna, water body, or sports activity), it was marked as "1"; otherwise, it received a "0" for that variable. It is important to note that the same publication could be classified with more than one variable. In some PAs, both on Facebook and Instagram, fewer than 30 posts were found, and in others, no posts were available, these were excluded from the analysis. As a result, the number of analyzed posts varied among biomes. To allow for comparison, results are presented as percentages of the total number of posts for each biome.

Results and Discussion

Of the 60 PAs selected for analysis, classified as popular according to the number of check-ins rather than the volume of posted content (Borges, 2022), photos and videos were only found for 45 of them (Supplementary Material). Only for the Amazon and Atlantic Forest biomes photos and videos were found for the 10 PAs previously selected. For Cerrado we found photos and videos for eight PAs, seven in the Pampa, six in the Caatinga and five in the Pantanal. Additionally, for some PAs, fewer photos or videos were found on Facebook or Instagram than the number intended to be analysed. Therefore, with the absence of records for some PAs or smaller number of posts for others, 496 posts were analysed in the Amazon, 341 in the Caatinga, 438 in the Cerrado, 475 in the Atlantic Forest, 151 in the Pantanal and 246 in the Pampa. A total of 2,147 posts were analyzed, 1.001 on Instagram and 1.146 on Facebook, of which 1.955 were photographic records and 192 were video records.

Analysis of the photos and videos showed that landscape was the most prevalent category in posts from the PAs visited, varying across biomes, being most prominent in the Caatinga and least evident in the Pantanal (Figure 1). We emphasize that the lower number of posts recording Pantanal landscapes may be related to visitors' interest in other variables, such as the presence of fauna, which is more visible in this biome and represented half of the posts.

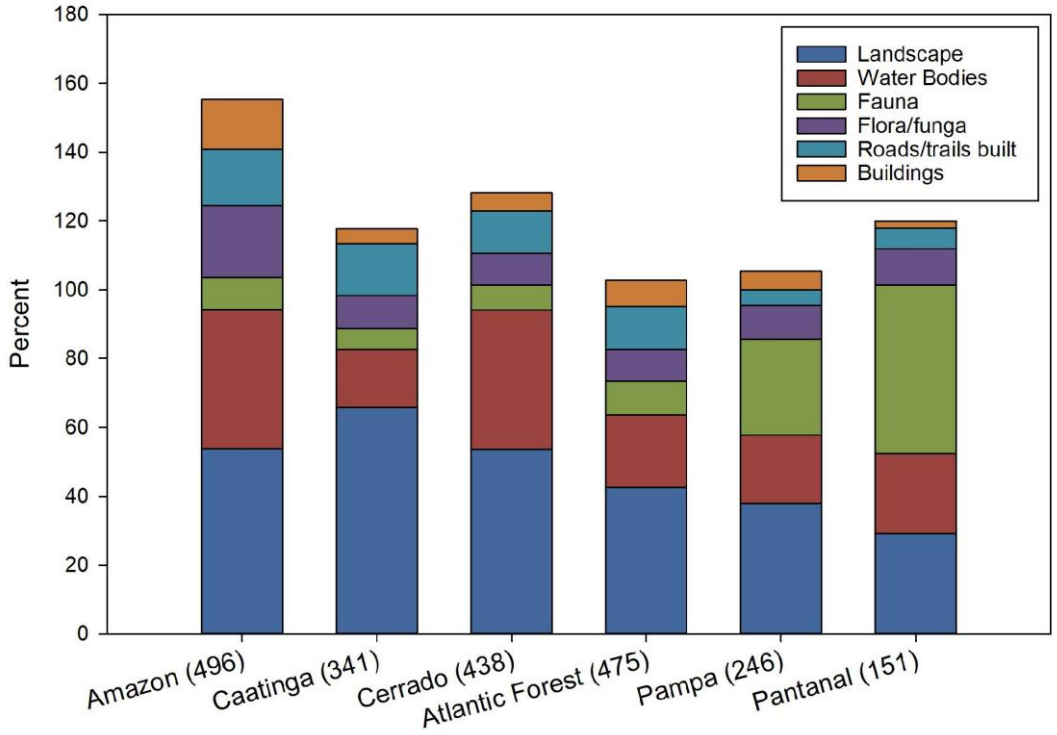


Figure 1: Characteristics recorded on social media publications in each Brazilian biome according to the number of publications in Protected Areas.
Figura 1: Características registradas nas publicações de mídias sociais em cada bioma brasileiro de acordo com o número de publicações nas Unidades de Conservação.
Source: Prepared by the authors.
Fonte: elaborado pelos autores.

This result is consistent with studies indicating that aesthetics and scenic beauty are among the predominant and most frequently shared components of CES (Ma; Furuya 2024; Smith, 2021; Tengberg *et al*., 2012). In the Caatinga, this category suggests that visitors highly value the natural scenery; however, these records largely depend on the unique characteristics of the ecosystems in each biome and the visibility of its natural elements. In this context, the sharing of photos and videos can serve as an indicator of which landscape characteristics are most valued by visitors, reflecting the specific biodiversity and visual attributes of each biome.

The second greatest interest observed in the posts was related to water bodies, with the Amazon and Cerrado biomes standing out. These results indicate that, when visiting PAs, in addition to landscapes, visitors also seek areas with rivers, lakes, waterfalls, dams, or cascades. The predominance of posts featuring water bodies in the Amazon and Cerrado regions is related to their ecological characteristics, which include extensive river basins, large rivers, and abundant biodiversity (Eva; Huber 2005; Latrubesse *et al*., 2019). The vast extent of these water resources becomes a central attraction in visitors' experiences and, consequently, in the social media content associated with these biomes. Therefore, the number of posts featuring water bodies may reflect not only the presence and wide distribution of aquatic ecosystems in

these regions but also their aesthetic and symbolic value, often associated with tranquility and scenic beauty. Similar findings have been reported in other international studies, where rivers, waterfalls, and lakes are among the main natural tourist attractions (Hausmann *et al*., 2018; Tenkanen *et al*., 2017).

However, our results suggest that this relationship is not necessarily direct. For instance, we expected a high number of fauna-related posts in the Amazon, especially featuring charismatic and emblematic species such as the pink river dolphin (*Inia geoffrensis*). Yet, we found few posts depicting fauna. This indicates that elements or species commonly encountered by visitors may generate less visual engagement.

The biome with the lowest number of posts related to water bodies was the Caatinga. Considering that the climate in this biome is semi-arid and that some rivers may disappear during the dry season, this may explain the lower number of hydrographic records on social media in this region.

Just as water bodies stood out in the Amazon and Cerrado, the fauna category was more prominent in the Pampa and Pantanal biomes. These regions are dominated by low, tussock-like open vegetation, with some scattered forest formations, which facilitates the observation of animals compared to forested biomes. Furthermore, documenting fauna on social media can be useful for mapping species occurrences (Chowdhury *et al*., 2023). However, in the results presented here, fauna occurrences were relatively low, limiting the potential of using Facebook or Instagram to obtain species records from Brazilian protected areas.

In the case of flora and fungi, the Amazon biome showed the highest proportion of posts. This biome harbors some of the greatest levels of biological diversity on the planet, with unmatched biodiversity and landscapes that attract numerous visitors (WWF, 2023). These posts demonstrate that flora and fungi play a fundamental role in the interaction between visitors and protected areas, not only due to their scenic beauty but also by arousing curiosity about vegetation and fostering a sense of connection with nature. This type of social media content, beyond indicating which species are most visible and appealing, also highlights the potential of social media for understanding human–nature interactions within protected areas.

Although natural elements stood out among the posts, the presence of infrastructure such as roads, trails, and buildings was also observed. These structures play an important role in facilitating visitor access and interaction with nature. However, the construction of trails or roads also represents an alteration of the natural ecosystem, leading to soil compaction and erosion, as well as the loss of vegetation cover, which exposes the soil directly to radiation and wind (Eisenlohr *et al*., 2013). Therefore, even though such infrastructures can enhance ecotourism in protected areas, they should be implemented with caution.

In this study, this category appeared in few records (Figure 1), suggesting that visitors tend to value natural elements more than human-made structures, a pattern consistent with several other studies. In Costa Rica, for instance, researchers found that while infrastructures can make sites more

accessible, ecological richness is what truly attracts visitors (Echeverri *et al*., 2022). Similarly, the low frequency of buildings reinforces the preference for capturing natural elements such as landscapes and biodiversity.

Regarding the people present in photos or videos, five variables were created to assess whether visitors prefer to record and share individual, group, pair, or couple photos on social media, and to analyze the presence of children and traditional populations in the posts. Among these categories, individual photos were the most frequently recorded across all biomes, totaling 949 posts. Although many PAs have playgrounds, sports areas, or other facilities designed for children, only 146 posts featuring children were found, and traditional peoples were represented only in the Amazon (Figure 2). This result highlights the desire for validation on social media and greater engagement (Kristinsdottir; Gylfason; Sigurvinsdottir, 2021). In this context, recent studies have examined personality traits, such as narcissism, and social media use to better understand behavioral patterns among users (Casale; Banchi, 2020; McCain; Campbell, 2018). Furthermore, the predominance of individual posts may reflect a search for personal connection and introspective experiences with nature, rather than collective ones.

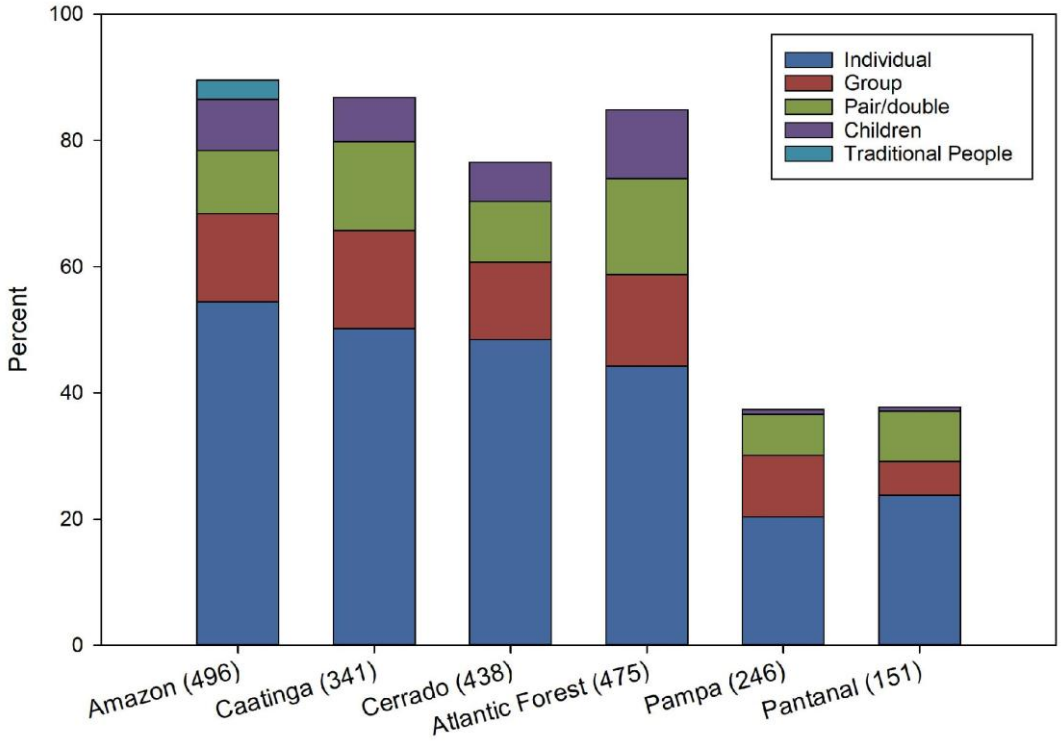


Figure 2: Percentage of posts on Instagram and Facebook that included photos/videos of individuals, pair/double, group, child or traditional population records were observed when visiting Protected Areas in the six Brazilian biomes.
Figura 2: Porcentagem de publicações no Instagram e Facebook em que foram observados registros de fotos/vídeos individuais, pares/duplas, grupos, crianças ou populações tradicionais durante visitas a Unidades de Conservação nos seis biomas brasileiros.
Source: Prepared by the authors.
Fonte: elaborado pelos autores.

Although many protected areas include playgrounds, sports facilities, or other spaces designed for children, their representation in social media posts was very low. This may be due to several factors, including the cost of traveling with children and limited accessibility to family-oriented amenities (such as cribs, extra beds, playgrounds, and children's pools). According to Ribeiro *et al*., (2023), the number of childless tourists who traveled three times per year decreased by approximately 75% after having children. This is often because parents or caregivers perceive the natural environment as risky for children. Activities such as playing by a river, climbing rocks, petting a dog, or handling wood are often associated with concerns about safety, injuries, and falls (Jidovtseff *et al*., 2022). Furthermore, studies indicate that family tourism with children increases costs, restrictions, and logistical challenges, in addition to making trips more tiring and stressful due to the need for constant routine adjustments, limitations on activities, and travel (Duarte *et al*., 2022; Tseng; Chien; Shen, 2023).

On the other hand, Sturges *et al*., (2023) demonstrated that, although parents and caregivers recognize the risks associated with playing in natural environments, they also identify multiple benefits, such as learning, autonomy, confidence, motor development, and creativity. Therefore, to increase the number of children in natural environments, it is suggested that managers invest in promoting the benefits of children visiting these areas, given that contact with nature contributes to better quality of life, cognitive development, and a reduction in respiratory problems (Cunha *et al*., 2022).

Beyond the representation of children, other social groups are also underrepresented, such as traditional and Indigenous peoples. These groups play a fundamental role in biodiversity conservation across different territories (Sandroni, 2023). However, their representation on social media was extremely low and limited only to the Amazon, creating a sense of exclusion from the planning and decision-making processes related to PAs. This reflects a representational gap regarding the way of life and practices of these peoples. According to Ricardo (2004), some federal and state PAs located in the northwest of the states of Amazonas and Roraima overlap fully or partially with seven Indigenous Territories, highlighting historical overlaps and land conflicts. Therefore, even though many traditional peoples live in remote areas, which prevents visitor's access, there is little recognition of their culture and territorial rights. For example, in Catimbau National Park, Indigenous communities had their lands reduced after the creation of PAs (Rodrigues, 2006).

Thus, much progress still needs to be made regarding the recognition of the land rights of Indigenous peoples and other traditional populations by the Brazilian population in general and, specifically, by visitors to PAs. In this context, social media can serve as a valuable tool to promote cultural recognition and appreciation, acting inclusively. However, visits to or the creation of protected areas can also generate conflicts, disrespect, and negative impacts on traditional populations, such as the degradation of cultural practices, exploitation of communities, and limited interaction with tourists (Dyer; Aberdeen; Schuler, 2003).

Regarding sports activities, visitors to the Amazon biome showed a preference for boat trips, hiking, cycling, fishing, and trail exploration. In this biome, we also observed a wide variety of aquatic activities, such as water biking, kayaking, and water trails, reflecting the strong connection between this biome and its abundant water bodies (Figure 3).

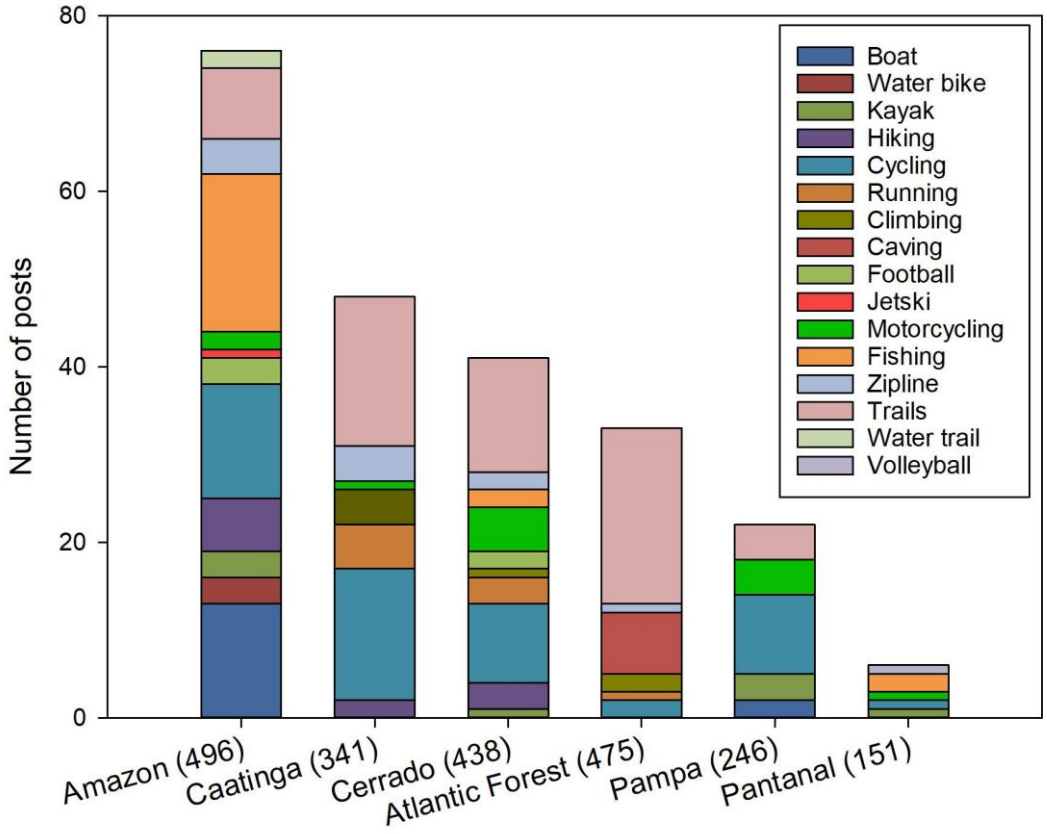


Figure 3: Sports activities carried out in Protected Areas on the six Brazilian biomes.
Figura 3: Atividades esportivas realizadas em Unidades de Conservação nos seis biomas brasileiros.
Source: Prepared by the authors.
Fonte: elaborado pelos autores.

In the Caatinga and Cerrado biomes, cycling and hiking were the most popular sports. In the Atlantic Forest, caving and hiking were the most common activities, while in the Pampa, cycling predominated. The Pantanal had the fewest posts, with fishing being the most common activity, observed in only two publications. This result may be related to limited accessibility during the rainy season and the biome's wildlife observation. Although other sports had fewer records, their presence in Brazilian PAs suggests that visitors engage in a wide range of activities to enhance their well-being and strengthen their connection with nature.

In the context of PAs, engaging in sports activities serves as a means of bringing visitors closer to natural environments. Cycling within PAs allows visitors to connect with nature, promoting both physical and mental health

benefits, especially when practiced in outdoor settings (Soldado *et al*., 2025). In addition to individual gains, activities such as cycling also contribute to reducing carbon dioxide emissions, decreasing noise pollution, and improving overall environmental quality (De Hartog *et al*., 2010; Brand *et al*., 2021). In this sense, ecotourism, combined with sports or adventure tourism, can play a fundamental role in the preservation and conservation of PAs, as visitation depends on maintaining these environments in good condition to attract and retain visitors (Azevedo, 2014). Conversely, the absence of certain sports in some biomes, such as fishing, jet skiing, and water cycling, is related to the fact that not all categories of PAs permit these activities.

Conclusion

Here we provide a comprehensive analysis of what people post when visiting a PA in Brazilian biomes. Most visitors tend to post individual photos/videos or content featuring landscapes and water bodies, suggesting that these elements are particularly significant in their experiences. The low representation of children in the posts indicates that this group is less frequently documented in social media content related to protected areas. In addition, the low presence of traditional people indicates a possible gap in how these social groups are represented in the perception of visitors, especially regarding the importance that traditional peoples have in these natural areas, playing a fundamental role in their preservation.

The high level of appreciation and the larger number of publications for certain variables in different biomes, such as water bodies in the Amazon and Cerrado and animal species in the Pampa and Pantanal, may reflect the unique characteristics of each biome. Sports activities were also very attractive and recorded by visitors in the PAs, where a variety of activities can be observed, with trekking being the most frequent, followed by cycling.

Overall, these results demonstrate patterns in visitor interests, contributing to a broader understanding of human interactions with nature in different ecological contexts. The observed patterns can also serve as a guide for future investigations and discussions on the use and management of PAs by the visiting public.

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