P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 7; SP-Issue 3; March 2024; Page No. 146-152

Received: 03-12-2023
Accepted: 10-02-2024

Indexed Journal
Peer Reviewed Journal

Characterization of commercial fish landings of Chandragiri estuary, Kerala, India

[1]Kalavathi NR, [2]HN Anjanayappa, [3]AS Kumar Naik, [4]Mahesh V and [5]Harish

[1, 2, 3, 5]College of Fisheries, Karnataka Veterinary Animal & Fisheries Sciences University, Mangaluru, Karnataka, India.

[4]ICAR-Central Marine Fisheries Research Institute, Calicut Regional Station, Kozhikode, Kerala, India

DOI: https://doi.org/10.33545/26180723.2024.v7.i3Sb.414

Corresponding Author: Kalavathi NR

Abstract

Between January 2020 and December 2021, the average exploited fisheries resources in the Chandragiri estuary was 87.98t. Finfish accounted for 67.3% of total landings, followed by molluscs (19.5%), and crustaceans (13.2%). The exploited fishery included 97 finfish species from 38 families, 7 penaeid shrimp species, 1 palaemonid prawn species, 6 crab species, and 6 bivalve species. *Gelonia bengalensi* (16.685 t), *Lutjanus argentimaculatus* (4.435 t), *Etroplus suratensis*(4.256 t), *Acanthopagrus berda*(3.841 t), *Epinephelus coioides* (3.221t), *Sillago sihama* (2.751 t), *Portunus pelagicus* (2.739 t), *Gerres filamentosus* (2.478 t), *Caranx heberi* (2.428 t) and *Lates calcarifer* formed the bulk of landings accounted for 52% of the total catch. The highest landings were recorded in January (8.988 t), December (8.151t), and March (8.151t). June had the lowest production (6.067 t), followed by July (6.244 t) and August (6.264 t). The seasonal mean fish catch was highest during the post-monsoon (35.60%), followed by the pre-monsoon (35.43%), and the lowest during the monsoon (28.97%). Finfish landings were highest during the monsoon season (21.385 t), followed by the post-monsoon season (20.394 t), and the lowest during the pre-monsoon season (17.433 t). In the case of shellfish, the pre-monsoon period had the highest landings (13.737 t), followed by the post-monsoon period (10.922 t), and the monsoon season had the lowest landings (4.108 t). From monsoon to post-monsoon, fish productivity in the estuary increased steadily, with the bulk of species supporting lucrative fisheries in the estuary peaking during high-saline months.

Keywords: Estuary, fish, season, food, abundance

Introduction

In tropical coastal ecosystems, estuaries play an important role in supporting a wide variety of aquatic life such as fish and crustaceans. Estuaries are considered nursery sites for many invertebrate and fish species (Barletta *et al*., 2003) [3] because the abundance of food in coastal lagoons promotes larval development and juvenile fish growth. These species congregate in this zone for reproduction, feeding, and shelter. Most of the world's fish-landed species spend at least part of their lives in estuarine waters (Pauly, 1988; Pauly and Yanez-Arancibia, 1994; Barletta *et al*., 1998) [13, 2, 14]. Their nutrient richness often improves yields and promotes good catches. Estuarine fisheries are a valuable resource with significant economic and biological benefits for many people by providing food and employment. The average yield of estuarine fish production in India was estimated to vary from 45 to 75 kg ha^{-1} (Sugunan, 2010) [17]. The fish and fisheries play an important role in the Kerala economy, especially among the communities near the coast. Kerala's backwaters provide habitat for more than 200 resident and migratory species of fish and shellfish, and fishing in these water bodies provides livelihoods for approximately 200,000 fishermen and full-time employment for more than 50,000 fishers (Bijoy Nandan, 2008) [4].

Estuary ecosystems are under significant stress as a result of fishing operations and many estuarine habitats are being rapidly degraded. Understanding the structure and dynamics of multispecies fisheries is necessary for predicting the ecological and fishery implications of exploitation tactics, as well as preventing undesirable changes in the particular composition (Brander, 1988; Sainsbury, 1982) [5, 15]. As a result, any new information about seasonal changes in fish composition and quantity, as well as the effects of environmental variables on the fishery, is critical not just for fishery managers but also for fishermen who want to engage in sustainable fishing. The current study attempted to quantify the fishery resources of Chandragiri estuary, Kasaragod district, Kerala to propose a management plan for the estuarine system.

Methodology

Estimation of fishery catch has been made fortnightly from fishermen who fished around Chandragiri estuary from January 2020 to December 2021. The total catches were sorted into finfish and shellfish. The total weight of all landed individuals was recorded. Landed species were identified up to species level with the help of standard references (Day, 1889; Talwar and Jhingran, 1991; Jayaram, 1999; Munro, 2000; Froese and Pauly, 2022) [6, 8, 18, 10, 12].

Results

Between January 2020 and December 2021, the estuary's average annual exploited fishery was estimated to be 87.98t. Finfish accounted for 67.3% of the total landings, followed by molluscan (19.5%) and crustacean (13.2%) (Fig.1). Major exploited fishery resources of estuary comprised 97

finfish species from 38 families, 7 species of penaeid shrimps, 1 species of palaemonid prawns, 6 species of crabs and 6 species of bivalves.

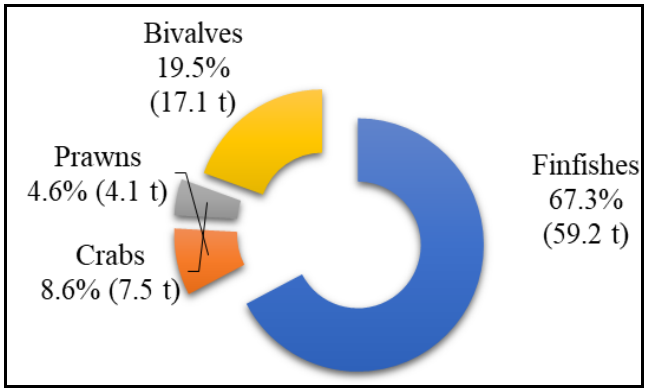

Fig 1: Groupwise percentage contribution to fish landings

The dominant fish family was Carangidae, which had nine species, followed by Sciaenidae, which had seven species, and the other fish families were Engraulididae, Mugilidae, and Lutjanidae, each with six species. The fish families Gerreidae, Serranidae, and Ariidae each had four species. Dasyatidae, Siganidae, Cichlidae, Clupidae, Haemulidae, and Cynoglossidae each had three species. Belonidae, Hemiramphidae, Terapontidae, Platycephalidae, Sillaginidae, Sparidae, Sphyraenidae, Soleidae and Bagridae had two species each while the remaining fish families in the study had one species each. In shellfish most dominant family was penaeidae, which had seven species followed by portunidae had six species, veneridae, cyrenidae and osteridae each had two species. Palaemonidae consisted of only one species.

The predominant groups in the exploited finfishes during the two years were Carangidae, Cichlidae, Lutjanidae, Serranidae, Sparidae, and Mugilidae. *Alepes djedaba*, *Atule mate*, *Carangoides coeruleopinnatus*, *Carangoides malabaricus*, *Carangoides praeustus*, *Caranx heberi*, *Caranx ignobilis*, *Caranx sexfasciatus*, and *Trachinotus blochii* formed the principal species among carangids contributed 6.297 t. The predominant species among Cichlid were *Etroplus suratensis*, *Oreochromis mossambicus*, and *Pseudetroplus maculates* which contributed 6.013t. Lutjanidae were represented by *Lutjanus argentimaculatus*, *Lutjanus bohar*, *Lutjanus fulviflamma*, *Lutjanus indicus*, *Lutjanus johnii*, and *Lutjanus russellii* contributed 5.917 t. Serranidae were represented by *Epinephelus coioides*, *Epinephelus malabaricus*, *Epinephelus lanceolatus* and *Epinephelus latifasciatus* contribute 5.066 t. Sparidae were represented by *Acanthopagrus berda* and *Sparidentex jamalensis* contributed 4.167 t. *Crenimugil crenilabis*, *Ellochelon vaigiensis* , *Mugil cephalus*, *Osteomugil cunnesius*, *Planiliza macrolepis* and *Planiliza parsia* belongs to the family Mugilidae contributed 4.125 t other 32 families contributed 26.997 t (Fig.2). The most dominant groups exploited in crustaceans were Cyrenidae, Portunidae and Penaeidae. *Geloina bengalensis*, and *Villorita cyprinoides* belonging to Cyrenidae contributed 16.746 t. *Charybdis feriatus*, *Charybdis lucifera*, *Portunus sanguinolentus*, *Portunus pelagicus*, *Scylla serrata*, and *Scylla olivacea* contributed 7.531 t. Penaeidae consisting of *Metapenaeus dobsoni*, *Metapenaeus monoceros*, *Metapenaeus brevicornis*, *Penaeus monodon*, *Penaeus merguiensis*, *Penaeus semisulcatus*, *Fenneropenaeus indicus* contributed 3.916 t. The remaining three families contributed 0.574 t (Fig.3).

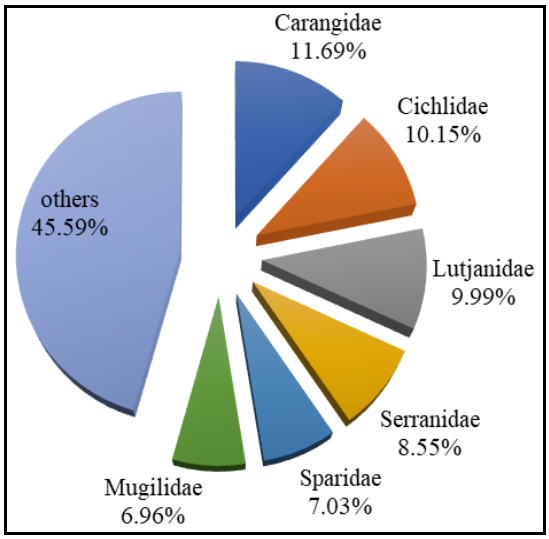

Fig 2: Finfish landings in different families of the study area

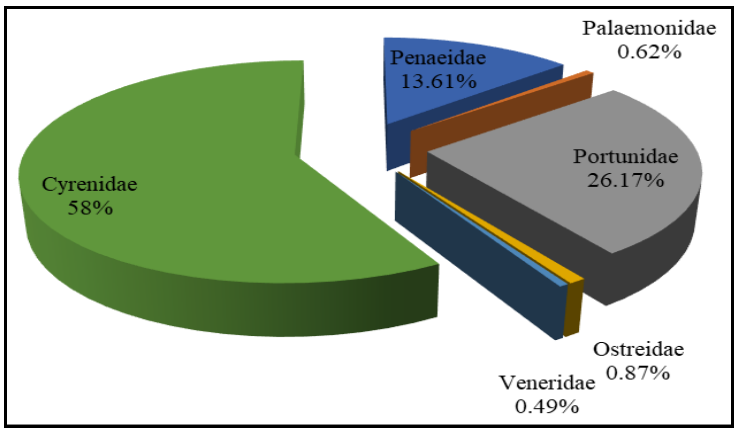

Fig 3: Shellfish landings in different families of the study area

At the species level, combined landings from sampling were dominated by *Gelonia bengalensis* (16.685 t), *Lutjanus argentimaculatus* (4.435 t), *Etroplus suratensis* (4.256 t), *Acanthopagrus berda* (3.841 t), *Epinephelus coioides* (3.221 t), *Sillago sihama* (2.751 t), *Portunus pelagicus* (2.739 t), *Gerres filamentosus* (2.478 t), *Caranx heberi* (2.428 t) and *Lates calcarifer* (2.379 t)) together accounted for 52% of the total landings. The remaining 77 species made up the remaining 48% (Fig.4).

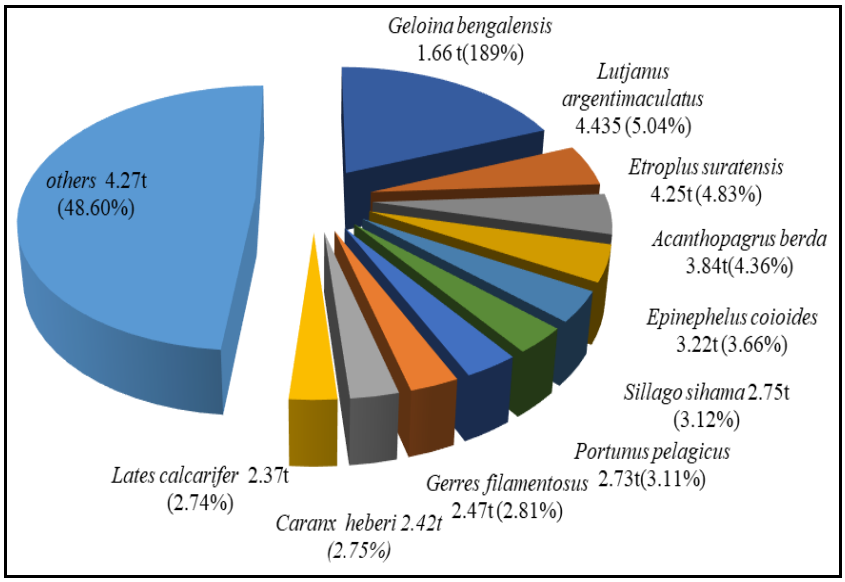

Fig 4: Major species landings in Chandragiri estuary

Lutjanus argentimaculatus (7.49%) had the highest biomass of finfish, followed by *Etroplus suratensis* (7.18%), *Acanthopagrus berda* (6.48%), *Epinephelus coioides* (5.43%), *Sillago sihama* (4.64%), *Gerres filamentosus* (4.18%), *Caranx heberi* (4.1%), *Lates calcarifer* (4.01%), *Arius maculates* (3.77%), *Planiliza macrolepis* (3.66%) and others contributed 49% of the total fish biomass (Fig.5).

In shellfish, *Geloina bengalensis* (58%) had highest biomass, followed by *Portunus pelagicus* (9.53%), *Scylla serrata* (6.63%), *Fenneropenaeus indicus* (4.46%), *Metapenaeus monoceros* (4.11%) and *Charybdis feriatus* (3.80%) in which if combined, comprised 86.54% of the total landings and other contributed 13.45% of the total shellfish biomass (Fig.6).

The month wise overall production from the estuary is given in Fig. 7. Highest landings were recorded during January (8.988 t) followed by December (8.151 t) and March (8.042%). The lowest production was recorded in June (6.067 t) followed by July (6.244 t) and August (6.264 t). Highest finfish catch was recorded in the month of January (5.718 t) followed by July (5.548 t) June (5.444 t) and August (5.407). April had the lowest catch (4.060 t), followed by May (4.394 t) and February (4.483 t). The highest catch of shellfish was recorded in April (3.593 t) followed by March (3.546 t) and February (3.485 t). The month of June had the lowest production (0.623 t), followed by July (0.696 t) and August (0.857 t).

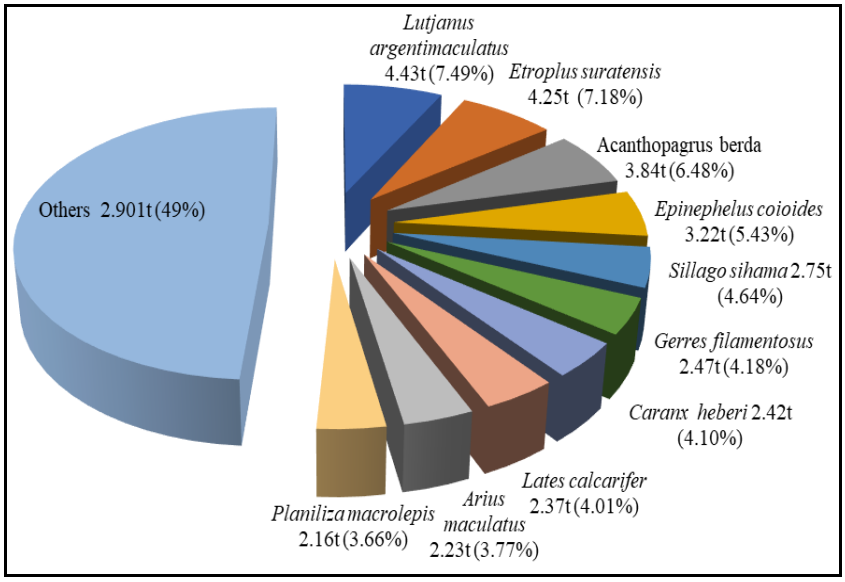

Fig 5: Major finfish landings in Chandragiri estuary.

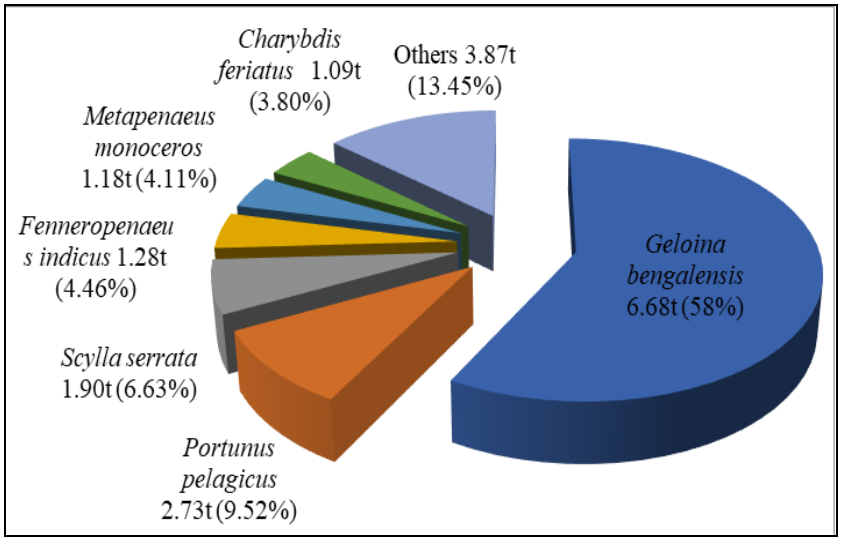

Fig 6: Major shellfish landings in Chandragiri estuary

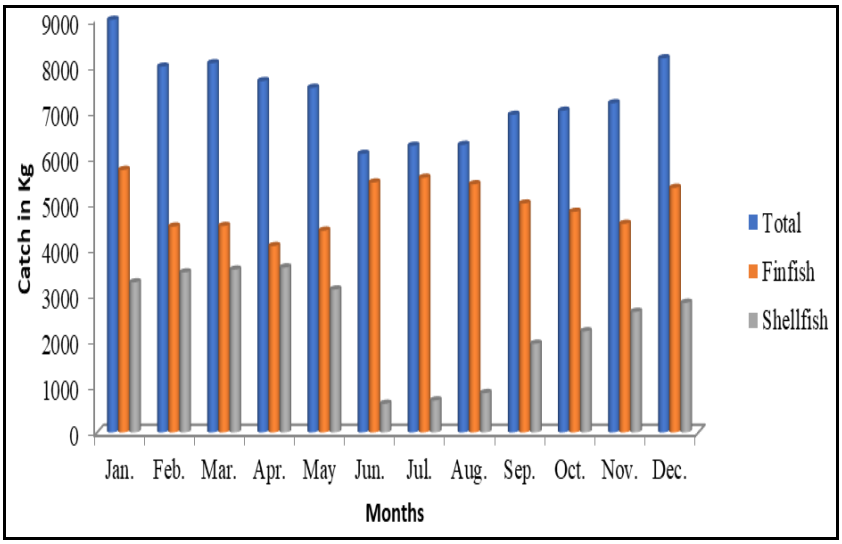

Fig 7: Monthly variation in fish landings.

Seasonal mean fish landings were highest during post-monsoon 31.316 t (35.60%), followed by pre-monsoon 31.170 t (35.43%) and the lowest production was observed during monsoon 25.493t (28.97 %,). Finfish landings were more during the monsoon at about 21.385 t followed by post-monsoon 20.394 t and the lowest catch was recorded during pre-monsoon at 17.433 t. In the case of shellfish, the highest landing was seen during pre-monsoon (13.737 t) followed by post-monsoon (10.922 t) and the lowest landing was recorded during monsoon (4.108 t) (Fig. 8).

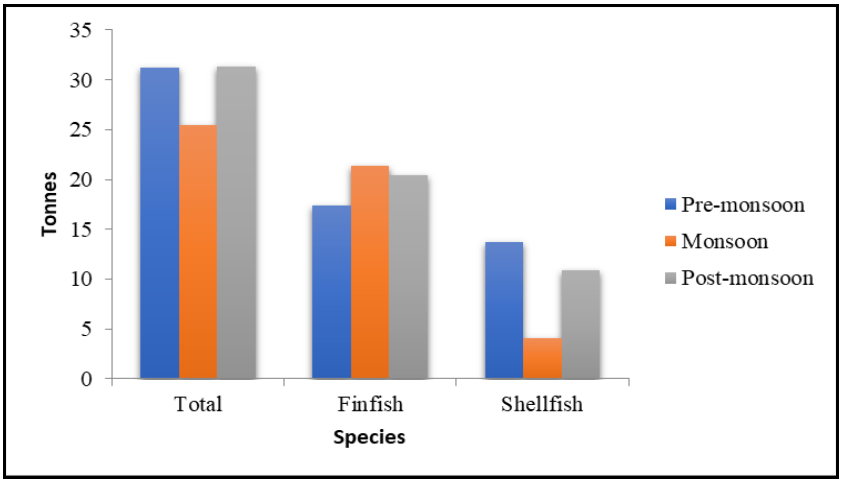

Fig 8: Seasonal variation in fish landings

Pre-monsoon season was dominated by *Etroplus suratensis* (1.797 t), *Lutjanus argentimaculatus* (1.541 t) and *Caranx ignobilis* (0.993 t) were the major finfish, *Portunus pelagicus* (1.085 t) and *Metapenaeus monoceros* (0.482) were the major species of shrimps, *Scylla serrata* (0.779 t) and *Charybdis feriatus* (0.377 t) were major crabs *Geloina bengalensis* (9.275 t) and *Meritrix meritrix* (0.018 t) were major bivalves which supported Pre-monsoon fishery of Chandragiri estuary. Fishery in the Monsoon season was formed by *Lutjanus argentimaculatus* (1.691 t), *Sillago sihama* (1.402 t), and *Acanthopagrus berda* (1.338 t). *Portunus pelagicus* (0.540 t) and *Scylla serrata*(0.489 t). *Fenneropenaeus indicus* (0.400 t) and *Metapenaeus monoceros* (0.279 t). *Geloina bengalensis* (1.050 t) and *Magallana bilineata* (0.086 t). During post-monsoon *Acanthopagrus berda* (1.608 t), *Etroplus suratensis* (1.498 t) and *Lutjanus argentimaculatus* (1.203 t). *Fenneropenaeus indicus* (0.435 t) and *Metapenaeus monoceros* (1.114 t). *Portunus pelagicus* (0.540 t) and *Scylla serrata* (0.640 t). *Geloina bengalensis* (6.36t) and *Magallana bilineata* (0.108 t) were dominant catches during post-monsoon (Fig. 9).

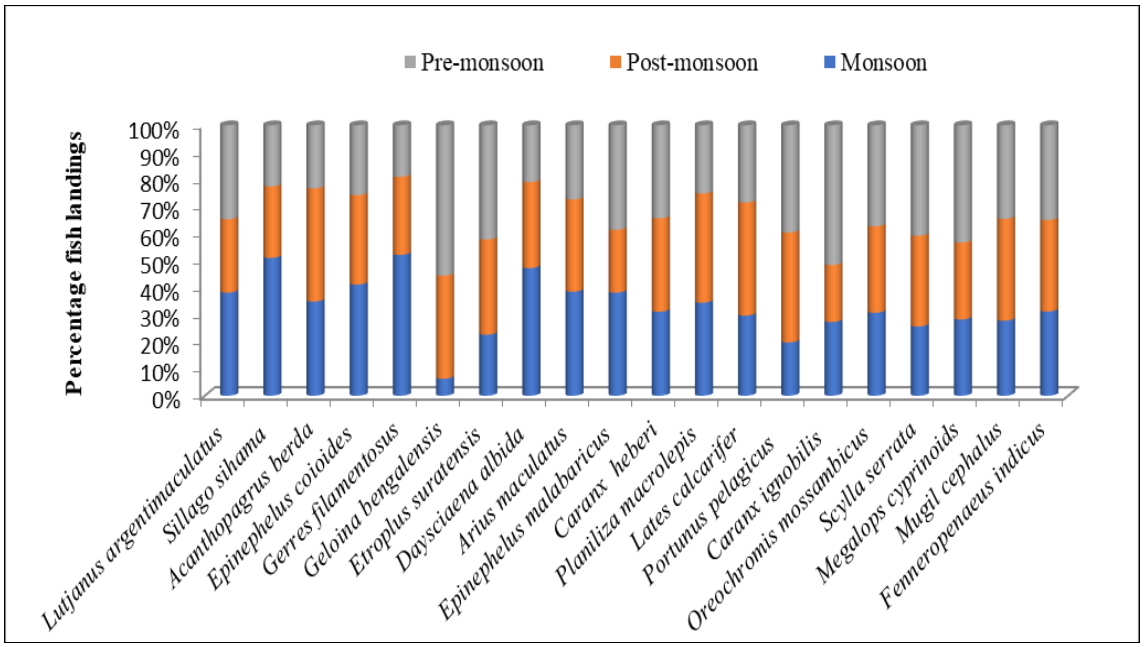

Fig 9: Seasonal percentage contribution of major species landings

Discussion

In the present study, the annual landings of finfish and shellfish were 87.98 t. The current study was compared to previous studies. According to Harkrishnan et al., 2011 from the Azhikode Estuary, 369 t (2005-2006) and 424.8 t (2006-2007) were recorded. Sugunan (2010) [17] reported 14000-17000 t in Vembanad Lake and other Kerala backwaters. The study found lesser fish landings than the Kerala estuaries and backwaters, possibly due to the area of the estuary, increased nutrient loading. Both fisheries exploitation and increased nutrient loading have a major impact on finfish and shellfish abundance and output in estuaries.

The exploited fishery in Chandragiri estuary was represented by 117 species belonging to 44 families in that 97 species of fishes, 7 species of penaeid shrimps, 1 species of palaemonid prawns, 6 species of crabs and 6 species of bivalves. The finfish contributed 67.3% to the total fishery followed by molluscs (19.5%) and crustaceans (13.2%). Sanu *et al.* (2010) [19] found 25 fish species, 6 prawn species, and 1 crab species in the Kodungallur-Azhikode estuary. According to Harikrishnan *et al.* (2011) [9], the Azhikode estuary's fisheries resources included 30 finfish species from 18 families, 6 species of penaeid shrimp, 2 species of palaemonid prawns, 2 species of crabs, and 4 species of bivalves. Fishery resources from Vembanad lake comprised of 80 species of finfishes, 5 species of penaeid shrimps, 3 species of palaemonid prawns and 2 species of crabs with the dominance of finfishes contributing 26.7% (1192.17 t) to the total fishery (Asha *et al.*, 2014) [1]. Changes in sampling methodology and effort, as well as differences in geomorphology and geography of estuaries, could cause a variation in the number of fish species and families.

During the study, the top finfish family was Carangidae, followed by Cichlidae and Lutjanidae, and the dominant shellfish family was Cyrenidae, Portunidae, and Penaeidae. The majority of Carangids found in the estuary are mostly piscivorous, feeding on the most frequent fish of a suitable size that is available in the area. On the other hand, their affinity for coastal ecosystems and estuaries contributed to their large collective weight. These explanations may not apply to the Family Cichlidae and Lutjanidae species found in the estuary. Cyrenidae, Portunidae, and Penaeidae production are generally higher near estuaries, which may be due to increased food availability, resulting in their high collective weight. *Gelonia bengalensis*, *Lutjanus argentimaculatus*, *Etroplus suratensis*, *Acanthopagrus berda*, *Epinephelus coioides* and *Sillago sihama* had high landings throughout the study period. This is because of the euryhaline and eurythermic characteristics.

The monthwise overall production showed that the highest landings were recorded in January (8.988 t) but least in June (6.067 t). The highest finfish catch were recorded in January

(5.718 t) and the least in April (4.060 t). In crustaceans, the highest landings were recorded in the month of April (3.593 t) and lowest in June (0.623 t). In both years, the highest landings were during post-monsoon 31.316 t (35.60%), followed by pre-monsoon 31.170 t (35.43%) and the lowest production was observed during monsoon 25.493 t (28.97%). Seasonal mean fish catch in Kodungallur-Azhikode estuary was highest during pre-monsoon (397.9 t) followed by post-monsoon (311.5 t) and south-west monsoon period (199.2 t) (Bijoy Nandan *et al*., 2012) [4].

In general, gillnets and cast nets catch more fish during the pre-monsoon and post-monsoon seasons. This could be due to the low water level and high plankton production. Plankton production increases significantly during the post-monsoon season as a result of the massive amount of nutrients brought in by rainwater reaching the estuary from the surrounding areas, as well as mixing activities. This high availability of plankton as food leads to a high rate of growth and breeding activity, resulting in an increased fish population. Food availability and abundance are two important factors that influence the abundance and CPUE of fish whereas Competition and predation are also important limiting factors (McConnell and Lowe-Mc Connel, 1987) [11].

Finfish landings were highest during the monsoon season, followed by the post-monsoon season, while the lowest catch was recorded during the pre-monsoon. Some fishes were attracted to the estuary during the monsoon due to physiological/behavioural attraction to river discharge and precipitation as a result of a preference for lower salinity for part or all of their life cycle (Day *et al*., 1989) [7]. In the case of shellfish, the maximum landings occurred during the pre-monsoon period, followed by the post-monsoon period, and the lowest landings occurred during the monsoon period. Due to strong river discharge, fishermen are unable to collect crustaceans during the monsoon, resulting in a lesser catch.

Acknowledgements

Constant support, encouragement and facilities provided by the Dean, College of Fisheries, Mangalore, the Director, ICAR-CMFRI, Kochi for conducting the study are highly appreciated and acknowledged. This study was a part of Ph.D. research by the first author at the Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, India. The first author would like to thank the Karnataka Science Technology Promotion Society (KSTePS), Department of Science and Technology, Government of Karnataka for providing fellowship for this study.

Conclusion

The study highlights fluctuations in fish and shellfish landings in the Chandragiri estuary, with an annual total of 87.98 t. Comparison with other estuaries and backwaters in Kerala reveals lower landings, possibly influenced by estuary size and increased nutrient loading. The estuary harbors a diverse fishery, dominated by finfish, molluscs, and crustaceans, with notable species contributing to overall production. Seasonal variations in catch indicate higher landings during pre-monsoon and post-monsoon seasons, attributed to factors like plankton abundance and fish behavior. Understanding these dynamics is crucial for sustainable fisheries management in estuarine ecosystems.

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