



# Biodiversity and Distribution of Brachyuran Crabs Along the Chennai Coast, Tamil Nadu, India

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

## Article Information

DOI: <https://doi.org/10.56557/upjoz/2024/v45i164306>

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://prh.mbimph.com/review-history/3691>

Original Research Article

Received: 19/05/2024  
Accepted: 22/07/2024  
Published: 31/07/2024

## ABSTRACT

Biodiversity encompasses all living organisms including plants, microorganisms, animals, and people. It refers to the abundance of a species and can be applied specifically to all species found in a particular area or environment. A healthy ecosystem supports a wide variety of lives, whereas a lack of biodiversity can indicate environmental issues, such as contaminated water or air. The Chennai marine ecosystem experiences many anthropogenic activities. This study examined the diversity of brachyuran crab species in the Chennai marine ecosystem at nine different stations, extending from Ennore in the north to Uthandi in the south. The significant result of this study is that it focuses on their taxonomy and range, revealing 11 families and 29 species of brachyuran crabs in

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**Cite as:** Jayaprakash, Jayanthi, Akil Jacob, Jeevanandam Ranjitha, and Manickavalli Gurunathan Ragunathan. 2024. "Biodiversity and Distribution of Brachyuran Crabs Along the Chennai Coast, Tamil Nadu, India". *UTTAR PRADESH JOURNAL OF ZOOLOGY* 45 (16):255-65. <https://doi.org/10.56557/upjoz/2024/v45i164306>.

the Chennai region. This study marks the first attempt to revisit the taxonomy of Brachyuran crabs along the coast of Chennai.

*Keywords: Biodiversity; brachyuran crab; Chennai; taxonomy.*

## 1. INTRODUCTION

Marine ecosystems are the most diverse ecosystems in the world, providing shelter to diverse and unique floral and faunal communities. Crabs play a crucial role in this ecosystem by feeding on organic matter, recycling nutrients, and aerating the soil, as reported by Harshith [1]. Crustaceans are a subphylum of Arthropoda comprising approximately 67,000 species worldwide [2]. Brachyuran crabs exhibit rich diversity and are both economically and environmentally significant, with over 5,000 species belonging to 700 genera identified worldwide [3,4,5,6]. According to Castro [7], brachyurans inhabit almost all aquatic habitats, ranging from mountain streams to the abyssal ocean, and are representative of terrestrial environments, including those with ephemeral or negligible water availability, such as tree holes. Trivedi [8] noted that crabs are a crucial food source for human consumption. However, brachyuran crabs face various threats from overexploitation, habitat degradation, pollution, invasive species, and climate change, as described by Cumberlidge [3]. Therefore, it is essential to document and monitor their diversity and distribution across different regions and ecosystems.

## 2. OBJECTIVE

The aim of this study was to document the biodiversity and distribution of Brachyuran crabs along the Chennai coast of Tamil Nadu, India. The specific objectives are:

To gather and recognize various brachyuran crab species from different locations and habitats along the Chennai coast.

The diversity and distribution patterns of brachyuran crabs were analysed in relation to spatial and environmental variables.

To assess the threats and challenges faced by brachyuran crabs along the coast of Chennai.

Conservation measures to protect and enhance the brachyuran crab population along the Chennai coast.

## 2.1 Social Relevance and Significance

Brachyuran crabs are a diverse and abundant group of crustaceans that play important ecological and social roles. Crabs are the chief food source for many animals, including fish, turtles, birds, and mammals [9]. Crab larvae are especially important for the survival and growth of juvenile fish, which forms the basis of many near-shore fisheries and aquaculture activities. Economically, crabs are important because of their high protein and mineral contents, and their skeletons are used as food for livestock and poultry [10]. Fisheries and aquaculture provide food, income, and employment for millions of people around the world, especially in developing countries, as mentioned by the FAO [11].

Brachyuran crabs are also part of the cultural heritage and identity of many coastal communities, which use them for rituals, festivals, and tourism, as observed by Kurien and Willmann [12]. Biodiversity studies of Brachyuran crabs can help us understand the richness and health of their habitats, such as coral reefs, mangroves, seagrass beds, and estuaries. According to Barbier, these habitats are essential for the functioning of the marine ecosystem and the provision of ecosystem services, such as carbon sequestration, coastal protection, and water purification [13]. Biodiversity studies can also help identify endangered or extinct species due to overexploitation, habitat loss, pollution, invasive species, and climate change [3]. By collecting and analysing data on the biodiversity and distribution of brachyuran crabs, we can monitor changes and impacts on their populations and habitats and take appropriate measures to conserve and restore them, if needed.

## 2.2 Threats and Conservation Measures for Marine Brachyuran Crabs

Coastal zones are relatively fragile. Disordered urbanization and infrastructure development, alone or in combination with uncoordinated industrial, tourism-related, fishing, and agricultural activities, can lead to the rapid degradation of coastal habitats and resources, as per the Decision Council (1996) of the European

**Table 1. Pollutant's Source, Place & Types**

Source	Place	Types
Urban wastes and small industries	Coovum River/Adyar	Garbage & Effluent
Surgical instrument factory	Adyar River/Nandampakkam	Heavy Metals
North Madras Thermal Power Station	Ennore back waters/ Ennore	Smoke plume migration, fly ash deposition & Fly ash slurry
Ennore Port	North of Chennai Sea	Coal, liquid nature gas (LNG) and liquid petroleum gas (LPG)
Madras Fertilizers	Buckingham Canal/Ennore	Sewage Effluent & Chemical effluent
Natives & Tourists	Sea shore & Rivers	Plastic bottles & covers

Union [14]. The Indian coast receives heavy passenger and commercial ship traffic from several ports. The disposal of ballast water from these ships can introduce non-indigenous species into the Indian coastal waters [15]. Coastal wetland ecosystems, such as salt marshes and mangroves, are especially threatened when they are sediment-starved or constrained on their landward margins [16]. Over the past 60 years, coastal environments have been subjected to dramatic changes associated with human activities [17].

Coastal regions are ecologically important, but face numerous problems, including urbanization, coastal erosion, loss of marine species, and climate change. Pollutants of domestic and industrial origin threaten the quality of freshwater and ocean water. Various types of pollution in ocean and inland water bodies have been observed, such as sewage, thermal, heavy metal, oil, acid, radioactive, industrial, and air pollution. These toxic pollutants affect the fauna and flora of natural ecosystems. A brief account of the various types of pollutants is presented in Table 1.

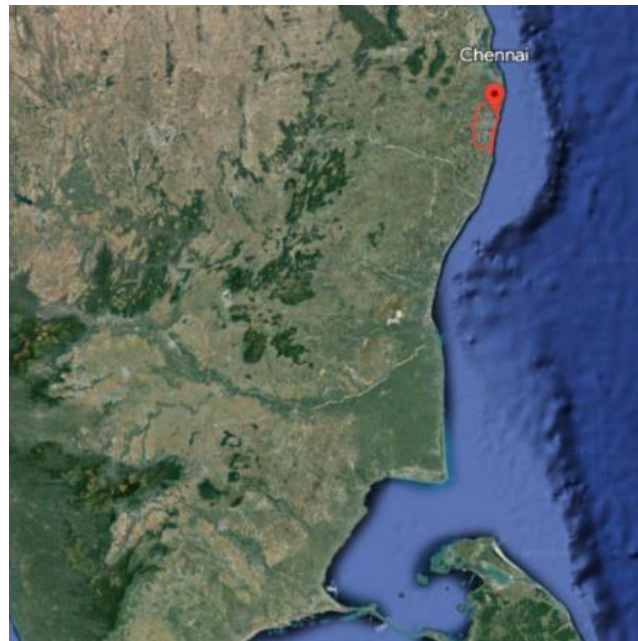
A single female crab can produce up to eight million eggs in one mating season; therefore, minimizing their capture is crucial. Berried crabs (those carrying eggs) should be released if they are caught. Juveniles and undersized crabs were not captured. Fishing of crabs should be strictly banned during the peak breeding season. Awareness should be created among the local people and fishermen regarding the depletion of crab populations. Extension programs for crab conservation should be implemented through media. Wastewater released into these complex areas should be treated well before it is released into natural waters. To maintain this population, sea ranching of commercially important crab species should be practiced [18].

### 3. MATERIALS AND METHODS

#### 3.1 Study Area

The coastal area of India is divided into two parts: the west coast, stretching over four coastal states (Gujarat, Maharashtra, Goa, Karnataka, and Kerala) and one island group (Lakshadweep Islands), and the east coast, which stretches over four states (Tamil Nadu, Andhra Pradesh, Odisha, and West Bengal) and one island group (Andaman and Nicobar Islands) [19]. The east coast of India has a coastline of 2,656 km, a continental shelf area of 122,000 sq km, and a coastal area of 64,956 million hectares, comprising four maritime states and one Union Territory (UT), namely, West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, and Puducherry (UT) [19]. Both coastal regions support various marine habitats such as rocky shores, sandy shores, mudflats, estuaries, mangroves, and coral reefs, which support unique marine biodiversity [20].

The coast of Tamil Nadu features a very narrow continental shelf with high salinity, a rocky shore, and strong wave action [21]. The coastline of the Bay of Bengal and Arabian Sea remains a rich fishing ground in the South Asian region, with India being one of the world's largest marine product-exporting nations. Marine ecosystems, such as estuaries, coral reefs, marshes, lagoons, sandy and rocky beaches, mangrove forests, and seagrass beds, are known for their high biological productivity and provide a wide range of habitats for many aquatic plants and animals [22]. The Indian Ocean extends over 30% of the global ocean area and is rimmed by 36 littoral and 11 hinterland nations that sustain approximately 30% of the world's population [23].



**Fig. 1. Chennai zone**  
*Source: Google earth*

In Tamil Nadu, the Zoological Survey of India, Chennai, has documented about 595 species of freshwater fauna, 2,247 species of marine fauna, and 1,898 species of terrestrial fauna [24]. The Chennai coast, extending from West Bengal to Tamil Nadu, is a part of the east coast of India. It has a coastline of approximately 200 km and an Exclusive Economic Zone (EEZ) of approximately 40,000 sq km. The Chennai coast harbors diverse marine habitats, such as sandy beaches, rocky shores, mudflats, estuaries, and offshore islands, supporting a rich diversity of marine fauna and flora, including Brachyuran crabs. According to Dev Roy [25], 482 species of brachyuran crabs belonging to 211 genera under 45 families have been recorded from different states on the east coast of India. The maximum diversity has been observed in Tamil Nadu (382 species), followed by Odisha (149 species), West Bengal (137 species), and Andhra Pradesh (128 species).

Chennai, the capital city of Tamil Nadu, is located on the Coromandel Coast of the Bay of Bengal and has a population of approximately 10 million people, with an estimated population of 12.6 million by 2026 [15]. However, the Chennai coast is exposed to high levels of anthropogenic pressure, such as urbanization, industrialization, fishing activities, sewage discharge, oil spills, and plastic waste, which negatively affect the quality and health of the coastal ecosystem and

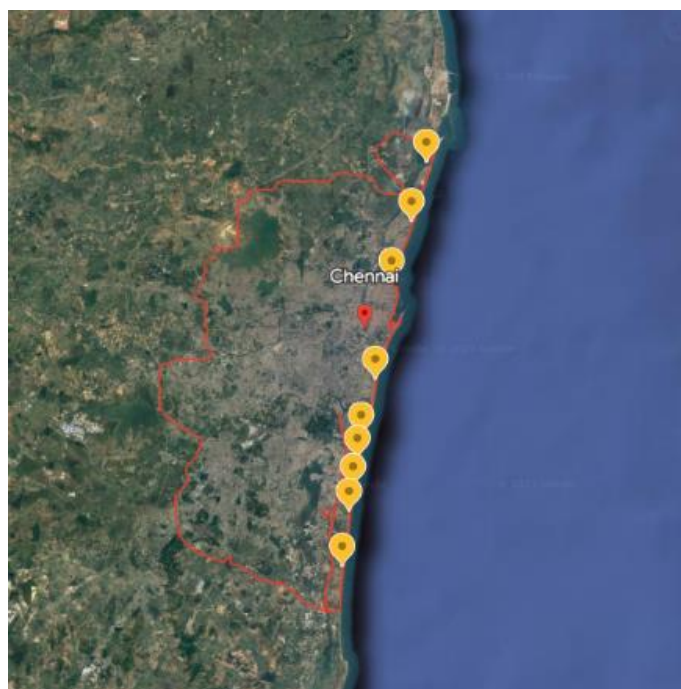
its biodiversity [26]. Trawling off Chennai occurs at a depth range of 30-60 m [27].

### 3.2 Study Area and Survey Design

Nine different study stations along the Chennai coast were selected to cover a diverse range of habitats and locations. These stations included the catchment areas and fishing ports (markets) of each station where crab specimens were collected. The stations spanned from Ennore (North) at Latitude 13°13'38" N and Longitude 80°19'35" E to Uthandi (South) at Latitude 12°52'30" N and Longitude 80°15'4" E. GPS coordinates for each station were accurately obtained using a GPS map camera, essential for precise mapping and geotagging purposes [28]. The distances between the stations and the area covered by each station were measured using maps.ie [29], as shown in Table 2.

### 3.3 Crab Identification and Data Collection

Crab species were identified using a database website and a literature survey, which provided information on the distribution and photographs of crab species [30]. Threats to marine brachyuran crabs in Chennai from various pollutant sources, their types, and conservation measures have been compiled from multiple sources, as summarized in Table 1.



**Fig. 2. Locations of the nine stations are shown in yellow**

Source: Google earth

**Table 2. Surveyed Zone**

<b>Chennai Coastal Zone</b>	<b>Km</b>
Ennore - Thiruvottiyur	7.182
Thiruvottiyur - Kasimedu	4.225
Merina beach - Pattinambakkam	6.065
Urrur kuppam - Thiruvanmiyur	3.05
Thiruvanmiyur - Kottivakkam	1.897
Kottivakkam beach - Palavakkam	1.168
Palavakkam - Neelankarai	1.613
Neelankarai - Injambakkam	2.978
Injambakkam - Uthandi	6.666

### 3.4 Data Analysis and Reporting

After the survey, the number of species and their percentage of presence at each station were calculated and are presented in Tables 3 and 3. A detailed analysis resulted in the preparation of a checklist of crab species, listing their scientific names, stations, and presence data, as presented in Table 4 (Distribution of Marine Brachyuran Crab Species in Chennai). All collected specimens were identified to the highest taxonomic level possible, following the latest classification and nomenclature of Brachyuran crabs. Taxonomy and valid scientific names of all brachyuran crabs were verified and referenced from research articles, the WoRMS website [31], and the crab database [30], which

are recognized as authoritative sources for marine biodiversity data. The Taxonomic Classification of Marine Brachyuran Crabs, categorized from species to kingdom, phylum, class, order, family, and genus, is detailed in Table 5.

### 4. RESULTS

This study conducted a comprehensive assessment of marine Brachyuran crab diversity along the highly urbanized and industrialized Chennai Coast. Sampling was conducted at nine stations encompassing diverse habitats, such as sandy beaches, rocky shores, and estuaries, revealing a total of 29 brachyuran crab species within the study area.

The diversity of crabs varied significantly among stations, reflecting habitat preferences and suitability.

#### 4.1 Station-Wise Diversity

Station S2 at Kasimedu exhibited the highest crab diversity, with 20 recorded species comprising 13.99% of the total identified species.

In contrast, stations S7 (Neelankarai) and S9 (Uthandi), both sandy beaches, showed the lowest diversity with only 13 species each, accounting for 9.09% of the total species recorded. Intermediate diversity levels, ranging from 14 to 17 species (9.79%–11.89% of total species), were observed at other stations, which included a mix of rocky shores and estuaries (Table 3).

**Table 3. Number of species & percentage of species present in each station**

Stations	S1	S2	S3	S4	S5	S6	S7	S8	S9
<b>Number of species in each station</b>	17	20	17	17	17	15	13	14	13
<b>Percentage of species in each station</b>	11.89%	13.99%	11.89%	11.89%	11.89%	10.49%	9.09%	9.79%	9.09%

**Table 4. Distribution of Marine Brachyuran crab species in Chennai**

SPECIES	STATIONS								
	S1	S2	S3	S4	S5	S6	S7	S8	S9
<i>Ashtoret lunaris</i> (Forskål, 1775)	+		+	+				+	
<i>Charybdis feriata</i> (Linnaeus, 1758)	+	+	+	+	+	+	+	+	+
<i>Charybdis natator</i> (Herbst, 1794)	+	+	+	+	+	+	+	+	+
<i>Charybdis lucifer</i> (Fabricius, 1798)	+	+	+	+	+	+	+	+	+
<i>Charybdis hoplites</i> (Wood-Mason, 1877)		+				+			+
<i>Charybdis smithii</i> (MacLeay, 1838)		+				+			
<i>Charybdis annulata</i> (Fabricius, 1798)		+							
<i>Calappa lophos</i> (Herbst, 1782)			+		+	+	+	+	
<i>Calappa clypeata</i> (Borradaile, 1903)			+	+	+	+	+		
<i>Calappa bilineata</i> (Ng, Lai & Aungtonya, 2002)			+	+		+		+	+
<i>Liagore rubromaculata</i> (De Haan, 1835)	+		+	+	+			+	+
<i>Doclea ovis</i> (Fabricius, 1787)			+	+	+			+	
<i>Galene bispinosa</i> (Herbst, 1783)				+					
<i>Lauridromia dehaani</i> (Rathbun, 1923)		+	+	+	+	+	+	+	+
<i>Monomia argentata</i> (A Milne-Edwards, 1861)	+	+		+	+		+		+
<i>Monomia gladiator</i> (Fabricius, 1798)	+	+	+	+	+	+	+	+	+
<i>Metacarcinus gracilis</i> (Dana, 1852)	+	+							
<i>Podophthalmus vigil</i> (Fabricius, 1798)	+	+	+	+	+	+	+	+	+
<i>Portunus sanguinolentus</i> (Herbst, 1783)	+	+	+	+	+	+	+	+	+
<i>Portunus pelagicus</i> (Linnaeus, 1758)		+	+	+					
<i>Scylla serrata</i> (Forskål, 1775)	+	+	+	+	+	+		+	
<i>Scylla olivacea</i> (Herbst, 1796)	+	+					+		
<i>Scylla tranquebarica</i> (Fabricius, 1798)	+	+	+		+	+	+		
<i>Thranita crenata</i> (Rüppell, 1830)		+							
<i>Ocypode brevicornis</i> (H. Milne Edwards, 1837)	+	+			+	+	+	+	+
<i>Ocypode macrocera</i> (H. Milne Edwards, 1837)	+	+			+				

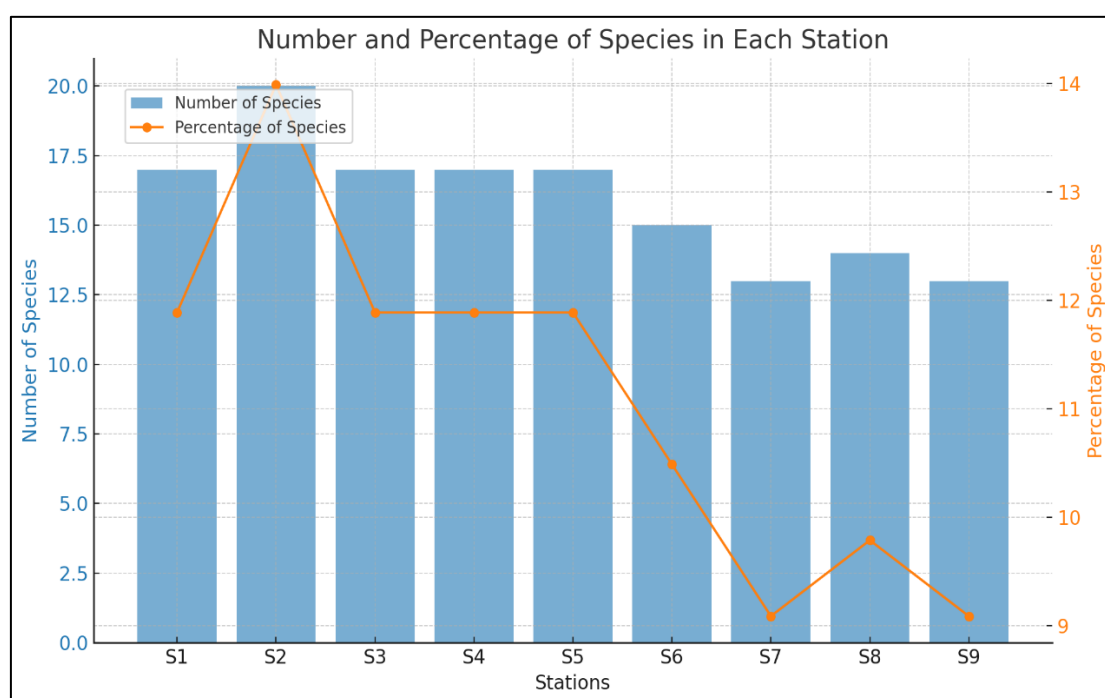
SPECIES	STATIONS								
	S1	S2	S3	S4	S5	S6	S7	S8	S9
<i>Rhinolambrus contrarius</i> (Herbst, 1804)		+							
<i>Coleusia huilianae</i> (Promdam, & Galil, 2014)	+								
<i>Ryphila cancellus</i> (Herbst, 1783)	+								

(S1-Ennore, S2-kasimedu, S3-Pattinambakkam, S4-Thiruvanmiyur, S5-Kottivakkam, S6-Palavakkam, S7-Neelankarai, S8-Injambakkam, S9-Uthandi)

**Table 5. Taxonomic Classification of Marine Brachyuran crabs**

Species	Kingdom	Phylum	Class	Order	Family	Genus
<i>Ashtoret lunaris</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Matutidae	Ashtoret
<i>Charybdis feriata</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Charybdis
<i>Charybdis natator</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Charybdis
<i>Charybdis lucifer</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Charybdis
<i>Charybdis hoplites</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Charybdis
<i>Charybdis smithii</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Charybdis
<i>Charybdis annulata</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Charybdis
<i>Calappa lophos</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Calappidae	Calappa
<i>Calappa clypeata</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Calappidae	Calappa
<i>Calappa bilineata</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Calappidae	Calappa
<i>Liagore rubromaculata</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Xanthidae	Liagore
<i>Doclea ovis</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Epialtidae	Doclea
<i>Galene bispinosa</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Galenidae	Galene
<i>Lauridromia dehaani</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Dromiidae	Lauridromia
<i>Monomia argentata</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Monomia
<i>Monomia gladiator</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Monomia
<i>Metacarcinus gracilis</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Cancridae	Metacarcinus
<i>Podophthalmus vigil</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Podophthalmus
<i>Portunus sanguinolentus</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Portunus
<i>Portunus pelagicus</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Portunus
<i>Scylla serrata</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Scylla
<i>Scylla olivacea</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Scylla
<i>Scylla tranquebarica</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Scylla

Species	Kingdom	Phylum	Class	Order	Family	Genus
<i>Thranita crenata</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	Thranita
<i>Ocypode brevicornis</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Ocypodidae	Ocypode
<i>Ocypode macrocera</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Ocypodidae	Ocypode
<i>Rhinolambrus contrarius</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Parthenopidae	Rhinolambrus
<i>Coleusia huiliana</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Leucosiidae	Coleusia
<i>Ryphila cancellus</i>	Animalia	Arthropoda	Malacostraca	Decapoda	Leucosiidae	Ryphila



**Fig. 3. Number of species & percentage of species present in each station** (S1-Ennore, S2-kasimedu, S3-Pattinambakkam, S4-Thiruvanmiyur, S5-Kottivakkam, S6-Palavakkam, S7-Neelankarai, S8-Injambakkam, S9-Uthandi)

#### 4.2 Family Diversity

Brachyuran crabs in the coastal waters of Chennai were classified into 11 different families. The family Portunidae, comprising swimming crabs, was the most diverse and abundant, with 15 species, representing over half of the total species identified. The second most diverse family was Calappidae, including box crabs, with three species. Leucosiidae and Ocypodidae each had two species: Leucosiidae includes crabs with rounded carapaces, whereas Ocypodidae includes intertidal zone crabs. Eight families (Xanthidae, Cancridae, Dromiidae, Epialtidae,

Galenidae, Matutidae, and Parthenopidae) were represented by one species each, including mud crabs, crabs, crabs, crabs, and crabs.

#### 5. DISCUSSION

A recent assessment of the global biodiversity of decapod Crustacea as of December 31, 2022, reported 17,229 species across 2,550 genera and 203 families, with Brachyura crabs comprising 107 of these families [32]. In Tamil Nadu, the state where Chennai is located, Kathirvel identified 404 crab species belonging to 26 families and 152 genera, with specific



observations of 7 families each in Mudasal Odai and Nagapattinam coasts [33]. In our study, we identified crabs from 11 families in Chennai. These findings underscore the ecological significance of Chennai within Tamil Nadu, contributing significantly to the state's overall crab diversity.

Our study revealed a rich and diverse brachyuran crab fauna along the Chennai coast, which is notable compared to other urban regions in India. However, this diversity is unevenly distributed among different habitats, suggesting varying vulnerability to human activities such as pollution, land reclamation, and overfishing. The Kasimedu fishing harbor (S2) exhibited high crab diversity, whereas stations S7 and S9, primarily sandy beaches with limited food and protection for crabs, showed lower diversity. Intermediate diversity levels were observed at the other stations, reflecting a mix of rocky shores and estuaries.

The dominance of the family Portunidae, characterized by its high species richness, underscores the ecological importance of swimming crabs in the marine ecosystem of Chennai. Less diverse families, such as Calappidae, Leucosiidae, and Ocypodidae, alongside single-species families, highlight the diverse ecological niches occupied by brachyuran crabs in this region.

Despite their importance and vulnerability, comprehensive and updated information on brachyuran crabs along the Chennai Coast remains scarce. Previous studies have often been limited to specific habitats, taxa, and sporadic collections. Therefore, there is an urgent need for systematic and extensive surveys covering different habitats and depths. Such efforts would provide insights into the status, patterns, and trends of brachyuran crab diversity and distribution in Chennai, as well as identify the key factors influencing them.

Our study serves as baseline data for future research and conservation initiatives. We recommend the ongoing monitoring of brachyuran crab populations and habitats along the Chennai coast to guide effective conservation strategies and ensure their sustainable management.

## 6. CONCLUSION

This study has significantly enhanced our knowledge of the biodiversity of brachyuran

crabs along the Chennai coast. Despite being a vital natural resource, the Chennai coast is facing substantial pollution challenges. Our research underscores the high diversity of brachyuran crabs in the region, yet highlights their vulnerability to pollution sources, such as sewage, industrial waste, agricultural runoff, oil spills, plastic debris, and unsustainable fishing practices.

We propose several conservation measures to safeguard and bolster brachyuran crab populations. These include enhancing waste management practices, enforcing stringent environmental regulations, establishing marine protected areas, advocating sustainable fishing techniques, and intensifying public awareness campaigns and educational initiatives.

This study underscores the importance of concerted conservation efforts aimed at preserving the brachyuran crabs of Chennai. This also emphasizes the necessity for continued research to identify additional species and monitor population dynamics along the Chennai coast.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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