


Recreational fishing in the Barra do Una Sustainable Development Reserve: subsidies for the integrated management of the Mosaic of Conservation Units Juréia-Itatins, São Paulo, Brazil

A pesca amadora na Reserva de Desenvolvimento Sustentável da Barra do Una: subsídios para a gestão integrada do Mosaico de Unidades de Conservação Juréia-Itatins, São Paulo, Brasil

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ABSTRACT

Recreational fishing is one of the most popular leisure activities in the world and, in Brazil, it is a relevant socioeconomic activity in several coastal populations. The management of this practice must conciliate traditional knowledge, scientific research, and the demands involved in using space and fishing resources to generate employment and income, without harming biodiversity. This article presents an analysis of recreational fishing in the Barra do Una Sustainable Development Reserve by primary and bibliographic data and results of participatory workshops, aiming to generate information and discussions relevant to fisheries management integrated in the Juréia-Itatins Mosaic of Conservation Units, in the south coast of São Paulo, southeastern Brazil. The main services provided to recreational fishing and structured in the territory are the activities of fishing guides or pilots, trading live baits, and renting boats, while, accommodation and food still require organization. *Centropomus parallelus* and *C. undecimalis* are target species, and the profile of practitioners – systematized by the scientific literature – demonstrates certain patterns related to age, fishing time, and place of origin. As for the use of space, of the 40 identified fishing spots, only nine used by recreational fishermen overlap with the fishing grounds used by artisanal fishermen, which may indicate little competition for resources between the fishing categories. Scientific

RESUMO

A pesca amadora é uma das atividades de lazer mais praticadas em todo o mundo e, no Brasil, é uma atividade socioeconômica relevante em diversas populações costeiras. A gestão desta prática deve conciliar o conhecimento tradicional, a pesquisa científica e as demandas envolvidas no uso do espaço e dos recursos pesqueiros para a geração de emprego e renda, sem prejuízos à biodiversidade. Este artigo apresenta uma análise da pesca amadora na Reserva de Desenvolvimento Sustentável da Barra do Una por meio de dados primários, bibliográficos e resultados de oficinas participativas, visando gerar informações e discussões pertinentes à gestão pesqueira integrada no Mosaico de Unidades de Conservação Juréia-Itatins, litoral sul de São Paulo, sudeste do Brasil. Os principais serviços prestados à pesca amadora e estruturados no território são as atividades de guias de pesca ou piloteiros, comércio de iscas vivas e aluguel de barcos, enquanto a hospedagem e alimentação ainda requerem organização. *Centropomus parallelus* e *C. undecimalis* são espécies-alvo, e o perfil dos praticantes – sistematizado a partir da literatura científica – demonstra certos padrões relacionados a idade, tempo de pescaria e local de origem. Quanto ao uso do espaço, dos 40 pontos de pesca identificados, apenas nove utilizados por amadores se sobrepõem aos utilizados por pescadores artesanais, o que pode indicar pouca disputa pelos recursos entre as categorias

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research, the engagement of managers, and the participation of the local community contributed to the organization of recreational fishing in the Barra do Una Sustainable Development Reserve, demonstrating that participatory management promoted interaction between the different users of fishing resources, favoring the development of recreational fishing, and meeting the socioeconomic and cultural expectations of the local community.

Keywords: sport fishing; participative management; ethnoecology; fisheries management.

Introduction

In Brazil, recreational fishing represents an important activity capable of generating jobs and income for fishing communities that apply their knowledge of the environment and natural resources to this practice. It is one of the most practiced leisure activities in the world, involving a series of services such as transportation, food, and lodging. It has great potential in the tourism sector, promoting social and environmental gains in socio-vulnerable areas (Barcellini et al., 2013; Silva et al., 2016; Miret-Pastor et al., 2020; Abbott et al., 2022).

To safeguard Brazilian ecosystems and biodiversity, some territories are protected by Conservation Units (CUs), which, in sustainable use categories, can house human populations that exploit natural resources through sustainable traditional practices (Brasil, 2000). These areas arouse the interest of recreational fishermen who seek natural environments rich in fish diversity, natural beauty, and local services that meet their needs (Alic et al., 2021; Ferreira et al., 2021; Oliveira et al., 2022). With the increase in this activity, it is essential to consider its implications for fisheries management and planning (Pita et al., 2020), especially in cases of conflicts between different fishing modalities (Gómez et al., 2021).

Although provided for by Law and supported by codes of ethical conduct and technical guidelines, the management of recreational fishing still requires biological and socioeconomic studies associated with sociocultural components. This might enable guiding public policies and management actions, in order to overcome gaps in the monitoring and evaluation of the fishing efforts. Thus, fisheries management should be based on research aimed at the potential and benefits of this activity, both for local residents and recreational fishermen, assessing the possible impacts on the ecosystem balance (FAO, 2012; Boucquoy, 2020; Gentil et al., 2020; Miret-Pastor et al., 2020; Pita et al., 2020; Shamsi et al., 2020; Cooke et al., 2021; Gómez et al., 2021).

For the practice of recreational fishing in CUs, adequate management must be planned and implemented considering the objectives of the CUs in relation to resource conservation and local socioeconomic development (Brasil, 2000; Mann et al., 2018). However, the history of CU origin in Brazil, especially in the coastal zone, has always been

de pescadores. A pesquisa científica, o engajamento dos gestores e a participação da comunidade local contribuíram para o ordenamento da pesca amadora na Reserva de Desenvolvimento Sustentável Barra do Una, demonstrando que a gestão participativa promoveu a interação entre os diferentes usuários dos recursos pesqueiros, favorecendo o desenvolvimento da pesca amadora e atendendo às expectativas socioeconômicas e culturais da comunidade local.

Palavras-chave: pesca esportiva; gestão participativa; etnoecologia; manejo pesqueiro.

marked by socio-environmental land conflicts, disorderly use of natural resources, and the absence of management plans – or even the difficulty in implementing them, with recreational fishing being neglected. Part of these conflicts and the inefficiency of public policies, in the face of land issues (Sanches, 2016), led to processes of recategorizing and adjusting limits of fully protected CUs (Pellin et al., 2017; Sousa and Serafini, 2018). Nevertheless, recreational fishing is still poorly elucidated. Studies are needed to support the implementation of public policies regarding fisheries sustainability and environmental conservation (Alves-Junior et al., 2020; Freire et al., 2020; Holder et al., 2020; Dal Negro et al., 2021; Jeanson et al., 2021).

According to the National System of Conservation Units (*Sistema Nacional de Unidades de Conservação da Natureza* – SNUC) (Brasil, 2000), when there is a set of CUs of different categories or not, close, juxtaposed or overlapped, and public or private protected areas, constituting a mosaic, management must be integrated and participatory, seeking to conciliate biodiversity conservation, appreciation of socio-diversity, and sustainable development in the regional scenario. In this context, the concept of mosaics can be an alternative for this integration and maintenance of biodiversity, considering that territorial and resource management should not be restricted to a CU, as fishing activities take place in several areas and show strong interdependence between ecosystems. Hence, integrated and cooperative planning, with goals and guidelines that effectively contribute to the objectives of the CUs, can reduce pressures on biodiversity and socio-environmental conflicts (Pellin et al., 2017). The connectivity of ecosystems is the key to reducing anthropogenic pressures; therefore, the institution of mosaics enables the dissemination of information through biodiversity monitoring programs, promotion of regional socioeconomic activities consistent with the maintenance of environmental quality, integration between different levels of administrative processes as well as partnerships for technical training and consolidation of management tools (Borrini-Feyerabend et al., 2017; Sousa and Serafini, 2018).

In Barra do Una Sustainable Development Reserve (SDR), located in Juréia-Itatins Mosaic of Conservation Units (*Mosaico de*

Unidades de Conservação Juréia-Itatins – MUCJI), in the south of the state of São Paulo, southeastern Brazil, recreational fishing has been practiced for several decades, representing an activity that permeates traditional activities even before the implementation of the CU (Silva et al., 2016; Molitzas et al., 2019). However, only in 2020, with the establishment of the Barra do Una SDR Usage Plan (São Paulo, 2020), recreational fishing received a specific plan, aimed at conserving resources and generating employment and income in the territory.

From the socio-environmental point of view, the MUCJI can comprise in its territory areas exclusively delimited for the use of traditional communities, but only defining the mosaic does not guarantee the achievement of its objectives. Taking this into consideration, over three decades after the creation of the Juréia-Itatins Ecological Station (*Estação Ecológica Juréia-Itatins – EEJI*), the discussion on how to include community participation and local ecological knowledge in the development of management instruments remains, as well as the discussion on how to transform local ecological knowledge applied to traditional activities into economic opportunities (Sanches, 2016), as is the case of recreational fishing in Barra do Una SDR.

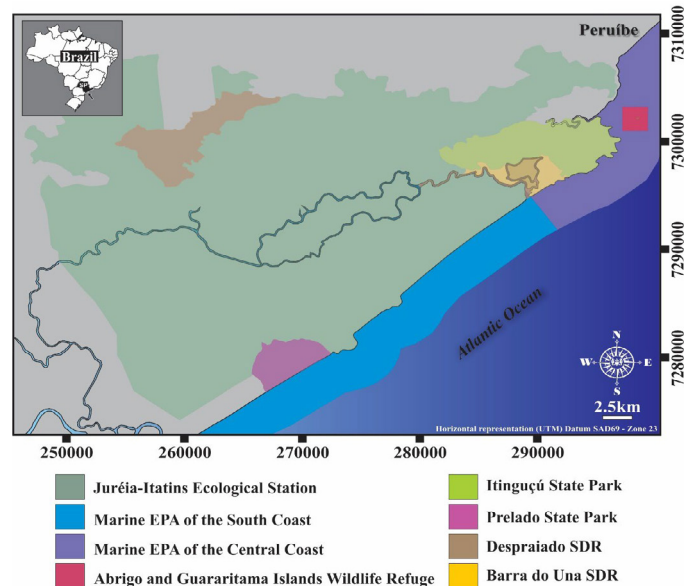
Within this context, this article aimed to characterize recreational fishing and its relations with the *caiçara* population of Barra do Una SDR, in order to generate information and foster discussions relevant to fisheries management integrated into the Juréia-Itatins Mosaic of Conservation Units.

Materials and methods

Study area

Barra do Una SDR belongs to the municipality of Peruíbe, in the south of São Paulo State (Figure 1). Its origin took place in 2012 with the recategorization of the area in Juréia-Itatins Mosaic of Conservation Units, which came to be composed of four fully protected CUs: Juréia-Itatins Ecological Station, Itinguçú State Park, Prelado State Park, and Abrigo and Guararitama Islands Wildlife Refuge, in addition to two CUs for sustainable use: Barra do Una and Despraiado SDRs (São Paulo, 2013). Although not part of the MUCJI, in the marine coastal zone, there are the Marine Environmental Protection Areas (EPA) on the Central and South coasts, both created in 2008 (São Paulo, 2021a, 2021b).

Figure 1 presents all the CUs that compose the MUCJI, in which the study area is inserted. The existing Marine CUs around the study area are also shown on the map. It is worth mentioning that the MUCJI, together with the Marine EPAs on the Central and South coasts of São Paulo, make the territory a continuum of protected areas that are relevant in terms of biodiversity conservation in the state.



EPA: Environmental Protection Areas.

Figure 1 – Mosaic of Juréia-Itatins Conservation Units and Marine Environmental Protection Areas on the Central and South coasts, São Paulo.

Data collection

Data were obtained from a bibliographical review (scientific articles, books, legal instruments, etc.) and the analysis of the Usage Plan (UP) of Barra do Una SDR (São Paulo, 2020). The bibliographic search was carried out in the search engines Google Scholar, Coordination for the Improvement of Higher Education Personnel (CAPES) Journal Portal, and in the SciELO database, using the keywords: Barra do Una SDR, recreational fishing, sport fishing, Juréia, Juréia-Itatins, and all possible combinations between them, both in Portuguese and English languages. In addition, the website of the Forestry Foundation, the agency responsible for the management of CUs in São Paulo, was consulted (São Paulo, 2020) to access the UP. All the material resulting from the bibliographic search was analyzed and, therefore, the time frame (1999 to 2019) presented in the summarized data was based on the identified studies, which mentioned recreational fishing in Barra do Una SDR.

This review enabled the characterization of fishing (methods, target species, fishing spots, etc.), the profile of fishermen, local activities and infrastructure related to services provided for recreational fishing as well as data on local ecological knowledge and demands for the organization and management of recreational fishing in the Barra do Una SDR.

Previous studies (Ferreira, 2019; Ferreira et al., 2021) pointed out that the main residents' demands related to recreational fishing management in Barra do Una SDR were the application of training and awareness programs on recreational fishing rules. Such demands guided the organization of seven participatory workshops as part of the "Communi-

ty training program for recreational fishing services” between March and July 2022. The community was previously mobilized for the workshops through visits to residents who provided recreational fishing services. In addition, a statement with the objectives and schedule was sent via WhatsApp in community groups, with an invitation extended to other individuals interested in recreational fishing. The main target of the workshops was to create a participatory and integrating space for the sharing of knowledge and discussions about the demands of fishermen and residents of Barra do Una SDR, regarding the territory and socioeconomic activities. This allowed the collective development of propositions for the implementation of the norms established in the recreational fishing UP. All workshops took place at the Barra do Una SDR Community Center (with the exception of the practical one), lasting three hours each, with the use of audiovisual resources (slideshow, videos, images, and graphic facilitation) and always with residents’ collaboration to organize the space and offer snacks. The number of residents participating in the workshops varied between 12 and 18 people.

In the first five workshops, specialists shared knowledge on the following topics: “Updates on recreational/sport fishing in Brazil and in the world”, “Conservation of target species for recreational fishing”, “Good catch and release practices”, “Technology at the service of monitoring recreational fishing”, and “Experiences in fisheries management for recreational fishing in other Brazilian CUs.” Throughout the presentations of the specialists, participants could ask questions about the topics and, thus, direct the discussions about local practices and demands. A practical workshop was held with the leadership of fishing guides, through an outing on the Una do Prelado River, in which the main recreational fishing techniques and notions for good fishing conduct were demonstrated, based on current legislation and local experience. The last participatory workshop emphasized the norms established for recreational fishing in the UP, encouraging the discussion on strategies for their implementation, and also providing a moment of debate and registration of additional demands on recreational fishing.

The methodological procedures were approved by the Ethics Committee for Research Involving Human Beings at Universidade Santa Cecília (Opinion No. 3.990.108), and authorization to conduct the research in Barra do Una SDR was issued by Instituto Florestal (COTEC No. 529/2020).

Results

Characterization of recreational fishing activities and services

Among the activities related to recreational fishing in Barra do Una SDR, the main one was fishing guide/pilot, followed by trading live baits, and renting boats and motors (Oliveira et al., 2022). The trade of baits (*camarão vivo*, *pitú*, *tatuíras*, *corrupto*, etc.) is carried out informally, close to or in the fishermen’s homes (Zeineddine et al., 2015; Ferreira, 2019). Other important activities are accommodation and food, although they do not have specific services for recreational fish-

ing (Silva et al., 2016; Molitzas et al., 2019). Recently, the management of tourist activities began to be directed by the UP of Barra do Una SDR, through the Community-based Tourism Program (*Programa de Turismo de Base Comunitária – TBC*), which encourages tourism management in the community, including the infrastructure: one inn, 15 campsites, six lodging houses, eight restaurants, three kiosks, 25 environmental monitors, and one tourism agency registered with Cadastur (*Cadastro de Prestadores de Serviços Turísticos*, the registration of people and businesses working in the tourism sector). Thus, the TBC of Barra do Una SDR focuses on small services provided by community residents (São Paulo, 2020).

The profile of recreational fishermen who frequented the Barra do Una SDR varied in terms of age, level of education, occupation, and place of residence, in all analyzed periods (1999 to 2019) (Table 1).

Table 1 – Profile of recreational fishermen in Barra do Una Sustainable Development Reserve, Peruíbe/SP, from 1999 to 2019.

Profile of recreational fishermen		1999-2000 ¹		2013-2014 ²		2018-2019 ³	
		N = 48		N = 88		N = 119	
		N	%	N	%	N	%
Sex	Men	44	91.7	78	88.6	113	95.0
	Women	4	8.3	10	11.4	6	5.0
Age (years)	Mean	NA	–	41.7	–	52.0	–
	Minimum	NA	–	18	–	18	–
	Maximum	NA	–	60	–	83	–
Level of education	Elementary School	18	37.5	0	0	17	14.3
	High school	23	47.9	43	48.9	52	43.7
	College degree	4	8.3	42	47.7	41	34.5
Occupation	Retired	12	25.0	0	0	12	10.1
	Self-employed	0	0	0	0	10	8.4
	Trader	10	20.8	0	0	8	6.7
	Businessperson	0	0	14	15.9	0	0
	Engineer	1	2.1	6	6.8	6	5.0
	Student	1	2.1	7	8.0	0	0
	Teacher	1	2.1	5	5.7	0	0
Place of origin	São Paulo	24	50.0	29	33.0	49	41.2
	Baixada Santista	3	6.3	8	9.1	31	26.1
	Metropolitan Region of São Paulo	12	25.0	13	14.8	20	16.8
	Smalls cities in São Paulo	2	4.2	0	0	0	0
Fishing experience (years)	Mean	NA	–	1.5	–	31	–
	Minimum	NA	–	0	–	1	–
	Maximum	NA	–	15	–	58	–
Fishing Document	None	43	89.6	74	84.1	NA	–
	Recreational fishing license	5	10.4	14	15.9	NA	–

¹Molitzas et al. (2019); ²Silva et al. (2016); ³Oliveira et al. (2022); NA: not available.

The analyzed studies indicate that, in relation to the sex of recreational fishing practitioners, men were always predominant, and most of the interviewed practitioners (over 80% for all studies) did not have a fishing license. As for the origin of recreational fishermen, the state of São Paulo and its metropolitan area were their main residences, who were mostly retired or had trade as their main occupation. The mean age of recreational fishermen exceeded 40 years for the entire period analyzed, and fishing experience revealed that the maximum time ranged between 15 and 58 years. Both the high mean age and the result of 58 years of experience specifically in the 2022 study (2018–2019 period) are indicative that recreational fishing is consolidated in the study region.

The main natural baits used were the live shrimp *Penaeus schmitti* (camarão branco) and *Macrobrachium acanthurus* (pitu), the dead shrimp *Xiphopenaeus kroyeri* (camarão-de-sete-barbas), *Callichirus major* (corrupto), and pieces of fish, which requires the involvement of residents of the community for their supply (Zeineddine et al., 2015). In addition to live baits, recreational fishermen also used artificial baits, characterized by a wide variety of models, materials, sizes, and colors (Ferreira, 2019).

The average number of fishermen in each group and duration time varied in the evaluated periods. Recreational fishing was practiced by two or three fishermen, with a mean time length of two hours each fishing, occurring in the morning (mostly), afternoon and throughout the day (from morning to night). The preference for certain phases of the moon chosen for practicing the activity, had the full moon as predominant. The frequency of fishing was prevalingly annual, and the best seasons mentioned were the summer or the whole year. Shrimp (live and dead) was the main bait used in the region, with live shrimp predominating in two of the three analyzed periods and dead shrimp in one of these; artificial bait was also mentioned in all studies analyzed (Table 2).

Recreational fishing was carried out on board or offshore, on the rocky shore, estuary, river, and on the beach. Among those on board, the main technique used was casting, practiced with fishing rods equipped with a windlass or reel, preferably using artificial baits. When offshore, the main modality was ravine fishing, using gear such as hand lines, simple reeds (bamboo), and hooks of different sizes and models, generally with natural baits. Beach fishing was done using long fishing rods (2.5 to 5 m) with lead and hooks to catch fish close to or in the surf zone (Silva et al., 2016).

The fish species most sought after by recreational fishermen are *Centropomus undecimalis* (robalo flecha ou robalão), *C. parallelus* (robalo gordo), *Mugil liza* (tainha), *M. curema* (parati), *Cynoscion* spp. (pescada), *Eugerres brasiliensis* (caratinga), *Micropogonias furnieri* (corvina), *Bagre* spp. (Ariidae), *Aspistor luniscutis* (bagre-branco), *Caranx crysos* (carapau), *Polydactylus virginicus* (parati barbudo), and *Hoplias malabaricus* (traíra) (Silva et al., 2016; Molitzas et al., 2019; Ferreira et al. 2021; Oliveira et al., 2022).

Table 2 – Characterization of recreational fishing practiced by respondents in Barra do Una Sustainable Development Reserve, Peruíbe/SP, from 1999 to 2019.

Characteristics		1999-2000 ¹		2013-2014 ²		2018-2019 ³	
		N = 48		N = 88		N = 119	
		N	%	N	%	N	%
Average time of each fishing (hours)	Mean	NA	–	2.1	–	NA	–
	Minimum	NA	–	1	–	NA	–
	Maximum	NA	–	12	–	NA	–
Number of fishing practitioners	Mean	2.4	–	2.6	–	NA	–
	Minimum	1	–	1	–	NA	–
	Maximum	6	–	5	–	NA	–
Fishing period	Morning	NA	–	45	51.1	NA	–
	Afternoon	NA	–	22	25.0	NA	–
	Morning to night	NA	–	20	22.7	NA	–
Fishing frequency	Annual	0	0	23	26.1	NA	–
	Semiannual	2	4.2	0	0	NA	–
	Monthly	1	2.1	0	0	NA	–
	Biweekly	1	2.1	0	0	NA	–
Best time/season	Whole year	NA	–	21	23.9	29	
	Winter	NA	–	20	22.7	10	8.4
	Fall	NA	–	13	14.8	3	
	Spring	NA	–	0	0	13	
	Summer	NA	–	50		49	41.2
Moon phase	Waning crescent	NA	–	42	47.7	0	0
	Full moon	NA	–	17	19.3	4	3.4
	New moon	NA	–	8	9.1	1	0.8
	Waning moon	NA	–	0	0	0	0
	Does not influence/does not know	NA	–	0	0	36	30.3
Main baits used	Dead shrimp	1	2.1	46	52.3	3	
	Live shrimp	31	64.6	15	17.0	70	58.8
	Mud shrimp	0	0	10	11.4	9	7.6
	Artificial bait	31	64.6	17	19.3	87	73.1

¹Molitzas et al. (2019); ²Silva et al. (2016); ³Oliveira et al. (2022); NA: not available.

A total of 31 unique fishing spots were identified, of which 14 were for recreational fishing and 17 for artisanal fishing. In addition, there were nine other common spots between the two modalities, demonstrating that the fishing area goes beyond the limits of Barra do Una SDR, comprising other units of the MUCJI and Marine EPAs of the Central and South coast (Figure 2) (Souza, 2019; Teixeira, 2020; Ferreira et al., 2021).

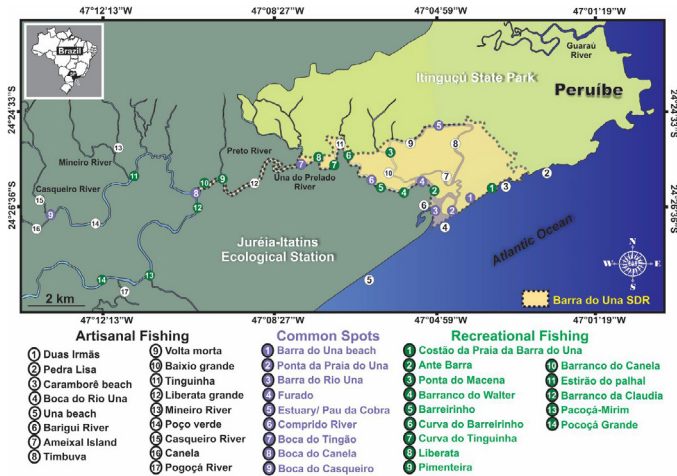


Figure 2 – Fishing spots used in Barra do Una Sustainable Development Reserve, Peruibe/SP.

- Recreational fishermen preferred fishing spots with the following characteristics:
- Regions close to “river outlets” (places where a body of water is integrated into the main channel of the river);
- Presence of “structures” (rocks, plants, branches, or submerged trees);
- “Sandbank” areas (places with low depth, usually composed of sandbanks and/or rocks submerged in the sea or river);
- Spots with “ravine” (slope or steep drop not covered by vegetation);
- Presence of marginal “vegetation” (water hyacinth and grass).

The choice of location for fishing was also defined according to the tidal range, with differences between ebb (low tide) and flood (beach) observed (Ferreira, 2019; Oliveira et al., 2022).

The organization of recreational fishing in Barra do Una SDR and the challenges for integrated management

Residents’ demands related to the management of recreational fishing in Barra do Una SDR, identified in the bibliographic survey, pointed to training (55.5%), awareness programs on species and minimum sizes (18.5%), and inspection of quotas and minimum catch sizes (14.8%) (Ferreira, 2019). In Ferreira et al. (2021), resident artisanal fishermen presented recommendations for recreational fishing management in Barra do Una SDR, which were used in the elaboration of the UP (São Paulo, 2020).

Although most of the norms that regulate local activities and services for recreational fishing are provided for the entire national territory (Brasil, 2005, 2009, 2012a, 2012b), the UP established specific norms for Barra do Una SDR, with the participation of the local population and the performance of the management council in resolving conflicts between fishing modalities (artisanal x recreational).

The norms established in the UP were related to the use of natural baits, which should be preferably purchased from local suppliers, with the entry, use, and sale of live exotic species prohibited; recreational

fishing hours from 7 am to 5 pm; allowed locations; and the recommendation to accompany local fishing guides for the practice of recreational fishing on board. The latter was established based on the mapping of fishing spots used by artisanal and recreational fishermen (Figure 2) to resolve conflicts about vessel traffic and the practice of artisanal fishing (São Paulo, 2020). Traditionally, artisanal fishermen set up their nets at the end of the day and harvested at dawn. Therefore, it was defined that, for the safety and protection of fishing materials and recreational fishermen, recreational fishing vessels should not operate during this period. In addition, the UP established the mandatory registration of fishing pilots and beneficiaries of Barra do Una SDR who worked in recreational fishing as well as the regulation of their vessels (São Paulo, 2020).

In order to meet the demands of residents for training, as pointed out in previous studies (Ferreira, 2019; Ferreira et al., 2021), participatory workshops were held to discuss pertinent information on the conservation and management of recreational fishing in Barra do Una SDR. Besides the previously known and addressed demands in the UP, the participants of the workshops discussed the area allowed for the practice of recreational fishing in the geographical limits between Barra do Una SDR, Itinguçu State Park, and Juréia-Itatins Ecological Station. The local fishing guides showed interest in meeting the request of recreational fishermen who aim to catch species such as *Hoplias malabaricus* (*traíra*), which is distributed in the upper portion of Una do Preto River, entering the CUs that border Barra do Una SDR. This demand was specifically for fishing on board, accompanied by local fishing guides, during specific periods. This issue was not contemplated in the UP as the aforementioned CUs are fully protected and, at the time, the integrated management of the MUCJI was not discussed. According to local fishing guides, this type of fishing does not impact the terrestrial portion of the CUs since it is practiced only by fishermen on board and accompanied by them. Moreover, the proposal only contemplates the modality of “catch and release” and respect for good practices. Thus, according to the guides, it would reduce the fishing pressure for sea bass in the estuary region, the main target of recreational and artisanal fishing.

At the end of the community training program, the last participatory workshop emphasized the norms established for recreational fishing in the UP, encouraging discussion on strategies for their implementation. The demands identified in the workshops were the increase in inspections and the production of informative materials for environmental education actions. Therefore, to contribute to the awareness of the importance of good practices, conservation of the environment and target species of recreational fishing, respecting the legislation and local community, illustrative pamphlets and logbooks containing the norms were produced and distributed. In order to ensure that recreational fishermen were aware of the legislation regarding the minimum catch size of the species, portable adhesive cloth rulers were produced and attached to the boats that provided recreational fishing services. In addition, information signs were installed at the main places for

embarkation/disembarkation for recreational fishing (Portinho and Tocaia), as well as at the doorway through which everyone passes to access the Barra do Una SDR.

Discussion

We observed changes in the profile of fishermen and fishing activities regarding the development of services provided to recreational fishing, mainly due to the increase of visitors practicing on the site (Molitzas et al., 2019), as well as the greater involvement of the community, for example, by the implementation of community-based tourism (Ferreira and Raimundo, 2016; Dopona et al., 2020). The predominance of men in recreational fishing is still a pattern in Brazil (Barrella, et al., 2016; Alves-Junior et al., 2020; Freire et al., 2020) and in other countries (Rees et al., 2017). The same pattern was observed in relation to the low frequency of possession of a recreational fishing license in other areas such as Deck do Pescador in Santos, where only 36.0% had a document to practice recreational fishing (Barrella et al., 2016) and 32.5% in the Mongaguá Fishing Platform (Alves-Junior et al., 2020). Nonetheless, most license issues were identified in the states of São Paulo and Paraná, between 2011 and 2013, representing 56.0% of the licenses in Brazil in this period (Freire et al., 2020).

It is noteworthy that the involvement of the Barra do Una SDR community with recreational fishing is not recent and is related to the difficulty in marketing and selling artisanal fishing production (Ferreira et al., 2021). Although historically linked to the recreational fishing by secondary activities (Ferreira et al., 2021), the Barra do Una SDR community could expand its involvement, for example, through the trade of live baits since the main techniques for recreational fishing require this type of bait (Zeineddine et al., 2015; Ferreira, 2019) and because there are restrictions established in the UP regarding the use of baits in this SDR (São Paulo, 2020).

The demand for inspection was also reported by users of the Anhatomirim EPA, located in the state of Santa Catarina, southern Brazil (Macedo et al., 2019). The request is legitimate once it generates effective results as observed by Corrales et al. (2020) in Marine Protected Areas in the Mediterranean Sea, including positive changes in users' perceptions, as identified by Gollan and Barclay (2020) in two Marine CUs in New South Wales (Australia), and by Katikiro et al. (2021), in the Mnazi Bay-Ruvuma Estuary Marine Park (Tanzania). In this sense, Holder et al. (2020) listed the inspection as one of the issues capable of changing the practitioners' perceptions concerning recreational fishing impacts and increasing the benefits both for the activity and the people involved. Overall, inspection is impaired by the lack of financial resources and/or due to the small number of CUs, in addition to controversial public policies (Macedo et al., 2019; Barbosa et al., 2021; Katikiro et al., 2021).

Considering that the main target species of recreational and artisanal fishing in Barra do Una SDR is the sea bass (Centropomidae), it is essential to know its local bioecological aspects such as feeding, reproduction, growth, and population structure. Such information should contemplate the entire ecotone (MUCJI and Marine EPAs) and not be restricted to political boundaries (Cresswell et al., 2019; Alic et al.,

2021; Watson et al., 2021). It should also be considered that the species has a high plasticity (diadromous, euryhaline, and stenotherm) and performs constant migrations for feeding (carnivores) and reproduction (protandrous hermaphrodites) (Dantas and Barletta, 2016; Daros et al., 2016; Assis et al., 2019; Stevens et al., 2020). Besides, management must evaluate the catch effort of both fishing activities, as well as integrate the management of the different CUs involved, and the participation of the local community, which plays a major role in the success of fishing management (Cresswell et al., 2019; Macedo et al., 2019; Gollan and Barclay, 2020; Alic et al., 2021; Jeanson et al., 2021; Watson et al., 2021). This entire framework reinforces the necessity for discussions on the uses and potential conflicts between the different activities in the fishing territory and the management of the CUs, where the need to review recreational fishing regulations for the monitoring of catches, especially within and around CUs, is emphasized in addition to the adoption of an integrative management system and resilience models (Cresswell et al., 2019; Corrales et al., 2020; Alic et al., 2021).

Cresswell et al. (2019) and Corrales et al. (2020) showed that the effects of recreational fishing on CUs are related to the bioecological characteristics of the target species and habitats as well as the size and age of the CUs. This relation was evident in the Barra do Una SDR, whose fishing effort is directed towards the estuary region and sea bass, due to fishing restrictions in the upper portion of the Una do Prelado River by the Itinguçu State Park and the Juréia-Itatins Ecological Station. Hence, a possible authorization for the demand of fishing guides concerning the controlled catch of *Hoplias malabaricus* (*traíra*) in the region could reduce the effort directed toward the sea bass species, which is categorized as "near endangered" in the state of São Paulo (São Paulo, 2018). It should be noted that trahiras are demonstrably of great interest in recreational fishing, identified as one of the species most caught by fishermen in inland waters (Freire et al., 2012; Oliveira et al., 2022). Furthermore, it has high physiological plasticity and resistance to the effects of catch and release, if good practices are observed such as reducing the time spent handling it out of the water (Andrade et al., 2021).

It is worth considering that in the Barra do Una SDR there are no data on recreational fishing catches, which makes fisheries management difficult (Dal Negro et al., 2021). Thus, it is extremely urgent that fishing monitoring be carried out, which can be implemented by "citizen science," in which recreational fishermen contribute to data collection, using new technologies (Pita et al., 2020; Cooke et al., 2021). This is also observed in the Madeira River (in Amazon region) since 2018, through an application called ICTIO, in which fishermen record their catches through photos and information about the place and date of the fishing (Doria et al., 2019).

Although recreational fisheries management is a global challenge due to the complexity and involvement of many transdisciplinary issues (Holder et al., 2020), the UP of Barra do Una SDR represented an important advance for Brazilian recreational fisheries management, mainly in the CUs. It should be noted that not meeting the demands of users does not completely invalidate the effectiveness of the CUs for

multiple uses, as it is often necessary to consider the specific objectives of the CUs, as well as understand that the long periods for meeting the demands are related to the lack of transversality of the institutions responsible or even their lack of authority (Macedo et al., 2019).

In this context, contemplating the local ecological knowledge of the artisanal fishermen who live in the Barra do Una SDR, and integrating them in an organized way into the recreational fishing activity is paramount. They have deep knowledge of the habitats and behaviors of target species and can be integrated into this activity as fishing guides, putting their knowledge into practice in the search for fishing resources, while benefiting from the provision of services. At Barra do Una SDR, the local fishermen were key actors in the development of the UP, which indicates their commitment and availability to participate, organize, and monitor the fishing activities that occur in their territory.

In this sense, studies and spaces for dialogue in other communities of artisanal fishermen also fostered the creation of Ordinance MMA/ICMBIO No. 91/2020 (Brasil, 2020). This ordinance provides procedures for the regulation of recreational and sport fishing activity in federal CUs of sustainable use and fully protected that home traditional populations, with the aim of generating legal instruments for planning the activity and providing for its inclusion in management plans.

Conclusions

The information presented on recreational fishing in Barra do Una SDR demonstrates its importance as a source of income, especially if the guidelines established by the UP are respected. In addition, this

information can be considered a model and replicated in other CUs where this type of fishing takes place without planning.

Scientific research, by socioeconomic, ethnoecological, and fishing dynamics studies, as well as the engagement of CUs managers and the participation of the local community, contributed to planning recreational fishing in Barra do Una SDR, through the UP. This experience should be considered for the Integrated Management of Conservation Units as provided in Law No. 9985/2000 (Brasil, 2000) and Decree No. 8974/2017 (Brasil, 2017) which provide, respectively, the integrated management of the set of CUs and the possibility of establishing integrated management centers, in any federative entity, to improve the management of CUs.

We emphasize the need for promoting research on the bioecological aspects of species in the region, exploited by recreational and artisanal fishing modalities, mainly sea bass and trahira, as well as further investigations into the demand of local residents regarding the controlled exploitation of trahira, as a measure to balance the exploitation of sea bass.

Finally, in order to advance the knowledge of recreational fishing in the region and generate effective management strategies for conservation, guidelines are still needed for participatory monitoring of target species, awareness of the regularization of licenses of recreational fishermen, and reinforcements in inspection.

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