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CATCH ASSESSMENT OF MARINE FISHES IN CABALIAN BAY, PHILIPPINES: COMPOSITION, ABUNDANCE, GEAR, AND CATCH RATE

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ABSTRACT

Marine fisheries play a crucial role in food security and livelihoods but face challenges from overfishing and environmental changes. This study assessed fish composition, abundance, fishing gear usage, and catch per unit effort (CPUE) at three key landing sites in Cabalian Bay, Philippines. Seventy-three fish species from 31 families were recorded, with the dominance of Carangidae (11%) and Scombridae (10%). Monthly fish catch data reveal fluctuations in fish abundance, with Scombridae consistently recording the highest catches, particularly in August, December, and January. Hook-and-line and gill net were the primary gear used with varying effectiveness across the landing sites. Simple handline (*pasol*) was the most widely used gear. *Tawa* recorded the highest CPUE in Pong-oy, while other gear remained consistently low across all months. These findings provide essential baseline data to support fisheries management and small-scale fishers. The study highlighted the need for strengthened marine protected areas and more sustainable fishing strategies to mitigate declining fish stocks and ensure the long-term sustainability of resources.

How to Cite

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INTRODUCTION

The Philippines' rich and highly productive marine ecosystem delivers vital ecosystem services, such as coastal protection, nutrient cycling, and significant economic value (Broszeit et al., 2022). These services are essential to millions of Filipinos, especially those relying on fishing for food security and livelihood sustainability (De Guzman et al., 2019). In 2024, the country's total fisheries production was recorded at 1.07 million metric tons (MT) with marine municipal capture fisheries contributing 176.24 thousand MT in the fourth quarter – an 8.8% decline from the previous year's 193.25 thousand MT (PSA, 2025). Marine municipal fisheries accounted for 16.5% of the total fisheries production (BFAR, 2024). Among the most caught species in small-scale fisheries, notable trends include declines in big-eyed scad by 20.6% in Q4 and 20.0% annually, round scad by 14.3% in Q4 and 9.8% annually, and Bali sardinella by 8.2% annually. Conversely, skipjack tuna showed mixed trends, declining by 19.1% in Q4 but increasing by 31.2% annually, while frigate tuna increased by 8.6% annually (BFAR, 2024). The productivity of these fisheries is significantly influenced by the fishing gear used, including bottom-set gill nets, multiple handlines, bottom-set longlines, simple handlines, troll lines, fish corrals, bag nets, gleaning, trammel nets, and drift gill nets (Macale et al., 2020).

Despite the significant contributions of small-scale fisheries to local and national fish supply, research specifically examining fish catch composition within this sector – particularly in local communities like Cabalian Bay – remains limited. Most studies on small-scale fisheries in the Philippines have focused on governance, socio-economic conditions, and management policies rather than detailed assessments of species composition, fishing gear use, and CPUE. For instance, fisheries governance and sustainability research have emphasized management interventions and the relationship between small- and large-scale fishers (Fabinyi, 2024). Studies have also explored fisherfolk livelihoods (Watts et al., 2022) and small-scale fishers' financial constraints (Atillo, 2024). While valuable, these studies overlook small-scale fisheries' biological and ecological dimensions, particularly fish species composition and abundance. Various research has examined fisheries management practices, such as the effectiveness of local policies (Tolentino-Zondervan & Zondervan, 2022) and the management dynamics in San Miguel Bay where overfishing and fish stock declines have been linked to unregulated, destructive, and illegal fishing (Bergonio et al., 2024). Similarly, studies on the closed fishing season policy in Davao Gulf have focused on its effects on fish supply, catch levels, and market prices, as well as the role of key actors in the fisheries supply chain (Macusi et al., 2022). Localized assessments of fishing practices exist, such as studies on small-scale fisheries in the coastal barangays of Malita, Davao Occidental (Bersaldo & Lacuna, 2022), and a rapid assessment of small-scale commercial sardine fisheries in the Sulu Archipelago (Muallil et al., 2024). However, research specifically addressing fish catch composition in Cabalian Bay remains unexplored.

Given these knowledge gaps, the lack of science-based assessments of the catch composition of fish in Cabalian Bay small-scale fisheries poses a substantial challenge to effective site-specific fisheries management. Without precise species-specific data and CPUE estimates, policymakers and resource managers are challenged to craft conservation and management interventions that benefit small-scale fishers and maximize the long-term sustainability of marine resources. Filling this gap is important to create evidence-based fisheries policies that balance socio-economic requirements with ecological sustainability. The study aims to assess the fish catch composition and abundance of fishes, fishing gear used by the local fishers, and the catch per unit effort of fishing gear used. The results of this study provide baseline data for evaluating the effectiveness of fishing gear and help data-based fisheries management. Eventually, this study will benefit policymakers, local fisheries authorities, and small-scale fishers by maximizing the use of resources and ensuring sustainable fishing in the area.

MATERIALS AND METHODS

Sampling sites and inclusion criteria

The research was conducted at key landing sites in Cabalian Bay, Philippines. Figure 1 depicts the map of the study area. The sampling sites are geographically under the jurisdiction of San Juan, Southern Leyte, Philippines, a municipality facing Cabalian Bay. This municipality is subdivided into 18 barangays, 14 of which are coastal. It has several fishing grounds and landing sites, which serve as initial sale points for fish products and where fishers can access necessary goods such as food, fuel, and ice. Most fishers prefer to land their catches near their homes for easier access to these supplies.

With these, we purposefully chose three barangays, Osao, Pong-oy, and Minoyho, as primary sampling units (PSUs) because these areas are identified as landing sites for most small-scale fishers in the area. Secondary sampling units (SSU) are chosen for sampling within each PSU. The SSU refers to the fishing vessel defined by the type of gear the fishers use. In selecting the SSU, inclusion criteria were used, which included gear ownership, the bulk of landings, the willingness of the fisherfolk to cooperate, and accessibility of the site.

Seven SSUs were chosen, representing 10% of the registered boats at the three landing sites. These SSUs were carefully selected to ensure they represent the entire small-scale fishing community. Based on the criteria, two SSUs for Pong-oy and Minoyho were chosen, respectively, and three SSUs in Osao.

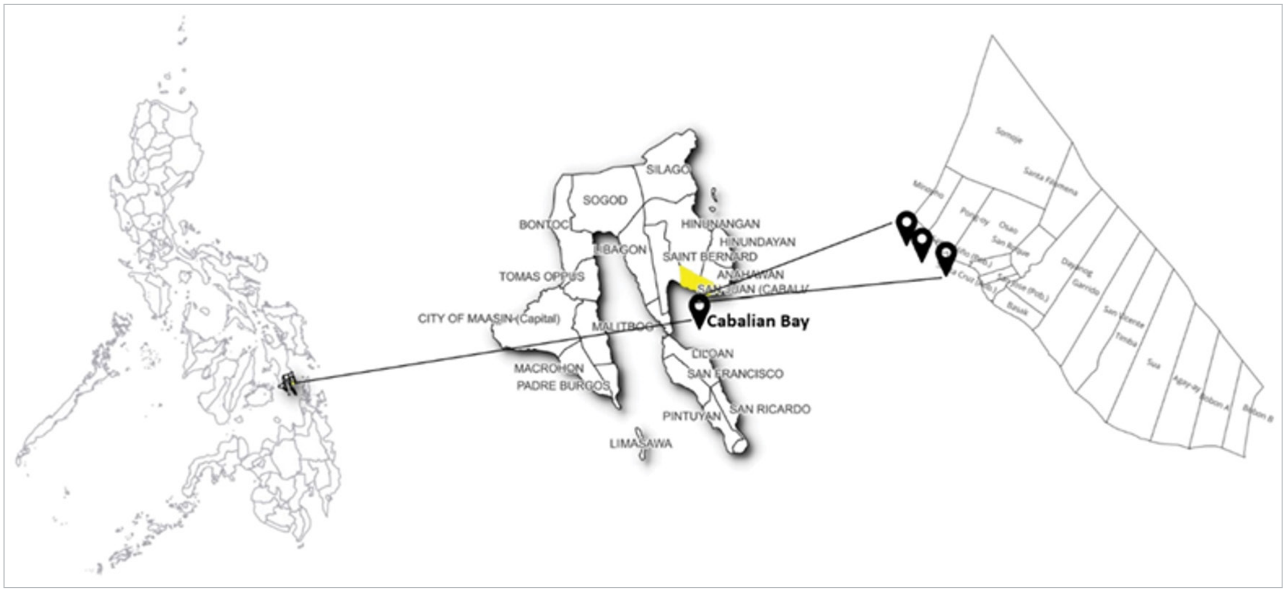

Fig 1. Study area: Philippines (A), Cabalian Bay (B), Landing sites (C)

Data collection methods

Before conducting the study, permission was sought from the local government authority. Upon approval, the researchers requested data on registered fishers and gear owners from the municipal agriculture department. The selection of SSUs was done through random sampling to ensure equal representation of all observations. The data collection focused on three key aspects: fish catch composition and abundance, fishing gear documentation and description, and CPUE.

Fish catch composition and abundance

Fish catch data were collected every two days over six months (from July 2022 to January 2023), following the standard sampling procedure of the National Stock Assessment Program (NSAP) (NFRDI-BFAR, 2021). Species composition and total catch per species were recorded at each landing site. Fish species were identified based on morphological characteristics using well-established taxonomic references, including Field Guide to the Coastal Fishes of Palawan (Gonzales et al., 2013), Common and Local Names of Marine Fishes of the Philippines (Ganaden & Lavapie-Gonzales, 1999), and the globally recognized FishBase species database (Froese & Pauly, 2024). Fish abundance was determined by calculating the average catch per month and per landing site based on total recorded landings.

Fishing gear documentation and description

The researchers conducted a detailed inventory of fishing gear used in the study area through direct observation and interviews with fishers. The data collected included the name and type of fishing gear, how it was used, target species, and frequency. Fishing gear was classified into active and passive categories, following the classifications by Dickson et al. (2003), Dickson et al. (2004) and He et al. (2021). Photographic documentation was conducted to validate gear descriptions and ensure data accuracy and consistency.

CPUE calculation

The data on catch and effort were collected at the landing sites through direct fisher interviews. The information gathered included the date and time of fishing trips, fishing location, total catch per trip (kg), fishing gear used, and effort manifested in the number of fishing hours. The CPUE was calculated using the formula:

$$CPUE = Total\ Catch / Effort$$

CPUE was recorded following the NSAP standard sampling procedure with catch per species, effort exerted, and the number of boat landings recorded using the adapted NSAP fish landing survey monitoring form (NFRDI-BFAR, 2021).

RESULTS

Species composition of the marine fishes

Figure 2 illustrates the distribution of different fish families according to their percentage occurrence. There were 31 families recorded. The family Carangidae takes the lead with the highest percentage (11%), followed by the family Scombridae with a close second (10%). Together, these two families represent a major proportion of the overall distribution, suggesting their prevalence in the bay. Other notable families include Epinephelidae (8%), Nemipteridae (8%), Lutjanidae (7%), Scaridae (5%), Lethrinidae (5%), and Labridae (5%), all of which contribute moderately to the overall fish diversity.

Many fish families such as Balistidae, Belonidae, Bramidae, Congridae and many others appear with only 1% each. While still present, these families have minimal representation, indicating that their populations or prevalence are relatively low compared to the dominant groups. Additionally, members of such families as Acanthuridae (3%), Anthiadidae (3%), Dorosomatidae (3%), and Siganidae (3%) contribute moderately to the fish community overall as a whole, occupying the mid-level of representation.

The species composition in Table 1 highlights the ecological richness of Cabalian Bay. Such diversity corresponds with the rich marine ecosystem in the bay where different species perform fundamental ecological roles of predation, herbivory, and habitat maintenance. A notable aspect in Table 1 is the variation in local names assigned to these species, as some taxonomically distinct species share common local names.

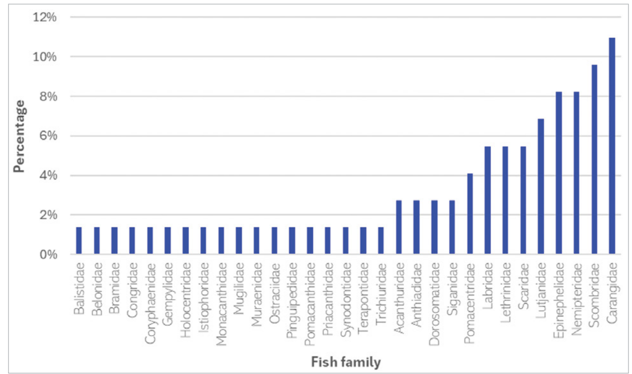

Fig 2. Species composition per family

Table 1. Local names of marine fishes in the landing areas

Family name	Scientific name	English name	Local name
Acanthuridae	*Naso vlamingii*	Humpnose unicorn	Banggisan
	Naso unicornis	Bluespine unicornfish	Banggisan
Anthiadidae	*Pseudanthias fasciatus*	One-stripe anthias/redstripe basslet	Lagas-lagas
	Pseudanthias rubrizonatus	Red-belted anthias/redbar anthias	Lagas-lagas
Balistidae	*Balistapus undulatus*	Orange-lined triggerfish	Pakol/Pugot
Belonidae	*Tylosurus crocodilus*	Hound needlefish	Bawo
Bramidae	*Taractes rubescens*	Pomfret/knifetail pomfret	Hasaan
Carangidae	*Selar crumenophthalmus*	Bigeye scad	Tamarong
	Selar boops	Ox-eye scad	Bodloy
	Decapterus macrosoma	Roundscad	Lambiyao
	Decapterus kurroides	Roundscad	Lambiyao
	Elagatis bipinnulata	Rainbow runner	Salindato
	Caranx tille	Tille trevally	Saminan/Talakitok
	Scomberoides tol	Needlescaled queenfish	Lapis
	Selaroides leptolepis	Yellowstripe scad	Salay
Congridae	*Conger cinereus*	Ashen conger eel	Obud
Coryphaenidae	*Coryphaena hippurus*	Common dolphinfish	Samarang
Dorosomatidae	*Sardinella lemuru*	Bali sardinella	Lupoy
	Sardinella melanura	Blacktip sardinella	Mangsi

Continued. Table 1

Family name	Scientific name	English name	Local name
Epinephelidae	*Epinephelus areolatus*	Areolate grouper	Lapu-lapu/Suno
	Variola albimarginata	White-edged lyretail grouper	Lapu-lapu/Senorita
	Variola louti	Yellow-edged lyretail grouper	Lapu-lapu/Lawihan
	Epinephelus fasciatus	Blacktip grouper	Lapu-lapu
	Cephalopholis boenak	Chocolate hind	Baghak
	Epinephelus tauvina	Greasy grouper	Baghak
Gempylidae	*Promethichthys prometheus*	Roudi escolar/night serpent	Tarzan
Holocentridae	*Myripritis kuntee*	Shoulderbar soldierfish	Baga-baga
Istiophoridae	*Istiophorus platypterus*	Indo-Pacific sailfish	Liplipan
Labridae	*Bodianus dictynna*	Pacific Diana's hogfish	Labajan
	Hemigymnus melapterus	Blackeye thicklip	Mulmol
	Bodianus rubrisos	Red-sashed hogfish	Labajan
	Cheilinus fasciatus	Redbreasted wrasse	Mulmol
Lethrinidae	*Lethrinus lentjan*	Pinkear emperor	Katambak
	Lethrinus olivaceus	Longface emperor	Katambak
	Gymnocranius elongatus	Forktail large-eye bream	Gangis
	Lethrinus nebulosus	Spangled emperor	Katambak
Lutjanidae	*Paracaesio xanthura*	Yellowtail blue snapper	Bilason solid
	Lutjanus decussatus	Checkered snapper	Bangayao
	Aphareus rutilans	Rusty jobfish	*Lambo*
	Lutjanus lutjanus	Bigeye snapper	Moko
	Lutjanus erythropterus	Crimson snapper	Suga
Monacanthidae	*Aluterus scriptus*	Scrawled filefish	Saguksok
Mugilidae	*Planiliza subviridis*	Greenback mullet	Banak
Muraenidae	*Gymnothorax nubilus*	Grey moray	Pananglitan
Nemipteridae	*Scolopsis aurata*	Yellowstripe monocle bream	Gapas-gapas
	Parascolopsis eriomma	Rosy monocle bream	Bukawn
	Scolopsis margaritifera	Pearly monocle bream	Katambak
	Nemipterus furcosus	Fork-tailed threadfin bream	Hutik
	Pentapodus caninus	Small-toothed whiptail	Salingukod
	Pentapodus numberii	Papuan whiptail	Salingukod
Ostraciidae	*Ostracion rhinorhynchos*	Horn-nosed boxfish	Bao-bao

Continued. Table 1

Family name	Scientific name	English name	Local name
Pinguipedidae	*Parapercis hoi*	Ho's sandperch	Tambud
Pomacanthidae	*Genicanthus lamarck*	Blackstriped angelfish	Pata
Pomacentridae	*Chromis analis*	Yellow puller	Pata
	Pomacentrus brachialis	Charcoal damsel	Pata
	Dischistodus prosopotaenia	Honey-head damsel	Mulmol
Priacanthidae	*Priacanthus sagittarius*	Arrow bulleye	Garalong/Gislang
Scaridae	*Chlorurus sordidus*	Daisy parrotfish	Mulmol
	Scarus quoyi	Quoy's parrotfish	Mulmol
	Scarus psittacus	Common parrotfish	Mulmol
	Scarus rivulatus	Rivulated parrotfish	Mulmol
Scombridae	*Thunnus tonggol*	Longtail tuna	Tulingan
	Katsuwonus pelamis	Skipjack tuna	Bulis
	Rastrelliger kanagurta	Indian mackerel	Hasa-hasa
	Auxis thazard	Frigate tuna	Mangko
	Scomber australasicus	Blue mackerel	Babher
	Thunnus albacares	Yellowfin tuna	Tulingan
	Euthynnus affinis	Kawakawa/mackerel tuna	Patikan
Siganidae	*Siganus guttatus*	Orange-spotted spinefoot	Kitong
	Siganus canaliculatus	White-spotted spinefoot	Danggit
Synodontidae	*Synodus dermatogenys*	Sand lizardfish	Tabili sa dagat/Turiki
Terapontidae	*Terapon jarbua*	Cresent perch	Bugaong
Trichiuridae	*Trichiurus lepturus*	Largehead hairtail	Diwit

Abundance of fish catch at the landing sites

Cabalian Bay's monthly fish catch reports indicate changes in the abundance of various fish families during late July and early January. Although the study did not cover an entire annual cycle, the trend gives some understanding of the potential seasonal change in fish availability.

Scombridae consistently recorded the highest catch volumes with notable peaks in August, December, and January. Carangidae also exhibited significant catches, particularly in August and September. Epinephelidae and Coryphaenidae displayed intermittent peaks, particularly in July and December. August and January recorded the highest fish catches across multiple families, while October and November had lower catches. Fish families such as Acanthuridae, Monacanthidae, and Mugilidae exhibited consistently low catch values across the months.

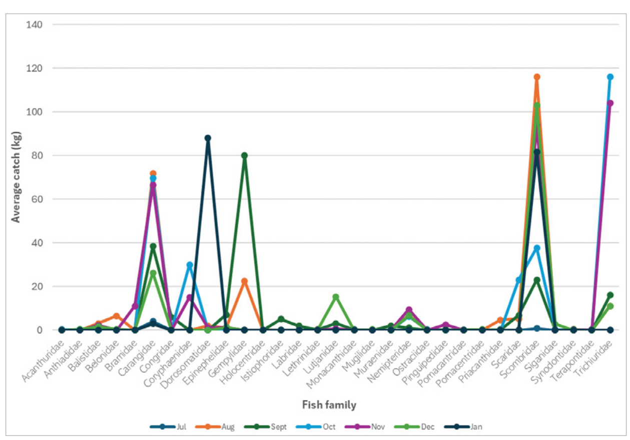

Fig 3. Monthly fish catch (approximate kg) per family in selected landing areas of Cabalian Bay

Figure 4 illustrates the trends in average fish catches per family in the selected landing areas. Certain families dominate the catch composition, while others contribute minimally. Scombridae recorded the highest average catch, exceeding 80 kg. Trichiuridae displayed relatively higher catch levels than other low-abundance groups (around 50 kg). Carangidae also exhibited high catch volumes, averaging around 40 kg. Fish families such as Coryphaenidae and Epinephelidae showed moderate catch levels, typically ranging from 20 to 30 kg. Several families, including Acanthuridae, Mugilidae, Pomacentridae, and others recorded consistently low average catches (below 10 kg).

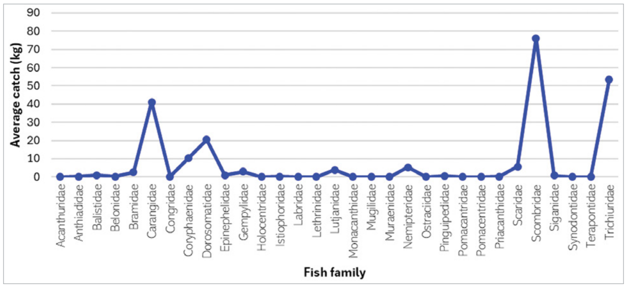

Fig 4. Trends in average fish catches per family in the selected landing areas of Cabalian Bay

Figure 5 presents the fish catch distribution across different families in the three selected landing areas: Minoyho, Pong-oy, and Osao. The data reveal significant variations in fish abundance and species composition across these sites. Pong-oy recorded the highest catch volumes among the landing sites. Carangidae had the highest catch in Pong-oy, exceeding 200 kg, making it the most dominant fish family in this area. Scombridae also showed high catches in Pong-oy, though slightly lower than in Osao.

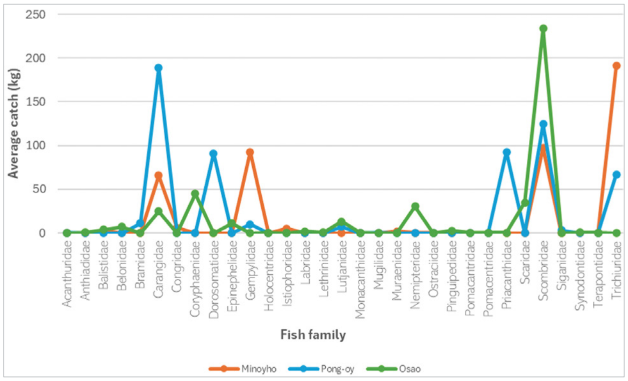

Fig 5. Fish catch in kilograms by family and landing area

Osao had the highest catch of Scombridae, surpassing 200 kg, making it the most significant contributor to the fish caught at this site. Minoyho recorded moderate catch volumes across several families. It did not have extreme peaks but consistently recorded moderate catches for Epinephelidae, Lutjanidae, and Coryphaenidae. Acanthuridae, Mugilidae, and Pomacentridae exhibited consistently low catch values across all landing areas.

Fishing gear

Fishers in the study area primarily utilized hook-and-line and gillnet. Each SSU typically employed two to three types of gear, depending on the season and the target species (Table 2).

Table 2. Fishing gear used

English name	Local name	Pong-oy	Minoyho	Osao
Simple handline	*Pasol*	a	a	b
Multiple handline	*Tapsay*			a
Multiple handline	*Lambo*			b
Drifting longline	*Tawa*	c	c	
Vertical line	*Untog*			b
Gill net	*Pukot*	c		
Drift gill net	*Palaran*	b	c	

Note: a – always/often used; b – moderately/fairly used; c – seldom/rarely used

Hook-and-line fishing was the most common method used with several variations observed. *Pasol*, a simple handline made of nylon with a hook and sinker, was employed to catch various fish using natural or artificial bait. Fishers consistently used this gear across all three landing sites, though in Osao, it was used more moderately. Some fishers use different local names for fishing gear based on their specific application. In this study, *tapsay* and *lambo* are classified as multiple handlines and fall under the broader category of trolling lines. A trolling line consists of one or more baited hooks or lures towed behind a boat to attract fish (He et al., 2021). Despite their classification under the same gear type, *tapsay* and *lambo* differ in their operation. *Tapsay* consists of a mainline with branching lines connected to a hook. It requires two boats to drag and stretch the mainline, increasing its reach across a wider area. Osao fishers frequently use this fishing gear. On the other hand, *lambo* is also a troll line, but it is a handline with multiple hooks towed behind a single boat. This gear was moderately used by fishers in Osao. The primary distinction between the two is that *tapsay* is operated by two boats, whereas *lambo* is managed by one boat. *Tawa*, a drifting longline with small hooks, was used to catch scads and sardinella near the surface, but it was rarely used in Minoyho and Pong-oy. Additionally, *untog*, a vertical line with multiple hooks and a sinker, was moderately used by Osao fishers.

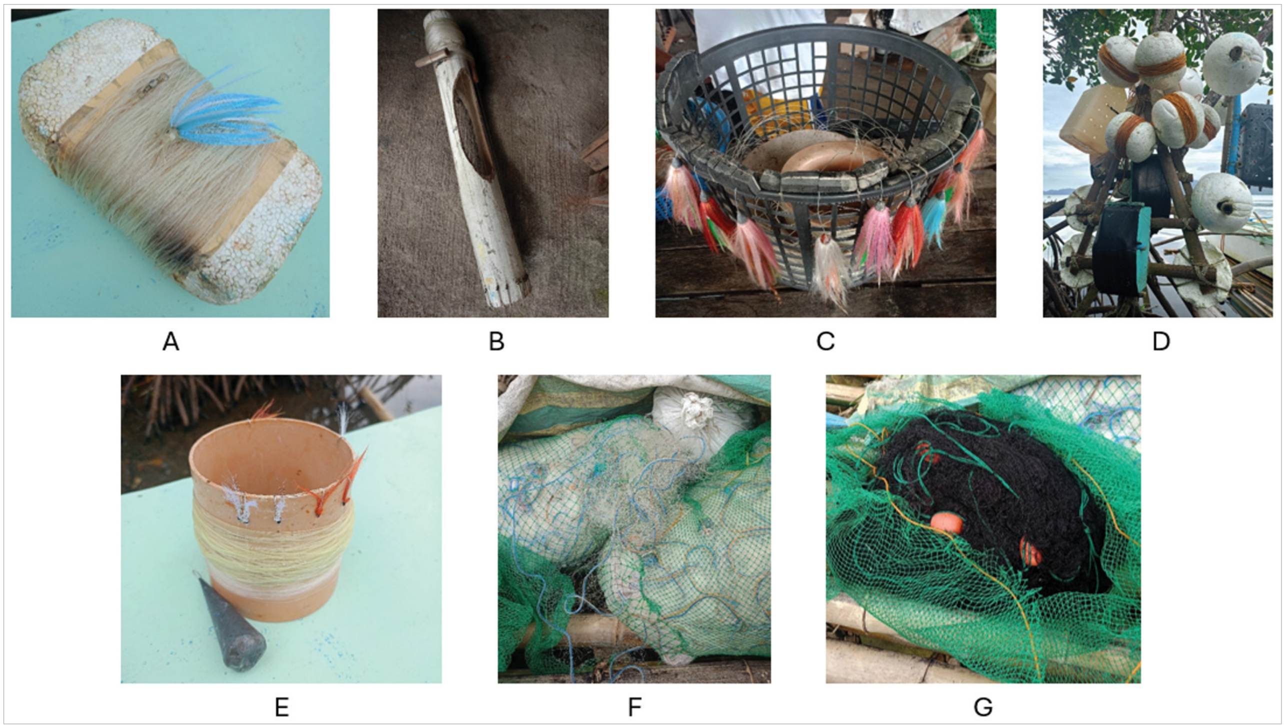

Fig 6. Fishing gear used: *Pasol* (A), *Tapsay* (B), *Lambo* (C), *Tawa* (D), *Untog* (E), *Pukot* (F) and *Palaran* (G)

Fishers also employed various types of gill nets, which are rectangular walls of netting designed to entangle fish by their gills. These nets were categorized based on the target species, operational method, and depth. Fishers in Pong-oy reported occasional use of *pukot*, a versatile gill net made of monofilament nylon, which could be used as a surface net (with buoys) or a bottom net (with sinkers) to catch species such as sardinella. Another gear, *palaran*, a drift gill net made of twisted or braided polyester filaments and equipped with sinkers and buoys, was commonly used for night fishing with lights attached to attract fish. Fishers in Pong-oy and Minoyho utilized this gear.

Table 3 highlights the diversity of fish species caught using different fishing gear in Cabalian Bay. The highest diversity of species composition was recorded for *pasol* with over 60 species from various families, including Carangidae, Scombridae, Epinephelidae, Lutjanidae, and Scaridae. This high diversity suggests that handlining is a highly selective fishing method that targets a wide range of reef-associated and pelagic species, depending on the bait and depth at which fishing occurs.

Catch per unit effort of fishing gear

The catch per unit effort was measured by dividing the fish catch in kg and the number of hours fishers spent at sea. Figure 7 presents the average monthly CPUE for various hook-and-line fishing methods (*pasol*, *lambo*, *tapsay*, *tawa*, and *untog*) recorded at three landing sites: Pong-oy, Minoyho, and Osao. CPUE indicates fishing efficiency, reflecting how much catch is obtained per unit of fishing effort. In Pong-oy, *tawa* recorded an exceptionally high CPUE of nearly 20 kg per fishing effort in July, significantly higher than any other gear across all months. Aside from the peak of *tawa* in July, CPUE values across all other types gear and months remained consistently low, generally below 2 kg per effort. Moreover, there are minor CPUE fluctuations across months and landing sites. *Pasol* recorded low but consistent CPUE values across all months. *Lambo*, *untog*, and *tapsay* exhibited small variations but remained below 2 kg CPUE throughout the study. In Osao, a slight increase in CPUE for *tapsay* and *untog* was observed in December and January.

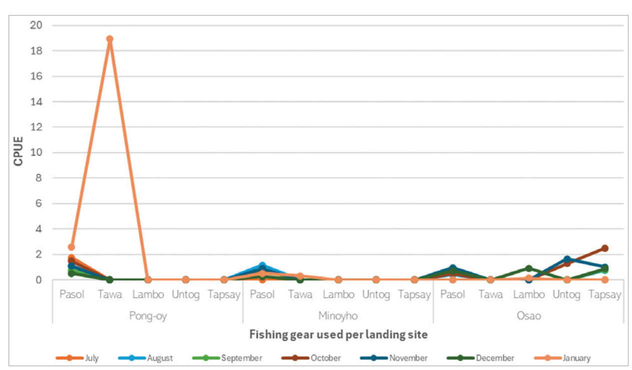

Fig 7. Average monthly CPUE (kg/effort) of hook and lines (*pasol, lambo, tapsay, tawa* and *untog*) recorded at three landing sites

Table 3. Species caught per fishing gear

Fishing gear	Family	Scientific name	English name
Pasol	Acanthuridae	*Naso vlamingii*	Humpnose unicorn
	Acanthuridae	*Naso unicornis*	Bluespine unicornfish
	Anthiadidae	*Pseudanthias fasciatus*	One-stripe anthias/redstripe basslet
	Anthiadidae	*Pseudanthias rubrizonatus*	Red-belted anthias/redbar anthias
	Balistidae	*Balistapus undulatus*	Orange-lined triggerfish
	Belonidae	*Tylosurus crocodilus*	Hound needlefish
	Carangidae	*Selar boops*	Ox-eye scad
	Carangidae	*Caranx tille*	Tille trevally
	Carangidae	*Decapterus macrosoma*	Roundscad
	Carangidae	*Decapterus kurroides*	Roundscad
	Carangidae	*Selaroides leptolepis*	Yellowstripe scad
	Carangidae	*Elagatis bipinnulata*	Rainbow runner
	Carangidae	*Selar crumenophthalmus*	Bigeye scad
	Congridae	*Conger cinereus*	Ashen conger eel
	Dorosomatidae	*Sardinella lemuru*	Bali sardinella
	Epinephelidae	*Cephalopholis boenak*	Chocolate hind
	Epinephelidae	*Epinephelus tauvina*	Greasy grouper
	Epinephelidae	*Epinephelus areolatus*	Areolate grouper
	Epinephelidae	*Variola albimarginata*	White-edged lyretail grouper
	Epinephelidae	*Variola louti*	Yellow-edged lyretail grouper
	Epinephelidae	*Epinephelus fasciatus*	Blacktip grouper
	Gempylidae	*Promethichthys prometheus*	Roudi escolar/night serpent
	Holocentridae	*Myripritis kuntee*	Shoulderbar soldierfish
	Istiophoridae	*Istiophorus platypterus*	Indo-Pacific sailfish
	Labridae	*Bodianus dictynna*	Pacific Diana's hogfish
	Labridae	*Hemigymnus melapterus*	Blackeye thicklip
	Labridae	*Cheilinus fasciatus*	Redbreasted wrasse
	Labridae	*Bodianus rubrisos*	Red-sashed hogfish
	Lethrinidae	*Gymnocranius elongatus*	Forktail large-eye bream
	Lethrinidae	*Lethrinus lentjan*	Pinkear emperor
	Lethrinidae	*Lethrinus olivaceus*	Longface emperor
	Lethrinidae	*Lethrinus nebulosus*	Spangled emperor
	Lutjanidae	*Lutjanus decussatus*	Checkered snapper
	Lutjanidae	*Aphareus rutilans*	Rusty jobfish

Continued. Table 3

Fishing gear	Family	Scientific name	English name
	Lutjanidae	*Paracaesio xanthura*	Yellowtail blue snapper
	Lutjanidae	*Lutjanus lutjanus*	Bigeye snapper
	Lutjanidae	*Lutjanus erythropterus*	Crimson snapper
	Monacanthidae	*Aluterus scriptus*	Scrawled filefish
	Mugilidae	*Planiliza subviridis*	Greenback mullet
	Muraenidae	*Gymnothorax nubilus*	Grey moray
	Nemipteridae	*Parascolopsis eriomma*	Rosy monocle bream
	Nemipteridae	*Scolopsis aurata*	Yellowstripe monocle bream
	Nemipteridae	*Pentapodus caninus*	Small-toothed whiptail
	Nemipteridae	*Pentapodus numberii*	Papuan whiptail
	Nemipteridae	*Scolopsis margaritifera*	Pearly monocle bream
	Nemipteridae	*Nemipterus furcosus*	Fork-tailed threadfin bream
	Ostraciidae	*Ostracion rhinorhynchos*	Horn-nosed boxfish
	Pinguipedidae	*Parapercis hoi*	Ho's sandperch
	Pomacanthidae	*Genicanthus lamarck*	Blackstriped angelfish
	Pomacentridae	*Dischistodus prosopotaenia*	Honey-head damsel
	Pomacentridae	*Chromis analis*	Yellow puller
	Pomacentridae	*Pomacentrus brachialis*	Charcoal damsel
	Priacanthidae	*Priacanthus sagittarius*	Arrow bulleye
	Scaridae	*Chlorurus sordidus*	Daisy parrotfish
	Scaridae	*Scarus quoyi*	Qouy's parrotfish
	Scaridae	*Scarus psittacus*	Common parrotfish
	Scaridae	*Scarus rivulatus*	Rivulated parrotfish
	Scombridae	*Scomber australasicus*	Blue mackerel
	Scombridae	*Katsuwonus pelamis*	Skipjack tuna
	Scombridae	*Rastrelliger kanagurta*	Indian mackerel
	Scombridae	*Auxis thazard*	Frigate tuna
	Scombridae	*Euthynnus affinis*	Kawakawa/mackerel tuna
	Scombridae	*Thunnus tonggol*	Longtail tuna
	Siganidae	*Siganus canaliculatus*	White-spotted spinefoot
	Siganidae	*Siganus guttatus*	Orange-spotted spinefoot
	Synodontidae	*Synodus dermatogenys*	Sand lizardfish
	Terapontidae	*Terapon jarbua*	Cresent perch
	Trichiuridae	*Trichiurus lepturus*	Largehead hairtail

Continued. Table 3

Fishing gear	Family	Scientific name	English name
Tapsay	Belonidae	*Tylosurus crocodilus*	Hound needlefish
	Carangidae	*Scomberoides tol*	Needlescaled queenfish
	Coryphaenidae	*Coryphaena hippurus*	Common dolphinfish
	Labridae	*Hemigymnus melapterus*	Blackeye thicklip
	Labridae	*Cheilinus fasciatus*	Redbreasted wrasse
	Pomacentridae	*Dischistodus prosopotaenia*	Honey-head damsel
	Scaridae	*Chlorurus sordidus*	Daisy parrotfish
	Scaridae	*Scarus quoyi*	Qouy's parrotfish
	Scaridae	*Scarus psittacus*	Common parrotfish
	Scaridae	*Scarus rivulatus*	Rivulated parrotfish
	Scombridae	*Katsuwonus pelamis*	Skipjack tuna
	Scombridae	*Auxis thazard*	Frigate tuna
	Scombridae	*Thunnus albacares*	Yellowfin tuna
Lambo	Carangidae	*Elagatis bipinnulata*	Rainbow runner
	Scombridae	*Katsuwonus pelamis*	Skipjack tuna
	Scombridae	*Auxis thazard*	Frigate tuna
	Scombridae	*Thunnus albacares*	Yellowfin tuna
Tawa	Carangidae	*Selar crumenophthalmus*	Bigeye scad
	Scombridae	*Auxis thazard*	Frigate tuna
	Scombridae	*Thunnus tonggol*	Longtail tuna
Untog	Scombridae	*Scomber australasicus*	Blue mackerel
	Carangidae	*Decapterus macrosoma*	Roundscad
	Carangidae	*Decapterus kurroides*	Roundscad
	Carangidae	*Selar crumenophthalmus*	Bigeye scad
	Scombridae	*Rastrelliger kanagurta*	Indian mackerel
	Scombridae	*Auxis thazard*	Frigate tuna
Pukot	Carangidae	*Selar boops*	Ox-eye scad
	Dorosomatidae	*Sardinella melanura*	Blacktip sardinella
	Dorosomatidae	*Sardinella lemuru*	Bali sardinella
Palaran	Carangidae	*Selar boops*	Ox-eye scad
	Carangidae	*Selar crumenophthalmus*	Bigeye scad
	Scombridae	*Scomber australasicus*	Blue mackerel
	Siganidae	*Siganus guttatus*	Orange-spotted spinefoot

Figure 8 illustrates the average monthly CPUE of two types of gill nets (*palaran* and *pukot*) across three landing sites. In Pong-oy, *pukot* showed exceptionally high CPUE values in August and January, exceeding 20 kg/effort, making it the most efficient gear in those months. Also, *palaran* recorded a moderate CPUE in September, indicating some success in catching target species but not at the same level as *pukot*. Moreover, there is a low and stable CPUE in Minoyho and Osao. These landing sites consistently recorded very low CPUE values for *palaran* and *pukot* across all months. Furthermore, CPUE for all landing sites and gear was near zero in November.

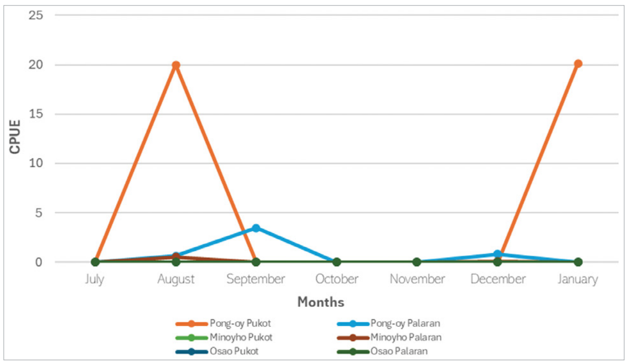

Fig 8. Average monthly CPUE (kg/effort) of gill nets (*palaran* and *pukot*) recorded at three landing sites

DISCUSSION

The dominance of Carangidae and Scombridae in the fish catch of Cabalian Bay can be attributed to their biological and ecological characteristics. These families are known for their schooling behavior (Sebastian et al., 2024), which makes them more susceptible to capture using purse seines, drift gillnets, and other bulk-harvesting fishing gear. Their rapid reproduction and broad distribution in tropical marine ecosystems ensure their continued occurrence in local fisheries (Sartori et al., 2021). The commercial value of these species also ensures that targeted fishing activities are directed at them, as they are highly sought after in local and export markets. Similar patterns have been observed in other Philippine fishing grounds, such as Lingayen Gulf where *Decapterus macrosoma* was identified as the highest-yield species (De Guzman et al., 2020), and Iligan Bay where round scads (*Decapterus* spp.) were second only to tunas in abundance (Jimenez et al., 2020). This result supported the study in Leyte Gulf where Leiognathidae is the most abundant catch (Salazar et al., 2024). The prominence of Scombridae in Cabalian Bay aligns with the observations of tuna larvae distribution in Philippine waters where upwelling events and nutrient-rich waters enhance their recruitment and survival (Nepomuceno et al., 2020).

The 31 fish families in the catch composition highlight the ecological richness of Cabalian Bay. The bay's rich marine ecosystems support diverse trophic groups such as predators, herbivores, and schooling pelagic fishes. Predatory fish, like Epinephelidae and Lutjanidae, are mostly found to be related to reef habitats where they prey on smaller fishes and invertebrates. This occurrence of predator fish at Cabalian Bay is consistent with a study at Palawan where predator fish in reef habitats have also been reported (Balisco et al., 2023). Their role is crucial for maintaining food web balance by regulating prey populations, a function emphasized in studies on predator-prey interactions (Free et al., 2021). Herbivorous fish families, including Scaridae and Siganidae, contribute significantly to reef resilience by controlling algal overgrowth, a function well-documented in coral reef health studies (Robinson et al., 2020). The presence of humpnose unicornfish, bluespine unicornfish, and various parrotfish species suggests that Cabalian Bay's reefs provide suitable conditions for herbivore populations to thrive. Similar findings were observed in the study by Eviota et al. (2021) on the abundance of coral reef fishes in Nonoc Island.

Fish families with low representation in the catch composition data, such as Belonidae, Bramidae, and Congridae, may exhibit naturally smaller populations in the bay or have specific habitat preferences that make them less accessible to common fishing gear. Many species inhabit deeper waters or are more solitary (Kar et al., 2022), reducing their vulnerability to bulk-harvesting methods. The relatively low abundance of groupers in Cabalian Bay may also indicate fishing pressure similar to patterns observed in the Northwest Sulu Sea where overharvesting has significantly reduced CPUE and fish sizes of *Plectropomus leopardus* (Gonzales et al., 2019). The loss of top predator populations is an increasing issue in Philippine fisheries because it can upset the trophic balance and result in changes in ecosystem dynamics. Monitoring efforts need to be increased to determine the sustainability of predator populations in the bay.

Biological, environmental, and socio-economic considerations affect Cabalian Bay fish catch variations. Observed changes through different months follow species-related behavior, seasonality, and fishing methods, affecting the availability and abundance of fish. The peaks in Scombridae and Carangidae observed during August, December, and January suggest that migratory behaviors and spawning events influence fish availability (Pruzinsky et al., 2020). Many pelagic fish species undergo seasonal migrations for optimal breeding grounds, prey abundance, and favorable water conditions (Chen, 2022). These spawning events often lead to temporary increases in fish density, making them more susceptible to capture. Seasonal fish abundance changes were also evident in Cabalian Bay, peaking in August and September for Carangidae, Scombridae, and Gempylidae. These fluctuations correlate with established migratory patterns and breeding seasons based on environmental variables like temperature fluctuations, availability of prey, and oceanography (Wang et al., 2021). Similarly, round scad (*Decapterus* spp.) landings in Iligan Bay exhibited seasonal patterns with higher catches recorded during the Northeast Monsoon (October to May) and lower yields during the Southwest Monsoon (June to September), likely due to weather conditions affecting fishing operations (Jimenez et al., 2020). These seasonal changes call for adaptive strategies in fisheries management to maintain fish stocks, especially at the peak spawning season when species are most vulnerable to fishing efforts (Silas et al., 2020).

Using fishing gear in Cabalian Bay is also a key determinant of fish catch fluctuations, species structure, and fishery yield. Handline (*pasol*) caught the largest number of species with more than 60 fish species. This method's selectivity allows fishers to target specific species based on bait type, fishing depth, and habitat preferences (Bhanja et al., 2024; Hutubessy, 2021). In contrast to passive gear which catch a broad array of fish indiscriminately, handlining allows the fishers to target reef- and pelagic-associated species (Bobiles et al., 2023). Handlining's high level of adaptability due to adjusting bait and hook size accounts for its rich diversity of species caught. This finding aligns with previous studies highlighting handlining as a sustainable fishing technique due to its low bycatch rates and minimal environmental impact (Dunning et al., 2023). Handline fishing also predominantly captured mature oceanic fishes in General Santos (Pechon et al., 2022). In Leyte Gulf, paired troll lines are fishers' most common hook-and-line gear, further emphasizing the prevalence of selective fishing techniques in the region (Picoy-Gonzales & Reducto, 2024). In Tawi-tawi, the most employed gear were bottom set gillnet, single hook and line, and speargun (Mohammad et al., 2022). Other fishing gear, such as *tapsay*, *lambo*, and *tawa*, primarily targets pelagic schooling species like tunas, mackerels, and scads. The species composition from these types of gear reflects the effectiveness of bulk fishing methods in harvesting migratory and fast-moving fish populations. However, the overreliance on specific fishing gear can lead to the overexploitation of target species, as seen in other Philippine fisheries (Herrón et al., 2020).

CONCLUSION

This study assessed fish catch, species richness, fishing gear and the CPUE at three landing points in Cabalian Bay, Philippines. Results indicate the bay's richness with 31 fish families contributing to fisheries productivity. Carangidae and Scombridae were dominant catches, and some families had low abundance, perhaps because of habitat conditions or fishing pressure. Seasonal peaks in August, December, and January indicate environmental impacts on fish availability. Pong-oy recorded the most total catch, and Osao recorded the most Scombridae catches. The employment of varied fishing gear indicates the resilience of local fishermen. Handlining, particularly *pasol*, emerged as the most widely used gear and contributed to the highest diversity of fish catches, including species from families such as Carangidae, Scombridae, Epinephelidae, and Lutjanidae. *Tawa* demonstrated the highest CPUE, particularly in July in Pong-oy, reaching nearly 20 kg per effort. CPUE for all other hook-and-line gear, including *pasol*, *lambo*, *tapsay*, and *untog*, remained consistently low (below 2 kg per effort) with minor fluctuations across months and locations. *Pukot* exhibited exceptionally high CPUE values for gill nets in August and January in Pong-oy, surpassing 20 kg per effort, while *palaran* recorded moderate CPUE in September but remained relatively low in all other months. These observations emphasize the necessity of sustainable harvesting and additional study on seasonal patterns and environmental pressures.

The study has limitations: (1) Data collection every two days may miss key variations in fish catch; more frequent sampling is recommended. (2) The study lacks weight and length data for fish species, which could aid in tracking overfishing and ecosystem changes. (3) Covering only half the year may overlook seasonal abundance variations. Future studies should address these gaps for a more comprehensive fisheries assessment.

PROCJENA ULOVA MORSKIH RIBA U ZALJEVU CABALIAN, FILIPINI: SASTAV, BROJNOST, OPREMA I STOPA ULOVA

SAŽETAK

Morsko ribarstvo ima presudnu ulogu u sigurnosti hrane, ali se suočava s izazovima zbog pretjeranog izlova i promjena u okolišu. U ovoj studiji napravljena procjena je sastava ribe, brojnosti, upotrebe ribolovnog alata te ulova po jedinici napora (CPUE) na tri ključna mjesta iskrcaja ulova u zaljevu Cabalian na Filipinima. Zabilježene su 73 riblje vrste koje pripadaju 31 porodici, s dominacijom Carangidae (11%) i Scombridae (10%). Mjesečni podaci o ulovu ribe otkrivaju fluktuacije u obilju ribe, pri čemu Scombridae dosljedno bilježe najveći dio ulova, posebno u kolovozu, prosincu i siječnju. Parangal i mreže bile su primarni alat koji se koristio s različitom učinkovitošću. Udičarnje (*pasol*) bila je najraširenija oprema. Tehnikom *Tawa* je zabilježen je najveći CPUE u Pong-oyu, dok je kod korištenja ostale opreme konstantno bilo manji tijekom svih mjeseci. Ovi nalazi pružaju bitne osnovne podatke za potporu upravljanju ribarstvom. Studija je istaknula potrebu za pojačavanjem morskog zaštićenog područja i održivim ribolovnim strategijama kako bi se ublažio pad ribljeg fonda i osigurala dugoročna održivost resursa.

Ključne riječi: učinkovitost ribolovnog alata, morska bioraznolikost, održivo upravljanje ribarstvom, CPUE

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