



# Notes on three species of leucosiid crabs of the genus *Arcania* (Crustacea: Brachyura: Leucosiidae) off east peninsular India

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Original Article

## Abstract

During an extensive sampling off the east peninsular Indian coast, three species of leucosiid brachyuran genus *Arcania* were encountered. Of these, *Arcania gracilis* Henderson, 1893 is reported about 125 years after it was originally found at the same expanse. *A. erinacea* (Fabricius, 1787) is a new record to this region. *A. septemspinosa* (Fabricius, 1787) is the third which co-inhabited. These are briefly described with taxonomic characteristics and distributional details. Information on the numerical abundance, depth, ambient salinity, dissolved oxygen, sediment, organic content are also presented. The present finding demonstrates the species resilience to environmental perturbations over the years.

**Keywords:** *Brachyura*, *Leucosiidae*, *Arcania gracilis*, *A. erinacea*, *A. septemspinosa*, rediscovery, new record, India, Bay of Bengal

## Introduction

The carcino-fauna of the Indian coasts was extensively studied and well documented particularly by Alcock (1894, 1895-1900) and in several publications of Zoological Survey of India. During an extensive survey of the near shore benthic

fauna more than 2000 specimens of brachyurans belonging to 41 species including three species of the leucosiid genus *Arcania* were encountered. Of these, the occurrence of *Arcania gracilis* in the present material is alluring, since, this is the first emergence of the species at the same locality (off Pudimadaka, Visakhapatnam) after about 125 years of its discovery and other three localities (Divi point, Mutthukuru and Antarvedi) on the Indian coast (Fig. 1). *A. erinacea* is newly recorded from Andhra Pradesh. *A. septemspinosa* co-inhabited the above two species. In the present communication, brief descriptions of *A. erinacea*, *A. gracilis*, and *A. septemspinosa* with ecological considerations (seawater quality, sediment texture, organic content) in relation to species distribution patterns are presented (Table 1).

## Material and methods

Benthic samples were collected with a naturalist's dredge (dimension 20x50 cm) having a nylon bag net made of mesh size 0.6cm<sup>2</sup> on board a fishing trawler. The collections were made at nearly 300 stations having a depth of 1-50m off the east coast of India during 2008-17. The specimens were washed and preserved in 4% sea water formaldehyde. The classification given in the World Register of Marine Species (WoRMS) is followed together with standard

references (Alcock, 1896; Galil, 2001). The specimens were deposited in the collections of Marine Biological Laboratory, Department of Zoology, Andhra University, Visakhapatnam -530 003, India (Registration Numbers MBLDZAU 50, 51, 52). The samples for hydrography were analyzed according to Standard Methods of the American Public Health Association (APHA, 2009), and Grasshoff *et al.* (1999). Sediment texture was determined through

wet sieving and pipette analysis (Krumbein and Pettijohn (1938) and organic matter by wet oxidation method of Walkley-Black, later modified by Gaudette *et al.* (1974).

## Result

The specimens of the leucosiid crabs collected belonged to *Arcania erinacea*, *A. gracilis* and *A. septemspinosa*. Fig.1 shows

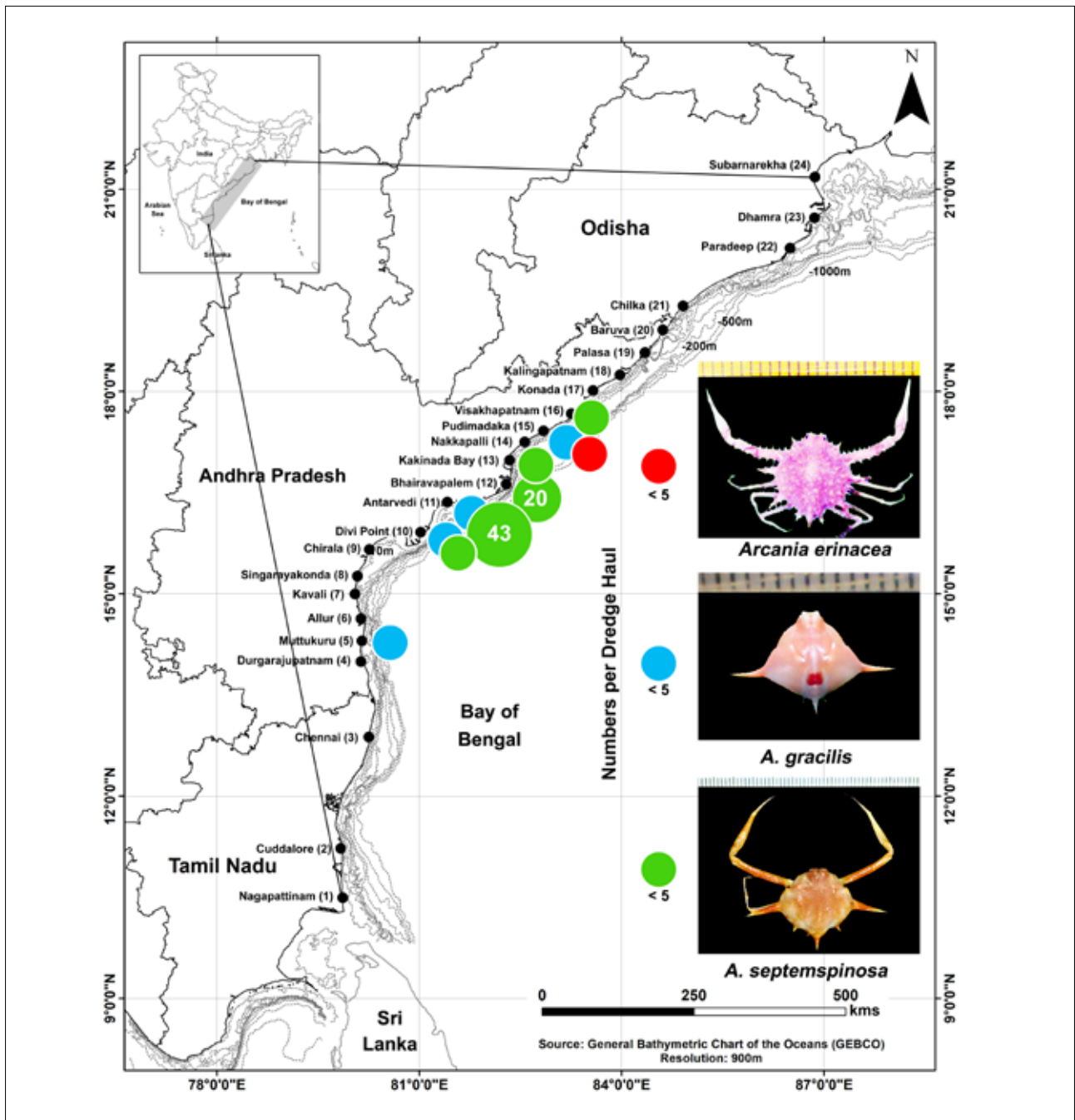


Fig. 1. Distribution and abundance (nos. dredge haul<sup>-1</sup>) of three Leucosiid crabs of genus *Arcania* off east peninsular India (20, 43 denote individuals per dredge haul).

the overall distribution of the species. Details of localities where the species were collected along with results of water and sediment analyses and morphometry of the species are given in Tables 1 and 2. The taxonomic accounts of the species are presented below.

Subphylum	: Crustacea Brünnich
Class	: Malacostraca Latreille
Order	: Decapoda Latreille
Infraorder	: Brachyura Linnaeus
Family	: Leucosiidae Samouelle
Genus	: <i>Arcania</i> Leach

### *Arcania erinacea* (Fabricius, 1787) (Figs. 1, 2a, and 2b)

**Synonymy:** *Cancer erinaceus* Fabricius, 1787; Herbst, 1790; *Leucosia erinacea* Fabricius, 1798; *Arcania erinaceus* Leach, 1814-1817; Milne Edwards H., 1836- 1844 (1837); Bell, 1855; Alcock, 1896; Lanchester, 1900; Ihle, 1918; Balss, 1922; Sakai, 1937; Shen, 1940; Sakai, 1976; Dai and Yang, 1991; Tirmizi and Kazmi, 1991; *Arcania erinacea* Sakai, 1999; Galil, 2001.

**Material:** One adult female, collected off Pudimadaka, Andhra Pradesh (Lat. 17°29'00.0"N Long. 83°07'48.0"E), India, depth 40 m (Table 1, Fig. 1).

**Description:** Carapace wider than long, globular, covered with thick spines, ten marginal and one intestinal acute spine, distinctly larger than spinules on upper surface of carapace; Chelipeds somewhat stout; arm thickly covered with granulated spinules; wrist and palm microscopically granulated; fingers slender and shorter than palm. Carapace pink in preserved state (Fig. 1).

**Remarks:** *Arcania erinacea* is closest to *A. globata*, but the carapace is covered with spinules whereas it is covered with granules in *A. globata*. The specimen has eleven large spines on the margins of the carapace, large chelipeds and merus granulated on ventral surface as noticed by Naderloo and Sari (2005). In addition, merus of the cheliped is dorsally spinose, ventrally granulose, anterior and posterior margins are prominently pectinate as described by Galil (2001). Locally, *A. erinacea* was found in muddy substrate (sand 17.6%, silt & clay 82.4%, organic matter 2.34%) with salinity 33.69 PSU and depth 40 m (Table 1).

**Geographical Distribution:** Indo-Pacific, **India:** Tamil Nadu (Madras, Gulf of Mannar); Odisha (Gopalpur coast) Puducherry; West Bengal (Sandheads). **Elsewhere:** Sri Lanka (Gulf of Mannar), Gulf of Oman, Pakistan, Thailand, China, Singapore and Japan (Galil, 2001). The species is newly reported from the coast of Andhra Pradesh.

### *Arcania gracilis* Henderson, 1893 (Figs. 1, 2c, 2d and 2g)

**Synonymy:** *Arcania septemspinosa* var. *gracilis* Henderson, 1893; *Arcania quinquespinosa* Alcock and Anderson, 1894; Alcock and Anderson, 1896; Alcock, 1896; Borradaile, 1903; Laurie, 1906; Ihle, 1918; Balss, 1922; Sakai, 1937; Sakai, 1965; Sakai, 1976; Stephensen, 1945; Miyake, 1983; Chen, 1989; Huang, 1989; Dai and Yang, 1991; Huang, 1994; Tan, 1996; Ng *et al.*, 2001; *Arcania gracilis* Takeda, 1973; Takeda, 1979; Galil, 2001; Galil and Ng, 2007; Ng. *et al.*, 2008; Galil and Ng, 2010; Galil, 2015; Naderloo *et al.*, 2015; Naderloo, 2017

**Material:** Five specimens. **India:** Andhra Pradesh (one female, off Pudimadaka; Divi point (2 males); Mutthukuru (one male) and Antarvedi (one male) (Table 1, Fig.1).

Table 1. Locality data of the three leucosiid crabs of the Genus *Arcania* off east peninsular India

Species	Location	Collection Date	Depth (m)	No. of Ind.	Latitude	Longitude	DO mg.l <sup>-1</sup>	Salinity PSU	Org. mat.%	Sand %	Silt & Clay %
<i>Arcania erinacea</i>	Pudimadaka	19.03.2009	40	1	17°29'00.0"N	83°07'48.0"E	5.88	35.35	2.34	17.6	82.4
<i>A. gracilis</i>	Muttukuru	Jul-08	15	1	14°20'16.14"N	80°12'41.16"E	4.88	34.66	0.17	17.4	82.6
	Pudimadaka	19.03.2009	40	1	17°29'00.0"N	83°07'48.0"E	5.88	35.35	2.34	17.6	82.4
	Antarvedi	04.02.2015	34	1	16°20'0.36"N	81°54'7.20"E	7.31	35.35	3.29	9	91
	Divi point	04.03.2017	30	2	16°0'6.24"N	81°20'10.38"E	7.87	33.94	2.68	29.0	71.0
<i>A. septemspinosa</i>	Divi point	04.03.2017	20-30	4	16°0'6.24"N	81°20'10.38"E	7.87	33.94	2.68	29.0	71.0
	Bhairavpalem	2014-2017	9-30	20	16°40'2.64"N	82°23'55.44"E	6.18	34.20	4.59	28.9	71.1
	Kakinada Bay	20.02.2017	10	1	17°0'50.88"N	82°19'51.96"E	7.70	32.53	1.04	34.2	65.8
	Antarvedi	2015-2017	12-43	43	16°20'0.36"N	81°54'7.20"E	5.6-8.01	22.3-35.4	0.1-3.4	1-77	99-24
	Visakhapatnam	2014-2017	9-10	2	17°33'15.55"N	83°09'23.91"E	5.79-5.91	21.5-26.9	~0.42	82-94	6-18

**Description:** Carapace rhomboidal, wider than long, lateral spines five, stout, posterior spine dorso-ventrally flattened, postero-lateral margins each with a short blunt spine. Chelipeds-legs are lost. General colour of carapace in the preserved state is pink, cardiac region with characteristic large, rectangular, milk-white edged, bright red ocellus. Male abdomen granulated, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> abdominal segments fused and 6<sup>th</sup> segment is long and slender. In the males, first gonopod (G1) is sinuous, long and slender whereas the second gonopod (G2) is short, distal end slightly bulged. Cardiac region bears a bright red spot on its dorsal side (Fig. 1) and five spines on lateral margin.

**Remarks:** *A. gracilis* is readily distinguished from *A. septemspinosa* and *A. heptacantha*, by the rudimentary spines on the postero-lateral margin of the carapace. Bright red spot in the cardiac region; very minutely granulate carapace; triangular frontal lobes; lateral and robust intestinal spines, are characteristic of the species (Galil, 2001). During the present study specimens of *Arcania gracilis* were found in muddy substrate (sand 9-29.39%, silt & clay 71-91%, organic matter

0.17-3.29%) with salinity 33.94-35.35 psu and depth 15-40m (Table 1).

**Geographical Distribution:** Indo-West Pacific, **India:** Andhra Pradesh (Pudimadaka, 30m; Divi point; Mutthukuru and Antarvedi); Tamil Nadu; Odisha Ganjam, (Alcock, 1896). **Elsewhere:** Persian Gulf; Red Sea; Madagascar; Gulf of Oman; Maldives; Myanmar (Gulf of Martaban); Sri Lanka; Singapore; Indonesia; Hong Kong; China; Vanuatu; Japan; Taiwan; the Philippines; New Caledonia; Australia (Galil, 2001, 2007; Galil and Ng 2007, 2010) and as far as Fiji. The present report is the only record of the species from India after Alcock and Anderson (1894) who reported it more than 125 years ago.

Henderson (1893) while describing *gracilis* as a new variety, unmistakably stated that one specimen from Gulf of Martaban (Myanmar) clearly differed from *Arcania septemspinosa*. As such that single specimen if identified should be considered as Holotype and Gulf of Martaban as Type locality.

The localities given by Borradaile (1903) are of Maldives, but they were inadvertently thought as of Laccadives by subsequent authors including Galil (2001) and included as such under distribution.

*Arcania septemspinosa* (Fabricius, 1787)  
(Figs. 1, 2e, 2f and 2h)

**Synonymy:** *Cancer septemspinus* Fabricius, 1787; Fabricius, 1793; *Leucosia septemspinosa* Fabricius, 1798; *Arcania septemspinosa* Miers, 1886; Alcock, 1896; Stebbing, 1910; Laurie, 1915; Ihle, 1918; Chopra, 1934; Suvatti, 1937; Stephensen, 1945; Suvatti, 1950; Barnard, 1950; Dawydoff, 1952; Chhapgar, 1957; Tirmizi and Kasmi, 1986; Devi *et al.*, 1988; Chen, 1989; Dai and Yang, 1991; Huang, 1994; Tan, 1996; Ng *et al.*, 2001; Galil, 2001; Dev Roy and Bhadra, 2005; Galil and Ng, 2007; Ng *et al.* 2008; Galil and Ng, 2010; Galil, 2015; Naderloo, 2017.

**Material:** Seventy specimens from Andhra Pradesh: Divi Pt., Bhairavpalem, Kakinada, Antarvedi, Visakhapatnam (India) (Table 1, Fig.1).

**Description:** Carapace rhomboidal, finely granulated and with seven marginal spines; chelipeds long, slender and granulated at base. Merus of cheliped as long as carapace; fingers slender, longer than palm. The general colour of the carapace in the preserved state is pinkish white. Male abdomen granulated, fused 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> abdominal segments and 6<sup>th</sup> segment is long and slender. In males, the first gonopod (G1) is sinuous, long and slender whereas the second gonopod (G2) is short

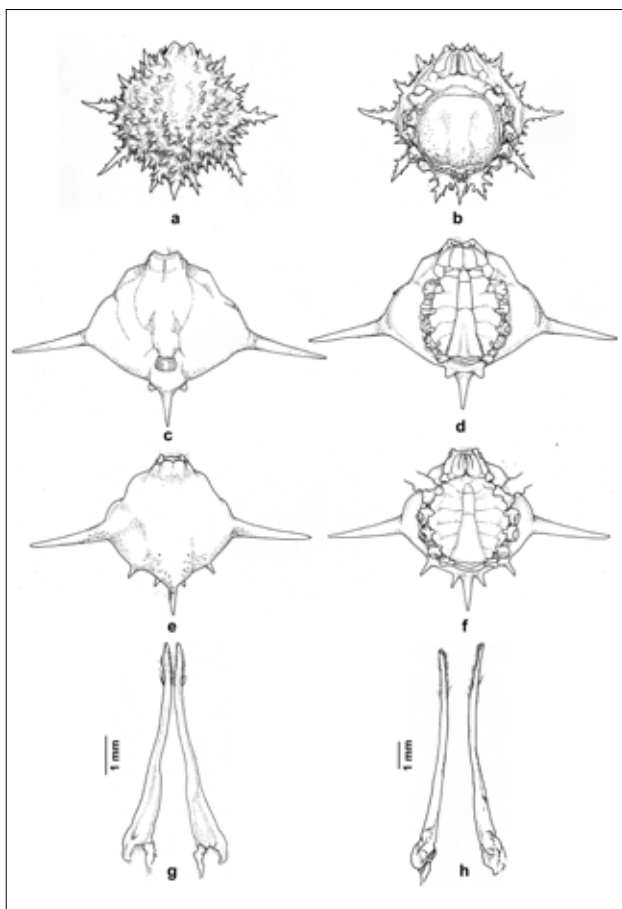


Fig. 2. *Arcania erinacea* (Fabricius, 1787), Female, a. Dorsal view, b. Ventral view; *A. gracilis* Henderson, 1893, Male, c. Dorsal view, d. Ventral view, g. Male pleopod (G1); *A. septemspinosa* (Fabricius, 1787), Male, e. Dorsal View, f. Ventral view; h. Male pleopod (G1).

Table 2. Morphometry (in mm) of the three species of *Arcania*

Characteristic	<i>Arcania erinacea</i>		<i>A. gracilis</i>		<i>A. septemspinosa</i>	
	Female	Male	Female	Male	Female	Male
Carapace length	16.38		9.48-12	7	12.32-19.00	14.76-18.94
Carapace width	17.04		10.88-14.12	11	12.64-21.28	15-20.28
Frontal lobe	1.36		1.6-1.82	1.5	0.3-0.44	1.6-1.68
Lateral spine length	4.86		4.2-6.32	4.72	6.34-13.42	6.08-9.18
Intestinal spine length	3.66		2.54-4.16	2.43	2.8-5.64	3.56-4.14
Dactylus of cheliped	4		-	-	10.96	9.4
Propodus of cheliped	7.2		-	-	11.4	10.5
Carpus of cheliped	4.2		-	-	5.5	4.68
Merus of cheliped	13.48		-	-	20.82	16.5

with distal end slightly bulging. Granulated carapace with seven spines on lateral margin is characteristic of the species.

**Geographical Distribution:** Indo-West Pacific (Poore, 2004), **India:** Andhra Pradesh (Krishnapatnam, Kottapatnam, Ongole, Chirala, Machilipatnam, Kakinada, Visakhapatnam); Odisha (Gopalpur coast, Mahanadi delta); Tamil Nadu (Chennai); Arukkattuthurai to Pasipattinam, south east coast of India (Varadharajan and Soundarapandian, 2014); Gujarat (Gulf of Kachchh, Chhappgar, 1957); Andamans (Alcock, 1896). **Elsewhere:** South Africa, Mozambique Channel, Red Sea, Gulf of Aden, Persian Gulf, Madagascar, Pakistan, Malay Archipelago; Gulf of Thailand, Hong Kong, China, Philippines, Vietnam, Indonesia, Australia, Vanuatu and Fiji (Galil, 2001).

**Remarks:** *Arcania septemspinosa* resembles *A. heptacantha* in some characteristics such as the shape of carapace, cheliped, ambulatory legs and pleopods (Beleem *et al.*, 2016). However, it differs in having cheliped merus as long as carapace; granulated ridge; carapace set with minute flattened granules; frontal lobes subquadrate, separated by slight notch; lateral and intestinal spine robust, slightly upcurved, granulate throughout, granules smaller distally; lateral spine two thirds as long as carapace, posterior spines slender, and dorso-ventrally flattened and granulate carapace (Galil, 2001). During the present study, *A. septemspinosa* appears to be more widespread, being found in both muddy and sandy substrates (sand 0.8-94.39%, silt & clay 5.61-99.2%, organic matter 0.1-4.59%) at depths 3-9m. Locally, *A. septemspinosa* appeared favouring low salinity conditions of 5.6-8.01 PSU (Table 1).

## Discussion

Of the 21 species of the genus *Arcania* Leach, recorded worldwide (Ng *et al.*, 2008), nine species are known from India *viz.* *Arcania brevifrons* Chen, 1989; *A. cornuta* (MacGilchrist, 1905); *A. erinacea* (Fabricius, 1787), *A. gracilis* Henderson, 1893; *A. heptacantha* (De Haan, 1861); *A. novemspinosa* (Lichtenstein, 1816); *A. septemspinosa* (Fabricius, 1787);

*A. tuberculata* Bell, 1855 and *A. undecimspinosa* De Haan, 1841 (Dev Roy and Bhadra, 2005) out of which, three species are represented in the present collections. Henderson (1893) while reporting material from Gulf of Martaban (Myanmar) and Chennai (former Madras, India) found one specimen from Gulf of Martaban to be differing from typical *A. septemspinosa* and named it as a new variety *gracilis* of *A. septemspinosa*. He clearly wrote "One of the Martaban specimens belongs to what is at least a distinct variety ... It differs from a specimen of the typical form ..." from which it is to be taken that the specimen from Martaban based on which the new variety was designated, as the Holotype of *Arcania gracilis* and Gulf of Martaban, Myanmar as the type locality. Galil (2001) while revising the genus *Arcania* Leach gave full synonymy of *Arcania gracilis* and included the report of Borradaile (1903) from Haddumati, Kolumlu and Suvadiva Atolls. But, these localities were inadvertently treated as Lakshadweep (Laccadives) and mentioned as such under distribution. However, these localities are actually in Maldives and thus there is no report of the species from Lakshadweep. Galil (2015) mentioned Gulf of Martaban, Myanmar as type locality of this species. It is noteworthy that *A. gracilis* has been reported in abundance from China (202 records) followed by Australia (62) and Vietnam (12) (OBIS, www.iobis.org). Its occurrence in the Indo-west Pacific region alone is an important aspect of *A. gracilis*. Galil (2001) observed *A. gracilis* from a wide range of depths (26-248m). OBIS (op.cit) had shown its presence between 22-30°C and salinity 30-40 PSU. In the present study, *A. gracilis* was found between 15 and 40m where the ambient dissolved oxygen was 4.88-7.87 mg.l<sup>-1</sup> and salinity 33-35 PSU. The organic matter of the sediment ranged from 0.17-3.29% where muddy sediments, 71-91% prevailed (Table 1).

Galil (2001) described *A. erinacea* occurring under various depth categories (7-40m) and the maximum recordings (5) were made from the Indian waters. It is noteworthy that the species has been reported merely from China and India (OBIS, www.iobis.org). Locally *A. erinacea* inhabited inshore sediments

(depth 40m) of muddy nature (82%) having salinity 35 PSU and dissolved oxygen 5.88 mg.l<sup>-1</sup>. Organic matter in the sediments was 2.34% (Table 1).

Off the east coast of India, *A. septemspinosa* is the common leucosiid crab found under various depths (9-43m). The species was found earlier with maximum records (189) from China followed by Australia (36) (OBIS, www.iobis.org, 20.07.2018). Galil (2001) reported *A. septemspinosa* as cosmopolitan. Locally its presence throughout most part of the east coast of India reemphasizes the species ubiquitous nature. During the study, the ambient salinity where the species was found varied between 21.5 and 35.4 PSU. Its presence in overwhelming numbers off Krishna and Godavari river mouths (Divi Point, Antarvedi, Bhairvapalem, Kakinada Bay; Fig. 1) is suggestive of its relative tolerance to low saline conditions. Unlike the other two species, *A. septemspinosa* inhabited both sandy (~94%) and muddy sediments (99%) rich in organic matter (mean 2.93%) (Table 1).

In conclusion, it is emphasized that despite the near shore waters at most places off India's east coast underwent appreciable human impingement (Ganesh *et al.*, 2014), the present finding is an example of the species' individual resilience over the years. The investigation underlines the need for further exploration of marine benthic diversity.

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