

Article

Brachyuran crab diversity of lower estuarine mud flats of Mahi River with new record of two species from Gujarat, India

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Abstract

A systematic study of brachyuran crab diversity and distribution was carried out for two years on the lower estuarine mud flats of the Mahi River, the upper Gulf of Khambhat, Gujarat. A total of 10 brachyuran crab species belonging to eight genera and eight families were identified. Study documented the distribution and habitat preference of the reported species on the intertidal area. The study records the occurrence of two species *Dotilla intermedia* and *Macrophthalmus brevis*, for the first time from Gujarat. Moreover the study briefed on the habitat preference, general ethology and morphometry of new recorded species.

Keywords brachyuran crabs; *Dotilla intermedia*; *Macrophthalmus brevis*; Mahi estuary; Gulf of Khambhat.

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1 Introduction

Understanding the composition and diversity of an ecosystem serves as the basis of understanding the equilibrium of the communities/habitats and factors affecting it (Bertini et al., 2004). Studies have revealed that the basic diversity studies for many faunal groups are inadequate which owes a great importance in the formulation of conservation policy (Fransozo et al., 1992; Hebling et al., 1994), as these studies serve as base to ecological understanding, distribution of species and ecosystem too. The intertidal invertebrate fauna has been still away from proper attention and documentation and hence the human effects on them are difficult to assess. Brachyuran crabs are noteworthy amongst these intertidal groups and are considered as the most relevant group in terms of their community dominance and biomass (Virnstein, 1987; Sheridan, 1992; Bertini et al., 2004). Some species, including crabs have been recognized as regulators of the structure of estuarine communities (Dittel et al., 1995; Heck and Coen, 1995). Furthermore, their biological outputs like feces of the crabs, which contain nitrogen, carbon, phosphorus and trace metals, form a rich source of food for other consumers (Kuraeuter, 1976).

The studies on the brachyuran fauna of the Indian coast line has been comparatively limited which were initiated earlier by Alcock and Anderson (1894), and has not been still streamlined. Scattered reports occur for the taxa which includes some studies pertaining to the brachyuran diversity on the southern coast (Pillai, 1951; Ajmalkhan et al., 2005; Roy and Nandi, 2007) and eastern coast (Roy and Nandi, 2008). Few of the studies also add-in the knowledge on brachyuran of western coast (Chhapgar 1957; 1985; 1995; 2004; Subba Rao and Sastry, 2005; Pandya and Vachhrajani, 2010; Trivedi and Vachhrajani, 2012; Trivedi et al., 2012), yet much remains to be known for their diversity in remaining coastal areas.

Gulf of Khambhat is one of the three Gulfs of India and second in the world in term of tidal amplitude. Moreover, the vast intertidal areas, a unique peculiarity of the Gulf offers diverse microhabitat to the biota. Four major rivers viz. Tapi, Narmada, Mahi and Sabarmati opens in the Gulf which along with the Gulf geomorphology, makes it prominent in elevated amount of suspended sediments load (Timmermans, 2002). This specification has portrayed Gulf very poor in terms of faunal diversity. The present study is an aims to describe the brachyuran fauna of Mahi river estuary along with their distribution and habitat preference.

2 Materials and Methods

2.1 Study Area

Upper portion of Gulf of Khambhat is a narrow structure receiving waters from two estuaries viz. Sabarmati and Mahi rivers. Mahi River is one of the major rivers of western India. The estuarine stretch (lat. $22^{\circ} 17'N$ and long. $72^{\circ} 13'E$) extends upto 50 kms upstream and discharges into Gulf of Khambhat (Fig. 1). Mahi represents a partially mixed type of estuary wherein geomorphology and hydrodynamic of the Gulf of Khambhat makes it very specific in terms of sedimentology and tidal dynamics (Kunte, 2008). Downstream of Mahi estuary and the adjacent areas forming the Upper Gulf of Khambhat was surveyed in the span of the present study. The study site Kamboi ($22^{\circ} 12'52.38'' N$ and $72^{\circ} 37' 17.89'' E$) was studied in detail specifically for the distribution pattern, burrowing and sediment association.

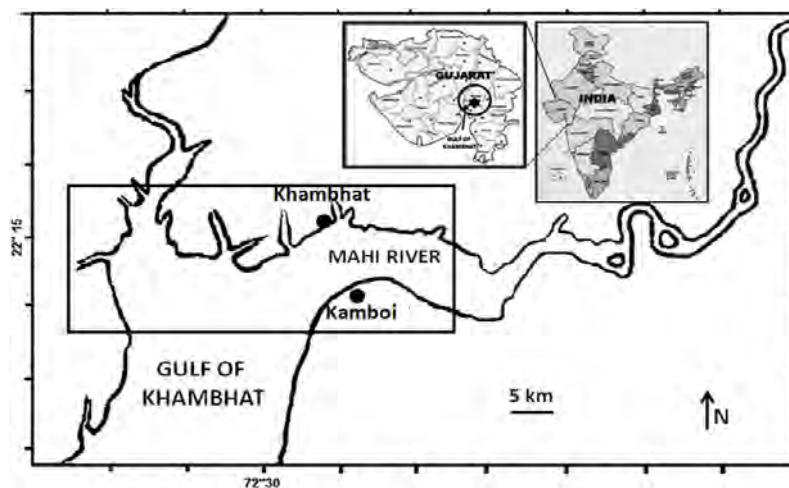


Fig. 1 Showing the study area with marked upper part of Gulf of Khambhat, Mahi estuary and adjoining area considered mainly for the study.

2.2 Survey methods

The lower estuarine mudflats of Mahi river and the adjoining areas of Gulf of Khambhat were surveyed from July 2006 to June 2008. Intertidal area was explored for the brachyuran crabs during the low tides on different moon days to look into different exposures during various tidal extents. Burrows of the crabs were examined in

different intertidal zones and the crabs were collected by hand picking or by excavating the burrow. Limited number of specimen was collected in order to fulfill the identification and study requirement taking care of not disturbing the system. This was further assured by taking only photographs and measurements in case of some common crab species. The collected crabs were narcotized on the field either by using Alcohol or menthol. Morphometric characters like carapace width (CW), carapace length (CL) and identification features were recorded for collected species. Moreover, ecological attributes like habitat preference, substratum preference, general behavior were also recorded for individual species. Crabs were identified to their taxonomic position using identification keys given by Sakai (1976), Sethuramalingam and Khan (1991) and National Institute of Oceanography, India web database (Chavan et al., 1998), as well as available literature on brachyuran taxonomy. To avoid ambiguity in classification scheme and to maintain uniformity and ensure widely accepted taxonomy, latest brachyuran nomenclature given by Ng et al. (2008) was followed.

3 Results

In total, 10 crab species belonging to eight genera and eight families were recorded from the downstream of the estuary and surrounding areas wherein two species are the new records from Gujarat. Specific dominance of particular family was not observed, family Ocypodidae and Macrophthalmidae reported two species in each while rest of the families showed occurrence of single species (Table 1).

Table 1 List of brachyuran species recorded from estuarine mud flats of Mahi River.

S. No.	Family	Sub family	Species
1	Ocypodidae	Ucinae	<i>Uca (Austruca) lactea annulipes</i> De Haan, 1835
2			<i>Uca (Tubuca) dussumieri</i> H. Milne Edwards, 1852
3	Macrophthalmidae	Macrophthalminae	<i>Macrophthalmus (Mareotis) depressus</i> (Rüppell, 1830)
4			<i>Macrophthalmus (Macrophthalmus) brevis</i> Herbst, 1804
5	Dotillidae	-	<i>Dotilla intermedia</i> De Man, 1888
6	Portunidae	Portuninae	<i>Scylla serrata</i> Forskal, 1775
7	Gecarcinidae	-	<i>Cardisoma carnifex</i> Herbst, 1796
8	Matutidae	-	<i>Ashtoret lunaris</i> Forskål, 1775
9	Sesarmidae	-	<i>Parasesarma pictum</i> De Haan, 1835
10	Grapsidae	Grapsinae	<i>Metopograpsus frontalis</i> Miers, 1880

Table 2 Species distribution, substratum preference and status of occurrence on the estuarine mud flats of Mahi River.

S. No	Speices	Distribution	Substratum preference	Occurance
1	<i>Uca (Austruca) lactea annulipes</i>	Supra tidal and upper intertidal	Silty and clayey	Abundant
2	<i>Uca (Tubuca) dussumieri</i>	Mid intertidal	Silty and clayey	Occasional/ Solitary
3	<i>Macrophthalmus (Mareotis) depressus</i>	Mid intertidal	Silty and clayey	Abundant
4	<i>Macrophthalmus (Macrophthalmus) brevis</i>	Lower intertidal	Sandy	Abundant
5	<i>Dotilla intermedia</i>	Lower intertidal	Sandy	Abundant
6	<i>Scylla serrata</i>	Mid intertidal	Silty and clayey	Occasional/Solitary
7	<i>Cardisoma carnifex</i>	Upper intertidal	Silty	Occasional/ Solitary
8	<i>Ashtoret lunaris</i>	Lower intertidal	Sandy	Occasional/ Solitary
9	<i>Parasesarma pictum</i>	Mid intertidal	Silty and clayey	Rare
10	<i>Metopograpsus frontalis</i>	Mid intertidal	Silty and clayey	Rare

The present study hypothesized the species specific habitat preference of brachyuran species in the area which is strongly brought forward in the present findings (Table 2). Furthermore, sediment type and intertidal zonation were seen to be the governing factors in the brachyuran distribution. Occurrence wise, though being confined to particular area, some of the species like *M. depressus* and *D. intermedia* showed highly dense and more or less homogenous distribution while certain species like *C. carnifex*, *P. pictum*, *M. frontalis*, *A. lunaris*, and *S. serrata* were unfrequent and solitarily distributed. The occurrence of *P. pictum* and *M. frontalis* was very rare in the area and were reported only twice from the study area in two years span of field visits.

Interestingly, though commonly seen at the Upper Gulf of Khambhat, *Dotilla intermedia* and *Macrophthalmus brevis* were not reported earlier from Guajrat and emerged to be the first record from Gujarat. The present finding also suggests the range extension of both the species on the Indian coastline.

Order DECAPODA

Family OCYPODIDAE Ortmann, 1894

Genus *Dotilla* Stimpson, 1858

i. Dotilla intermedia (de Man, 1888)

Dotilla intermedia De Man, 1888: 135, pl. ix, figures 4–6; Kemp, 1919: 331, figures 9f & 10; Gordon, 1941: 137, figure 11c; Vogel, 1984: 225, figures 2a & 4; Ng. et al., 2008:235

Dotilla clepsydrodactylus Alcock, 1900: 367, pl. lxii, figure 2, 2a; Kemp, 1915: 226.

Material: 1 ♂ (CW- 6.4mm, CL-5.6 mm), ♀ (CW- 6mm, CL- 5mm), Mahi estuary mouth, Gujarat, India, 17.xii.2006, Coll. P.J. Pandya.

Diagnosis: Carapace (Fig. 2a): Carapace more or less oval/triangular and highly sculptured in meso and uro gastric regions. Eystalks short and slender. A deep mid dorsal present with two pairs of beaded structures on mid gastric regions. A prominent transverse groove runs from mesogastric region to anterio-lateral angle and from side of cardiac region to lateral region.

Appendages (Fig. 2b-d): Chelipeds larger, equal and bulky compared to the carapace and other appendages. Presence of distinct tooth in initial part of lower dactyla. Lower finger serrated with granular ridge (Fig. 2b & c) and usually longer than the palm. Chela and palm not slender and long as seen in *Dotilla myctiroides*. Walking legs slender and long. Merus 1.5 to 2 times longer than carpus and propodus. Dactylus thin and long. Presence of tympanum on the merus of forth ambulATORY legs (Fig. 2d) which covers half to three fourth area of the merus. Presence of hairs on carpus and propodus of cheliped and periopods.

Habitat: The species usually prefers lower intertidal areas dominated by sand. During low tides the species usually forages solitarily or many times in groups. The burrows are shallow and many times sculptured by sediment pellets giving a chimney shape. The sand loving nature of the species is also been documented by Allen et al., (2011) from the coastal areas of Thailand.

Distribution: The species is reported to be distributed in Bay of Bengal. It has been previously recorded from Tamilnadu coast, Andhra Pradesh (Ravichandran et al., 2007; Roy and Nandi, 2008), Chilika lake, Orissa (Sahoo et al., 2008) (distribution verified with www.biosearch.org) and Kerela. This is the first record of the species from Gujarat and west coast of India except Kerela (present in Kerela as per the personal communication with Dr. M. K. Roy, ZSI).

Family MACROPHTHALMIDAE Dana, 1851

Sub Family Macrophthalminae Dana, 1851

Genus *Macrophthalmus* (Macrophthalmus) Desmarest, 1823

ii. Macrophthalmus (Macrophthalmus) brevis (Herbst, 1804)

Ocypode (Macrophthalmus) dilatata DE HAAN 1835, p. 55, pl. 15, fig. 3.

Macrophthalmus dilatatus ORTMANN 1894, p. 744; TESCH 1915, p. 168, pl. 6, fig. 4 (lit.); BALSS 1922, p. 145; URITA 1926, p. 26; SHEN 1932, p. 220, pl. 9, fig. 6, text-figs. 135-137; SAKAI 1934, p.320; 1935, p. 216, text-fig. 114; 1939, p. 624, pl. 105, fig. 3; 1995, p. 190, pl. 90, fig. 3; KAMITA 1941, p. 164, text-figs. 90a-d. Ng. et al., 2008:235

Macrophthalmus (Macrophthalmus) brevis HERBST, 1804, Ng et al., 2008, p. 237

Material: 02 ♂ (CW- 18.3mm, CL-8.3 mm), ♀ (CW- 17.3mm, CL- 8mm), Mahi estuary mouth, Gujarat, India, 17.xii.2006, Coll. P.J. Pandya.

Diagnosis: Carapace (Fig. 3a-b): Body dorsoventrally depressed and rectangular with carapace broader (2.5 times) as compared to length. Eyestalk slender and longer than carapace extending out of the orbital gap. Interorbital distance 2 – 3 mm. Carapace sculptured and covered by fine granules. Meso and meta gastric regions well emerged. Metagastric region separated by a longitudinal groove on either sides running upto metagastric region. A transverse groove presents running from mid metagastric region towards antero-lateral end. Lateral post-cardiac regions separated by upper narrow ridge giving noticeable bluish large spots seen on the lateral side of mesobranchial region of carapace on either side (color seen in fresh specimen). Anteriolateral angle marked with three small spines (projections) giving a petal shape to central spine. Lateral borders sparsely hairy.

Appendages (Fig. 3c-e): Chela with long propodus. Merus and carpus hairy. Propodus and dactylus hairy towards inner surface. Immobile finger of chela almost rectangularly deflected downwards with tip curved towards inner side. Lower dactylar region with prominent serrated projection. Merus of preiopod nearly double the length of carpus and propodus. Fine serration seen on the upper dactylar margin.

Habitat: The species shows its distribution in lower intertidal and fine sand dominated areas. The animal prefers areas having small ripples, more or less flat area and sometimes shallow water filled areas. The species seems to be shy which swiftly moves either in the burrow or camouflages itself beneath fine sand on slight disturbance.

Distribution: Indo-pacific distribution. In India, the species has been recorded from West Bengal, Tamil Nadu and Kerala (Roy and Nandi, 2007, 2008). On western coast, the species is only reported from Kerala. This is the first published record from Gujarat and nearby coast.

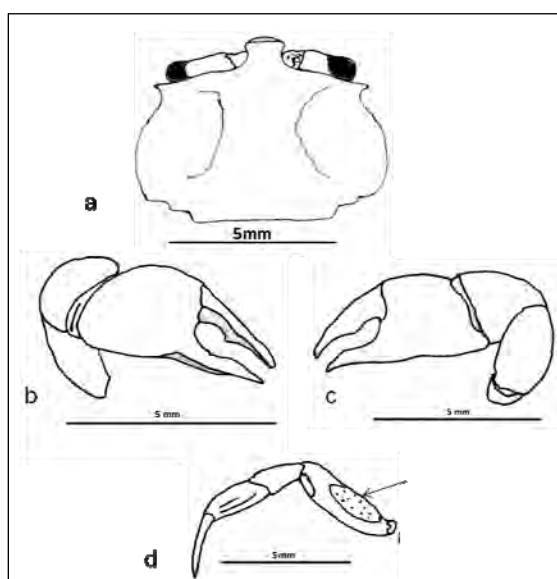


Fig. 2 *Dotilla intermedia* from Mahi estuarine mud flats. a. Carapace features; b & c. outer and inner view of dactyla; d. 4th pereopod with distinct semicircular tympanum on the merus.

4 Discussion

Baseline listing and diversity documentation has become an evitable tool in assessment of ecology, species extinction and rate of human pressure on the ecosystem (Naeem et al., 1994). Scarce literature exists on the brachyuran crab diversity of the Gujarat and specially for Gulf of Khambhat. The present study documented total 10 brachyuran crab species from upper Gulf of Khambhat and estuarine stretches. Moreover, the study supported the earlier study of species specific habitat preference along the intertidal area (Ribeiro et al., 2005).

A remarkable contribution on brachyuran fauna of west coast was made by Chagppgar (1957, 1985, 1995, 2004), which later remained deprived of any addition or updation from research community. Later on, Pandya (2011) described benthic macrofaunal diversity, distribution and some aspects of ecology from upper region of Gulf of Khambhat. Additionally, distribution of one of the dominant species *M. depressus* in the area has been described in detail by Pandya and Vachhrajani (2010). In same line, along with the diversity listing, the present study synthesizes that open mudflats which are usually considered as poor habitats in terms of biota, serves as a rich habitat for brachyuran diversity if properly investigated. Similar observation were also made by other published research from same area as well as different areas (Pandya and Vachhrajani, 2010; Trivedi et al., 2012).

The present study describes in general two species of crabs i.e. *D. intermedia* and *M. brevis* which were not earlier reported from west coast of India (except Kerela) and specially Gujarat. The species *D. intermedia* had a long taxonomic debate with its close resemblance to species *D. myctiroides* or *D. wichmanni* till the detailed taxonomic note on the species presented by Kemp (1919). Recently, the occurrence of the species is also reported from Thailand by Allen et al., (2011). Along Indian coast, the species has been reported from east and south-east coast of India (Ravichandran and Kannupandi, 2007; Roy and Nandi, 2007;2008; Sahoo et al., 2008).

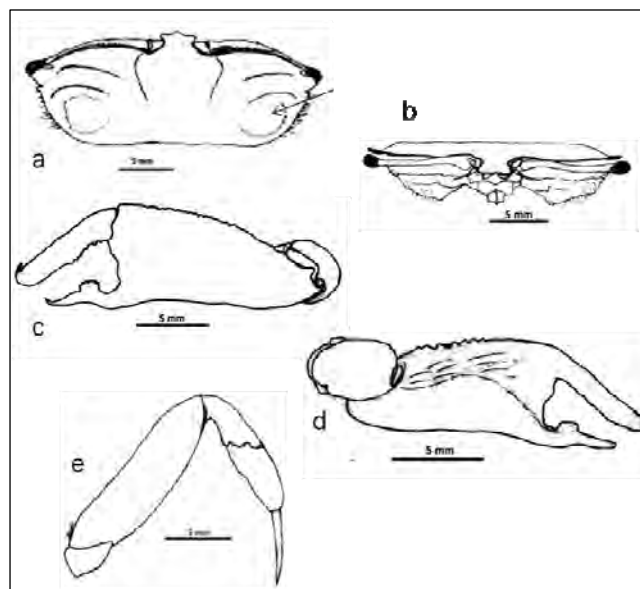


Fig. 3 *Macrophthalmus brevis* from Mahi estuarine mud flats. a. Carapace features showing distinct circular impressions on each lateral side (branchial region) of the carapace; b. Frontal view of species showing extension of eyestalk from the orbital socket as well as dorso ventrally depressed structure; c & d. outer and inner view of dactylus e. outer view of propodus.

Similarly, the occurrence reports of *M. brevis* seem inadequate along the western Indian coast. Study of literature shows the reports of the species earlier from West Bengal and adjacent areas (e.g. Roy and Nandi, 2008; Roy, 2010). The document presents the range extension of *D. intermedia* and *M. brevis* along the Indian coast.

Presence of remarkable diversity of crabs in a confined stretch of habitat with two new occurrence records justifies the aforementioned statement of biological richness of mudflats and importance of microhabitat they facilitate to diverse species. It can be projected that further exploration of lower stretches of Gulf may add in to the existing list of brachyurans from the area.

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