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. Despite its ecological significance, research on faunal diversity of Korapuzha is limited, emphasizing the need for extensive studies. This study focuses on crustaceans, a diverse group of invertebrates playing a crucial role in biogeochemical cycles. This research aims to comprehensively study the crustaceans in the Korapuzha estuary, addressing a critical gap in understanding the estuarine ecosystem of Korapuzha. Sampling efforts started from 2021 to 2023, involved various fishing gears and active participation of local fishers. The study identified 30 crustacean species across 21 genera, 11 families, and two orders revealing the complexity in crustacean faunal assemblages of the estuarine environment. Shrimps and crabs, particularly *Fenneropenaeus indicus* and *Scylla serrata*, emerged as economically important components of local fisheries. The study also highlighted the diversity of non-commercial species like hermit crabs (*Clibanarius infraspinatus)*, barnacles (*Balanus Amphitrite* and *Balanus balanoides*) and mantis shrimp (*Oratosquilla* sp). These findings contribute to the detailed understanding of the Korapuzha estuary, providing baseline data crucial for conservation and management strategies in future. The study underscores the economic importance of crustaceans in the region's fishery resources and emphasizes the need for long-term observations to support effective conservation measures in the face of environmental changes.

Introduction

The Korapuzha estuarine stretches exhibit a delicate and fragile nature, characterized by distinctive physical, chemical, and biological features. The estuary serves as a crucial link between the freshwater expanse of Akalapuzha and the seawater at Elathur; these stretches form a dynamic and essential ecosystem. This ecosystem is highly productive and provides a unique habitat for a diverse array of biota, including birds, fishes, and various flora and fauna. Despite its ecological significance, the research findings on Korapuzha are very scanty, indicating a lack

of comprehensive exploration of faunal diversity. The sparse nature of these findings underscores the need for more extensive and high focused studies to better understand the intricate ecological dynamics and the rich diversity of faunas within the Korapuzha estuarine environment. Such research efforts are crucial for developing effective conservation and management strategies to preserve this unique and fragile ecosystem.

Crustaceans, classified under the sub-phylum Crustacea, represent a vast and diverse group of invertebrate animals, comprising approximately 45,000 species distributed worldwide. Their morphological diversity is notable, making them one of the most varied taxonomic groups on the planet (Martin and Davis, 2001). Beyond their diversity, crustaceans play a crucial ecological role as converters of biomass and organic matter in biogeochemical cycles, contributing to the stabilization of ecosystems (Dunn et al., 2008). These invertebrates exhibit various feeding strategies that further underscore their ecological significance. Crustaceans can directly consume organic matter as deposit feeders, actively participating in nutrient cycling within their habitats. Additionally, they act as scavengers, feeding on dead organisms. This scavenging behavior is particularly significant as it initiates the transformation of organic matter to higher trophic levels in the ecosystem (Jeong *et al*., 2014; Duffy *et al*., 2015), underscores their role in directing the flow of energy and nutrients through the ecosystem. This multifaceted contribution highlights the importance of studying crustaceans in the Korapuzha estuary so as to gain a comprehensive understanding of their ecological functions and overall impact on the stability and sustainability of the environment.

Given the significant role of crustaceans as a vital faunal component in the Korapuzha estuary, the primary objective of the current study is to undertake a thorough inventory of crustaceans within this estuarine ecosystem. This research represents a crucial 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 underscores the urgency and importance of this communication, as it addresses a critical gap in the understanding of the estuarine ecosystem in the Korapuzha region. By conducting a comprehensive inventory of crustaceans, this research seeks to contribute valuable insights into the diversity of crustacean present in the estuary so that shedding light on their ecological roles and interactions within the ecosystem can be understood in future hours. The

findings of this study are anticipated to not only enhance the scientific understanding of the Korapuzha estuary but also provide a baseline data for conservation and management strategies. Recognizing the unique characteristics and ecological significance of this estuarine environment, the research endeavors to contribute essential knowledge to support the sustainable management measures to conserve, protect and preserve 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 7-10% formalin. Certain cases 0.1% Rose Bengal Stain was added to aid in the identification of smaller samples. The subsequent species-level identification of the collected samples in the laboratory contributed to a detailed understanding of the biodiversity within the Korapuzha ecosystem (Anusha and Roopavathy, 2021; Radhakrishnan et al, 2011, Jayachandran, 2002).

Results and Discussions

The Korapuzha estuary boasts 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, Penaeus, Marsupenaeus, Parapenaeopsis, Alpheus, Ocypode, Uca (Cranuca), Austruca, Dotilla, Metopograpsus, Sesarma, Parasesarma, Thalamita, Charybdis, Clibanarius,* 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 observation of *Fenneropenaeus indicus, Penaeus monodon, Metapenaeus monoceros*, and *Metapenaeus dobsonii* stand out as recorded and commercially exploited shrimp species within the Kadalundi estuary in Kerala (Vinod *et al*. 2020). This underscores the economic importance of these shrimp species and the reliance of local fisheries on their sustainable management and conservation.

The crab diversity within the Korapuzha estuary is marked by the presence of 14 distinct species, including *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*. Notably, only three of these crab species, *Scylla serrata* (mud crab), *Scylla tranquibarica* (Green mud crab), and *Portunus pelagicus* (blue swimmer crab), actively contribute to the local 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) further documented nine crab species in the Kadalundi estuary, with a particular emphasis on the commercial exploitation of *Scylla serrata* and *Scylla tranquebarica* by local fishermen. Among commercially important crabs, the genus Scylla takes precedence, followed by Portunus species such as *Portunus pelagicus* and *Portunus sanguinolentus*. Anusha and Roopavathy (2021) highlights the significance of Portunid crabs in Dharmadom, Kerala emphasizing the commercial value of swimming crabs, three-spot crabs (*P. sanguinolentus*), and blue swimming crabs (*P. pelagicus*), along with the mud crab (*Scylla serrata*). This underscores the economic importance of these crab species in the region's fishery resources.

Commercial Crustaceans

Commercial crustaceans in the Korapuzha Estuary, including shrimps and crabs, play a dual role in both sustaining local fisheries and contributing to the ecological balance of the estuarine ecosystem. Their economic importance is evident in the thriving local fisheries that depend on these species for livelihoods and sustenance. However, beyond their commercial value, these crustaceans actively participate in maintaining the ecological equilibrium of the estuarine

environment. Shrimps, such as *Fenneropenaeus indicus, Penaeus monodon, and Metapenaeus affinis*, are integral components of the commercial shrimp fishery in the Korapuzha region. The economic significance of these species is underscored by their high demand in local markets. Stake nets, among other fishing methods, are employed to catch these shrimps, supporting the local economy. Sustainable management of these commercial species is the need of the hour to ensure the continuity of these economic fishery activities and the well-being of the communities relying on them. Crabs, including *Scylla serrata, Scylla tranquibarica, and Portunus pelagicus*, are another group of commercially important crustaceans in the Korapuzha Estuary. Their contribution to the local fishery is substantial, with stake nets, gill nets and crab traps being primary methods of capture. The high demand for these crabs in local markets emphasizes their economic importance in this region. Conservation efforts and sustainable harvesting practices are very vital to prevent overexploitation thus maintaining the delicate balance between ecological health and economic activities.

Despite their commercial exploitation, these crustaceans also play a role in nutrient cycling and energy transfer within the estuarine ecosystem. Shrimps, for example, participate in the consumption of organic matter as deposit feeders, contributing to the overall nutrient cycling in their habitats. Crabs, through their feeding behaviors and interactions with other species, influence the dynamics of the estuarine food web. Understanding the ecological roles of these commercially important crustaceans is essential for implementing conservation measures that ensure the long-term health and sustainability of the Korapuzha Estuary.

In conclusion, the commercial crustaceans of the Korapuzha Estuary are not only economically valuable but also integral to the ecological balance of the region. Balancing the exploitation of these species for economic purposes with conservation measures is crucial for maintaining a sustainable and long thriving estuarine ecosystem.

Non-commercial Crustaceans

Non-commercial crustaceans within the Korapuzha Estuary play a vital role in contributing to the ecological balance and overall health of the estuarine ecosystem. The diversity of non-commercial crustaceans in the Korapuzha estuary includes *Clibanarius infraspinatus* (orange striped hermit crab), *Balanus Amphitrite* (striped acorn barnacle), *Balanus*

balanoides (rock acorn barnacles), and *Oratosquilla* sp (mantis shrimp). Unlike the shrimps and crabs previously mentioned, none of these crustaceans are subject to commercial fisheries. While often overshadowed by the economic importance of commercial crustaceans like shrimps and crabs, these lesser-known species, including hermit crabs, barnacles, and mantis shrimp, fulfill unique ecological functions that contribute to the richness and diversity of the coastal habitat. 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. Additionally, Sahadevan (2016) reported the occurrence of *Balanus Amphitrite* in coastal areas of coastal waters of Puthuvypeen, Kerala. While these crustaceans may not be commercially exploited, they contribute to the ecological richness and diversity of the coastal habitats in the studied areas. Understanding the distribution and abundance of these less-commercially targeted species is crucial for comprehensive ecosystem management and conservation efforts.

The other crustacean diversity is comprised of *Clibanarius infraspinatus* (orange striped Hermit crab), *Balanus Amphitrite* (Striped acorn barnacle), *Balanus balanoides* (Rock acorn barnacles) and *Oratosquilla* sp (Mantis shrimp). 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. Anusha and Roopavathy (2021) recorded three species of hermit crabs of Diogenidae family under genera Diogenes and Clibanarius at Dharmadam coast, Kerala. Barnacles, such as *Balanus Amphitrite* and *Balanus balanoides*, are additional non-commercial crustaceans found in the estuary. Although they are not subject to commercial fisheries, their presence contributes to the overall ecological richness of the coastal waters. Barnacles are filter feeders, extracting organic particles from the water and participating 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. Studying these species in detail can help in understanding the broader ecosystem dynamics and interactions between various components.

Understanding the distribution, abundance, and ecological roles of non-commercial crustaceans is crucial for comprehensive ecosystem management and conservation efforts. Although these species might not be economically exploited, they contribute significantly to the overall stability and sustainability of the estuarine environment. Preserving the diversity of crustaceans, both commercial and non-commercial, is essential for maintaining the ecological integrity of the Korapuzha Estuary and ensuring its long-term health.

Conclusion

The present study was conducted to make a baseline inventory of crustacean fishery of Korapuzha estuary. By documenting the diverse array of crustaceans, the study provides a valuable baseline dataset for future research and conservation efforts. The collected information not only contributes to the current understanding of the estuarine ecology but also lays the foundation for subsequent studies. This baseline data becomes instrumental in monitoring changes in species composition, population dynamics, and overall ecosystem health over time. The study thrusts on vital long-term observations for formulating effective conservation strategies and sustainable management practices. The present investigation, therefore, plays a pivotal role in advancing the scientific knowledge of the Korapuzha estuary's crustacean fishery. It can serve as a reference point for researchers, policymakers, and conservationists to assess the impact of human activities, climate change, and other environmental factors on the estuarine ecosystem. Ultimately, the findings of this study pave the way for informed decision-making and holistic management of the estuarine resources for the benefit of both biodiversity and local communities on a long run.

Ethical Statement

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

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

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.

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

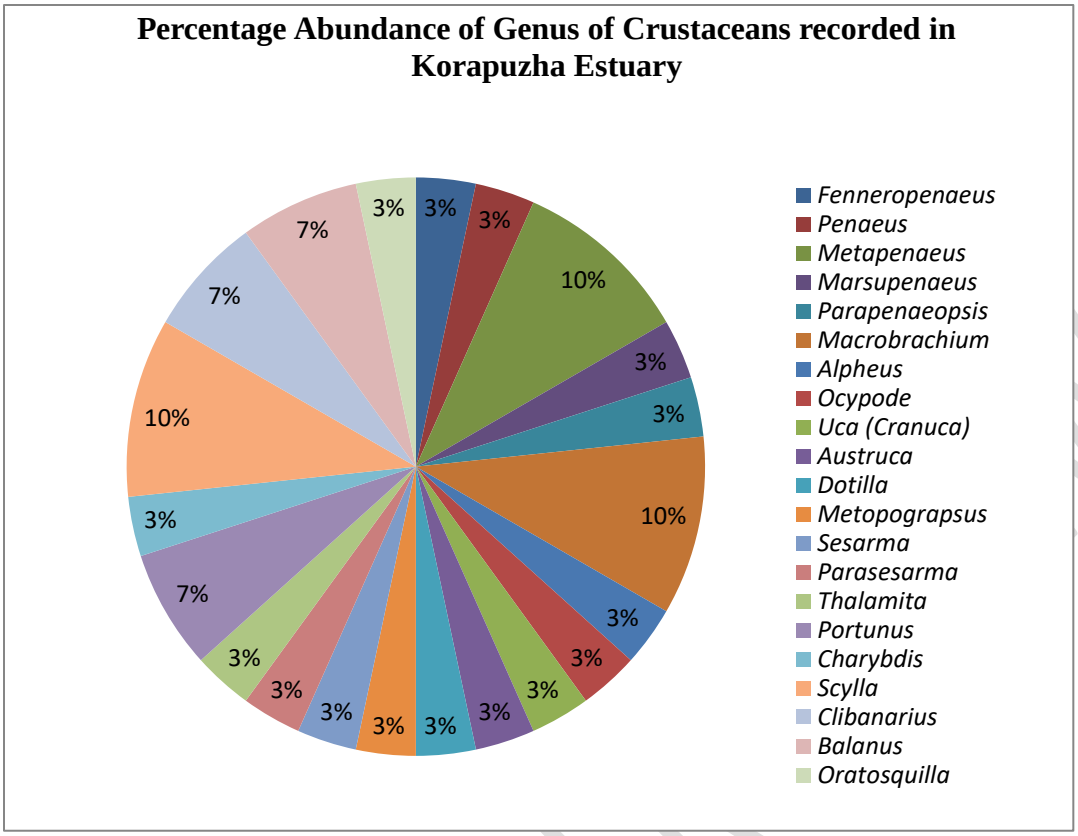

Figure 1: Percentage Abundance of Genus of Crustaceans recorded in Korapuzha estuary

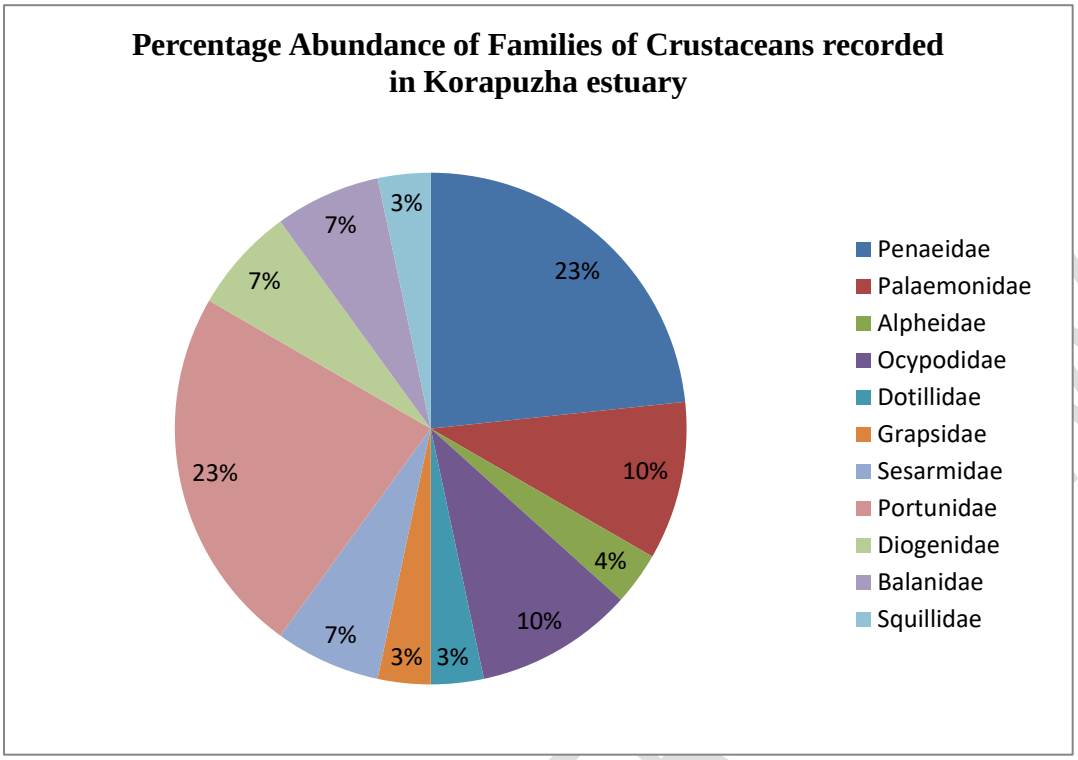

Figure 2: Percentage Abundance of Families of Crustaceans recorded in Korapuzha estuary