Species composition of Crustaceans of Korapuzha Estuary, Kerala, India

Abstract

The Korapuzha estuarine ecosystem, acting as a link between the freshwater expanse of Akalapuzha and the seawater at Elathur, is characterized by delicate and fragile features. Besides its ecological importance, scientific studies on faunal diversity of Korapuzha is very scarce which emphasizes the necessity of elaborate studies. The present study focusses on species composition of crustaceans, playing a vital role in biogeochemical cycles. The study aims to undertake comprehensive study on crustaceans of Korapuzha estuary, thus minimizing the critical gap in understanding the estuarine ecosystem. Sampling efforts were from 2021 to 2023 involving local participation using various gears. 30 rustaceans were identified under 21 genera, 11 families and two orders, showcasing the complexity in faunal diversity of crustaceans. Shrimps (*Fenneropenaeus indicus*) and crabs (*Scylla serrata*) were the dominant species of commercial fisheries. The study highlighted the non-commercial species like *Clibanarius infraspinatus* (hermit crabs), *Balanus Amphitrite* and *Balanus balanoides* (Barnales) and *Oratosquilla* sp (mantis shrimp). The present study focused on understanding of Korapuzha estuary in detail, thus generating baseline data for conservation and management of estuary. The study also stresses on the economic importance of commercial crustaceans and shows the need for long-term effective conservational measures.

Keywords: Korapuzha, estuary, crustaceans, ecosystem, diversity, species composition

Introduction

The Korapuzha estuarine stretches exhibit a delicate and fragile nature, characterized by distinctive physical, chemical, and biological features. This estuary offers a vital role in linking the freshwater expanse of Akalapuzha and the seawater in Elathur. This ecosystem is one of the highly productive ecosystems providing a unique habitat for a diverse kind of biota, including birds, fishes, and various flora and fauna. Despite its ecological importance, the scientific research on Korapuzha is very scanty, indicating a lack of scientific data on its diversity. This

sparse nature of findings shows the need for more elaborate studies so as to understand the complex intricate eco-dynamics and the rich diversity within the Korapuzha estuarine environment. These kind of research efforts are very vital for developing effective conservational and management measures to preserve this unique and fragile ecosystem.

Crustaceans coming under the crustacea sub-phylum, is a vast and diverse group comprising of 45,000 species. This group consists of the most diverse taxonomic group (Martin and Davis, 2001; Davis et al,2022). The important ecological role played by the crustaceans are biomass and organic matter converters in biogeochemical cycles, stabilizes the ecosystem (Dunn et al., 2008). Along with these, the invertebrates exhibit various feeding strategies which underscores their ecological importance. Crustaceans can directly consume organic matter as deposit feeders, actively participating in nutrient cycling within their habitats. In addition, these act as scavengers feeding on dead ones, signifies the transformation of organic matter to higher trophic levels in the environment (Jeong *et al*., 2014; Duffy *et al*., 2015) showcasing their pivotal role in energy flow and nutrient recycling, highlights the importance of studying crustaceans of Korapuzha estuary to gain knowledge on their ecological relationships and overall sustenance of the ecosystem.

Knowing the significant role of crustaceans in Korapuzha estuary, the primary objective of the present study was to explore the species composition of crustaceans within this estuarine system. This study research represents a vital initiative aimed at compiling essential information on the aquatic biodiversity of the Korapuzha estuary. Despite numerous studies examining estuarine crustacean faunal assemblages along the east and west coasts, the available information specific to the Korapuzha estuary is negligible.

The limited existing data urges to initiate addressing the critical gap in knowing the complexities of estuarine environment of Korapuzha. By an elaborate study on species composition of crustaceans, this study insights into the diverse crustacean fauna in the estuary, imparting light on their ecological roles and interactions within the ecosystem. This study finds a way in scientific understanding of Korapuzha estuary and provides a valid baseline data for further conservation and management strategies. Understanding the unique importance and significance of this estuary can lead to support sustainability over conservation and management of Korapuzha estuarine ecosystem.

Materials and method

The research study was conducted in the Korapuzha region from 2021 to 2023. Sampling efforts included various fishing gears such as stake nets, trap fishery, gill net catches, and cast net catches with the active participation of local fishers. Additionally, mangrove forests in the study area were surveyed through visual counting and photography to capture the diversity of aquatic life. Crustacean burrows were systematically excavated to ensure a comprehensive representation of crustacean species. Prior to excavation, all specimens were carefully hand-picked and preserved in 5 % formalin. Certain cases 0.1% Rose Bengal Stain was added to aid in the identification of smaller samples (Khatun et al., 2023). The subsequent species-level identification of the collected samples in the laboratory contributed to a detailed understanding of the biodiversity within the Korapuzha ecosystem (FAO, 1988; Anusha and Roopavathy, 2021; Radhakrishnan *et al*, 2011, Jayachandran, 2002).

Results and Discussions

The Korapuzha estuary supports a diverse group of crustaceans, including shrimps, crabs, hermit crabs, mantis shrimp and barnacles, totaling of 30 species across 21 genera (Fig 1), 11 families (Fig 2), and two orders. This rich crustacean diversity is indicative of the complex ecosystem within the estuarine environment. Roy and Rath (2012) comprehensively studied and documented a total of 119 crab species distributed across 63 genera and 27 families in various estuaries across India. Sahadevan (2016) recorded 19 crustacean species spanning across seven families in coastal area of Puthuvypeen, Kochi, India. Furthermore, Dev Roy (2008) observed 22 mangrove-associated crab species in Kerala, emphasizing the ecological significance of these habitats. More recently, Anusha and Roopavathy (2021) focused on the decapod order, revealing 20 crustacean species distributed among 13 genera and 7 families from Dharmadom beach, Kerala. Together, these studies underscore the remarkable crustacean biodiversity in Indian estuarine and coastal ecosystems, contributing valuable insights into the intricacies of these habitats.

Among the 21 genera identified in the Korapuzha estuary, the prominent contributors were *Metapenaeus, Macrobrachium*, and *Scylla*, each contributing three species, played a significant role in shaping the crustacean composition, with each genus contributing 10% of the

total species observed (Fig 1). Similar findings by Akshad (2021) justified our results and reported *macrobrachium rosenbergii* as maximum contributing species in all three stations of Kadalundi estuary, Kerala. Additionally, Portunus and Balanus each added two species (7% each) to the diversity, while *Fenneropenaeus* sp, *Penaeus* sp, *Marsupenaeus* sp, *Parapenaeopsis* sp, *Alpheus* sp, *Ocypode* sp, *Uca (Cranuca)* sp, *Austruca* sp, *Dotilla* sp, *Metopograpsus* sp, *Sesarma* sp, *Parasesarma* sp, *Thalamita* sp, *Charybdis* sp, *Clibanarius* sp, and *Oratosquilla* sp contributed one species each (3% each). In terms of families, among the 11 identified, Pennaeidae and Portunidae emerged as major contributors, each comprising seven species (23%). Palaemonidae and Ocypodidae followed closely, each with three species (10%). Sesarmidae, Diogenidae, and Balanidae each contributed two species (7%). Alpheidae, Dotillidae, Grapsidae, and Squillidae contributed with one species each (3%; Fig 2). Anusha and Roopavathy (2021) findings from Dharmadam, Kerala, echoed the same kind of dominance of Penaeidae and Portunidae as the primary families, further highlighting the consistency of these patterns in crustacean diversity across different estuarine regions of Northern Kerala.

Shrimps and crabs emerge as pivotal components in the fisheries of the Korapuzha regions. The shrimp species recorded during the study were 11 in number, comprising of *Fenneropenaeus indicus, Penaeus monodon, Metapenaeus affinis, Metapenaeus dobsonii, Metapenaeus monoceros, Marsupenaeus japonicas, Parapenaeopsis stylifera, Macrobrachium rosenbergii, Macrobrachium equidens, Macrobrachium idella*, and *Alpheus malabaricus*. The commercial shrimp fishery is particularly driven by the first five species: *Fenneropenaeus indicus* (Indian white shrimp), *Metapenaeus affinis* (Brown shrimp), *Penaeus monodon* (Tiger shrimp), *Metapenaeus dobsonii* (Flower tail prawn), and *Metapenaeus monoceros* (Speckled shrimp). Stake nets serve as the predominant method for catching the majority of the shrimp species. Notably, similar findings of Vinod *et al*. (2020) observed that *Fenneropenaeus indicus, Penaeus monodon, Metapenaeus monoceros,* and *Metapenaeus dobsonii* were the major contributors in commercial shrimp fishery in Kadalundi estuary. This shows the economic viability of these resources and local fisheries sustenance.

The crab species observed and recorded are comprising of 14 species viz *Ocypode ceratophthalmus, Uca (Cranuca) inversa inversa, Austruca lactea, Dotilla myctiroides, Metopograpsus messor, Sesarma bidens, Parasesarma plicatum, Thalamita crenata, Portunus*

sanguinolentus, Portunus pelagicus, Charybdis feriatus, Scylla serrata, Scylla tranquibarica, and *Scylla olivacea*. Of these only three species namely *Scylla serrata* (mud crab), *Scylla tranquibarica* (Green mud crab), and *Portunus pelagicus* (blue swimmer crab) contributes to the local crab fishery. The stake net fishery and crab traps serve as the primary methods for capturing these crabs, reflecting the importance of these techniques in the overall catch. In the broader context of the Indian coast, fifteen edible crab species are commonly available (Sathiya and Valarmathi, 2018). Vinod *et al.* (2020) observed a total of nine crab species in the Kadalundi estuary. Of these, *Scylla serrata* and *Scylla tranquebarica* are mostly collected and marketed by local fishermen. Among commercially important crabs, the genus *Scylla* is the major contributor followed by *Portunus* species such as *Portunus pelagicus* and *Portunus sanguinolentus*. Similar work by Anusha and Roopavathy (2021) highlights the significance of Portunid crabs in Dharmadom, Kerala which shows commercial value for swimming crabs, three-spot crabs (*P. sanguinolentus*), and blue swimming crabs (*P. pelagicus*), along with the mud crab (*Scylla serrata*).

Commercial Crustaceans

Commercial crustaceans in the Korapuzha Estuary are shrimps and crabs. These have a important role in sustenance of local fisheries and balance the ecology of estuary. *Fenneropenaeus indicus, Penaeus monodon, and Metapenaeus affinis*, are major contributors of the commercial shrimp fishery in the Korapuzha. The economic significance of these species is very high with good market demand. The major gears used for catching the shrimps are stake nets. It is very essential to sustain these resources in future. Crab fishery, majorly contributed by *Scylla serrata, Scylla tranquibarica, and Portunus pelagicus*, do have immense local fishery using the gears like stake nets, gill nets and crab traps. The high market demand for crabs in local markets underscores the economic importance of the species. It is high time to regulate over-exploitation of these resources, thus maintaining the fragile ecosystem and delicate balancing between the ecological health and economic activities of the ecosystem.

Besides this commercial importance, these resources have a major role in nutrient cycling and energy transfer within the ecosystem. Thus, the commercial crustacean resources of Korapuza are economically valuable as well as provide ecological balance of the estuary. It is necessary to balance the exploitation of these resources so as to sustain it for long generations.

Non-commercial Crustaceans of Korapuzha estuary

Non-commercial crustaceans of the Korapuzha Estuary play a crucial role in ecological balance as well as overall health of the ecosystem. The various species of non-commercial crustaceans in the Korapuzha estuary includes orange striped hermit crab (*Clibanarius infraspinatus*), striped acorn barnacle (*Balanus Amphitrite*), rock acorn barnacles (*Balanus balanoides*), and Mantis shrimp (*Oratosquilla* sp). These species do not have contribution to commercial fisheries. These species are often overshadowed by the important commercial species. Despite this, these contribute to ecological functions that leads to richness and diversity of the area.

Anusha and Roopavathy (2021) specifically recorded three species of hermit crabs belonging to the Diogenidae family under the genera Diogenes and Clibanarius at Dharmadam coast, Kerala. The presence of these hermit crab species adds to the overall crustacean diversity in the region. Earlier studies by Sahadevan (2016) observed the occurrene of *Balanus Amphitrite* in Puthuvypeen coastal waters in Kerala. Our study finds out similar species of other non-commercial crustaceans are *Balanus balanoides* (rock acorn barnacles), *Balanus amphitrite* (striped acorn barnacle), *Oratosquilla* sp (Mantis shrimp) and *Clibanarius infraspinatus* (orange striped Hermit crab). None of these have a commercial fishery. Hermit crabs, belonging to the Diogenidae family under genera Clibanarius, constitute a noteworthy portion of the non-commercial crustacean community in the Korapuzha Estuary. Their role in the ecosystem extends beyond economic value, as they actively participate in nutrient cycling and habitat structuring. These creatures use empty gastropod shells as their protective homes, contributing to the natural recycling of shells and playing a crucial role in maintaining the balance of the estuarine environment. Similar study by Anusha and Roopavathy (2021) observed three species of hermit crabs under Diogenidae family (genera Diogenes and Clibanarius) at Dharmadam coast, Kerala which justifies our findings. The present study recorded two species of barnacles ie *Balanus Amphitrite* and *Balanus balanoides* and states these as additional non-commercial crustaceans found in the estuary. Though, their contribution to commercial fisheries is negligible, the abundance of these species can contribute to overall ecological richness of the coastal waters. Barnacles, being filter feeders, filter in organic matter from the water and thus helps in nutrient

cycling. Their colonization on substrates also provides additional habitat complexity, supporting a diverse array of marine life. Sahadevan (2016) have reported the occurrence of *Balanus Amphitrite* from coastal areas of Puthuvypeen, Kerala**.**

Mantis shrimp, represented by species like *Oratosquilla sp* recorded from Korapuzha estuary, add to the non-commercial crustacean diversity from the sampling stations. These are considered as one of the unexplored faunas, well known for their unique hunting techniques like spearing and smashing the prey (Ahyong, 2012) and vibrant coloration. While mantis shrimp are not targeted for commercial purposes, their presence adds to the estuarine biodiversity and ecological intricacies. Detailed study on these species can understand the dynamics of the estuary and thereby the interactions between various resources.

Hence, these kinds of studies can lead to understand the spatial distribution, its abundance with more imparting on its ecological functions of these non-commercial resources for better management of these resources. Although, these resources may not be economically utilized, but they do contribute significantly to overall stability and sustainability of the estuary. Hence, it is high time to protect the crustacean diversity including commercial and non-commercial species so as to maintain the long-term ecological integrity of Korapuzha estuary

Conclusion

Our study was initiated to come up with baseline work on present diversity of crustacean fishery of Korapuzha estuary. With this study, the documentation of diverse crustaceans, it provides a valuable baseline documentation for future protection and conservational efforts. The present study contributes to the understanding of the current status of estuarine fishery and paves the way for futher subsequent researches in future. This baseline work can be instrumental in estimating the species composition changes over time, changes in its population dynamis and overall health of the ecosystem. The study thrusts on vital long-term observations for formulating effective conservation strategies and sustainable management practices. Our study, therefore, provides a crucial role in bringing up scientific studies on Korapuzha estuarine crustacean resources.this study can be considered as reference work for researchers, conservationalists and policy makers so as to assess human impact, climate change and environmental factors on the ecosystem. Ultimately, this study can impart in decision making and overall conservation and

management of the estuary, thereby benefitting local communities as well as biodiversity of the area over a long run.

Ethical Approval

All applicable international, national and/or institutional guidelines for the care and use of animals were followed by the authors

Disclaimer (Artificial intelligence)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

References

Ali Akshad. 2021. Distribution And Abundance of Estuarine Shrimps and Crabs in Kadalundi, Kerala, South India. Uttar Pradesh Journal of Zoology42(2): 72-82, 2021issn: 0256-971x

Ahyong, S. T. The Marine Fauna Of New Zealand: Mantis Shrimps (Crustacea: Stomatopoda) / By Shane T. Ahyong—Wellington: Niwa (National Institute of Water and Atmospheric Research Ltd), 2012 (Niwa Biodiversity Memoir, Issn 1174-0043; 125)

Anusha, C. and J. Roopavathy. 2021. A Survey on The Species Compostion of Decapod Crustaceans in Dharmadam Coast, Kannur District, Kerala. IJCRT | Volume 9, Issue 5 May 2021 Issn: 2320-2882

Davis, K.E., de Grave, S., Delmer, C., Payne, A.R.D., Mitchell, S., and Wills, M.A. 2022. Ecological transitions and the shape of the decapod tree of life. *Integr. Comp. Biol. in press*. [Google Scholar] [CrossRef] [PubMed]

Dev Roy, M.K And S. Rath. 2012. Diversity And Distribution of Brachyuran Crabs of Indian Estuaries. In Estuaries of India. Edited By D.V. Rao* Laishram Kosygin Swetapadma Dash. Estuarine Biology Regional Centre, Zoological Survey of India, Hilltop Gopalpur-On-Sea - 761 002, Odisha, India *Freshwater Biology Regional Centre, Zoological Survey of India, Attapur (V) Hyderguda Ring Road, Hyderabad - 500 048, Andhra Pradesh. Nature Books India 119, Jodhpur Garden, 2nd Floor Kolkata - 700 045

Dunn JC, McClymont HE, Christmas M, Dunn AM (2008) Competition and parasitism in the native white clawed crayfish Austropotamobius pallipes and the invasive signal crayfish Pacifastacus leniusculus in the UK. Biol Invasions 11:315–324.

Duffy, G. A., Z. R. S. Gutteridge, M. H. Thurston, and T. Horton. (2015). A comparative analysis of canyon and non-canyon populations of the deep-sea scavenging amphipod Paralicella caperesca. Journal of the Marine Biological Association of the United Kingdom, available online at http://dx.doi.org/10.1017/S0025315415002064.

Jeong, H; Kotov, A.A; Wonchoel Le (2014) Checklist of the freshwater Cladocera (Crustacea: Branchiopoda) of South Korea Proceedings of the Biological Society of Washington (2014) 127 (1): 216–228.

Khatun, B., Jewel, M.A.S., Haque, M.A.; Akter, S., Hossain, M.B., Albeshr, M.F., Arai, T. 2023. Seasonal Pattern of Taxonomic Diversity and Functional Groups of Macro-Benthos from a Sub-Tropical Mangrove Estuary. J. Mar. Sci. Eng. 11, 1453. https://doi.org/10.3390/ jmse11071453

Martin, J.W and Davis, G.E. 2001. An updated classification of the Recent Crustacean, Natural History Museum of Los Angeles Country, Science Series, No. 39:124pp

Sahadevan p. 2006. Diversity of fishes, Crustaceans and Molluscs of Puthuvypeen of Ernakulam District, Kerala, South India. International Journal of Fisheries and Aquatic Studies 2016; 4(6): 101-107

Sathiya U, and Valarmathi V Diversity of commercially important marine crabs in Nagapattinam coastal area, Tamilnadu, India. IOSR Journal of pharmacy and biological Science, 2018b; 81-86.

Table 1: List of Crustacean species recorded of Korapuzha estuary

S.No	Species	Common name	Family	Order	IUCN Status
1	*Fenneropenaeus indicus*	Indian white shrimp	Penaeidae	Decapoda	NE
2	*Penaeus monodon*	Tiger shrimp	Penaeidae	Decapoda	NE
3	*Metapenaeus affinis*	Brown shrimp	Penaeidae	Decapoda	NE
4	*Metapenaeus dobsonii*	Flower tail prawn	Penaeidae	Decapoda	NE
5	*Marsupenaeus japonicus*	Kuruma shrimp	Penaeidae	Decapoda	NE
6	*Metapenaeus monoceros*	Speckled shrimp	Penaeidae	Decapoda	NE
7	*Parapenaeopsis stylifera*	Karikadi /Marine shrimp	Penaeidae	Decapoda	NE
8	*Macrobrachium rosenbergii*	Giant freshwater prawn	Palaemonidae	Decapoda	NE
9	*Macrobrachium equidens*	Rough river prawn	Palaemonidae	Decapoda	NE
10	*Macrobrachium idella*	Slender river prawn	Palaemonidae	Decapoda	NE
11	*Alpheus malabaricus*	Pistol shrimp	Alpheidae	Decapoda	NE
12	*Ocypode ceratophthalmus*	Fiddler crab	Ocypodidae	Decapoda	NE
13	*Uca (Cranuca) inversa inversa*	Inversed fiddler crab	Ocypodidae	Decapoda	NE
14	*Austruca lacteal*	Milky fiddler crab	Ocypodidae	Decapoda	NE
15	*Dotilla myctiroides*	Soldier crab	Dotillidae	Decapoda	NE
16	*Metopograpsus messor*	Messor’s shore crab	Grapsidae	Decapoda	NE
17	*Sesarma bidens*	Red clawed crab	Sesarmidae	Decapoda	NE

18	*Parasesarma plicatum*	Mud flat crab	Sesarmidae	Decapoda	NE
19	*Thalamita crenata*	Crenate swimming crab	Portunidae	Decapoda	NE
20	*Portunus sanguinolentus*	Three spotted crabs	Portunidae	Decapoda	NE
21	*Portunus pelagicus*	Blue crab	Portunidae	Decapoda	NE
22	*Charybdis feriatus*	Crucifix crab	Portunidae	Decapoda	NE
23	*Scylla serrata*	Mangrove crab	Portunidae	Decapoda	NE
24	*Scylla tranquibarica*	Green mud crab	Portunidae	Decapoda	NE
25	*Scylla olivacea*	Orange mud crab	Portunidae	Decapoda	NE
27	*Clibanarius infraspinatus*	Orange stripped Hermit crab	Diogenidae	Decapoda	NE
28	Balanus amphitrite	Striped acorn barnacle	Balanidae	Decapoda	NE
29	Balanus balanoides	Rock acorn barnacles	Balanidae	Decapoda	NE
30	Oratosquilla sp	Mantis shrimp	Squillidae	Stromatopoda	NE

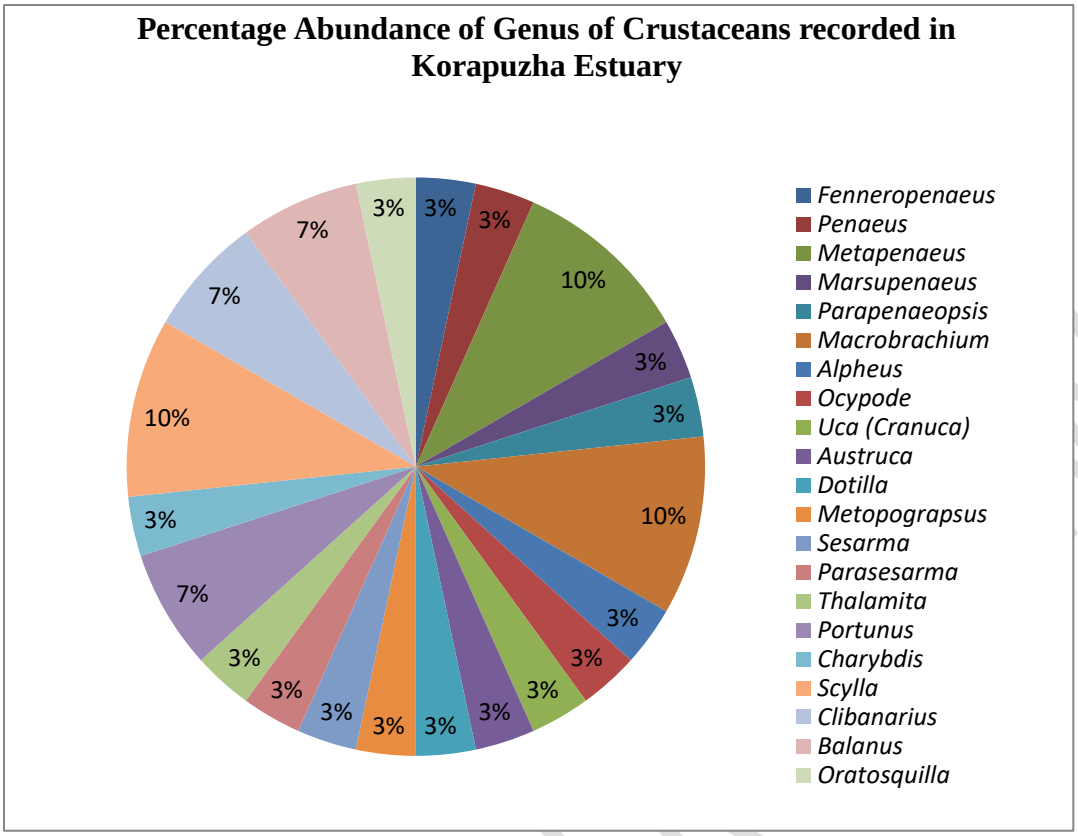

Figure 1: Percentage Abundance of Genus of Crustaceans recorded in Korapuzha estuary

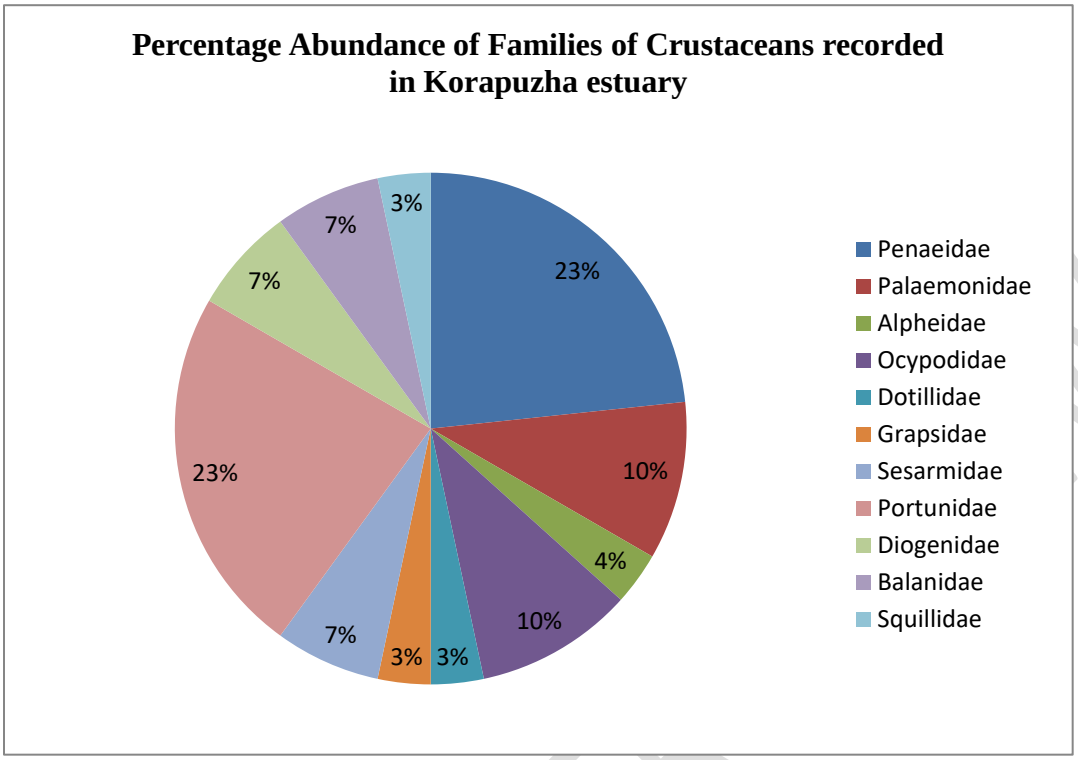

Figure 2: Percentage Abundance of Families of Crustaceans recorded in Korapuzha estuary