



Mapping the distribution of stingray fishing grounds in the south west waters of Aceh during the east season

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ARTICLE INFO

Keywords:

Mapping
Fishing Ground
Stingray
Eastern Season

DOI: 10.13170/depik.13.3.34532

ABSTRACT

One of the regions contributing to stingray fisheries production in Indonesia is Aceh province. The condition of stingray fisheries in Indonesia is currently facing challenges as the population is decreasing while the demand for stingray fishery resources domestically and abroad continues to increase. This condition certainly requires integrated stingray fisheries management efforts so that the rays' population, especially in the waters of Aceh province, remains sustainable. This study aimed to determine the number, type, and distribution of stingray fishing grounds landed at the Ujong Baroh Fish Landing Base (PPI). The research was carried out in 2 stages; the first stage was to conduct a field survey by following fishermen directly to the sea and using interview questionnaires, and the second stage was to take satellite image data of sea depth, fishing location, and fishing distance and then make a map of stingray fishing ground distribution landed at Ujong Baroh Fish Landing Base, West Aceh. The number of stingray catches landed at Ujong Baroh Fish Landing Base during the study was 428, consisting of 11 species: 369 *Maculabatis macrura*, 42 *Myliobatis tobijei*, 14 *Rhynchobatus australiae*, 28 *Dasyatis kuhlii*, 8 *Pateobatis uarnacoides*, 7 *Gymnura zonura*, 6 *Himantura leoparda*, 2 *Rhina ancylostoma*, 2 *Rhinobatos borneensis*, 1 *Aetobatus narinari*, and 1 *Taeniuriops meyeri*. The results of the mapping analysis showed 18 distribution points of stingray fishing grounds and 4 fishing locations that obtained stingray catches, namely at the coordinates of 3°38.136'N and 96°29.056'E, 4°2.144'N and 96°2.431'E, 4°16.599'N and 95°32.000'E, 3°34.51472'N and 96°25.80414'E.

Introduction

Aceh Province is located on the tip of the western island of Indonesia, which is surrounded by the ocean and has abundant fishery resources with the potential to be further developed. Aceh Province is located at the coordinates of 01°58'37,2"-06°04'33,6" North Latitude and 94°57'57,6"-98°17'13,2" East Longitude located in the Fisheries Management Area (WPP) 571 or in the waters of the Malacca Strait and WPP 572 in the waters of the Indian Ocean (Fuadi *et al.*, 2018; Fuadi *et al.*, 2022). With its position, Aceh is rich in biological and non-biological resources that can be utilized for human welfare.

Aceh is also one of the regions that contributes to stingray production in Indonesia. Furthermore, stingray fisheries in Aceh are currently facing major challenges because the ray population has decreased

while the demand for rays itself has increased domestically and abroad (Simeon *et al.*, 2020). In 2021, it was recorded that the stingray fishery production data noted in PPI Ujong Baroh reached 18,626 kg with an average selling price of Rp. 33,100/kg (DJPT, 2022).

The catch of stingrays landed at PPI Ujong Baroh is sold at prices ranging from Rp. 25.000/kg to Rp. 50.000/kg, with different sizes from saplings to adults. Therefore, the type of ray has an important economic price, although fishermen who land stingrays at PPI Ujong Baroh consider it bycatch. Based on the results of monitoring conducted (Simeon *et al.*, 2020) at PPS Kutaraja, TPI Rigaih, and TPI Ujong Serangga, there were six species of stingrays landed at the base, namely *Rhynchobatus australiae*, *Rhynchobatus laevis*, *Rhinobatos borneensis*,

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Maculabatis macrura, *Maculabatis gerardi*, and *Neotrygon caeruleopunctata*. The species of stingrays landed were among the types of fish conserved in the International Union for Conservation of Nature's (IUCN) red list. The results of the study (Wijayanti et al., 2018) stated that the conservation status was attached to stingrays because of their increased fishing and overfishing due to increased market demand for fins, meat, and skin.

According to Muttaqin et al. (2018), the use of stingray species in Indonesia is for food consumption and traded as export commodities. Indonesia is the third-largest stingray exporting country in the world, and with 90% of the world's ray catch, Indonesia is one of the shark- and ray-catching countries (Yuwanda et al., 2020; Dulvy et al., 2017). Based on information from FAO, Indonesia is among the countries producing the most stingrays and sharks and is in the top position every year (Fuadi et al., 2022).

Special attention needs to be paid to the stingray fishing fleet, which is considered baycatch through several fishing gear such as gill nets, trawls, long lines, and purse seines that need to be managed in stingray fisheries. Information data related to the distribution and biology of stingrays can be used as initial information for the basis of proper stingray fisheries management. There are several types of stingrays that require a long time to recover their populations to their original condition after exploitation.

Considering the conditions described above, stingray resources need to be carried out or managed properly so that the stingray population can be sustainable, maintain the economy of fishing communities, and conserve stingray resources. Therefore, attention to stingray fishing activities urgently needs to be increased, and updated data related to stingray fisheries in Indonesia needs to be updated every year. The availability of scientific data and information from researchers, especially information about the existence of stingrays in Indonesia, is currently very limited (Faizah et al., 2012). Therefore, by conducting research on stingrays all the time, it could provide information on the current condition of stingray fisheries in Indonesia. Based on the description of the problem above, it is necessary to conduct research to map the distribution of stingray fishing grounds in the waters of South West Aceh that are landed in PPI Ujong Baroh, West Aceh district.

The purpose of this study is to determine the type and number of stingray catches landed at PPI Ujong Baroh, then make a map of stingray fishing area distribution in the waters of South West Aceh.

Materials and Methods

Location and time of research

This research was carried out from June to August 2023, or in the East season, in two stages. The first stage was to conduct a field survey by following fishermen to the sea and using interview questionnaires, and the second stage was downloading satellite image data of sea depth, fishing locations, and fishing location distances, then making a map of stingray fishing ground distribution in the waters of South West Aceh, which was landed at PPI Ujong Baroh, West Aceh. The site of research was PPI Ujong Baroh, West Aceh district, as shown in Figure 1.

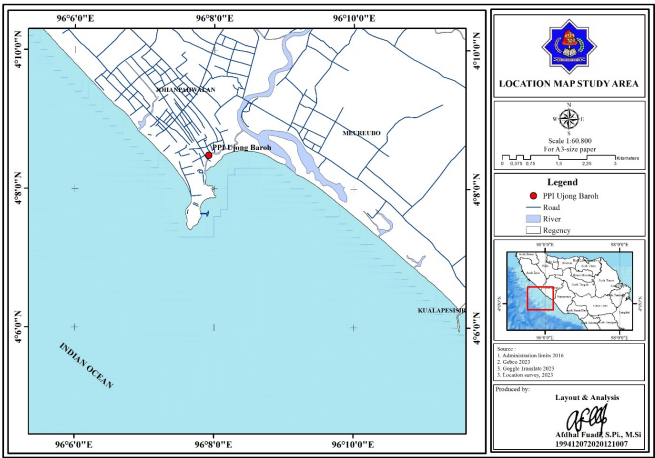


Figure 1. Research Site Map (Google Earth, 2023).

Tools and Materials

This research uses tools and materials to facilitate the implementation of research that can assist in the processes of data collection, data processing, and data analysis (Fuadi et al., 2022). The tools and materials used and their uses can be seen in Table 1.

Table 1. Tools and materials used in research.

No	Tools/Materials	Information
1	Global Positioning System (GPS)	Used to determine the coordinate position of the stingray fishing ground.
2	Life jacket	Used for safety during fishing activities.
3	Stationery	Used to record the catch of stingrays
4	Water map of South West Aceh	Used to determine the position of the stingray fishing grounds.
5	Camera	Used for pigeonification of stingrays, fishing fleets, and fishing gear used by fishermen.
6	Personal computer	Used to run Microsoft ArcGis 10.3 software, Google Earth, and Microsoft Excel to create maps of the distribution of stingray fishing grounds.

Research methods

The method used in this study was a survey method by observing the fleet or stingray fishing unit landed at PPI Ujong Baroh. According to Fuadi et al. (2016); Fuadi et al. (2022), to obtain data from phenomena in the field and to find factual information, it is necessary to use survey methods. Data collection in this study was categorized into two parts: primary data (questionnaires, coordinates of fish areas, time, and number of catches) and secondary data (data on water depth, fishing location, and distance of fishing locations).

Primary data

Primary data collection began with interviews with ship captains to obtain information on stingray fishing times and then directly followed the activities of the stingray fleet. The fishing fleets used in this study were gill net fishing gear, long line, and trawl, as the fishing gear is a fleet that conducts stingray fishing by fishermen at the Ujong Baroh Fish Landing Base (PPI). The considerations used in determining the vessel were (1) vessels that carry out loading and unloading at PPI Ujong Baroh and (2) vessels that catch fish in the waters of the West Strait of Aceh province.

Data collected from each fishing vessel fleet, namely fishing ground coordinates, fishing time, and number of fish catches (Liestina et al., 2015) can be seen in Table 2.

Secondary data

This secondary data collection used satellite imagery data, namely sea depth data, fishing locations, and fishing location distances (Table 2). The next stage was the preparation of a map of stingray fishing area distribution in the waters of South West Aceh.

Table 2. Data collection methods

Data Type	Required Data	Data Sources
Primary	- Number of stingrays caught	PPI Fisherman
	- Coordinates of the stingray fishing ground	
	- Stingray fishing time	PPI Fisherman
	- Size of the length of the stingray	
Secondary	- Depth of water	Google Earth
	- Distance of capture location	GEBCO

Analysis of stingray catches

The stingray catch data obtained during the study was grouped based on the number of catches landed at the Ujong Baroh Fish Landing Base (PPI). The number of stingray catches was analyzed by the

monthly catch, and the data was transformed in the form of graphs (Fuadi et al., 2022).

Analysis of the type of stingray catch

The types of stingrays obtained from the Ujong Baroh Fish Landing Base (PPI) were observed and identified for their species based on book guidelines, namely: 1) Rays of the World (Last et al., 2016); and 2) Descriptions of New Sharks and Rays from Borneo (Last et al., 2016). Then the next stage was to group the stingray data by type and make it into a graphic form.

Analysis of stingray fishing ground distribution map

The map of stingray fishing ground distribution was obtained from the results of analysis using the ArcGIS 10.3 application with several stages, namely: a) data on the distribution of stingray fishing ground, depth of waters, and distance of fishing base locations to fishing ground were inputted into the Arc Map. The results of the data input obtained information on the distribution of stingray fishing location points in the waters of South West Aceh; b) conduct an analysis (Extension of ArcMap) by interpolating and overlaying stingray coordinate data, depth, and distance of stingray fishing to obtain information on the spatial distribution of stingray fishing areas; c) do the layout in accordance with cartographic rules. The final result obtained from the data processing and analysis was a map of stingray fishing area distribution in the waters of South West Aceh during the East season.

Results

Number of stingray catches

The number of stingrays landed at the Ujong Baroh Fish Landing Base (PPI) during the East season (June to August 2023) was 428. The highest catch of stingrays occurred in June, at 333, while the lowest occurred in July 2023, at 70. The data can be seen in Figure 2.

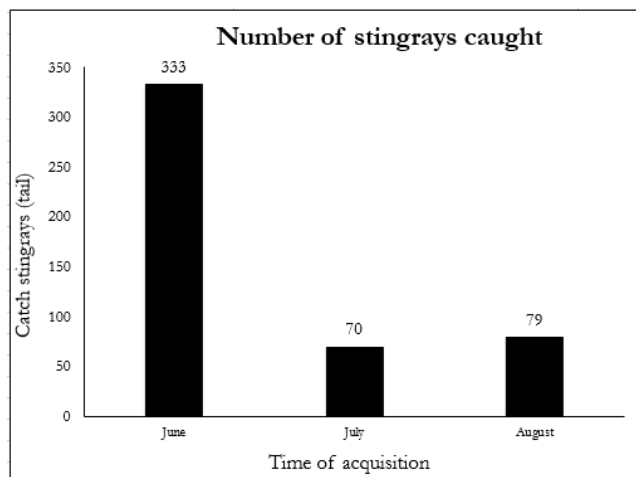


Figure 2. The number of stingray catches landed at PPI Ujong Baroh during the East season

Types of stingray catches

There were 11 species of stingrays landed at PPI Ujong Baroh from June to August 2023. They were 369 *Maculabatis macrura*, 42 *Myliobatis tobijei*, 14 *Rhynchobatus australiae*, 28 *Dasyatis kuhlii*, 8 *Pateobatis uarnacoides*, 7 *Gymnura zonura*, 6 *Himantura leoparda*, 2 *Rhina ancylostoma*, 2 *Rhinobatos borneensis*, 1 *Aetobatus narinari*, and 1 *Taeniuriops meyeri* (Figure 3). Data on the production of stingrays landed at PPI Ujong Baroh in 2021 amounted to 17,985 heads and in 2022 amounted to 20,445 heads.

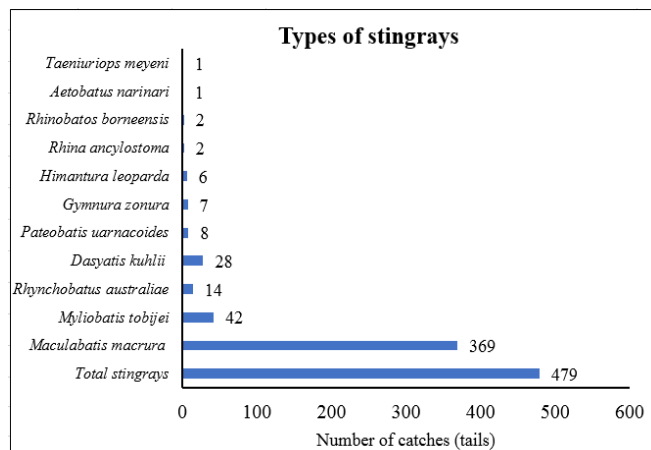


Figure 3. Types of stingray catches landed at PPI Ujong Baroh during the East Season

Based on Figure 4, it shows that the most caught stingray species is *Maculabatis macrura* with 369 heads, while the lowest catch is *Aetobatus narinari* and *Taeniuriops meyeri* with 1 head each.

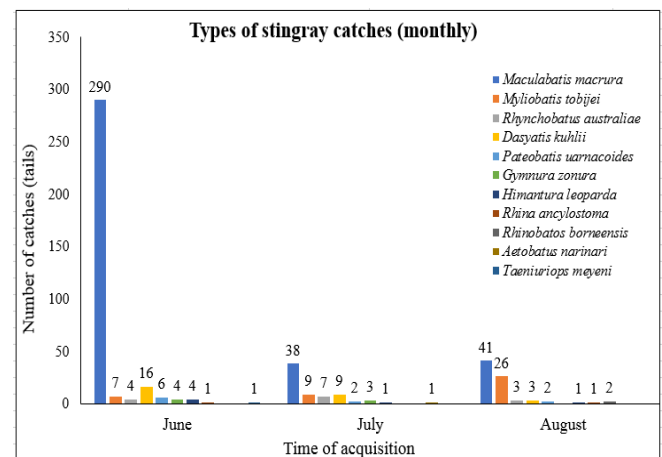


Figure 4. Types of monthly stingray catches landed at PPI Ujong Baroh

Map of stingray fishing grounds distribution

The distribution of stingray fishing grounds landed at PPI Ujong Baroh during the East season (June to August 2023) noted 18 fishing ground locations in the South West Waters of Aceh. The distribution of fishing grounds was used by gill net fishermen and long lines to carry out fishing operations. For the distance of the fishing location from the fishing base to the fishing ground, the closest was 9,63 miles, and the farthest was 42,41 miles (Figure 5).

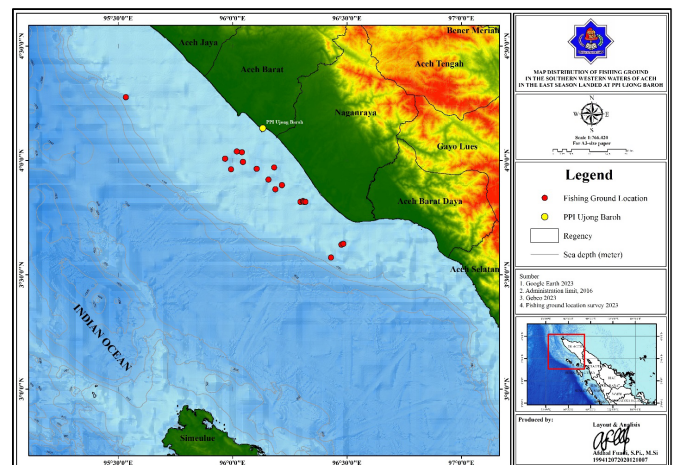


Figure 5. Map of fishing grounds distribution in the East season

Based on Figure 6, it shows that from 18 fishing ground locations, there are 4 locations for stingray catches, as shown in green. The types of stingrays caught at the location were *Maculabatis macrura*, *Rhynchobatus australiae*, and *Himantura leoparda*. The most dominant stingray fishing area caught at coordinates 95°59.575E and 3°57.644'N is the *Maculabatis macrura* ray species.

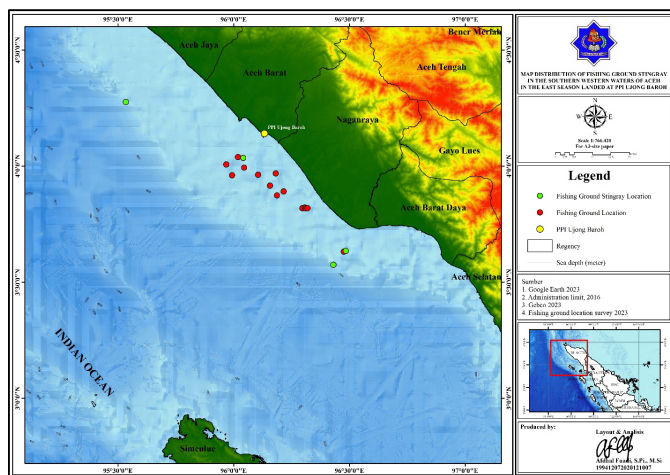


Figure 6. Map of stingray fishing grounds distribution during the East season

The distance of the stingray fishing location from the fishing base to the closest fishing gorund was 8,37 miles at a water depth of 5,18 meters, and the farthest distance was 38,23 miles at a water depth of 6,70 meters, based on satellite image calculations (Figure 6).

Discussion

The total catch of stingrays in the east season caught in the south-west waters of Aceh is less when compared to the west season. The catch in the east season was 428, while in the west season it was 2.232 (Figure 2). Based on the technical report on monitoring the catch of sharks and rays in Aceh province, stingray species landed in 3 ports (PPS Kutaraja, TPI Rigaih, and TPI Ujong Serangga) and noted 33 species and 9 families, and the most caught stingrays were species from the *Dasyatidae* family (39%), *Rhinidae* (33%), *Rhinopteridae* (13%), *Myliobatidae* (6%), *Mobulidae*, and *Rhinobatidae* (3%) (Simeon et al., 2020).

The types of stingrays landed at PPI ujong Baroh during the study were 11 species, including *Maculabatis macrura*, *Myliobatis tobijei*, *Rhynchobatus australiae*, *Dasyatis kublii*, *Pateobatis uarnacoides*, *Gymnura zonura*, *Himantura leoparda*, *Rhina ancylostoma*, *Rhinobatos borneensis*, *Aetobatus narinari*, and *Taeniuriops meyeri* (Figures 3 and 4). During the Western season, there are 10 species of stingrays, consisting of *Maculabatis macrura*, *Neotrygon caeruleopunctata*, *Taeniuriops meyeri*, *Gymnura zonura*, *Pateobatis uarnacoides*, *Himantura undulata*, *Rhynchobatus australiae*, *Aetomylaenus nichofii*, *Himantura leoparda*, and *Mobula kublii*.

Based on a technical report on monitoring shark and ray catches in Aceh province researched by Simeon et al. (2020), it stated that there were 6 types of stingray catches landed in 3 ports (PPS Kutaraja, TPI Rigaih, and TPI Ujong Serangga), namely

Rhynchobatus australiae, *Rhynchobatus laevis*, *Rhinobatos borneensis*, *Maculabatis macrura*, *Maculabatis gerardi*, and *Neotrygon caeruleopunctata*, and 2 types of rays that were most often caught in the waters of South West Aceh, namely *Rhynchobatus australiae* and *Neotrygon caeruleopunctata*, which were baycatch on gill net, purse seine, long line, and trawl fishing gear.

The results of field observations in the East season showed that there were 18 coordinate points of fishing carried out by fishermen of the West Aceh district in the waters of the West Aceh Strait. Based on 18 fishing locations, there are 4 fishing locations that get stingray catches, namely *Maculabatis macrura*, *Rhynchobatus australiae*, and *Himantura leoparda* with gill net and long line catches (Figure 6). The catch of the rays was found at the closest distance to the fishing base, which was 8.17 miles with a water depth of 5.18 meters, while the farthest distance was 38.23 miles with a water depth of 6.70 meters.

According to Simeon et al. (2020), stingray fishing areas are scattered in coastal waters up to offshore waters or in WPPNRI 572 waters caught in gill net fishing gear, long lines, trawls, and baycatch. *Rhynchobatus australiae* species are most commonly caught in muddy, shallow waters or waters close to river mouths with a depth of less than 30 meters (Tirtadanu et al., 2018; Simeon et al., 2020).

According to Ghotbeddin et al. (2014), the catch of stingrays will decrease along with the increasing depth of the waters. Based on the results of research by Tirtadanu et al. (2018), the average stingray is most caught at a depth of less than 30 meters. Because the water area is shallow and close to the estuary, there is a lot of food available that can maintain the balance of stingray fisheries in a body of water (Pane et al., 2018).

Habitats favored by stingrays are sandy and mud-shaded waters, the availability of coral reefs, estuaries, and bay waters, but there are some stingrays that live in offshore waters. The distribution of stingray fishing grounds is most abundant in tidal waters and estuary areas (Utami et al., 2014; Abubakar et al., 2016). Most stingrays use coastal waters as a nurturing and spawning area because the area has a lot of food for stingrays.

Conclusion

The number of stingray catches landed at PPI Ujong Baroh during the study was 428, consisting of 11 species: *Maculabatis macrura*, *Myliobatis tobijei*, *Rhynchobatus australiae*, *Dasyatis kublii*, *Pateobatis uarnacoides*, *Gymnura zonura*, *Himantura leoparda*, *Rhina ancylostoma*, *Rhinobatos borneensis*, *Aetobatus narinari*, and *Taeniuriops meyeri*. There were 18 distribution points

of stingray fishing grounds and 4 fishing locations that obtained stingray catches, namely at coordinates of 3°38,136'N and 96°29,056'E, 4°2,144'N and 96°2,431'E, 4°16,599'N and 95°32,000'E, 3°34,51472'N and 96°25,80414'E.

Acknowledgments

This scientific paper is part of research activities funded by the Ministry of Education and Culture for the 2023 fiscal year, Number 175/E5/PG.02.00.PL/2023, on June 19, 2023. The author would like to thank the research team, DIKTI and LPPM-PMP Teuku Umar University for supporting the implementation of this research activity.

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How to cite this paper:

Fuadi, A., M. Arif, R. Dianshar, D. Kusumayadi, G. Oktavinanda. 2024. Mapping the distribution of stingray fishing grounds in the southern western waters of Aceh the eastern season. Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan, 13(3): 385-390.