

Brachyuran Crabs Associated with Echinoderms from the Andaman and Nicobar Islands, India

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Abstract

The present paper provides five symbiotic brachyuran crabs belonging to two families of Pilumnidae and Portunidae which are associated with echinoderms of Andaman and Nicobar Islands. They are associated with three classes of Echinodermata, such as Echinoidea, Holothuroidea and Crinoidea. The specimens were collected from intertidal and subtidal habitats of South Andaman, North Andaman and Great Nicobar Island. The brachyurans namely, *Ceratocarcinus longimanus* White, 1847, *Harrovia elegans* de Man, 1887 and *Tiamedon spinosum* (Miers, 1879) were associated with Crinoidea (Feather stars) while *Echinoecus pentagonus* (A. Milne-Edwards, 1879) is reported from Echinoidea (Sea urchin). One Portunid crab, *Lissocarcinus orbicularis* Dana, 1852 was recorded from Holothuroidea (Sea cucumber). *Tiamedon sphinosum* (Miers, 1879) was earlier recorded from Gulf of Mannar and it is recorded to Andaman Islands, while, *Harrovia elegans* de Man, 1887 and *Lissocarcinus orbicularis* Dana, 1852 were listed in literature from Andaman Islands with their description and host details.

Keywords: Andaman, Nicobar, Association, Echinoderms, malacostraca, symbiosis

Introduction

Andaman and Nicobar Islands are situated between Bay of Bengal and Andaman sea, contributing one of the major coral reef ecosystems in India. The Andaman Islands (10°30'-14°; 92°-93°) are emerged as a part of a mountain chain and lie on a ridge, which extends southward from the Irrawaddy delta area of Burma. The Andaman group is separated from the Nicobar group by Ten Degree Channel about 150 km wide. The Andaman and Nicobar Islands have fringing reefs around many islands, and a long barrier reef (329 km) on the west coast (Tikadar and Das, 1985).

The reef-associated biodiversity especially Echinoderm fauna of the Andaman and Nicobar Islands is well diversified with 478 species under 108 families and 48 orders. However, the studies on the associate species of Echinodermata symbionts were scanty (Sastry, 1981; Castro *et al.*, 1995; Roy and Nandi, 2012; Kumaralingam *et al.*, 2013, 2017). A total of 588 species of brachyuran crabs belonging to 275 genera and 58 families have been reported from Andaman and Nicobar Islands (Trivedi *et al.*, 2018). Many of them have shown to display specific

animal associations, especially with marine benthic invertebrates (Castro, 1989). Two families *i.e.* Pilumnidae and Portunidae of brachyuran crabs are closely associated with various species of echinoderms. In Andaman and Nicobar Islands, only five species of Echinoderms are associated with brachyuran crabs have been reported (Dev Roy and Nandini, 2012). The species of the families, Eumedoninae and Caphyrinae crabs are obligate symbionts of Feather stars (Comatulids), Sea urchin (Regular echinoids) and Sea cucumbers (Holothuroids). The present paper dealt with echinoderms associated brachyuran crabs of Andaman and Nicobar Islands with new record of *Tiamedon sphinosum* (Miers, 1879) to Andaman Islands, and *Harrovia elegans* de Man, 1887 and *Lissocarcinus orbicularis* Dana, 1852 are to Nicobar Islands.

Methods

The surveys have been carried out in intertidal and subtidal habitats of Andaman and Nicobar Islands (Fig. 1). The specimens were collected by hand picking and scuba diving at subtidal regions. Field photographs of Echinoderms and their associates were taken using

Canon G7X. The collected specimens with their associates were preserved in ethanol for further study. Identification of associated brachyuran crabs were based on external morphological characters by using standard literature (Crosnier, 1962; Clark and Rowe, 1971; Castro, 1995; Chia and Ng, 1998; Chia *et al.*, 1999; Ng and Jeng, 1999; Evans, 2016; Kumaralingam *et al.*, 2017) and terminology used by follows Ng *et al.* (2008). Photographs and measurements of crabs were taken using a digital camera attached to the Stereo Zoom Microscope (LEICA M 205A). The specimens were deposited in the National Zoological Collection, Andaman Nicobar Regional Centre, Zoological Survey of India, Port Blair. Abbreviations used are CL (Carapace Length), CW (Carapace Width).

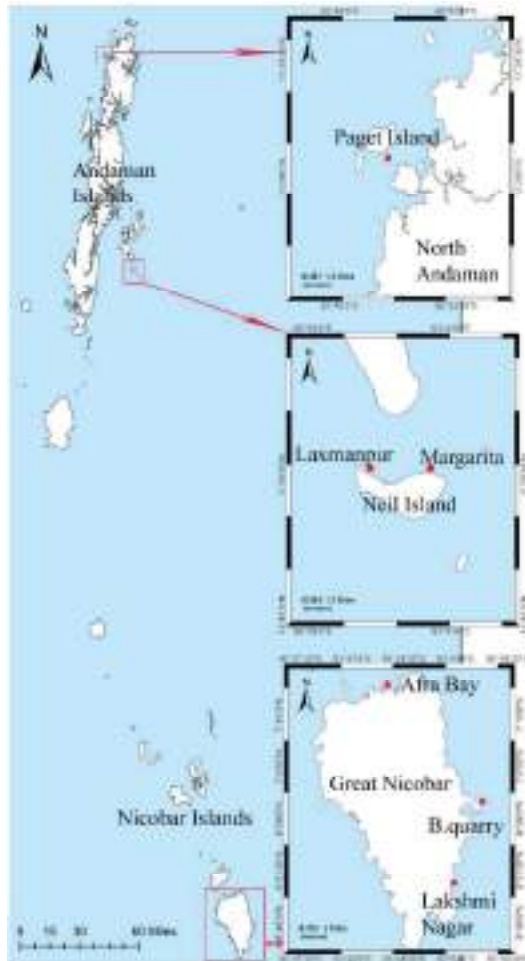


Fig. 1: Map showing the study areas of Andaman and Nicobar Islands

Results and discussion

During the study we have documented five species of brachyuran crabs which are obligate associated with echinoderms. The systematics, diagnosis, geographical distribution and their host details are presented in this paper (Table1).

Table1. Systematics of brachyuran crabs

Systematics
Phylum Arthropoda von Siebold, 1848
Subphylum Crustacea Brünnich, 1772
Class Malacostraca Latreille, 1802
Order Decapoda Latreille, 1802
Infraorder Brachyura Latreille, 1802
Family Pilumnidae Samouelle, 1819
Subfamily Eumedoninae Dana, 1852
Genus <i>Ceratocarcinus</i> White, 1847
<i>Ceratocarcinus longimanus</i> White, 1847
Genus <i>Echinoecus</i> Rathbun, 1894
<i>Echinoecus pentagonus</i> (A. Milne-Edwards, 1879)
Genus <i>Harrovia</i> Adams & White, 1849
<i>Harrovia elegans</i> de Man, 1887
Genus <i>Tiaramedon</i> D.G.B. Chia & P.K.L. Ng, 1998
<i>Tiaramedon spinosum</i> (Miers, 1879)
Family Portunidae Rafinesque, 1815
Subfamily Caphyrinae Paulson, 1875
Genus <i>Lissocarcinus</i> Adams & White, 1849
<i>Lissocarcinus orbicularis</i> Dana, 1852

1. *Ceratocarcinus longimanus* White, 1847 (Fig.2a-c)

Common Name: Horned Crinoid Crab

Type Locality: Malaysia (White, 1847)

Ceratocarcinus longimanus White, 1847: 125; Adams & White, 1848-1849: 34, pl. 6: Figs. 6&6a; Castro *et al.*, 1995: 239, Fig. 1; Chia and Ng, 1998: 497, Figs. 1&2; Kumaralingam *et al.*, 2017: 133, Fig. 114.

Synonyms

Ceratocarcinus speciosus Dana, 1851; *Ceratocarcinus dilatatus* A. Milne-Edwards, 1872 *Ceratocarcinus intermedius* Zehntner, 1894.

Material examined: One female (CL 8.7 mm, CW 11.5mm), Laxmanpur, Neil Island (Lat: 11°50.807' N; Long: 93°01.280' E), South Andaman, 12m, Coll. date. 21 March 2018, Reg. No. ZSI/ANRC/M/24895, Coll. by N.K. Nigam; One female (CL 9.2 mm, CW 11.4 mm) Paget Island (Lat:13°24.961' N; Long:92°50.286' E) North Andaman, 7m, Coll. date 21 February 2018, Reg. No. ZSI/ANRC/M/25060, Coll. by N.K. Nigam.

Hosts: The present specimens were collected from Comatulid feather star *Comanthus parvicirrus*. Generally, this species associates with *Zygometra* sp. (Stevcic *et al.*, 1988) *Comanthus gisleni*, *Comanthus parvicirrus* and *Comatula purpurea* (Fabricius & Dale, 1993), *Comatella stelligera*, *Comatella nigra*, *Oxycomanthus bennetti*, *Comanthina scheglii*, *Comanthus parvicirrus*, *Capillaster multiradiatus*, *Clarkcomanthus* sp. *Comaster tenella*, *Himerometra robustipinna* (Castro *et al.*, 1995) and unidentified Comatulid (Comatulidae) (Kumaralingam *et al.*, 2017).

Geographical distribution: This species was reported from Nancowry (Nicobar Islands), Singapore, Malaysia, Indonesia, Papua New Guinea, Australia, New Caledonia, Solomon Islands, Fiji, Philippines, Palau, Japan (Castro *et al.*, 1995; Chia and Ng, 1998); Indo-west pacific regions (Miers, 1886; Balss, 1922; Flipse, 1930; Serene *et al.*, 1958; Estampador, 1937; Griffin and Yaldwyn, 1968; Serene, 1968; Monod and Serene, 1976; Stevcic *et al.*, 1988). Recent records from Andaman Islands, India (Dev Roy and Nandi, 2012; Kumaralingam *et al.*, 2017; Nigam *et al.* present study).

Remarks: Castro *et al.* (1995) provided the detailed diagnosis and description of *Ceratocarcinus longimanus* from tropical Indo-west Pacific region. Chia and Ng (1998) revised the genus *Ceratocarcinus* with description of two new species. This species characterized by the inner supraorbital teeth longer than broad; large tubercles on protogastric, metagastric, branchial and cardiac

regions of carapace; anterolateral lobe 1-3 truncate, seldom fused with callosities, lower part of lobe three not often expanded to direct laterally except in very large specimens, lobe 4 very prominent, laterally directed; angle between anterolateral and posterolateral margins not as distinct; surfaces not as strongly tuberculated (Chia and Ng, 1998). *Ceratocarcinus longimanus* strictly associated with feather stars (Comatulids) and this symbiotic crab is typically located at the oral side of the host's central disk. This symbiotic brachyuran crab found on almost all comatulid species, which belonging to the family Comatulidae (Comasteridae) and Himerometridae (Castro *et al.*, 1995). Recently, Kumaralingam *et al.* (2017) have made documentation of *Ceratocarcinus longimanus* from unidentified Comatulids. This species has not recorded from mainland India, and reported from the A & N Islands.

2. *Echinoecus pentagonus*

(A. Milne-Edwards, 1879) (Fig. 2d-f & 3a)

Common Name: Sea Urchin Crab

Type locality: Mauritius (Milne-Edwards, 1879)

Eumedon pentagonus Milne Edwards A., 1879: 104.

Echinoecus pentagonus Chia *et al.*, 1999: 811, Figs. 1&2; Ng & Jeng, 1999: 268, Figs 1-2; Prakash *et al.*, 2012: 62, Figs. 1&2; Kumaralingam *et al.*, 2017; Meher and Thiruchitrambalam, 2019: 14774, Image 1, Fig. 2.

Synonymy: *Eumedon pentagonus* Milne Edwards A., 1879; *Eumedon convictor* Bouvier and Seurat, 1905; *Liomedon pentagonus* Klunzinger, 1906; *Eumedonus convictor* Laurie, 1915; *Eumedonus petiti* Gravier, 1922; *Eumedonus pentagonus* Ballas, 1922b; *Echinoecus rathbunae* Miyake, 1939; *Echinoecus rathbunae convictor* Miyake, 1939; *Echinoecus petiti nipponensis* Miyake, 1939; *Echinoecus klunzingeri* Miyake, 1939.

Material examined: One female specimen (CL 10.46mm, CW 9.99mm), Lakshmi Nagar, (Lat: 06°52.158' N; Long: 93°53.725' E), Great Nicobar Island, Intertidal, Coll. date 9th August 2018, Reg. No. ZSI/ANRC/M/25061, Coll. by N.K. Nigam.

Hosts: The present specimen was collected from Sea urchin, *Echinothrix diadema*. This species commonly associated with *Diadema setosum*, *Diadema savignyi*, *Echinothrix calamaris*, *Echinothrix diadema*, *Pseudocentrotus depressus* and *Heterocentrotus mammillatus* (Chia *et al.*, 1999).

Geographical distribution: Recorded from Australia (Mather and Bennett, 1984; Chia *et al.*, 1999), Cocos Islands, Indian Ocean (Clark 1950; Tweedie, 1950; Yang 1979; Chia *et al.*, 1999), French Polynesia (Morrison, 1954, Holthuis, 1953; Chia *et al.*, 1999), Israel (Chia *et al.*, 1999), Hawaiian Islands (Rathbun, 1906; Castro, 1971; Castro, 1978; Van Dover *et al.*, 1986; Chia *et al.*, 1999), Indonesia (Serene *et al.*, 1974; Chia *et al.*, 1999), Japan (Rathbun, 1894; Balss, 1922; Miyake, 1939; Sakai, 1976; Nagai and Nomura, 1988; Chia *et al.*, 1999), Kenya (Chia *et al.*, 1999), Kikambala (Chia *et al.*, 1999), Madagascar (Gravier, 1922; Chia *et al.*, 1999), Mauritius (Milne Edwards, 1879), Moluccas (Serene *et al.*, 1974), Mombassa (Chia *et al.*, 1999), Papua New Guinea (Bouvier and Seurat, 1905; Chia *et al.*, 1999), Ogasawara (Bonin) Island (Rathbun, 1894; Miyake, 1939), Philippines (Chia *et al.*, 1999), Red Sea (Klunzinger, 1906; Klunzinger, 1913; Chia *et al.*, 1999), South China Sea (Anonymous, 1974; Chen, 1975; Dai *et al.*, 1986; Dai and Yang, 1991; Chia *et al.*, 1999), South Korea (Kim and Chang, 1985), Sudan (Chia *et al.*, 1999), Thailand (Stevcic *et al.*, 1988; Chia *et al.*, 1999), Tuamotu Archipelago (Bouvier and Seurat, 1905; Nobili, 1907; Holthuis, 1953; Morrison, 1954), Vietnam (Serene, *et al.*, 1958; Chia *et al.*, 1999). Record from India: Lakshadweep (Prakash *et al.*, 2012; Kumarlingam *et al.*, 2017), Andaman Islands (Dey Roy and Nandi, 2012; Meher and Thiruchitrambalam, 2019), Car Nicobar Island (Sastry, 1981) and Great Nicobar Island (Nigam *et al.* present study).

Remarks: Chia *et al.* (1999) revised the genus *Echinoecus* and provide the detailed diagnosis and description of *Echinoecus pentagonus* with examined the holotype specimen collected by A. Milne Edwards from Mauritius. *Echinoecus pentagonus* characterized by sharp and longer rostrum, significantly distinguishes from other two species *Echinoecus nipponicus* and *Echinoecus sculptus*. As in agreement with previous record (Castro,

1971), the symbiotic crab *Echinoecus pentagonus* female has been found to invade the rectum of sea urchin hosts species. Other sea urchin associated crab *Echinoecus nipponicus* always lives on the external surface (Chia *et al.*, 1999). While, *Echinoecus sculptus* lives on oral region of helmet sea urchin *Colobocentrotus (Podophora) atratus* (Castro, 2015). Previously, this species has been recorded on sea urchin *Echinothrix diadema* from the Car Nicobar by Sastry (1981). Dev Roy and Nandi (2012) listed this species from Nicobar Islands. In 2019, Meher and Thiruchitrambalam was recorded from the Port Blair, Andaman Islands. The present study records of *Echinoecus pentagonus* from the Great Nicobar Island.



Figure 2: a-c. *Ceratocarcinus longimanus* White, 1847 (a. in-situ photograph, b. dorsal view, c. ventral view); d-f: *Echinoecus pentagonus* (A. Milne-Edwards, 1879) (d. in-situ photograph, e. dorsal view, f. ventral view)

3. *Harrovia elegans* De Man 1887 (Fig. 3b-d)

Common Name: Elegant Crinoid Crab

Type locality: Mergui Archipelago, Burma (Myanmar) (De Man 1887)

Harrovia elegans De Man, 1887-1888: 5, 21, pl. 1: Figs. 5, 6; Chia and Ng, 1998: 523, Figs. 14&15.

Synonymy: *Harrovia albolineata* Laurie, 1906

Material examined: One female specimen (CL 5.1 mm, CW 7.8 mm), B. Quarry (Lat: 07°00.737'N; Long: 93°56.821'E), Campbell Bay, Great Nicobar Island, 13m depth, Coll. date 28th December 2017, Reg. No. ZSI/ANRC/M/25062, Coll. by N.K.Nigam.

Hosts: The present species *Harrovia elegans* was collected from Feather star *Comanthus parvicirrus*. Earlier this species recorded from *Lamprometra* sp. (Jones and Sankarankutty, 1961) and *Comanthus wahlbergii* (Jose and Kutty, 2020).

Geographical distribution: Records from Myanmar (De Man, 1887-1888), Indonesia (De Man, 1902; Chia and Ng, 1998), Vietnam (Serene *et al.*, 1958), Marshall Islands, Central Pacific Ocean (Garth, 1964; Castro, 1989), South Korea (Kim, 1970; Kim and Rho, 1972), Philippines (Serene and Vadon, 1981; Chia and Ng, 1998), Pakistan (Tirmizi and Kazmi, 1982), Somalia, Thailand (Castro, 1989; Chia and Ng 1998), Sri Lanka, Malaysia, South China Sea (Chia and Ng, 1998). Records from India- Gulf of Manaar (Laurie, 1906; Jones and Sankarankutty, 1961; Jose and Kutty, 2020) Andaman Islands and Nicobar Islands (Dev Roy and Nandi, 2012; Nigam *et al.* present record).

Remarks: Chia and Ng (1998) provided the detailed diagnosis and description of *Harrovia elegans* with neotype male specimen from Sri Lanka. *Harrovia elegans* characterized by the existence of two prominent teeth like anterolateral spines in their carapace and occurrence of dark bands on the white background of the carapace (Castro 1989; Serène *et al.*, 1958). The characters of *Harrovia elegans* resembles *Harrovia japonica* and it is distinguished by the form of the margins of the first and second anterolateral teeth are straight or subtruncate

and no spiniform edges (Chia and Ng, 1998). Chia and Ng (1998) revised the genus *Harrovia* with clarification of *Harrovia albolineata* reported by Laurie (1906), Sankarankutty (1961) and Sankarankutty (1966) redetermined as *Harrovia elegans*. Recently this species was recorded by Dey Roy and Nandi (2012) from their survey in these islands. They have found the species from 51-200m depth range while the present specimen was found at subtidal 13m from Great Nicobar Island. Recently, the same species was recorded from Gulf of Mannar (Jose and Kutty, 2020). The present record of *Harrovia elegans* geographical range is here extending to Great Nicobar Island.

4. *Tiaramedon spinosum* (Miers, 1879) (Fig. 3e-f)

Common Name: Unknown

Type locality: Australia (Miers, 1879)

Ceratocarcinus spinosus Miers, 1879c: 27, pl. 5, fig. 11 *Tiaramedon spinosum* Chia & Ng, 1998: 508, figs 7-8; Ng and Jeng, 1999: 270, fig. 6; Mariyambi *et al.*, 2020: 3, Fig. 2.

Synonymy: *Ceratocarcinus spinosus* Miers, 1879

Host: *Tiaromedon spinosum* was collected from Feather star *Comanthus parvicirrus*. Earlier this species recorded from *Clarkcomanthus littoralis*, *Comanthus parvicirra*, *Comanthussuavia* and *Lamprometra klunzingeri* (Chia and Ng, 1998); *Comanthus gisleni* and *Stephanometra indica* (Fujita, 2011).

Geographical distribution: Records from Red Sea (Balss, 1924a, Gordon, 1934, Fishelson, 1973, Chia and Ng, 1998), Christmas Island (Chia and Ng, 1998), Japan (Sakai, 1954; Sakai, 1976a; Miyake, 1983; Fujita, 2011), Taiwan (Hwang and Yu, 1980), South China Sea (Serène *et al.*, 1958), Borneo (Chia and Ng, 1998), Indonesia (Flipse, 1930; Serène *et al.*, 1976; Chia and Ng, 1998), Papua New Guinea (Chia and Ng, 1998), Australia (Chia and Ng, 1998), New Caledonia (Chia and Ng, 1998), Niue (Chia and Ng, 1998), Israel, Malaysia (Chia and Ng, 1998). Record from India- Lakshadweep, Arabian Sea, Western Indian Ocean (Mariyambi *et al.*, 2020); Andaman Islands (Nigam *et al.*, Present study).

Remarks: *Tiamedon spinosum* is monotypic genus. Chia and Ng (1998) re-described and provided the detailed diagnosis and description of *Tiamedon spinosum* from Australia Sea. *Tiamedon spinosum* characterized by six spines prominent on the carapace, Carpus and propodus of chelipeds with distal spines (Sakai, 1976). The carapace of *Tiamedon spinosum* is ornamented with very long spines. The length of the spines varies among specimens, but in almost all cases, the protogastric spines are the longest, even in juveniles (Chia and Ng, 1998). Recently Fujita (2011) have made the complete larval development documentation of *Tiamedon spinosum* (Miers, 1879) from *Comanthus gisleni* and *Stephanometra indica*. In the present study material was observed from Neil Island, South Andaman and this is the new record to Andaman Islands.



Figure 3: a. *Echinoecus pentagonus* (A. Milne-Edwards, 1879) frontal view; b-d. *Harrovia elegans* de Man, 1887 (b. dorsal view, d. ventral view, e. frontal view); e, f. *Tiamedon spinosum* (Miers, 1879) (e. in-situ photo showing the host, f. ex-situ photograph)

5. *Lissocarcinus orbicularis* Dana, 1852
(Figure 4 a-d)

Common name: Harlequin crab

Type locality: Fiji (Dana, 1852)

Lissocarcinus orbicularis Dana, 1852: 86, 288, pl. 18, fig. 1a-e; Crosnier, 1962: 25, Figs. 26, 27&31; Ng and Jeng, 1999: 270, figs 7-8; Evans, 2016: 116, Figs. 2.3d, 3-9.

Synonymy: *Lissocarcinus pulchellus* Müller, 1887

Material examined: One female specimen (CL6.8 mm, CW8 mm), Afra Bay (Lat: 07°12.425'N; Long: 93°46.398'E), Great Nicobar Island, 6m, dated. 27th December 2017, Reg. No. ZSI/ANRC/M/25063, Coll. by N.K. Nigam.

Hosts: The present study *Lissocarcinus orbicularis* collected from Sea cucumber, *Bohadschia* sp. Commonly this species found on holothurians *Actinopyga mauritiana* (James, 2000), *Actinopyga obese* (Ayotte, 2005), *Holothuria atra* (Stephenson and Campbell, 1960; Crosnier, 1962; Evans, 2016), *Holothuria scabra* (Caulier *et al.*, 2014), *Holothuria whitmaei* (Lyskin and Britayev, 2001; Evans, 2016), *Stichopus chloronotus* (Hoover, 1998; Lyskin and Britayev, 2004; Evans, 2016), *Thelenota ananas* (Caulier *et al.*, 2010; Evans, 2016), *Actinopyga echinites*, *Bohadschia argus*, *Holothuria fuscogilva*, *Holothuria isuga*, *Stichopus horrens*, *Thelenota anax* (Evans, 2016), *Thelenota ananas* (Woo *et al.*, 2014).

Geographical distribution: Recorded from Fiji (Dana, 1852; Evans, 2016), Madagascar (Caulier *et al.*, 2012, 2014; Evans, 2016), Maldives, Marshall Islands, Palau, Moorea Island, Society Islands, Philippines, W. Australia, Gulf of Tadjoura, Djibouti, Moorea Island, Society Islands Pacific Ocean, Hawaiian Islands Mayotte Island, Comoros Islands Caroline Islands, Fiji, Kenya; New Caledonia, Oman, Papua New Guinea, Tanzania, Vanuatu, Europa Island, Iles Eparses (Evans, 2016), Malaysia (Woo *et al.*, 2014). Records from Tamil Nadu (Kathirvel and Gokul 2010); Lakshadweep Islands (Alcock 1899; Sankarankutty and Thomas, 1963; Thomas 1969; Dev Roy and Nandi, 2015); Andaman Islands

(Kumaralingam *et al.*, 2013); Nicobar Islands (Nigam *et al.* Present study).

Remarks: Evans (2016) provided the detailed diagnosis of *Lissocarcinus orbicularis* from Indo-West Pacific region. *Lissocarcinus orbicularis* characterized by carapace without transverse, striated ridges, broader than long; anterolateral border with lobes, broad teeth, epibranchial ridges nearly absent or weakly to moderately developed. This species is beige to white and black to deep red patterned with white spots. Recently Evans (2016) have made molecular characterization of *Lissocarcinus orbicularis* collected from nine species of sea cucumber under the genera *Actinopyga*, *Bohadschia*, *Holothuria*, *Stichopus*, *Thelenota*. This species *Lissocarcinus orbicularis* closely resembles with *Lissocarcinus holothuricola*, but typically has a much smoother carapace and always exhibits lanceolate dactyli on the fifth pereopods (Evans, 2016). This genus consists of nine species, among only two species *viz.*, *L. orbicularis* Dana, 1852, *L. holothuricola* (Streets, 1877) ectosymbionts of holothurians (Stephenson, 1972; Spiridonov, 1990, Evans, 2016). Previously, *L. orbicularis* symbiotic crab was recorded on the host *Actinopyga mauritiana* from the Port Blair, Andaman Islands (James, 2000).



Figure 4: a-d. *Lissocarcinus orbicularis* Dana, 1852 (a. dorsal view, b. ventral view, c. frontal view, d. in-situ photo showing the host)

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