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Taxonomy and ecology of brachyuran crabs in Sunderbans

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Abstract

Indian part of Sunderbans is a wide area spread between the rivers Matla in the west and Roymangal in the east. The Mangroves are unique intertidal ecosystem that supports the biodiversity in a wide band. The brachyuran crabs prefer mangroves to complete their biological cycle and along with the crabs, shrimps, prawns, lobsters are also found to be abundant in the mangrove creeks. The present study is an attempt to find the occurrence of some eco-sensitive species and to access the diversity loss. The eco-sensitive crab species acts as eco indicators. The present study mainly focused on the distribution and diversity of Brachyuran crabs in Sunderbans. The brachyuran crabs were collected from different ecosystems. It was collected from mud by hand-picking and using forceps. Crabs were counted with their holes within the area and accessed. The diversity and distribution of the crabs were examined along the coast and mangrove areas of different ecosystems. The GPS points were made using *GARMIN* 12 channel GPS. The present study resulted with the collection of 405 examples of brachyuran crabs comprises of 06 families, 07 genera and 14 species. All the species were taxonomically analysed and their distribution is illustrated. The ecological analysis resulted with the abundance of brachyuran crabs are more in the mangrove areas compared with the mud flats of Sunderbans. Comparatively the *Ocypode* crabs were found to be abundant on the disturbed Bali Island. Studies were limited on the diversity, abundance and dynamic pattern of the brachyuran crabs in Sundarbans hence the present study undertaken. The mode of adaptation and successful completion of life cycle determines the species richness in the respective habitat. The Anthropogenic threats played a major role to change both the sandy beach and island ecosystem from vulnerable to endangered. Rapid increase of human population and solid constructions is the growing threat to not only to Gangasagar and Bakkhali but also to the entire Sundarbans.

Keywords: Abundance, Anthropogenic, Ecology, Ecosystem, Matla, Mangrove, Sunderbans, Taxonomy

Introduction

Sundarbans in West Bengal is the estuarine phase of the Ganges as well as Brahmaputra river systems. The area comprising of the present tiger reserve was constituted as Reserve Forest in 1978. The total area of the Sunderbans is 9630 sq. km. out of which 4264 sq. km. bears mangrove forest. The area of the Reserve is 2585 sq. km. covering land area of 1600 sq. km. and water body over 985 sq. km. Within this area 1330.12 sq. km. is designated as core area, which was subsequently declared as Sundarban National Park in 1984.

An area of 124.40 sq. km. within the core area is preserved as primitive zone to act as gene pool. The Sundarbans has been described as ***World Heritage Site*** in 1985. About 32,400 hectares of the Sundarbans came under the UNESCO World Heritage Site in 1999. The Sundarbans mangroves spread at 4264 sq km which has scientific significance. The mangrove vegetation along with the tidal rhythms in Sundarban alternates the faunal dynamics in the area. The fishing season of this area is from October – February. During these periods the local fisherfolks are using the islands of Sunderbans (Bikash, 1967) for fishing and also to make dry-fish. Sunderban experienced hot and humid condition during the major part of the year. The seasons of these area are classified into three categories viz., premonsoon (June-September), monsoon (July-October) and post monsoon (November-February).The temperature of the region varies around 30°C but during winter it drops down to 20°C. The mean annual rainfall is 1700 mm (Khan, 2002).

Sundarbans the world largest coastal wetland experiences a sub tropical monsoonal climate with

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an annual rainfall of 1600-1800 mm and severe cyclonic stroms (Brij and Malavika 2006). Sundarbans provide livelihood to approximately 300,000 people. Approximately 2.5 million people live in the surrounding villages.

Berry (1963) reported that physical conditions vary widely within the mangrove areas. The mangrove ecosystem supports fishery by developing a detritus based food web and help regulating regional climate (Mandal and Nandi, 1989). Since mangroves are unique intertidal ecosystem that supports the biodiversity in a wide band. The crabs prefer mangroves to complete their biological cycle (Soundarapandian *et al.*, 2008). The Shrimps, prawns, lobsters, and crabs are found to be abundant in the mangrove creek, sandy beaches, estuaries etc. Both the brachyuran and anomuran crabs are abundant in the esturian and mangrove ecosystem of Sundarbans.

Various studies carried out on the diversity, distribution and also on the chemical composition of the brachyuran crabs (Subbha Rao, 1995; Soundarapandian *et al.*, 2008; Stanley and Hait, 2000; Allison *et al.*, 2003; Mukherjee *et al.*, 2008; Lehane, 2000).

The brachyuran crabs are well diversified group among all fauna. In India the diversity of the brachyuran fauna is roughly estimated to be more than 710. However a compilation work has been made on the diversity of the brachyuran crabs in Gulf of Mannar Marine Biosphere Reserve reported 236 species. It denotes the species richness of a particular coral reef area. Similar to the coral reef ecosystem the brachyuran crabs was also associated with the other ecosystems like mangrove, coastal etc.

Various ecosystems play a significant role on the diversity and distribution of the brachyuran crabs in Sunderbans. The mangroves, estuaries, coral reefs, coastal and sandy beaches reflect the diversity and distribution of the brachyuran crabs with seasonal fluctuation. The ecosystem study and habitat preference of the brachyuran crabs in Sunderbans enable us to understand the status of the crabs pertaining to its particular niche.

The Objectives of the present study is to

- focus on some eco-sensitive species.
- access the diversity loss.
- locate the eco indicators.
- update the taxonomic status of the crabs.
- understand their physical resilience to different ecosystems.

Materials and Methods

The present study mainly focused on the distribution and diversity of Brachyuran crabs in Sunderbans. The brachyuran crabs were collected from different ecosystems. It was collected from mud by hand-picking and using forceps. Similarly in sandy beaches it was collected by hand-picking. However the off-shore crabs were collected from the fishing harbors.

Field identification was done upto the genus level and was confirmed in lab with the help of manuals of Alcock (1895–1900), Sankarankutty (1961a,b; 1962a,b), Sakai (1976), Guinot (1976), Jeyabaskaran *et.al.* (2000) and Dev Roy and Bhadra (2005). The collected crabs were sorted, labelled and preserved with 10% formaldehyde.

The population dynamics of the shore crabs was accessed using 20m (20 sq m) Line Intercept Transect (LIT) method (English et al., 1997) and Quadrat method (1mx1m). Crabs were counted with their holes within the area and accessed. The diversity and distribution of the crabs were examined along the coast and mangrove areas of different ecosystems. The GPS points were made using *GARMIN* 12 channel GPS.

Results

Areas Surveyed

Sunderbans is a wide area spread between the rivers Matla in the west and Roymangal in the east. Hence the present study focused to cover a maximum areas with different ecosystem and to complete the surveys within stipulated period.

The brachyuran crabs collected from the present study was analysed and its systematic position is briefed below,

Systematic List of Brachyuran Crabs

Phylum: CRUSTACEA
Class: MALACOSTRACA
Order: DECAPODA
Family: PORTUNIDAE

1. *Scylla serrata* (Forskål, 1775)
2. *Charybdis rostrata* A. Milne Edwards, 1861
3. *Charibdis feriata* (Linnaeus, 1758)
4. *Charybdis helleri* (A. Milne Edwards, 1867)
5. *Charybdis hoplites* (Wood-Mason, 1877)
6. *Charybdis natator* (Herbst, 1794)
7. *Charybdis edwardsii*

Family: MATUTIDAE

8. *Matuta planipes*, Fabricius, 1798

9. *Matuta victor* (Fabricius, 1781)

Family: OCYPODIDAE

10. *Ocypode ceratophthalma* (Pallas, 1772)

11. *Ocypode macrocera* (H. Milne Edwards, 1837)

Family: GRAPSIDAE

12. *Metapograpsus messor* (Forskål, 1775)

Family: SESARMIDAE

13. *Episesarma taeniolata* (White, 1847)

Family: VARUNIDAE

14. *Varuna litterata* (Fabricius, 1798)

1. *Scylla serrata* (Forskal, 1775)

1775. *Cancer serratus* Forskal, *Desc. Anim*.: 90.

1957. *Scylla serrata*, Chhapgar, *J. Bombay nat. Hist. Soc*., **54**(2): 416, pl. 5, figs. a-c.

1972. *Scylla serrata*, Ummerkutty and Deb, *Rec. zool. Surv. India*, **66**(1-4): 193 (Mangalore, Kumta beach).

Materials: Total 07 examples; KN 1405, Coll. A. Gokul, 26.3.08, Gosoba, 01 ex; KN 1409, Coll. A. Gokul, 29.3.08, Champta, 01 ex; KN 1458, Coll. A. Gokul, 22.4.09, Bakkhali, 01 exs; KN 1507, Coll. A. Gokul, 13.9.09, Jharkhali, 01 ex; KN 1508, Coll. A. Gokul, 14.9.09, Bakkhali, 01 ex; KN 1744, Coll. A. Gokul, 7.8.11, Fresergunj Harbour, 02 exs.

Characters: Frontal lobes high, bluntly pointed with concave margins. Antero-lateral teeth nine, equally arranged, narrow, outer margin straight or slightly concave. Chelipeds and legs marked with polygonal patternings in both sexes and on female abdomen.

Distribution: Indo-West Pacific. In India: Karnataka, Gujarat, Maharashtra, Goa, Kerala. East coast: West Bengal, Orissa, Andhra Pradesh, Tamil Nadu. Islands: Andaman and Nicobar Islands. *Elsewhere:* South Africa, Red Sea, Mauritius, Philippines, Taiwan, Japan, Indonesia, Timor, Australia, Western Samoa, Solomon Islands, Fiji and New Caledonia.

2. *Charybdis* (*Charybdis*) *rostrata* A. Milne Edwards, 1861

1861. *Goniosoma rostratum*. A. Milne Edwards, Archs. Mus. Nat., Paris, ser. 1, 10: 379, 385, pl 35, Fig.2

1985. *Charybdis rostrata*: Mandal and Misra, *Proc. Nat. Symp. Biol. Util. Cons. Mangroves:* 430 (Mangroves, sunderbans, west Bengal)

1989. *Charybdis rostrata*. Mandal and Nandi, Fauna of conservation Areas, 3. *Zool. Surv. India*, **3**:26 (Mangroves, Sunderbans, West Bengal).

2001. *Charybdis* (*Charybdis*) *rostrata*. Dev Roy and Nandi, Bull. Nat. inst. Ecol., **11**: 17 (Mangroves, Sunderbans, West Bengal)

Materials: Total 145 examples; KN 1408, Coll. A. Gokul, 29.3.08, Champta, 01 ex; KN 1417, Coll. A. Gokul, 12.12.08, Gangasagar, 07 exs; KN 1483, Coll. A. Gokul, 11.9.08, Gangasagar, 03 exs; KN 1484, Coll. A. Gokul, 12.9.08, Gangasagar, 05 exs; KN 1485, Coll. A. Gokul, 13.9.08, Gangasagar, 04 exs; KN 1486, Coll. A. Gokul, 15.9.08, Bakkhali, 02 exs; KN 1488, Coll. A. Gokul, 10.9.08, Gangasagar, 02 exs; KN 1489, Coll. A. Gokul, 15.09.08, Bakkhali, 17 exs; KN 1490, Coll. A. Gokul, 16.9.08, Bakkhali, 03 exs; KN 1511, Coll. A. Gokul, 5.12.09, Rangabelia, 02 exs; KN 1516, Coll. A. Gokul, 11.12.09,Pakhirala, 04 exs; KN 1518, Coll. A. Gokul, 12.12.09,Pakhirala, 06 exs; KN 1519, Coll. A. Gokul, 12.12.09,Dayapur & Sujobdey, 02 exs; KN 1581, Coll. A. Gokul, 13.3.10, Dobanki, 02 exs; KN 1583, Coll. A. Gokul; 18.3.10; Dayapur; 05 exs; KN 1584; Coll. A. Gokul; 13.3.10; Vidya; 02 exs; KN 1617; Coll. A. Gokul; 19.9.10; Bakkhai; 12 exs; KN 1629; Coll. A. Gokul; 21.9.10; Bakkhali; 12 exs; KN 1633; Coll. A. Gokul; 20.9.10; Bakkhali; 09 exs; KN 1636; Coll. A. Gokul; 23.9.10; Bakkhali; 08 exs; KN 1747; Coll. A. Gokul; 3.8.11; Fresergunj Harbour Is; 15 exs; KN 1751; Coll. A. Gokul; 4.8.11; Fresergunj Harbour Is; 06 exs; KN 1755; Coll. A. Gokul; 6.8.11; Fresergunj Harbour Is; 09 exs; KN 1757; Coll. A. Gokul; 7.8.11; Fresergunj Harbour Is; 07 exs

Characters: Six tooth in the front is dentate. Among which two middle tooth are blunt prominently and projecting outwards the other tooths. First antero-lateral tooth is acute and last tooth is larger and spiniform. Chelipeds are unequal. Palm having six costate bearing two spines on its upper surface. Sixth segment of the male abdomen broader than long with curved and gently convergent sides.

Distribution: Indo-pacific. In India: Andhra Pradesh, Orissa, Tamil Nadu, West Bengal, Kerala, Gujarat. *Elsewhere:* Srilanka, Myanmar, Thailand and Indonesia.

3. *Charybdis (Charybdis) feriata* (Linnaeus, 1758)

1758. *Cancer feriatus* Linnaeus, *Syst. Nat*., (10th ed.), **1**: 627.

1899. *Charybdis* (*Goniosoma*) *crucifera*, Alcock, J. Asiatic Soc. Bengal., **68** (1):51.

1938. *Charybdis* (*Charybdis*) *cruciata*, Leene, *Siboga Exped. Monogr*., 39C. p. 24.

1976. *Charybdis (Charybdis) feriata*, Sakai, *Crabs of Japan and Adjacent seas*, p. 357

2005. *Charybdis (Charybdis) feriatus*, Dev Roy and Bhadra, *Zool. Surv. India. Andhra Pradesh, State Fauna Series,* **5**: *(Part 5):* **432**, pl. 2, fig. 4.

Materials: Total 01 example; KN 1557, Coll. A. Gokul, 15.03.10, Bali Island, 01 ex.

Characters: Carapace smooth, convex and glabrous. Transverse ridge lacking behind the level of last antero-lateral spine. Front cut into six blunt teeth. Antero-lateral teeth five (excluding the outer orbital angle) – first tooth truncated and notched, second to fourth very broad with anteriorly acuminate lobes, last one spine-like. Major diameter of orbit nearly half of the width of front. Chelipeds stout, little unequal; inner border of arm adorned with three elongated spines, distal one largest; upper border granular; outer surface of wrist bearing three spinules, inner corner with a large strong spine; outer surfaces of both wrist and palm costate; upper border of palm with four spines – one just behind the finger-joint on the inner border, two side by side slightly behind the preceeding one and last one near apex of the wrist-joint; cutting edges of fingers strongly dentate. In the last pair of leg, length of merus about 2/5th of its breadth. Sixth segment of male abdomen much broader than long with gently curved sides.

Distribution: Indo-West Pacific. In India: Karnataka, Gujarat, Maharashtra, Kerala, West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Pondicherry and Andaman Islands. *Elsewhere:* South Africa, Madagascar, Pakistan, Bangladesh, Malay Peninsula, Singapore, Hong Kong, Taiwan, Japan and Australia.

4. *Charybdis (Charybdis) helleri* (A. Milne Edwards, 1867)

1867. *Goniosoma helleri* A. Milne Edwards, *Annls. Soc. Ent. Fr.*, sér. 4, **7**: 282.

1899. *Charybdis (Goniosoma) merguiensis*, Alcock, *J. Asiat. Soc. Bengal*, **68**(2): 55.

2000. *Charybdis (Charybdis) helleri*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.*, **185**: 36, pl. 2, fig. 1 and pl. 9, figs. 7, 8.

Materials: Total 04 examples; KN 1559, Coll. A. Gokul, 17.3.10, Bali Island, 04 exs.

Characters: Carapace broad, convex, pubescent and bearing the usual transverse ridges. Front deeply cut into six teeth, apices of middle two teeth rounded. Antero-lateral teeth six, of which, first five pointed anteriorly, sixth tooth directed antero-laterally. Lobule at the outer end of lower border of orbit obtuse not dentiform. Chelipeds stout, unequal; arm with three spines on the anterior border; proximal spine shortest, almost inconspicuous; distal two very strong and much larger; wrist armed with a large pointed spine at its inner angle, outer surface also with three spinules; palm bearing five spines on the dorsal surface, larger two along the inner border and smaller two on the outer border, fifth spine near articulation of the wrist-joint. Posterior border of carpus of last pair of legs armed with an acute spine, dactylus serrated at the lower margin. Sixth segment of male adomen as long as broad with the sides parallel at basal two-thirds and then convergent distally.

Distribution: Indo-West Pacific. In India: Kerala, West Bengal, Orissa, Tamil Nadu and Middle Andamans. *Elsewhere:* Sri Lanka, Myanmar, Thailand, Indonesia and from Mediterranean to Hawaii.

5. *Charybdis (Goniohellenus) hoplites* (Wood-Mason, 1877)

1877. *Goniosoma hoplites* Wood-Mason, *Ann. Mag. nat. Hist.*, ser. 4, **19**: 422.

1899. *Goniosoma (Goniosoma) hoplites*, Alcock, *J. Asiat. Soc. Bengal*, **68**(2): 66.

2005. *Charybdis (Goniohellenus) hoplites*, Dev Roy and Bhadra, *Zool. Surv. India. Andhra Pradesh, State Fauna Series,* **5**:*(Part 5):* 436.

Materials: Total 40 examples; KN 1561, Coll. A. Gokul, 15.3.10, Bali Is, 02 exs; KN 1577, Coll. A. Gokul, 14.3.10, Satjalia, 18 exs; KN 1578, Coll. A. Gokul, 16.3.10, Jhilla, 13 exs;

KN 1580, Coll. A. Gokul, 13.3.10, Dobanki, 02 exs; KN 1582, Coll. A. Gokul, 18.3.10, Dayapur, 05 exs.

Characters: Carapace thick, pubescent; epibranchial area swollen. Last antero-lateral spine largest. Anterior border of arm of chelipeds adorned with two large spine and a spinule, posterior border with a single spine; palm six costate, costae with squamiform sculpturings. Sixth segment of male abdomen truncate triangular.

Distribution: Indian Ocean. India: West coast – Karnataka, Gujarat. East coast – Orissa, Andhra Pradesh, Tamil Nadu. *Elsewhere:* Red Sea, Persian Gulf, Indus Delta, Akyab, Hong Kong.

6. *Charybdis (Charybdis) natator* (Herbst, 1794)

1794. *Cancer natator* Herbst, *Krabben und Krebse*, **2**: 156, pl. 40, fig. 1.

1899. *Charybdis (Goniosoma) natator*, Alcock, *J. Asiat. Soc. Bengal*, **68**(2): 61.

2005. *Charybdis (Charybdis) natator*, Dev Roy and Bhadra, *Fauna of Andhra Pradesh, State Fauna Series,* **5**:*(Part 5):* 435.

Materials: Total one example. KN 1562, Coll. A. Gokul, 15.3.10, Bali Island, 01 ex.

Characters: Carapace broad, convex and densely covered with short, soft tomentum; regions well-defined; in addition to the usual transverse ridges of gastric and branchial regions, two short but prominent ridges present side by side on the cardiac region, other two ridges shorter than the preceeding pair also present just behind the inner ends of the branchial ridge. Front cut into six subequal teeth with their tips bluntly rounded. First antero-lateral tooth truncated, last one not much enlarged. Chelipeds marked with transverse squamiform tubercles, markings more prominent on palm. Abdomen consisting of seven separate segments.

Distribution: Indo-Pacific. India: Gujarat, Karnataka, Kerala, Andhra Pradesh, Tamil Nadu, Pondicherry. *Elsewhere:* South and East coast of Africa, Madagascar, Red Sea, Sri Lanka, Malay Archipelago, Singapore, Philippines, Hong Kong, South China Sea, Taiwan, Japan and Australia.

7. *Charybdis* (*Goniohellenus*) *smithii* McLeay, 1838

1861. *Goniosoma truncata*, A. M. Edwards, Arch. Mus. Hist. nat. **10**: 380, pl. 34, Fig. 4.

1952. *Charybdis* (*Goniohellenus*) *edwardsii*, Leene and Buitendijk, *Zool. mededlingen Deel*, **31**:213

1967. *Charybdis smithii*, McLeay, *J. Nat. Hist*., **1**: 285-288.

Materials: Total three examples. KN 1748, Coll. A. Gokul, 3.8.11, Fresergunj Harbour, 1 ex;

KN 1752, Coll. A. Gokul, 7.8.11, Fresergunj Harbour, 2 exs.

Characters: Posterior border of carapace straight and forms an angular junction with postero-lateral borders. Anterolateral spines were square cut and serrated. Posterior border of carapace characteristically reduplicated. The basal antennal joint did not join in the front so that the antennal flagellum could lie in the orbit.

Distribution: In both the Indian coasts. *Elsewhere:* Myanmar.

8. *Matuta planipes*, Fabricius, 1798

1798. *Matuta planipes* Fabricius, Ent. Syst. Suppl., **2**: 369

1896. *Matuta lunaris* Alcock, *J. Asiatic soc. Bengal*, **65** (2): 161

1936. *Matuta flagra* Shen, Contr. Inst. Zool. Nat. Acad. Peiping, **3**(3): 64-66

1976. *Matuta planipes* Sakai, *Crabs of Japan and Adjacent Seas*, 41

1991. *Matuta planipes* Dev Roy and Nandi, *J. Indian Soc. Coastal agric. Res*., **9**(1/2):72

Materials: Total 109 examples; KN 1406, Coll. A. Gokul, 26.3.08, Gosoba, 03 exs; KN 1407, Coll. A. Gokul, 29.3.08, Champta, 01 ex; KN 1415, Coll. A. Gokul, 10.12.08, Bakkhali, 01 ex; KN 1487, Coll. A. Gokul, 13.9.08, Gangasagar, 02 exs; KN 1501, Coll. A. Gokul, 13.12.08, Gangasagar, 12 exs; KN 1502, Coll. A. Gokul, 11.12.08, Jambudweep, 05 exs; KN 1517, Coll. A. Gokul, 11.12.09,Dayapur & Sujobdey, 05 exs; KN 1558, Coll. A. Gokul, 7.12.09, Bali Is, 02 exs; KN 1574, Coll. A. Gokul, 15.3.10, Bali Is, 16 exs; KN 1575, Coll. A. Gokul, 17.3.10, Bali Is, 08 exs; KN 1579, Coll. A. Gokul, 18.3.10, Sajnekhali, 01 ex; KN 1618, Coll. A. Gokul, 17.9.10, Bakkhali, 02 exs; KN 1620, Coll. A. Gokul, 22.9.10, Bakkhali, 07 exs; KN 1628, Coll. A. Gokul, 18.9.10, Bakkhali, 05 exs; KN 1630, Coll. A. Gokul, 21.9.10, Bakkhali, 06 exs; KN 1632, Coll. A. Gokul, 22.9.10, Bakkhali, 02 exs; KN 1635, Coll. A. Gokul, 20.9.10, Bakkhali, 03 exs; KN 1639, Coll. A. Gokul, 23.9.10, Bakkhali, 04 exs; KN 1740, Coll. A. Gokul, 10.12.08, Bakkhali, 10 exs; KN 1745, Coll. A. Gokul, 3.8.11, Fresergunj Harbour, 06 exs; KN 1749, Coll. A. Gokul, 4.8.11, Fresergunj Harbour, 02 exs; KN 1753, Coll. A. Gokul, 6.8.11, Fresergunj Harbour, 05 exs; KN 1756, Coll. A. Gokul, 7.8.11, Fresergunj Harbour, 01 ex.

Characters: Carapace circular and with a strong spine at junction of anterolateral and posterolateral border. Carapace is with vermicular lines, rings and red spots. A tubercle present at angle of hand where it touches external angle of arms. Longitudinal ridge of dactylus of cheliped well striated.

Distribution: In India: Nellore, Chilka, Gopalpur, Chennai, Parangipettai, West Bengal, Bombay, Ratnagiri Dist. *Elsewere:* Pakistan, Myanmar, Thailand, Japan and Australia

9. *Matuta victor* (Fabricius, 1781)

1781. *Cancer victor* Fabricius, *Species Insectorum Exhibentes*, **2**: 502.

1951. *Matuta victor*, Patil, *J. Bombay nat. Hist. Soc*., **50**(1): 137.

2000. *Matuta victor*, Dev Roy and Das, *Rec. zool. Surv. India, Occ. Paper No.* **185**: 19.

Materials: Total one example. KN 1560, Coll. A. Gokul, 15.03.10, Bali Island, 01 ex.

Characters: Carapace sub-circular, little convex, broader than long, surface finely granular in epibranchial, post-gastric and cardiac regions. Antero-lateral borders with six small tubercles just behind the outer orbital angle followed by three crenular teeth, of which, the middle one smallest. Postero-lateral borders oblique with a large, granular lateral epibranchial spine on either side; posterior posterior-lateral margins forming a finely beaded, slightly elevated ridge culminating slightly beneath the epibranchial spine. Front bilobed with rounded apices. Chelipeds almost equal and symmetrical; upper margin of palm tridentate, proximal tooth broadest; mid-palm in male consisting of a smooth rounded ridge running to tip of fixed finger, proximally bearing a granular tubercle, a very conspicuous acute strong spine lying in front of it, this ridge absent in female and instead, five tubercles present, of which, fourth one largest and triangulate; lower proximal angle of palm ended with an acute, prominent spine (often absent in female) or represented by a granular tubercle; in male, a row of tubercles running from proximal angle of lower border of palm ending at base of fixed finger while in female in addition to these, another row of granules extending from the proximal spine of palm to almost up to the tip of immobile finger running sub parallel to its lower margin; dactylus traversed by a strongly milled ridge from base to tip on its outer surface in male but smooth in female.

Distribution: Indo-West Pacific. India: Maharashtra, Karnataka, Malabar Coast, West Bengal, Orissa, Tamil Nadu, Pondicherry and Andaman Islands. *Elsewhere:* Mozambique, Madagascar, Comoros, Tanzania, Somalia, Red Sea, Gulf of Aden, Gulf of Oman, Pakistan, Sri Lanka, Myanmar, Thailand, Hong Kong, China, Japan, Taiwan, Philippines, Malaysia, Singapore, Indonesia, Timor, Australia, New Caledonia, New Hebrides, Norfolk, Ovolan and Fedjee.

10. *Ocypode ceratophthalma* (Pallas, 1772)

1772. *Cancer ceratophthalmus* Pallas, *Spicilegia Zool.*, **9**: 83, pl. 5, fig. 7.

1957. *Ocypoda ceratophthalma*, Chhapgar, *J. Bombay nat. Hist. Soc.*, **54**(3): 506, pl. 13, figs. a-c.

2005. *Ocypode ceratophthalma*, Dev Roy and Bhadra, *Zool. Surv. India. Fauna of Andhra Pradesh State, Fauna Series,* **5**:(Part 5): 500.

Materials: Total 31 examples; KN 1410, Coll. A. Gokul, 29.3.08, Champta, 02 exs; KN 1503, Coll. A. Gokul, 20.4.09, Bakkhali, 27 exs; KN 1627, Coll. A. Gokul, 15.9.10, Gangasagar, 01 ex; KN 1634, Coll. A. Gokul, 16.9.10, Gangasagar, 01 ex.

Characters: Carapace thick, squarish, surface covered with fine granules, regions indistinct. Antero-lateral angles acute and directed outwards, anterior one-third of the lateral borders nearly straight and parallel; margins finely beaded except the posterior border. Orbits large, upper orbital margin wavy and finely crenulated; lower margin also crenated with an indistinct notch at its middle, no gap at the outer margin; eye-salks prolonged beyond the carapace as a blunt narrow horn. Chelipeds maekedly unequal and scabrous, rugulose or with squamiform arrangement; inner corner of wrist armed with a strong spine. Palm compressed, high; outer surface coarsely granular; a stridulating organ present on the inner surface very close to the base of fixed finger and consisting of a few rounded granules on the upper part followed by several rather widely spaced striae and then more very close-set striae at the lower half; upper border of dactyl, outer surface of both dactyl and fixed finger granular, lower border of fixed finger also granular; fingers pointed at tips, their cutting edges adorned with large teeth. Leg joints long, stout; merus of first three pair of walking legs broadened, fourth pair shortest with a much narrower merus; propodus of first two pair densely hairy on the anterior edges of adults, hairs absent in juveniles; dactylus stout, fluted, fringed with hairs on the antero-lateral margin. Sixth segment of male abdomen larger than broad.

Distribution: Indo-West Pacific. India: Karnataka, Maharashtra, West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Andamans and Lakshadweep Islands. *Elsewhere:* East coast of Africa, Madagascar, Mauritius, Maldives, Srilanka, Australia and Hawaii.

11. *Ocypode macrocera* (H. Milne Edwards, 1837)

1837. *Ocypode macrocera*, H. Milne Edwards, *Hist. Nat. Crust.*, **2**:49

1986. *Ocypode macrocera*, Chakraborty, Choudary and Deb, *J. Beng. Nat. Hist. Soc.*, (NS), **5**(1): 56, 57 (Mangroves, Sunderbans, West Bengal)

2001. *Ocypode macrocera*, Ravichandran, Soundrapandian and Kannupandi, Indian J. Fish., **48**(2): 222

Materials: Total 11 examples; KN 1638, Coll. A. Gokul, 16.9.10, Gangasagar, 07 exs; KN 1741, Coll. A. Gokul, 11.12.08, Jambudweep Island, 02 exs; KN 1742, Coll. A. Gokul, 30.7.11, Fresergunj Harbour, 01 ex; KN 1743, Coll. A. Gokul, 31.7.11, Fresergunj Harbour, 01 ex.

Characters: Carapace squarish, little convex, surface covered with small granules. Granules of the external maxillipeds are minute and less prominent. Fingers are broad, spatulate and lamellar right upto the tips. Anterior surface of the propodus of first two pairs of legs conspicuously fringed with brushes of hairs. Sixth segment of male abdomen is almost equal to its width.

Distribution: Indian ocean, Godavari, Krishna, Nellore, Srikakulam, visakapatinam, Bitharkanika, Gopalpur coast, Chilka, Mahanadi estuary, Palk Bay, Gulf of Mannar, Bakkhali, Gangasagar.

12. *Metapograpsus messor* (Forskal, 1775)

1775. *Cancer messor*, Forskal, *Hauniae.*, I–XXXIV, p. 88.

1893. *Metapograpssus messor*, Henderson, *Trans. Linn. Soc. Zool,* 5, p. 390; pls. 36–40.

1900. *Metapograpssus messor*, Alcock, *J. Asiat. Soc. Bengal*, **69**, p. 397.

1927. *Metapograpssus messor*, Gravely, *Bull. Madras Govt. Mus (M.S)*, 1, p. 147, pls 19–26.

1957. *Metapograpssus messor*, Chhapgar, *Tarapore. Mar. biol. stn*, 1, p. 54.

1976. *Metapograpssus messor*, Sakai, *Crabs of Japan and adjacent seas*, p. 630.

Materials: Total 08 examples; KN 1512, Coll. A. Gokul, 7.12.09, Jharkhali, 04 exs; KN 1513, Coll. A. Gokul, 8.12.09, Jhilla, 01 ex; KN 1514, Coll. A. Gokul, 9.12.09, Satjelia, 01 ex; KN 1515; Coll. A. Gokul, 10.12.09, Vidya, 02 exs.

Characters: Carapace trapezoidal, 1.25-1.35 times broader than long, with strongly converging lateral margins; surface smooth and slightly convex; front very broad, about 3/5th of greatest carapace width; lateral margins entire, without tooth behind the outer orbital angle; chelipeds unequal, larger one about 1.5 times the length of the carapace, strong and stout; palm inflated, outer surface smooth; fingers with blunt tips; walking legs with broad, flattened merus and strongly spinose dactyli.

Distribution: East Godavari, West Godavari, Krishna, Visakapattinam, Orissa, Parangipettai, Haora, North and South 24 parganas, Midnapore, Gujarat, Karnataka, Bombay, Andaman & Nicobar Islands. *Elsewhere:* Suez canal, Red Sea, aden, Madagascar, Pakistan, srilanka, Bangladesh, Myanmar and Australia.

13. *Episesarma taeniolata* (White, 1847)

1847. *Sesarma taeniolata* White, *List of specimens of Crustacea in the collection of the British Museum, London*: 38

1900. *Sesarma taeniolatum*, Alcock, *J. Asiatic Soc. Bengal*, **69**(2): 419.

1957. *Sesarma (Sesarma) taeniolata*, Chhapgar, *J. Bombay Nat. Hist. Soc*., **54** (3): 521, pl. 16, Figs h-j.

2001. *Neoepisesarma (Neoepisesarma) taeniolata*, Dev Roy and Bhadra, *Zool. Surv. India, Estuarine Ecosystem Series,* 4: *Fauna of Godavari Estuary*: **47**

Materials: Total one example. KN 1619; Coll. A. Gokul; 21.9.10; Bakkhali; 01 ex

Characters: Carapace flat and square-cut. The surface of the carapace is completely covered with tufts of hairs. A pectinated crest is observed in the palm of male cheliped from its proximal to distal margin. The upper boarder of dactylus elegantly milled with 40-60 fine lamellae.

Distribution: India: Andra Pradesh, East Godavari, West Godavari, Visakapatinam, Sunderbans, Maharashtra, Ratnagiri and South Andamans. *Elsewhere:* Pakistan, Mergui Archipelago, Malay Peninsula, Singapore, Indonesia, Thailand, China and Japan.

14. *Varuna litterata* (Fabricius, 1798)

1798. *Cancer litterata*, Fabricius, *Entom. Syst. Suppl*., **342**.

1900. *Varuna litterata*, Alcock, *J. Asiatic Soc. Bengal*., **69**(2): 401.

2001. *Varuna litterata*, Dev Roy and Bhadra, *Zool. Surv. India Estuarine Ecosystem Series* 4: *Fauna of Godavari Estuary*: **49**

Materials: Total 43 examples. KN 1631, Coll. A. Gokul, 21.9.10, Bakkhali, 10 exs; KN 1637, Coll. A. Gokul, 18.9.10, Bakkhali, 04 exs; KN 1746, Coll. A. Gokul, 3.8.11, Fresergunj Harbour Is, 02 exs; KN 1750, Coll. A. Gokul, 4.8.11, Fresergunj Harbour Is, 1 ex; KN 1754, Coll. A. Gokul, 6.8.11, Fresergunj Harbour Is, 3 exs; KN 1758, Coll. A. Gokul, 4.8.11, Bakkhali, 9 exs;

KN 1759, Coll. A. Gokul, 5.8.11, Bakkhali, 14 exs

Characters: The carapace is quadrangularly rounded. The dorsal surface of the carapace is depressed and a clear demarcation is observed between the gastric and cardiac regions on the carapace. The front is pronouncedly expanded and its free margin almost straight and entire. The chelipeds are symmetrical and a spiniform tooth is present at the inner angle of the

wrist. One or two accessory spinules are also present on the wrist. The palm of male is high and its inner surface marked with several tubercles in the middle position. The propodus and dactylus of the ambulatory legs are expanded and their posterior margin thickly fringed with hairs.

Distribution: India: Andra Pradesh, East Godavari, Krishna, Visakapatinam, Orissa, Sunderbans, Maharashtra and Trivandrum. *Elsewhere:* East Africa, Bangladesh, Myanmar, Singapore, Phillipines, Hong-Kong, Japan, New Guinea, Australia and New zealand.

Population Dynamics of Shore Crabs

The population dynamics of the shore crabs was accessed using 20m Line Intercept Transect (LIT) method (English et al., 1997) and Quadrat method. The ecological analysis resulted with the abundance of brachyuran crabs are more in the mangrove areas compared with the mud flats of Sunderbans. The abundance is mainly based on their feeding habits. Their burrowing and feeding habit has high ecological significance. Comparatively the *Ocypode* crabs were found to be abundant on the disturbed Bali Island (Figure 1). They are also a good environmental indicator. The shore crab abundance is positively correlated with the amount of organic waste created due to human interference. Various studies carried out on the diversity, distribution and also on the chemical composition of the brachyuran crabs (Soundarapandian *et al.*, 2008; Stanley and Hait, 2000; Allison *et al.*, 2003; Mukherjee *et al.*, 2008; Lehane, 2000).

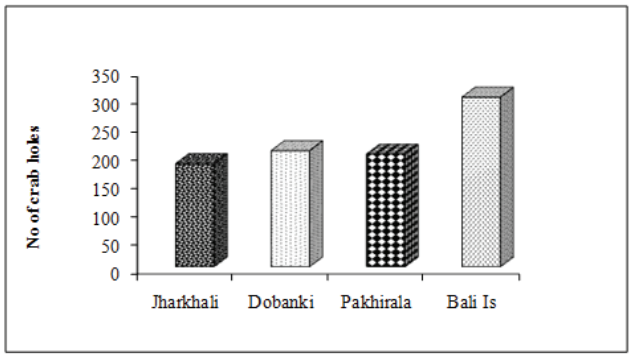

Figure 1. Brachyuran Crab Abundance using Quadrat Method.

The occurrence of the brachyuran crabs was also observed to be more in the mangrove rich areas of the Sundarbans (Figure 2). Studies were limited on the diversity, abundance and dynamic pattern of the brachyuran crabs in Sundarbans (Gokul, 2008). Brachyuran crabs are positively correlated with the healthiness of the habitat. Hence the habitat potential is measured with the crab species richness. The mode of adaptation and successful completion of life cycle determines the species richness in the respective habitat. The food availability and the secured ecosystem acts as tool to construct the community zones of the shore crabs.

The Anthropogenic threats played a major role to change both the sandy beach and island ecosystem from vulnerable to endangered. Rapid increase of human population and solid constructions is the growing threat to not only to Gangasagar and Bakkhali but also to the entire Sundarbans.

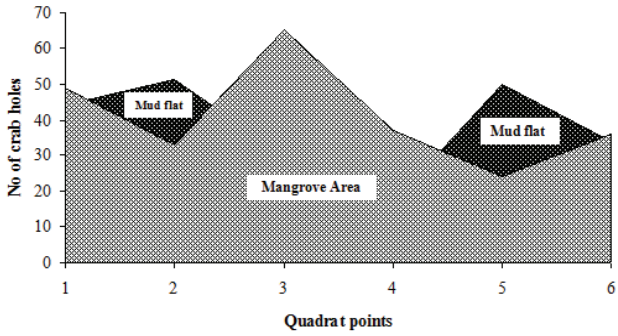

Figure 2. Comparative analysis of brachyuran crab abundance.

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