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## Productivity and Catch Composition of the Handline Fishing Fleet at Palabuhanratu Nusantara Fishing Port, Sukabumi, Indonesia

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## ABSTRACT

Small-scale fisheries are the most dominant category of fishing fleet among all active fishermen in Indonesia. Various small-scale fishing fleets are also found at the Palabuhanratu Nusantara Fishing Port. Handline fishing is one of several small-scale fishing fleets (<5 GT) with outboard motor engine power and a one-day fishing trip duration. One of the problems in every small-scale capture fishery is that data collection is not considered correctly due to its low productivity. However, the dominance of small-scale fishing fleets certainly contributes to the supply of fish resources that are not bit. This study was conducted to evaluate the productivity and composition of the handline fishing fleet's catch at the Palabuhanratu Nusantara Fishing Port. Data on catches and the number of fishing trips from the handline fishing fleet were obtained from the Central Fisheries Statistics Agency of Palabuhanratu and fishing logbooks from handline fishing groups for the past five years, from 2019 to 2023. The presence of 15 species of catches from the handline fishing fleet, with the main catch composition being the ribbonfish (Trichiurus lepturus), which occupies 68.1  $\pm$  10.3% of the total catch was recorded. Monthly analysis reveals the highest productivity value of the handline fishing fleet catch during the transition from the east season to the west season in October (100.6  $\pm$ 18.8kg/trip) and the lowest at the end of the west season in February (24.3  $\pm$ 8.9kg/trip). Meanwhile, the annual analysis shows a trend in the productivity value of handline catches, which is decreasing from year to year, with a decline rate of 4.26% per year.

## INTRODUCTION

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Small-scale capture fisheries are a common fishing effort by local fishermen around coastal areas using 1-5 GT vessels powered by sails or outboard motors (Ambarini, 2023). Groups of fishermen in small-scale fisheries generally catch fish with the aim of meeting their families' daily consumption and economic needs (Akbarsyah *et al.*, 2017). The main characteristic of small-scale capture fisheries is using traditional fishing gear

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such as rods, traps, nets, or other simple and environmentally friendly fishing gear to obtain fish catches. The scope of fishing areas for small-scale fishing groups is also limited to coastal areas near the coast, such as bays (Kinseng *et al.*, 2019; Winarno & Salsabila, 2024).

The main problem in small-scale capture fisheries in Indonesia is the lack of catch data. This is because small-scale fishermen generally do not report their catch data. Catch data are more common for large-scale capture fisheries because it relates to post-sea permit reporting and tax payments (Halim *et al.*, 2019; Sari *et al.*, 2021). Although the catch of small-scale fishermen is much smaller when compared to industrial-scale fishing fleets, the quantity of small-scale fishermen in Indonesia is known to exceed 90% of the total active fishermen in 2023. This indicates that data on many fish caught in Indonesian waters is not adequately reported. This problem certainly has an impact on fisheries management in Indonesia (Sari *et al.*, 2021; Herdiana *et al.*, 2024). To realize sustainable fisheries management, complete data on fish catches is a must. For this reason, attention is needed to improve data on catches from small-scale fishermen (Sari *et al.*, 2021; Napitupulu *et al.*, 2022).

One of the small-scale capture fisheries commonly found in various fishing ports in Indonesia is the handline fishing fleet. The handline fishing fleet is one of the small-scale fishing fleets spread throughout the region, one of which is in the Palabuhanratu Nusantara Fishing Port, Sukabumi, West Java. The Central Statistics Agency for Capture Fisheries of Sukabumi Regency 2023 noted that the composition of handline fishermen is in second place as the most dominant small-scale fishermen in the Palabuhanratu Archipelago Fisheries Port after the boat seine fishing fleet. In general, the handline fishing fleet at the Palabuhanratu Archipelago Fisheries Port consists of two groups in terms of business scale. The two groups in question are small-scale handline fishermen with fishing vessels measuring <5 GT and outboard motor engines and medium-scale handline fishermen measuring 5-10 GT with 23-37 HP engines (**CSA**, 2023).

This study evaluated small-scale handline fishing fleets' productivity and catch composition at the Palabuhanratu Nusantara Fishing Port, Sukabumi, Indonesia. The results of this study can be used as baseline data to complement the multigear and multispecies fisheries management policy in the coastal area of Palabuhanratu Bay.

## MATERIALS AND METHODS

The object of the study was determined on a small-scale handline fishing fleet with a vessel size of <5 GT and powered by an outboard motor operating around the coast of Palabuhanratu Bay and docked at the Palabuhanratu Nusantara Fishing Port. Data on catches and the number of fishing trips were obtained from the Sukabumi Central Fisheries Statistics Agency and the handline fishermen's catch logbook at the Palabuhanratu Archipelago Fisheries Port for the last 5 years from 2019 to 2023. Data on catches and the number of fishing trips were analyzed to determine the value of catch

productivity. The productivity of handline catches was, calculated using the formula for the value of the number of catches per unit of fishing effort (CPUE) referring to **Gulland** (1983).

Where, CPUE: catch per unit effort (kg/trip); c: catch (kg) and f: number of fishing trips as fishing effort (trip).

CPUE values were presented as annual and monthly averages. They were then used as a basis for determining the composition of the catch, which was also presented in annual and monthly forms. The composition of the catch was calculated using a function referring to **Krebs (2014)**.

Catch composition  $=\frac{Y_i}{y}$ ....(2)

Where, Y<sub>i</sub>: biomass of catch for fish species-i (kg); dan Y: total biomass of all fish caught (kg).

### RESULTS

The handline fishing fleet is one of the small-scale fishing fleets that operates around Palabuhanratu Bay and docks at the Palabuhanratu Archipelago Fisheries Port, Sukabumi, West Java. Small-scale handline fishing vessels are <5 GT in size with outboard motor power (15-25 HP). The dimensions of handline fishing vessels generally have a length of between 7.0-10.3 meters, a width of 0.8-2.0 meters, and a height of 0.7 - 1.3 meters. Handline fishing vessels are generally made of kempas wood or ironwood.

Handline fishermen generally catch for a full day. Departure is usually done in the morning and finished in the afternoon. In carrying out fishing operations, handline fishermen only use simple fishing gear consisting of 10-25 meters of monofilament PA string connected to 10-22 branch lines ending in hooks numbered 5-10. Each branch line has an interval of 1.0-1.5 meters. At the end of the handline, there is a galvanized steel sinker. Handline fishing gear was operated vertically to obtain various types of fish from pelagic and demersal groups (Fig. 1). Fishing gear was set passively in coastal waters.



Fig. 1. Fishing operations and construction of handline fishing gear

The productivity of the handline fishing fleet catches over the past 5 years, from 2019 to 2023, showed a downward trend every year with an average decrease of 4.26%/year (Fig. 2). The monthly analysis revealed that the productivity value of the handline fishing fleet catch tends to reach the peak fishing season during the transition from the east season to the west season in October (100.6  $\pm$  18.8kg/ trip). The lowest catch productivity was at the end of the west season in February (24.3  $\pm$  8.9kg/ trip) (Fig. 3).



Fig. 2. The average productivity of the handline fishing fleet catches in 2019-2023



Fig. 3. The average productivity of handline catches each month

Composition analysis revealed that 15 species of fish were obtained as catches from the handline fishing fleet. Both annual (Fig. 4) and monthly (Fig. 5) calculations showed that the ribbonfish (*Trichiurus lepturus*) was the main catch species, always dominating around  $68.1 \pm 10.3\%$  of the total catch obtained.



Fig. 4. Catch composition of the handline fishing fleet in 2019-2023



Fig. 5. Composition of the monthly catch of the handline fishing fleet

#### DISCUSSION

The productivity of catch is a measure used to determine the value of fish catch production in tons or kilograms caught at a specific time per unit of fishing effort used in units of the number of fishing trips or the number of fishing gear used (Annida *et al.*, 2023, 2024). In sustainable capture fisheries management, the value of catch productivity observed over a certain period can describe changes in fish populations in nature and estimates of changes in stocks in the future (Annida *et al.*, 2021; Baihaqi & Annida, 2024b). The dynamics of catch productivity value can also be used to group the fishing seasons of a fishing fleet (Baihaqi & Annida, 2024b). Regarding business, the dynamics of catch productivity value can also be a consideration in the feasibility of a capture fisheries business unit (Baihaqi & Annida, 2024a).

Observations of catch dynamics and the number of fishing trips over the past 5 years show an analysis of catch productivity with a downward trend of 4.26% per year. The decline in catch productivity can occur due to several things, such as declining fish resource conditions, deteriorating ecosystem conditions, climate change, and changes in the distribution of fish species moving away from the main fishing areas (Monnereau & Oxenford, 2017; Erauskin-Extramiana *et al.*, 2023). Factors that cause the decline in fish resource conditions can occur due to excessive fishing exploitation, which decreases the recovery capacity of fish resource populations (Cudmore & Investigator, 2009; Pham *et al.*, 2023). Deteriorating ecosystem conditions can occur due to environmentally unfriendly fishing gear, water pollution, and habitat destruction (Ballesteros *et al.*, 2018; Thushari & Senevirathna, 2020; Carneiro & Martins, 2022). Climate change, such as increasing water temperatures and changes in ocean current patterns, can affect the shift in the distribution of fish species from their original distribution locations (Dahms & Killen, 2023; Itsukushima, 2023; Bas *et al.*, 2024; Nuon *et al.*, 2024).

On the other hand, monthly analysis reveals that the productivity value of the handline fishing fleet tends to reach the peak fishing season during the transition from the east season to the west season in October, and the lowest catch productivity is at the end of the west season in February. The peak fishing season conditions that occur during the transition from the east season to the west season can be influenced by the transition of ocean currents from the east current to the west current. This transition of current changes also presents a mixing of seawater masses with different temperatures (Baihaqi & Annida, 2024b; Syamsuddin et al., 2025). The temperature differences can cause upwelling, especially in several locations in the waters around the Bay Coast. Upwelling brings most of the nutrients to the surface, including plankton, the leading food for small fish. More dynamic nutrient enrichment occurs during this transition season when most coastal areas receive additional excess nutrients from river estuaries (Lumban-Gaol et al., 2021; Umasangaji & Ramili, 2021). Another factor that causes high catch productivity during the transition season is the condition of fish migration in search of food. During the transition season, it is known that the dominance of marine fish migrates quite a lot to coastal areas to search for food in areas with increased nutrients (Rubio-Rodríguez et al., 2017; Tezzo et al., 2021). The small-scale handline fishing fleet commonly used on the coast of Palabuhanratu Bay is the background to the optimal productivity of this fleet's catch during the transition season from the east to the west.

The small-scale handline fishing fleet at the Palabuhanratu Nusantara Fisheries Port is known to have 15 species of catches that have been successfully identified. Of the 15 species, it is known that the ribbonfish (*Trichiurus lepturus*) is the main catch that occupies around  $68.1 \pm 10.3\%$  of the total catch obtained. The ribbonfish (*Trichiurus lepturus*) are indeed widely found spreading around Palabuhanratu Bay (**Airlangga** *et al.*, **2018; Putra** *et al.*, **2018; Imron** *et al.*, **2021**). Not only the handline fishing fleet, this fish is also the main catch species from the boat seine fishing fleets (**Annida** *et al.*, **2024**). Palabuhanratu Bay is even known as one of the largest ribbonfish-producing areas in Indonesia. The ribbonfish specimens live in deep waters as demersal fish. Pelabuhanratu Bay is known to have intense waters, even though it is near the coast, which is also rich in nutrients. This condition makes the waters of Palabuhanratu Bay highly suitable for the life of the ribbonfish (**Airlangga** *et al.*, **2018; Putra** *et al.*, **2018; Rahmawaty** *et al.*, **2021**).

# CONCLUSION

A total of 13 species were identified as the catches of the handline fishing fleet, with the highest composition in the ribbonfish (*Trichiurus lepturus*). The productivity of the handline fishing fleet's catches reached its highest point at the transition from the east to the west seasons in October, with the lowest condition at the end of the west season in February. The productivity of the handline fishing fleet's catches has decreased yearly since 2019-2023.

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