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Estimation of Species Composition, Catch Per Unit Effort, and Biomass of Some Marine Fishes of Chaungtha, Ayeyarwady Region in Myanmar

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Abstract
The assessment of the marine fishery was investigated in the Chaungtha Coastal Area for ten months from November 2023 to August 2024. In this study area, seven different types of fishing gear have been recorded, such as bottom set gillnets, purse seines, beach seines, drift gillnets, longlines, dive fishing, and trap fishing. Beach seine was the most efficient fishing gear (27.63%) of species composition, followed by purse seine (25.66%) and bottom set gillnet (22.37%), while trap fishing was the least efficient (0.66%). Sardinella forms the significant component of landings (16.20%), followed by groupers (14.77%) and yellow pike conger (13.58%). The mean catch per unit effort (catch/unit effort/day) was 3.55 kg, and the range was 0.15- 6.47 kg, recorded in July 2024 and November 2023. The highest total catches, 2199.35 kg, were recorded in November 2023, followed by 1843.13 kg in January and 1590.3 kg in March 2024, while 50.18 kg was the least caught in July 2024. The biomass of marine fishes ranged from 7.91 mt to 723.70 mt. The mean biomass was recorded at 205.09 mt in the present study.

Keywords
Chaungtha, species composition, catch per unit effort, biomass, Myanmar

1. Introduction

Myanmar has a coastline of over 2800 kilometers and is rich in marine resources, which play an important role in the livelihoods of coastal communities and the country's economy. The Ayeyarwady Region, situated in the southwestern part of Myanmar, is abundant in natural resources. Generally, fisheries in the Ayeyarwady Region are classified into three categories: freshwater or inland, aquaculture, and marine capture fisheries.

In the Ayeyarwady Region, marine capture fisheries have inshore and offshore fishing systems. Inshore fishing vessels are operated within the range of the shoreline to 10 nautical miles. In offshore fishing, the vessels operate beyond the outer limit of the inshore fishing zone to the Exclusive Economic Zone (EEZ). Artisanal or small-scale fisheries are common in tributaries of deltaic areas. Chaungtha and adjacent areas are the central portion of the Ayeyarwady continental shelf, surrounded by very productive ocean water, making the fishing industry one of its most important industries. The people of Myanmar like fish and fishery products, which are essential for daily meals, fish sauce, fish, and shrimp paste are the favourite dishes of Myanmar. Therefore, there has been great stimulation productive capacities of the fishery communities, and the local fishery sector has been pushed to the strongest growing stage. The development of fisheries can be examined by studying and identifying the production, consumption, and export situation of the fisheries sectors in Myanmar.

Depending on the available literature, a review was conducted on the assessment of the marine fishery in the Chaungtha coastal area. Cho (2015) observed the species composition of fish caught by beach seine nets and also described the highest and lowest catch rates of beach seine nets in the Chaungtha coastal area. de Graaf et al. (2015) outlined international training courses in fisheries statistics and data collection. These programs covered socio-economic

aspects, improved decision-making, and encouraged responsible management of fisheries. DoF (2021) reported how sustainable fisheries management is linked with secure fishery production, income generation, and fishery-dependent livelihoods, as well as a linkage to the proper management and conservation of the fishery resources now and in the future. FAO (1999) described guidelines for routinely collecting captured fishery data. FAO reported that the guidelines aim to help the routine data collection programmes, focusing on the relationship between typical questions asked by policymakers and managers, and the data required for providing reliable answers.

Nories et al. (1991) described a fishermen's guide to CPUE and bycatch data from the National Marine Fisheries Service Observer Program Bering Sea/Aleutian Island Yellowfin Sole Trawl Fishery. Scientists reported that the Bering Sea/Aleutian Islands yellowfin sole trawl fishery is one of a six-part series of reports summarizing catch per unit effort (CPUE) and bycatch data extracted from the National Marine Fisheries Service Observer Program North Pacific (NORPAC) database. They also presented that the overall goal of this research is to help individual skippers and vessel owners maintain their bycatch rates for prohibited species (Halibut, Herring, Red King Crab, and Bairdi Tanner crab) within guidelines established by the North Pacific Fishery Management Council. Olopade et al. (2017) presented the fish catch composition of selected small-scale fishing gear used in the Bonny River, Rivers State, Nigeria.

Fishery scientists reported that a total of 25 fish species from 18 families were recorded during their study period. They also observed that the most efficient fishing gear is the cast net, while the gill net is the least efficient.

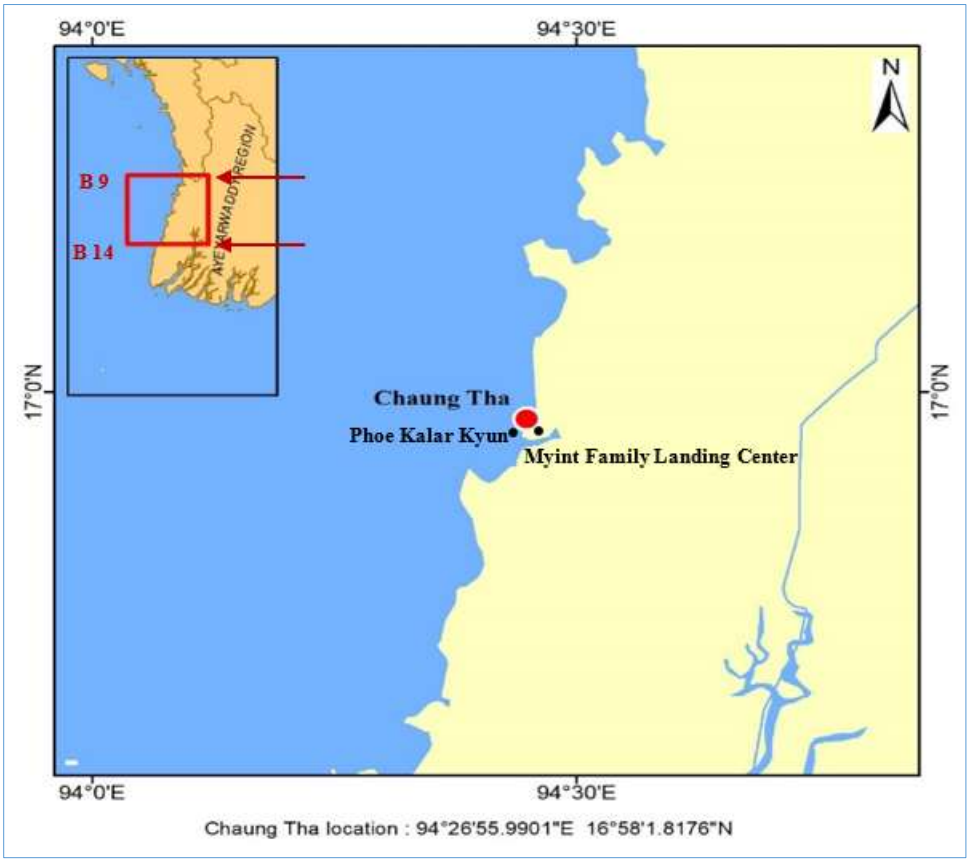

Fig. 1 Map showing the study site of Chaungtha Coastal Area

In a study conducted in the Chaungtha coastal area, Oo (2020) presented the population dynamics of the commercially important fishes. The author described that a total of 83 species belonging to 64 genera, 46 families, and 13 orders were recorded from five different fishing gears: beach seine, net fence, seine net, drift gillnet, and trawl net. He also observed the species composition, occurrence, and the highest and lowest catch rates of five different fishing gears.

Pascoe and Gréboval (2003) published on measuring capacity in fisheries. These authors described the fisheries technical paper in four parts. The first part includes papers addressing theoretical considerations and definitions of capacity. The second part includes case studies outlining the existing practice undertaken in some member countries. The third section includes papers that outline alternative methods for deriving output-based measures of capacity. The last section contains papers that outline alternative methods for assessing input-based measures of capacity. These include the estimation of fishing power, hold capacity, and bioeconomic modelling to determine optimal fleet sizes.

Psomadakis et al. (2019) reported a field identification guide for the living marine resources of Myanmar. The authors

emphasized that this guide is an essential resource for individuals engaged in Myanmar's fisheries. It offers comprehensive descriptions of key species, including their scientific names, FAO designations in English and French (when applicable), local names used in Myanmar, distinguishing characteristics, one or more illustrations, maximum size, and details about their fisheries and habitats. Additionally, the guide is fully indexed and includes a list of further literature for reference. Saglamn and Saglam (2016) studied the CPUE of whiting *Merlangius merlangus* (Linnaeus, 1758) gillnet fishery in Ordu, the southeast Black Sea. These scientists reported the catch samples and CPUE of three different boats of the gillnet fishery in Ordu.

In 2018, San conducted an assessment of anchovy and sardine catches using purse-seine nets in the Kyeintali coastal area of Rakhine State. His research focused on 13 species from the Engraulidae and Clupeidae families collected from this region. Throughout the study, he also analyzed the length frequency distribution and recorded the highest and lowest catch weights for both families.

Sparre (2000) published a manual on sample-based data collection for fisheries assessment. This researcher mentioned that this manual deals with practically implementing a routine data collection programme. The data collection programme is developed through a top-down approach, from the identification of the objectives down to the practical recording and management of data obtained from the fishery. This researcher also described that the methodologies used are mainly appropriate for a tropical, developing country, with many small (artisanal) vessels and a few large (industrial) vessels.

Stamatoulos (2002) described sample-based fishery surveys as a technical handbook. The author presented that the purpose of this handbook is to summarize experience gained over recent years in fishery statistical development by the Fishery Information, Data and Statistics Unit (FIDI) of FAO, and provide planners and users of fishery surveys with simple and step-by-step guidance for developing and implementing cost-effective and sustainable fishery surveys.

The author also reported that the methodological and operational concepts discussed here apply equally to both marine and inland capture fisheries and are presented in a manner that is generic enough to make them adaptable to the most commonly used data collection systems. Statistical aspects are presented in a descriptive rather than theoretical manner.

Tezzo et al. (2018) reported Myanmar's fisheries in transition: current status and opportunities for policy reform. These researchers described that the fisheries sector occupies an important place in Myanmar's economy and culture and is set to change rapidly as the country enters a period of unprecedented political and economic transition.

WCS Myanmar (2018) reported the characterization of fisheries and marine wildlife occurrence in southern Rakhine State and western Ayeyarwady Region, Myanmar. This report described that this document represents the final report of the project "Identifying and mapping the occurrence of fishing activity and marine wildlife along the Rakhine and Ayeyarwady coast, Myanmar," implemented from 26 June 2017 to 31 July 2018 by WCS Myanmar in collaboration with Pathein University's Marine Science Department, Rakhine Coastal Region Conservation Association, the University of Exeter, and other partners. The present study mainly focused on the catch performance and landing survey of some marine commercial fish species in Chaungtha Coastal Area from November 2023 to August 2024.

2. Materials and Methods

Chaungtha Coastal Area lies between Latitude N 16˚ 24' to N 16˚ 52' and Longitude E 094˚ 24' to E 094˚ 36' in the southern Rakhine Coastal Region of the Bay of Bengal. Inshore fishing grounds B10 and B15, and offshore fishing grounds B9 and B14, adjoin this area. However, there are no offshore fisheries in the Chaungtha Coastal Area. The study was monthly assessed from November 2023 to August 2024 in two different landing sites: Phoe Kalar Kyun and Myint Family Landing Center (Fig. 1).

2.1. Species Composition

The species composition of a given area or period is defined as the total catch of individual species to the total catch of all species present in the effort multiplied by 100 (Norris et al., 1991).

$$\text{Species composition} = \frac{\text{Total catch of individual species}}{\text{Total catch of all species}} \times 100 \quad (1)$$

2.2. Estimating Catch

The total catch can be estimated from sample CPUE multiplied by the estimated effort (Stamatopoulos 2002).

$$Catch = CPUE \times Effort \quad (2)$$

where; 1. *Catch (total)* refers to all species taken together and is usually computed within the logical context of a given reference period (a calendar month). 2. *CPUE (sample, overall Catch-Per-Unit-Effort)* is an overall average deriving from sampling and expressing how much fish (all species) is caught by a unit effort. The sampling context is the same as that for the estimated catch. 3. *Effort (estimated from the sample)* is expressed uniformly in the total number of boat days within the same logical context used for total catch and overall CPUE. Total fishing effort is assumed to be known.

2.3. Estimating Biomass

The biomass can be estimated from the total catch sample multiplied by effort and days (FAO, 2002).

$$Biomass = Total\ catch\ rate \times Boat\text{-}day \times Fishing\text{-}day \quad (2)$$

where; 1. *Fish biomass* refers to the total mass of fish within a particular area, typically measured in weight. 2. *The total fish catch*, which refers to the total quantity of fish harvested from a particular area over a specific period, has a range of outcomes that affect ecological, economic, and social dimensions. 3. *Boat day* refers to the fishing activity level most often measured by boat activity, expressing the probability that any boat will be active on any day. 4. *Fishing day* refers

to determining active days in simplified sampling time (landings and/ or effort) that are frequent enough to cover 12-15 days of the month, giving sufficient days for low or zero activity to enter the samples.

3. Results and Discussion

The estimation of species composition, catch per unit effort, and biomass of some marine fish was carried out at two landing sites in the Chaungtha Coastal Area. This study took place for ten months, from November 2023 to August 2024. The fishery composition, makeup, and dynamics of fish species in a specific inshore fishing area of Chaungtha Coastal Area are influenced by factors like fishing practices, environmental conditions, and local management strategies.

In the present study, the sardinellas (*Amblygaster leiogaster*, *Sardinella brachysoma*, *S. gibbose*, *S. lemuru*, *Dussumieria acuta*) was highest composition 16.20% followed by groupers (*Cephalopholis formosa*, *C. miniata*, *Epinephelus coioides*, *E. erythrurus*, *E. quoyanus*) 14.77%, yellow pike conger (*Congrexsox talabon*) 13.58%, and lizard fish (*Saurida micropectoralis*) was lowest composition 0.23% each (Fig. 2).

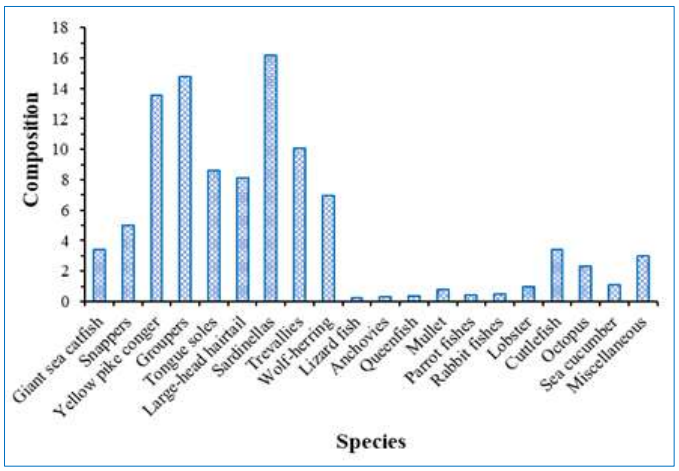

Fig. 2. Species composition of some marine fishes in Chaungtha Coastal Area

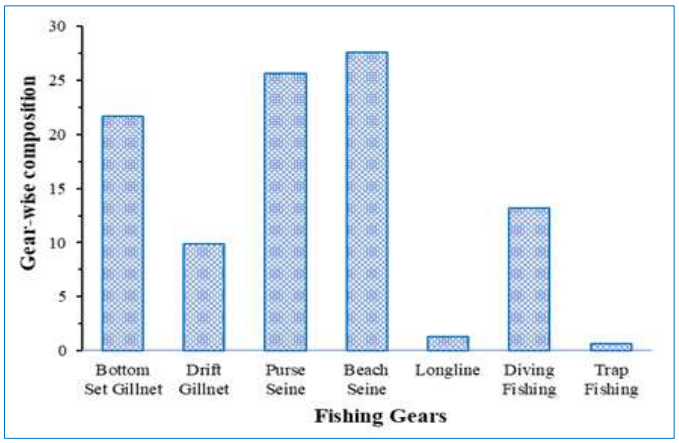

Fig. 3. Gear-wise composition of some marine fishes in Chaungtha Coastal Area

According to current research, it has been observed that 7 types of fishing gear are used in the Chaungtha coastal area, depending on the season. Therefore, the fishing gear catch composition also recorded that beach seine caught (27.63%) of the total composition, followed by purse seine (25.66%) and bottom set gillnet (22.37%), while the least was recorded in trap fishing (0.66%) (Fig. 3). The common catches of these gear consisted of the following families Engraulidae, Chirocentridae, Clupeidae, Mugilidae, Sillaginidae, and Leiognathidae were divergent species caught by beach seine while Engraulidae, Clupeidae, Leiognathidae, and Scombridae were dominant families caught by the purse seine net. The families Ariidae, Serranidae, Lactariidae, Leiognathidae, Lutjanidae, Caesionidae, Mullidae, and Scaridae were caught by a bottom set gillnet in this study.

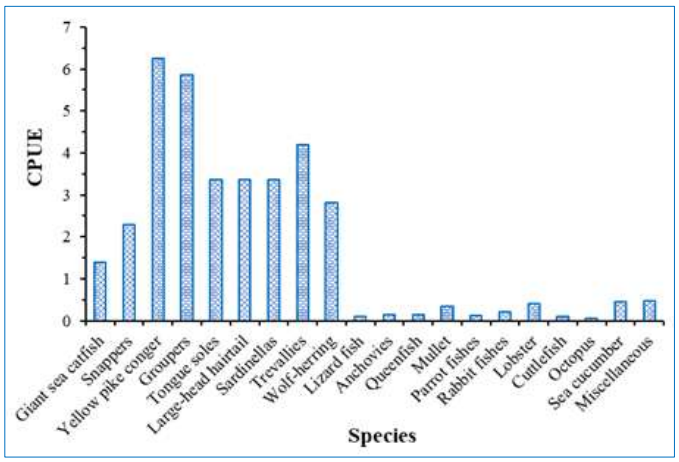

Fig. 4. CPUE of some marine fish species in Chaungtha Coastal Area

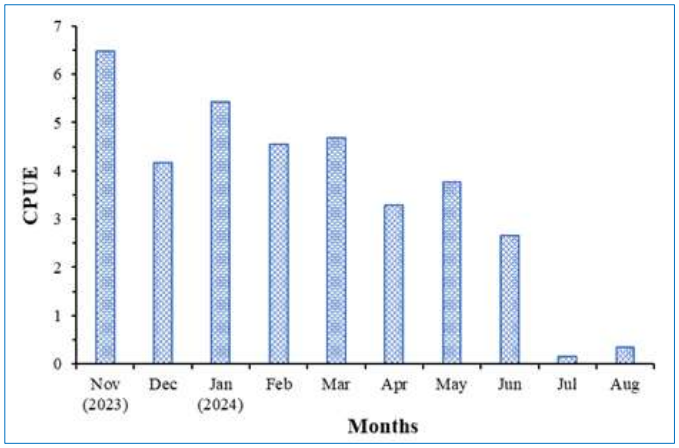

Fig. 5. Monthly CPUE of some marine fish species in Chaungtha Coastal Area

CPUE is a crucial metric in fisheries management, representing the amount of catch (e.g., fish) obtained per unit of effort (e.g., hours fished, number of traps used). It is used to assess the abundance and status of fish stocks in the Chaungtha Coastal Area.

This study area and the adjacent estuarine system supported a fishery of considerable magnitude. The studies on the resource characteristics of marine fish were conducted at two study areas for ten successive months from November 2023

to August 2024, as part of investigations on both pelagic and demersal fisheries resources. Samples were collected from the motorized fishing boats that landed at the Chaungtha landing place. The highest CPUE was recorded for the yellow pike conger at 6.26 kg, followed by groupers at 5.86 kg, and trevallies at 4.19 kg, respectively (Fig. 4). The mean CPUE was 3.55 kg and the range was 0.15- 6.47 kg recorded in July 2024 and November 2023 (Fig. 5). Dominant CPUE was drift gillnet (4378.52 kg) followed by purse seine (2494.8 kg), beach seine (445.2 kg), and trap fishing (17.36 kg) (Fig. 6).

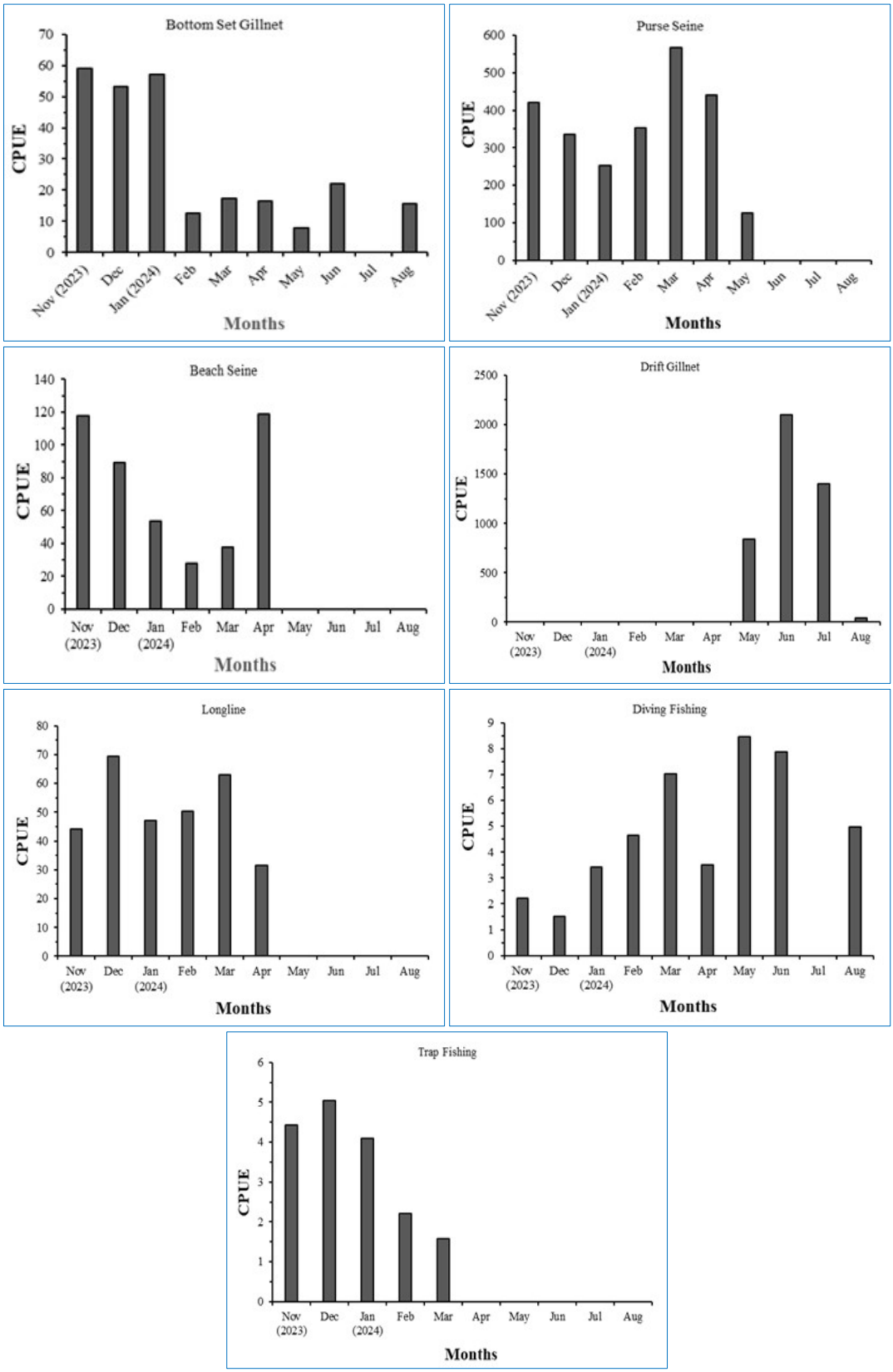

Fig. 6. Monthly CPUE of different fishing gears in Chaungtha Coastal Area

Fishing along the Chaungtha Coastal Areas was seasonal because of the weather conditions at different times. During the northeast monsoon (November to April), the fishing areas are very calm, and fishing is carried out along the entire coast. Conversely, during the southwest monsoon (May to October), the sea is rough and choppy, making fishing activities difficult. Marine fish were highly esteemed food fish and were mostly consumed in their fresh condition. Occasionally, when the catch exceeded the local demand, they were sundried along with other small varieties of fish, like miscellaneous. To process the fish for dried fish, it was soaked in a salt solution for a day and sundried by spreading on the sandy beach. This method was particularly employed for smaller fish. After drying, the fish was packed in plastic bags or newspapers and sent to the interior marketing places.

Present CPUE data supports the enforcement of fishing regulations, such as catch limits or gear restrictions. It can help detect illegal, unreported, and unregulated (IUU) fishing activities by highlighting inconsistencies in reported catches versus effort. For economic efficiency, CPUE can help optimize fishing efforts, ensuring that the amount of time, fuel, and resources spent fishing is proportional to the amount of catch. This improves economic returns for fishers and reduces wasteful practices. In the present study, the local CPUE is still a regular practice because the number of vessels, gear types used, and the time spent fishing are balanced in Chaungtha.

In the inshore fishery, fishing was operated within around 9.66 km from the shore and at a depth of 15 m. Although in inshore regions, fish were caught with bottom set gillnet, drift gillnet, purse seine, beach seine, longline, diving fishing, and trap fishing. The total catch of 12064.37 kg and biomass of marine fish 4101.89 mt were recorded from November 2023 to August 2024. Monthly, a high catch rate was recorded in November 2023, and a low catch rate occurred in July 2024. The mean catch rate was 120.64 kg, and the total catch range was 50.18- 2199.35 kg. The highest production was 747.78 mt in November 2023, followed by 626.67 mt in January and 540.70 mt in March 2024. The lowest production was 17.06 mt in July 2024 (Fig. 7).

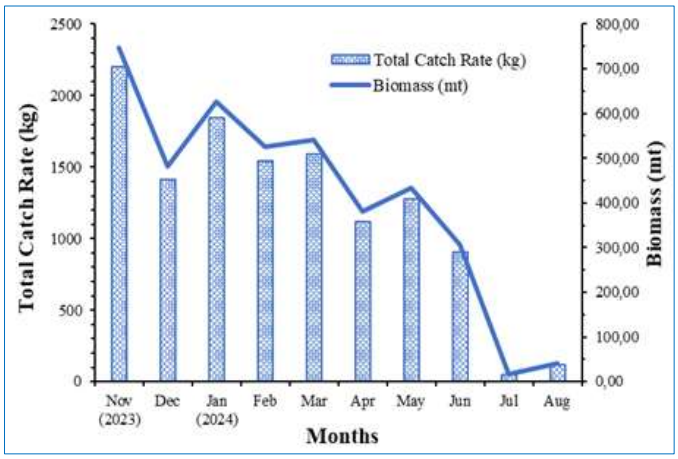

Fig. 7. Total catch and Biomass of some marine fishes in Chaungtha Coastal Area

In each boat, 3 to 20 crews were working and landed on an average of about 5 to 2000 kg/boat. The catch details of the marine fishery from November 2023 to August 2024 in the study areas were presented by common species groups. The average catch weight or catch composition (kg/boat) of marine fish was randomly collected at the study areas. A variety of finfish, shellfish, echinoderms, and others were recorded in these study areas. During the study period, at each of the collecting places, one or more species might occur at a time and contribute to the fishery, while some species were recorded to occur in few numbers but did not seem to contribute to the fishery. In Chaungtha Coastal Area, 1072 fishermen were actively engaged in the marine fishery with 153 boats and 1500 nets, the craft and gear operating in the captured fishery.

4. Conclusion

Observation of some marine fish was conducted in two landing sites of Chaungtha Coastal Area, and the study period lasted for ten months from November 2023 to August 2024. The fishing grounds in the marine capture of the present study could be determined exactly as inshore fishing grounds B10 and B15, around 30 miles. Currently, seven different types of fishing gear are being utilized in the Chaungtha coastal area. The highest and lowest monthly occurrence was recorded in May 2024 and November 2023. Beach seine (27.63%) was a highly effective fishing gear, followed by purse seine (25.66%) and bottom set gillnet (22.37%). The species occurrence and gear-wise composition are used to inform adjusting fishing seasons or fishing operations, as well as ensure long-term economic benefits in the local area. The mean CPUE (catch/unit effort/day) was 3.55 kg, and the range was 0.15- 6.47 kg, recorded in July 2024 and November 2023. Overall, CPUE is a versatile and practical measure that plays a significant role in promoting fishing practices in the study area. The total catch of 12064.37 kg and biomass of 4101.89 mt of marine fish were recorded from November 2023 to August 2024. Information was gathered from interviews with local fishermen during periods, especially fishing activities and other aspects of the fishery.

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