Crab Diversity in Kapshi Lake, Akola District (M.S.)

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Abstract
This study investigates the diversity of crab species in Kapshi Lake, located in the Akola District of Maharashtra, India. Crabs are significant members of aquatic ecosystems, playing key roles in maintaining ecological balance. The research identifies four crab species from three families under the order Decapoda: Gecarcinucidae, Portunidae, and Crustacean, with the species Barytelphusa cunicularis from Gecarcinucidae being the most dominant. The study also examines the relationship between human settlements and crab diversity, revealing that freshwater crabs in proximity to human populations have fewer species compared to those in more isolated areas. The findings highlight the impacts of human activities, such as overharvesting and habitat destruction, on the local crab populations and their habitats. This baseline data will be useful for future research and the monitoring of anthropogenic effects on freshwater crab species in Kapshi Lake.

Keywords: Crab Diversity, Kapshi Lake, Akola District, Freshwater Crabs, Human Impact, Biodiversity Monitoring, Crustaceans, Gecarcinucidae, Portunidae, Environmental Conservation.

Introduction: -
The marine ecosystem is one of the most diverse ecosystems on Earth. It requires focused study and detailed knowledge to understand its processes and functions, as it provides a habitat for a wide range of unique plant and animal species. [Shukla, M.L., B.K. Patel, J.N. Trivedi and K.D.Vachhrajan, 2013] The coastal environment offers a wide variety of habitats, including estuaries, lagoons, mangroves, salt marshes, rocky shores, sandy beaches, and coral reefs, which collectively support a high level of biodiversity. [Shet, Ganesh N., M.D. Subash Chandran and T.V. Ramachandra,2016] Marine organisms are vital to biodiversity research, serving as a cornerstone for aquaculture and forming the basis of essential ecosystem services. [Varadharajan, D., P. Soundarapandian and N. Pushparajan,2013]
Crustaceans, particularly those in the infraorder Brachyura, are a significant component of macrobenthic fauna. Among the 2,934 crustacean species identified, marine species dominate, accounting for 94.85% of this diversity. [Venkataraman, K. and M. Wafer,2005.]
Crustaceans have a lengthy evolutionary history and exhibit remarkable adaptability. [Varadharajan, D. and P. Soundarapandian, 2014]. Crustaceans are key members of benthic communities, with many species utilized for human consumption. Additionally, the vast diversity of smaller crustacean species plays a crucial role in the complexity and functioning of tropical ecosystems. [Sakthivel, Kollimalai and Fernando, Antony, 2012].
Crustaceans typically exhibit higher diversity in tropical and subtropical regions compared to temperate and colder areas. [Bertini,Giovana,Adilson,Fransozo, and Gustavo A. S. De Melo, 2004].
Crustaceans are highly valuable globally due to their crucial role in the seafood industry. [Varadharajan, D., P. Soundarapandian and N. Pushparajan,2013]. True crabs of the infraorder Brachyura are among the most recognized and extensively researched groups of marine organisms. These crabs are part of the Order Decapoda, which is the most species-rich group of crustaceans. According to Ng *et al.* (2008), there are 6,793 species of brachyuran crabs distributed across 1,271 genera and 93 families worldwide. Their considerable abundance makes them one of the most prominent groups in marine benthic communities, significantly contributing to both biomass and the overall structure of these ecosystems (Bertini *et al.,* 2004). In India, Venkataraman and Wafer (2005) reported 705 species of brachyuran crabs across 28 families and 270 genera, with 226 species identified along the country's west coast from 130 genera and 39 families (Jose, 2015).
Crabs play a crucial role in maintaining ecosystem health and are integral to the marine food web, exemplifying predator-prey dynamics. Their feeding activity and pellet production can modify the characteristics of the substrate, alter organic matter content, and regulate microalgal deposition (Arya *et al.,* 2014). Additionally, the burrowing behavior of crabs impacts surface properties, nutrient cycling, soil porosity, sediment quality, and microbial diversity (Pandya, 2011). The biogenic structures and markings resulting from crabs' bioturbatory processes in intertidal zones are essential for ecosystem health, serving as a key link in the food chain (Idowu & Ugwumba, 2005; Olawusi-Peters & Ajibare, 2004).
Seafood products are in high demand due to their reputation for being healthy and nutritious (Sudhakar *et al.,* 2011). They are easily digestible because they contain minimal connective tissue. Crabs are an excellent source of protein,

carbohydrates, lipids, and essential minerals (Soundarapandian *et al.,* 2013). Radhakrishnan (2000) highlighted that marine crab eggs, an often underutilized resource, are rich in protein, glycogen, and fats. Crabs can be an important supplement to human diets, providing vital protein and minerals to help prevent nutritional deficiencies (Jeyalakshmi Kala *et al.,* 2014). Rameshkumar *et al.* (2009) and Kohilam *et al.* (2015) reported that the haemolymph of the crab *Charybdis lucifera* and the hermit crab *Clibanarius clibanarius* contains biologically active compounds with antibacterial and antifungal properties, which remain largely untapped. Leffler (1997) noted that crab waste is a valuable source of chitin and chitosan, which have various applications in medical sutures, seed coatings, dietary supplements, and as coagulants for waste treatment. Haragi *et al.* (2010) and Tharmine et al. (2014) found that the meat of edible crabs is rich in vitamins, stimulates brain function, and is beneficial for conditions such as colds, asthma, eosinophilia, primary complex, and wheezing. Morgan *et al.* (2006) documented that shore crabs can serve as sentinel species to monitor pollutant effects in estuaries. Additionally, because heavy metals accumulate in the tissues of marine animals, crabs are also used to assess heavy metal contamination (Arun Kumar & Achyuthan, 2007; Zhou *et al.,* 2008).

Species diversity is an important measure for comparing communities affected by biotic disturbances or for understanding the stages of succession and stability within a community. Species richness, which refers to the total number of species present, is the most commonly used indicator of diversity (Olawusi-Peters & Ajibare, 2014).

The coastal environment of Uran has faced significant stress due to the development of various industrial activities, including the Jawaharlal Nehru Port (JNPT), the Oil and Natural Gas Commission (ONGC), an LPG Distillation Plant, Grindwell Norton Ltd., a Gas Turbine Power Station (GTPS), Bharat Petroleum Corporation Limited (BPCL) Gas Bottling Plant, DP World, and Container Freight Stations (CFS). These activities have had a detrimental impact on the ecology of brachyuran crabs along the Uran coast in Navi Mumbai (Pawar, 2012).

Although several studies have focused on evaluating the species diversity of brachyuran crabs in India, no scientific research has been conducted on the species composition of brachyuran crabs along the Uran coast in Navi Mumbai. Therefore, this study aims to assess the impact of human activities on the species composition of brachyuran crabs, taking into account tidal and seasonal variations. The Sangli and Kolhapur districts of Maharashtra are primarily characterized by the Sahyadri mountain range, with flat-topped hills and plains. These regions are rich in water bodies such as rivers, lakes, streams, ponds, and waterfalls, providing an ideal habitat for biodiversity. The Akola district also contains various small and moderate-sized water bodies and river tributaries that serve as water sources. Crabs, being ecologically significant species, thrive in these water bodies, which host a variety of crab species that remain largely unexplored. Freshwater crabs are found predominantly in tropical and subtropical regions, inhabiting diverse water bodies, from fast-flowing rivers to swamps. Many species are endemic to small geographical areas due to their limited dispersal abilities and low reproductive output (Yeo *et al.,* 2008). Furthermore, habitat fragmentation caused by human population growth has also contributed to the decline in their distribution (Collen *et al.,* 2009).

Freshwater crabs primarily feed on live or dead animal matter. They are a crucial food source for various fish, birds, and mammals. Additionally, freshwater crabs provide an affordable and vital source of protein for humans, particularly for tribal and economically disadvantaged communities. These crabs are highly endemic, largely due to their limited dispersal ability, low reproductive rates, and specific habitat requirements (Ahmed *et al.,* 2008).

In most decapods, gonopores (reproductive openings) are located on the legs. However, in crabs, the first two pairs of pleopods (abdominal appendages) are used for sperm transfer, and this arrangement has evolved over time. As the male abdomen became more narrow, the gonopores shifted towards the midline, moving away from the legs and positioning themselves on the sternum (Laurent, 1980). The freshwater crab fauna of the Sangli and Kolhapur districts in Maharashtra has been broadly surveyed by researchers. To support conservation efforts, it is essential to understand the biodiversity of freshwater crabs in these regions. Therefore, the current study aims to identify the crab species present in the area and assess their abundance.

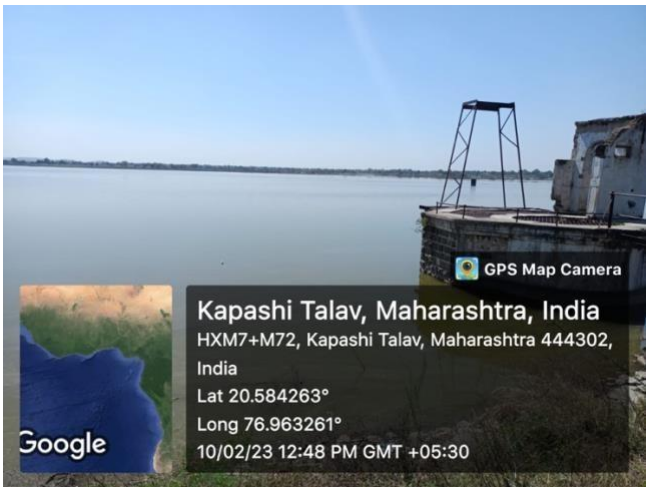
Hermit crabs, classified under the Decapoda (infra-order Anomura), are a highly distinctive and ecologically significant group found across a wide range of habitats, including intertidal, subtidal, estuarine, mangrove, and coral reef areas of tropical countries (Reese, 1969). The diversity of habitats they occupy has led them to develop various behavioral and physiological adaptations, influencing their diversity, distribution, and resource selection. Known for their fragile, uncalcified abdomens, hermit crabs are heavily reliant on gastropod shells, which offer protection from predators and prevent desiccation (Reese, 1969; Hazlett, 1983). As important members of the marine food web, anomurans serve as a primary food source for several economically valuable fish species. The Anomura group includes 7 superfamilies, 17 families, 200 genera, and around 1500 species worldwide (Martin & Davis, 2001). Hermit crabs belong to the superfamily Paguroidea, which is divided into 5 families, with approximately 1100 species globally. In India, hermit crabs are represented by 112 species, a number that continues to grow (Trivedi & Vachhrajani, 2017).

Most research has focused on organisms with high market value, while animals like hermit crabs have received less attention. Despite this, several regional faunal surveys have been conducted across India, such as those by Henderson (1893, 1915), Alcock (1905), Southwell (1906), and Sundara Raj.

Several regional faunal surveys have been conducted in India, including those by Henderson (1927), Reddi (1935), Kamalaveni (1950), Khan and Natarajan (1984), and Thomas (1989). During this period, significant changes have occurred in the nomenclature and systematics of species, with new additions to the faunal list (Komai *et al.,* 2012; 2013; 2015; Reshmi and Bijukumar, 2010 and 2011). However, despite some progress, there remains considerable uncertainty at both the genus and species levels, which requires further research. Although hermit crabs are ecologically important, their systematics and ecology are poorly understood in India, particularly in the Maharashtra region. Therefore, it is essential to generate up-to-date information on the status of hermit crabs, which will serve as a foundation for future

research. This study will help future researchers identify and classify the species involved, supporting further biodiversity and ecological studies.

Material and Methods



Study Area:
Akola is situated in the north-central part of Maharashtra, Western India, along the Morna River. The town spans an area of 124 km² and lies between latitudes 20.17°N and 20.16°N, and longitudes 76.7°E and 77.4°E. Kapashi Talav village, located 20 km from Akola, covers a geographical area of 836.67 hectares.

Sampling Strategy:
The study was conducted over a period of four months, from December 2022 to March 2023, at various sites of Kapashi Lake. Sampling took place twice each month during this period.
The study sites were monitored monthly during spring low tides, and crabs were collected through hand-picking from the intertidal zones and shallow coastal waters. Burrowing crabs were captured either by patiently waiting for them to emerge from their burrows, digging the burrows, or by introducing dilute formalin into the burrows. To prevent limb shedding, live crabs were first narcotized using menthol crystals before being preserved in a 10% formalin solution neutralized with hexamine.

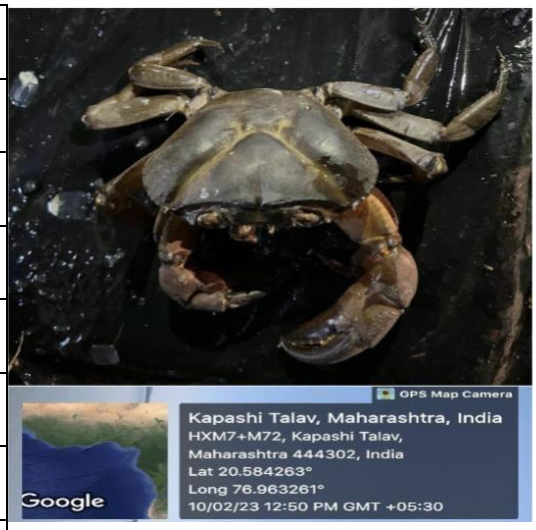
Identification of Crabs:
All the crabs collected during the study were photographed using a digital camera and identified up to the species level using standard identification keys, including those from Chhapgar (1957, 1958), Jeyabaskaran and Wafar (2002) (http://www.niobioinformatics.in), and the Marine Species Identification Portal (http://species-identification.org). The scientific names and classification of the brachyuran crabs were taken from the World Register of Marine Species (WRoMS) website (http://www.marinespecies.org).

Results and Discussion
A total of four crab species from three families under the order Decapoda in the class Malacostraca were recorded from Kapashi Lake. In this study, crabs from the families Gecarcinucidae, Portunidae, and Crustacean were identified. The families Crustacean and Portunidae each contributed one species, while the family Gecarcinucidae had two species.
Species of crabs recorded from Kapashi lake

Sr. No	Order	Family	Scientific Name
1	Decapoda	Gecarcinucidae	*Barytelphusa cunicularis*
2	Decapoda	Portunidae	*Scylla serrata*
3	Decapoda	Gecarcinucidae	*Barytelphusa guerini*
4	Decapoda	Crustacean	*Brachyura*

1. Freshwater crab
Scientific Classification

Kingdom	Animalia
Phylum	Arthropoda
Subphylum	Crustacea
Class	Malacostraca
Order	Decapoda
Family	Gecarcinucidae
Genus	*Barytelphusa*
Species	*B.cunicularis*



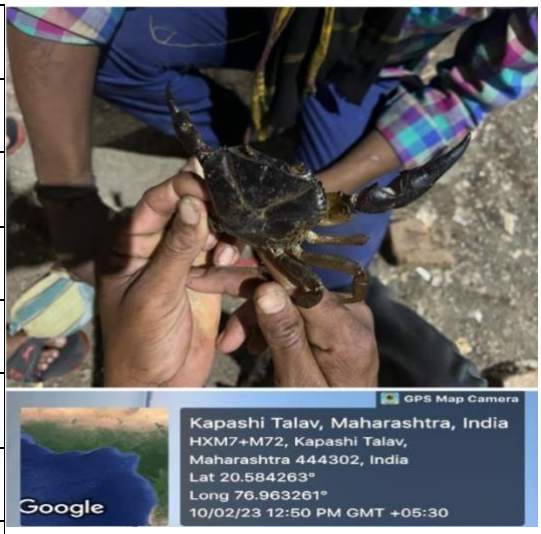
Barytephusa cunicularis is a widely distributed freshwater crab species found across most parts of India, excluding the Northeast.

- Its carapace is dark chestnut black in color and has a nearly smooth texture.
- The claws match the color of the shell, but the basal joint of the first leg and the entire length of the other legs are much lighter, appearing in a dirty brown hue with numerous small black transverse markings.
- The external morphology of freshwater crabs shows minimal variation, making the form of the gonopod (first abdominal appendage, modified for reproduction) a key feature for classification.
- The development of freshwater crabs is direct, meaning the eggs hatch into juvenile crabs, bypassing free-living larval stages.
- To adapt to freshwater environments, these crabs have evolved mechanisms to conserve water, such as the ability to reabsorb salt from their urine.
- In addition to gills, freshwater crabs possess a "pseudolung" in their gill chamber, enabling them to breathe air.
- These adaptations make freshwater crabs well-suited for terrestrial environments, although they must return to water periodically to excrete ammonia.

2. Black Crab

Scientific Classification

Kingdom	Animalia
Phylum	Arthropoda
Subphylum	Crustacea
Class	Malacostraca
Order	Decapoda
Family	Portunidae
Genus	*Scylla*
Species	*Scylla serrata*



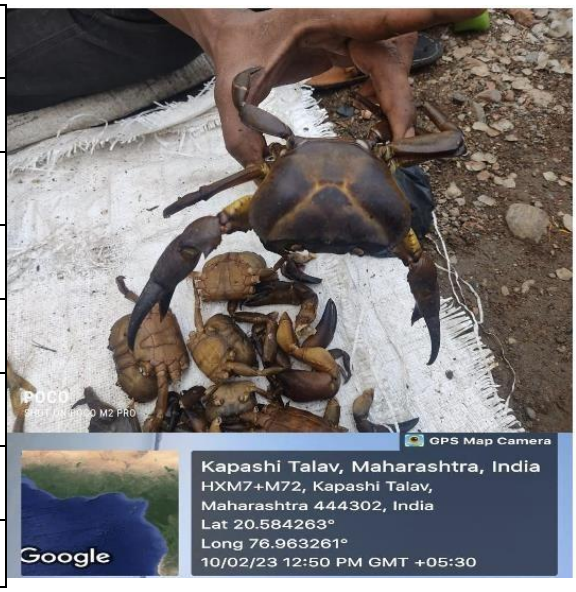
Scylla serrata, commonly known as the mud crab, mangrove crab, or black crab, is an ecologically significant species found in the estuaries and mangroves of Africa, Australia, and Asia.

- The shell color of these crabs typically ranges from a deep, mottled green to a dark brown.
- They are large crabs with a smooth and wide carapace, and they have powerful claws that are used for crushing and cutting prey.

- The two hind legs are flattened, enabling them to swim efficiently.
- The chelipeds (claw-legs) are large, smooth, and longer than the other legs.
- Their eyes are mounted on stalks, but can be retracted into protective sockets. Two pairs of antennae located between the eyes help them detect subtle changes in water currents and chemistry.
- Beneath the antennae, there are two small openings used for excreting urine.
- These crabs are known for their cannibalistic behavior. When crabs molt, others with hard shells may attack and consume the molting crabs.

3. Freshwater Crab
Scientific classification

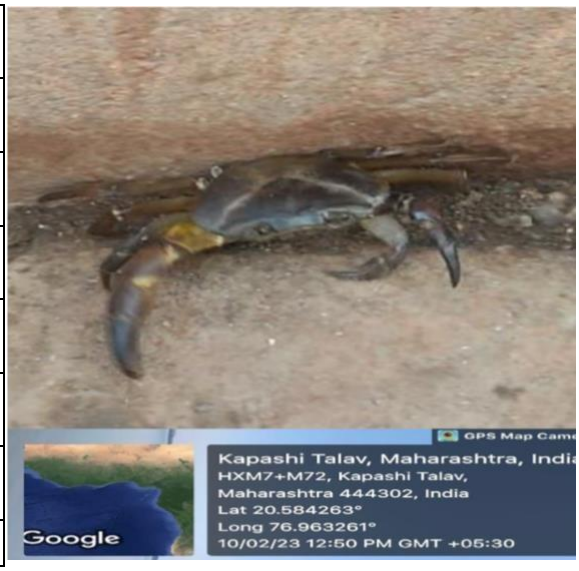
Kingdom	Animalia
Phylum	Arthropoda
Subphylum	Crustacea
Class	Malacostraca
Order	Decapoda
Family	Gecarcinucidae
Genus	*Barytelphusa*
Species	*B.guerini*



- The carapace is wider than long, with a more convex shape. The epigastric cristae are well-developed, located anterior to the postorbital cristae, which are also prominent and form a concave ridge when viewed from above, though they do not reach the anterolateral border. The external orbital angle's outer margin is twice the length of the inner margin. The epibranchial tooth is poorly developed, positioned notably above the level of the postorbital cristae. The frontal median triangle is incomplete, with only the dorsal margin present, and the epistomal median lobe lacks a median tooth.
- The exopods of the first and second maxillipeds have long flagella, while the third maxilliped's exopod has a flagellum longer than the ischium.
- The ambulatory legs are the longest, with the propodus more than three times as long as it is broad.
- The chelipeds are unequal, with a distinct, blunt carpal spine.
- The suture between thoracic sternites 2 and 3 is distinct, while the suture between sternites 3 and 4 is visible as shallow grooves along the side
- The first gonopod (G1) is long and narrow, curving slightly outward, with a very long terminal segment (approximately 0.9 times the length of the subterminal segment) and a slightly swollen or bulging tip.
- The second gonopod (G2) is short, with a distal segment about 0.2 times the length of the basal segment.

4. True Crab
Scientific Classification

Kingdom	Animalia
Phylum	Arthropoda
Subphylum	Crustacea
Class	Malacostraca
Order	Decapoda
Suborder	Pleocyemata
Family	Crustacean
Species	*Brachyura*



- Crabs are decapod crustaceans belonging to the infraorder Brachyura, characterized by a very short, projecting “tail” (abdomen), which is usually entirely hidden under the thorax. The term "Brachyura" comes from the Greek word for “short tail.”
- Crabs inhabit oceans worldwide, freshwater environments, and land. They are typically covered by a thick exoskeleton and possess a single pair of pincers.
- Crabs first emerged during the Jurassic Period.
- Their exoskeleton is made of highly mineralized chitin, and they are equipped with a pair of chelae (claws).
- Crabs vary significantly in size, from the tiny pea crab, which is just a few millimeters wide, to the Japanese spider crab, which has a leg span of up to 4 meters (13 feet).
- In most male crabs, the abdomen is narrow and triangular, while females have a broader, rounded abdomen, as they brood fertilized eggs on their pleopods.
- Crabs often exhibit noticeable sexual dimorphism.

Conclusion

The present study indicates that Kapshi Lake supports a diverse range of crab species. The species from the family Gecarcinucidae were the most dominant, followed by those from the Crustacean and Portunidae families. The study also highlights those freshwater crabs located near human settlements tend to have fewer species, while areas further from human development exhibit a more diverse species composition. Human activities such as overharvesting, habitat destruction, and the disposal of sewage, waste, and effluents pose a threat to the coastal ecosystem, which provides critical habitats for many crustaceans. The findings on crab species diversity will serve as valuable baseline data for future monitoring of human impacts on the crab populations in Kapshi Lake.

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