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Assessing Aquatic Landscape Health Using Brachyuran Crab Habitats in the Chennai Coastal Region: A Case Study

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Authors' contributions

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

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ABSTRACT

This study focuses on the marine brachyuran crab species habitat used as a biosensor for aquatic landscape analysis in the Chennai region. Brachyuran crabs have been recognized as potential biosensors owing to their sensitivity to environmental changes and specific habitat requirements. By analyzing their distribution patterns and abundance, valuable insights can be gained regarding the overall health and quality of aquatic landscapes in the Chennai region. This study aimed to explore the feasibility of utilizing brachyuran crabs as indicators for assessing the ecological conditions of Chennai's marine ecosystems. A significant finding of this study is that we assessed aquatic landscape health using marine brachyuran crab habitats, and identified that Chennai's marine

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landscape is dominated by a soft substrate region, followed by a region that has a mixture of soft and hard substrates, and then by estuary and mangrove substrates. The findings from this research could potentially assist in the development of effective management strategies and conservation measures to protect and sustain diverse marine life in Chennai's coastal waters and marine landscape types in the Chennai region.

Keywords: Chennai; India; marine brachyuran crab; species dispersion; Tamil Nadu.

1. INTRODUCTION

Inspiration from nature brings innovation; we borrow nature blueprints to solve research challenges by observing animals and their habitats. From that inspiration, the aerodynamics of the Shinkansen bullet train and wind turbines to water-repellent surfaces. A potential area of research is the use of living organisms as biosensors to assess environmental conditions. Landscape determines the animal’s stay or disperser from place to place. Multiple forms of landscapes attract different species of crabs in marine ecosystems. The need for tools for environmental monitoring has encouraged the development of new technologies and more suitable methodologies, the ability to monitor the increasing number of analyses of environmental relevance as quickly and as cheaply as possible, and even the possibility of allowing on-site field monitoring As highlighted by Ranveer [1]. For millennia, people across the globe have reported alarmed animal behavior in run-up to natural disasters. In 2004, a tsunami triggered by a 9.1 magnitude undersea earthquake off Indonesia decimated the coastal communities around the Indian Ocean, killing at least 225,000 people across a dozen countries. The huge death toll was partly caused by the fact that many communities received no warning. Local manmade early warning systems, such as tidal and earthquake sensors, failed to raise clear alerts. Many sensors were out of action owing to maintenance issues, while many coastal areas lacked tsunami siren warning systems. Haphazard communication has also failed to provide warnings, with many text messages failing to reach mobiles in threatened areas or going unread. However, in the minutes and hours before surging walls of water up to 9m (30 ft) high smashed through coastlines, some animals seemed to sense impending peril and made efforts to flee. According to eyewitness accounts, elephants ran on higher ground, flamingos abandoned low-lying nesting areas, and dogs refused to go outdoors. Carvalho [2] studied functional connectivity patterns in forest carnivore Genets as an animal model using path-level analysis, and to explore how connectivity is affected by land cover patterns and road networks, functional connectivity was favored by large forest patches and by the presence of riparian areas. In the coastal village of Bang Koey in Thailand, locals reported a herd of buffalo by the beach suddenly pricking their ears, gazing out to the sea, and then stamped to the top of a nearby hill a few minutes before the tsunami struck [3]. The earliest recorded reference to unusual animal behavior prior to a natural disaster dates back to 373 BC, when the Greek historian Thucydides reported rats, dogs, snakes, and weasels deserting the city of Helice, days before a catastrophic earthquake. Minutes before the Naples quake of 1805, oxen, sheep, dogs, and geese supposedly started making alarm calls in unison, while horses were said to have run off in panic immediately prior to the San Francisco earthquake of 1906. "Even with all the technology available today, we are not able to properly predict earthquakes or most natural catastrophes," says Charlotte Francesiaz, leader of an ornithological team at the French Biodiversity Office (OFB), and part of the Kivi Kuaka project, which is examining how migratory birds crossing the Pacific seem able to dodge storms and other hazards as observed by Bernard Friel and Getty [4]. Even with advanced technology, it can be difficult to detect many types of impending natural disasters. In the case of earthquakes, for example, seismic sensors lurched into jolted squiggles only as earth-juddering shocks actually occur. Reliable predictions require precursor signals and, as yet, scientists have not found any signals that seem to occur consistently before large quakes. Hence, the growing willingness of some scientists to consider more unorthodox warning signals, such as animal behavior. Millipedes are soil invertebrates that play an important role in terrestrial ecosystems. They help decompose litter and recycle carbon and nutrients in the soil, as observed by Wang [5]. Earthworms, which are not often diverse and easy to count, are the only biota that have been considered usable as biological indicators by personnel regardless of special training and are presently measured in the field by determining their abundance, as reported by the USDA [6]. Marine landscape structure refers to the spatial patterns and arrangements of different habitats and substrates in the ocean. This is important, because it influences the distribution, diversity, and connectivity of marine organisms and ecosystems. This type of study has supported studies that have revealed how landscape complexity in marine environments drives ecological interactions in a number of systems. According to Garza [7], this type of basic research can be used to provide fisheries managers with insight into the importance of incorporating landscape complexity into the design of modern fisheries management plans.

2. CRAB INTRODUCTION

According to Marochi and Masunari [8], brachyuran crabs are among the most diverse taxa of crustaceans and occur in almost all coastal habitats. Decapod crustaceans, generally categorized as lobsters, shrimps, and crabs, are paramount faunal components that are widely distributed in a variety of habitats, such as coral reefs, mangroves, estuaries, marine water, freshwater streams, lakes, rivers, seafloor vents, open ocean, ponds, ditches, semi-terrestrial habitats, and even in relation to other organisms, as mentioned by Dhar [9]. Crabs are important for ecological studies and species conservation assessments, particularly when the species concerned is threatened by habitat destruction and uncontrolled resource utilization [10]. Brachyuran crabs, a type of decapod crustacean typically found in coastal regions, exhibit unique habits and environmental sensitivity, making them ideal candidates for monitoring landscape determinants. Some of the morphometric characteristics changed due to the habitat of brachyuran crabs, such as chela size and shape, carapace width and length, rostrum length, and eye stalk length. Owing to their high morphological diversification, the authors sought to ascertain the existence of morphological patterns related to the habitat of coastal brachyuran crabs. According to Lakshmi Pillai [11], the crab fauna landed by trawlers at the Chennai Fisheries Harbor is composed of several families, namely Calappidae, Corystidae, Dorippidae, Dromiidae, Epialtidae, Galenidae, Leucosiidae, Matutidae, Parthenopidae, Portunidae, and Xanthidae. Despite the importance and vulnerability of brachyuran crabs along the Chennai coast, there is a lack of comprehensive and updated information on their diversity and distribution. Most of the previous studies on brachyuran crabs in this region have been limited to specific habitats or taxa or have been based on sporadic collections or records.

2.1 Study Area

Chennai was the state capital of Tamil Nadu, formerly known as Madras. Chennai is in the significant south-eastern coastal area of southern India along the Bay of Bengal and is influenced by a tropical climate. Coastal ecosystems are natural habitats near Chennai. It has a population of approximately 10 million and is located on the Coromandel Coast of the Bay of Bengal. Chennai is well known for its cultural, educational, and commercial activities as well as its historic and religious sites. The Chennai coastal region is home to a variety of freshwater and marine plants and animals. Some of the species found here are phytoplankton, as observed by Palani [12], crabs noted by Subrahmanyan [13], and birds reported by Gandy [14]. The land along the Chennai Coast (40 km) extends into the sea as a continental shelf with a variable width. Furthermore, the coastal zone of Chennai is also endowed with a very wide range of coastal ecosystems, such as estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy stretches, and coral reefs, characterized by unique biotic and abiotic properties and processes. More than half of the Chennai coastline is sandy, as reported by Fauna of the Chennai Coast [15]. The Chennai coast, which extends from West Bengal to Tamil Nadu, is 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, mud flats, estuaries, and offshore islands. It also supports a rich diversity of marine fauna and flora, including Brachyuran crabs. According to Roy [16], 482 species of brachyuran crabs belonging to 211 genera under 45 families have been recorded from different states on the east coast of India. Maximum diversity has been observed in Tamil Nadu (382 species) followed by Odisha (149 species), West Bengal (137 species) and Andhra Pradesh (128 species). However, the Chennai coast is also exposed to high levels of anthropogenic pressures, such as urbanization, industrialization, fishing activities, sewage discharge, oil spills, and plastic waste, which negatively impact the quality and health of the coastal ecosystem and its biodiversity. Loss of biodiversity can have significant direct human health impacts if ecosystem services are no longer adequate to meet social needs. Indirectly, changes in ecosystem services affect livelihoods, income, and local migration, and occasionally may even cause or exacerbate political conflict, and the biological diversity of microorganisms, flora, and fauna provides extensive benefits for biological, health, and pharmacological sciences. Significant medical and pharmacological discoveries have been made through a greater understanding of Earth’s biodiversity. Loss of biodiversity may limit the discovery of potential treatments for many diseases and health problems, as stated by the World Health Organization [17].

2.2 Habitats and Substrate

The crab lives in different habitats, such as sandy, muddy, algal, seagrass, burrows, rocky, stones, devoid of limestone rock, coral reef, cobble, broken shells or pebbles, oyster banks, gravel, rubble, backwaters, low salinity, river mouth, and mangroves, by their morphology, feeding type, and sensitivity; these habitats are compressed into soft substrates (S), hard substrates (H), estuary substrates (E), mangrove substrates (M), and pelagic substrates (P). Each Substrate provides resources and environmental conditions for the various crab species. Understanding the links between crab diversity and these landscapes is critical for conservation efforts, ecosystem management, and for sustaining the ecological equilibrium of marine ecosystems. The goal of this study was to use brachyuran crabs as biosensors for marine landscape identification in the Chennai zone.

Fig. 1. Chennai zone.
Source: Google earth

Table 1. Evaluated chennai's Coastal Zone

S. No	Chennai Coastal Zone		Km
	From	To	
1	Ennore	Thiruvottiyur	7.182
2	Thiruvottiyur	Kasimedu	4.225
3	Merina beach	Pattinambakkam	6.065
4	Urrurkuppam	Thiruvanmiyur beach	3.05
5	Thiruvanmiyur	Kottivakkam beach	1.897
6	Kottivakkam beach	Palavakkam	1.168
7	Palavakkam	Neelankarai	1.613
8	Neelankarai	Injambakkam	2.978
9	Injambakkam	Uthandi	6.666

Table 2. Habitats are fixed within the substrate

Substrate			
Soft substrate (S)	**Hard substrate (H)**	**Estuary (E)**	**Mangroves (M)**
Sandy	Rocky	Backwaters	Shrubs
Muddy	Stones	Low Salinity	Trees
Algal	Devoid of Limestone Rock	River Mouth	
Seagrass	Coral Reef		
Burrows	Cobble		
	Broken Shells or Pebbles		
	Oyster Banks		
	Gravel		
	Rubbles		

3. MATERIALS AND METHODS

Understanding the links between crab diversity and these landscapes is critical for conservation efforts, ecosystem management, and sustaining marine ecosystem ecological equilibrium. By utilizing the list of marine brachyuran crab data that we surveyed, we can conduct a comprehensive analysis of crab abundance in relation to the different zones and substrates in the marine environment. This analysis will allow us to determine the variety and abundance of substrates found in each zone and how they influence the distribution of crabs. Based on this information, we can draw conclusions about the marine landscape structure of the locations studied and how it affects the biodiversity and ecology of the marine system. Our aim was to study the structure of aquatic landscapes in marine regions. For this purpose, we used brachyuran crab species as a biosensor for their habitat conditions. Each species has a distinct preference for a certain habitat type, which depends on its morphometric characteristics, such as body shape and size. We grouped these habitats into five different categories based on their physical features: soft substrate (S), which includes sand, mud, and silt; hard substrate (H), which includes rocks, coral, and shells; estuary substrate (E), which includes brackish water where rivers meet the sea; mangrove substrate (M), which includes coastal forests with salt-tolerant trees; and pelagic substrate (P), which includes open water with plankton and fish (Table 2). We surveyed the diversity of crabs in the Chennai region, which is located on the eastern coast of India. We covered nine stations along the coastline from Ennore in the north to Uthandi in the south, as well as the markets and catchment areas where crabs are sold and caught. GPS information for each station wasrecorded (Table 3). We identified crabs using various sources of information, such as online databases that contain images and descriptions of crabs and literature sources that provide

Table 3. Stations and Zones in Chennai with GPS Data

Stations	GPS Information		Zone
Ennore	Latitude	13°13'38" N	North
	Longitude	80°19'35" E	
Kasimedu	Latitude	13°7'27" N	
	Longitude	80°17'45" E	
Pattinambakkam	Latitude	13°1'30" N	
	Longitude	80°16'43" E	
Thiruvanmiyur	Latitude	12°58'59" N	Central
	Longitude	80°16'8" E	
Kottivakkam	Latitude	12°58'1" N	
	Longitude	80°15'55" E	
Palavakkam	Latitude	12°57'55" N	
	Longitude	80°15'49" E	
Neelankarai	Latitude	12°56'32" N	South
	Longitude	80°15'38" E	
Injambakkam	Latitude	12°55'8" N	
	Longitude	80°15'25" E	
Uthandi	Latitude	12°52'30" N	
	Longitude	80°15'4" E	

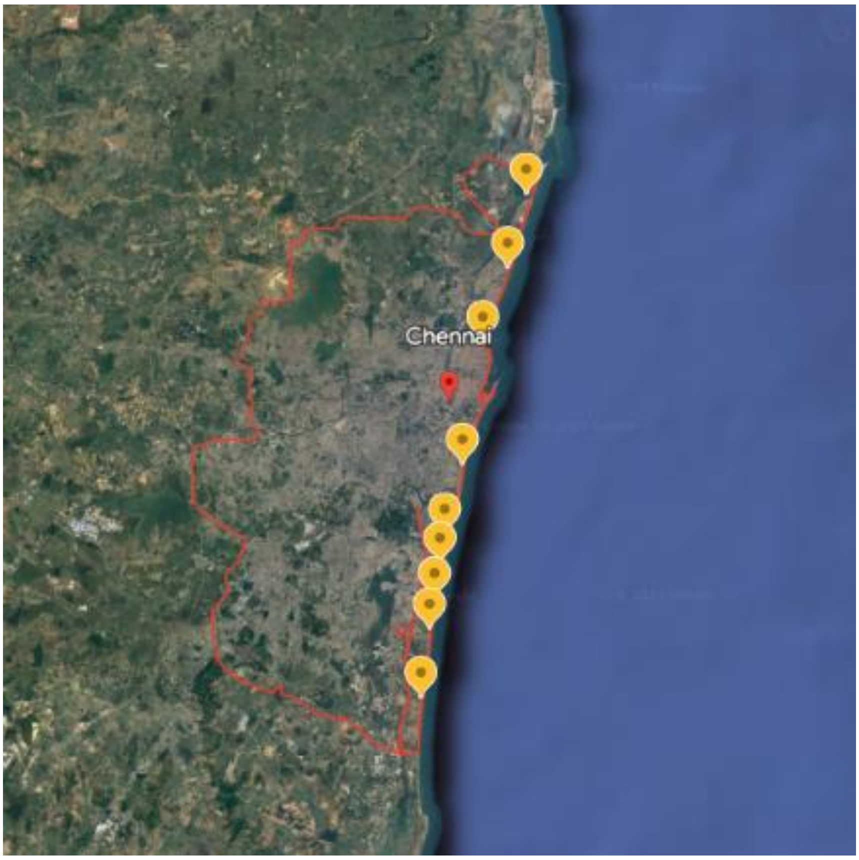

Fig. 2. Nine Station's location is shown by the colours yellow
Source: Google earth

scientific names and classifications of crabs. We compiled a list of marine brachyuran crabs found in the Chennai region, and we gathered their habitat details from research articles, books, and websites that have relevant information about crabs and their habitats.

3.1 Anthropogenic Threats to Marine Brachyuran crabs

The coastal region is ecologically important, but it also faces several problems such as urbanization, coastal erosion, loss of marine species, and climate change. Pollutants of domestic and industrial origin threaten the quality of freshwater and ocean waters. Various types of pollution in Ocean Inland water bodies include sewage, thermal, heavy metal, oil, acid, radioactive, industrial, and air pollution. The fauna and flora of natural ecosystems are affected by toxic pollutants. A brief account of the various types of pollutants is presented in Table 4.

Table 4. Pollutant's source, place & types

Source	Place	Types
Urban waste 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	Effluent
Natives & Tourists	Sea shore & Rivers	Plastic bottles & covers
Madras Fertilizers	Buckingham Canal/Ennore	Chemical effluent

4. RESULTS

4.1 Abundance and Habitat Pattern

The coastal zone of Chennai is a habitat for a large number of brachyuran crab species, which vary in abundance across sites. The northern zone had the highest abundance of species, with 30 different kinds of crabs living in the area. This is mainly due to the presence of favorable environmental conditions, such as seagrass beds and coral reefs, which offer protection and nourishment for crabs. The central zone had a reasonable number of species, with 23 different types of crabs found in the region. This is likely due to the predominance of sandy substrates, which have limited vegetation cover and require crabs to adapt to the environment. The southern zone had the least number of species, with only 20 different varieties of crabs observed in the area. This suggests that the habitat is less suitable for crabs, as it may lack the resources and features needed by crabs. These patterns provide insights into the spatial distribution and density of Brachyuran crabs in relation to their preferred habitats. The abundance of species in each zone is presented in (Table 5 and Fig. 3). Crab abundance according to zone and substrate is shown in (Table 7 and Fig. 4).

4.2 Habitat Distribution of Brachyuran Crab Species

After the survey, a list of marine brachyuran crabs was created. We identified 30 Brachyuran crab species in the marine environment of Chennai. From the list and the help of previous literature on crab habitats, we made zone- and substrate-wise abundance of crab data (Table 6). Ten species were predominantly found in coastal areas with sandy, muddy, algal association, and seagrass beds, which are considered soft substrates, such as *Charybdis feriata* (Linnaeus, 1758), which lives on sandy and muddy substrate habitats, as pointed out by Peter NG Kee Lin [18]. *Charybdis lucifer* (Fabricius, 1798) lives in muddy, sandy muddy, or sand habitats, as mentioned by Satheeshkumar [19]. *Podophthalmus vigil* (Fabricius 1798) lives in sand and mud, as reported by Hosie [20]. *Lauridromia dehaani* (Rathbun, 1923) lives in sand and muddy regions, as observed by Kingsley [21]. *Doclea ovis* (Fabricius, 1787) lives in a sandy bottom, as reported by Chou [22]. *Calappa clypeata* (Borradaile, 1903) lives in sand and mud, as observed by Hosie [20]. *Monomia argentata* (A Milne-Edwards, 1861) lives in a sandy bottom, as reported by Chou [20]. According to Turan [23], *Ashtoret lunaris* (Forskål, 1775) lives on sandy shores. *Galene bispinosa* (Herbst 1783) lives in sand and mud, as observed by Hosie [20]. *Ryphila cancellus* (Herbst, 1783) lives in middle and low sandy intertidal zones, as reported by Naderloo [24]. Eight species exhibited a wider distribution range, occurring in both soft and Hard Substrates, such as sandy, muddy, algal, seagrass, rocky, stones, limestone rock, coral reef, cobble, broken shells or pebbles, oyster banks, gravel, and rubble in deeper waters. Such as *Charybdis natator* (Herbst, 1794) live in sandy-rocky areas, as reported by Peter NG Kee Lin [18]. *Monomia gladiator* (Fabricius, 1798) habitats are 30–100 m deep, with bottoms composed of sand, broken shells, or pebbles, as observed by Huang and Shih [25]. *Portunus sanguinolentus* (Herbst, 1783) Marine, from littoral line to 30 m depth, sand mud or broken shells, as reported by Satheeshkumar [19]. *Portunus pelagicus* (Linnaeus, 1758) lives in sandy and sand-muddy depths in shallow waters between 10 and 50 m depth, including areas near reefs. Mangrove, seagrass, and algal beds have been reported by Satheeshkumar [19]. *Calappa bilineata* (Ng et al., 2002), muddy and sandy flats at low tide, devoid of limestone rock, shallow sea shelf, and coral colonies, as reported by Akash [26]. *Coleusia huilianae* (Promdam et al., 2014) lives in sandy mixed substrates of gravel and mud, as reported by Giraldes [27]. *Coleusia signata* (Paulson 1875) lives in the sand-pebble region. *Charybdis annulata* (Fabricius, 1798) lives in habitats such as algal assemblages, sand-filled surfaces under stones, sand-filled tide pools, rock crevices, and rocky areas, as reported by Trivedi and Vachhrajani [28]. *Thalamita crenata* (Rüppell, 1830) inhabits mudflats, sandy beaches, mangroves, estuaries, burrows, and crevices, as reported by Satheeshkumar [17]. *Scylla olivacea* (Herbst, 1796) is associated with mangrove forests and coastlines inundated with seawater of reduced salinity during the wet season, as reported by Keenan [29]. *Liagore rubromaculata* (De Haan, 1835) inhabits coral reefs, shallow subtidal, rocky, and cobble substrates, oyster banks, and sandy beaches, as reported by Mahapatra [30]. *Scylla serrata* (Forskål, 1775) lives in the river mouth, estuary, mangrove, nearshore, and muddy substratum, as reported by Satheeshkumar [17]. *Calappa lophos* (Herbst, 1782) live in the marine environment and mouth of the estuary, as reported by Satheeshkumar [17]. *Charybdis hoplites* (Wood-Mason, 1877) live in low-salinity backwaters, as observed by Devi [31]. Three species exhibit Mangroves Substrate only, such as *Scylla tranquebarica* (Fabricius, 1798), living in the river mouth, estuary, mangrove, near shore, and muddy substratum, as reported by Satheeshkumar [17]. *Thalamita crenata* (Rüppell, 1830) lives in mudflats, sandy beaches, mangroves, estuaries, and burrows or uses crevices, as reported by Satheeshkumar [17]. *Scylla olivacea* (Herbst, 1796) is associated with mangrove forests and coastlines inundated with seawater of reduced salinity during the wet season, as reported by Keenan [29]. Two species exhibit burrowing habitats: *Ocypode macrocera* (H. Milne Edwards, 1837) live in burrow on sand flats zone, as observed by Haque & Choudhury [32]. *Ocypode brevicornis* (H. Milne Edwards, 1837) live in intertidal, sandy beach, crabs remain buried in upper intertidal zone of sandy shore near Casuarina plantations, as observed by Khot & Jaiswar [33]. One species exhibits a pelagic habitat, *Charybdis smithii* (MacLeay, 1838), as reported by Romanov [34]. One species, *Metacarcinus gracilis* (Dana, 1852), was found in all habitat types: rock, coral, rubble, and mostly seagrass, as reported by Gross [35]. One species, *Rhinolambrus contrarius* (Herbst, 1804), lives in preference for Hard Substrate with Hard bottom, Rocky and Stones habitat, live in Benthic; depth range 0–42 m, as reported by Legall and Poupin [36].

Table 5. Abundance of species in each zone

Zone	North Zone	Central Zone	South Zone
No. of Species	**30**	**23**	**20**

Table 6. Crab abundance in stations and zones according to substrate

S.No	SPECIES	North Zone			Central Zone			South zone		
		S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**
1	***Charybdis feriata***	S	S	S	S	S	S	S	S	S
2	***Charybdis lucifer***	S	S	S	S	S	S	S	S	S
3	***Podophthalmus vigil***	S	S	S	S	S	S	S	S	S
4	***Lauridromia dehaani***	S	S	S	S	S	S	S	S	S
5	***Doclea ovis***	S	S	S	S	S	S	S	S	S
6	***Calappa clypeata***	S	S	S	S	S	S	S		
7	***Monomia argentata***	S	S		S	S		S		S
8	***Ashtoret lunaris***	S		S	S				S	
9	***Galene bispinosa***	S	S	S	S					
10	***Ryphila cancellus***	S								
1	***Charybdis natator***	SH	SH	SH	SH	SH	SH	SH	SH	SH
2	***Monomia gladiator***	SH	SH	SH	SH	SH	SH	SH	SH	SH
3	***Portunus sanguinolentus***	SH	SH	SH	SH	SH	SH	SH	SH	SH
4	***Portunus pelagicus***	SH	SH	SH	SH	SH	SH	SH	SH	SH
5	***Calappa bilineata***			SH	SH		SH		SH	SH
6	***Coleusia huilianae***	SH		SH						
7	***Coleusia signata***	SH		SH						
8	***Charybdis annulata***		SH							
1	***Liagore rubromaculata***	E	E	E	E	E			E	E
2	***Scylla serrata***	E	E	E	E	E	E			
3	***Calappa lophos***	E		E		E	E	E	E	
4	***Charybdis hoplites***		E				E			E
1	***Scylla tranquebarica***	SME	SME	SME		SME	SME	SME		
2	***Thranita crenata***		SME							
3	***Scylla olivacea***	ME	ME					ME		
1	***Ocypode macrocera***	SB	SB	SB	SB	SB	SB	SB	SB	SB
2	***Ocypode brevicornis***	SHB	SHB	SHB	SHB	SHB	SHB	SHB	SHB	SHB
1	***Rhinolambrus contrarius***	H	H			H				
1	***Charybdis smithii***		P				P			
1	***Metacarcinus gracilis***	ALL	ALL							

S-Soft Substrate, H-Hard Substrate, E-Estuary& M-Mangroves.
S1-Ennore, S2-Kasimedu, S3-Pattinambakkam, S4-Thiruvanmiyur, S5-Kottivakkam, S6-Palavakkam, S7-Neelankarai, S8-Injambakkam&S9-Uthandi.

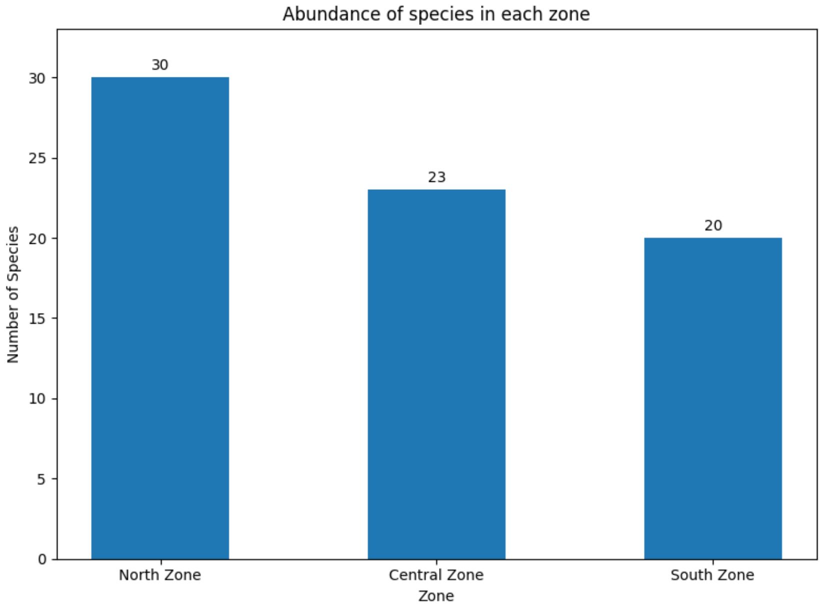

Fig. 3. Abundance of species in each zone

Table 7. Crab abundance according to zone and substrate

Substrate	North Zone	Central Zone	South Zone
Soft Substrate	10	9	8
Hard Substrate	1	1	0
Soft and Hard Substrate	8	5	5
Estuary	4	5	5
Mangroves	3	1	2
Estuary And Mangroves	7	5	5
Soft Burrow	1	1	1
Soft and Hard substrate Burrow	1	1	1
Pelagic	1	1	0
All Substrate	1	0	0

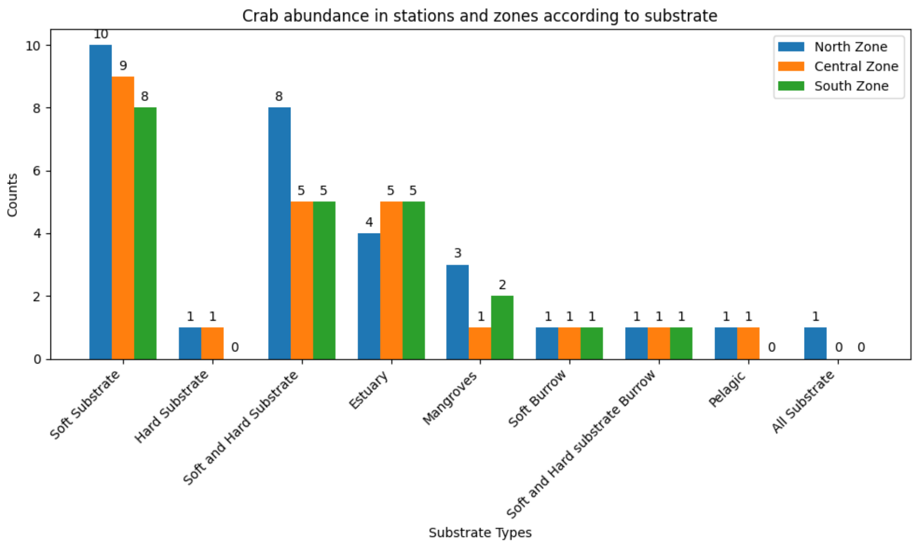

Fig. 4. Crab abundance in stations and zones according to substrate

5. DISCUSSION

Our study assessed the health of aquatic landscapes in the Chennai coastal region, focusing on marine brachyuran crab habitats. We found significant correlations between crab population density and habitat, suggesting that these habitats serve as indicators of ecosystem health. The presence of 30 Brachyuran crab species in the marine environment of Chennai also highlights the biodiversity of the region. Furthermore, our findings underscore that soft substrates dominate across all zones, with 10 species in the North Zone, nine species in the Central Zone, and eight species in the South Zone. Following closely, soft and hard substrates were represented by eight species in the North Zone and five species in both the central and southern zones. Estuaries, which are crucial transitional zones, host five species each in the central and southern zones, with four species in the North Zone. Estuary and mangrove ecosystems support seven species in the northern zone and five species in both the central and southern zones. Mangroves, with three species in the North Zone, two species in the South Zone, and one species in the Central Zone. Hard substrate and soft and hard substrate burrows were minimal, each represented by one species across zones. Pelagic substrates are represented by one species in the northern and central zones, with no representation in the southern zone. Finally, all substrate types were represented by one species in the northern zone.

6. CONCLUSION

Chennai is a city that may not often be associated with biodiversity hotspots, unlike regions such as the Amazon rainforest or the Coral Triangle, which are renowned for their rich and diverse flora and fauna. However, this city has its own distinctive and valuable biodiversity, which warrants recognition and conservation. Chennai's marine habitats host a variety of crab species, some of which are endemic to this region and some of which are endangered by human activities. Chennai's biodiversity may not be as plentiful as that in other regions, but it is still significant and essential. Urbanization and human activities can pose threats to biodiversity; therefore, efforts are needed to conserve and protect existing natural habitats and wildlife in and around the city. The study of crab diversity offers a fascinating glimpse into the wondrous variety of life on the Earth. It also helps us to understand the effects of human activities and environmental changes on coastal regions. Crabs are remarkable creatures that exhibit diverse shapes, sizes, functions, and behaviors. They also play important roles in ecosystems, such as recycling nutrients, filtering water, and providing food for other animals. By studying and appreciating the diversity of crabs, we not only gain a deeper understanding of the complex web of life, but also reinforce the need to protect and conserve these amazing creatures for future generations to cherish and learn from. By utilizing brachyuran crabs as biosensors for landscape determination, we can explore new possibilities for understanding marine environments. By integrating data from different stations with habitat information, we could investigate how different landscape features influence different regions. In this study, we identified that Chennai's marine landscape is dominated by a soft substrate region, followed by a region that has a mixture of soft and hard substrates, estuaries, and mangrove substrates. This study provides a foundation for future studies that aim to employ brachyuran crabs as research models for various assessments.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors hereby declare 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 manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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