Study of Color Morphs of Brachyuran crab *Etisus laevimanus* Randall, 1840

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(Received 30 January 2012; revised 13 August 2012)

Present study consists the color polymorphism in brachyuran crab *Etisus laevimanus* Randall, 1840, which is common species found on the rocky shores of indo-pacific region. Total 83 specimens were collected from four different rocky shore sites of Saurashtra coast. Seven different morphs including orange morph, orange morph with brown dots on carapace, green morph, white morph with brown markings on carapace, yellow morph with brown markings on carapace, orange morph with white stripe on carapace and green morph with black spot on carapace were identified. Yellow morph with brown markings on carapace was the most common morph while green morph with black spot on carapace was rare morph found in the study area. Morphs also show peculiar micro habitat preference.

**Keywords:** Brachyuran crab, Polymorphism, *Etisus laevimanus*, Saurashtra coast

**Introduction**

Polymorphism in coloration is known as polychromatism which commonly occurs in different animal taxa. Geographical variation in distribution of animals and hence difference in coloration is one of the reasons for occurrence of polychromatism. Color morphs can be observed in the different age groups and sexes of the same species and it is thought to be having direct impact on mate selection, species recognition and micro habitat utilization. Huyghe et al. carried out a comparative study of ecology and behaviour on three morphs of a lizard species *Podarcis melisellensis* and they found that polychromatism plays an important role in mate selection. Bau has identified five different morphs in two species of shrimp *Heptacarpus pictus* and *H. paludicola*. To study the influencing factors for coloration changes, one has to describe the morphological basis of variation in naturally occurring color patterns of the species. In the fish *Holacanthus ciliaris*, habitat preference and breeding specificity are shown to be responsible for color changes. In invertebrate taxa, crustaceans and fishes are studied for polymorphism in colors. Lee has described the biochemical, cellular and ecological bases of color changes in isopod species *Idothea montereyensis*. Gambel & Keeble have worked extensively on the chromatophores and coloration of shrimp *Hippolyte varians*. However brachyuran crab fauna have not been studied thoroughly for polychromatism, except the work of Sangthong & Jondeung, who have identified three color morphs of genus *Scylla*. During the crab diversity survey of Saurashtra coast, we came across the presence of different morphs of *Etisus laevimanus*, though researchers have seen the presence of different morphs in the species but the detail description about the morphs is not available. So to fulfill the lacuna the details of different morphs of *Etisus laevimanus* are presented in the paper.

**Materials and Methods**

The intertidal area of Saurashtra coast is mostly rocky and provides unique habitat for diverse intertidal flora and fauna. 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 was
adopted for the survey in which 40 × 10 m transects were laid in different zones of rocky shore. Transect area was searched thoroughly for the presence of the species and on the sighting of the animal, it was hand picked and its microhabitat description was recorded.

Specimen were brought to the lab and preserved in 10% formalin. Specimen were identified and described to the species level following the illustrative key. 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 (Olympus Fe-330) and morphometry were done by digital vernier calipers.

Results and Discussion

Total 83 specimens were collected, 49 specimens were male and 24 specimens were female. Total seven morphs have been identified including orange morph, orange morph with brown dots on carapace, green morph, white morph with brown markings on carapace, yellow morph with brown markings on carapace, orange morph with white stripe on carapace, green morph with black spot on carapace.

*Etisus laevimamus* Randall, 1840

The species belongs to family: Xanthidae, subfamily: Estinae, genus: *Etisus*, species: *laevimamus*. Carapace of the species is distinctly broad than long. Amongst all regions, gastric region is fairly demarcated; the branchio-hepatic region contains three lobes; the antero-lateral margin of the carapace has four teeth which are not separated by small intercalated tooth; the outer margins of the teeth are smooth but sometimes they can be endowed with the spinules or denticles; the front is divided into two lobes by single groove in the middle; the anterior border of the front makes bow like structure; blunt tooth is present on the inner angle of the orbit (Fig. 1a). Chelipeds are very long and slightly unequal; in males the chelipeds almost reach the maximum length of the carapace but in females they

![Fig. 1—*Etisus laevimamus* Randall, 1840 (a) Carapace; (b) Cheliped; (c) Female abdomen; (d) Male abdomen; (e) Male pleopod 1 (f) male pleopod 1 (superior part).]
are slightly smaller; carpus has blunt spine at the inner angle; both the surfaces of the chelipeds are smooth but sometimes the outer surface of the cheliped can be ornamented with the dots or irregular markings of brown color; fingers are black or brown in color; black or brown color of pollex covers some distal part of palm; few cutting teeth are also present on the inner side of pollex; the tips of the finger make hoof like structure (Fig. 1b). Ambulatory legs are covered with hair on both sides; the density and length of hair is slightly high on merus as compared to other segments; the dactylus has small hook like spine on the distal end. Outer border of female abdomen is covered with small hair (Fig. 1c) while in male abdomen hair are not present (Fig. 1d); male pleopods are slender in shape while the superior margin of pleopod 1 of male contains small hair tuft on outer margin (Fig. 1e, 1f); The color of the body ranges from yellow to green.

The species has wide spread distribution in indo-pacific oceanic region. In Indian subcontinent the species is recorded from rocky shores of Gujarat, Mumbai state, Laccadive Islands, Andaman Islands, and Karachi. Species prefers rocky shore habitat and is abundantly found in coral reefs. In current study, the species was recorded in different kinds of micro habitats like tide pool completely covered by Zoanthus sp., algal assemblage or sand filled tide pools having sparse vegetation and in the rock crevices.

Orange morph

Material: 3 males and 2 females; Measurements: carapace length- 4.9 cm; carapace width- 3.25 cm; frontal border length- 1.1 cm; left chelae length- 8.1 cm & height- 2.6 cm; right chelae length- 7.5 cm & height- 2.4 cm; Habitat: Rock crevices, tide pool (Fig. 2a).

Surface of the carapace is smooth; gastric, cardiac, hepatic and major part of branchial region is covered by dark orange color; intestinal region and the area of branchial region adjacent to intestinal region is light orange in color; the orbital region is light orange in color with very small brown dots. Abdominal segments are covered by light orange color with very small brown dots.

Chelipeds are almost equal; coxa, basis, ischium and proximal part of merus are light orange in color; major parts of merus, carpus and propodus have dark orange color with brown dots on the outer margin; the density of brown dots is high on upper margin; the inner margin of chelipeds is light brown in color; the fingers are dark brown in color.

Orange morph with brown dots on carapace

Material: 8 males and 4 females; Measurements: carapace length- 6.25 cm; carapace width- 3.98 cm; frontal border length- 1.27 cm; left chelae length- 9.6 cm & height- 2.6 cm; right chelae length- 8.3 cm & height- 2.1 cm; Habitat: Rock crevices, tide pool (Fig. 2b).

Surface of the carapace is smooth and all the regions are sparsely covered with the brown dots; the density of brown dots is high at frontal and orbital region while low at intestinal region; the size of the brown dots is large in gastric and branchial region; very small dots are also present on frontal region as well as on antero-lateral border; the frontal border is dark brown in color and the supra orbital region is covered by small brown dots; the merus and palp of the 3rd maxillipeds are dark brown in color while rest of the parts are light orange. Chelipeds are slightly unequal in size; the outer margins of the merus and carpus are orange in color with large brown dots; the density and size of brown dots is high on dactylus as compared to merus and the inner border of both is light orange in color; the outer and inner borders of palm are dark brown in color with small brown and white dots; the inner margin of pollex and dactylus of large chelipeds contain two and one blunt teeth respectively; straight line of microscopic pits is also present on outer margin of dactylus of both fingers; The upper border of merus of walking legs contains large and thick hair.

Green morph

Material: 12 males and 9 females; Measurements: carapace length- 3.8 cm; carapace width- 2.9 cm; frontal border length- 0.7 cm; left chelae length- 6.25 cm & height- 1.9 cm; right chelae length- 5.45 cm & height- 1.7 cm; Habitat: Sand filled tide pools, algal assemblage (Fig. 2c).

Surface of the carapace is smooth with some lobules on hepatic region; the gastric (except urogastric), hepatic and epibranchial region are dark green in color with some scattered white dots while the cardiac, urogastric, intestinal and mesobranchial regions are covered with very small dots of green color; supraorbital region is dark green in color; merus and palp of the 3rd maxillipeds are dark brown.
in color while rest of the parts are light orange. Chelipeds are almost equal in size; both the margins of coxa and eschium are light orange in color; the outer and inner margins of merus are dark green and light orange in color respectively. Both margins of carpus and palm are dark green in color with small patch of light orange color on inner margin of palm; fingers are dark black in color with white tipped hoof like structure of tips; fingers do not show any kind of dentition; dark coloration of pollex is not extended on palm.

**White morph with brown markings on carapace**

Material: 3 males and 5 females; Measurements: carapace length- 2.1 cm; carapace width- 1.9 cm; frontal border length- 0.6 cm; left chela length- 3.0 cm & height- 1.2 cm; right chela length- 2.8 cm & height- 1.28 cm; Habitat: Crevices of rocks, sand filled tide pool (Fig. 2d).

Surface of the carapace is smooth and lobulated; all the regions of carapace are covered with unusual markings of brown color. Size and density of brown markings are large in gastric, cardiac and intestinal region while it is small in antero-lateral and branchial region; triangular shape of brown color is clearly observed on meso and meta gastric regions; two lobes of the frontal region are covered with circular brown markings; frontal border is white in color; supra orbital region and epistome are covered with small brown dots; merus and some part of exopods of 3rd maxillipeds are covered with scattered and small brown dots, while palp and other parts are light orange. Chelipeds are almost equal in size; coxa, ischium and merus are white in color on both margins; outer margins of dactylus and palm are covered with brown markings; the size of brown markings is large on dactylus; inner margins of palm and dactylus contain white and few brown margins respectively; fingers are light brown in color with hoof like structure on the tips; two blunt teeth are present on pollex and dactylus, teeth of pollex are compact while space is observed between teeth of dactylus. Except dactylus of walking legs, outer border of all the parts contain brown marking while
the inner border is white; density and size of hair is less on walking legs.

Yellow morph with brown markings on carapace

Material: 21 males and 12 females; Measurements:
carapace length- 3.2 cm; carapace width- 2.3 cm;
frontal border length- 0.65 cm; left chelae length- 4.1 cm &
height- 1.3 cm; right chelae length- 5.4 cm &
height- 1.8 cm; Habitat: Sandy bottom of rock, algal
assemblage. (Fig. 2e).

Carapace is yellow in color with scattered brown markings; the surface of the carapace is rough and highly lobulated, the density of lobules is high in hepatic, epibranchial, mesogastric, protogastric, and antero-lateral region; frontal region and mesogastric region contain two cube shaped lobules each. Lobules are not present in cardiac, metagastric and intestinal region; supraorbital region and epistome are covered by brown dots; 3rd maxillipeds and exopods are also covered by brown dots chelipeds are slightly unequal; coxa, ischium and merus are white in color; outer border of carpus and palm of large cheliped is covered with large spots and unusual shapes of brown color; in small chelipeds the carapace and palm are covered with unusual shapes of brown color; fingers are dark brown in color and contain two blunt teeth on dactylus and pollex. Outer border of walking legs is yellow in color with brown marking while inner border is light cream in color. Thoracic sternum and abdomen are also covered by light brown dots; the upper parts of thoracic sternum also contain four large dots of brown color.

Orange morph with white stripe on carapace

Material: 2 males; Measurements: carapace
length- 2.2 cm; carapace width- 1.8 cm; frontal
border length- 0.4 cm; left chelae length- 3.6 cm &
height- 0.8 cm; right chelae length- 3.9 cm &
height- 1.1 cm; Habitat: Algal assemblage, sandy
bottom of tide pool, tide pool with Zoaanthus. (Fig. 2f & g).

Surface of carapace is smooth and orange in color; two large lobes are present on epibranchial region; the surface of mesobranchial region is covered by microscopic granules; large white stripe is present on the central part of the carapace, which starts from frontal region and ends in intestinal region; the central part of the stripe covers part of metagastric region and whole area of cardiac and urogastric region. In juveniles the white stripe is also present in the same region; supra orbital region and epistome are covered with small brown dots; merus and palp of the 3rd maxillipeds are dark brown in color while rest of the parts are light orange. Chelipeds are slightly unequal; the outer border of chelipeds is orange in color and inner border is white in color; the upper border of carpus and palm contains microscopic granules; fingers are dark brown in color with hoof like tips; the dactylus and pollex of both fingers contain two and three teeth respectively. Small orange dots are present on thoracic sternum and abdomen. Outer border of all walking legs is dark orange in color with very small brown dots and hair.

Green morph with black spot on carapace

Material: 2 males; Measurements: carapace
length- 2.2 cm; carapace width- 1.8 cm; frontal
border length- 0.4 cm; left chelae length- 3.6 cm &
height- 0.8 cm; right chelae length- 3.9 cm &
height- 1.1 cm; Habitat: Algal assemblage, sandy
bottom of rock. (Fig. 2h).

Surface of the carapace is rough, green and covered with microscopic orange dots, two large black spots are present on the carapace, the first one covers the area of mesogastric, protogastric, and metagastric regions while in juveniles the first spot also covers some part of hepatic region; the second spot covers the area of cardiac and urogastric regions; small unusual light orange shapes are present on hepatic and mesobranchial regions; frontal border, antero – lateral border, supra orbital region and epistome are dark green in color; small dots of orange color are present on merus and palp of the 3rd maxillipeds while rest of the parts are white in color. Chelipeds are slightly unequal; the outer and inner border of chelipeds are dark green and white in color respectively; very small dots of black color is present on the outer border of carpus; pollex and dactylus of finger of large cheliped contain two and three teeth respectively amongst one teeth of pollex is large in size. The outer border of walking legs is light orange in color with very small and dense black dots while inner border is light orange or pale white in color.

Brachyura is the most diverse and well studied group amongst marine fauna but as far as Gujarat coast is concerned it is least studied. *Etisus laevimanus* is common rocky shore crab and during the survey we could identify seven different color morphs of the species on the basis of morphological characteristics amongst them yellow morph with brown marking on carapace was very common while green morph with black dots on carapace was rare. In the present study it is also recorded that the species
explores different types of micro habitats. Rock crevices and sand filled tide pools were the common habitats preferred by different morphs because it gives high level of protection from predators. Green morph and green morph with black dots on the carapace were abundantly found in algal assemblage because the green color of algae creates best camouflageing background to deceive the predator. So, the biotic and abiotic factors which play important role in determination of color morph and habitat preference need to be studied in detail.

Acknowledgement
Authors are thankful to Mr. Ravi Vasava and Kashmira khaire, for technical support.

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