Fish Diversity and Catch Composition of Purse Seine Fisheries Across Multiple Fishing Grounds in Weru Village, Lamongan Regency

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Abstract

Purse seine fisheries represent an important component of capture fishing activities conducted by local fishers in Weru Village, Lamongan Regency. However, spatial variations in catch composition and fish diversity across different fishing grounds are still poorly documented. This study aims to analyze fish community structure at four purse seine fishing locations through assessments of catch composition and ecological indices. Data were collected during July–August 2025 through direct observations at landing sites by recording the number of individuals for each species. Analytical procedures included the Shannon-Wiener Diversity Index (H'), Pielou's Evenness Index (E), and Simpson's Dominance Index (C) to evaluate community differences among locations. The results reveal clear spatial differences in fish community structure. In total, the purse seine fishery recorded 11 fish species with a total of 15,041 individuals across four fishing locations, indicating a marked disparity in catch abundance across the sites. Locations A and B were dominated by Hilsa kelee, with high catch numbers (3,886 and 7,286 individuals), resulting in low diversity (H' = 0.18 and 0.06) and high dominance (C = 0.94 and 0.98). In contrast, location D demonstrated a more balanced and stable fish community structure, reflected in its notably higher diversity (H' = 1.29), high evenness (E = 0.66), and low dominance (C = 0.40). These findings offer important baseline insights to support spatially informed management of small pelagic fisheries in the coastal.

Keyword: Beach, Diversity, Hilsa kelee, Indigenous species

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INTRODUCTION

Indonesia, as an archipelagic nation, possesses substantial fisheries potential, particularly in coastal areas that serve as centres of local economic activity* (UU RI No 45/2009). The coastal waters of Lamongan, especially Weru Village, are highly dependent on capture fisheries as the primary livelihood source. In this region, purse seine is widely used due to its effectiveness in targeting pelagic fish species (Dinas Perikanan Kabupaten Lamongan, 2024). Despite its significant contribution to local fish production, scientific assessments on spatial variation in fish diversity and catch composition across different fishing grounds remain limited.

Fish diversity is a key parameter for characterizing aquatic ecosystem conditions and detecting fishing pressure (Retnoningtyas et al., 2023). In purse seine fisheries, fish community dynamics are influenced by distance from shore and depth gradients (Safruddin et al., 2019). The Java Sea surrounding Lamongan is shaped by east–west monsoonal patterns that govern the distribution of pelagic resources. These factors may lead each fishing ground to exhibit distinct community structures (Apriansyah et al., 2024), highlighting the importance of understanding spatial variation for sustainable fisheries management.

Weru Village comprises several fishing grounds routinely accessed by purse-seine fishers, each characterized by different conditions such as distance offshore and water depth. These environmental differences are presumed to influence species richness, dominance patterns, and catch composition (Nazarullah et al., 2022). However, primary data describing inter-site variation in fish community structure have not been systematically documented.

As an active, multi-species fishing gear, purse seine fisheries are commonly evaluated using ecological indicators such as the Shannon–Wiener Diversity Index (H'), Pielou's Evenness Index (E), and Simpson's Dominance Index (C) (Wijayanti et al., 2025). These indices provide insights into species richness, community balance, and dominance levels within fishing grounds. Low index values may signal ecosystem imbalance (Kunda et al., 2022).

Although numerous studies on purse seine fisheries in Indonesia have been conducted, most remain focused on production aspects. An early investigation in Weru Village by Fillanthropy (2023) documented 14 fish species across four sampling stations. However, primary data–based studies emphasizing spatial differences among fishing grounds, particularly in Weru Village, are still scarce. Therefore, this research is necessary to fill this information gap.

This study aims to analyse fish diversity and catch composition of purse seine fisheries across multiple fishing grounds in Weru Village, Lamongan Regency, and to compare fish community structures among these locations. The findings are expected to support adaptive fisheries management, provide baseline information for stakeholders, and offer practical benefits for local fishers in determining more efficient fishing strategies.

METHOD

This study was conducted at the Weru Village Fishing Port, Lamongan Regency. Data collection was carried out from July to August 2025 (Figure 1).

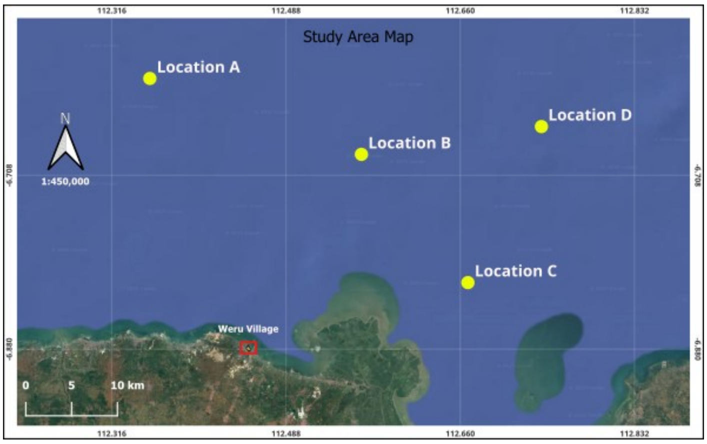

Figure 1. Map of Study Area

The study was conducted across four fishing grounds situated in the coastal waters of Lamongan Regency, a region of the Java Sea that supports intensive small-scale purse seine fisheries. These fishing grounds differ in oceanographic and ecological attributes, particularly in water depth and proximity to the shoreline, factors that may shape spatial variation in catch composition and fish community structure.

A descriptive survey design was employed through interviews and direct observations during fish landing activities at the Weru Village Fishery Port. Data were derived from purse seine operations conducted at the four designated fishing grounds. For each landing event, all specimens were enumerated at the species level. Species identification followed standard ichthyological references, including *Marine Fishes of the Great Barrier Reef and South-East Asia* (Allen, 1999) and *Market Fishes of Indonesia* (White et al., 2013). All parameters, notably species-specific abundance and the geographic coordinates of fishing locations, were compiled into a structured dataset for subsequent analyses aimed at characterizing spatial differences in fish community assemblages among fishing grounds.

Fish community structure analysis was conducted to determine species diversity, species dominance, and community evenness. The analyses included the following components:

a. Diversity Index (Shannon–Wiener Diversity Index, H')

The diversity index was used to describe the stability and complexity of fish communities at each fishing ground (Magurran, 2004). The formula applied is:

$$H' = -\Sigma (Pi \times \ln(Pi))$$

Description:

$Pi = ni / N$

ni = number of individuals of species *i*

N = total number of individuals of all species

Diversity index classification:
H' < 1 : low diversity
1 < H' < 3 : moderate diversity
H' > 3 : high diversity

b. Evenness Index (Pielou's Evenness Index, E)

The evenness index describes whether individuals are evenly distributed across species or dominated by certain species (Krebs, 2014). The formula is:

$$E = H' / \ln(S)$$

Description:
S = number of species recorded

Category values:
E < 0.3 : low evenness
0.3 – 0.6 : moderate evenness
E > 0.6 : high evenness

c. Dominance Index (Simpson Dominance Index, C)

The dominance index was used to determine the extent to which a species dominates the catch in each fishing ground (Odum, 1994). The formula used is:

$$C = \Sigma (pi^2)$$

Category values:
0 < C < 0.5 : low dominance
0.5 < C ≤ 0.75 : moderate dominance
0.75 < C ≤ 1.0 : high dominance

RESULT

1. Species Composition

This study recorded 11 fish species with a total of 15,041 individuals across four fishing locations. Location B had the highest abundance, followed by A, C, and D. *Hilsa kelee* dominated locations A to C, while several species were more concentrated in Location D. These findings, as summarized in Table 1.

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Table 1. Species and Individuals per Location

Spesies	Number of Spesies			
	Location A	Location B	Location C	Location D
Argyrosomus japonicus	-	2	-	-
Chirocentrus dorab	14	6	-	44
Eleutheronema tetradactylum	17	28	40	88
Euthynnus affinis	-	-	-	67
Hilsa kelee	3886	7286	2429	-
Pampus argenteus	20	3	85	150
Parastromateus niger	38	8	38	-
Scomberomorus commerson	-	3	-	34
Sphyraena obtusata	-	2	94	567
Trichiurus lepturus	4	2	-	3
Tylosurus crocodilus	23	2	-	-
Total Number of Spesies	**4002**	**7342**	**2686**	**953**

The pattern of species abundance shown in Table 1 aligns strongly with the geographic and bathymetric setting of each fishing ground illustrated in Figure 2. Location B, which recorded the highest number of individuals (7,342), lies within waters of 40–50 m depth, a zone that likely functions as a transitional corridor for pelagic fish schools moving between mid-shelf and offshore areas (Fach et al., 2024). This depth range may also support stronger fish aggregation, explaining the dominance of Hilsa kelee (7,286 individuals) in this location. Location A, positioned in the western area with waters nearing 50 m, also showed substantial catches (4,002 individuals), particularly of *Hilsa kelee*, indicating that this species may prefer mid-depth habitats that provide suitable feeding and migratory routes.

Location C, located in the southern nearshore zone with depths approaching 40 m, exhibited moderate abundance (2,686 individuals) with a mixture of pelagic species such as *Pampus argenteus* and *Sphyraena obtusata*, likely influenced by shoreline proximity and variable depth gradients. In contrast, Location D, situated in the easternmost region with depths exceeding 50 m and more complex underwater topography, contributed the lowest catch (953 individuals). However, this area supported species such as *Eleutheronema tetradactylum* and *Sphyraena obtusata* in higher proportions relative to other sites, suggesting that deeper and structurally complex habitats may attract larger or more mobile species despite lower overall density (Ferrari et al., 2018).

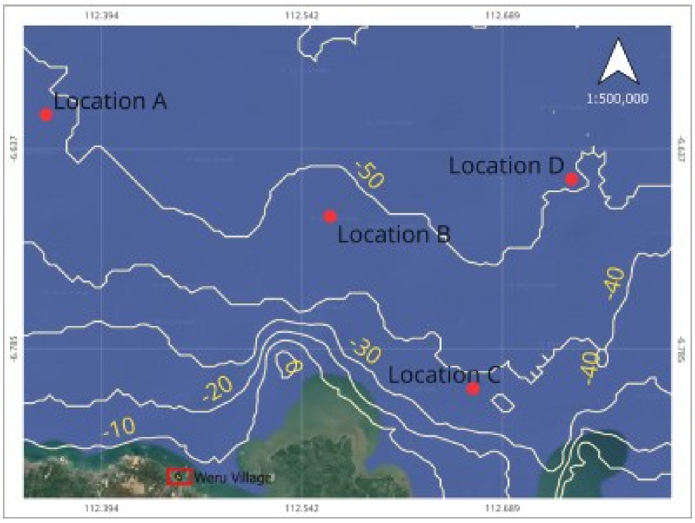

Figure 2. Fishing Grounds and Depth Contours

2. Analysis of Fish Species Diversity, Evenness, and Dominance

The analysis of fish community structure across the four purse-seine fishing locations revealed clear spatial variation in species diversity, evenness, and dominance (Table 2). Location A exhibited a low diversity value (H' = 0.1788), primarily due to the overwhelming dominance of *Hilsa kelee*, which contributed 97.10% of the total catch. This strong dominance is further reflected in its high Simpson's dominance index (C = 0.943) and very low evenness (E = 0.0919), indicating a highly uneven community structure.

Location B showed the lowest diversity among all sites (H' = 0.0574), again driven by extreme dominance of *Hilsa kelee* (99.24%). The evenness index at this site (E = 0.0249) was the lowest in the study area, confirming that the fish community was heavily skewed toward a single species. Consistently, the dominance index was highest (C = 0.9848), characterizing Location B as a highly monospecific fishing ground.

In contrast, Location C displayed a more moderate community pattern, with diversity increasing to H' = 0.4404 and evenness reaching E = 0.2737. Although *Hilsa kelee* remained the most abundant species, the presence of *Pampus argenteus*, *Sphyraena obtusata*, and *Eleutheronema tetradactylum* in higher proportions reduced overall dominance (C = 0.8204). These metrics suggest that Location C supports a more balanced species composition relative to the northern sites.

Location D exhibited the highest diversity (H' = 1.2856) and the highest evenness (E = 0.6607), indicating a more equitable distribution of individuals among species. Species such as Sphyraena obtusata, Scomberomorus commerson, *E. tetradactylum*, and *P. argenteus* contributed substantially to the catch composition, lowering the dominance index to C = 0.3936—the lowest among the four locations. This suggests a more stable and heterogeneous fish community structure in deeper eastern waters.

The results demonstrate that diversity and evenness increased toward the deeper and more offshore fishing grounds, while dominance decreased. Locations A and B exhibited highly concentrated catches dominated by *Hilsa kelee*, whereas Locations C and especially D showed more even community structures with reduced species dominance. These findings highlight the influence of spatial and ecological gradients on fish assemblages within the purse-seine fishing grounds of Weru Village.

Table 2. Diversity, Evenness, and Dominance Indices Across Fishing Locations

Fishing Ground	H' (Diversity)	E (Evenness)	C (Dominance)
Location A	0.1788	0.0919	0.943
Location B	0.0574	0.0249	0.9848
Location C	0.4404	0.2737	0.8204
Location D	1.2856	0.6607	0.3956

The graphical representations of diversity, evenness, and dominance offer further evidence of how community structure varies across the four fishing locations when spatial arrangement and depth gradients are taken into account. The diversity plot (Figure 3) demonstrates that values are not distributed linearly along the north–south axis. Although Locations A and B exhibit very low diversity, the highest diversity occurs at Location D which is situated north of B but lies in the deepest waters (±50 m). Location C, positioned furthest south and in slightly shallower waters (approaching 40 m), also shows a moderate increase in Shannon diversity. These patterns indicate that depth, rather than geographic latitude alone, plays a more influential role in shaping species richness, where deeper habitats such as those at Location D offer broader ecological niches and potentially more favorable pelagic conditions.

A similar tendency emerges in the evenness plot (Figure 4), where the distribution of individuals among species becomes more balanced in the deeper and semi-offshore fishing grounds. Locations A and B despite A being nearly as deep as D display extremely low evenness because their communities are overwhelmingly dominated by a single taxon. In contrast, Locations C and especially D exhibit higher evenness values, reflecting a more equitable partitioning of individuals across multiple species. This increase in evenness is typically associated with greater ecological stability (Moore et al., 2021), suggesting that the more complex and deeper habitat at Location D supports a more resilient fish assemblage, with Location C showing a similar but slightly weaker pattern.

The dominance plot (Figure 5) further illustrates how depth influences community composition. Although Locations A and B lie along different parts of the north–south axis, both exhibit very high Simpson dominance due to the strong predominance of *Hilsa kelee*. In comparison, dominance decreases markedly at Location D and moderately at Location C, indicating that these deeper or semi-offshore locations support a more diverse set of co-occurring species (Carrington et al., 2021). This reduction in dominance implies that environmental and bathymetric conditions particularly the deeper contour at Location D and the transitional depth at Location C may lessen the monopolizing effect of a single species and promote greater species coexistence.

The three diagrams collectively portray that depth gradients, rather than simple geographic positioning, better explain the observed increase in diversity and evenness and the corresponding decrease in dominance across the fishing grounds. These visual patterns underscore the ecological importance of bathymetry and habitat heterogeneity in determining fish community structure in purse-seine fisheries and reinforce the conclusion that Location D situated in the deepest part of the fishing area—supports the most balanced and structurally complex assemblages, followed by the moderately deep Location C. Such insights enhance the quantitative interpretation and provide clearer ecological grounding for spatially informed fisheries management.

Figure 3. Diversity

Figure 4. Evennes

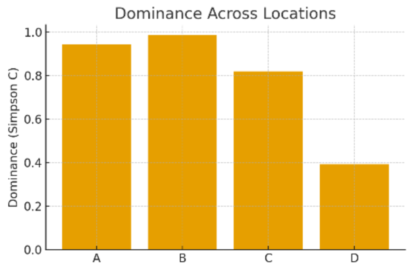

Figure 5. Dominance

A total of 11 fish species were documented across the four fishing locations during the study period (Figure 6). The catch composition was dominated by small pelagic species, with *Hilsa kelee* representing the most abundant taxon. In addition, several accompanying species were identified, including *Pampus argenteus*, *Sphyraena obtusata*, *E. tetradactylum*, *Euthynnus affinis* and *Scomberomorus commerson*, along with other pelagic taxa that contributed variably across locations.

The presence of these 11 species indicates a moderately diverse pelagic assemblage influenced by spatial variability across the fishing grounds. Although *Hilsa kelee* dominated numerically, the occurrence of multiple secondary taxa demonstrates that each location supported a distinct ecological subset shaped by depth, current dynamics, and habitat characteristics. Several species, such as *Euthynnus affinis* and *Scomberomorus commerson*, appeared in lower abundances but are ecologically significant due to their roles as mobile predators that interact with both coastal and offshore food webs. Meanwhile, species like *Pampus argenteus* and *E. tetradactylum* reflect the influence of transitional habitats where productivity and substrate conditions vary. The heterogeneous composition observed among the four sites suggests that purse-seine fisheries in this region capture a mixture of schooling pelagics and opportunistic predators, highlighting the complexity of local fish communities.

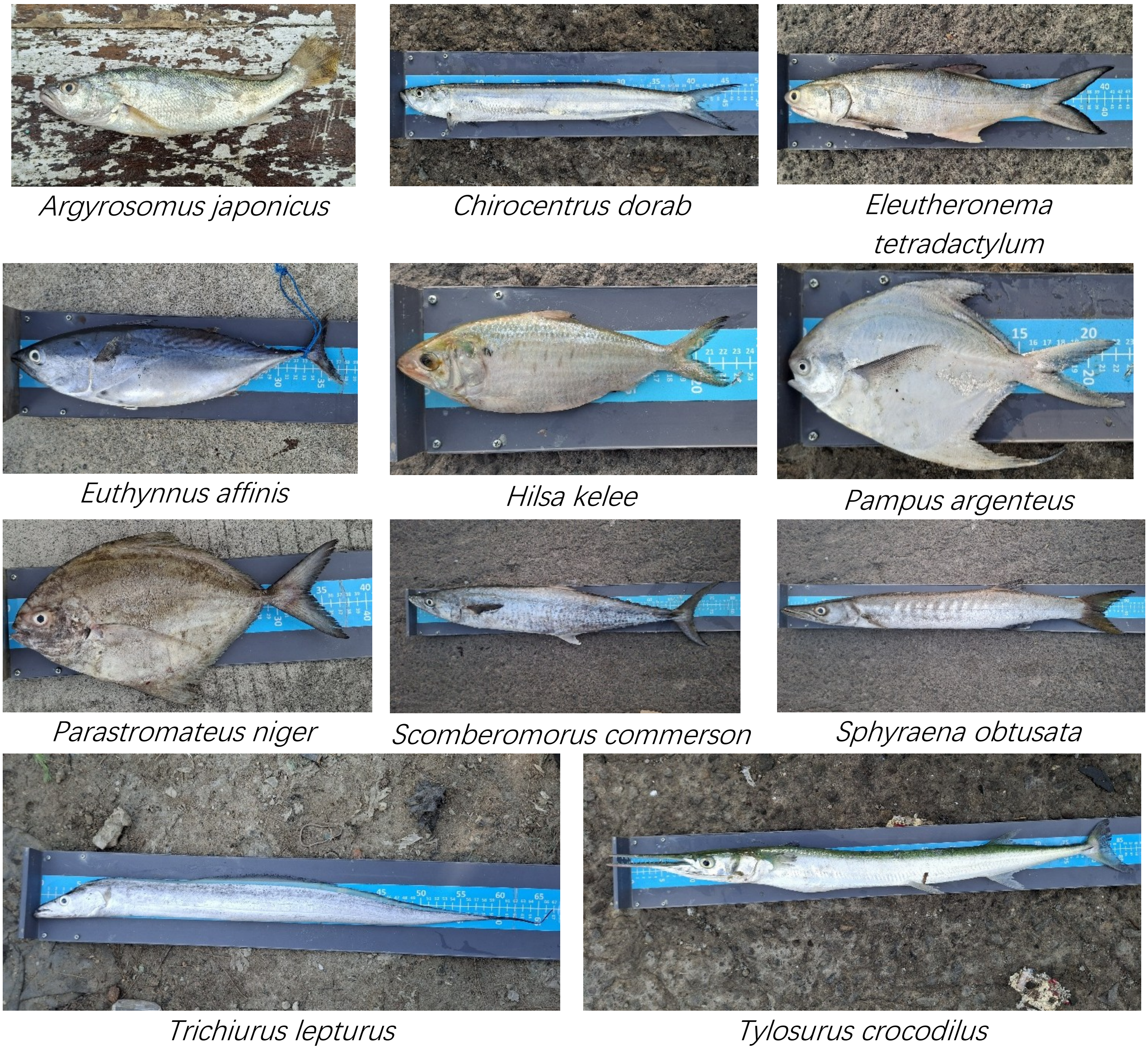

Figure 6. Fish Species Documentation

DISCUSSION

The present study demonstrates clear spatial structuring in the fish community composition across the four purse-seine fishing locations in Weru Village. The identification of eleven species highlights a moderately diverse pelagic assemblage, with *Hilsa kelee* emerging as the overwhelmingly dominant species in the northern, shallower fishing grounds. Its numerical predominance explains the low diversity and evenness observed at Locations A and B, reflecting the strong schooling behavior typical of small pelagic fish and the environmental homogeneity of nearshore habitats (Brochier et al., 2018).

Conversely, Locations C and D exhibited higher diversity and more balanced species distributions. These patterns coincide with their greater depth profiles and more heterogeneous habitat characteristics, which facilitated the presence of multiple accompanying species such as *Pampus argenteus*, *Sphyraena obtusata*, *Eleutheronema tetradactylum*, *Euthynnus affinis*, and *Scomberomorus commerson*. The occurrence of these taxa, including several mid- and upper-trophic-level predators, indicates a more complex community structure influenced by depth gradients, current regimes, and ecological connectivity between coastal and semi-offshore waters.

The findings affirm that bathymetric variation plays a decisive role in shaping community assemblages in purse-seine fisheries. The spatial patterns recorded in this study effectively address the research objectives by elucidating the environmental determinants underlying differences in species composition across fishing grounds.

CONCLUSION

This study recorded eleven fish species across four purse-seine fishing locations, revealing distinct spatial variation in community structure. Locations A and B were characterized by low diversity and strong dominance of *Hilsa kelee*, whereas Locations C and D supported more heterogeneous assemblages with higher evenness and reduced dominance. These differences underscore the influence of depth and habitat heterogeneity on species distribution within the fishing grounds.

The findings successfully address the research objective by demonstrating that spatial environmental gradients significantly shape fish community composition. This baseline information is essential for informing spatially oriented fisheries management and future ecological assessments.

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