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Knowledge of marine mammal professionals on ecosystem services associated with the marine manatee (*Trichechus manatus*) in Brazil

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ABSTRACT

Ecosystem services are the benefits derived from the ecosystems we occupy. These services are related to biodiversity and this interaction ensures the functioning of the processes necessary for their own maintenance. This study aimed to describe and analyze social and professional variables and identify the knowledge of ecological and ecosystem services of professionals who work with the marine manatee in Brazil. National legislation lacks data about ecosystem services associated with manatees, so the familiarity of professionals with the subject becomes essential for their identification. Data were collected using forms completed autonomously by professionals who participated in the elaboration of the National Action Plan for the Conservation of Sirenia. The questionnaires were sent by email to 21 professionals from April to October 2020. Among these professionals, 15 completed and returned the form. Most respondents work at private institutions and have more than ten years' experience. No differences were observed regarding the presence of ecosystem services, that is, the respondents believe that all categories were relevant in their geographic area. We found a positive and significant correlation between pressures and threats in manatees, demonstrating that the current impacts affecting the species and its ecosystem services will remain in the future. Most respondents stated that there is a relationship between the culture of the community and the manatee. The cultural manifestations associated with the animal proved to be exclusive to some areas of occurrence, thus providing an identity for these regions. This attraction can generate income for local communities and reduce threats to the animal. Recognizing ecosystem services can help in the management of protected areas and in conducting priority actions for the conservation of the manatee.

Keywords: Biodiversity; Threats; Cultural manifestations; Tourism.

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SIGNIFICANCE STATEMENT

Information about ecosystem services can help protected areas in decision-making and support the protection and management of natural ecosystems. In recent years, there has been an increase in the identification of ecosystem services, especially those related to cultural services such as recreation, tourism and relaxation. Regarding local development, considering these services in policy information can help reduce future economic costs, as well as provide leverage for local economies and improve quality of life. In this way, we can ensure a continuous and sustainable flux of benefits for current and future generations. Our study fills knowledge gaps about the relationship of ecosystem services and manatees, as well as their interactions with the community in which they occur.

INTRODUCTION

The Millennium Ecosystem Assessment defines ecosystem services as the benefits that humans derive from their surrounding ecosystems. According to Reid et al. (2005) these services include provisioning (such as food, water, wood and fiber), regulating (which affects climates, floods, disease, waste and water quality), cultural (which provides recreational, aesthetic and spiritual benefits) and supporting (such as soil formation, photosynthesis and nutrient cycling).

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The availability of ecosystem services also varies spatially across landscapes, determined by diverse human social, political and ecological interactions (Peh et al. 2013). In many cases, people are unaware of the ecological processes that benefit them and may have different views and experiences of their relationship with ecosystem services (Preston and Raudsepp-Hearne 2017).

Biodiversity and ecosystem services are interdependent (Preston and Raudsepp-Hearne 2017) and the functioning of ecosystems depends heavily on biodiversity (Isbell et al. 2017). Thus, ecosystem functions and services are eventually shaped by their biodiversity and, consequently, as intuitively observed, they are associated with human well-being (Naeem et al. 2016). The growing loss of biological diversity, combined with the lack of recognition of ecosystem contributions to human activities, represents the main causes of ecosystem degradation.

Many species that are essential for ecosystem functioning are also susceptible to the anthropogenic factors of biodiversity loss (Isbell et al. 2017). The scarcity of data is especially acute for members of the order Sirenia, which impairs predictions on how changes to the abundance and distribution of these species are likely to impact aquatic ecosystems and, consequently, limits the scope of discussions pertaining to their conservation (Wirsing et al. 2022). Among the sirenians, the West Indian manatee (*Trichechus manatus*) is classified as vulnerable, according to the International Union for the Conservation of Nature and Natural Resources (Deutsch et al. 2008). However, Meirelles et al. (2022) detected a still drastic reduction in the current population size, with expectations of a decrease in the future. For this reason, its reclassification as "critically endangered" is recommended.

Habitat destruction and excessive hunting have severely reduced and fragmented the wild population and restricted existing subpopulations to the northern and northeastern coast of Brazil (Normande et al. 2015). Alves et al. (2016) estimated that the average population between the coast of Piauí and Alagoas was approximately 1,104 individuals in 2010. The distribution area of manatees in Brazil currently extends discontinuously along the northeast coastal region from the Oiapoque River, in the state of Amapá (4°00′ N - 51°50′ W; Luna et al. 2010) to Pontal do Peba in the state of Alagoas (10°21′ S - 36°17′ W; Lima et al. 2011a). However, before European colonization, marine manatees also inhabited the states of Bahia (16°21′ S) and Espírito Santo (20° S; Luna et al. 2008a; Normande et al. 2015; Whitehead 1978).

The assessment of ecosystem services is a comparatively new way (1990s) of conceptualizing the dynamics of human relationships with the environment (Preston and Raudsepp-Hearne 2017). Understanding how the multidisciplinary professional can evaluate these services is important for planning engagement and communication with the public. Biodiversity experts may or may not be familiar with or agree with the concepts of ecosystem services (Value of Nature to Canadians Study Taskforce 2017). In general, there is a lack of literature on ecosystem services related to aquatic mammals. Likewise, the national legislation, such as the National Action Plan for the Conservation of Sirenians (ICMBio 2011), does not include these services among their work goals. However, the management plans of some conservation units with the occurrence of the manatee mention the need to evaluate ecosystem services (ICMBio

2014 2021).

In order to fill this gap, this study aimed to describe and analyze the social and professional variables and the ecological and ecosystem services knowledge of professionals who work with the marine manatee in Brazil.

MATERIAL AND METHODS

Data collection

The National Action Plan (NAP) for the conservation of sirenians appointed thirty professionals to work together and carry out activities related to the species *Trichechus manatus*. These professionals were chosen during the preparation of the NAP (for further information on the NAP, see Baptista et al. 2019). The chosen professionals work in different institutions, such as civil society associations, companies, non-governmental organizations, government agencies and higher education institutions. Of these 30 professionals, 21 work directly or indirectly with the species, while the others work in areas such as communication or administration/finance.

We prepared a structured questionnaire with 29 questions that covered four topics, namely (1) Social and education level; (2) professional experience; (3) ecological information of the species; and (4) ecosystem services (supplementary material). The services were evaluated using a symmetric 5-point Likert scale. All questionnaires were sent and returned by email.

This research was approved regarding ethical requirements by the *Comitê de Ética da Universidade Estadual de Santa Cruz* (CAAE 03964918.0.0000.5526). An informed consent form was attached to the email and signed by the participants, containing all the necessary information in clear, objective and easy-to-understand language regarding all aspects of the research (Conselho Nacional de Saúde 2012). All the forms were submitted to the professionals from April to October 2020. Authorization to perform research inside protected areas was provided by the *Instituto Chico Mendes de Conservação da Biodiversidade* (SISBIO-ICMBio: 66890-3).

Data analysis

All statistical analyses were conducted using the R program (R Core Team 2020). One-way analysis of variance (One-way ANOVA) was used to assess the existence of differences in the researchers' knowledge of the presence of ecosystem services associated with marine manatees. The ANOVA was conducted using the "perm.oneway.anova" function of the wPerm package (Weiss 2015) and the significance of the test was estimated using the Monte Carlo simulation with 1000 randomizations. A value of $P < 0.05$ was considered significant.

The Student T-tests were used to determine whether the researchers' knowledge of the presence of ecosystem services differed in relation to their gender, level of education and institution of activity. In the T-tests, the values obtained using the Likert scale acted as the dependent variable, while information on gender, education and work institution represented the categorical factor. The analysis was performed considering each type of ecosystem service separately. The assumptions of normality and homogeneity of variance between groups were tested using the functions "shapiro.test" and "var.test", respectively, both in the Stats package (R Core Team 2020). These assumptions were met in all evaluations. The T-test was conducted using the "t.test" function in the Stats package (R Core Team 2020). Values of $P < 0.05$ were considered significant.

Pearson correlations were used to verify whether the researchers' knowledge of the presence of ecosystem services was related to their age and the length of time since graduation. Analyses were performed considering each type of ecosystem service separately.

A Pearson correlation was also used to investigate the relationship between the impacts on the marine manatee and the ecosystem services provided and observed by the researchers as already existing (pressure), and those expected to happen (threat). A negative r value indicates that the impacts currently pressuring the marine manatee populations are different from the threats predicted to happen in the future. In contrast, a positive r value indicates that the impacts currently pressuring the populations are the same impacts predicted to generate threats in the future. Likewise, an r value equal to zero indicates no relationship between these two variables.

The significance of all correlations was estimated using Monte Carlo simulation with 1,000 randomizations. Values of $P < 0.05$ were considered significant. Correlations were performed using the "perm.relation" function from the wPerm package (Weiss 2015).

Ethical aspects

The authorization to perform research inside protected areas was provided by the *Instituto Chico Mendes de Conservação da Biodiversidade* (SISBIO-ICMBio: 66890-3).

RESULTS

Professional experience of respondents

Twenty-one professionals were eligible to participate in the research, which corresponded to 70% of the total sample. Among these, fifteen professionals sent the completed questionnaire (Table 1). Regarding the profile of the respondents, the genders were equally divided between male (53.33%, $n = 8$) and female (46.67%, $n = 7$). In terms of academic training, 93.33% of professionals said they were from the area of biology and had a postgraduate degree.

With regard to length of time working in activities related to aquatic mammals, 13% of respondents said they had worked in the area for five to 10 years; 47% for 10 to 19 years; 27% for 20 to 29 years and 13% declared they had more than 30 years of experience. The places and Institutions of work of the professionals are illustrated in Figure 1.

Ecological information about *T. manatus*

When asked about the location of observation of the marine manatee, 46.7% of the respondents ($n = 7$) stated that the animals were observed within protected areas, 6.7% ($n = 1$) stated the animals were observed outside of these areas and 46.7% ($n = 7$) reported they observed the animals inside and outside the areas.

Among the respondents, 93.33% ($n = 14$) reported negative interactions between the community and the marine manatee (Figure 2). We also found a positive and significant correlation between pressure

Table 1. Social and professional variables of the responding interviewed professionals.

Variable	Frequence	Percentage
Gender	*n*	*(%)*
Female	7	46.67
Male	8	53.33
Education level	*n*	*(%)*
Graduate	1	6.67
Specialist	2	13.33
Master's degree	5	33.33
Doctorate degree	4	26.67
Postdoctoral studies	3	20.00
University graduate	*n*	*(%)*
Biologist	8	53.33
Oceanographer	3	20.00
Veterinary	3	20.00
Civil engineer	1	6.67
Institution of activity	*n*	*(%)*
Association	1	6.67
Company	1	6.67
Governmental*	3	20.00
Higher Education Institution	2	13.33
Organizations**	8	53.33

Legend: * Instituto Chico Mendes de Conservação da Biodiversidade; ** Non-governmental organization, civil society, social.

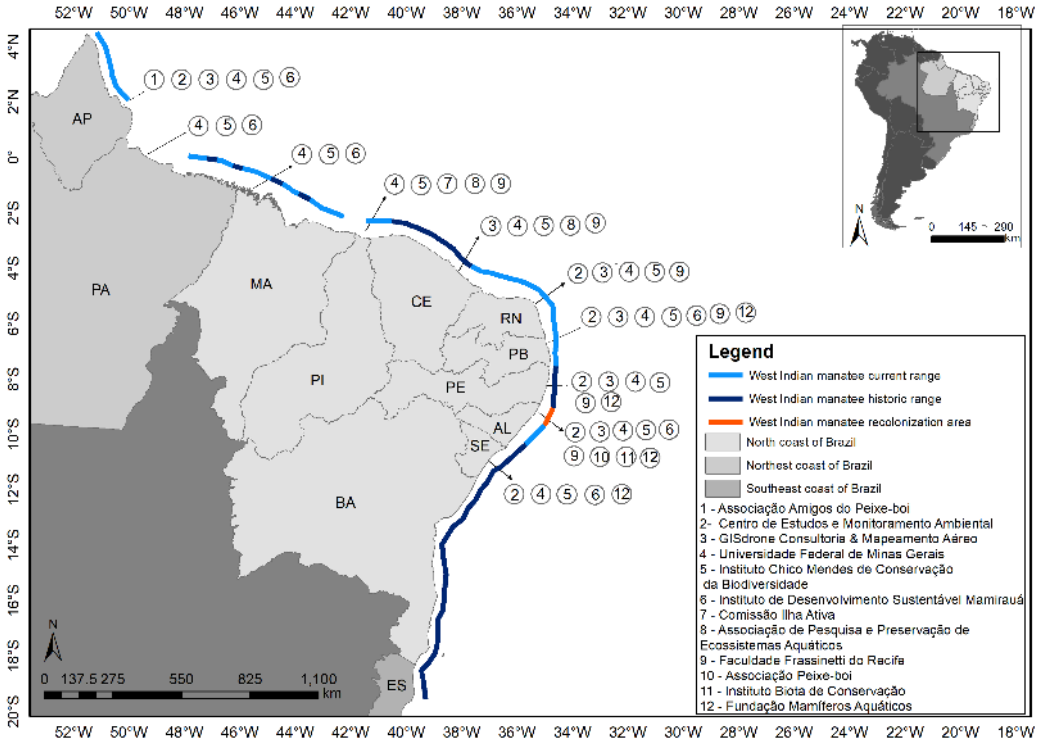

Figure 1. Institutions and geographic range of activities of professionals responsible for the National Action Plan for the Conservation of Sirenians in Brazil (contributed by Romário Oliveira de Santana).

and threat ($r = 0.88$, $P = 0.001$). Similarly, 93.33% ($n = 14$) of the respondents also mentioned the occurrence of positive interactions between the community and the animals. Among the positive interactions, the following were mentioned: 35.7% ($n = 5$) community-based observation tourism; 28.5% (n=4) educational activities; 14.3% ($n = 2$) community support in reporting sightings and rescue; 14.3% ($n = 2$) conservation actions; and 7.14% ($n = 1$) enterprises and businesses.

Ecosystem services

No differences were observed in the researchers' knowledge regarding the presence of ecosystem services associated with the marine manatee. Moreover, the knowledge of the presence of ecosystem services also did not differ in relation to gender, education and work institution, regardless of the type of ecosystem service assessed. No significant relationships were observed between the researchers' age or length of time since graduation and their knowledge of the presence of ecosystem services in their area of activity, regardless of the service category.

When asked about the public benefits of ecosystem services, 57% ($n = 13$) of the respondents stated that the beneficiaries were traditional fishing communities, followed by 26% ($n = 6$) society in general; 9% ($n = 2$) tourists and beach users; 4% ($n = 1$) local residents; and 4% stated ($n = 1$) researchers.

Regarding the existence of governmental actions for the protection of ecosystem services, 66.67% ($n = 8$) of the interviewees answered in the affirmative, while 33.33% ($n = 4$) declared the lack of protection.

Cultural ecosystem services

Sixty percent ($n = 9$) of respondents affirmed that there is a relationship between the culture of the local community and the marine manatee. Cultural events (41.67%; $n = 5$), tourism (25%; $n = 3$) and handicrafts (16.67%; $n = 2$) were mentioned as occurring in the Costa dos Corais Environmental Protection Area and in the Mamanguape River Environmental Protected Area. While fishing assistance (16.67%; $n = 2$) was reported only in the Coral Coast Environmental Protection Area. The cultural manifestations related to the marine manatee for each Brazilian state are shown in Figure 3.

Among the respondents, 73.33% ($n = 11$) recognized that the community was dependent on tourist activities related to the marine manatee. The most cited communities were Rio Tatuamunha in Alagoas (42.86%, $n = 6$) and the Mamanguape River Environ-

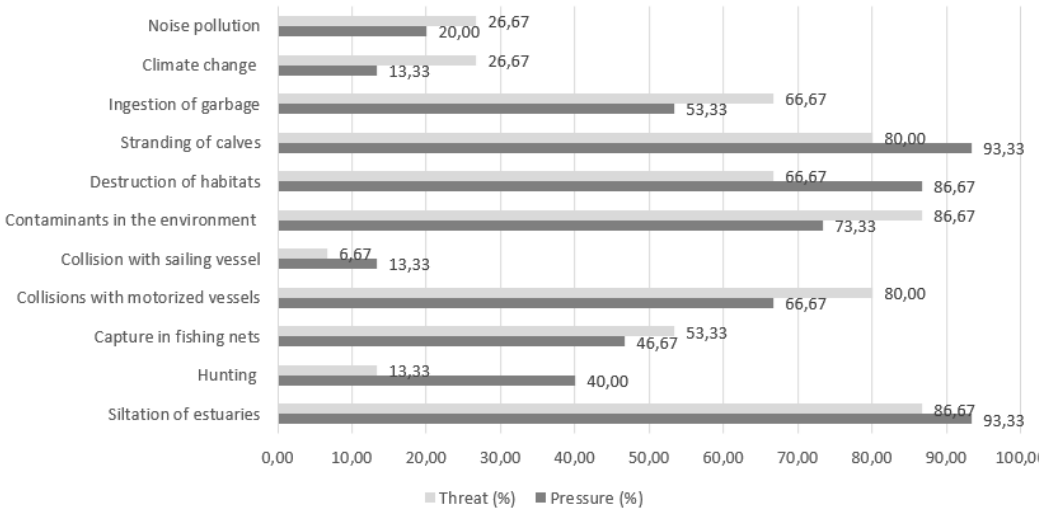

Figure 2. Main pressures and threats suffered by the marine manatee in Brazil.

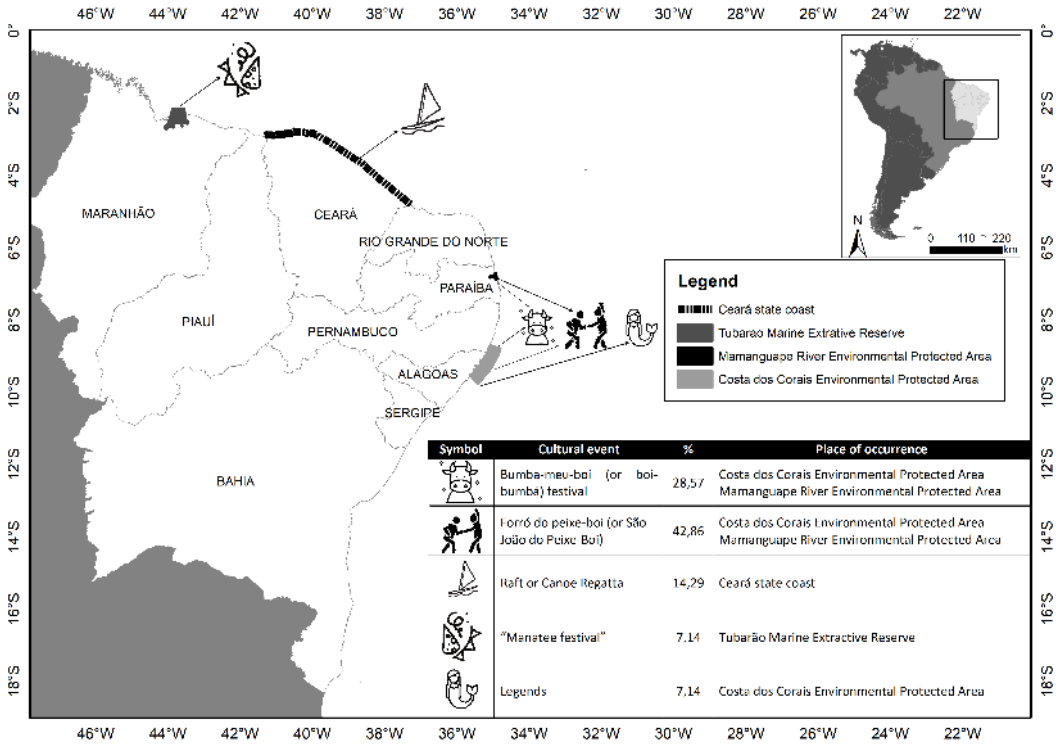

Figure 3. Representation of typical cultural manifestations associated with the *T. manatus* for each state in northeastern Brazil (contributed by Romário Oliveira de Santana).

mental Protected Area in Paraíba (35.71%, $n = 5$).

DISCUSSION

The responses of the interviewed professionals provided valuable insight and greatly contributed to this study. Most of the respondents are trained in an area of biology, held a postgraduate degree and have worked in private institutions for more than 10 years, which denotes the participation of a technical body specialized in the management and conservation of the marine manatee in Brazil (Baptista et al. 2019). Some studies have mentioned that gender differences related to the perception of ecosystem services may

be the result of an intersection of one or several factors, including educational background, culture, socioeconomic status, age, religious beliefs and access to information (Yang et al. 2018). In our study, no differences were noted in the respondents' knowledge with regards to the variables gender, education, and type of work institution. This demonstrates that female and male researchers, both from governmental and private institutions and with different levels of education, scored similar values on the Likert scale for the presence of different types of services, contrary to the findings of Yang et al. (2018). Pearson's correlations in our study indicated that young researchers, older researchers, and researchers with varying career lengths observed the presence of ecosystem services in their area of activity in the same way.

With regard to ecological information about manatees, the researchers affirmed the importance of protected areas for conservation. According to Schiavetti et al. (2013), the region of occurrence of the manatee is the Large Marine Ecosystem with the highest number of marine/coastal areas in Brazil. One of the marine protected areas in the region has an effectiveness rate of over 60%, which is considered a high level of management (Brandão et al. 2017). In the last 50 years, humans have changed ecosystems at an increasingly faster rate and more extensively than at an equivalent period in human history. In general, the changes are a consequence of the growing and immediate demand for natural resources. This transformation of the planet has resulted in improved human well-being and economic development, but not in an egalitarian way (Reid et al. 2005). In the present study, the positive and significant correlation between pressure and threat showed that the impacts on the marine manatee and the ecosystem services are expected to continue in the future. The results of this work corroborated with the pressure and threat categories presented by other authors, such as hunting (Luna et al. 2008a, 2008b); accidental capture in fishing nets (Lima et al. 2007; ICMBio 2011); alteration and destruction of breeding habitats (ICMBio 2011; Medeiros et al. 2021), which intensifies the stranding of calves (Parente et al. 2004; Medeiros et al. 2021); siltation of estuaries (Anzolin et al. 2012); the presence of contaminants in the environment (Anzolin et al. 2012); ingestion of garbage; noise pollution; climate change (ICMBio 2011) and collisions with motorized vessels (Borges et al. 2007). In our study, calf stranding, the silting of estuaries and habitat destruction were among the most cited pressures and threats. These factors can prevent females from accessing estuarine waters and forces them to provide parental care in unprotected, often open areas (Meirelles 2008). Medeiros et al. (2021) found a relationship between the temporal changes resulting from the reduction of mangrove forest areas and increased manatee calf stranding over the years. Their results revealed the importance of intact mangroves for the maintenance of marine manatee populations, which would enable adult females to access protected locations and care for their calves with a lower risk of separation. In this regard, the integrity of mangroves is of extreme importance to the maintenance and sustainability of marine manatee populations and the ecosystem services associated with them.

Our results also showed that the professionals believe that all ecosystem services were relevant. This fact may be a consequence of the lack of familiarity with the different categories of ecosystem services or the inability to determine which category would be closely associated with the marine manatee. Management plans for protected areas with occurrence of marine manatees, such as the Mamanguape River Environmental Protected Area (2014) and Costa dos Corais Environmental Protected Area (2021), showed the lack of information related to these services, as well as the need for partnerships with universities and non-governmental organizations to carry out evaluation studies.

The literature describes some examples and situations of ecosystem services associated with manatees, including the following:

Supporting - Manatees are herbivores considered nutrient recyclers (Castelblanco-Martínez et al. 2012; Reynolds et al. 2008; Meirelles et al. 2022). As such, they consume aquatic plants and supply nutrients through their feces and urine to aquatic grass banks (Wirsing et al. 2022), thus promoting growth and recovery after herbivory (Heinsohn et al. 1977). Sirenians may also mediate the translocation of nutrients from seagrass beds to coral reef ecosystems (Wirsing et al. 2022).

Regulating - The herbivory of sirenians can affect biomass, productivity, and species composition in macrophyte communities (Heinsohn et al. 1977; Wirsing et al. 2022). Moreover, manatees help control the population growth of aquatic plants (Reynolds et al. 2008). Consequently, the consumption of this vegetation in canals and watercourses allows the passage of vessels and reduces costs associated with the removal of vegetation (Solomon et al. 2004).

Provisioning – Historically, both Brazilian manatee species (*T. manatus* and *T. inunguis*) have been exploited by predatory hunting since the 16th century (Brito 2019; Correia Filho 1939; Domning 1982; Whitehead 1977). Initially, the main reason for hunting the manatee was for meat and fat, and later, for the skin (Silva et al. 2017). A combination of subsistence hunting and small-scale commercial hunting eventually reduced known populations to extinction

(in the case of Steller's sea cow), or close to extinction, in the case of manatees (Forestell 2008; Silva et al. 2017). In 1964, commercial statistics revealed that two tons of meat were produced in the state of Alagoas in 1959 and one ton was produced in Bahia (Domning 1982). Although manatee hunting is prohibited, manatees are still caught for their meat (Luna et al. 2008a) mainly by older people in Amazonian communities (Hoffmann et al. 2021). Ethnoecological studies carried out in Amanã Lake (Japurá River, Brazil) revealed that local populations do not believe that the manatee could end. According to these communities, this resource is provided by God and still exists despite being hunted for decades (Silva et al. 2017). The use of these animals, mainly *T. inunguis*, may also be associated with superstitions. In the Amazon, manatee ear bones were reportedly used to treat deafness. Furthermore, the scapula bone was used as an instrument to stir flour; portions of the rib were used for fishing and for making amulets and ornaments (Silva et al. 2017) and the viscera were used with meat and fat to make sausages (Hoffmann et al. 2021). The fat was also used to treat respiratory diseases, swelling and relieve muscle pain, rheumatism, hernias and erysipelas (Silva et al. 2017, Hoffmann et al. 2021). In some locations, the skin was roasted and ground to produce teas that fight respiratory diseases and impotence (Silva et al. 2017) and turned into plaster for muscle damage (Hoffmann et al. 2021).

Cultural - These are the non-material benefits obtained from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences (Mace et al. 2005). The importance of ecosystem services associated with aesthetic pleasure and recreational options is currently growing (Reid et al. 2005). Simultaneously, the importance we place on our needs for spiritual and mental well-being is becoming as important as access to other natural resources of consumption. In this context, tourism in protected areas has shown positive results for human health and well-being (IUCN 2019). Tourism for observation and interaction with animals in nature has been considered a potential conservation measure for faunal species (Vidal et al. 2017). In this regard, evidence suggests that when this form of tourism is managed and combined with effective education, it can make people more environmentally responsible (Orams 1996). Tourism related to the manatee is a non-extractive activity that can reduce threats to the species. In Brazil, manatee watching occurs mainly in Porto de Pedras (Costa dos Corais Environmental Protection Area) and in Rio Tinto (Mamanguape River Environmental Protection Area). In these locations, community-based tourism appears as an alternative for sustainable local development (Braga and Selva 2016) without disturbing the species. This activity also stands out for not necessarily being seasonal, with the potential to become an annual attractive (Guidino et al. 2020). According to Morris et al. (2007), stimulating the empowerment of communities can result in greater ecological respect for live organisms and their functions in the ecosystem. In our study, the researchers strengthen this knowledge when they cited observation tourism, educational activities, supporting sightings and rescue, and the involvement of communities in management activities. This reinforces the planned environmental education actions aimed at manatee conservation contained in the National Action Plan for the Conservation of sirenians in Brazil. The cultural events associated with the marine manatee proved to be exclusive and attributed an identity to certain regions (Figure 3). The *Forró do Peixe-boi* and the *Bumba-meu-boi* festivals are held in the Costa dos Corais Environmental Protected Area and Mamanguape River Environmental Protected Area Environmental. The *Forró do Peixe-boi* festival in Mamanguape River Environmental Protected Area Environmental is based on a partnership between the Aquatic Mammals Centre and *Instituto Chico Mendes de Conservação da Biodiversidade* (ICMBio 2014) and aims to enhance the local culture and integrate the population with the protection of the marine manatee and its natural habitat. Moreover, the raft/canoe regatta is held in the state of Ceará and the manatee festival occurs in the state of Maranhão. The manatee festival, held since 2007, also focuses on the preservation of the sea manatee (ICMBio 2020).

Some ethnographic studies (Verde et al. 2021; Filho and Silva 2020; Silva and Júnior 2019) describe the Eco Festival *Peixe Boi* as another cultural event for the Amazonian manatee. The event, held in Novo Airão, 180 km from the state of Manaus includes walking crowds that celebrate with musical, scenic and choreographic elements carrying ecological messages and supporting the preservation of Amazonian ecosystems and biomes. The festival regulations direct the content of the presentation and establish rules for the dispute between two different teams, each of which represents the manatee conservation units, Parque Nacional do Jaú and Anavilhanas Ecological Station. According to Silva 2020, the *Eco Festival Peixe Boi* was influenced by the Folkloric Festival of Parintins, which is considered a Cultural Heritage of Brazil. The event started as a local festivity to provide leisure and culture to the residents through dances. The population disagrees as to the beginning of the festivities, but the two most cited years were 1987 and 1989. These records, associated with our results, confirm the existence of specific cultural manifestations that vary according to the location where the manatee occurs. In addition, they reinforce the

need to include local populations in the production chain of this tourism.

Some respondents also mentioned folk legends among the cultural manifestations in the Costa dos Corais Environmental Protection Area. The name of the order of manatees, Sirenia, has its origin in the legends of the mermaids (Silva et al. 2017). The first Europeans to see New World manatees were Columbus and his crew, and they were reportedly disappointed by these ungainly "mermaids." The notion of mermaids was already well established at that time, but as a sirenian element originating from the Indian Ocean similar to a dugong (Whitehead 1977). At least two possible origins have been suggested for the name *manatus*, referring to subspecies. One of these names may refer to the hand (*manus*), as manatees sometimes use their front or pectoral limbs to push food into their mouths. According to Silva et al. (2017), it is believed that the name manatu was given by Spanish explorers due to the hand-shaped fins (*manus* = hands) of the animal. However, the term most likely comes from the indigenous Caribbean word manati, meaning a woman's breast, referring to the axillary location of the manatee's mammary glands, positioned like female breasts. This particular anatomical feature, according to Reynolds et al. (2008), contributed to the association of the manatee with the mythical mermaid legend. In colonial Brazil, however, indigenous peoples and native fishermen called the manatee iguaraguâ (Brito 2019; Whitehead 1977, 1978), guarabá or igarakuê, which means "upside down canoe", a reference to the similarity of the animal's back to a floating canoe (Lima et al. 2011b). Other names given to the manatee include *Goaravá*, *goaragoá*, *Yuárauá* or *yauárauá*, *ipupiára*, *yauárauá* or *gáragoá* and *manay*, according to Silva et al. (2017). The surviving mythology regarding these animals represent a strong syncretism with European folklore and the economic and political context of colonization itself (Silva et al. 2017).

CONCLUSION

Knowledge about ecosystem services was regular among the respondents and similar for the genders, age groups and length of career or professional experience.

Current knowledge has shown us that the presence of the marine manatee reduces costs with environmental repair through the cycling of nutrients and fertilization of aquatic grass banks, which are important nurseries for many aquatic animal and plant species. Furthermore, the consumption of aquatic vegetation by manatees also controls their exacerbated growth, thus allowing the movement of vessels in important channels used for navigation. The use of animals as a food resource, although still existent, has been greatly reduced in recent years, probably as a result of educational campaigns informing of the risks of its consumption, in addition to inspection. In contrast, the interest in recreational activities (cultural manifestations) and in manatee observation tourism provide physical and emotional well-being, which are increasingly pursued (Andrade and Romeiro 2015). Currently, the importance we place on our needs for spiritual and mental well-being is becoming as important as access to other natural resources for consumption. This new perspective arouses the increased interest of visitors in locations with the presence of manatees. Furthermore, it reinforces the cultural manifestations of each state and strengthens the inclusion of local populations in the tourism chain. The results of this survey corroborate this information by showing that, according to the respondents, all ecosystem services presented the same level of importance in the areas of occurrence. That said, the assessment of ecosystem services helps to integrate them into public decision-making and ensure the continuity of the ecosystems that provide them (Sekercioglu 2010).

The assessment of ecosystem services provides important data that can help managers of protected areas define priority actions for the conservation of manatees. The information shared here also contributes to the updating of the objectives foreseen for the marine manatee in the National Action Plan for the Conservation of Sirenia.

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DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived the presented idea: FBI, AS.
Carried out the experiment: FBI.
Carried out the data analysis: FBI, RMR.
Wrote the first draft of the manuscript: FBI.
Reviewed and performed the final writing of the manuscript: FBI, RMR, AS.
Supervised the study: AS.

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