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Fisheries monitoring in Brazil: How can the 2030 agenda be met without fisheries statistics?

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Abstract: Every activity that involves exploitation of natural resources, such as fishing, needs to be organized and conducted based on information from monitoring programs to allow continuous evaluation. With the increasing fishing pressure in Brazil, the understanding of the importance of fisheries monitoring programs and how they can inform and assist in conservation decision-making remains limited. Based on the literature on fisheries and participatory conservation, we call attention to the need to generate information on the national fisheries sector in order to improve fisheries in the country. Given the context of the need to generate information on fishing stocks under exploitation, as well as to identify potential alternative fisheries and carry out various sectoral analyses in compliance with the 2030 Agenda for Sustainable Development, we present and discuss in the present paper the lack of a system of continuous fishing monitoring in Brazil and its effects on the fisheries sustainability in the country.
Keywords: *sustainable development; fishing resources; conservation.*

Monitoramento da pesca no Brasil: como cumprir a agenda 2030 sem estatísticas da pesca?

Resumo: Toda atividade que atua envolvendo a exploração de recursos naturais, como a pesca, precisa ser organizada e conduzida com base nas informações dos programas de monitoramento para permitir uma avaliação contínua. Com o aumento da pressão pesqueira no Brasil, o entendimento da importância dos programas de monitoramento da pesca e como eles podem informar e auxiliar na tomada de decisões de conservação permanece limitado. Com base na literatura sobre pesca e conservação participativa, chamamos a atenção para a necessidade de gerar informações sobre o setor pesqueiro nacional para melhorar a pesca no país. Dado o contexto da necessidade de gerar informações sobre os estoques pesqueiros em exploração, bem como identificar potenciais alternativas de pesca e realizar diversas análises setoriais em conformidade com a Agenda 2030 para o Desenvolvimento Sustentável, é apresentada e discutida no presente trabalho a falta de um sistema de monitoramento contínuo da pesca no Brasil e seus efeitos na sustentabilidade da pesca no país.
Palavras-chave: *desenvolvimento sustentável; recursos pesqueiros; conservação.*

Introduction

Every activity that involves the exploitation of natural resources, such as fishing, needs to be organized and conducted based on information from monitoring programs to allow continuous reassessment of the activity in order to adjust procedures and support management actions, which ensure the protection of stocks, and biodiversity (Pereira et al. 2013; Mendonça, 2018). The periodic monitoring of this information system makes it possible to identify and correct knowledge gaps and to guarantee access and transparency to the actors involved such that maximum efficiency is achieved and the resource is harvested in a sustainable way.

The fragility of the fisheries policy laws and the lack or inefficiency of monitoring and management have been the main drivers of the depletion of fisheries resources on a planetary scale, where various fisheries have capture levels above the natural replacement capacity of the exploited stocks, compromising the sustainability of the activity and the health of the fish, seas and oceans (OCEANA, 2016), as well as inland aquatic ecosystems (Allan et al. 2005). To face this reality and the need to maintain a balance between human population growth and social, economic and environmental demands, representatives of heads of state and government met in September 2015 at the headquarters of the United Nations (UN) in New York and launched the "2030 Sustainable Development Agenda" with 17 Sustainable Development Goals, or SDGs (UN, 2015). In 2017, Brazil presented its Voluntary National Report on the SDGs at an event to support SDG 14 "Conserve and ensure the sustainable use and development of the oceans, seas, freshwater bodies and marine resources" (Brazil, 2017). In this report, the country described actions linked to the elaboration of plans for the management of fisheries resources, including monitoring with coverage of species relevant to the fisheries sector and for the conservation of biodiversity.

Decision makers need updated data on exploitation in order to control and promote the activities without reaching the overexploitation threshold (FAO, 2020). Given the context of the need to generate information on fishing stocks under exploitation, as well as to identify potential alternative fisheries and carry out various sectoral analyses in compliance with the 2030 Agenda for Sustainable Development, we present and discuss in the present paper the lack of a system of continuous fishing monitoring in Brazil and its effects on the fisheries sustainability in the country.

Results and Discussion

1. Fisheries in Brazil and the precariousness of monitoring

South America has the greatest diversity of fish on the planet, considering marine, estuarine and freshwater species, corresponding to about 30% of all fish species in the world, about one-third of the world's freshwater fish species, and one-fourth of the planet's marine fish species (Buckup et al. 2007, Reis et al. 2016, Cassemiro et al. 2023). Brazil has the largest hydrographic network in the region and more than 8500 km of coastline, making this country the continent's leader in diversity of species of fish (Buckup et al. 2007, Reis et al. 2016).

Fishing is the extraction of aquatic organisms from their natural environment for the purpose of consumption, recreation and commercialization as food or hobby (aquarium) (Frédou et al. 2021). The large territorial extent, combined with the enormous diversity of native fish species, gives the Brazil a huge potential for both marine and freshwater fisheries. The lack of monitoring hampers properly responses to the multiple threats facing aquatic ecosystems in Brazil, which include expansion of agricultural and urban areas, overfishing, pollution, river damming and construction of hydroelectric power plants, aquaculture, few river regulations, soil erosion and silting of the freshwater environments, deforestation, ghost fishing, modification and diversion of the river channels, species introductions, irregular water abstraction for different urban, industrial and agricultural uses, release of domestic and industrial effluents and chemical products from agricultural activities, and others (Azevedo-Santos et al. 2011, Azevedo-Santos et al. 2021, Bergmann et al. 2020, Castro 1999, Castro & Polaz 2020, Doria et al. 2021, Figueredo & Giani 2005, Fearnside et al. 2021, Giacomini et al. 2011, Pereira et al. 2016, Pelicice et al. 2017, Pelicice et al. 2021, Rocha et al. 2023, Vitule et al. 2015, Vitorino et al. 2022, Vieria et al. 2023, Zeni et al. 2019). In Brazilian marine ecosystems, the activity is practiced along the entire coast and is related to a territorial strip that houses about 2/3 of the Brazilian population (Araújo & Maia 2011).

Despite providing the livelihood of many riverine and coastal populations, information on the socioeconomic importance and sustainability of fishing activity is fragmented, limited or even non-existent, especially those related to artisanal or small-scale fishing (Silva 2014, FAO 2022), which is precisely the most widespread modality in Brazil. There is a notorious lack of an integrated fisheries monitoring system that generates essential information on the socioeconomic situation of fishermen, in addition to biological, economic, environmental and technological data linked to fishing activities (EMBRAPA 2021) for the development of fisheries management programs, and, consequently, the organization of the activity and maintenance of fish stocks in exploitation (Silva 2014). Historically, there is enormous inefficiency in the census and maintenance of records obtained by fishing colonies and the federal government on fishing activities and catches, that generates an inaccurate and underestimated census of the fishing production chain (Rodrigues, 2022). The information available on continental fisheries in Brazil has already been classified as extremely poor, in quality and quantity (Welcomme 1990, Agostinho et al. 2007).

The first fish landing monitoring in Brazil records were published by the Brazilian Institute of Geography and Statistics (IBGE) for the years from 1946 to 1953 (IBGE 1955). Subsequently, responsibility for monitoring the activity was transferred to the Fisheries Development Superintendency (SUDEPE), an agency under the Ministry of Agriculture, Livestock and Supply (MAPA) from 1950 to 1988 (MAPA 1962). The structuring of fisheries monitoring in Brazil gained more tools with the creation, in the mid-1990s, of the Fishing Statistical Data Generation System (ESTATPESCA) (Aragão 2008). In 1989 SUDEPE was abolished and incorporated into the newly created Brazilian Institute of the Environment and Renewable Resources (IBAMA), and from 1989 to 2007 monitoring was the responsibility of IBAMA's Center for Research and Fisheries Extension in the Northeast (CEPENE) (IBAMA 1995). Isolated and discontinued initiatives took place in several parts of the Paraná-Paraguay basin, such as those of Embrapa for the Paraguai river basin, and Iguaçu river basin (Petrere & Agostinho 1993, Okada et al. 2005), Paraná Tietê e Grande basins (AES-Tietê 2007). Even with these tools and structural mobilization, many limitations regarding the methods used made the data insufficient to elucidate the real scenario of fishing in Brazil, a deficiency that persists to the present.

In 2008, despite the progress made with the creation of the Ministry of Fisheries and Aquaculture (MAPA), the values began to be estimated using statistical imputation models (Zamboni et al. 2020); fisheries statistics were published until 2011, and the transfer of information on fishing activity to FAO were completely suspended beginning in 2014 (FAO, 2018). Since then, Brazilian fisheries began to face deeper difficulties, without specific public policies for the sector, such as the establishment of quotas for fishing, strengthening the local socio-economy, access to lines of credit and support for the governance of fishing communities (EMBRAPA 2021).

One of the main obstacles to the maintenance of a fisheries monitoring program is the cost of technical personnel and the maintenance of monitoring activities, which require the responsible institutions to adjust their collections and methodologies to include as much information as possible to help in the planning and operationalization of financial resources (Mendonça 2018). Establishing operational fisheries monitoring in Brazil represents a great logistical, human, and financial challenge, considering the territorial extent of the country, the difficulty access to certain locations, the diversity of ecosystems, fish and fishing methods, and the diffuse character of fishing activity. One of the promising strategies launched by specialists and researchers around the world is self-reporting, such as the model proposed by the São Paulo Fisheries Institute (IP/SP) and the actions used by the Chico Mendes Institute for Biodiversity (ICMBio) under the Global Socioeconomic Monitoring Initiative for Coastal Management (SocMon), which is used in more than 30 countries to generate information for coastal management (Gomes & Barros 2017, Mendonça 2018, Dias & Seixas 2019), a strategy linked to the obtaining of information in a participatory manner with community involvement.

It is essential that Brazilian authorities resume fisheries monitoring programs. The relevance of monitoring fish landings for sustainable fisheries management is highlighted by Fredou et al. (2021), who emphasize the importance of government involvement in continuous programs for the collection and analysis of data in a systematic way, encompassing technical, socioeconomic, and ecological information and ensuring the application of the Fisheries Ecosystem Approach. In fact, monitoring represents the main challenge for national fisheries management. From this perspective, public managers, researchers, local leaders and other actors will be able to devise more effective and participatory strategies for each region, fishing fleet, fishing gear, target and fish species (including non-target species). This would significantly reduce the risk of generating perfunctory data. It is also very important that authorities seek to improve methodologies, including the consideration of new variables, such as: i) morphometric and reproductive data on target and non-target species, aiming at stock assessment analysis, minimum capture size, size at first maturity (L50), natural mortality and fishing mortality; ii) social and economic data, including prices of fish sales at each step from the producer to the final consumer and the costs of labor, boats and other operating expenses, in addition to relevant information on family income and on satisfaction with the profession. With this

volume of information, it will be possible to generate ecosystem models encompassing all of the variables necessary for efficient fisheries management, not just production estimates.

In order to meet the needs of generating information on the national fishing sector and help in complying with the SDGs, there is an urgent need to create a federal institute destined exclusively for the management of fisheries in the country, which can actually develop actions that strengthen discussions in the sector, in line with the conduct of scientific research and the need to guide public policies to promote sustainable fishing in Brazil. Attention should be paid to the following guidelines:

I. Work with existing data and metadata reporting systems and create online systems for exchanging information, including reporting on key indicators, and providing opportunities for horizontal and vertical coordination.
II. Create a national network that allows the compilation of data collected punctually by state and municipal governments through their secretariats.
III. Expand and strengthen the Permanent Management Committees, which enable the effective participation of civil society in building an efficient fisheries system.
IV. Create a National Fisheries and Aquaculture Database similar to the Brazilian navy's National Bank of Oceanographic Data (BNDO).
V. Create digital tools (apps and statistical programs applied to fisheries and aquaculture) to obtain and process national fisheries data.
VI. Use self-reporting to carry out fishing monitoring, as it enables the recording of accurate data on fishing, enabling better conditions for collecting information, reducing costs, logistics and the need for technical personnel to visit fishermen.
VII. Resumption of strategic programs for the assessment of marine and estuarine fish stocks similar to the Program for the Sustainable Assessment of Living Resources in the Exclusive Economic Zone of Brazil (REVIZEE).
VIII. Create certification or quality seals backed by fish tracking mechanisms, for both species of commercial and ecological importance and for non-target species.
IX. Modernization and expansion of the Floating Teaching Laboratories Project funded by the Ministry of Education.
X. Popularization of ocean science with a view to democratizing scientific knowledge and promoting the right to information and social participation.

Conclusion

In contrast to increasing fishing pressure in Brazil, the understanding of the importance of fisheries monitoring programs and how they can inform and assist in conservation decision-making remains limited. Based on the literature on fisheries and participatory conservation, we call attention to the need to generate information on the national fisheries sector in order to improve fisheries in the country. Fishing monitoring data and information is critical for decision-making on conservation and to guide public policies that promote sustainable fishing in Brazil.

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Conflicts of Interest

The authors declares that they have no conflict of interest related to the publication of this manuscript.

Ethics

This study did not involve human beings and/or clinical trials that should be approved by one Institutional Committee.

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