

DIVERSITY OF HERMIT CRAB (DECAPODA: ANOMURA) ALONG THE SIKKA COAST, GUJARAT

Abstract

This study documented the species composition and relative abundance of hermit crabs along the Sikka coast of Gujarat. Specimens were collected fortnightly by hand during low tide from the Vador site and GSFC Jetty between October 2020 and March 2021. Collected animals and their occupied shells were preserved in 70% alcohol and identified using taxonomic characters. Six hermit crab species belonging to the family Diogenidae and two genera were recorded: *Diogenes avarus*, *Diogenes klaasi*, *Diogenes manaarensis*, *Diogenes edwardsii*, *Clibanarius longitarsus*, and *Clibanarius padavensis*. The counts presented in the study comprised 986 individuals, including 538 from Vador and 448 from GSFC Jetty. *Diogenes edwardsii* was the most abundant species, with 312 individuals across both sites, followed by *D. manaarensis* with 261, *D. klaasi* with 199, and *D. avarus* with 152 individuals. *Clibanarius padavensis* and *C. longitarsus* were less abundant, with 33 and 29 individuals, respectively. The recorded species occurred in sandy and muddy intertidal habitats. Morphological descriptions, colour patterns, habitat observations, and photographic documentation were provided for each species. The findings establish a site-specific inventory of hermit crabs from the surveyed coast and indicate differences in the recorded abundance of species between the two sampling locations. The dataset provides baseline information for future taxonomic, ecological, and monitoring studies of intertidal hermit crab assemblages in the Sikka coastal region.

Key words: Anomuran, Diversity, Hermit crabs, Gastropod Shells, Sikka coast, Intertidal

1. Introduction

India is one among 12 mega biodiversity countries and 25 hotspots of the richest and highly endangered eco-regions of the world. Anomuran form very important link in the food web of the oceans as the major food of economically valuable species of fishes. Anomura approximately comprised 1500 species belonging to 200 genera from 17 families of 7 superfamilies worldwide. The Anomura is one of the least studied groups of decapod crustaceans occurring in Indian waters. So far, total 112 species of hermit crabs (Paguroidea) belonging to 26 genera and 5 families are reported from Indian waters, of which 13 species are found in Gujarat State (Trivedi and Vachhrajani, 2017).

The infraorder Anomura is most diverse in the body form among the decapod crustaceans. For example, the species, classified under the superfamily Paguroidea usually have membranous or softly calcified abdomen and therefore require an external protective covering, such as a gastropod shell. Most types of hermit crabs are adapted to the life in the ocean, while some species spend their life on the solid ground. Marine hermit crab can be found both in the shallow coastal waters and in a deep sea, while terrestrial species usually inhabit tropical areas (Gosavi et al., 2017).

Hermit crabs are connected part of the intertidal animal community and play important role in the food chain. Hermit crabs depend on gastropod shells for various purposes such as protection from predators, physical stress, reproductive success, and locomotion. Intertidal habitats are particularly susceptible to changes in temperature, salinity and hermit crab species vary in their tolerance of these changes. (Trivedi and Vachhrajani, 2014).

2. Materials and Methods

The samples of hermit crabs were collected by hand picking from intertidal areas during low tide, viz. Vador site and GSFC Jetty at Sikka coast, Gujarat. The Sikka coast is situated between 22°27'31.0"N and 69°48'17.4"E and 22°28'14.9"N and 69°49'31.9"E. The sampling was carried out fortnightly during October 2020 to March 2021. Collected animals, along with the shells were preserved in 70 % alcohol and brought to lab for further studies. Later, the abdomen of the crabs was pulled out of the shells by twisting the animal slowly against the direction of shell spiral. A light hammer was used to crack the shell in difficult cases. The specimens were identified using the key.

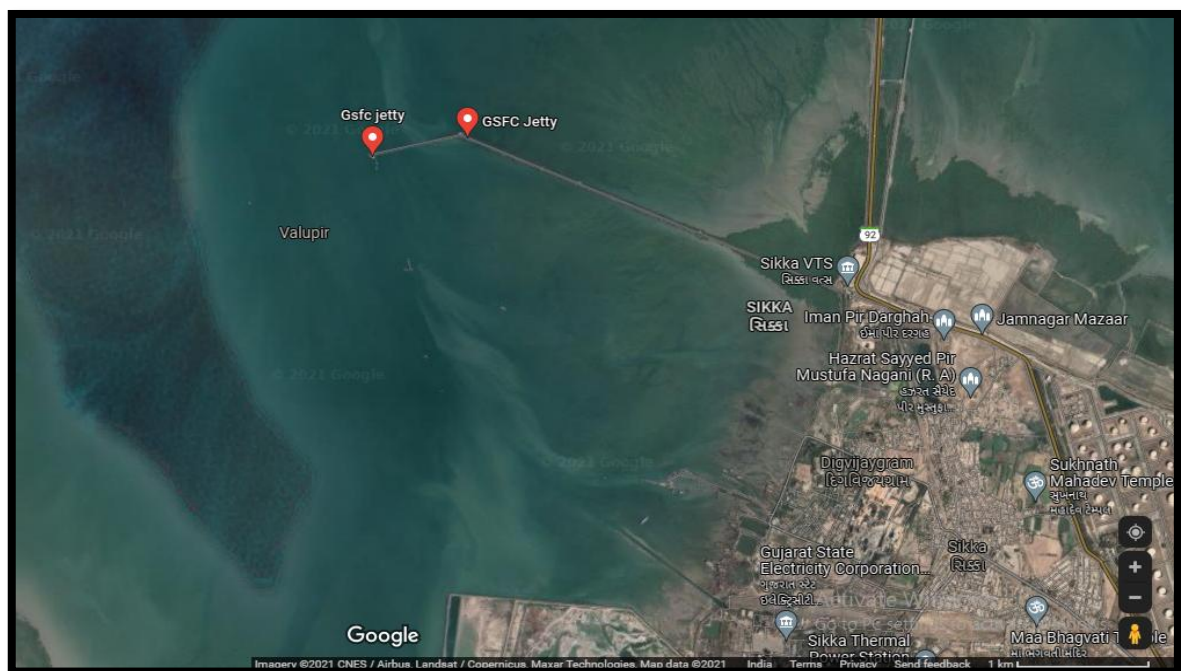


Fig.1. Satellite view of Sikka coast, Gujarat (Source: Google map)

3. Results and Discussions

The checklist of hermit crabs was prepared with detailed of taxonomic position covering from phylum to species. There were 6 species identified from Vador site and GSFC Jetty at Sikka coast belonging to two sub classes, one order, one super family, one family, one subfamily and two genera. Total numbers of individuals recorded from Vador site and GSFC Jetty at Sikka coast (Fig.1). The IUCN status showed that all the available species were Not Evaluated (NE) under the criteria of International Union for Conservation of Nature (IUCN). The check lists of hermit crabs from Vador site and GSFC Jetty at Sikka coast are presented in Table 1.

Among two genera, Diogenidae has the largest representation with four species followed by the genera Clibanarius with two species. Six species of hermit crabs of the genus Clibanarius (Family: Diogenidae), namely, *Clibanarius longitarsus* (De Haan, 1849), *C. padavensis* (De Haan, 1888), and genus Diogenes (Family: Diogenidae), namely, *Diogenes avarus* (Heller, 1865), *Diogenes Klaasi* (Rahayu & Forest, 1995), *Diogenes mannarensis* (Henderson, 1893), *Diogenes edwardsii* (De Haan, 1849) were observed from Vador site and GFSC Jetty at Sikka coast, Gujarat.

Table 1. Checklist of Hermit crabs in Vador site and GSFC Jetty at Sikka coast of Gujarat

Super family	Family	Sub family	Genus	Species	IUCN status
Paguroidea	Diogenidae	Paguroidea	Diogenes	<i>Diogenes avarus</i> (Heller, 1865)	NE
				<i>Diogenes klaasi</i> (Rahayu & Forest, 1995)	NE
				<i>Diogenes mannarensis</i> (Henderson, 1893)	NE
				<i>Diogenes edwardsii</i> (De Haan, 1849)	NE
			Clibanarius	<i>Clibanarius longitarsus</i> (De Haan, 1849)	NE
				<i>Clibanarius padavensis</i> (De Man, 1888)	NE

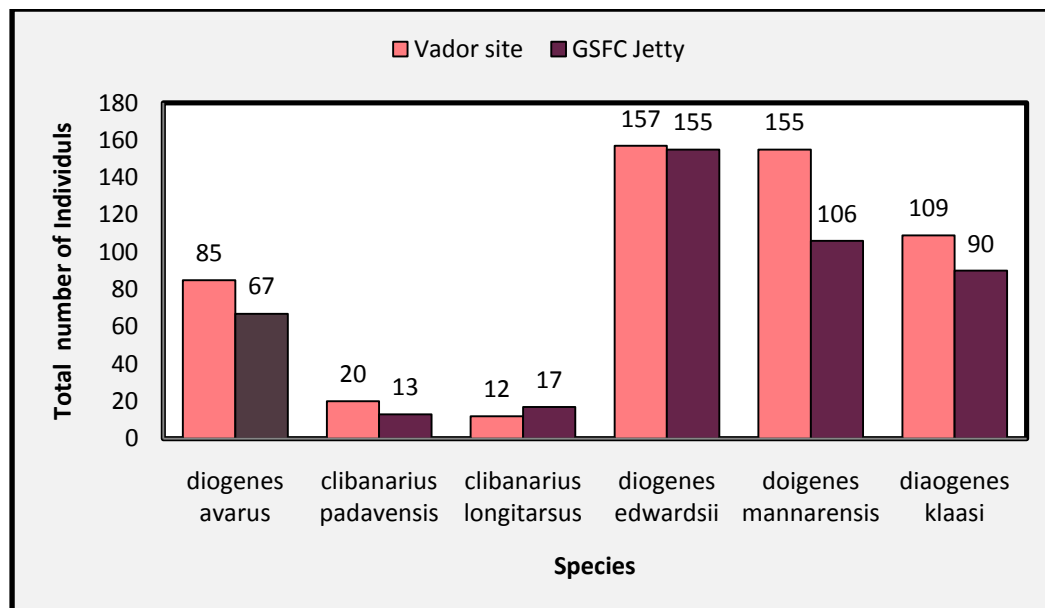


Figure 2. Total numbers of individuals recorded from Vador site and GSFC Jetty at Sikka coast during October 2020 to March 2021

Similar work was carried out by Ashok and Rahul (2012) at rocky intertidal area of the Saurashtra coast and they found by 2 species of hermit crabs. Sardar *et al.* (2019) observed, only 2 species of hermit crabs namely, *Clibanarius padavensis* and, *Clibanarius infraspinus* from the intertidal zone of extended mud flats of Bakkhali and Frazerganj of Indian Sundarban for a period of one year.

Similar in this study Trivedi and Vachhrajani (2017) listed 112 species belonging to 26 genera and 5 families of hermit crab. East coast of India, with 81 species is more diverse than the west coast of India (73 species). Maximum species diversity was recorded from coastal areas of Tamil Nadu state (50 species) whereas the least number of species were reported from coastal areas of Maharashtra state (7 species). Nirmal *et al.* (2017) recorded the occurrence of 4 hermit crabs from the Maharashtra coast, India. The similar study was conducted Jhala *et al.* (2017) during December 2012 to May 2013 in 4 different site of southern gulf of Kachchh. All these 5 species of crabs were found to be using shells of total 27 Gastropod species. In present study the IUCN status showed that all the available species were Not Evaluated (NE) indicating the studies are required to identify the status of Hermit crabs. A total of 6 species was identified from Vador site and GSFC Jetty site at Sikka coast belonging to one order, one family and two genera while Kachhiya *et al.* (2017) recorded the 7 hermit crab species of the genus *Clibanarius* from the intertidal zone of Gujarat State on the west coast of India.

The taxonomy, diagnoses, and distribution of the recorded hermit crabs are shown below.

Order: Decapoda

Infraorder: Anomura

Superfamily: Paguroidea

1 *Diogenes avarus* (Heller, 1865)



Fig 3. *Diogenes avarus* (Heller, 1865)

Description: Carapace moderately elongated, with anterolateral margins finely serrated. Rostrum slender, not reaching tip of ophthalmic scales. Ophthalmic scales large with teeth on anterolateral margin. Eyestalks stout, reaching middle of last antennal joint and beyond third segment of antennular peduncle. Antennal flagellum shorter than carapace and less setose. Antennal acicle straight with spines on inner aspect and almost reaching base last antennal joint. Chelipeds unequal, left being vastly longer, about two and half times length of carapace, closely granulose, more finely on hand. Carpus longer than palm and merus. Teeth present on inner margin of merus, carpus and dactylus. Dactylus less than half length of palm.

Colour: General body colour grey or pale yellow with orange or yellow spots scattered on legs and carapace.

Habitat: sandy shores, usually occupy small gastropods.

2. *Clibanarius padavensis* (De Man, 1888)



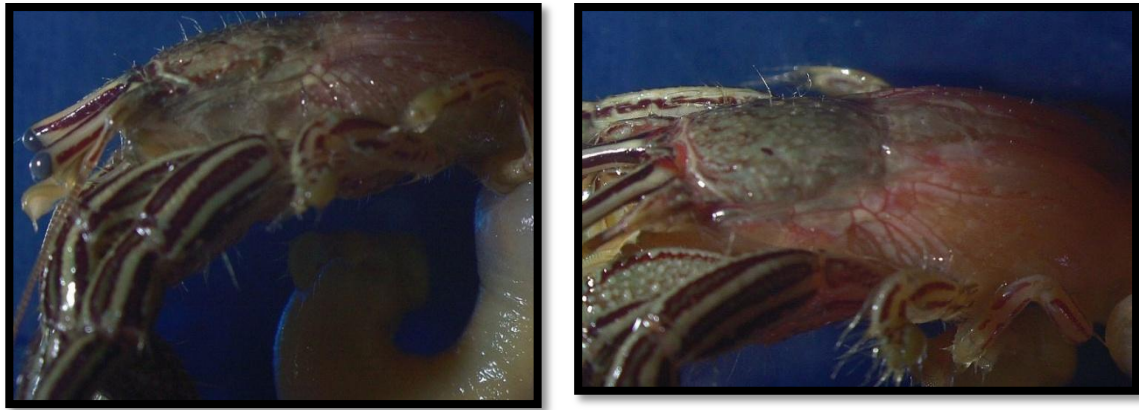


Fig 4. *Clibanarius padavensis* (De Man, 1888)

Description: Carapace longer than broad. Rostrum well formed, reaching base of ophthalmic scales and beyond level of antennal angles of carapace. Eyestalks longer than anterior border of carapace, almost as long as antennular peduncle. Cornea about one-eighth of eyestalk. Ophthalmic scales situated close to one another, with spinose outer margin. Antennal acicle with serrated margins, almost reaching base of terminal joint of antennal peduncle. Flagellum twice as long as carapace. Chelipeds of equal size, one-third as long as carapace. Two spinules at distal and lower aspect of merus, lower inner margin being serrulate. Carpus with a strong spine on dorsal inner aspect distally. Fingers with dorsal spine in rows. Setae long and sparsely uniform.

Colour: In live specimens colour yellowish with straight red longitudinal lines in two or three rows on second to fifth legs. Eyestalk with one dorsal red band and another on its inner aspect. Chelipeds with less distinct and interrupted bands of same colour. Carapace yellow. Antennular and antennal peduncles with red bands, flagella yellow.

Habitat: muddy shores, usually occupy large gastropods.

3. *Clibanarius longitarsus* (Haan, 1849)



Fig 5. *Clibanarius longitarsus* (Haan, 1849)

Description: Carapace well developed, reaching level of base of ophthalmic scale. Eyestalks without colour bands, as long as antennular peduncle, equal to anterior breadth of carapace. Ophthalmic scale small, with pointed tips. Antenna acicles reaching a little short of last segment of antennal peduncle, with serrated inner margins. Cheliped equal, with spooned fingers ending in dark corneous tips; tmi firmly provided with long setae. Palm and wrist

with dark tipped spines in one or two rows on fingers and irregularly arranged on palm. Merus with a spinule on outer distal aspect, carpus with a well developed spine dorsally towards distal end internally. Dactylus of third leg longer than propodus. Ambulatory legs with a blue band bordered with red.

Colour: Bluish green body with characteristic blue and red band on ambulatory legs.

Habitat: muddy shores, usually occupy large gastropods.

4. *Diogenes edwardsii* (De Haan, 1849)

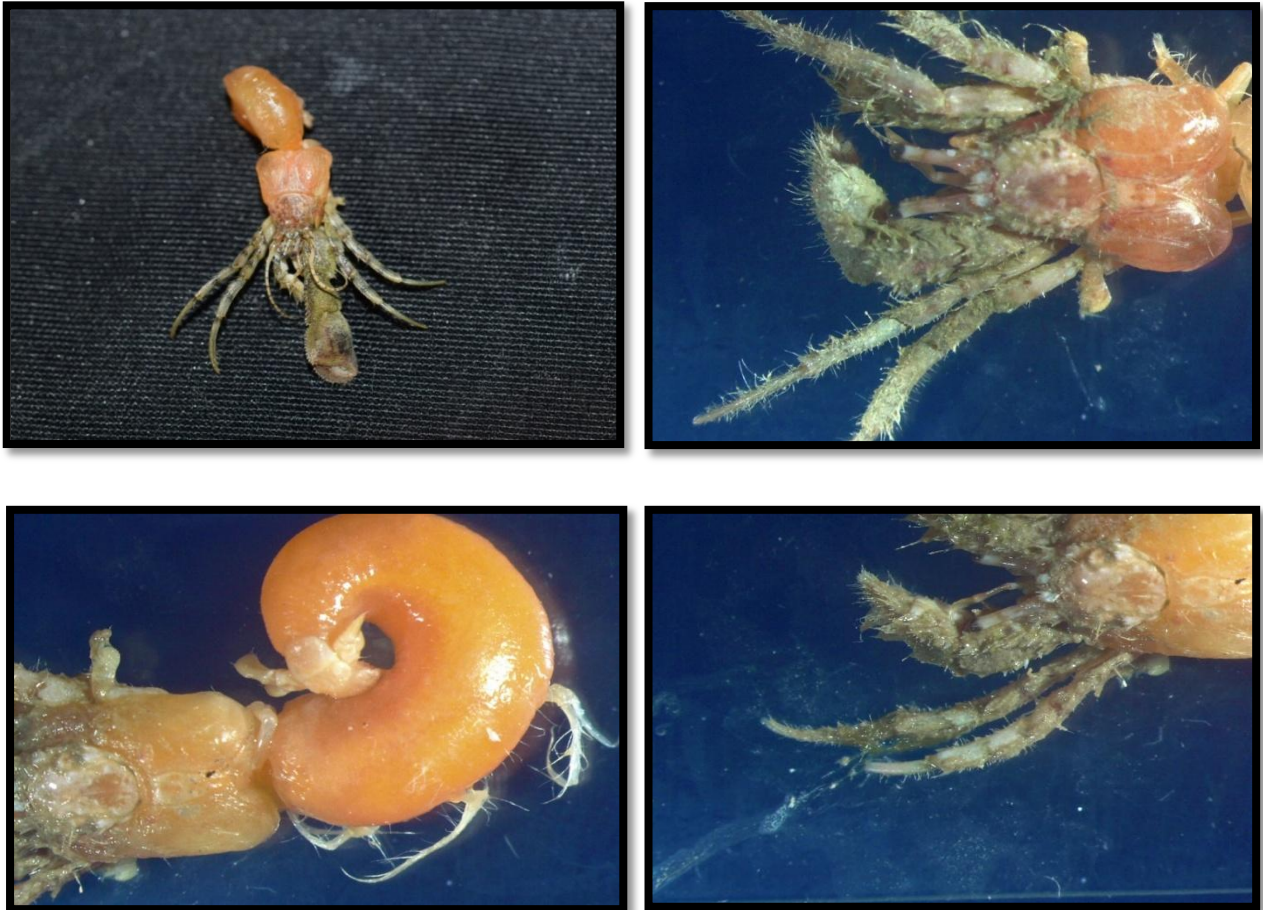


Fig 6. *Diogenes edwardsii* (De Haan, 1849)

Description: Shield slightly broader than long, anterior margin between rostrum and anterior part of branchiostegite with row of about 10 small spines on dorsal margin, anterior margin rounded. Ocular peduncles equal in length, Antennular peduncle overreaching distal corneal margin by 0.4-0.5 length of ultimate segment. Antennal flagellum more than twice length of shield, articles each with paired long setae on ventral margin. Third maxillipeds moderately slender. Merus with small spine at dorsolateral distal angle. Left cheliped much larger than palm. Chela with narrow hiatus between dactylus and fixed finger. Right cheliped moderately stout, with numerous tufts of long setae. Ambulatory legs subequal in length.

Colour: Shield ocular, antennular and antennal peduncles cream. Left cheliped generally cream, carpus and merus also cream.

Habitat: sandy or muddy shores, usually occupy small gastropods.

5. *Diogenes mannarensis* (Henderson, 1893)



Fig 7. *Diogenes mannarensis* (Henderson, 1893)

Description: Carapace, chelipeds and ambulatory legs all covered by gray muddy setae. Shield longer than broad with rugose outer surface. Ocular peduncles long, slender but not overreaching the antennal and antennular peduncles; ocular acicles with 6-9 spines in distal outer margins, apical spine large. Chelipeds unequal; left larger than right; carpus, palm and fingers spinose. Inner margin of palm and dactyls with spines, much smaller spines on the upper surface and outer margin of fixed finger. Right cheliped with surfaces strongly pubescent but with fewer spines than on left. Second pereopods with a dorsodistal spine on the carpus; meri with row of small spines on ventral margin; segments moderately pubescent. Telson weakly asymmetrical with very small median cleft; terminal margins each with row of spines, extending onto lateral margin.

Colour: Shield, carapace and dorsal side of abdomen brick red with slightly bluish tinge and with scattered pale and dark spots; antennal, antennular and ocular peduncles light orange; antennular flagella white or cream in colour; antennal flagella bluish.

Habitat: sandy shores, usually occupy small gastropods.

6. *Diogenes klaasi* (Rahayu and Forest, 1995)



Fig 8. *Diogenes klaasi* (Rahayu and Forest, 1995)

Description: Shield longer than broad, rostrum bluntly triangular, not reaching up to ocular acicle projections. Chelipeds unequal, left than right. Upper and lower margins of left cheliped with irregular row of spines. Palm convex; outer surface with small spines or tubercles and median longitudinal row of spines. Carpus also spinulose on outer surface. Dactyls of right chela slender. Carpus with a dorsodistal spine. Ambulatory legs thin, slender and dactyls longer than propodus. Carpi of second and third pereopods with a dorsodistal spine and an additional spine at the proximal end of carpus of second pereopods. Chelipeds and an additional spine at the proximal end of carpus of second pereopods. Chelipeds and ambulatory legs covered with long setae. Telson broad and asymmetrical with a small median cleft. Left lobe large than right with oblique terminal margin and about 25 large spines laterally and few spinules; right lobe is smaller than left and with 13 large spines laterally and few smaller spinules on terminal margin.

Colour: Shield reddish orange. Ocular peduncles light greenish orange with antennules and antennae pale yellow. Chelipeds dark brownish green. Ambulatory legs pale yellow with irregular dark green spots seen in different segments.

Habitat: sandy shores, usually occupy small gastropods.

4. Conclusion

The survey recorded six hermit crab species from the Vador site and GSFC Jetty along the Sikka coast during October 2020 to March 2021. All recorded species belonged to the family Diogenidae, with four species assigned to Diogenes and two to Clibanarius. Based on the counts presented, 986 individuals were documented, of which 538 were collected at Vador and 448 at GSFC Jetty. Diogenes edwardsii was the most abundant species across the two sites, whereas Clibanarius longitarsus was the least abundant. The species were associated with sandy and muddy intertidal habitats, and the observed assemblage showed clear differences in numerical representation among taxa and between sampling locations. The morphological descriptions and photographs support the taxonomic documentation of the recorded species. However, the results should be interpreted as a baseline inventory for the sampled period rather than a complete assessment of regional diversity. Continued surveys using standardized sampling effort, broader seasonal coverage, and measurements of habitat and environmental variables would strengthen understanding of hermit crab distribution and abundance along the Sikka coast.

Limitations

The study covered two intertidal locations over six months and therefore may not represent year-round or coast-wide hermit crab diversity. Sampling effort, sampled area, number of collectors, tidal timing, and habitat-specific effort were not quantified, limiting direct comparison between sites. The investigation reported species counts but did not calculate diversity indices, detection probability, or statistical differences. Environmental variables were not measured, although habitat-related explanations were proposed. The identification key, voucher specimens, and repository details were not specified. Gastropod-shell use mentioned in the abstract was not supported by corresponding results. These limitations restrict ecological interpretation and generalization of the recorded assemblage.

FUTURE PROSPECTS AND RECOMMENDATIONS

- The results of present study may set out as a veritable database for further studies in Sikka coast of Gujarat.
- Since the gastropods are important resources as food, medicine and ornamental items, it is need of hour to conserve their population in the Saurashtra coast which is at present under intense anthropogenic pressure.
- Strict prohibition on discharging of chemicals from the industries should be made.
- Micro plastic disrupt hermit crabs ability to choose shell, study suggests.
- However, the status of the great majority of hermit crabs taxa is not evaluated under IUCN criteria, thus further studies are required to know the status of the hermit crabs species for proper conservation strategies.

Declaration of AI Use

This manuscript was prepared through the combined contributions of all author(s), including contributions to the study design, data, content development, results, interpretation, and related scholarly work. The author(s) acknowledge the use of Grammarly and ChatGPT to assist with grammar checking, language refinement, reference formatting. These AI-assisted tools were not used as authors and did not replace the intellectual contributions or scholarly judgment of the author(s). All AI-assisted outputs, including content, references, and interpretations, were carefully reviewed, revised, verified, and approved by the author(s). The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

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