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Distribution of Newly Recorded Intertidal Hermit Crabs Along Gujarat Coast

Pradip Kachhiya[1], Paresh Poriya[2],Jatin Raval[3] and rahul Kundu[4]

[1,4] *Department of Biosciences, UGC Centre of Advanced Study in Arid Zone Biology, Saurashtra University, Rajkot-360 005, Gujarat, India*
[2,3] *Department of Marine Sciences, Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar 364001, India*
Emails: [1] pradipkachhiya@gmail.com; [2] pareshporiya@gmail.com; [3] drjatinraval@gmail.com
[4] Corresponding Author; Email: rskundu@sauuni.ernet.in

ABSTRACT

Present study reports the diversity, distribution and population abundance of hermit crabs in the intertidal zone of three contrasting coastline off Arabian Sea, Gujarat, India. The south Saurashtra coastline is unique in harboring the species which are sometimes different than that of the mainland Indian coastline. Three sampling sites, which differ in the characteristics of the intertidal zone, were selected for the study. The sites include a muddy intertidal zone at Koliyak, a sandy shore at Sarkeshwar near Jafrabad and a rocky coast at Veraval. Twelve species of hermit crabs belonging to three genera, i.e., *Clibanarius*, *Diogenes*, and *Pagurus* from two families *Diogenidae* and *Paguridae* were recorded from the three sampling sites. Among these, eight species were new record from this coastline. It was observed that Veraval and Sarkeshwar were more similar followed by Veraval and Koliyak while no similarity was observed between Koliyak and Sarkeshwar in terms of the species diversity. The population abundance of the hermit crabs showed spatial variations between the intertidal zones at Veraval and Sarkeshwar. However, very little temporal variation in the population abundance was observed at the three sampling sites.

Key Words: Hermit Crab; Diversity; Distribution; Abundance; Intertidal Area; Kathiawar Peninsula.

INTRODUCTION

Biodiversity is important for human survival and economics and the marine and intertidal ecosystem harbours important natural biological resources (Siddiqui et al. 2004). The intertidal areas exhibit different types of habitats that provide a variety of ecological niches for decapod crustaceans (Ajmal Khan and Natarajan 1984). Hermit crabs are decapod crustaceans that occupy empty gastropod shells to protect themselves from predation, osmotic pressure and physical shocks. The superfamily Paguroidea contains 1117 species belonging to six families, of which the family Paguridae is the most diverse group with 542 species (McLaughlin et al. 2010). The family Diogenidae is represented by two genera (*Clibanarius*, *Diogenes*,) and family Paguridae represented by one genera (*Pagurus*). Hermit crabs are particularly abundant in the tropical coasts and the studies on the hermit crab fauna of an ecologically important region, the Persian Gulf, have been the subject of intense surveys since the beginning of the last century (Alcock 1905). The south Saurashtra coastline of India shares the same characteristics of this coast as it harbours similar type of intertidal assemblages which are different than that of the rest of the mainland Indian coastline (Sneha Joseph et al. 2014a). Hermit crabs of the Indian waters were studied earlier by few authors (Alcock 1901, 1905, Chopra and Das 1940, Sarojini and Nagabhushanam 1972, Ajmal Khan and Natarajan 1984, Nayak and Neelakantan 1989, Thomas 1989, Lemaitre 1999, McLaughlin 2002a, 2005, Komai and Osawa 2006, Komai and Poupin 2012, Rahayu 2007, Ramesh et al. 2009). In the recent past, few species were reported for the first time from the east coast of India (Reshmi and

Bijukumar 2010, Komai et al. 2012, 2013, Ravinesh and Bijukumar 2013). This clearly suggests that the inventory of the hermit crab species from the Indian subcontinent is still far from complete. Hermit crabs of the Gujarat coast, which is different than that from the rest of the mainland Indian cost in terms of the intertidal assemblage types, were least documented and only two known species were studied for their population ecology (Desai and Mansuri 1989, Vaghela and Kundu 2012). It was observed that this coastline is unique in harboring species which are different than other Indian coastline (Sneha Joseph et al. 2014a). During present study the intertidal zones of the Saurashtra coastline off Arabian Sea, Kathiawar Peninsula, India was extensively surveyed to explore the diversity, distribution and population abundance of hermit crabs in the intertidal zone of three contrasting coastline off Arabian Sea, Gujarat, India.

Figure 1. Map of the study area showing sampling sites

MATERIALS AND METHODS

Gujarat has about 1,650 km longest coastline of which 28 % is sandy beach, 21 is % rocky coast, 29 % is muddy flats and 22 % is marshy coast. The Saurashtra coastline, located in south-western part of Gujarat, occupies a total stretch of 865 km. Three sampling sites, which differ in the characteristics of the intertidal zone and assemblage types, were selected for the study. The sites were: a muddy intertidal zone at Koliyak, a sandy shore at Sarkeshwar near Jafrabad and a rocky coast at Veraval (Figure 1). Veraval (Site-1: 21^0 35' N, 69^0 36' E) is one of the largest fish landing sites of Asia surrounded by a large chemical factory, a medium scale cement factory, number of small to medium scale industries and fish processing units. It involves port activities like transport, boat manufacture and receive waste from different sources. The total length of the study area is about 3 km with rocky substratum (Figure 2). Sarkeshwar (Site-2: 20°50' N, 71°19' E) is located on the outer rim of the Gulf of Khambhat. It is situated around 20 km west of Jafrabad and 35 km west of Pipavav Terminus, one of the biggest transportation port of India. The intertidal

Figure 2. Different habitats at the selected sites on the Saurashtra coast, Gujarat, India

zone at Sarkeshwar has turbid sea-water with specific semidiurnal tide action. The coast of Sarkeshwar is around 3 km and has mostly sandy intertidal zone (Figure 2). Koliyak (Site-3: 21º 35' N, 72º17' E) is situated near the Ghogha-Dahej transportation RO-RO ferry station of Bhavnagar district. A nuclear power station is also coming up at about 8 km west of Koliyak. The intertidal zone of Koliyak coast is about 3 km long and is totally muddy with highly turbid water (Figure 2). Surveys were conducted at the selected sites during the lowest tide for a period of one year (August 2014 to July 2015) and encountered hermit crabs were recorded. Voucher specimens of the species were collected for further identification and kept in the museum of the Department of Biosciences, Saurashtra University, Rajkot. Collected hermit crabs were identified up to species level by comparing differences in morphology, size and color by available identification keys. Population data were collected by random quadrat (50 x 50 cm) method along a transect, covering upper middle and lower littoral zones, on the intertidal zones of the coast. Population attributes like abundance and frequency of hermit crabs were calculated (Misra 1968). All data were statistically analysed for their cumulative acceptability (Sokal and Rohlf 1987).

Figure 3. Intertidal hermit crab species recorded in coastal Gujarat A. *Clibanarius infraspinatus.* B. *Clibanarius longitarsus.* C. *Clibanarius nathi*, D. *Clibanarius rhabdodactylus*, E. *Clibanarius rutilus*, F. *Clibanarius signatus* G. *Clibanarius virescens*, H. *Clibanarius zebra*, I. *Diogenes avarus*, J. *Diogenes edwardsii*, K. *Diogenes alias*, L. *Pagurus kulkarnii*

RESULTS AND DISCUSSION

After a thorough survey, a total of 12 species of hermit crabs belonging to the genera *Clibanarius* and *Diogenes* of family Diogenidae and genus *Pagurus* of family Paguridae, were recorded from the intertidal zones of Saurashtra coastline of Gujarat state (Figure 3). Seven species were recorded from Veraval coast, two species from Sarkeshwar coast and three species from Koliyak coast (Table 1). Earlier, four hermit crab species, *Clibanarius nathi, Clibanarius zebra, Clibanarius infraspinatus* and *Clibanarius signatus,* were reported from Saurashtra coastline; however, the present study reports another eight hermit crab species, all of which are new report from the Saurashtra coastline. All the three sites were quite different in case of species similarity as none of the hermit crab was found to be present at all the three sites (Figure 4). *Clibanarius infraspinatus* and *Pagurus kulkarnii* were reported from Veraval and Sarkeshwar and *Clibanarius zebra* was reported from Veraval and Koliyak.

Similarity between hermit crab species composition of different sites from the same coastline was checked using the Sorenson‘s index of similarity. Site-wise similarity index indicates that the three sites differed in case of a single species. The sites of Veraval and Sarkeshwar were more similar (QS= 0.4). Two hermit crabs species were found at these sites. Veraval and Koliyak were next similar sites (QS=0.22) with one similar species while Koliyak and Sarkeshwar had all the different species (Table 2).

At Veraval significant variation was observed in the abundance between different intertidal zones while little variation was observed between different seasons (Figure 5). This situation indicates the preference of different intertidal zone as suitable habitat by members of these species (Vaghela and Kundu, 2012). In case of the intertidal zones of Sarkeshwar, similar spatio-temporal variation in the abundance was observed.

Table 1. Checklist of the hermit crab species recorded from the three sampling sites along the Saurashtra coast (+/– denote the presence or absence of the species).

Species	Veraval	Sarkeshwar	Koliyak
Pagurus kulkarnii	+	+	-
Dardanus setifer	-	+	-
Diogenes avarus	-	-	+
Diogenes edwardsii	+	-	-
Clibanarius infraspinatus	+	+	-
Clibanarius longitarsus	-	-	+
Clibanarius nathi	+	-	-
Clibanarius rhabdodactylus	+	-	-
Clibanarius rutilus	-	+	-
Clibanarius signatus	+	-	-
Clibanarius virescens	+	-	-
Clibanarius zebra	+	-	+

Table 2. Sorenson's index (QS) of similarity for occurrence of intertidal macrofauna at the sampling sites.

Sites	Sorenson's index (QS)
Veraval vs. Sarkeshwar vs. Koliyak	0
Veraval vs. Sarkeshwar	0.40
Veraval vs. Koliyak	0.22
Sarkeshwar vs. Koliyak	0

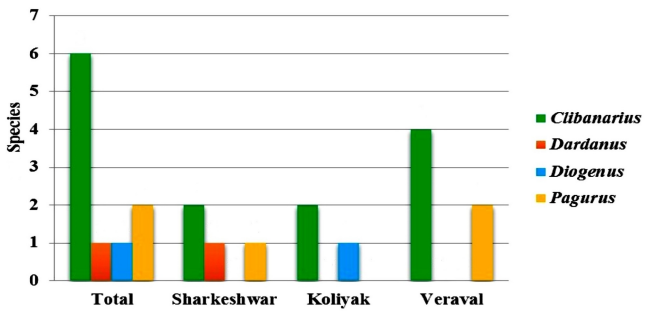

Figure 4. Comparative chart of the recorded hermit crab species at all the three sampling sites along the Saurashtra coast

Compared to Veraval, highly significant variation was observed in population abundance between different intertidal zones. It may be possible that the microhabitat

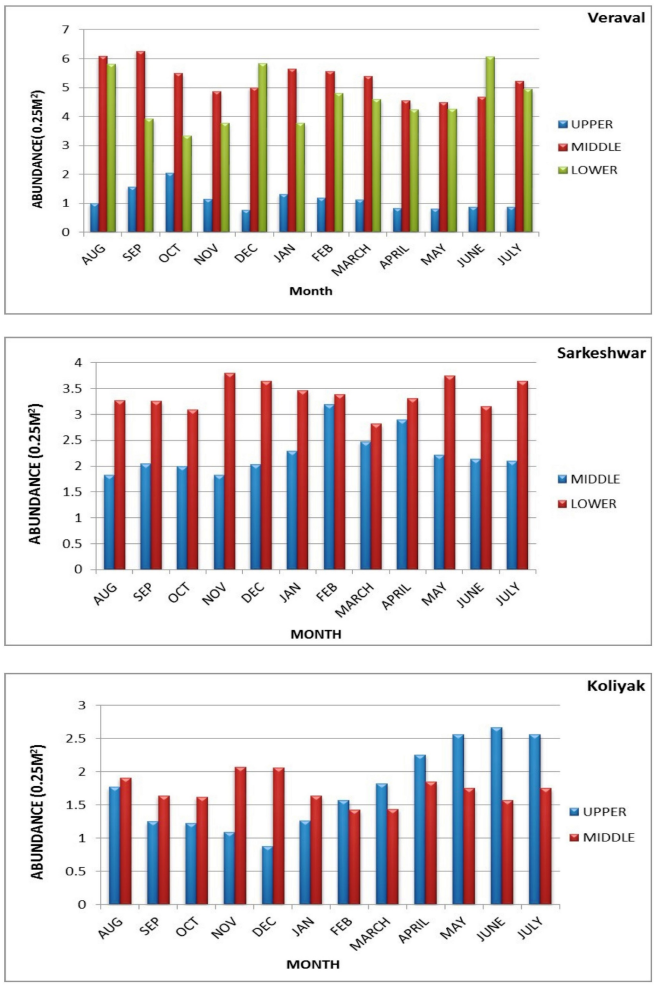

Figure 5. Monthly variations in the abundance of hermit crab species at the Veraval, Sarkeshwar and Koliyak sampling sites.

of different intertidal zone plays an important role in the uneven distribution of hermit crabs (Desai 1986). It was reported earlier that *Pagurus kulkarnii* was distributed in entire intertidal zone while *Clibanarius infraspinatus* and *Clibanarius rutilus* were distributed in somewhat hard substratum or in biogenic reef of *Sabellaria* worm (Underwood and Chapman 1996). On the other hand, in case of the intertidal zones of Koliyak, no significant spatio-temporal differences in the abundance values were noted. *Clibanarius longitarsus, Clibanarius zebra* and *Diogenus avarus* were found distributed in similar pattern in both the intertidal zone of Koliyak. This may be due to similar muddy substratum throughout the intertidal zone (Desai and Mansuri 1989). Interestingly at Sarkeshwar, dynamic muddy habitat which was found to be changing its shape and composition during all the months, may be responsible for this kind of distribution

pattern of the hermit crabs in this shore line (Thomas 1989, Vaghela and Kundu 2012).

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