Fish community diversity and conservation status in coral reef and seagrass ecosystems of Teluk Singkama coastal village, East Kalimantan, Indonesia

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Abstract. The coastal waters of Teluk Singkama village, Sangatta Selatan District, East Kalimantan, encompassing seagrass meadows at Pantai Pasir Putih and coral reefs at Teluk Kaba, represent ecologically significant habitats that sustain diverse fish assemblages and support local livelihoods. The objective of this study was to analyze fish diversity and conservation status in these two ecosystems, thereby providing baseline information for sustainable management. Fish sampling was conducted in February 2025 using a traditional stationary fishing gear known as a set net ("sero"), with purposive sampling locations selected based on ecological considerations and expected migration routes of fish, and standardized collections performed every two days. A total of 176 individuals from 37 species, 20 families, and 5 orders were recorded in coral reefs, while 299 individuals from 23 species, 19 families, and 8 orders were documented in seagrass beds. Shannon-Wiener diversity indices revealed moderate diversity in both ecosystems, with coral reefs exhibiting higher diversity (H' = 2.95) compared to seagrass beds (H' = 2.44). Sørensen similarity analysis indicated 51.17% overlap between habitats, reflecting ecological connectivity while maintaining distinct assemblage structures. Conservation assessment based on the IUCN Red List categorized 40 species as Least Concern (LC), two species as Data Deficient (DD), and eight species as unlisted, suggesting relatively low immediate extinction risks but highlighting gaps in conservation knowledge. Ecologically, the findings emphasize the complementary roles of seagrass and coral reef ecosystems, with seagrass supporting higher abundance and coral reefs sustaining greater taxonomic richness, underscoring the necessity of conserving both habitats as interconnected units. Socio-economically, the exploitation of 23 species for local consumption and trade demonstrates strong community reliance on coastal biodiversity, necessitating continuous monitoring and adaptive management. Importantly, these results provide a critical baseline for sustainable coastal resource management in East Kalimantan, ensuring that biodiversity conservation and community livelihoods can be balanced in long-term planning.
Keywords: coastal biodiversity, fish assemblages, IUCN Red List, seagrass-coral reef connectivity.

Introduction. Coastal ecosystems in tropical regions are widely recognized as biodiversity hotspots that support a high diversity of marine organisms, particularly fish communities. Among these ecosystems, coral reefs and seagrass meadows are considered two of the most productive and ecologically significant habitats in shallow coastal waters. Coral reefs provide structurally complex habitats that offer food resources, shelter, and breeding grounds for numerous fish species, thereby sustaining high levels of species richness and ecological interactions (Messmer et al 2011; Jarquín-Martínez et al 2025). Likewise, seagrass meadows function as important nursery and feeding habitats for many reef-associated fish species and contribute to the overall connectivity of tropical seascapes (Dunne et al 2023). The ecological linkage between these habitats plays a crucial role in maintaining fish biodiversity and ecosystem functioning across coastal landscapes.

The spatial connectivity between coral reefs and seagrass ecosystems forms an integrated coastal mosaic that supports multiple life stages of marine fishes. Many reef fish species utilize seagrass beds during juvenile stages before migrating to coral reefs as adults, highlighting the functional connectivity between these habitats (Dunne et al 2023). Such habitat linkages contribute to ecological resilience by allowing species to exploit complementary resources across ecosystems. In tropical seascapes, the coexistence of coral reefs, seagrasses, and other coastal habitats enhances biodiversity and ecosystem stability by providing diverse ecological niches and supporting complex trophic interactions (Carlson et al 2021).

Fish communities are widely used as ecological indicators to assess the condition and resilience of coral reef ecosystems. The diversity and abundance of reef fish assemblages often reflect habitat complexity, coral cover, and environmental quality (Ditzel et al 2022). Coral reef habitats with greater structural complexity tend to support higher species richness and functional diversity of fish due to increased availability of refuges and feeding opportunities (Jarquín-Martínez et al 2025). Conversely, degradation of coral reef habitats through anthropogenic disturbances, including coastal development, sedimentation, and overfishing, can significantly alter fish community structure and reduce biodiversity.

Seagrass ecosystems also play a significant ecological role in sustaining fish biodiversity and coastal fisheries productivity. Seagrass beds serve as nursery grounds for juvenile fishes, providing shelter from predators and abundant food resources. These habitats support not only seagrass-associated species but also many reef-associated fish that rely on seagrass during early life stages (Dunne et al 2023). The ecological functions of seagrass ecosystems extend beyond fish habitat provision, including carbon sequestration, nutrient cycling, and shoreline stabilization, making them critical components of coastal ecosystem sustainability (Valdez et al 2020).

In Indonesia, coastal ecosystems are part of the Coral Triangle, a global center of marine biodiversity that hosts one of the highest diversities of coral reef fishes in the world. Numerous studies conducted in Indonesian waters have documented high diversity and abundance of reef fishes associated with coral reef and seagrass ecosystems. For example, research in Karimunjawa National Park recorded diverse reef fish assemblages influenced by coral cover and environmental conditions (Yuliana et al 2017). Similarly, studies on Indonesian coral reef ecosystems have demonstrated that fish diversity is strongly influenced by habitat structure, substrate composition, and environmental parameters (Safitri et al 2025).

Despite the ecological importance of coral reef and seagrass ecosystems, many coastal areas in Indonesia remain poorly documented in terms of fish community composition and conservation status, particularly in East Kalimantan (Syafrie 2016; Irawan et al 2019; Jumartang et al 2019). Rapid coastal development, destructive fishing practices, land conversion, industrial operations, oil and gas extraction, transportation, and tourism intensify pressures on coastal waters, leading to habitat degradation, declining biodiversity, and shifts in fish species composition (Rogers et al 2023). Assessing fish community diversity and conservation status is therefore essential for understanding ecosystem health and for guiding effective coastal management and conservation strategies. Biodiversity assessments provide baseline ecological data that can inform marine spatial planning and sustainable fisheries management.

Teluk Singkama village, located in East Kalimantan, represents a coastal ecosystem characterized by the presence of coral reef and seagrass habitats that potentially support diverse fish assemblages. However, scientific information regarding fish community structure and conservation status in this area remains limited. Therefore, this study aims to analyze the diversity, composition, and conservation status of fish communities across coral reef and seagrass ecosystems in Teluk Singkama village. Understanding the ecological patterns of fish assemblages in these interconnected habitats will contribute to a better understanding of coastal biodiversity and provide important insights for the conservation and sustainable management of coastal ecosystems in East Kalimantan.

Material and Method

Description of the study area and sampling sites. Teluk Singkama village is administratively located in Sangatta Selatan District, Kutai Timur Regency, East Kalimantan, Indonesia, along the coastal zone bordering the Makassar Strait. Geographically, the study area is situated approximately at 0°22′-0°25′ N and 117°32′-117°35′ E, based on regional geographic references near Sangkima and Teluk Singkama. The coastal landscape is characterized by mangrove vegetation and the presence of the Sangkima River, which discharges into the coastal waters near Pantai Pasir Putih Teluk Singkama. Two main aquatic habitats dominate the study area, namely the seagrass ecosystem located in the shallow coastal waters of Pantai Pasir Putih and the coral reef ecosystem in Teluk Kaba, a semi-enclosed bay situated west of Teluk Singkama. Environmental conditions in these two habitats differ considerably due to riverine sediment input and coastal geomorphology. The waters of Pantai Pasir Putih are influenced by sediment discharge from the Sangkima River, producing muddy to sandy-mud substrates and moderately turbid waters where extensive seagrass meadows develop. In contrast, Teluk Kaba is characterized by clearer waters and substrates dominated by coral reef structures composed of calcium carbonate produced by reef-building corals in symbiosis with zooxanthellae.

Oceanographically, the coastal waters of Teluk Singkama village are relatively shallow, with depths generally ranging from 1 to 5 m in the seagrass meadow zone and approximately 5-15 m in the coral reef areas of Teluk Kaba. Surface water salinity typically ranges between 28 and 33 PSU, depending on tidal conditions and freshwater input from the Sangkima River, while seawater temperature averages 28-30°C, reflecting typical tropical coastal conditions. The hydrodynamic regime is influenced by tidal processes associated with the Makassar Strait, which exhibit mixed predominantly semidiurnal tides with tidal ranges generally between 1.5 and 2.5 m. Coastal currents are relatively moderate, with velocities commonly ranging from 0.1 to 0.3 m s^{-1}, driven primarily by tidal circulation and seasonal monsoonal winds. These oceanographic conditions, combined with heterogeneous substrates and coastal geomorphology, create suitable habitats for both seagrass and coral reef ecosystems. Consequently, the coexistence of these two ecosystems forms a complex coastal seascape that supports diverse fish assemblages and enhances the ecological productivity of Teluk Singkama.

The geographic location of the sampling sites within the seagrass and coral reef habitats is illustrated in Figure 1, which presents the spatial distribution of the research area along the coastal waters of Teluk Singkama village, Sangatta Selatan, East Kalimantan. The map shows four set net positions: two located within the coral reef ecosystem of Teluk Kaba and two within the seagrass ecosystem of Pantai Pasir Putih. These positions are strategically chosen to study the diverse marine life and ecological interactions within each habitat type. The proximity to mangrove vegetation further enriches the biodiversity and complexity of these sites.

Fish sampling methods. Fish sampling was conducted using a purposive sampling approach, in which sampling locations were selected based on ecological considerations and the expected migration routes of fish. A traditional stationary fishing gear known as a set net ("sero") (Figure 2) was installed in areas presumed to represent fish migration pathways or frequently used movement corridors. With the assistance of local fishermen, two set nets were strategically deployed in each habitat, namely Pantai Pasir Putih Teluk Singkama and Teluk Kaba, to facilitate a comprehensive sampling of marine biodiversity. These sites represent important coastal habitats influenced by seagrass beds and adjacent coral reef ecosystems. Fish collection from the cod-end pocket (locally known as "borong") of each set net was conducted every two days over a 28-day sampling period during February 2025. Sampling activities were carried out using local fishermen's boats, and retrieval of fish catches was performed during low tide conditions in the morning between 08:00 and 11:00 WITA to ensure consistent sampling conditions and facilitate the collection process. This methodological framework provided robust and representative data for evaluating fish diversity and conservation status across seagrass and coral reef ecosystems in Teluk Singkama.

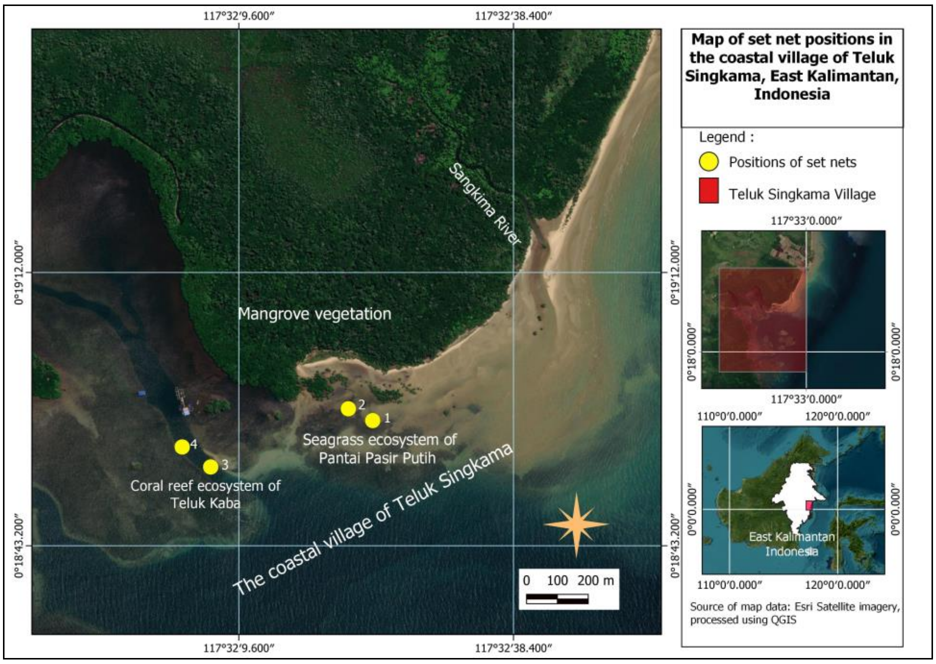

Figure 1. Study site map showing the locations of sampling in the seagrass ecosystem of Pantai Pasir Putih and the coral reef ecosystem of Teluk Kaba, Teluk Singkama coastal village, East Kalimantan, Indonesia.

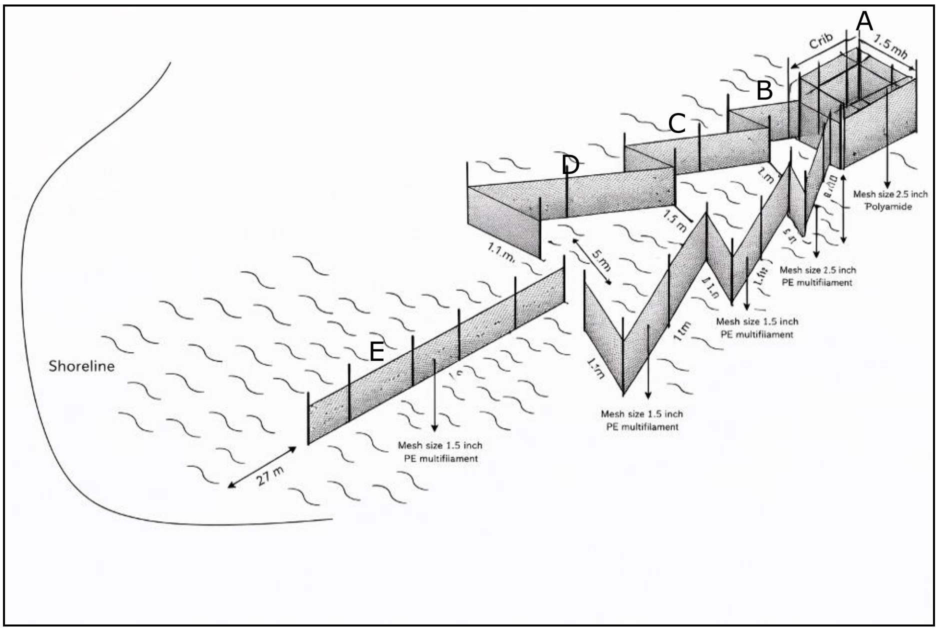

Figure 2. Schematic illustration of the traditional set net (sero) used for fish sampling. Showing its five components: (A) cod-end pocket, (B) perch, (C) body, (D) wing, (E) leader net.

Fish collection and species identification. All captured fish specimens from each sampling location were recorded and examined. Data collected included species identity, local name, number of individuals, total length, and information on their utilization by the surrounding community. Representative specimens of each species were photographed using a digital camera for documentation purposes and preserved as voucher specimens. The specimens were fixed in 10% formalin solution and labeled for subsequent laboratory identification. Fish species identification was conducted at the Ecology Laboratory, Faculty of Mathematics and Natural Sciences, Universitas Mulawarman. Identification was based on morphological characteristics using standard taxonomic references, including Allen (1999) and Allen et al (2003). Species nomenclature and taxonomic validity were further verified using the global fish database FishBase.

Conservation status. The conservation status of the identified fish species was subsequently assessed using the International Union for Conservation of Nature Red List of Threatened Species available at the IUCN Red List (https://www.iucnredlist.org/). The obtained data, including species composition, number of individuals, and fish biomass recorded at each sampling location, were further analyzed using ecological indices to evaluate the structure of the fish community. These analyses included commonly used community metrics such as species diversity, species richness, evenness, and dominance indices to provide a comprehensive assessment of fish community structure in the study area.

Data analysis. Fish community structure was analyzed using several ecological indices. Species diversity was calculated using the Shannon-Wiener diversity index following Magurran (2004):

$$\mathbf{H'} = -\sum_{\mathbf{i=n}}^{\mathbf{s}} \mathbf{PilnPi}$$

where: H′ is the Shannon-Wiener diversity index and Pi is the proportion of individuals belonging to species *i* relative to the total number of individuals. In general, Shannon-Wiener diversity values typically range between 1.5 and 3.5 and rarely exceed 4.0 in natural ecological communities.

Species evenness was calculated to determine the distribution of individuals among species using the following equation (Magurran 2004):

$$\mathbf{E} = \frac{\mathbf{H'}}{\mathbf{lnS}}$$

where: E is the species evenness index, H′ is the Shannon-Wiener diversity index, and S is the total number of species recorded. The species evenness index ranges from 0 to 1, where values approaching 1 indicate that the abundance of individuals among species is relatively evenly distributed within the community.

Species dominance in the fish community was evaluated using the Simpson dominance index (Magurran 2004):

$$\mathbf{C} = \sum_{\mathbf{i=1}}^{\mathbf{S}} (\mathbf{Pi})^2$$

where: C represents the Simpson dominance index, Pi is the proportion of individuals of species *i*, and S is the total number of species. This index ranges from 0 to 1, where values closer to 1 indicate a higher dominance of a few species, while values closer to 0 suggest a more even distribution of species within the community.

The similarity of fish species composition among sampling locations was analyzed using the Sørensen similarity coefficient (Magurran 2004):

$$\mathbf{CCs} = \frac{\mathbf{2C}}{\mathbf{S_1 + S_2}}$$

where: CCs is the Sørensen similarity coefficient, C is the number of species shared between two communities, S_1 is the total number of species in community 1, and S_2 is the total number of species in community 2.

To examine the similarity patterns among sampling stations and locations, hierarchical cluster analysis was performed using cluster variables analysis with the assistance of Minitab 22 for Windows. The results were presented in the form of a dendrogram to illustrate the grouping patterns of fish communities among sampling sites.

Results. A total of 475 individual fish representing 50 species, 31 families, and 10 orders were recorded from the seagrass ecosystem of Pantai Pasir Putih and the coral reef ecosystem of Teluk Kaba (Table 1). The seagrass habitat yielded 299 individuals from 23 species, whereas the coral reef habitat contributed 176 individuals from 37 species. Within the taxonomic composition, the order Perciformes was dominant, comprising the highest number of species (34) and families (19). Other orders such as Tetraodontiformes (6 species, 3 families) and Pleuronectiformes (2 species, 2 families) were represented by fewer taxa.

In terms of abundance, *Gazza minuta* (Leiognathidae) was the most numerically dominant species, with 65 individuals, all captured in Pantai Pasir Putih. Other abundant species included *Platycaranx chrysophrys* (Carangidae, 63 individuals) and *Lutjanus fulviflamma* (Lutjanidae, 57 individuals). Conversely, several species were represented by only a single individual, such as *Lutjanus carponotatus*, *Lutjanus fulvus*, *Parupeneus barberinus*, *Upeneus vittatus*, *Diagramma labiosum*, *Epinephelus corallicola*, *Epinephelus quoyanus*, *Chaetodon vagabundus*, *Scarus quoyi*, *Platycephalus indicus*, *Arothron mappa*, *Pseudorhombus arsius*, *Pardachirus pavoninus*, *Hypanus* sp., and *Maculabatis toshi*, indicating low occurrence or rarity in the sampled habitats. Spatially, the seagrass ecosystem of Pantai Pasir Putih supported a higher abundance of fish (299 individuals) compared to Teluk Kaba (176 individuals). However, Teluk Kaba exhibited greater species richness (37 species) relative to Pantai Pasir Putih (23 species).

Several species were shared between both habitats, including *Lutjanus argentimaculatus*, *Lutjanus fulviflamma*, *Lutjanus fulvus*, *Platycaranx chrysophrys*, *Siganus canaliculatus*, *Siganus guttatus*, *Gerres filamentosus*, *Scatophagus argus*, *Sphyraena qenie*, and *Hyporhamphus quoyi*. These overlapping taxa suggest ecological connectivity and potential habitat overlap between seagrass and coral reef ecosystems.

Overall, the results highlight that while the seagrass ecosystem harbored higher fish abundance, the coral reef ecosystem supported greater taxonomic diversity. The dominance of Perciformes and the numerical prevalence of *G. minuta* underscore the ecological importance of these taxa in structuring fish assemblages in coastal ecosystems of East Kalimantan.

Table 1

Composition and abundance of fish species captured in the seagrass ecosystem of Pantai Pasir Putih and the coral reef ecosystem of Teluk Kaba, Teluk Singkama coastal village, East Kalimantan, Indonesia

No	*Order/Family*	*Species*	*Location*		*Total (ind.)*
			Pantai Pasir Putih (ind.)	*Teluk Kaba (ind.)*	
1	Perciformes				
	Lutjanidae	*Lutjanus argentimaculatus*	15	13	28
		Lutjanus carponotatus	-	1	1
		Lutjanus decussatus	-	4	4
		Lutjanus fulviflamma	43	14	57
		Lutjanus fulvus	1	2	3
	Carangidae	*Alectis indica*	-	6	6
		Atropus hedlandensis	-	3	3
		Platycaranx chrysophrys	18	45	63
		Scomberoides tala	-	4	4
	Mullidae	*Parupeneus barberinus*	-	1	1
		Parupeneus indicus	-	2	2
		Upeneus sulphureus	-	5	5
		Upeneus vittatus	-	1	1
	Haemulidae	*Diagramma labiosum*	-	1	1
		Plectorhinchus chaetodonoides	-	2	2
	Nemipteridae	*Scolopsis ciliata*	-	4	4
		Pentapodus bifasciatus	-	5	5
	Epinephelidae	*Epinephelus corallicola*	1	-	1
		Epinephelus quoyanus	-	1	1
	Siganidae	*Siganus canaliculatus*	23	17	40
		Siganus guttatus	16	9	25
	Acanthuridae	*Acanthurus xanthopterus*	-	2	2
	Chaetodontidae	*Chaetodon vagabundus*	-	1	1
	Drepaneidae	*Drepane punctata*	-	2	2
	Ephippidae	*Platax batavianus*	3	-	3

	Gerreidae	*Gerres filamentosus*	4	4	8
	Labridae	*Choerodon rubescens*	-	4	4
		Scarus quoyi	-	1	1
	Leiognathidae	*Gazza minuta*	65	-	65
	Platycephalidae	*Platycephalus indicus*	1	-	1
	Scatophagidae	*Scatophagus argus*	4	1	5
	Sphyraenidae	*Sphyraena qenie*	2	1	3
	Terapontidae	*Pelates quadrilineatus*	5	-	5
	Toxotidae	*Toxotes jaculatrix*	6	-	6
2	Tetraodontiformes				
	Tetraodontidae	*Arothron hispidus*	-	3	3
		Arothron immaculatus	-	2	2
		Arothron manilensis	-	3	3
		Arothron mappa	-	1	1
	Balistidae	*Rhinecanthus verrucosus*	-	2	2
	Monacanthidae	*Monacanthus chinensis*	-	3	3
3	Pleuronectiformes				
	Paralichtyidae	*Pseudorhombus arsius*	1	-	1
	Soleidae	*Pardachirus pavoninus*	1	-	1
4	Myliobatiformes				
	Dasyatidae	*Hypanus* sp.	1	-	1
		Maculabatis toshi	1	-	1
5	Atheriniformes				
	Atherinidae	*Atherinomorus vaigiensis*	-	2	2
6	Beloniformes				
	Hemiramphidae	*Hyporhamphus quoyi*	3	2	5
7	Elopiformes				
	Megalopidae	*Megalops cyprinoides*	15	-	15
8	Gonorynchiformes				
	Chanidae	*Chanos chanos*	20	-	20
9	Mugiliformes				
	Mugilidae	*Crenimugil buchanani*	50	-	50
10	Syngnathiformes				
	Syngnathidae	*Syngnathoides biaculeatus*	-	2	2
	Number of individuals		299	176	475
	Species		23	37	50
	Family		19	20	31
	Order		7	5	10

The comparative analysis of fish community structure between Kaba Bay (H' = 2.95) and Pasir Putih Beach (H' = 2.44) revealed medium diversity levels, indicating that both ecosystems maintain relatively stable assemblages without substantial ecological stress. Medium diversity values are often associated with balanced trophic interactions and moderate habitat heterogeneity, which allow species coexistence through niche differentiation. The high evenness indices (0.78-0.82) suggest that individuals are distributed almost uniformly across species, reflecting equitable resource partitioning and reducing the likelihood of competitive exclusion. Meanwhile, the low dominance indices (0.10-0.12) approaching zero demonstrate the absence of species monopolization, which enhances functional redundancy and contributes to ecosystem resilience (Table 2).

Table 2

Ecological indices of fish species at Pasir Putih Beach and within the coral reef ecosystem of Kaba Bay, Teluk Singkama coastal village, East Kalimantan, Indonesia

No	*Ecological index*	*Location*	
		Pantai Pasir Putih	*Teluk Kaba*
1	Diversity (H')	2.44	2.95
2	Evenness (E)	0.78	0.82
3	Dominance (C)	0.12	0.10

The similarity index of fish species among set nets exhibited higher values when the nets were deployed on identical substrates, whereas lower similarity values were observed when the nets were positioned on different substrates (Table 3). Set nets 1 and 2 were located at Pantai Pasir Putih, where the benthic substrate is dominated by seagrass beds, while set nets 3 and 4 were situated in Teluk Kaba, characterized by coral reef substrates. The homogeneity of substrate type resulted in higher species similarity indices among set nets within the same location. Conversely, when set nets from different substrate types were compared, the similarity index of fish species declined, reflecting the influence of habitat heterogeneity on community composition.

Table 3
Sørensen similarity index of fish species among set nets at Pantai Pasir Putih and Teluk Kaba, Teluk Singkama coastal village, East Kalimantan, Indonesia

Sørensen similarity index	*Set net 1*	*Set net 2*	*Set net 3*	*Set net 4*
Set net 1	-	0.79	0.44	0.31
Set net 2		-	0.38	0.26
Set net 3			-	0.63
Set net 4				-

The dendrogram analysis of species presence across sampling sites revealed two distinct clusters. The first cluster comprises Set net 1 and Set net 2, which are grouped at a higher similarity level of 83.18%. The second cluster consists of Set net 3 and Set net 4, with a similarity of 59.74%. These two clusters are subsequently merged at a lower similarity threshold of 51.17%, indicating that while intra-cluster similarity is relatively high, inter-cluster similarity is considerably lower. This pattern suggests that the fish assemblages at Pantai Pasir Putih (Set net 1 and 2) are more homogeneous compared to those at Teluk Kaba (Set net 3 and 4), whereas the overall similarity between the two locations remains limited, reflecting nearly 49% differences in species composition (Figure 3).

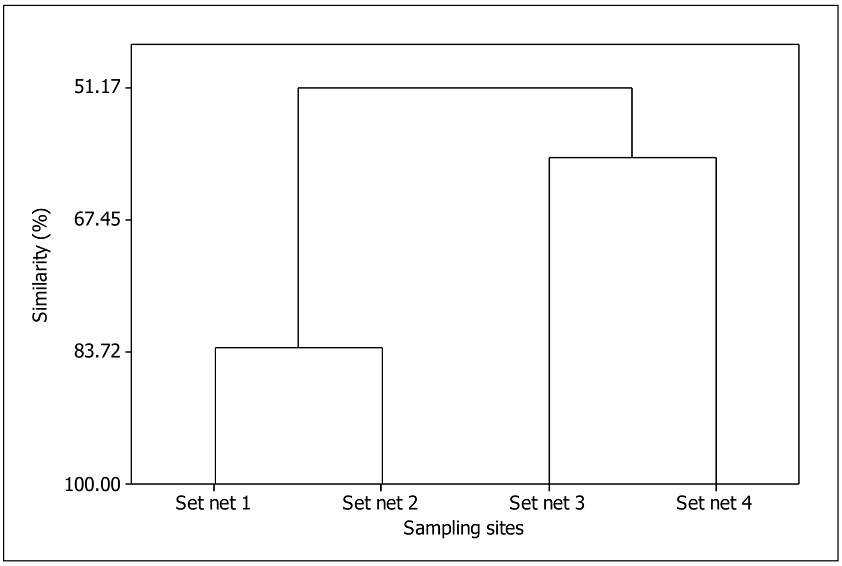

Figure 3. Dendrogram of clustering among sampling sites at Pantai Pasir Putih and Teluk Kaba, Teluk Singkama coastal village, East Kalimantan, Indonesia.

The conservation assessment of recorded fish species, based on the IUCN Red List, indicates that most are categorized as Least Concern, with only two species listed as Data Deficient and eight unlisted. Utilization patterns reveal that nearly all species captured in Kaba Bay and Pasir Putih Beach are primarily consumed, with 23 species also traded commercially due to their economic value. Beyond consumption and trade, several species serve additional purposes: eleven are valued as ornamental aquarium fish, eight are exploited in recreational angling by tourists, and three are utilized as raw materials in traditional medicine. These diverse utilization patterns underscore the ecological, economic, and cultural significance of local fish resources.

Table 4
Benefits, potential, and conservation status of fish fauna at Pasir Putih Beach and Kaba Bay, Teluk Singkama coastal village, East Kalimantan, Indonesia

No	*Species*	*Local name*	*Benefits, potential*	*IUCN Red List*
1	*Acanthurus xanthopterus*	Baronang	K, D, P, SF, SM	LC
2	*Alectis indica*	Rambo	K, D, SF, SM	LC
3	*Arothron hispidus*	Buntal	K, P	LC
4	*Arothron immaculatus*	Buntal	P	LC
5	*Arothron manilensis*	Buntal	P	LC
6	*Arothron mappa*	Buntal	K, P	LC
7	*Atherinomorus vaigiensis*	Belombong	PI	-
8	*Atropus hedlandensis*	Putih	K, D, SF, SM	LC
9	*Chaetodon vagabundus*	Karang/kepe kepe	P	LC
10	*Chanos chanos*	Bandeng	K, D, SF, SM	LC
11	*Choerodon rubescens*	Batu	K, D, M	LC
12	*Crenimugil buchanani*	Belanak	K, D.	LC
13	*Diagramma labiosum*	Kaneke	K, D	LC
14	*Drepane punctata*	Ketang-ketang	K	LC
15	*Epinephelus corallicola*	Kerapu	K, D	LC
16	*Epinephelus quoyanus*	Kerapu macan	K, D	LC
17	*Gazza minuta*	Bete-bete	K, PI	LC
18	*Gerres filamentosus*	Kalang pute	K	LC
19	*Hypanus* sp.	Pari	K	LC
20	*Hyporhamphus quoyi*	Togeng	K	-
21	*Lutjanus argentimaculatus*	Merah/ketamba	K, D	LC
22	*Lutjanus carponotatus*	Kakap ekor kuning	K	LC
23	*Lutjanus decussatus*	Baba-baba	K, D, P	LC
24	*Lutjanus fulviflamma*	Tanda- tanda	K, D	LC
25	*Lutjanus fulvus*	Kunyit	K, D, SF	LC
26	*Maculabatis toshi*	Pari	K	LC
27	*Megalops cyprinoides*	Bulan-bulan	K, D, SF, SM	DD
28	*Monacanthus chinensis*	Sape	K, P	LC
29	*Pardachirus pavoninus*	Ikan sebelah	K	LC
30	*Parupeneus barberinus*	Batu	K, D, PI	LC
31	*Parupeneus indicus*	Batu	K, D, PI,M	LC
32	*Pelates quadrilineatus*	Peo-peo	K	-
33	*Pentapodus bifasciatus*	Jangki	K	-
34	*Platax batavianus*	Jaleman	K	-
35	*Platycaranx chrysophrys*	Putih	K, D	LC
36	*Platycephalus indicus*	Oppang-oppang	K	DD
37	*Plectorhinchus chaetodonoides*	Kaneke	K, D	-
38	*Pseudorhombus arsius*	Ikan sebelah	K, SM	LC
39	*Rhinecanthus verrucosus*	Pogo	P	-
40	*Scarus quoyi*	Batu	K, D	LC
41	*Scatophagus argus*	Titang	K, P,SF	LC
42	*Scolopsis ciliata*	Jangki timun	K	LC
43	*Scomberoides tala*	Pajallari	K, D	LC
44	*Siganus canaliculatus*	Bawis	K, D	LC
45	*Siganus guttatus*	Baronang	K, D, P	LC
46	*Sphyraena qenie*	Barakuda	K, D	-
47	*Syngnathoides biaculeatus*	Kuda laut	P, M	LC
48	*Toxotes jaculatrix*	Sumpit	K	LC
49	*Upeneus sulphureus*	Ciko-ciko	K	LC
50	*Upeneus vittatus*	Mia-mia	K,SF	LC

The classification codes applied in this study are defined as follows: K = consumption, D = trade/commercially exploited, P = ornamental fish, SF = recreational fishing, SM = museum specimen, M = medicinal use, PI = fish feed, LC = least concern, and DD = data deficient.

Figure 4 documents several fish species from the coastal village of Teluk Singkama, illustrating their roles as food resources of economic value, ornamental species, components of traditional medicine, and as targets for recreational fishing tourism.

Figure 4. Several fish species from the coastal village of Teluk Singkama, illustrating their roles as food resources of economic value (a-d), ornamental species (e-g), targets for recreational fishing tourism (h-l), components of traditional medicine (m-o). a. *Siganus guttatus*; b. *Atropus hedlandensis*; c. *Lutjanus argentimaculatus*; d. *Sphyraena qenie*; e. *Chaetodon vagabundus*; f. *Rhinecanthus verrucosus*; g. *Monacanthus chinensis*; h. *Chanos chanos*; i. *Lutjanus fulvus*; j. *Lutjanus decussatus*; k. *Scatophagus argus*; l. *Upeneus vittatus*; m. *Parupeneus indicus*; n. *Syngnathoides biaculeatus*; o. *Choerodon rubescens*.

Discussion. The contrasting patterns of fish abundance and species richness between seagrass and coral reef habitats underscore the complementary ecological functions of these ecosystems. Seagrass beds often serve as critical nursery grounds, providing shelter and food resources that support high fish abundance, particularly for small-bodied and juvenile species (Nanami 2022). In contrast, coral reefs typically sustain higher taxonomic diversity due to their structural complexity, which offers a wide range of ecological niches (Rosdianto et al 2021). The dominance of Perciformes, with 34 species and 19 families recorded, is consistent with global observations that this order represents the most diverse and ecologically significant group in tropical coastal ecosystems (DeVantier & Turak 2017). The numerical prevalence of *G. minuta* in seagrass habitats further illustrates the role of specific taxa in shaping assemblage structures, while the rarity of several species suggests habitat specialization or limited distribution.

The presence of shared species between seagrass and coral reef habitats, such as *L. fulviflamma* and *P. chrysophrys*, highlights ecological connectivity and potential habitat overlap. Such connectivity is critical for sustaining fish populations, as many species utilize seagrass beds during juvenile stages before migrating to coral reefs as adults (Campbell et al 2011). This interdependence emphasizes the need for integrated management approaches that consider the seagrass-coral reef continuum, rather than treating these habitats as isolated units (Du et al 2020). Conservation strategies should therefore prioritize maintaining habitat integrity and connectivity to ensure the resilience of fish assemblages in East Kalimantan. Overall, the findings reinforce the ecological significance of both habitats, with seagrass ecosystems contributing to fish abundance and coral reefs supporting taxonomic diversity, together forming a vital foundation for coastal biodiversity and fisheries sustainability.

The ecological indices observed in Pantai Pasir Putih and Teluk Kaba reflect medium diversity levels, high evenness, and low dominance, which together indicate stable fish assemblages with balanced trophic interactions. The Shannon-Wiener diversity values (H' = 2.44-2.95) fall within the range commonly associated with moderately heterogeneous habitats, suggesting that both ecosystems provide sufficient structural complexity to support species coexistence (Magurran 2004). The high evenness values (0.78-0.82) demonstrate equitable distribution of individuals across species, a condition that reduces competitive exclusion and enhances resource partitioning (Krebs 2014). Meanwhile, the low dominance indices (0.10-0.12) highlight the absence of monopolization by a single taxon, thereby promoting functional redundancy and resilience against ecological disturbances (Rosdianto et al 2021). These findings align with studies in tropical coastal ecosystems where seagrass and coral reef habitats jointly sustain diverse and stable fish communities through niche differentiation and habitat connectivity (Alsaffar et al 2020). Thus, the ecological indices reinforce the importance of conserving both habitats to maintain ecosystem stability and biodiversity in East Kalimantan.

The similarity analysis of fish assemblages across set nets revealed clear substrate-driven clustering, with higher Sørensen similarity values among nets deployed on identical benthic substrates and lower values across different habitats. The dendrogram further supports this pattern, showing two distinct clusters: Set nets 1 and 2 in seagrass-dominated substrates with 83.18% similarity, and Set nets 3 and 4 in coral reef substrates with 59.74% similarity, which merge at a lower threshold of 51.17%. This indicates that habitat heterogeneity strongly influences species composition, as seagrass beds and coral reefs provide distinct ecological niches that shape assemblage structures (Unsworth et al 2019). The relatively high intra-cluster similarity reflects homogeneity within each habitat type, while the reduced inter-cluster similarity underscores the role of substrate complexity in driving community differentiation (Nagelkerken et al 2015). Such findings are consistent with broader studies in tropical coastal ecosystems, where seagrass-coral reef connectivity enhances biodiversity but also maintains distinct assemblages due to habitat-specific resource availability and structural features (Moustaka et al 2024). Therefore, the observed clustering highlights the ecological importance of conserving both habitat types to sustain complementary fish communities and overall coastal resilience in East Kalimantan.

The conservation assessment of fish species in Pantai Pasir Putih and Teluk Kaba that the majority of taxa fall under the Least Concern category of the IUCN Red List, with only two species classified as Data Deficient and eight species unlisted. This pattern indicates that local fish assemblages are relatively secure from immediate extinction risks, yet their high utilization for consumption and trade underscores the importance of sustainable management. The fact that 23 species are commercially exploited in local markets highlights their economic significance, while additional uses such as ornamental trade, recreational fishing, museum specimens, medicinal applications, and fish feed production demonstrate the multifunctional value of coastal fish biodiversity.

The predominance of Least Concern species in local consumption and trade suggests that current exploitation may not yet pose severe conservation threats; however, continuous monitoring is essential to prevent overfishing and ensure long-term sustainability (FAO 2020). Moreover, the diverse utilization pathways reflect the socio-economic reliance of coastal communities on fish resources, aligning with global findings that tropical fisheries provide both subsistence and commercial benefits while contributing to cultural practices and ecosystem services. Thus, integrating conservation status with utilization patterns offers a holistic perspective for balancing biodiversity protection and community livelihoods in East Kalimantan.

The results of this study carry important implications for coastal ecosystem management in East Kalimantan. The contrasting yet complementary roles of seagrass and coral reef habitats in supporting fish abundance and species richness highlight the necessity of conserving both ecosystems as interconnected units rather than isolated environments. The medium diversity levels, high evenness, and low dominance indices observed suggest that current fish assemblages are relatively stable, but the substrate-driven clustering of species composition demonstrates that habitat heterogeneity strongly influences community structure. This implies that degradation of either habitat type could disrupt ecological connectivity, reduce functional redundancy, and compromise resilience. Therefore, integrated conservation strategies should prioritize maintaining habitat integrity and connectivity across the seagrass-coral reef continuum, ensuring that ecological processes such as nursery functions, trophic interactions, and species migration remain intact (Du et al 2020).

From a socio-economic perspective, the predominance of Least Concern species in local consumption and trade indicates that current exploitation may not yet pose severe conservation risks. However, the multifunctional utilization of fish resources including ornamental trade, recreational fishing, medicinal use, and fish feed production underscores the strong dependence of local communities on coastal biodiversity. This reliance necessitates continuous monitoring and adaptive management to prevent overexploitation, particularly for species with high commercial value. Aligning biodiversity conservation with community livelihoods is essential to achieve sustainable fisheries and ecosystem resilience. Policy frameworks should therefore integrate ecological indices, species similarity patterns, and conservation status into fisheries management, ensuring that both ecological sustainability and socio-economic benefits are balanced. Such an approach would strengthen the long-term resilience of coastal ecosystems in East Kalimantan while safeguarding the cultural and economic well-being of local communities.

Conclusions. This study demonstrates that seagrass and coral reef habitats in East Kalimantan provide complementary ecological functions, with seagrass beds supporting high fish abundance and coral reefs sustaining greater taxonomic richness. Ecological indices indicate stable assemblages shaped by habitat heterogeneity, while similarity analysis highlights the importance of connectivity across ecosystems. Although most species are categorized as Least Concern, their widespread exploitation underscores strong socio-economic reliance on coastal biodiversity. Importantly, this study provides one of the first baseline assessments of fish diversity and conservation status in Teluk Singkama, East Kalimantan, offering critical insights for integrated conservation strategies that maintain seagrass-coral reef continuum integrity, safeguard biodiversity, and support sustainable community livelihoods.

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Conflicts of Interest. The authors declare that there is no conflict of interest.

Data Availability. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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