

Article

## **New record of color morphs of brachyuran crab *Charybdis annulata* Fabricius, 1798 (Decapoda: Portunidae)**

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### **Abstract**

*Charybdis annulata* (Fabricius, 1798) is a common portunid crab species found on rocky shore habitat. It mostly prefers coral reef and algal assemblage area as living and foraging habitats. During the study on brachyuran crab diversity of Saurashtra coast, Gujarat, India, we came across the presence of color polymorphism in the species. Total 62 specimens were collected from the field and two color morphs- orange morph and brown morph were identified. The differences in the morphological characteristic were recorded properly on the basis of detail observation of both the morphs. The orange morph shows specific micro habitat preference while the brown morph utilizes wide range of micro habitats.

**Keywords** polymorphism; *Charybdis annulata*; brachyuran crab; rocky shore; Saurashtra coast.

### **1 Introduction**

Polymorphism or color variation in different individuals of the same species is the common phenomenon observed in many invertebrates, especially in mollusks and arthropods like butterflies, spiders etc. (Wicksten, 1989). A color change is employed by many animals in the form of crypsis as survival strategy because it decreases predation risk (Endler, 1991; Bonte and Maelfait, 2004). Factors like geographic isolation of population, predation risk, age, diet, infection by pathogens and genetic inheritance play significant role in occurrence of color morphs in species (Oetinger and Nichol, 1982; Jormalainen and Tuomi, 1989). Polymorphism in animals allows them to explore different habitat in heterogeneous environment like use of macro algal assemblage by marine isopods (Merilaita and Jormalainen, 1997). Polymorphism is studied in detail from genetical and ecological point of view for fishes, mollusks and isopods. Harley et al. (2006) had studied the genetic structure of *Pisaster ochraceus* for color variation. Hoagland (1977) had stated that gastropods use polymorphism as adaptive strategy for survival while Luiz – Junior (2003) had studied the color morphs of *Halacanthus ciliaris*. Amongst all marine fauna, crustacean are least studied with reference to polymorphism except for the detail work of Sangthong and Jondeung (2006) on color morphs in genus *Scylla* and Bedini (2002) on brachyuran crabs like *Xantho poressa* and *Carcinus maenas*. The brachyuran crab diversity of estuarine and coastal areas of Gujarat has been reported however, the ecology, behavior, habitat preferences and colour polymorphism are not studied so far (Chhapgar, 1957; Pandya and Vachhrajani, 2010; Trivedi et al., 2012). The crabs of family Portunidae, Rafinesque-Schmaltz, 1815 are commonly known as

swimming crabs because their last pair of peripods is of paddle shape. They are mostly found in subtidal, estuarine and intertidal zones, and widely distributed in indo- west pacific waters (Stephenson, 1972). Genus *Charybdis* De Haan, 1833 is the second largest genus (63 species) of sub family Thalamitinae, Paulson, 1875 (Ng et al., 2008).

*Charybdis annulata* Fabricius, 1798 is a common swimming crab found mostly on rocky intertidal zone. The species utilizes wide range of habitats like under surfaces of rock, tide pools, tide pools filled with sand, algal assemblage and coral reefs (Stephenson et al., 1957). As part of field work of brachyuran crab diversity of Saurashtra coast, we came across the presence of color morphs in *Charybdis annulata*, so to examine the details of color morphs present study was carried out.

## 2 Materials and Methods

With respect to marine habitat diversity, rocky shore is the dominant habitat type observed on Saurashtra coast, Gujarat, India, followed by sandy shore and mudflats. Four different rocky shores of Sutrapada (Coordinates 20° 49' 53" N, 70° 29' 17" E and 20° 50' 22" N, 70° 28' 28" E) and Dhamlej (Coordinates 20° 46' 29" N, 70° 36' 19" E and 20° 46' 11" N, 70° 37' 07" E) of Saurashtra coast were selected for the study. Belt transect method (Anderson et al., 1979) which is best suitable method for the survey of mobile organisms was adopted for the study in which 40 × 10 m transects were laid in different zones of rocky shore. For the presence of the species the transect area was meticulously scanned and the individuals were hand-picked and its microhabitat was recorded.

All the specimens were preserved in 10% formalin and identified to the species level with the help of illustrative identification key (Sethuramalingam and Khan, 1991; Jeyabaskaran et al., 2000). The following observations were recorded in the laboratory: sex of the specimen, morph type, carapace length, carapace width, frontal border length, left chelae length and height, and right chelae length and height. Different morphs were photographed by digital camera (Canon 1000 D) and all the measurements were recorded by digital vernier calipers.

## 3 Results

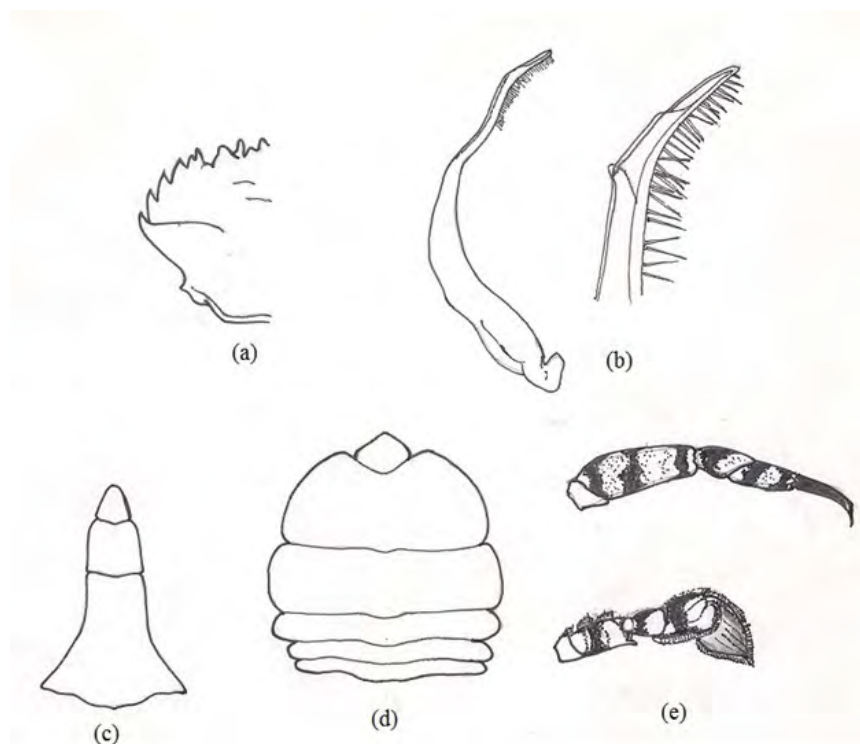
Total 62 specimens were collected from the field and two color morphs were identified- orange morph and brown morph. Out of the two morphs, brown morph was commonly observed and it utilizes wide range of habitats.

*Charybdis annulata* Fabricius, (1798) belongs to the family: Portunidae, Rafinesque, (1815), subfamily: Thalamitinae, Paul'son, (1875), genus: *Charybdis*, De Haan, (1833), subgenus: *Charybdis*, Species: *annulata*, Fabricius, (1798). The species is commonly known as "Banded leg swimming crab" because its peripods are covered by bands of brown color.

Carapace of the species is more convex and transverse granular lines are observed on gastric regions especially prominent on protogastric and mesogastric regions; the epibranchial line is interrupted at two places first at cervical groove and second at mid line region; the front in the adult comprises six deeply cut, triangular sharp teeth; anterolateral border cut into six teeth in which first two are small and acute as compared to the following ones; last tooth is small, thin and sharply pointed then the immediate three tooth which are present in front of it; posterolateral junctions are rounded in shape; antennal flagellum is excluded from orbit (Fig. 1a).

Chelipeds are almost equal in size and larger than the carapace length; three spines are present on the outer surface of merus while inner surface is smooth; carpus contains strong internal spines and three small spines

on the outer border; palm or hand with five spine on the upper surface amongst which the first two and last one are small while the central two are large and sharp; the fingers of the large cheliped are as long as palm while the fingers of the small cheliped are longer than palm; the outer and inner borders of the legs are covered with the fringes of hair; the merus of the swimming leg contains subdistal posterior spine; the posterior border of the propodite of swimming leg is serrated with 4 to 7 denticles; banded pattern is observed on walking legs (Fig. 1e).



**Fig. 1** (a) Carapace, (b) Male left pleopod, (c) Male abdomen, (d) Female abdomen, (e) Walking legs

Male left pleopode is stout and the superior part is one fourth of total length; the superior part is curved laterally at right angle; superior part contain sharp tip at the end point; inner border of the superior part is covered with the continuous ridge of hair; sparse hair are observed at the angular part of outer border of superior part (Fig. 1b).

The species has wide distribution that ranges from Madagascar, South Africa, India, Thailand and Japan. In Indian sub continent the species is recorded from Karanchi (Alcock, 1899; Apel and Spiridonov, 1998), Maungmagan, near Tavoy in Burma (Chopra and Das, 1937) and Sri Lanka (Apel and Spiridonov, 1998). As far as India is concerned the species is recorded from East and West coast including Bimlipatam (Alcock, 1899) and Bombay (Chhapgar, 1957), Gulf of Mannar and Andaman and Nicobar islands (Jeyabaskaran et al., 2000).

### 3.1 The orange morph

Material: 16 males and 8 females; Measurements: carapace length-  $4.96 \pm 1.29$  cm; carapace width-  $3.13 \pm 1.28$  cm; frontal border length-  $1.23 \pm 0.34$  cm; left chelae length-  $5.78 \pm 0.49$  cm & height-  $1.38 \pm 0.07$  cm; right chelae length-  $5.83 \pm 0.48$  cm & height-  $1.33 \pm 0.05$  cm; Habitat: crevices of tide pool, sand filled areas under stones, sand filled tide pool (Fig. 2a).



(a)



(b)

**Fig. 2** (a) Orange morph of *Charybdis annulata*; (b) Brown morph of *Charybdis annulata*

Carapace is convex, pubescent and orange in color; small red color spot is observed on the centre of urogastric region; small dark orange color spot is observed on mesobranchial and intestinal region.

Chelipeds are almost equal in size; the outer surface of the merus is dark orange in color while the inner border is white in color; small brown color patch is observed on the upper margin of carpus; the large internal spine of carpus is covered with brown and light orange bands; the upper margin of hand is covered with orange color while inner border is white in color; the anterolateral border of palm contains patch of vermicular lines of brown color; two parallel ridges are present on the posterior margin of palm; fingers are dark brown in color; large patch of grey color is observed on the upper border of dactylus and lower border of pollex; surface of the dactylus is covered by thin ridges; while two ridges are observed on the lower border of pollex; tip of the chelipeds is white in color.

### 3.2 The brown morph

Material: 24 males and 14 females; Measurements: carapace length-  $3.13 \pm 0.62$  cm; carapace width-  $2.43 \pm 0.47$  cm; frontal border length-  $0.77 \pm 0.14$  cm; left chelae length-  $4.64 \pm 0.15$  cm & height-  $1.4 \pm 0.06$  cm; right chelae length-  $3.97 \pm 0.37$  cm & height-  $1.04 \pm 0.14$  cm; Habitat: sandy surface of under stone, sand filled tide pool, tide pool, algal assemblage; rocky area covered with *Zoanthus* sp. (Fig. 2b).

Carapace is convex and covered with very short setae; the length of setae is big in meso gastric, proto gastric and anterolateral region as compare to other regions; small brown color dot is present in urogastric region

Chelipeds are almost equal in size; the upper border of merus, carpus and palm are brown in color as well as covered with very short setae; lower borders of all the parts are white in color; the inner spines of merus shows banded pattern; the density of setae is high on the upper border of carpus and its internal spine shows banded pattern; two parallel ridges are present on the postero-lateral side of the palm; patch of vermicular lines of purple color is also observed on the antero-lateral side of palm; the fingers are as long as palm and dark purple in color; the upper border of dactylus contains a large patch of grey color while the lower border of pollex is entirely covered with grey color except tip region; the upper border of the dactylus is covered with four ridges while the posterior part of pollex with two ridges; the tip of the fingers is white in color.

## 4 Discussion

In diverse kind of environment color polymorphism induces animals to use different kind of habitat. Calver and Bradley (1991) have demonstrated the micro habitat utilization of different color morphs of grasshopper in mosaic grassland. In the present study we observed that the two morphs of *Charybdis annulata* utilize different kind of habitats. Orange morph is observed to be very specific to micro habitat; it was found in crevices of tide pools, sand filled surfaces under the stones and sand filled tide pools. These habitats provide it best camouflaging cover because its bright coloration makes it vulnerable to predators. On the other hand, brown morph utilizes different kind of habitats like algal assemblage, sand filled surfaces under the stones and sand filled tide pools, rock crevices and rocky area with *Zoanthus* sp. One possible reason behind the adaptation of different micro habitat could be its dull coloration and presence of short setae on its carapace which provides it best camouflaging environment with *Zoanthus* sp. and algal assemblage. In the present paper we have tried to explore only the presence of color morphs in the population of *Charybdis annulata* but the factors which are playing significant role in determination of different color morphs need to be studied in detail.

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