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Incidental fishing of *Epinephelus itajara* (Lichtenstein, 1822): the vulnerability of a critically endangered species of the Brazilian coast

Pesca incidental de *Epinephelus itajara* (Lichtenstein, 1822): a vulnerabilidade de uma espécie criticamente ameaçada na costa brasileira

Pesca incidental de *Epinephelus itajara* (Lichtenstein, 1822): la vulnerabilidad de una especie en peligro crítico frente a la costa brasileña

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Abstract
Epinephelus itajara, popularly known as grouper, has a wide distribution and is considered the largest fish in the Atlantic Ocean. Behavioral characteristics allied to overfishing and degradation of marine habitats caused declines in *E. itajara* populations throughout the entire geographic distribution area. The goliath grouper is currently ranked on the IUCN RedList as Vulnerable in Global Status and Critically Endangered in the Gulf of Mexico. In Brazil, even with a fishing moratorium that has protected it since 2002, the species is categorized as critically endangered in the Red Book of the Instituto Chico Mendes de Conservação da Biodiversidade. Taking into account these factors and the information gap on the goliath grouper, this study addresses an account of an occasional "post mortem" encounter with a specimen on the edge of Pajuçara beach, Maceió - Alagoas. It was an adult individual, whose size was estimated at 1.6 m and 70 kg of body mass. This study also presents discussions about the conservation status of the species and the efficiency in the management of marine protected areas, revealing that even with many marine protection areas, incidental captures and port records are still recurrent on the Brazilian coast. This record highlights the need to reinforce inspections, in addition to suggesting that the management of these areas be more efficient, ensuring the reestablishment of grouper populations in the region.
Keywords: Atlantic Goliath grouper; Endangered species; Marine protected areas; Coastal management, Incidental catch.

Resumo

Epinephelus itajara, popularmente conhecida como mero, possui ampla distribuição e é considerado o maior peixe do oceano Atlântico. Características comportamentais aliadas a sobrepesca e a degradação dos habitats marinhos ocasionaram declínios nas populações de *E. itajara* ao longo de toda área de distribuição geográfica. Atualmente, o mero está classificado na RedList da IUCN como vulnerável no status global e criticamente ameaçado no Golfo do México. No Brasil, mesmo com uma moratória de pesca que o protege desde 2002, a espécie é categorizada como criticamente ameaçada no Livro Vermelho do Instituto Chico Mendes de Conservação da Biodiversidade. Levando em consideração esses fatores e o hiato de informações sobre o mero, este estudo aborda um relato sobre um encontro ocasional *"post mortem"* com um exemplar na orla da praia de Pajuçara, Maceió - Alagoas. Tratava-se de um indivíduo adulto, cujo tamanho foi estimado em 1,6 m e 70 kg de massa corporal. Esse estudo também apresenta discussões sobre o status de conservação da espécie e a eficiência na gestão das áreas marinhas protegidas, revelando que mesmo com muitas áreas de proteção marinha, as capturas incidentais e registros portuários ainda são recorrentes na costa brasileira. Esse registro evidencia a necessidade de reforço na fiscalização, além de sugerir que a gestão dessas áreas seja mais eficiente garantindo o restabelecimento das populações de mero na região.

Palavras-chave: Mero; Espécies ameaçadas; Áreas marinhas protegidas; Gestão costeira; Captura incidental.

Resumen

Epinephelus itajara, conocido popularmente como mero, tiene una amplia distribución y es considerado el pez más grande del Océano Atlántico. Las características de comportamiento aliadas a la sobrepesca y la degradación de los hábitats marinos provocaron disminuciones en las poblaciones de *E. itajara* en toda el área de distribución geográfica. El mero está actualmente clasificado en la Lista Roja de la UICN como Vulnerable en Estado Global y en Peligro Crítico en el Golfo de México. En Brasil, incluso con una moratoria de pesca que la protege desde 2002, la especie está catalogada como en peligro crítico en el Libro Rojo del Instituto Chico Mendes de Conservação da Biodiversidade. Teniendo en cuenta estos factores y el vacío de información sobre el mero, este estudio aborda un relato de un encuentro "post mortem" ocasional con un ejemplar en el borde de la playa de Pajuçara, Maceió - Alagoas. Se trataba de un individuo adulto, cuya talla se estimó en 1,6 m y 70 kg de masa corporal. Este estudio también presenta discusiones sobre el estado de conservación de la especie y la eficiencia en la gestión de las áreas marinas protegidas, revelando que incluso con muchas áreas marinas protegidas, las capturas incidentales y los registros portuarios siguen siendo recurrentes en la costa brasileña. Este registro destaca la necesidad de fortalecer las inspecciones, además de sugerir que el manejo de estas áreas sea más eficiente, asegurando el restablecimiento de las poblaciones de mero en la región.

Palabras clave: Mero; Especies en peligro de extinción; Áreas marinas protegidas; Manejo costero; Captura incidental.

1. Introduction

Popularly known as the Atlantic Goliath grouper, the *Epinephelus itajara* (Lichtenstein, 1822) has a wide geographical distribution, occurring in the tropical regions of the Western Atlantic, from Florida, USA, to Santa Catarina, at the Brazilian South; and in the Eastern Atlantic, from Congo to Senegal, in Africa (Heemstra & Randall, 1993; Craig, 2011). It is the biggest tropical and subtropical Atlantic fish, reaching up to 2.5 m long, 400 kg, and can live more than 37 years (Bullock et al., 1992; Sadovy & Eklund, 1999).

The Atlantic Goliath grouper has a slow growing rate, taking more than 6 years to reach its first sexual maturity, and are protogynous hermaphrodites, which gives them the ability to switch sex (from the female to male) after the first maturation (Bullock et al., 1992; Koenig et al., 2016; Koenig et al., 2017). While young, they habit mangrove, estuaries and shallow rocky areas; when adult, they are frequently found in rocky reefs, wreck/sinkings, artificial reefs, and oil platforms (Sadovy & Eklund, 1999).

Several factors led the *E. itajara* populations to decline to critical levels. A few of the specie characteristics, such as the aggregation during the reproduction periods, the slow growing rates and the late sexual maturation, are barriers that make it difficult for the reestablishment of those populations and leave them vulnerable to fishing activity (Sadovy de Mitcheson et al., 2012; Bertoncini et al., 2018). These threats are even bigger when associated to the growing degradation rates of habitats favorable for their feeding, and reproduction, such as mangroves and coastal reefs (Rhodes & Graham, 2009).

Due to the *E. itajara* populations decline around its occurrence areas, the last IUCN red list of threatened species pointed the Atlantic Goliath grouper as globally vulnerable (A2bcd), and critically threatened in the Mexican Gulf (Bertoncini et al.,

2018). In Brazil, according to the Instituto Chico Mendes de Conservação da Biodiversidade's Red Book, the grouper is classified as critically threatened (Ferreira et al., 2018). In light of the difficulty obtaining data about the *E. itajara*, this study, in addition to the biometric register and distribution, also approaches discussions about the conservation status and the threats that have been causing the decline of *E. itajara* populations.

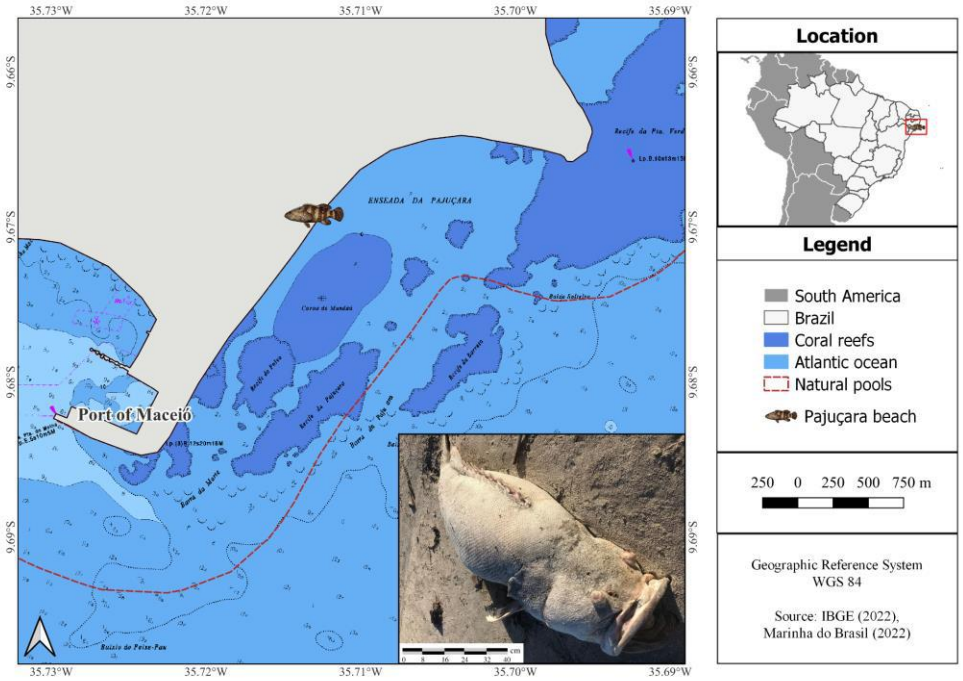
2. Methodology

One of the authors has found a "*post mortem*" *E. itajara* individual at the Pajuçara beach, located at the Maceio municipality, Alagoas state, Brazil. The Pajuçara beach is located under the coordinates 9° 40' 8.43" S e 35° 42' 46.73" O, limited by the Atlantic Ocean to the east, and by the Maceió municipality to the other directions. This beach presents rocky reefs with more than a kilometer long extension that follows along with a large part of the waterfront, highly frequented by tourists for recreational purposes, such as practicing nautical sports, diving, underwater hunting, shellfish collection, and fishing (Nascimento, 2021).

The specimen found at the Pajuçara beach was photographed with a smartphone camera, which allowed the length estimation, according to the Johnson & Farid (2006) method, by using a known size object in the same photograph taken of the grouper, and utilizing the Adobe's Photoshop "vanishing point".

We georeferenced the specimen location with Google Earth Pro v. 7.3.4.8642, produced the map with the QGIS v. 3.2237 utilizing the shapefiles provided by the "Instituto Brasileiro de Geografia e Estatística" database, the Nautic Card provided by the Brazilian Marine, and inserted a photograph of the dead animal found (Figure 1). Finally, for this case study, we used the available literature to gather information and discuss the conservation status of the *E. itajara* in marine protected areas (MPAs).

Figure 1: Location map of the *Epinephelus itajara* found at the Pajuçara beach, in Maceió municipality, Alagoas.



Source: Authors.

3. Results and Discussion

On December 8, 2021, at the edge of the Pajuçara beach, one of the authors found a *E. itajara* specimen with approximately 1.6 m length and around 70 kg of corporal mass. The animal had fishnet marks on its tegument, close to the opercular region, indicating an incidental capture, later confirmed by the locals at the moment of the encounter (Figure 1). The Pajuçara beach is well known for attracting tourists looking for its long rocky reefs and pools, usually inhabited by *E. itajara* individuals.

Since the specie is still a victim of incidental captures, it is important to emphasize that the minimum distance from reef environments, whether natural or artificial, were not respected, damaging the grouper protection. The incidental capture makes the fishermen, afraid of retaliation from control organs, discard the captured individuals into the sea or illegally store it to sell in the black market.

In Brazil, the population decline of the specie in several regions prompted the creation of the IBAMA decree – Nº 121/2002 to protect the specie for the following 5 years (from 2002 to 2007), and it was the first marine fish in Brazil to receive such treatment. However, with the continuous decline in the grouper population, it was renewed in 2007 (IBAMA decree – Nº 042/2007), and once again in 2015 (IBAMA decree – Nº 013/2015), which guaranteed its protection until 2023 (Giglio et al., 2016). Despite the decrees, reports of *E. itajara* in port landings are still common. They are derived from illegal fishing, and are commercialized along the entire Brazilian coast (Giglio et al., 2014).

Despite the low grouper captures reported by fishermen (Sales, et al., 2022), the incidental captures with industrial trawl nets are recurrent, especially in the Brazilian Northeast (Bentes et al., 2019), where more than 49 tons were landed between 2008 and 2010 in the Pará state (Pereira et al., 2021). The commercialization prices varied from R$ 6.00 to R$ 20.00 per kilogram depending on the time of the year. In the Amazon region, the grouper fishing coincides with its reproductive cycles that occur between the months of September and March. However, despite the time of the year and the capture conditions, direct or

incidental, most of the illegally captured groupers are commercialized in the Amazonian littoral (Pereira et al., 2016; Pereira et al., 2020).

Situations like this, as the one found in the Pajuçara beach, allows us to examine the threats faced by other megafauna species that can lead to stock depletion, occasioning population declines, and, eventually, local extinctions. Despite the higher resistance of some sea species to population declines when compared to the terrestrial fauna, this defaunation seems to be quickly rising in marine ecosystems, mainly occasioned by the increase of anthropical effects, that causes ecological imbalance (McCaulen et al., 2015).

Marine fauna abundance reduction is well documented, and the existing studies show it reduced by 38% in the last decade. Many of these declines were considered ecological extinctions, which means that these species can no longer play their functional roles (Hutchings et al., 2010). The permanent influence over the species interactions, structure and trophic dynamics are factors that contribute to the population decline of several marine fish species (Hutchings & Reynolds, 2004). In addition to that, the expansion and technological innovations of fishing methods make overfishing the main threat to marine biodiversity (McClenachan et al., 2016; Riple et al., 2019; Yan et al., 2021).

Overfishing, on artisanal and industrial scales, are the main aggravating factor faced by 19 *Epinephelidae* species considered as critically threatened by the IUCN's RedList. In addition to overfishing, coastal development and the pollution of marine environments are also among the threats faced by this group. The big sized grouper species, that live longer and have spawning aggregations during the reproduction cycles are the most threatened (Sadovy de Mitcheson et al., 2020), and these characteristics are also shared by the *E. itajara* (Sadovy de Mitcheson et al., 2012; Bertoncini et al., 2018).

In this context, the Brazilian government established 187 marine protected areas (MPAs), but the coastal management efficiency, in general, is not satisfactory (Fioravanso & Nicoldi, 2021). The MPAs were created to protect the species from local impacts, like pollution and overfishing, however, impacts caused by climate changes were not considered (Bates et al., 2019; Wilson et al., 2020). The MPAs are important strategies for the conservation of marine ecosystems, once they allow the expansion of reefs and reef fishes inside these areas, especially in those of integral protection (Cinner et al., 2018; Graham et al., 2020; Ferreira et al., 2021), presenting positive effects even in areas close to coastal cities (Huijbers et al., 2014).

Despite several threats to those populations, the groupers have shown positive responses in MPAs, with an increase in the population growth and reproductive success (Gerber et al., 2005). In addition to the MPAs, projects involving the fishermen communities, the society in general, and the researchers, aiming for the conservation of species and natural habitats can also be an effective strategy, especially when associated with environmental education actions with multidisciplinary groups, that create important information to foster the creation of public policies around the topic, and provide a better coastal management.

An excellent example is the "Meros do Brazil" (Brazil's groupers) project, which has been active on the Brazilian coast since 2001, and has been applying great effort to reverse the conservation status of the *E. itajara*. Its research efforts, participative monitoring of fishermen communities, and environmental education actions are executed in several Brazilian states, including the partnership of educational, research, and cultural institutions, with the common purpose of conserving the groupers and their living areas (Ferreira et al., 2018).

4. Final Considerations

To conserve a vulnerable marine species, such as the *E. itajara*, there is a need for an effective and participative coastal management, focused on assuring that more selective and less harmful capture practices in oceanic systems can be guaranteed along with respecting the established territorial limits.

The conservation measures must be urgent, in the determination of priority areas for threatened/vulnerable species. Also, the education of the general public about the importance of the conservation of marine ecosystems and its living fauna.

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