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On the diversity of some Brachyuran Crabs (Crustacea: Decapoda) from bycatch at the Gulf of Mannar, Tamil Nadu, India

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Abstract: The present study provides taxonomical information on a collection of some marine brachyuran crabs from the Gulf of Mannar of Tamil Nadu. The specimens were collected from fisheries bycatch at Mandapam fishing harbor located in the Gulf of Mannar during July 2019 to March 2020. A total of 18 species (15 genera, 8 families) of brachyuran crabs were identified. Maximum species were recorded from the family Leucosiidae (8 species), followed by Parthenopidae (4 species). Families like Epialtidae, Scalopidiidae, Corystidae, Euryplacidae, Iphiculidae, and Xanthidae were represented by single species each. Out of these 18 species, *Lyphira heterograna* is reported first time from the East coast of India.

Keywords: New records; Marine; Brachyuran crabs; Gulf of Mannar; India.

1 Introduction

Brachyuran crabs are the most diverse and species-rich group of decapod crustaceans alive today with 73 families and over 7000 species reported worldwide (Ng et al., 2008; Davie et al., 2015).

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Their distribution ranges from the depth of the 6000 meters in the oceanic environment (Hessler and Wilson, 1983) to the height of 4000 meters above sea levels (Colosi, 1924). Brachyuran crabs are one of the most dominant groups in many marine habitats where salinity and temperatures can alter intensely (Ng et al., 2008). Studies on brachyuran fauna of Indian seas have been initiated since mid-1700s and the pace increased after British colonial scientists started collecting on a larger scale and reported the material in a series of important papers (Henderson, 1893; Alcock, 1895, 1899, 1900; Alcock and Anderson, 1894a, 1894b; Wood-Mason and Alcock, 1891a, 1891b, 1891c, 1891d, 1891e, 1891f, 1891g, 1891h, 1892a, 1892b, 1893). In India 910 marine brachyuran crab species (361 genera, 62 families) have been reported (Trivedi et al., 2018a), out of which Tamil Nadu coast has 453 species belonging to 46 families and 215 genera (Trivedi et al., 2018a; Viswanathan et al., 2019). It has been observed that the Gulf of Mannar, Palk Bay, Nagapattinam, and Pondicherry landing sites of Tamil Nadu state are having maximum catch percentage of crabs in entire India (Rao et al., 1973).

The Gulf of Mannar is situated on the southeast coast of India which is remarkable for its species richness and diversity of marine fauna (Jeyabaskaran et al., 2000). Numerous studies are carried out on the diversity of brachyuran crabs of Gulf of Mannar (Sankarankutty, 1966; Jeyabaskaran et al., 2000; Jeyabaskaran and Khan, 2007; Gokul and Venkataraman, 2010; Vidhya et al., 2017). Gulf of Mannar is well known for its faunistic richness and diversity and Henderson (1893) has appropriately remarked “No collection ground in the Indian seas can show a greater profusion of animal life than the Gulf of Mannar". The present study provides detailed diagnostic characters of some deep-sea species sampled from the discarded fisheries bycatch at Mandapam fishing harbor located in the Gulf of Mannar. This is the first study exclusively carried out on the diversity of brachyuran crabs in bycatch from Gulf of Mannar.

2 Materials and Methods

The specimens examined during the present study were collected from the discarded bycatch captured by commercial trawlers operating in Gulf of Mannar, Tamil Nadu, India during July 2019-March 2020. The specimens were washed properly to remove debris, and photographed to record live coloration. The specimens were preserved in 70% alcohol and deposited in the Zoological Reference Collection (LFSc.ZRC), Department of Life Sciences, Hemchandracharya North Gujarat University, Patan, Gujarat, India.

- **Abbreviations**: CW, carapace width; CL, carapace length; P2–5, pereopod 2–5 (ambulatory leg 1–4); G1, male first gonopod; coll, Collector.

3 Results and Discussions

Among the examined crab samples from the bycatch in present study, 18 species belonging to 15 genera and 8 families were recorded. 8 species were recorded belonging to family Leucosiidae followed by 4 species belonging to Parthenopidae. Families like Epialtidae, Scalopidiidae, Corystidae, Euryplacidae, Iphiculidae and Xanthidae were represented by single species each. From the collection *Lyphira heterograna* Ortmann, 1892 is reported first time from the East coast of India.

3.1 Species Account:
Order Decapoda Latreille, 1802
Infraorder Brachyura Latreille, 1802.

3.1.1 Family Scalopidiidae Števčić, 2005
Genus *Scalopidia* Stimpson, 1858
Scalopidia indica Ng and Castro, 2013 (Figs. 1A and B)
Scalopidia spinosipes: Henderson, 1893: 379; Alcock, 1900: 325; Chopra, 1935: 513; Guinot et al., 2013: 118, 294 (part).
Scalopidia indica Ng and Castro, 2013: 63-65, Fig. 2G; Trivedi et al., 2018b: 306-308, Fig. 2.

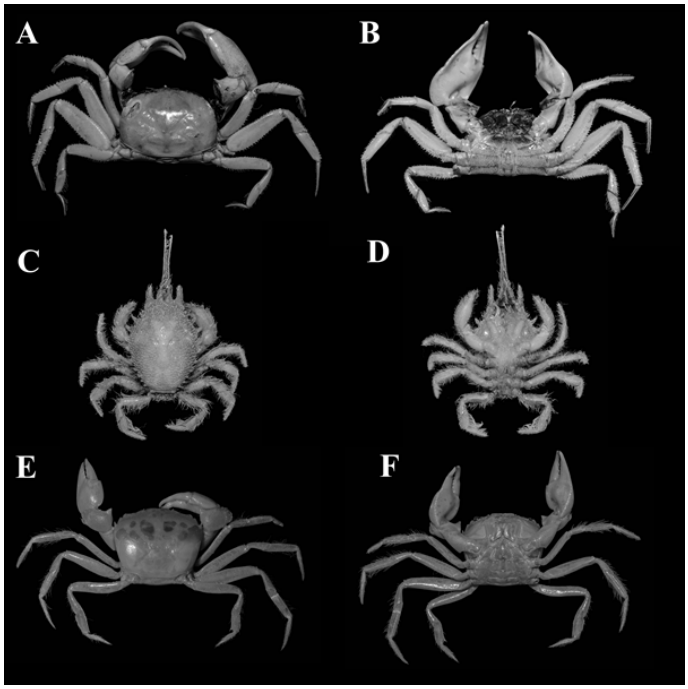

Figure 1: A. *Scalopidia indica* Ng and Castro, 2013, male (CL: 17.61mm, CW: 24.63mm), LFSc.ZRC-90, dorsal view; B. ventral view; C. *Gomeza bicornis* Gray, 1831, male (CL: 21.01mm, CW: 16.83mm), LFSc.ZRC-163, dorsal view; D. ventral view; E. *Eucrate indica* Castro and Ng, 2010, female (CL: 17.31mm, CW: 21.14mm), LFSc.ZRC-164, dorsal view; F. ventral view.

Material examined: 1 male (CL: 17.61 mm, CW: 24.63 mm), LFSC.ZRC–90, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Ng and Castro (2013: 63–65).

Remarks: The specimen examined in the present study agrees with the description given by Ng and Castro (2013) and Trivedi et al., (2018b). *Scalopidia indica* is closely related to *S. spinosipes* Stimpson, 1858, but differs from the latter in having following characters: the P5 merus relatively longer and more slender (Fig. 1A) (the P5 merus relatively less longer and slender in *S. spinosipes*, cf. Ng and Castro, 2013: Figs. 8A, B); abdominal somite 6 moderately wider than long (Fig. 1B) (male abdominal somite 6 as wide as long in *S. spinosipes*, cf. Ng and Castro, 2013: Figs. 10A, B); the distal part of G1 elongated and distinctly flared (the distal part of G1 elongated and slightly flared in *S. spinosipes*, cf. Ng and Castro, 2013: Figs. 12A-D).

Worldwide Distribution: The species is reported from Thailand (Ng and Castro, 2013); Sri Lanka (Laurie, 1906) and India (Trivedi et al., 2018b).

Distribution in India: The species is so far reported from West Bengal (Chopra, 1935; Deb 1999); Tamil Nadu (Trivedi et al., 2018b; present study) and Andaman and Nicobar Islands (Ng and Castro, 2013).

3.1.2 Family Corystidae Samouelle, 1819

Genus *Gomeza* Gray, 1831
Gomeza bicornis Gray, 1831 (Figs. 1C and 1D)
Gomeza bicornis Gray, 1831: 39; Gray, 1833: 296, pl. 24, Fig. 1; Muraoka, 1998: 31.
Corystes (*Oeidea*) *vigintispinosa* De Haan, 1833-1849 (1833): pl. 2, Figs. 5-5a, pl. A; Yamaguchi, 1993: 578.
Corystes (*Oeidea*) *20-spinosa* De Haan, 1833-1849 (1835): 44.
Gomeza vigintispinosa Milne Edwards A., 1874: 52, pl. 3, Fig. 5.

Material examined: 1 male (CL: 21.01 mm, CW: 16.83 mm), LFSC.ZRC-163, Gulf of Mannar (8°28'12" N, 79°01'12" E), 09/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Gray (1831: 39–40).

Remarks: The specimen examined in the present study agrees with the description given by Gray (1831) and Ng et al., (1998). The genus *Gomeza* closely resembles with *Jonas* Jacquinot and Lucas, 1853 but differs from the latter by having the carapace comparatively broader and egg-shaped, the dorsal surface is prominently convex, anterolateral margin bearing three small blunt teeth and the P5 dactyli is not spatuliform.

Worldwide Distribution: The species is reported from Mozambique (Barnard, 1946); Sri Lanka; Japan (Sakai, 1976; Miyake, 1983; Dai and Yang, 1991); China (Dai et al., 1991); Singapore (Nobili et al., 1903); Australia (Campbell and Stephenson, 1970; Hale, 1927) and India (Savurirajan et al., 2018).

Distribution in India: The species is so far reported from Andaman and Nicobar Islands (Savurirajan et al., 2018) and Tamil Nadu (Rajan et al., 2012; Gopalakrishnan et al., 2012).

3.1.3 Family Euryplacidae Stimpson, 1871

Genus *Eucrate* De Haan, 1835
Eucrate indica Castro and Ng, 2010 (Figs. 1E and 1F)
Eucrate alcocki Ng and Davie, 2002: 378; Rajkumar et al., 2009: 832, Fig. 1.
Eucrate crenata var. *dentata*: Alcock, 1900: 299 and 301; Sankarankutty, 1966: 350.
Eucrate indica Castro and Ng, 2010: 32-35, Fig. 9.

Material examined: 1 female (CL: 17.31mm, CW: 21.14 mm), LFSc.ZRC–164, Gulf of Mannar (8°28'12" N, 79°01'12" E), 09/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Castro and Ng (2010: 32–35).

Remarks: The specimen examined in the present study agrees with the original description given by Castro and Ng, (2010). *Eucrate indica* closely resembles *E. alcocki* Serène in Serène

and Lohavanijaya, 1973, but can be distinguished from the latter on the basis of the following characters: there are usually six large spots arranged transversely across the median portion of the carapace and numerous smaller spots on the anterior portion of the carapace (Fig. 1E) (there are consistently one to six large spots or blotches on the median portion of the carapace, and the anterior portion has numerous smaller spots in *E. alcocki* cf. Castro and Ng, 2010: Figs. 2C, 4A, B), the carapace is comparatively wider (Fig. 1E) (the carapace is comparatively less wider in *E. alcocki* cf. Castro and Ng, 2010: Figs. 2C, 4A, B), the frontal margin is generally more prominent, well produced, and with a distinct median notch (Fig. 1E) (less prominent, with the median notch shallow or barely visible in *E. alcocki*, cf. Castro and Ng, 2010: Figs. 4A–C), the cleft between the frontal margin and inner suborbital tooth is deep and pronounced (the cleft between the frontal margin and inner suborbital tooth is shallow in *E. alcocki*, cf. Castro and Ng, 2010), the supraorbital border has a deep and prominent notch (the supraorbital border has a shallow and less distinct notch in *E. alcocki*, cf. Castro and Ng, 2010: Figs. 4A–C).

Worldwide Distribution: The species is reported from Malaysia; Thailand (Castro and Ng, 2010) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Gujarat (Trivedi et al., 2018a) and Tamil Nadu (Jeyabaskaran et al., 2000; Rajkumar et al., 2009; Krishnamoorthy, 2009; Castro and Ng, 2010; Silambarasan et al., 2017; present study).

3.1.4 Family Iphiculidae Alcock, 1896

Genus Iphiculus Adams and White, 1849

Iphiculus spongiosus Adams and White, 1849 (Figs. 2A and 2B)

Iphiculus spongiosus Adams and White, 1849: 57, pl. 13, Fig. 5; Stephensen, 1946: 70, Figs. 6d, e; Apel, 2001: 50; Naderloo and Sari, 2005: 33, Fig. 2; Naderloo and Sari, 2007: 342, tab. 1.

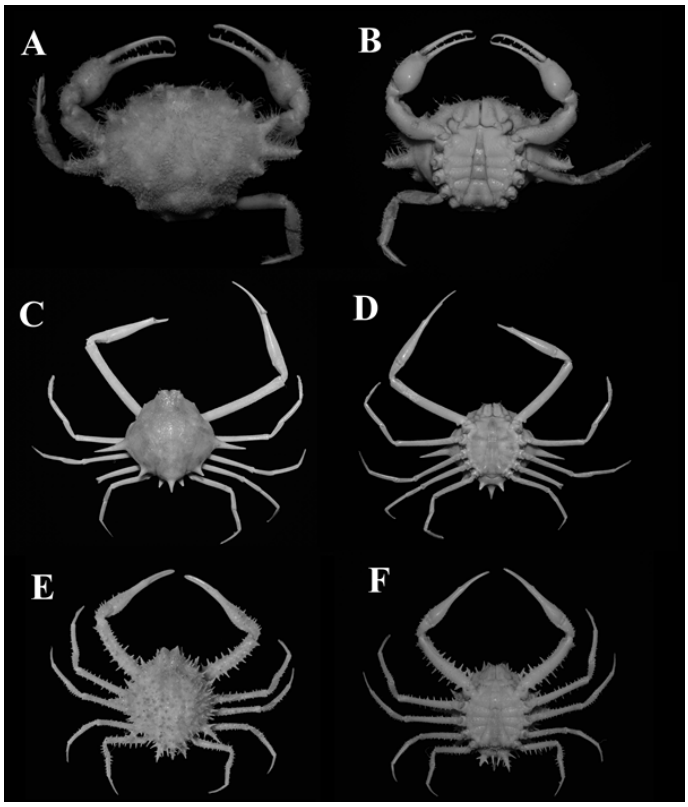

Figure 2: A. *Iphiculus spongiosus* Adams and White, 1849, male (CL: 13.59mm, CW: 17.71mm), LFSc.ZRC-165, dorsal view; B. ventral view; C. *Arcania heptacantha* (De Man, 1907), male (CL: 16.96mm, CW: 17.86mm), LFSc.ZRC-166, dorsal view; D. ventral view; E. *Arcania erinacea* (Fabricius, 1787), male (CL: 12.14mm, CW: 10.74mm), LFSc.ZRC-167, dorsal view; F. ventral view.

Material examined: 1 male (CL: 13.59mm, CW: 17.71mm), 1 female (CL: 9.22 mm, CW: 12.42 mm), LFSc.ZRC–165, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Adams and White (1849: 57).

Remarks: The specimen examined in the present study completely agrees with the original description given by Adams and White (1849). The genus *Iphiculus* is represented by only two species *I. spongiosus* and *I. convexus* Ihle, 1918. *Iphiculus spongiosus* can be distinguished from the latter by having comparatively longer anterolateral teeth.

Worldwide Distribution: The species is reported from Iran (Apel, 2001; Naderloo and Sari, 2005, 2007); Gulf of Oman (Stephensen, 1946); Pakistan (Alcock, 1896); Japan (Sakai, 1976; Miyake, 1983; Naruse et al., 2017); Taiwan (Lin, 1949); China (Stimpson, 1907; Dai and Yang, 1991); Thailand, Singapore (Nobili, 1903); Philippines (Serène and Vadon, 1981; Chen, 1989); Indonesia (Ihle, 1918) and India (Trivedi et al., 2018a)

Distribution in India: The species is so far reported from Tamil Nadu (Alcock, 1894, 1896; Dev Roy, 2015; present study); Odisha (Dev Roy and Rath, 2017; present study); West Bengal (Chopra, 1933; Deb, 1999); Andaman and Nicobar Islands (Alcock, 1895, 1896)

3.1.5 Family Leucosiidae Samouelle, 1819

Genus *Arcania* Leach, 1817
Arcania heptacantha De Man, 1907 (Figs. 2C and 2D)
Cancer septemspinosus Herbst, 1792: 259, pl. 20, Fig. 112.

Iphis heptacantha de Haan; Herklots, 1861: 27 [nomen nudum].
Iphis septemspinosa Stimpson, 1858: 161; 1907: 157.
Arcania heptacantha de Man, 1907: 398, pl. 31, Figs. 8-10; Ng et al., 2001: 9.
Arcania septemspinosa Rathbun, 1902: 30; K. Sakai, 1999: 16, pl. 6d.
Arcania siamensis Rathbun, 1910: 314 (part).

Material examined: 1 male (CL: 16.96 mm, CW: 17.86 mm), 1 female (CL: 20.01 mm, CW: 20.39 mm), LFSc.ZRC–166, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Galil (2001a: 87–88).

Remarks: The specimens examined in the present study agrees with the description provided by Galil (2001a). *Arcania heptacantha* closely resembles *A. septemspinosa* (Fabricius, 1787) but differs from the latter in the following characters: the dorsal surface of the carapace is uniformly granulated (Fig. 2C) (the dorsal surface of the carapace with granulated ridges going medially from intestinal spine in *A. septemspinosa*, cf. Galil, 2001a: Fig. 3B) and the merus of cheliped shorter as compared to the carapace (Fig. 2C) (the merus of cheliped longer as compared to the carapace in *A. septemspinosa*, cf. Galil, 2001a: Fig. 3B).

Worldwide Distribution: The species is reported from Philippines (Serène and Vadon, 1981); Japan (Sakai, 1976); China (Dai et al., 1991); Taiwan (Lin, 1949); Hong Kong; Singapore (Galil, 2001a); Gulf of Thailand (Rathbun, 1910); Japan (Ganmanee et al., 2004); Australia (Campbell, 1971); Papua New Guinea (Galil and Ng, 2015) and India (Trivedi et al., 2018).

Distribution in India: The species is so far reported from Gujarat (Beleem et al., 2016) and Tamil Nadu (Jeyabaskaran et al., 2000; Krishnamoorthy, 2009; Gokul and Venkatraman, 2010; present study).

Arcania erinacea Fabricius, 1787 (Figs. 2E and 2F)
Cancer Erinaceus Fabricius, 1787: 325; Fabricius, 1793: 460; Zimsen, 1964: 647.
Leucosia erinaceus Fabricius, 1798: 352; Bosc, 1830: 288.
Arcania erinaceus Leach, 1817: 24; Fransen et al., 1997: 87.
Arcania crinaceus Naiyanetr, 1998: 58. [erroneous spelling].
Arcania erinacea K. Sakai, 1999:16, pl. 6c.

Material examined: 2 males (CL: 12.14 mm – 15.91 mm, CW: 10.74 mm – 14.42 mm), 1 female (CL: 14.60 mm, CW: 13.09 mm), LFSc.ZRC–167, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Galil (2001a: 79–80).

Remarks The specimens examined in the present study agree with the description given by Galil (2001a) and Rout et al., (2019). The species *Arcania erinacea* (Figs. 2E, F) differs from all other *Arcania* species by having secondarily spinous lateral, posterolateral and posterior spines (cf. Galil, 2001a).

Worldwide Distribution: The species is reported from Iran (Naderloo and Sari, 2005, 2007); Kuwait (Apel, 2001); Qatar (Apel, 2001); Oman (Galil, 2001a); Pakistan (Tirmizi and Kazmi, 1986); Sri Lanka; Japan (Sakai, 1976); China (Shen, 1940); South China Sea (Dai and Yang, 1991); Thailand (Galil, 2001a); Singapore (Galil, 2001a) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Tamil Nadu (Alcock, 1896; Jeyabaskaran et al., 2000; Krishnamoorthy, 2007, 2009; present study); Andhra Pradesh (Alcock, 1895); Odisha (Alcock, 1895; Pal and Khora, 1999; Dev Roy, 2008; Dev Roy and Rath, 2017) and West Bengal (Alcock, 1895; Chopra, 1933; Dev Roy and Nandi, 2012).

Genus *Seulocia* Galil, 2005
Seulocia vittata Stimpson, 1858 (Figs. 3A and 2B)
Cancer craniolaris Herbst, 1783: 90, pl. 2, Fig. 17.
Leucosia craniolaris Fabricius, 1798: 350 (part); K. Sakai, 1999: 19, pl. 7E.
Leucosia vittata Stimpson, 1858: 159; 1907: 149, pl. 18, Figs 3, 3a; Alcock, 1896: 232; Ihle, 1918: 316; Lin, 1949: 15; Shen and Dai, 1964: 28, Fig.; Chhapgar, 1969: 609; Serène, 1968: 47; Huang, 1994: 580; Chen and Sun, 2002: 436, Fig. 197, pl. 16.8.
Leucosides craniolaris Rathbun, 1910: 310 (part).
Leucosia sinica Shen and Chen, 1978: 80, pl. 2, Figs 12, 13, text-Fig. 5; Huang, 1994: 580; Chen and Sun, 2002: 440, Fig. 199.
Not *Leucosia vitata* Sakai, 1937: 150, text Fig. 30 [= *S. rhomboidalis* (De Haan, 1841) juv.].
Not *Leucosia vittata* Sakai, 1976: 123, pl. 35, Fig. 4; Ng et al., 2001: 9, Fig. 1g [= *S. latirostrata*].

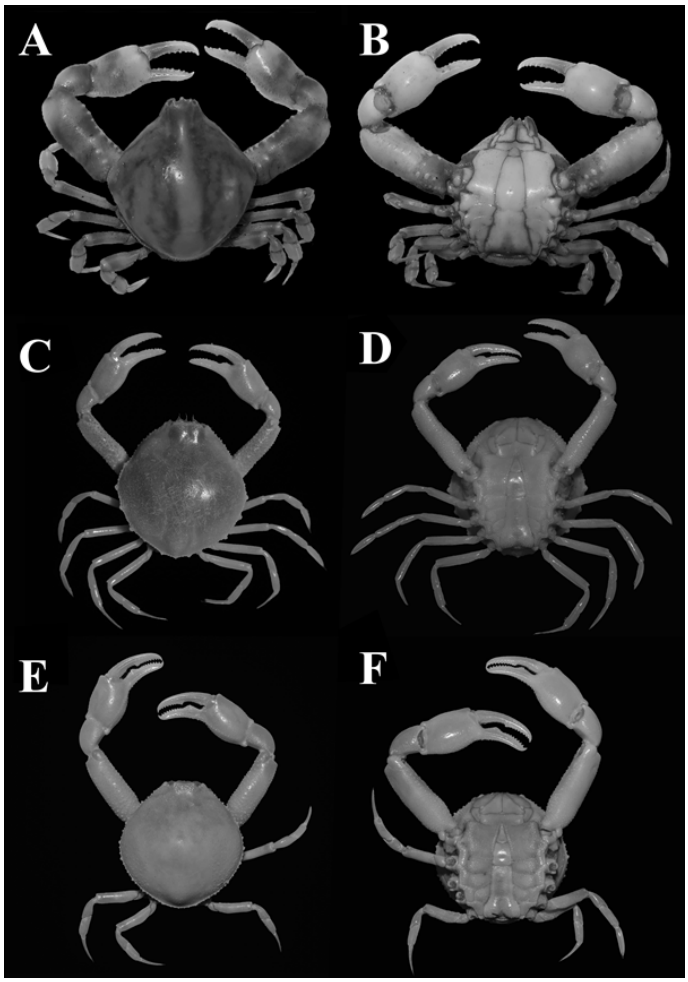

Figure 3: A. *Seulocia vittata* (Stimpson, 1858), male (CL: 22 mm, CW: 20 mm), dorsal view; B. ventral view; C. *Lyphira heterograna* (Ortmann, 1892), male (CL: 12.20mm, CW: 12.17mm), LFSc.ZRC-168, dorsal view; D. ventral view; E. *Lyphira perplexa* Galil, 2009, male (CL: 23.36mm, CW: 23.39mm), LFSc.ZRC-169, dorsal view; F. ventral view.

Material examined: 1 male, (CL: 22 mm, CW: 20 mm), MBRC/ZSI D1-609, Gulf of Mannar (8°28'12" N, 79°01'12" E), 09/03/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Galil (2005: 54–55).

Remarks: The specimens examined in the present study agree with the description given by Galil, (2005) and Prakash and Kumar (2020).

Worldwide Distribution: India, Mauritius, China, Malaysia, Singapore, Thailand, Indonesia and Philippines (Galil, 2009).

Distribution in India: The species is so far reported from Malabar coast and Tamil Nadu (Galil, 2005; Prakash and Kumar, 2020).

Genus *Lyphira* Galil, 2009
Lyphira heterograna Ortmann, 1892 (Figs. 3C and 3D)
Philyra globulosa H. Milne Edwards, 1836-1844 (1837), pl. 24, fig. 4; 1837: 132.
Philyra heterograna Ortmann, 1892: 582, pl. 26, Fig. 17; Chen and Sun, 2002: 379, text Fig. 169, pl. 14.4.
Philyra globosa Lanchester 1900: 764 (p.p.).

Philyra peitahoensis Shen, 1932: 18, pl. 1.1-2, text Figs. 10-12, 16b.; Serène, 1968: 46.
Philyra anatum Rathbun, 1910: 312.
Philyra acutidens Chen, 1987: 195, Fig. 1.; Chen Sun, 2002: 381, text Fig. 170, pl. 15.1.
Lyphira heterograna Galil, 2009: 300, Fig. 14.

Material examined: 2 males (CL: 10.62 mm – 12.20 mm, CW: 10.58 mm – 12.17 mm), 1 female (CL: 11 mm, CW: 11.24 mm), LFSc.ZRC–168, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Galil (2009: 300–301).

Remarks: The specimens examined in the present study agree with the description given by Galil (2009). *Lyphira heterograna* can be confused with *L. perplexa* Galil, 2009 however, it can be differentiated from the latter species in the following characters: the overall body size comparatively smaller (male: 10.62 mm –12.20 mm; female: 11 mm –11.24 mm) (Figs. 3C, D) (overall body size comparatively larger (male: 27.9 mm–10.2 mm; female: 14.2 mm–21.8 mm) in *L. perplexa*, cf. Galil, 2009: Fig. 17); merus of first pereiopod without a ventral line of pearliform granules (Fig. 3C) (merus of first pereiopod with a ventral line of pearliform granules in *L. perplexa*, cf. Galil, 2009: Fig. 17) and G1 with digitate apical process (G1 with flattened, squat, distally rounded apical process in *L. perplexa*, cf. Galil, 2009: Fig. 12B).

Worldwide Distribution: The species is reported from Japan; Taiwan; China; Malaysia; Indonesia; Philippines; East China Sea (Galil, 2009) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Kerala (Kumar et al., 2007) and in present study; it is reported for the first time from east coast of India from Tamil Nadu.

Lyphira perplexa Galil, 2009 (Figs. 3E and 3F)
Cancer globus Fabricius, 1775: 401.
Cancer anatum Herbst, 1783: 93, pl. 2, Fig. 19.
Cancer globosus Fabricius, 1787: 315, 1793: 441.
Leucosia globosa Fabricius, 1798: 349.
Lyphira perplexa Galil, 2009: 303, Figs. 12c, 17.
Philyra globulosa Alcock, 1896: 245; Chopra, 1934: 38; Stephensen, 1946: 77, Figs. 10, 11a–l; Tirmizi and Kazmi, 1986: 98, Fig. 28; Apel, 2001: 57; Naderloo and Sari, 2005: 40, Fig. 9, 2007: 342, Tab. 1.

Material examined: 1 male (CL: 23.36 mm, CW: 23.39 mm), LFSc.ZRC–169, Gulf of Mannar (8°28'12" N, 79°01'12" E), 10/10/2019. Coll. S. Prakash.

Diagnosis: see Galil (2009: 303–305).

Remarks: The specimen examined in the present study agrees with the description given by Galil (2009). *Lyphira perplexa* closely resembles with *L. heterograna* but can be differentiated from the latter species in several characters which are discussed in the remarks of *L. heterograna* above.

Worldwide Distribution: The species is reported from Persian Gulf; Gulf of Oman; Pakistan and India (Galil, 2009).

Distribution in India: The species is so far reported from Kerala (Alcock, 1896; Galil, 2009; Lakshmi Pillai et al., 2013); Tamil Nadu (Alcock, 1896; Galil, 2009; present study); West Bengal (Alcock, 1896; Deb, 1999; Galil, 2009) and Andaman and Nicobar Islands (Alcock, 1896; Galil, 2009).

Genus *Myra* Leach, 1817
Myra affinis Bell, 1855 (Figs. 4A and 4B)
Myra affinis Bell, 1855: 296, pl. 32, Fig. 2a–c; Alcock, 1896: 201 (in key), 205; Stephensen, 1946: 71, Fig. 7a–c; Apel, 2001: 53; Galil, 2001b: 413 (in key), 414–416, Figs. 1a, 4.

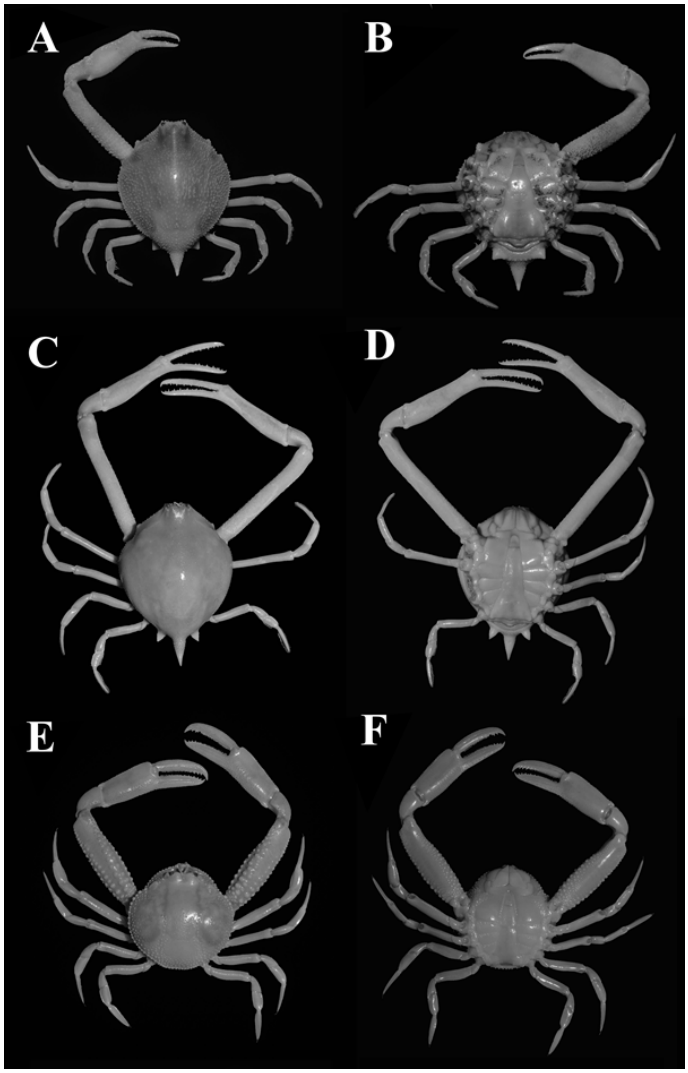

Figure 4: A. *Myra affinis* Bell, 1855, male (CL: 17.08mm, CW: 14.92mm), LFSc.ZRC-170, dorsal view; B. ventral view; C. *Myra fugax* (Fabricius, 1798), male (CL: 23.86mm, CW: 21.34mm), LFSc.ZRC-171, dorsal view; D. ventral view; E. *Ryphila cancellus* (Herbst, 1783), male (CL: 13.67mm, CW: 14.42mm), LFSc.ZRC-172, dorsal view; F. ventral view.

Material examined: 1 male (CL: 23.86 mm, CW: 21.34 mm), LFSc.ZRC–170, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Galil (2001b: 414–416).

Remarks: The specimen examined in the present study agrees with the description given by Galil (2001b). *Myra affinis* closely resembles *M. mammillaris* Bell, 1855 but can be distinguished from the on the basis of following characters: the median posterior carapacial denticle is acuminate (Fig. 4A) (the median posterior carapacial denticle is rounded in *M. mammillari*, cf. Galil, 2001b: Fig. 2e); the third male thoracic sternite with horizontal granulate band (Figs. 4B) (the third male thoracic sternite without horizontal granulate band in *M. mammillari*, cf. Galil, 2001b) and granulated abdominal margin of female (smooth abdominal margin of female in *M. mammillari*, cf. Galil, 2001b).

Worldwide Distribution: The species is reported from Persian Gulf (Alcock, 1896); United Arab Emirates (Nobili, 1906); Pakistan (Naderloo, 2017); Myanmar (Alcock, 1896); Japan (Naderloo, 2017); Sri Lanka (Alcock, 1896); Taiwan; China (Dai and Yang, 1991); Thailand (Stephensen, 1946); Philippines (Bell, 1855); Indonesia (Ihle, 1918; Tyndale-Biscoe and George, 1962); Australia (Tyndale-Biscoe and George, 1962; Campbell and Stephenson, 1970) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Odisha (Alcock, 1896; Dev Roy and Rath, 2017); Tamil Nadu (Krishnamoorthy, 2007, 2009; Dev Roy, 2015; present study) and Andaman and Nicobar Islands (Alcock, 1896; Dev Roy and Nandi, 2012).

Myra fugax Fabricius, 1798 (Figs. 4C and 4D)
Cancer punctatus Herbst, 1783: 89, pl. 2, Figs. 15, 16.
Leucosia fugax Fabricius, 1798: Latreille, 1802: 119, pl. 1, Figs. 1, 2.
Myra fugax Desmarest, 1825: 169, pl. 28, Fig. 3; K. Sakai, 1999: 17, pl. 6, Fig. f.

Material examined: 2 males (CL: 12.68 mm – 13.43mm, CW: 15.84 mm – 16.99 mm), LFSc.ZRC–171, Gulf of Mannar (8°28'12" N, 79°01'12" E), 15/07/2019. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Galil (2001b: 418–421).

Remarks: The specimens examined in the present study agrees with the description given by Galil, 2001b and Shih et al. (2015). *Mrya fugax* closely resembles with *M. subgranulata* Kossmann, 1877 and *M. celeries* Galil, 2001 but differs in the following characters: the male cheliped merus 1.1 times as long as the carapace (Figs. 4C) (male cheliped merus 1.4 times as long as the carapace in *M. subgranulata* while male cheliped merus 1.5 times as long as the carapace in *M. celeries*, cf. Galil, 2001b: Figs. 3a, 1d respectively); the fingers as long as the upper margin of the palm (Figs. 4C) (0.7 times as long as the palm in *M. subgranulata* while fingers half as long as the palm in *M. celeries*, cf. Galil, 2001b: Figs. 3a, 1d respectively) and apical process of G1 outcurved, distally vulvate (apical process of G1 curved distad, entire in *M. subgranulata*; the apical process of the first male pleopod curved distad, bearing a denticle on the interior margin in *M. celeries*, cf. Galil, 2001b: Figs. 16, 7 respectively).

Worldwide Distribution: The species is reported from Fiji; Vietnam; Solomon Islands; Sri Lanka (Galil, 2001b) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Maharashtra (Chhapgar, 1969; Dev Roy, 2013); Karnataka (Dev Roy, 2013); Kerala (Kumar et al., 2007); Tamil Nadu (Henderson,

1893; Alcock, 1894; Jeyabaskaran et al., 2000; Krishnamoorthy, 2007, 2009; Galil, 2001b; present study); West Bengal (Chopra, 1933; Deb, 1999) and Andaman and Nicobar Islands (Sankarankutty, 1962; Bakus, 1994; Venkataraman et al., 2004).

Genus *Ryphila* Galil, 2009
Ryphila cancellus Herbst, 1783 (Figs. 4E and 4F)
Cancer cancellus Herbst, 1783: 94, 95, pl. 2, Fig. 20.
Leucosia scabriuscula Weber, 1795: 92.
Philyra scabriuscula Stephensen, 1946: 88, 89, Figs. 15c–e; Tirmizi and Kazmi, 1986: 98 (in key), 106–109, Figs. 31a–i.
Philyra cancella Sakai, 1999: 17, 18, pl. 7b; Apel, 2001: 56.
Ryphila cancellus Galil, 2009: 310–312, Figs. 21a, 22; Naderloo et al., 2013: 449, Tab. 1, 3.

Material examined: 1 male (CL: 13.67 mm, CW: 14.42 mm), 1 female (CL: 12.06 mm, CW: 12.57 mm), LFSc.ZRC–172, Gulf of Mannar (8°28'12" N, 79°01'12" E), 09/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Galil (2009: 310–312).

Remarks: The specimen examined in the present study agrees with the description provided by Galil (2009). *Ryphila cancellus* closely resembles *R. verrucose* (Henderson, 1893), but differs from the latter in having following characters: the dorsal surface of carapace bearing comparatively smaller perliform granules on branchial, cardiac, intestinal regions, along branchio-cardiac grooves, and medially on gastric region (Fig. 4E) (the dorsal surface of carapace excluding frontal region, bearing closely-spaced comparatively larger perliform granules in *R. verrucose*, cf. Galil, 2009: Fig. 23A) the anterior margins of thoracic sternite in male granulated (Fig. 4F) (the entire thoracic sternite surface in male prominently granulated in *R. verrucose*, cf. Galil, 2009: Fig. 23B), the exognath reniform, punctate (the exognath greatly distended in *R. verrucose*, cf. Galil, 2009), branchio-cardiac grooves shallow (Fig. 4E) (branchio-cardiac grooves deep in *R. verrucose*, cf. Galil, 2009: Fig. 23A), the cheliped merus comparatively slender with dorsal surface less granulated (Fig. 4E) (the cheliped merus comparatively shorter, thicker bearing more numerous granules in *R. verrucose*, cf. Galil, 2009: Fig. 23A) and male first pleopod with apical process needle-like, nearly as long as shaft (male first pleopod with apical process sinuous, nearly as long as shaft in *R. verrucose*, cf. Galil, 2009).

Worldwide Distribution: The species is reported from East Africa; Madagascar; Oman; Persian Gulf; Gulf of Oman; Pakistan; Myanmar; Thailand; Borneo; Sumatra, Australia (Galil, 2009) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Gujarat (Trivedi et al., 2016); Maharashtra (Chhapgar, 1957a, b); Goa (Galil, 2009); Tamil Nadu (Galil, 2009; Kathirvel and Gokul, 2010; present study) and Andhra Pradesh (Devi et al., 1988).

3.1.7 Family Epialtidae MacLeay, 1838

Genus *Hyastenus* White, 1847
Hyastenus hilgendorfi De Man, 1887 (Figs. 5A and 5B)
Halimus hilgendorfi Rathbun, 1906: 881.

Hyastenus hilgendorfi De Man, 1887: 14–18, pl. i, Figs. 3, 4.
Hyastenus hilgendorfi Stephensen, 1946: 107, Figs. 20d, e; Griffin, 1968: 103–105, pl. 1, Fig. 1; Naderloo and Sari, 2007: 342, Tab. 1; Trivedi et al., 2020: 24-29. Figs, 1 a, b.

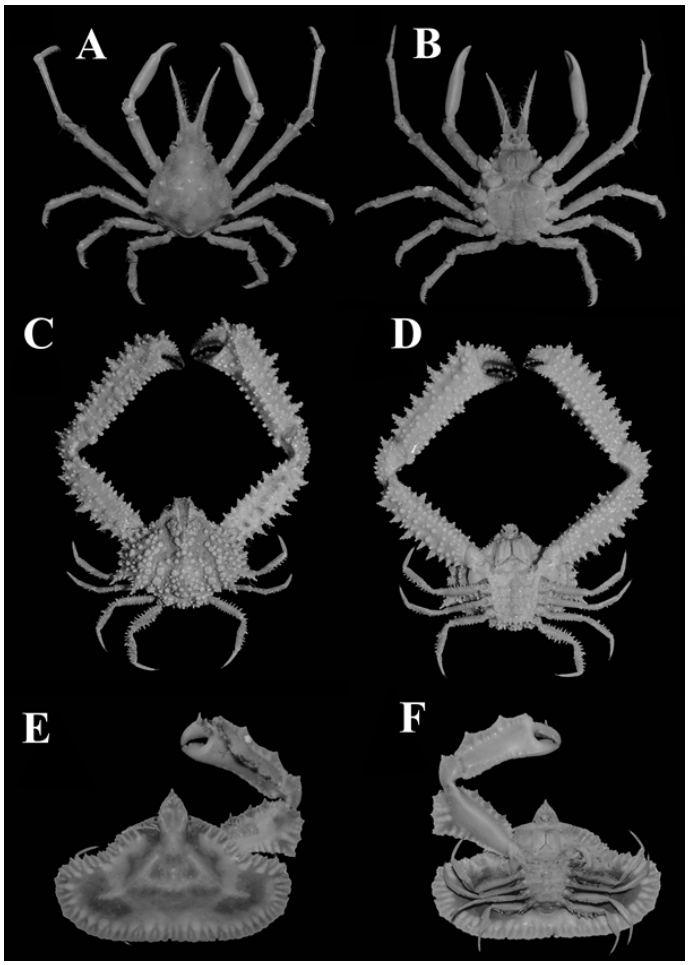

Figure 5: A. *Hyastenus hilgendorfi* de Man, 1887, male (CL: 18.25mm, CW: 13.57mm), LFSc.ZRC-175, dorsal view; B. ventral view; C. *Enoplolambrus echinatus* (Herbst, 1790), male (CL: 20.38mm, CW: 24.05mm), LFSc.ZRC-176, dorsal view; D. ventral view. E. *Cryptopodia fornicata* (Fabricius, 1787), male (CL: 23.02mm, CW: 35.3mm), LFSc.ZRC-177, dorsal view; F. ventral view

Material examined: 1 male (CL: 18.25 mm, CW: 13.57 mm), 1 female (CL: 15.67 mm, CW: 10.9 mm) LFSc.ZRC–175, Gulf of Mannar (8°28'12" N, 79°01'12" E), 29/09/2019. Coll. S. Prakash and D Adhavan.

Diagnosis: see Trivedi et al. (2020: 25–27).

Remarks: The specimens examined in the present study agree with the description given by Stephensen (1946) and Trivedi et al., (2020). *Hyastenus hilgendorfi* shows similarities with *H. auctus* Rathbun, 1916 but differs from the latter in following character: the margins having tubercles around branchial region (Fig. 5A) (margins not having tubercles around branchial region in *H. auctus*, cf. Trivedi et al., 2020).

Worldwide Distribution: The species is reported from East Africa; Red Sea; Persian Gulf; Thailand; Indonesia; Philippines; Australia; Hawaii (Griffin, 1968; Naderloo, 2017) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Gujarat (Trivedi et al., 2020); Tamil

Nadu (Henderson, 1893; Alcock, 1895; Griffin and Tranter, 1986; Dev Roy and Nandi, 2005, 2007; Dev Roy, 2015; present study); Odisha (Alcock, 1895; Dev Roy, 2008; Dev Roy and Rath, 2017) and Andaman and Nicobar Islands (Alcock, 1895; Dev Roy, 2008).

3.1.8 Family Parthenopidae MacLeay, 1838

Genus *Enoplolambrus* Milne-Edwards A., 1878
Enoplolambrus echinatus Herbst, 1790 (Figs. 5C and 5D)
Cancer echinatus Herbst, 1790: 255, pl. 19, Figs. 108-109; Herbst, 1803: 33.
Lambrus (*Platylambrus*) *echinatus* Alcock, 1895: 264; Sakai, 1938a: 333; Michel, 1964: 8.
Lambrus tuberculosus Stimpson, 1858: 220.
Lambrus echinatus Alcock, 1896: 264.
Enoplolambrus echinatus Pillai et al., 2014: 9.; Trivedi et al., 2018: 57.

Material examined: 1 male (CL: 20.38 mm, CW: 24.05 mm), LFSc.ZRC–176, Gulf of Mannar (8°28'12" N, 79°01'12" E), 08/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Herbst (1790).

Remarks: The specimens examined in the present study agree with the description given by Herbst (1970) and Alcock (1896).

Worldwide Distribution: The species is reported from Mauritius; Sri Lanka; Gulf of Thailand and Singapore (Herbst, 1790); China (Stimpson, 1907), Taiwan (Lin, 1949); Philippines (Flipse, 1931); Sulu Sea (Flipse, 1930); Indonesia (Flipse, 1930) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Gujarat (Beleem et al., 2014); Tamil Nadu (Herbst, 1790; Alcock, 1894; Krishnamoorthy, 2007, 2009; Lakshmi Pillai et al., 2013; Vidhya et al., 2017; present study); Andhra Pradesh (Alcock, 1895); Odisha (Alcock, 1895; Sahoo and Palita, 2013; Dev Roy and Rath, 2017) and Andaman and Nicobar Islands (Alcock, 1895).

Genus *Cryptopodia* H. Milne Edwards, 1834
Cryptopodia fornicata Fabricius, 1787 (Figs. 5E and 5F)
Cancer fornicata Fabricius, 1781:502; Herbst, 1790: 204, pl. 13, Figs. 79-80 (list only).
Parthenope (*Cryptopodis*) *fornicata* de Haan, 1833-1849 (1837): pl. 20, Figs. 2-2a, pl. F.; de Haan, 1833-1849 (1839).
Cryptopodia fornicate Milne Edwards H., 1834: 362; Chen and Xu, 1991; 81, Fig. 25.
Cryptopodia fornicata (sic) Dai et al., 1986: 159, pl. 21(7), Fig. 90 (Southern China).

Material examined: 1 male (CL: 23.02 mm, CW: 35.3 mm), 1 female (CL: 23.68 mm, CW: 37.23 mm), LFSc.ZRC–177, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Ravichandran et al., (2010: 164–165).

Remarks: The specimen examined in the present study agrees with the description given by Ravichandran et al. (2010). The specimen examined in the present study agrees with the description given by Ravichandran et al., (2010) and Trivedi and Vachhrajani (2013) *Cryptopodia*

fornicata closely resembles *C. angulata* H. Milne Edward and Lucas, 1841 and *C. echinosa* Chiong and Ng, 1998 but differs in the following characters: the dorsal surface of the carapace with comparatively shallow triangular depression at the center of the carapace (Fig. 5E) (dorsal surface of the carapace with deep triangular depression at the center of the carapace in *C. angulate*, cf. Trivedi and Vachhrajani, 2013: Fig. 2, and *C. echinosa*, cf. Fatemi et al., 2012: Fig. 2A) also, the posterolateral and posterior margin of the carapace crenulated (Fig. 5E) (the posterolateral and posterior margin of the carapace bearing broad, pointed spines in *C. angulate*, cf. Trivedi and Vachhrajani, 2013: Fig. 2 and *C. echinosa*, cf. Fatemi et al., 2012: Fig. 2A).

Worldwide Distribution: The species is reported from Persian Gulf (Alcock, 1895); Japan (de Haan, 1837); Taiwan (Lin, 1949); China (Stimpson, 1907); Malaysia (Lanchester, 1902); South China Sea (Chen and Xu, 1991); Indonesia (Flipse, 1930); Cambodia (Naruse et al., 2014); Australia; Gulf of Martaban; Gulf of Thailand and Philippines (Fabricius, 1781); New Guinea (Miers, 1886); Singapore (Dana, 1852; Nobili, 1903) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Tamil Nadu (Alcock, 1895; Krishnamoorthy, 2007, 2009; Ravichandran et al., 2010; Lakshmi Pillai et al., 2013; present study) and Andaman and Nicobar Islands (Alcock, 1895, 1896).

Genus *Parthenope* Weber, 1795
Parthenope longimanus Linnaeus, 1758 (Figs. 6A and 6B)
Cancer longimanus Linnaeus, 1758: 441.
Cancer longimanus Herbst, 1790: 252, pl. 19, Figs. 105, 106.
Lambrus (*Lambrus*) *longimanus* Flipse, 1930: 29, 84 (in list), Figs. 3, 11, 12, 16, 20, 21, 23a, b; Stephensen 1946: 113, Figs. 23a, b.
Parthenope longimana Tirmizi and Kazmi, 1986: 198–201, Figs. 61a–d.
Parthenope longimanus Apel, 2001: 67; Naderloo and Sari, 2007: 342, Tab. 1.

Material examined: 1 female (CL: 28.24 mm, CW: 30.05 mm), LFSc.ZRC–178, Gulf of Mannar (8°28'12" N, 79°01'12" E), 15/07/2019. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Linnaeus (1764).

Remarks: The specimen examined in the present study agrees with the description given by Shen (1982) and Linnaeus (1764). *Parthenope longimanus* closely resembles *P. sinensis* Chen in Shen, Dai and Chen, 1982 but differs from the latter in following character: Carapace is less convex with more finely granules (Fig. 6A) (carapace with sharp spines in *P. sinensis*, cf. Shen, 1982: Fig. 1).

Worldwide Distribution: The species is reported from Mauritius (Michel, 1964); Persian Gulf (Stephensen, 1946); Pakistan (Tirmizi and Kazmi, 1991); Japan (Sakai, 1976); Australia (Campbell and Stephenson, 1970); Malaysia (Lanchester, 1902); Philippines (Serène and Vadon, 1981); South China Sea (Chen and Xu, 1991); Sri Lanka ; Gulf of Thailand (Linnaeus, 1764); Indonesia (Miers, 1886); Arakan and Mergui Archipelago (Alcock, 1895); Taiwan (Lin, 1949); Singapore (Nobili, 1903c) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Kerala (Alcock, 1895; Dev Roy, 2013); Tamil Nadu (Henderson, 1893; Alcock, 1894, 1895; Fransen et al., 1997; Venkataraman et

al., 2004; Krishnamoorthy, 2007, 2009; Lakshmi Pillai et al., 2013; Vidhya et al., 2017; present study); Andhra Pradesh (Dev Roy, 2008); Odisha (Pal Khora, 1999; Dev Roy, 2008; Dev Roy and Rath, 2017) and Andaman and Nicobar Islands (Alcock, 1895; Dev Roy, 2008; Dev Roy and Nandi, 2012; Kumaralingam et al., 2017).

Genus *Rhinolambrus* A. Milne-Edwards, 1878
Rhinolambrus pelagicus Rüppell, 1830 (Figs. 6C and 6D)
Lambrus pelagicus Rüppell, 1830: 15, pl. 4, Fig. 1, pl. 6, Fig. 8; Milne Edwards H., 1834: 355.
Parthenope (*Rhinolambrus*) *lamelliger* Adams and White, 1848.
Lambrus affinis Milne Edwards A., 1872: 261, pl. 14, Fig. 1.
Parthenope (*Rhinolambrus*) *affinis heraldicus* Paulson, 1875
Lambrus (*Rhinolambrus*) *pelagicus* Alcock, 1895: 267; Nobili, 1903: 28.
Parthenope (*Rhinolambrus*) *pelagicus* Kim and Chang, 1985: 50.
Rhinolambrus pelagicus Ng and Davie, 2002: 372 (in list); Trivedi et al., 2018: 58.

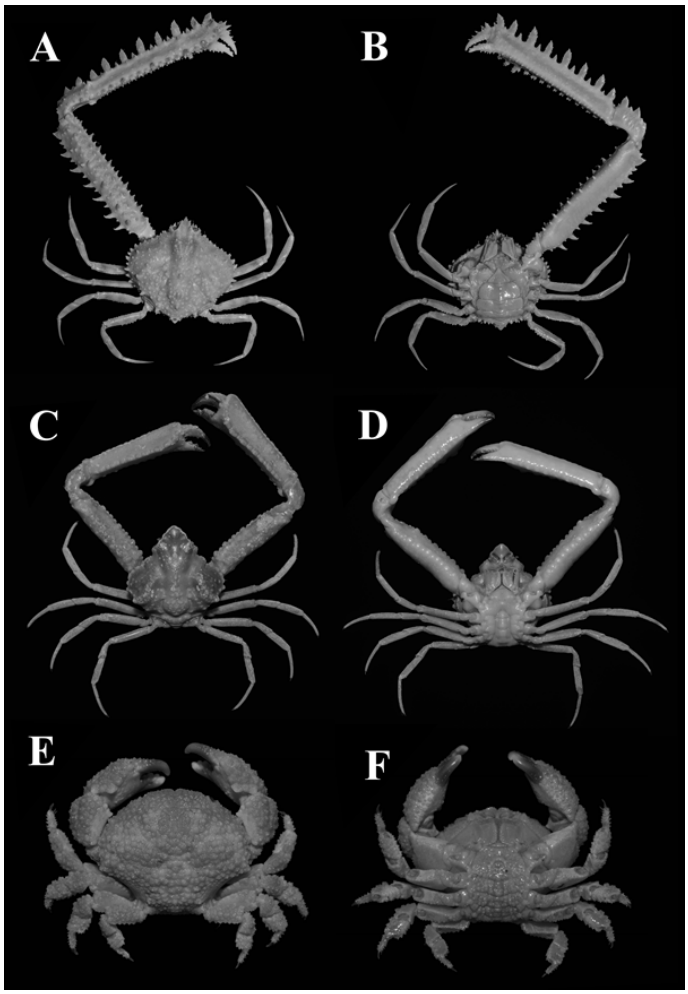

Figure 6: A. *Parthenope longimanus* (Linnaeus, 1758), female (CL: 28.24mm, CW: 30.05mm), LFSc.ZRC-178, dorsal view; B. ventral view; C. *Rhinolambrus pelagicus* (Rüppell, 1830), male (CL: 17.41mm, CW: 17.46mm), LFSc.ZRC-179, dorsal view; D. ventral view; E. *Actaea jacquelinae* Guinot, 1976, male (CL: 13.43mm, CW: 16.99mm), LFSc.ZRC-180, dorsal view; F. ventral view

Material examined: 2 males (CL: 16.58 mm – 17.41 mm, CW: 16.32 mm – 17.46 mm), LFSc LFSc.ZRC–179, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash.

Diagnosis: see Rüppell (1830).

Remarks: The specimen examined in the present study agrees with the description given by Rüppell (1830).

Worldwide Distribution: The species is reported from Somalia; Kenya; Tanzania; Madagascar; Red Sea; Sudan; Djibouti; Sri Lanka; Thailand; Indonesia; Malaysia; Singapore; Philippines; Taiwan; Japan; Korea; Palau; Australia; New Caledonia; Fiji; Samoa (Shinji Nagai and Gianna Innocenti, 2015) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Tamil Nadu (Henderson, 1893; Kathirvel and Gokul, 2010; present study) and Andaman and Nicobar Islands (Alcock, 1895; Dev Roy and Nandi, 2012; Dev Roy, 2015).

3.1.9 Family Xanthidae MacLeay, 1838

Genus *Actaea* De Haan, 1833
Actaea jacquelinae Guinot, 1976 (Figs. 6E and 6F)
Actaea calculosa Alcock, 1898: 152 (partly: material from the Persian Gulf); Stephensen, 1946: 153.
Actaea granulata Nobili, 1906: 127.
Actaea savignyi Stephensen, 1946: 151, Fig. 38c; Guinot, 1964: 44.
Actaea jacquelinae Serène, 1984: 113, fig. 65, pl. 14c; Tirmizi and Ghani, 1996: 11–13, Fig. 3.

Material examined 2 males (CL: 12.68 mm – 13.43 mm, CW: 15.84 mm – 16.99 mm), LFSc LFSc.ZRC–180, Gulf of Mannar (8°28'12" N, 79°01'12" E), 07/01/2020. Coll. S. Prakash and Amit Kumar.

Diagnosis: see Guinot (1976: 227).

Remarks: The specimens examined in the present study agrees with the description given by Guinot (1976) and Serène (1984).

Worldwide Distribution: The species is reported from Northern Indian Ocean: Persian Gulf, Gulf of Oman, Pakistan (Naderloo, 2017) and India (Trivedi et al., 2018a).

Distribution in India: The species is so far reported from Tamil Nadu (Henderson, 1893; Kathirvel and Gokul, 2010; present study); Odisha (Dev Roy and Rath, 2017) and Andaman and Nicobar Islands (Dev Roy and Nandi, 2012).

Conflict of interests

The authors declare that there are no competing interests.

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