Journal of Applied and Natural Science
14(3), 921 - 930 (2022)
ISSN : 0974-9411 (Print), 2231-5209 (Online)
journals.ansfoundation.org

Research Article

Diversity of freshwater crabs (Crustacea: Decapoda: Brachyura) in the Subansiri River basin of Arunachal Pradesh and Assam, northeast India

Awarlin Chetia
Department of Zoology, Rajiv Gandhi University, Arunachal Pradesh, India
Amit Tripathi
Department of Zoology, University of Lucknow, Uttar Pradesh, India
Debasish Borbora
Department of Biotechnology, Gauhati University, Assam, India
Debangshu Narayan Das*
Department of Zoology, Rajiv Gandhi University, Arunachal Pradesh, India

*Corresponding author. Email: ndas2011@gmail.com

Article Info
https://doi.org/10.31018/jans.v14i3.3524
Received: May 28, 2022
Revised: August 1, 2022
Accepted: August 14, 2022

How to Cite
Chetia, A. *et al.* (2022). Diversity of freshwater crabs (Crustacea: Decapoda: Brachyura) in the Subansiri River basin of Arunachal Pradesh and Assam, northeast India. *Journal of Applied and Natural Science*, 14(3), 921 - 930. https://doi.org/10.31018/jans.v14i3.3524

Abstract
Crabs are significant invertebrates in the Subansiri River basin, one of the major sub-basins of the Brahmaputra valley in north-east India. They have immense ecological and economic value and provide an alternative source of income for the local inhabitants. Following thirteen sites in the Subansiri River basin were surveyed to determine the availability and diversity of crab species in this region: Hatinala, Kalma river, Dikrong river, Senki river, Poma river, Harmuti, Ranganadi river dam site, Diju stream, Lower Subansiri river, Downstream Ranganadi, Pani gaon wetlands, Bosa gaon beel, and Bhelamora beel. Crab samples were collected using a random sampling method and identified using standard taxonomic keys. Seven species from two families were identified and distinguished by their morphology and habitat preferences: *Sartoriana spinigera*, *Sartoriana trilobata*, *Maydelliathelphusa lugubris, Maydelliathelphusa harpax, Liotelphusa laevis* (Gecarcinucidae) *Lobothelphusa woodmasoni,* and *Acanthopotamon horai* (Potamidae). These crabs are thought to be endemic to the Eastern Himalayan region due to their limited dispersibility. This is the first study aimed at contributing to the documentation and conservation of freshwater crabs in North East India. Additionally, the economic relevance of freshwater crabs is highlighted.

Keywords: Subansiri River basin, Freshwater crab, Documentation, Ranganadi River, Crab livelihood

INTRODUCTION

Brachyuran crabs (Malacostraca, Decapoda) are one of the most diverse crustaceans, with over 7,400 species that live in marine, freshwater, and terrestrial environments (Ng *et al*., 2008; Ahyong *et al*., 2011). Over 1300 freshwater crab species are found in diverse habitats ranging from clear, torrential mountain streams to slow-moving lowland rivers and streams, ponds, rice fields and tree holes (Yeo et al., 2008). The study of these freshwater crabs is vital because they are 1) food source for many species of fish, birds, turtles, and mammals including humans (Magalhaes, 2003; Cumberlidge *et al*., 2009), 2) bioindicators due to their detritivorous activity, which cleans the surrounding water and soil in their habitat (Dobson, 2004), and 3) intermediate hosts for the lung fluke *Paragonimus* spp. (Narain *et al*., 2003; Zhou *et al*., 2021).

In India, Potamidae (30 species) and Gecarcinucidae (67 species) are two families of brachyuran crabs that have dominated the country's freshwater biogeographical areas (Pati & Thackeray, 2018). In northeast India, freshwater crabs are the most extensively consumed aquatic species by the various tribal communities, second only to fish, due to their distinct taste, medicinal properties, and aboriginal faith in crab meat. Despite the fact that 44 species of freshwater crabs have been reported in northeast India (Ghosh et al., 2006; Takeda *et al*., 2012; Mitra, 2017, 2020; Pati and Thackeray, 2018; Pati *et al*., 2019; Mitra *et al*., 2021; Pati, 2021), there is currently no systematic and evidence-based record of freshwater crab diversity in this region. As a result, the current survey was carried out to contribute to the documentation of freshwater crabs in Arunachal

Pradesh and Assam, India's far northeast.

MATERIALS AND METHODS

Study area

The Subansiri River is the largest tributary of the Brahmaputra River, which is one of the largest alluvial rivers in the world. The river originates from Tibetan Himalayas and flows nearly 9636 km^2 through the Assam-Arunachal foothill region before draining into the Brahmaputra River in Assam. The Subansiri River basin is known for its biological diversity and comprises various aquatic habitats, including beels, marshy land, ponds, networks of streams, rivers, and rice wetlands (Chetia and Das, 2019; Kaushik and Bordoloi, 2016).

Sampling of crabs

Between January 2019 and February 2020, freshwater crabs were collected from 13 different Lower Subansiri River basin ecosystems using a random sampling method (Fig. 1 and Table 1). Samples were collected using a fishing net and handpicking and immediately transported to the Fishery, Aquatic, and Ecology Laboratory in Rajiv Gandhi University, Arunachal Pradesh, where they were preserved in 10% formalin. Experiments were conducted following institutional guidelines for animal care. Experiments were conducted following Institutional guidelines for Animal Ethical Care.

Morphological characterization

The specimens were identified using the standard taxonomic principles of Alcock (1909, 1910), Bott (1970), and Ng *et al*. (2008). When describing paired appendages, terminologies were used in a singular form and abbreviated as CL, carapace length; CW, carapace width; CH, carapace height; MjCPL, major cheliped propodus length; MjCPH, major cheliped propodus height; MnCPL, minor cheliped propodus length; MnCPH, minor cheliped propodus height. Morphometric measurements were taken with a vernier slide calliper (0.02 mm precision). Gonopods were examined under a Stereomicroscope.

RESULTS

The present investigation discovered seven crab species that were distinguished by their morphology and habitat preferences (Figs. 2, 3, 4) (Table 2). Five species (*Sartoriana trilobata, Sartoriana spinigera*, *Maydelliathelphusa lugubris*, *Maydelliathelphusa harpax, and Liotelphusa laevis*) belonged to the Gecarcinucidae family; while the other two (*Lobothelphusa woodmasoni*, and *Acanthopotamon horai*) belonged to the Potamidae family. The similarities and differences between various morphological parameters of all seven species are summarised in Table 2.

Family Gecarcinucidae Rathbun, 1904

Sartoriana Bott, 1969

Sartoriana trilobata Alcock (1909) (Figs. 2, 4)

Diagnosis: Carapace broad, CW ca. 1.4 times CL; cervical groove prominent; surface almost smooth; gastro cardiac groove distinct; epigastric cristae inflated, anterior to postorbital cristae; postorbital cristae sinuous, sharp; epibranchial tooth acute; one lobe like extension between orbital tooth and epibranchial tooth (Fig. 2A). Pleon 'T' shaped (Fig. 2B). Cheliped unequal; small to medium gap between polex and dactylus, medium-size triangular teeth on the cutting edges of polex, dactylus; acute carpal tooth; blunt merus tooth; dacty-

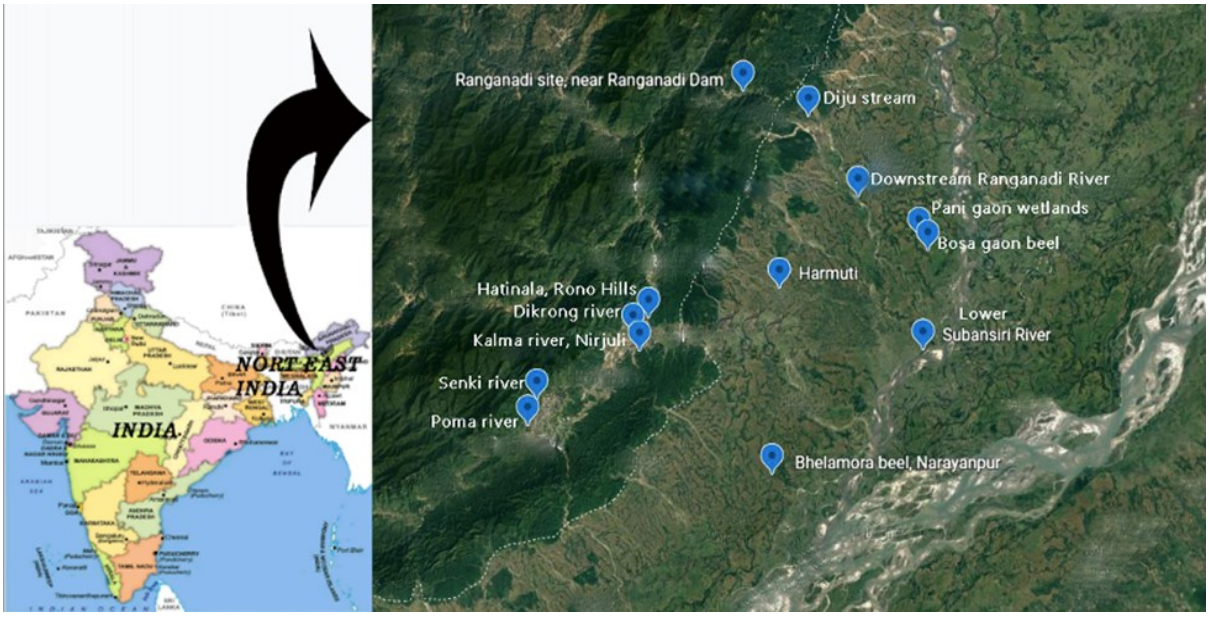

Fig. 1. *Study sites in Lower Subansiri basin, North East India*

lus with strong spiny setae (Fig. 2A). G1 robust with numerous short bristles; terminal segment conical; flexible zone narrow, 'V' shaped; subterminal segment robust. (Fig. 4A). G2 longer than G1.

Live colour: Dorsally, the colour ranged from dull brownish-yellow to olive green, with numerous brown spots. The ventral surface ranged from pale yellow to light brown.

Habitat type: This was mainly a riverine crab. They were occasionally seen in beels or other riverine wetland habitats near rivers Ranganadi and Subansiri.

Sartoriana spinigera (Wood-Mason, 1871) (Figs. 2, 4)

Diagnosis: Carapace broader than long, CW ca. 1.5 times CL; surface extremely glabrous; cervical groove deep; gastro-cardiac groove deep, H shaped; epigastric cristae strong; postorbital cristae sinuous, mildly sharp; epibranchial tooth sharp (Fig. 2C). Cheliped unequal, small to medium gap between dactylus and polex; small, medium triangular teeth on cutting edge of polex, dactylus; acute carpal tooth, merus tooth (Fig. 2C). Pleon trunk shaped (Fig. 2D). G1 stout; surface nearly glabrous; terminal segment narrowly conical; flexible zone prominent; sub-terminal segment robust (Fig. 4B). G2 long.

Live colour: Dorsally, the colour appeared brightly polished cinnamon brown. Ventrally, they appeared yellowish brown.

Habitat type: They preferred to live in muddy ponds and wetlands such as beels, swamps etc.

Maydelliathelphusa Bott, 1969

Maydelliathelphusa lugubris (Wood-Mason, 1871) (Figs. 3, 4)

Diagnosis: Carapace broader than long, CW ca. 1.4 times CL; surface almost flattened, covered by numerous pits; cervical groove deep posteriorly; epigastric cristae inflated; postorbital cristae sharp; anterolateral margin with one nearly blunt epibranchial tooth (Fig. 3A). Pleon T-shaped (Fig. 3B). Cheliped unequal, surface mildly pitted, glabrous, a clear gap between dactylus and polex; cutting edges of dactylus, polex armed with small to large-sized rounded molar teeth; dactylus of ambulatory legs armed with sharp setae (Fig. 3A). G1 robust, elongated; terminal segment slightly narrow distally, tiny bristles on surface; flexible zone thin, deep; subterminal segment stout (Fig. 4D). G2 remarkably short.

Live colour: Dorsally, the colour was dark chocolate brown; ventrally, the surface was slightly brown.

Habitat type: Most crabs were found under the stone of rocky banks of streams and rivers.

Maydelliathelphusa harpax (Alcock, 1909) (Figs. 3, 4)

Diagnosis: Carapace broad, CW ca. 1.4 times CL, surface slightly pitted, dorsally almost smooth; cervical groove broad, posteriorly deep; gastro-cardiac groove prominent with low facet; epigastric cristae strongly inflated, obliqued, anterior to postorbital cristae; anterolateral margin short, arcuate with an acute epibranchial tooth (Fig. 3C). Pleon trunk shaped (Fig. 3D). Cheliped strong, unequal, surface slightly granulated; medium to large gap between curved dactylus and polex, small to large molariform teeth on cutting edge of dactylus and polex (Fig. 3C). G1 stout; terminal segment elongated, tip narrowly rounded, many fine setae on surface; flexible zone deep; subterminal segment robust (Fig. 4E). G2 short.

Live colour: The colour of this species ranged from pale blackish brown to dark walnut on both dorsal and ventral sides.

Habitat type: These species were found in the mud of ponds, beels and rivers of the Subansiri basin.

***Liotelphusa* Alcock, 1909**

Liotelphusa laevis (Wood-Mason, 1871) (Figs. 3, 4)

Diagnosis: Carapace broad, CW ca. 1.26 times CL, smooth surface; cervical groove shallow; inflated epigastric cristae, moderately notable, slightly anterior to postorbital cristae; postorbital cristae weekly noticeable, blunt; anterolateral margin with hardly visible epibranchial tooth (Fig. 3E). Pleon T- shaped (Fig. 3F). Cheliped unequal; minor gap between polex and propodite, cutting edge of polex, dactylus with few molar teeth, numerous tiny truncated teeth; carpal tooth sharp, pointed; merus unarmed (Fig. 3E). G1 robust, margin sinuous; terminal segment short; flexible zone weekly visible; subterminal segment elongated, stout G1 (4F). G2 thin and shorter than.

Live colour: This species appeared bright chestnut red on the dorsal side and light brownish-red on the ventral side.

Habitat type: *Liotelphusa laevis* preferred to live inside burrows in soft soil near wetlands such as streams.

Family Potamidae Ortmann, 1896

Lobothelphusa Bouvier, 1971

Lobothelphusa woodmasoni (Rathbun, 1905) (Figs. 2, 4)

Diagnosis: Carapace hexagonal, broader than long, CW ca.1.3 times CL; dorsally surface smooth; cervical groove deep; strong epigastric cristae; postorbital cristae slightly sinuous; anterolateral margin arcuate with four sharp, acute teeth Fig. 2E). Pleon broadly triangular (Fig. 2F). Chelipeds almost equal, surface smooth; chela with sharp cutting edge, numerous small teeth on cutting edge of polex, dactylus; no gap or small gap between polex and dactylus; sharp tooth on carpus, merus; ambulatory legs with short thick bristles; dactylus with sharp setae (Fig. 2E). G1 stout, tiny bristles on terminal segment; terminal segment narrowly slender, extremely bent outward; flexible zone broad; subterminal segment robust (Fig. 4C). G2 nearly equal to G1; distal segment thin.

Live colour: Dorsally, it appeared light olive to light

Table 1. Sites wise distribution of freshwater crabs in Lower Subansiri basin of Arunachal Pradesh and Assam, northeast India (Abbreviations: S.T. *Sartoriana trilobata*; S.S. *Sartoriana spinigera*; L.W. *Lobothelphusa woodmasoni*; M.L. *Maydelliathelphusa lugubris*; M.H. *Maydelliathelphusa harpax*; L.La. *Liotelphusa laevis,* and A.H. *Acanthopotamon horai*)

Sites	Coordinates	Species Name						
		S. T	S. S	L. W	M. L	M. H	L. La	A. H
Hatinala, Rono Hills	27.351˚N, 93.960˚E	-	-	-	+	-	-	-
Kalma river, Nirjuli	27.121˚N, 93.743˚E	-	-	-	+	-	-	-
Dikrong river	27.140˚N, 93.748˚E	-	-	-	+	-	-	-
Senki river	27.104˚N, 93.610 ˚E	-	-	-	+	-	-	+
Poma River	27.080˚N, 93.588˚E	-	-	-	+	-	-	-
Harmuti	27.141˚N, 93.928 ˚E	-	+	+	-	+	-	-
Ranganadi River dam	27.351˚N, 93.960 ˚E	-	-	-	+	-	-	-
Diju stream	27.304˚N, 94.026˚E	-	+	+	-	-	+	-
Lower Subansiri river	27.045˚N, 94.084˚E	+	-	+	-	+	-	-
Downstream Ranganadi	27.211˚N, 94.062 ˚E	+	-	-	-	+	-	-
Pani gaon wetlands	27.144˚N, 94.118 ˚E	-	+	-	-	+	-	-
Bosa gaon beel	27.131˚N, 94.123˚E	+	+	+	-	+	-	-
Bhelamora beel, Narayanpur	26.954˚N, 93.861˚E	-	+	-	-	+	-	-

greenish-yellow, and ventrally, it appeared light yellow.
Habitat type: These crabs were found near underwater hyacinth and other floating vegetation, as well as muddy beel banks and swampy wetlands.

Acanthopotamon Kemp, 1918
Acanthopotamon horai Pati, Mitra & Yeo, 2019 (Figs. 3, 4)
Diagnosis: Carapace broader than long, CW ca. 1.2 times CL; surface uneven, covered with numerous short bristles, cervical groove superficial; epigastric cristae weekly prominent; postorbital cristae short, blunt; anterolateral margin with three epibranchial tooth (Fig. 3G). Pleon triangular (Fig. 3H). Cheliped unequal extremely; large gap between polex and dactylus, small -medium blunt teeth on cutting edge of polex, dactylus; carpus smooth with broad tooth; merus with narrow, blunt tooth; dactylus of ambulatory legs with sharp setae (Fig. 3G, 3H). G1 stout; terminal segment short; flexible zone greatly reduced; subterminal segment robust, (Fig. 4G). G2 long.
Live colour: All specimens were charcoal grey on both the dorsal and ventral sides.
Habitat type: These species were found underneath small rocks in streams and rivers.

DISCUSSION

Yeo and Ng (2012) identified *Sartoriana trilobata* and *S. spinigera* as two distinct species based on specimens deposited at the Zoological Survey of India in Kolkata. Chetia *et al*., (2021) elaborated on structural differences between their gonopods, thus validating these two species. The current study found *S. spinigera* bearing a single sharp anterolateral tooth and a blunt merus tooth. *Sartoriana trilobata,* on the other hand, had one epibranchial tooth, one lobe-like tooth just ahead of the epibranchial tooth, and the merus tooth was very sharp. During colour analysis, live *S. trilobata* was olive green with spotted carapace and cheliped surfaces, whereas *S. spinigera* had a polished, dark reddish-brown surface.
Maydelliathelphusa was previously recognised as a subgenus of *Barytelphusa* (Alcock, 1909), with *M. lugubris* included as *Barytelphusa lugubris* (Brandis and Sharma 2005). However, Ng *et al*., (2008) elevated *Maydelliathelphusa* as a separate genus. *Maydelliathelphusa lugubris* may be mistaken for *M. harpax* due to their close morphological similarities (Table 2). However, morphological differences, such as the presence of a blunt epibranchial tooth and a nearly flat, or less convex carapace in *M. lugubris* distinguish these two species.
Liotelphusa laevis is an ornamentally important *Gecarcinucidae* crab recorded in the Subansiri river basin. This species can be distinguished from all other *Gecarcinucidae* crabs collected in this study by its small body size and dorsally deep red appearance. Moreover, the longitudinally oval carapace with an obscure cervical groove on a smooth rugulous surface and the overall G1 morphology are noteworthy.
Lobothelphusa is often confused with *Acanthopotamon*.

Table 2: Morphometric measurement of seven freshwater Crabs reported in this study – *Sartoriana trilobata, Sartoriana spinigera, Maydelliathelphusa lugubris, Maydelliathelphusa harpax*, *Lobothelphusa woodmasoni, Acanthopotamon horai,* and *Liotelphusa laevis*

	Sex	CW (mm) (mean ± SD)	CL (mm) (mean ± SD)	AW (mm) (mean ± SD)	AL (mm) (mean ± SD)	CH (mm) (mean ± SD)	MjCPL (mm) (mean ± SD)	MjCPH (mm) (mean ± SD)	MnCPL (mm) (mean ± SD)	MnCPH (mm) (mean ± SD)
S. trilobata	M	35.4-45.6; 41.5±3.5	25.0-33.5; 30.0±2.4	12.4-15.5; 14.1 ±1.2	17.4-24.7; 20.5±2.2	13.0-19.0; 16.6±2.4	27.3-47.4; 38.3±7.4	10.4-22.1; 18.4±4.3	25.0-37.5; 31.4±4.2	8.8-16.5; 13.6±2.4
	F	37.8-41.8; 39.5±2.0	26.5-31.1; 28.6±1.6	16.5-24.7; 22.2±2.3	18.8-24.8; 22.6 ±1.7	10.9-16.8; 15.1±1.9	25.9-32.6; 29.2±2.3	12.0 -16.0; 14.0±1.4	22.4-28.0; 25.2±2.0	9.7-12.1; 10.9±0.9
S. spinigera	M	46.8-58.7; 52.8±3.7	32.7-41.0; 37.4±2.6	18.3-20.4; 20.6±3.0	21.6-26.9; 25.0±1.9	19.4-23.6; 22.0±1.6	32.3-46.7; 39.9±5.6	12.9-20.1; 15.9±3.4	30.2-39.9; 35.0±3.2	11.2-15.1; 13.1±1.0
	F	49.2-56.8; 52.0±2.4	31.6-39.4; 36.9±2.2	26.1-31.8; 28.7±1.9	26.9-31.8; 28.9±1.4	19.2-23.3; 22.1±1.3	31.3-43.2; 36.5±4.2	12.0-15.6; 13.9±1.2	26.2-34.6; 31.5±2.4	10.6-14.4; 12.4±1.0
L. Woodmasoni	M	31.2-43.0; 38.0±3.3	25.8-34.4; 29.4±2.2	11.3-15.3; 13.3 ±1.2	15.0-19.9; 17.8±1.4	14.0-21.0; 17.7±1.7	20.5-31.3; 25.6±3.0	7.9-13.3; 9.8±0.9	12.1-27.9; 22.5±4.5	7.8-17.9; 10.1±3.3
	F	30.5-57.0; 40.0±4.6	24.2-41.4; 31.0±2.6	11.6-26.4 17.5±4.2	14.8-31.5; 21.3±3.2	13.7-28.6; 18.5±2.4	17.9-30.8; 21.3±2.4	6.3-12.0; 7.9±1.3	17.7-33.5; 23.3±2.4	6.3-11.8; 8.6 ±1.2
M. lugubris	M	39.4-51.6; 46.7±4.1	29.8-37.6; 34.1±2.6	15.3-19.0; 17.2±1.1	20.6-26.3; 24.1±1.9	16.7-19.2; 18.2±0.9	28.1-47.9; 38.2±5.7	18.2-26.8; 20.7±3.2	23.7-36.3; 30.5±4.2	9.9-17.4; 14.4±2.3
	F	33.7-52.8; 39.6±6.0	25.4-34.5; 29.7±4.6	13.8-26.4; 17.3 ±4.1	18.1-30.7; 21.8±4.1	12.6-16.8; 15.4±1.2	22.1-38.9; 28.8±5.6	8.2-26.5; 16.3±4.7	11.7-28.4; 22.1±5.0	8.9-15.2; 11.3±2.3
M. harpax	M	49.2-71.6; 57.1±7.2	36.2-50.3; 40.7±5.2	18.4-25.5; 20.8±2.3	24.9-36.3; 29.0±3.6	20.8-31.7; 24.4±3.7	37.9-68.2; 50.5±9.7	20.1-32.7; 25.7±4.5	30.8-46.5; 39.3±6.7	16.8-23.3; 19.0±2.9
	F	39.4-63.9; 56.8±9.1	30.7-50.8; 43.0±6.9	17.2-35.0; 29.7±6.4	22.2-39.4; 31.9±5.8	16.7-28.3; 24.5±4.1	28.1-51.4; 42.6±7.8	14.3-25.5; 21.1±3.4	23.7-43.8; 36.9±6.9	11.2-37.6; 19.4±6.9
L. laevis	M	18.86	15.02	8.04	8.6	10	16.0	7.4	13.1	5.0
Horai	M	17.5-23.0; 20.3±2.8	14.6-18.1; 16.4±1.8	7.0-7.2; 8.0±0.1	10.1-12.7; 11.4±1.3	7.4-10.1; 8.7±1.4	12.1-12.5; 12.3±0.2	5.8-6.1; 6.0±0.2	9.9-10.9; 10.4±0.5	3.4-4.0; 3.7±0.3
	F	14.2-24.0; 19.6±4.0	12.3-20.3; 16.5±3.2	7.0-15.1; 10.8±3.7	8.3-15.1; 11.8±2.7	6.2-11.0; 8.6±1.9	7.5-12.1; 10.4±1.8	2.4-5.8; 4.0±1.2	6.4-10.4; 8.5±1.6	2.3-3.9; 3.2±0.6

Note: 10 number of males and females (M, n=10; F, n=10) crabs were considered for *S. trilobata, S. spinigera, L. woodmasoni, M. lugubris, M. harpax*., whereas 1 male for *L. laevis*, and 2 males and 4 females for *A. horai* (M, n=2; F=4).

Fig. 2. *2A-B: Sartoriana trilobata, A: dorsal view of carapace, B: ventral view of male pleon; 2C-D: Sartoriana spinigera, C: dorsal view of carapace; D: ventral view of male pleon; 2E-F: Lobothelphusa woodmasoni, A: dorsal view of carapace, B: ventral view of male pleon (scale bar 10 mm).*

However, the smooth and glabrous carapace and short sternopleonal cavity that reaches only up to the level of the imaginary line that connects the median part of the cheliped coxae are the main morphological characteristics of *Lobothelphusa* (absent in *Acanthopotamon*) (Pati *et al*., 2019). Apart from the generic differences, the following are the most noticeable differences between *L. woodmasoni* and *A. horai*: the anterolateral margin of the carapace was with four epibranchial teeth in *L. woodmasoni*, but three epibranchial teeth in *A. horai*; a convex carapace with a deep cervical groove was found in *L. woodmasoni*, but a comparatively less convex carapace with a superficial cervical groove in *A. horai*.

The present study revealed that the crab species dwelled in more than one habitat. *Sartoriana trilobata* is a riverine crab found only in Assam and Mizoram (Chetia *et al*., 2021; Pati and Thackeray, 2018). *Sartoriana spinigera*, on the other hand, is found in lowland areas of the northwestern states of India to Assam and Nagaland (Brandis and Sharma, 2005). *Sartoriana spinigera* is also reported from Nepal and Myanmar (Brandis and Sharma, 2005). Interestingly, the present work rarely observed *S. trilobata* and *S. spinigera* together in any wetlands of the Subansiri basin. Also, *S. trilobata* was recorded in Bosa gaon beel during the Monsoon season, which could have been relocated there by the monsoon flood of the Subansiri River.

Sartoriana trilobata was found in streams in the plains of the Subansiri basin (Lakhimpur district of Assam),

Fig. 3. *3A-B: Maydelliathelphusa lugubris, A: dorsal view of carapace, B: ventral view of male pleon; 2C-D: Maydelliathelphusa harpax, C: dorsal view of carapace; D: ventral view of male pleon; 2E-F: Liotelphusa laevis, E: dorsal view of carapace, F: ventral view of male pleon; 3G-H: Acanthopotamon horai, G: dorsal view of carapace, H: ventral view of male pleon (scale bar 10 mm).*

but never in Arunachal Pradesh, despite the fact that the same streams run through both states. *S. spinigera*, on the other hand, was found in streams and ponds, rice fields, and beels in the Subansiri basin plain (Lakhimpur district of Assam). It can be concluded that, in contrast to *S. trilobata*, *S. spinigera* is a generalist species that can live in a variety of habitats.

Maydelliathelphusa lugubris appears to be a specialist species, found primarily in the clear, moving water of the Poma and Dikrong Rivers of Arunachal Pradesh (Table 1), as this species could not be found in the rivers of plain areas of the Subansiri River basin. Ghosh et al. (2006) also reported this species in different parts of Arunachal Pradesh, but not from the Subansiri basin. According to Brandis and Sharma (2005), *M lugubris* is distributed along the Ganges and Brahmaputra valleys ranging from Punjab to Nagaland. However, Bisht (2015) found *M lugubris* in rice fields and canals of Nepal, which indicated the environmental adaptability of this species. *Maydelliathelphusa harpax* was found exclusively in the Rangana River and its watersheds such as beels, marshy wetlands etc. (Table 1). This species is known to live in turbid rivers, ponds, and wetlands of Assam, Meghalaya, Mizoram, Nagaland, West Bengal and Bihar (Pati and Thackeray, 2018).

Liotelphusa laevis is exclusively endemic to the Eastern Himalayan region, distributed in Northeastern India and West Bengal (Chetia *et al*., 2020). While Ghosh *et al*.

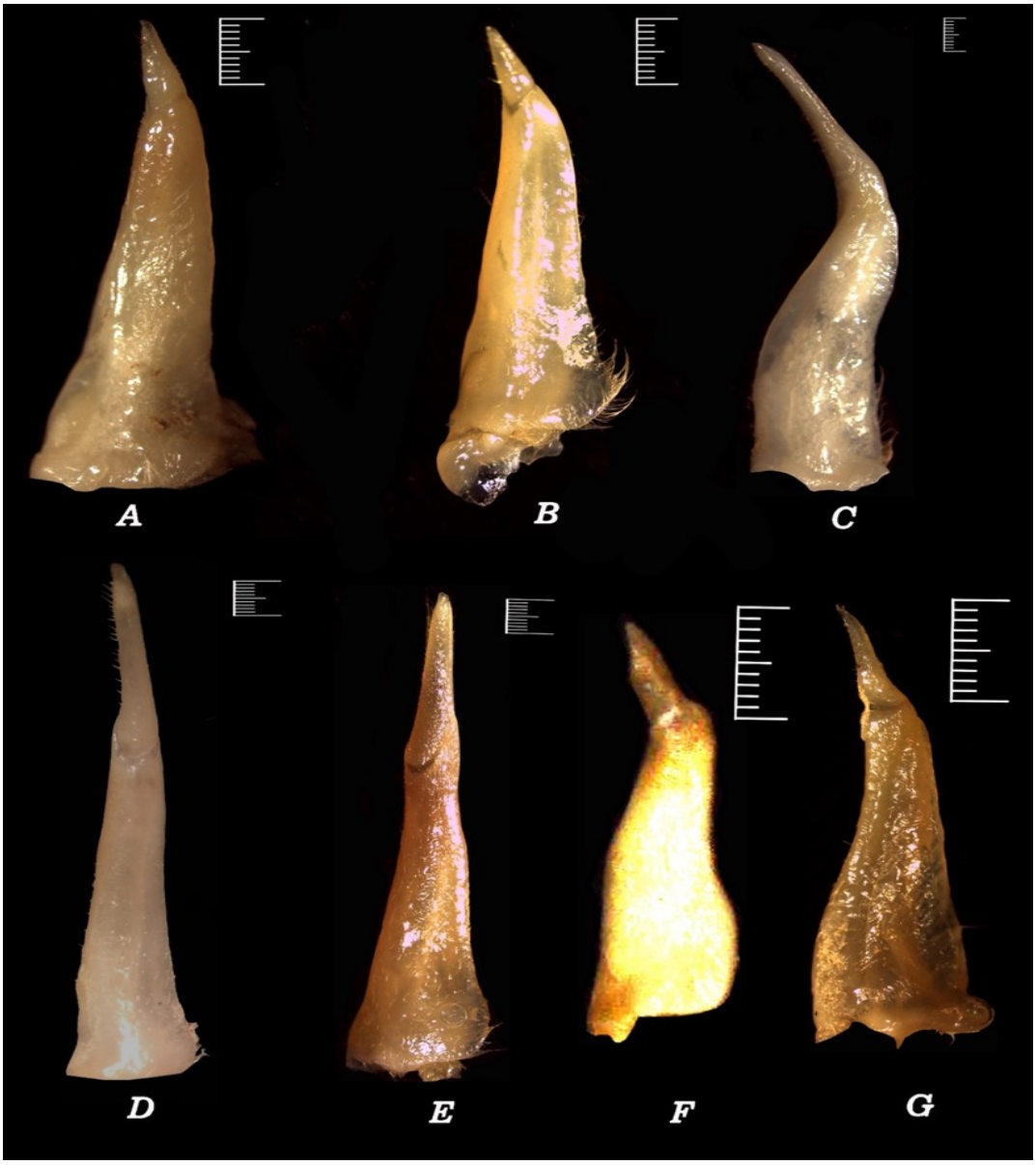

Fig. 4. *4A: G1 of Sartoriana trilobata; 4B: G1 of Sartoriana spinigera; 4C: G1 of Lobothelphusa woodmasoni, 4D: G1 of Maydelliathelphusa lugubris; 4E: G1 of Maydelliathelphusa harpax; 4F: G1 of Liotelphusa laevis; 4G: G1 of Acanthopotamon horai.*

(2006) reported this species from Arunachal Pradesh, we found only one specimen in a stream located near the Ranganadi tributary. A more extensive survey would likely provide more specific information about their distribution in the aforementioned basin.

The present study collected two potamid crabs: *L. woodmasoni* and *A. horai*. *Lobothelphusa woodmasoni* was found in both the streams and the beels (e.g., Bosagaon beel) of the Subansiri river basin, along with *M. harpax* and *S. spinigera*. Whereas *A. horai* was found only in the Senki river- a clear flowing water body - located in the foothills of Papum Pare district, Arunachal Pradesh. These crabs appeared immobile each time they were obtained inside or beneath the rock. Pati *et al*. (2019) have opined that *A. horai* has greater adaptability as this species is found inside small rocks in both lowland and upland areas.

The findings show that, while all of these crabs are endemic to the Eastern Himalayan region, their habitats differ. For example, despite the fact that Dikrong and Ranganadi are the two main rivers of the River Subansiri, they do not harbour common crab species (Table 1). Crab endemism to a specific habitat may be caused by their poor dispersibility and sensitivity to a distinct ecological environment.

According to local community-level data, freshwater crabs are the most commonly consumed aquatic species by the various tribal communities of Northeast India, second to fish. Ethnic groups native to the Subansiri basin, including Niyshi, Mishing, Adi, Bodo, Tiwa and Ahom, Adibashi, and Nepali, prefer crabs for their unique taste and medicinal properties. Freshwater

crabs are regarded as traditional medicine in some communities for treating jaundice and gastrointestinal problems. They also have aboriginal faith in crab meat, though it varies among the tribes. Therefore, live crab production may be considered a profitable and feasible business in the area. Unfortunately, no attempts at their domestication have been made in the region to date, and the community is entirely reliant upon the wild resources. The present study provides baseline information about the crab species, which will aid in its captive rearing programme. Such initiatives will help in the conservation of the dwindling wild population as well as overall socio-economic upliftment.

Paragoniums (lung fluke) is a trematode parasite (Platyhelminthes) that utilises the freshwater crabs as intermediate hosts and is transmitted to humans through the consumption of these crustaceans, causing Paragonimiasis. Epidemiological studies have revealed that Assam, Nagaland, Meghalaya, Mizoram, Manipur and Arunachal Pradesh are Paragonimiasis-prone areas where *S. spinigera Potamiscus manipurensi* and *M. lugubris* have been discovered as the main host of *Paragoniums* spp. (Narain *et al.,* 2003; Roy *et al.,* 2016, Singh *et al*., 2012). Thus, the data generated herein on the diversity of crabs can be used as a proxy for understanding the epidemiology of Paragonimiasis, an important foodborne parasitic disease.

Conclusion

Seven crab species from two families were identified in the Subansiri River basin of Arunachal Pradesh and Assam in northeast India: *Sartoriana spinigera*, *Sartoriana trilobata*, *Maydelliathelphusa lugubris, Maydelliathelphusa harpax, Liotelphusa laevis* (Gecarcinucidae) *Lobothelphusa woodmasoni,* and *Acanthopotamon horai* (Potamidae). All seven crab species appear endemic to the Eastern Himalayan geography, which can be attributed to their poor dispersibility and environmental sensitivity. Future research should focus on the eco-biology of these crabs in the Subansiri basin, with a particular emphasis on studying the physicochemical parameters of this river basin. This is also the first study to contribute to crab aquaculture's conservation and sustainable use as an alternative livelihood resource for indigenous communities in the Subansiri River basin of North East India.

Conflict of interest

The authors declare that they have no conflict of interest.

ETHICAL STATEMENT

Experiments were conducted following institutional guidelines for animal care.

REFERENCES

1. Ahyong, S.T., Lowry, J.K., Alonso, M., Bamber, R.N., Boxshall, G.A. Castro, P., Gerken, S., Karaman, G., Goy, J.W., Jones, D.S., Meland, K., Rogers, D.C & Svavarsson, J. (2011). Subphylum Crustacea Brünnich, 1772 In: *Animal biodiversity: an outhline of higher- level classification and survey of taxonomic richness* (pp 164-191). *Zootaxa* 3148, Mangolia press.
2. Alcock, A. (1909). Diagnoses of new species and varieties of freshwater crabs. *Records of the Zoological Survey of India*, 3(4), 375-381.
3. Alcock, A. (1910). Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum. Brachyura I. Fasc. II. The Indian Freshwater Crabs-Potamonidae. Calcutta.
4. Bott, R. (1970). Die Süßwasserkrabben von Europa, Asien, Australien und ihre Stammesgeschichte. Eine Revision der Potamoidea und der Parathelphusoidea (Crustacea, Decapoda). *Abhandlungen der Senckenbergischen Naturforschenden,* 526, 1-338.
5. Bisht, S.R. (2015). Morphotaxonomy and eco biology of some crabs of Nepal. Kumaun University (Doctoral dissertation).
6. Brandis, D. & Sharma, S. (2005). Taxonomic revision of the freshwater crab fauna of Nepal with description of a new species (Crustacea, Decapoda, Brachyura, Potamoidea and Gecarcinucoidea). *Senckenbergiana Biologica,* 85(1), 1-30.
7. Chetia, A. & Das, D.N. (2019). Enumeration of fresh water crab and aquatic fauna in Ranganadi River basin, Assam In: *Research Trends on Fish and Fisheries in Mountain Waters of Eastern Himalayan Region*. Notion Press, Chennai.
8. Chetia, A., Mitra, S. & Das, D.N. (2020). Morphotaxonomic review for conserving *Liotelphusa laevis* (Wood-Mason, 1871) (Decapoda: Brachyura: Gecarcinucidae), A near threatened freshwater crab from North East India. *Journal of Scientific Research,* 64(1), 59-63. doi.org/10.37398/JSR.2020.640107
9. Chetia, A., Mitra, S. & Das. D.N. (2021). Redescription of *Sartoriana trilobata* (Alcock, 1909) (Crustacea: Decapoda: Brachyura: Gecarcinucidae) from Assam, Northeast India, with notes on the morphology of male gonopods. *Zootaxa,* 5026(1), 136–144. doi.org/10.11646/zootaxa.5026.1.6
10. Cumberlidge, N., Ng, P.K., Yeo, D.C., Magalhães, C., Campos, M.R., Alvarez, F., Naruse. T., Daniels, S.R., Esser, L.J., Attipoe, F.Y.K., Clotilde-Ba, F-L., Darwall, W., McIvor, A., Ram, M., & Collen, B. (2009). Freshwater crabs and the biodiversity crisis: importance, threats, status, and conservation challenges. *Biological Conservation*, 142(8), 1665–1673. doi.org/10.1016/j.biocon.2009.02.038
11. Dobson, M. (2004). *Freshwater crabs in Africa*. Freshwater Biological Association. *Freshwater Forum*, 21, 3-26
12. Ghosh, S.K., Ghatak, S.S. & Roy, T. (2006). Crustacea: Decapoda Palaemonidae and Potamonidae In: *Fauna of Arunachal Pradesh, Stale Fauna Series* (pp 39-45). Zoological Survey of India, Kolkata.
13. Kaushik, G. & Bordoloi, S. (2016). Ichthyofauna of Ranganadi River in Lakhimpur, Assam, India. *Check List,* 12(2), 1-6. doi.org/10.15560/12.2.1872

14. Magalhaes, C. (2003). Brachyura: Pseudothelphusidae e Trichodactylidae In: *Manual de Identificacao dos Crustaceos Decapodos de Agua Doce Brasileiros* (pp 143-297). Sao Paulo, Edicoes Loyola, Museu de Zoologia Universidade de Sao Paulo.

15. Mitra, S. (2017). *Freshwater Crabs: Crustacea : Decapoda : Gecarcinucidae and Potamidae of Mizoram*. Zoological Survey of India.
16. Mitra, S. (2020). *Abortelphusa namdaphaensis*, a new genus and new species of freshwater crab (Decapoda, Brachyura, Gecarcinucidae) from Arunachal Pradesh, India. *Crustaceana,* 93(7), 803-817. doi.org/10.1163/15685403-bja10027.
17. Mitra, S., Pati, S. K., & Ng, P. K. (2021). Abormon, a new genus of freshwater crab (Crustacea: Brachyura: Potamidae) from northeastern India, with descriptions of two new species. *Nauplius*, *29*. doi.org/10.1590/2358-2936e2021014
18. Narain, K., Devi, K.R., & Mahanta, J. (2003). Paragonimus and paragonimiasis–a new focus in Arunachal Pradesh, India. *Current Science,* 84(8), 985-987.
19. Ng, P.K., Guinot, D. & Davie, P.J. (2008). Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *The Raffles Bulletin of Zoology,* 17, 1-286.
20. Pati, S. & Thackeray, T. (2018). The freshwater crab genera *Ghatiana* Pati Sharma, *Gubernatoriana* Bott, and *Inglethelphusa* Bott (Crustacea: Decapoda: Brachyura: Gecarcinucidae) revisited, with descriptions of a new genus and eleven new species. *Zootaxa,* 4440(1), 1-73. doi.org/10.11646/zootaxa.4440.1.1
21. Pati, S.K., Mitra, S. & Yeo, D.C. (2019). A new species of *Acanthopotamon* Kemp, 1918 (Decapoda: Brachyura: Potamidae: Potaminae) from northeastern India, with a key to the species of the genus and notes on their distribution in relation to freshwater ecoregions. *Journal of Crustacean Biology,* 39(4), 450-458. doi.org/10.1093/jcbiol/ruz040
22. Pati, S. K., Mitra, S., & Ng, P. K. (2020). The identity of the freshwater crab Indochinamon manipurense (Alcock, 1909), with description of a new species of Potamiscus Alcock, 1909, from Manipur state, India (Decapoda, Brachyura, Potamidae). *Crustaceana*, *93*(7), 703-725. doi.org/10.1163/15685403-bja10009
23. Pati, S.K. (2021). Two new species of freshwater crabs of the genus *Potamiscus* Alcock, 1909 (Brachyura: Potamidae) from Nagaland, northeastern India. *Nauplius,* 29. doi.org/10.1590/2358-2936e2021006
24. Roy, J.S., Das, P.P., Borah, A.K. & Das, J.K. (2016). Paragonimiasis in a child from Assam, India. *Journal of clinical and diagnostic research*, 10(4), 6-7. doi.org/10.7860/JCDR/2016/18160.7616
25. Singh, T.S., Sugiyama, H. & Rangsiruji, A. (2012). Paragonimus and paragonimiasis in India. *Indian journal of medical research,* 136(2), 192-204.
26. Takeda, M., Sugiyama, H & Singh, T. (2012). Some freshwater crabs from northeast India bordered on Myanmar. *Journal of Teikyo Heisei University,* 23(1), 199-213.
27. Yeo, D.C. & Ng, P.K. (2012). Sodhiana, a new genus of freshwater crab from South Asia (Decapoda: Brachyura: Gecarcinucidae). *Raffles Bulletin of Zoology,* 25, 279-284.
28. Zhou, X.J., Yang, Q., Tan, Q.H., Zhang, L.Y., Shi, L.B. & Zou, J.X. (2021). Paragonimus and its hosts in China: an update. *Acta Tropica*, 223, 106094, 1-11. doi.org/10.1016/j.actatropica.2021.106094