

**First record of galatheid squat lobster, *Shinkaia crosnieri* Baba & Williams, 1998  
(Decapoda: Galatheaidea) from cold-seep environment of the Indian Ocean**

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**Abstract**

In this paper, we report the first record of the deep-water squat lobster, *Shinkaia crosnieri* Baba & Williams, 1998 from the Indian waters. Specimens were collected from cold seep environment located at 1750–1760 m depth in the Krishna–Godavari basin, western Bay of Bengal, India. This species was only distributed in the Western Pacific, and the present observation assumes significance as it extends the distribution record west to the Indian Ocean. Notes on its morphological diagnosis and geographical distribution are also provided.

**Keywords:** Cold seep, Deep-sea, Krishna–Godavari basin, squat lobster, Anomura, First record

## Introduction

Baba and Williams (1998) described a new genus and species of deep-sea squat lobster, *Shinkaia crosnieri* Baba & Williams, 1998, from hydrothermal vents off Bismarck Archipelago, Papua New Guinea, and Okinawa Trough, off southwestern Japan from a depth range of 1330–1483 meters (Fig. 1). Since then, no other species of this genus has been described, therefore, it is the only monotypic genus in the family Munidopsidae. Chan et al. (2000) reported two male specimens from an 800 m deep hydrothermal vent off northeast Taiwan (Fig. 1). Watabe and Miyake (2000) recorded this species from a 1500 m deep hydrothermal vent on the Hatoma Knoll off Iriomote-jima, southern Japan (Fig. 1). Subsequently published literature (Baba et al. 2009, Fujikura et al. 2002, Dong and Li, 2015; Yang et al. 2016, Cheng et al. 2020, Xiao et al. 2020) reported this species from cold-seep environments in the South China Sea, and from several vent fields around Okinawa Trough in the East China Sea, such as Minami-Ensei Knoll, Izena Caldron, Iheya field, Sakai field (Fig. 1).

In the Indian Exclusive Economic Zone, only two cold-seep environments have been recorded till date in the Krishna–Godavary (K–G) (Mazumdar et al. 2019) and Cauvery–Mannar basins (Mazumdar et al. 2021). Geomorphic features in the KG offshore basin include delta front between the outer shelf and upper slope incised with numerous canyons (Ramana et al. 2009), bathymetric mounds formed due to deeply buried shale diapir and sedimentary ridge controlled by toe thrust fault system (Dewangan et al., 2010), and several mass transport deposits in the upper slope region associated with diapirism, faulting, and gas venting (Ramprasad et al. 2011).

The cold seep in the K–G basin was first discovered by Mazumdar et al. (2019) during cruise SSD-045 onboard Oceanographic Research Vessel Sindhu Sadhana during early 2018. Located at 900–1800 m depths, and characterized by 3.55–7.15°C temperature, 9–18 MPa pressure, and gas flares, this site was detected through analysis of water column images of the multi-beam echosounder Atlas-Hydrosweep DS (Mazumdar et al. 2019). This cold-seep was reported to have methane gas hydrates at 2–3 metres below sea floor, and inhabited by chemosymbiont-bearing bivalves, gastropods, polychaetes, barnacles, caridean shrimps, galatheoid crabs and echinoderms (Mazumdar et al. 2019; Sangodkar et al. 2022). The present study reports *S. crosnieri* Baba & Williams, 1998 from the K–G basin in the Bay of Bengal, which is the first record of this species in the Indian Ocean (Fig. 1).

## Materials and Methods

The samples were collected during an expedition on-board Research Vessel Sindhu Sadhana on a transit cruise in March 2018 in the K–G basin, western Bay of Bengal, India. The specimens were sorted onboard, photographed, and preserved in 10% formalin. Taxonomic identification was done following Baba and Williams (1998). Photographic plates were made using Adobe® Photoshop CS5. Measurements of the carapace and the appendages were made with vernier calipers accurate to 0.1 mm.

The terminology used in the description mainly follows that of Baba et al. (2009), except for “dorsal” and “ventral” instead of “extensor” and “flexor” margins with regards to the third maxilliped and ambulatory legs. Specimen size is indicated by postorbital carapace length (measured along the dorsal midline from the posterior margin of the orbit to the posterior margin of the carapace) and maximum width of the carapace. Material examined during this study is deposited as reference voucher collection in the National Repository for Marine Flora and Fauna at CSIR-National Institute of Oceanography, Dona Paula, Goa, India.

Map was plotted using ODV mapping software (Schlitzer 2021). Abbreviations used are: CW: carapace width; coll.: specimen collector; G1, G2: male first and second gonopods; Mxp3: third maxilliped; NIO: “National Institute of Oceanography” voucher series; P1, P2, P3 and P4: first to fourth pereopods, respectively; PCL: postorbital carapace length; SP2: spade core 2; stn.: station number.

## Results

The present study provides a systematic account of the deep-water squat lobster *S. crosnieri* recorded for the first time from a cold seep ecosystem in the Bay of Bengal, India.

### Taxonomy

Order Decapoda Latreille, 1802

Infraorder Anomura, MacLeay, 1838

Superfamily Galatheaidea Samouelle, 1819

Family Munidopsidae Ortmann, 1898

Genus *Shinkaia* Baba & Williams, 1998

*Shinkaia crosnieri* Baba & Williams, 1998

(Figs. 2–4)

Munidopsidae gen. sp., new species(?): Hashimoto et al. 1995: 585, list (Izena Calderon and Iheya Ridge, Minami-Ensei Knoll, Okinawa Trough, SW off Japan).

*Munidopsis* sp.: Fujikura et al. 1995: 233 (Minami-Ensei Knoll, 28.39–28.41°N, 127.63–127.65°E, 600–740 m depth).

*Shinkaia crosnieri* Baba and Williams 1998: 148, Figs. 3, 4A–G, 5A–M, 6A–H (type locality: Bismarck Archipelago, West Pacific Ocean, Papua New Guinea, Edison Seamount, northeastern crater rime near Lihir Island, 3.31°S, 152.58°E (1330–1483 m depth); Okinawa Trough, 27.55°N, 126.97°E, 1394 m, 27.27°N, 127.08°E, 1330 m, 27.55°N, 126.96°E, 1390 m; Mid Okinawa Trough, 27.78°N, 126.89°E, 976 m); Chan et al. 2000: 800, Figs. 1, 2a–d (DR 11, dredge, NE off Taiwan, 1200 m); Tsuchida et al. 2000: list, Photo 1 (Hatoma Knoll, 24.85°N, 123.84°E, 1470–1520 m); Watabe and Miyake 2000: 31, Fig. 2 (Hatoma Knoll, off Iriomote-jima, Ryukyu Islands, southern Japan, ca. 1500 m); Ohta and Kim 2001: 666, 671, Photograph 4 (Iheya Ridge, Okinawa Trough, 27.54°N, 126.97°E, 1400 m); Fujikura et al. 2002: 24 (Minami-Ensei Knoll, 28.39–28.41°N, 127.63–127.65°E, 600–740 m depth); Kojima 2002: 350 (for details see Chan et al. 2000, Tsuchida et al. 2000); Baba 2005: 307 (synonymy); Martin and Haney 2005: 481 (hydrothermal vents and cold seeps review); Watanabe et al. 2005: 234, Fig. 1, map (Hatoma Knoll, 1500 m); Macpherson and Baba 2006: 449, unnumbered Fig. (no record); Baba et al. 2008: 181, Fig. 4I (synonymy); Baba et al. 2009: 294, Figs. 267 (near Diaoyutai/ Senkaku, ca. 1200 m), 268, 269 (Formosa Ridge off Taiwan, 1100 m), 270a–e (Iheya Seamount, 976 m); Watanabe et al. 2010: Fig. 12.2g, list (Okinawa Trough: Minami Ensei Knoll, 28.40°N, 127.65°E, 600–800 m; North Knoll of Iheya Ridge, 27.80°N, 126.90°E, 900–1000 m; Iheya Ridge, 27.55°N, 126.96°E, 1300–1500 m; Izena Hole, 27.21–27.26°N, 127.05–127.10°E, 1300–1600 m; Hatoma Knoll, 24.86°N, 123.85°E, 1400–1530 m; Dai-yon Yonagumi Knoll, 24.85°N, 122.70°E, 1320–1387 m); Dong and Li 2015: 95 (South China Sea, SW off Taiwan, 22.12–22.12°N, 119.26–119.29°E, 1120–1160 m); Yang et al. 2016: Figs. 1A–B, 2 (Formosa Ridge, 22.11°N, 119.28°E, 1126–1145 m; Izena Calderon, 27.27°N, 127.08°E, 1310 m; Hatoma Knoll, 27.85°N, 123.84°E, 1490 m); Miyazaki et al. 2017: Fig. 6c (Yokosuka site, southern Okinawa Trough, 25.26°N, 124.36°E, 2190 m); Cheng et al. 2020: Fig. 1, map (Ikeya North, Okinawa Trough, 27.79°N, 126.98°E, 983.5 m; Formosa Ridge, South China Sea, 22.19°N, 119.48°E, 1133.4 m).

Galatheidae: Mazumdar et al. 2019: Fig. 3o (Krishna–Godavari Basin, Bay of Bengal, 15.70–15.73°N, 82.05–82.18°E, 1752–1756 m); Peketi et al. 2022: list (for details see Mazumdar et al.

2019); Sangodkar et al. 2022: Fig. 3e (K-G basin in the Bay of Bengal 15.72°N, 82.06°E; 15.72°N, 82.06°E, ~1750m depth.).

**Material Examined:** 1 female, (PCL 22.8 mm, CW 19.7 mm), 1 male, (PCL 17.9 mm, CW 16.5 mm), NIO1013/22, Krishna-Godavari Basin, western Bay of Bengal, off Machilipatnam, India, stn. SP2 (15.72°N, 82.07°E), 1754.5 m depth, 17 March 2018, coll. Dr. M.J. Gonsalves.

#### **Description of the present material (modified from Baba and Williams 1998)**

Carapace (Fig. 2a) oval longitudinally in dorsal view; PCL 1.0–1.1 times CW. Dorsal surface with unevenly distributed rugae bearing short setae, regions ill-defined; posterior branchial regions adjacent to intestinal region devoid of rugae. Anterolateral angle produced into distinct forwardly-directed spine; hepatic margin with 2–3 small spines, followed by notch at anterior branchial margin marking lateral end of anterior cervical groove; lateral branchial margins bearing 21–23 spines, increasing in size posteriorly; cervical grooves indistinct, posterior half of posterior branchial margin unarmed. Pterygostomian flap (Fig. 2b) minutely rugose, surface bearing dense long brownish setae, anteriorly ending in acute spine, and 3 small spines.

Rostrum (Figs. 2a, 3a–b) strap-shaped, flattened dorsoventrally (damaged in male), 0.25 times PCL in female, with small rugae setose dorsally; lateral margins subparallel, smooth along proximal four-fifth portion, distal one-fifths portion abruptly converging at tip, bearing 5–6 minute spines laterally.

Thoracic sternum (Fig. 2c–d) covered with dense long plumose setae; sternite 3 0.54 times long as long as wide, anterior margin gently sinuous; anterior margin of sternite 4 narrower than sternite 3.

Pleonal tergites (Fig. 2a) smooth, tergites 2–6 bearing sparse tufts of setae, setae on tergites 3–5 arranged in anterior and posterior transverse rows. Telson (Fig. 2a, e) almost as long as broad, comprising 7 unequal plates, 2 elongate intercalated plates each obliquely placed between midlateral and postero-lateral plates. Uropods (Fig. 2a, e) broad, protopod large with distal margin scalloped.

Eyestalks (Figs. 2a, 3a–b) dorsoventrally, not reaching distal tip of rostrum; mesial margin gently concave, spinose proximally; lateral margin gently convex, bearing strong spine at distal one-thirds length; cornea (Fig. 3b) vestigial, reduced to a transverse band ventrally across midlength of eyestalk.

Antennular article I (Fig. 3c) bearing two distolateral spines, tips falling short of distal end of lateral spine of eyestalk.

Antennal article I (Fig. 3d, e) bearing 1 compressed triangular lateral spine not reaching base of article 2; article 2 bearing 1 flattened lateral spine and 2 mesial spines; article 3 bearing 1 spine on mesial margin (damaged) and 2 distomesial spines; article 4 not reaching level of lateral spine of eyestalk.

Mxp3 (Fig. 3f) basis to merus bearing sparse setae, carpus to dactylus unarmed, bearing dense setose tufts ventrally; exopod well-developed, bearing flagellum.

P1 (Fig. 4a–b) subequal, length 1.4–1.5 times PCL. Merus 0.3 times length of P1, bearing strong distomesial spine, distolateral spine small; dorsal surface bearing few well-spaced distal tubercles, subdistal spines (largest spine at anterolateral corner) followed by several longitudinal rows of rugae bearing setae. Carpus mesial margin with 6 spines, proximal third spine largest, mid-dorsal surface with longitudinal row of 6 spiniform tubercles flanked by 3 irregular rows of short spines. Chela 1.4 times length of merus; palm robust, length subequal to height; mesial margin with 5 (in male) to 6 (in female) strong spines; lateral margins of both palm and fixed finger with 15 (in female) to 16 (in male) curved spines, followed by row of 11–12 ventral spines bearing setal tufts; excavate ovate pit ventrally at base of fixed finger; fingers almost straight, prehensile edges serrated, straight along distal three-fourths, with small gape and molariform tooth basally; dactylus length 1.3 times palm length, mesial margins with 7–8 curved spines, distally bifurcate receiving dactylar tip.

P2, P4 shorter than P1, P3 slightly longer than P1 in male (Fig. 4c–e), shorter in female (Fig. 2a); coxae to meri covered with thick setose patches on mesial surfaces of P2–4, carpi to dactyli bearing setal tufts arising from widely spaced pits; meri with spinose crests on dorsal and ventral margins, carpi and propodi with spinose crests on dorsal margins only, dorsal crests prominent, terminating in strong distal spine on each meri and carpi; dorsal crests of carpi and propodi bearing 7–8 spines, flanked by a dorsolateral row of 7–8 shorter spines; propodi bearing 1 corneous spine behind dactylar articulation; dactylar ventral margins with 14–15 corneous spines.

Epipods present on P1–3.

G1 curved, shorter than G2 (Fig. 3g–h).

**Remarks:** *Shinkaia crosnieri* is among the few deep-sea decapods which inhabit both hydrothermal vents and cold seep environment with a depth range of 700–2200 m (Yang et al. 2016, Xiao et al. 2020). The specimens examined in the present study were collected with a box corer from a cold seep site in the western Bay of Bengal. These specimens generally agree with the original

description of the holotype (Baba and Williams, 1998), but, differ from the latter in the following characters.

1. Fewer lateral branchial spines (21–23), as compared to 25–30 in the holotype.
2. Relatively wider rostrum, abruptly tapering distally, as compared to gradually tapering in the holotype.
3. Thoracic sternite with gently sinuous anterior margin, compared to anteriorly concave in the holotype.
4. Comparatively shorter lateral spine of antennal article 1, not reaching base of article 2, compared to longer spine overreaching articulation with article 2 in the holotype.
5. Fewer number of spines (6) on the mesial margin of P1 carpus, as compared to 7 in the holotype.
6. Fewer number of spines (5–6) on the mesial margin of P1 propodus, as compared to 7–8 in the holotype.
7. Fewer number of corneous spines (14–15) on the ventral margins of P2–4 dactyli, as compared to 17–18 in the holotype.

## **Discussion**

It is noteworthy that the morphological description provided above is only the second description after the original one by Baba and Williams (1998). Therefore, such description was not available for specimens from cold-seep environments. Recently, the results of the Principal Component Analysis performed on 16 morphometric characters of *S. crosnieri* specimens from both hydrothermal vents and cold seep environments (Yang et al. 2016) did not reveal any morphological differences between the vent and cold seep populations. The morphological differences between the present material and holotype could be attributed to the smaller size of the Indian specimens, and DNA barcoding of fresh material could reveal genetic variations among the Indian and Pacific Ocean populations. Recently, Hwang et al. (2022) reported a Pacific hydrothermal vent species *Munidopsis lauensis* Baba and de Saint Laurent, 1992 in the Indian Ocean, and proved that vent fauna from these two oceanic basins could interact through active ridges.

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### **Compliance with Ethical Standards**

**Conflict of Interest** The authors have no conflict of interest.

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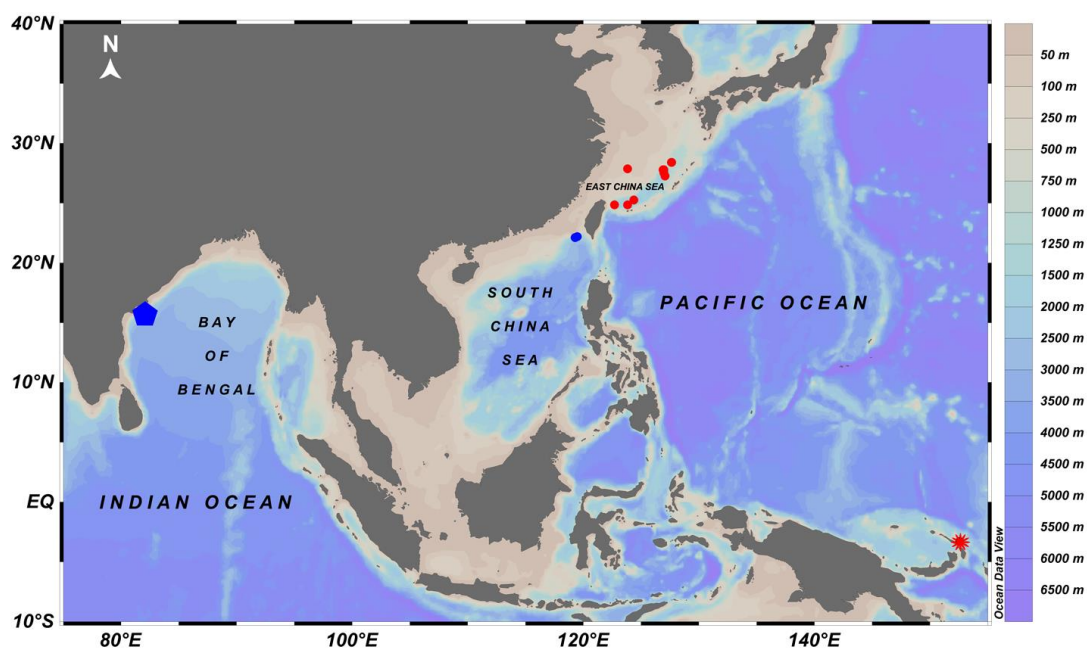


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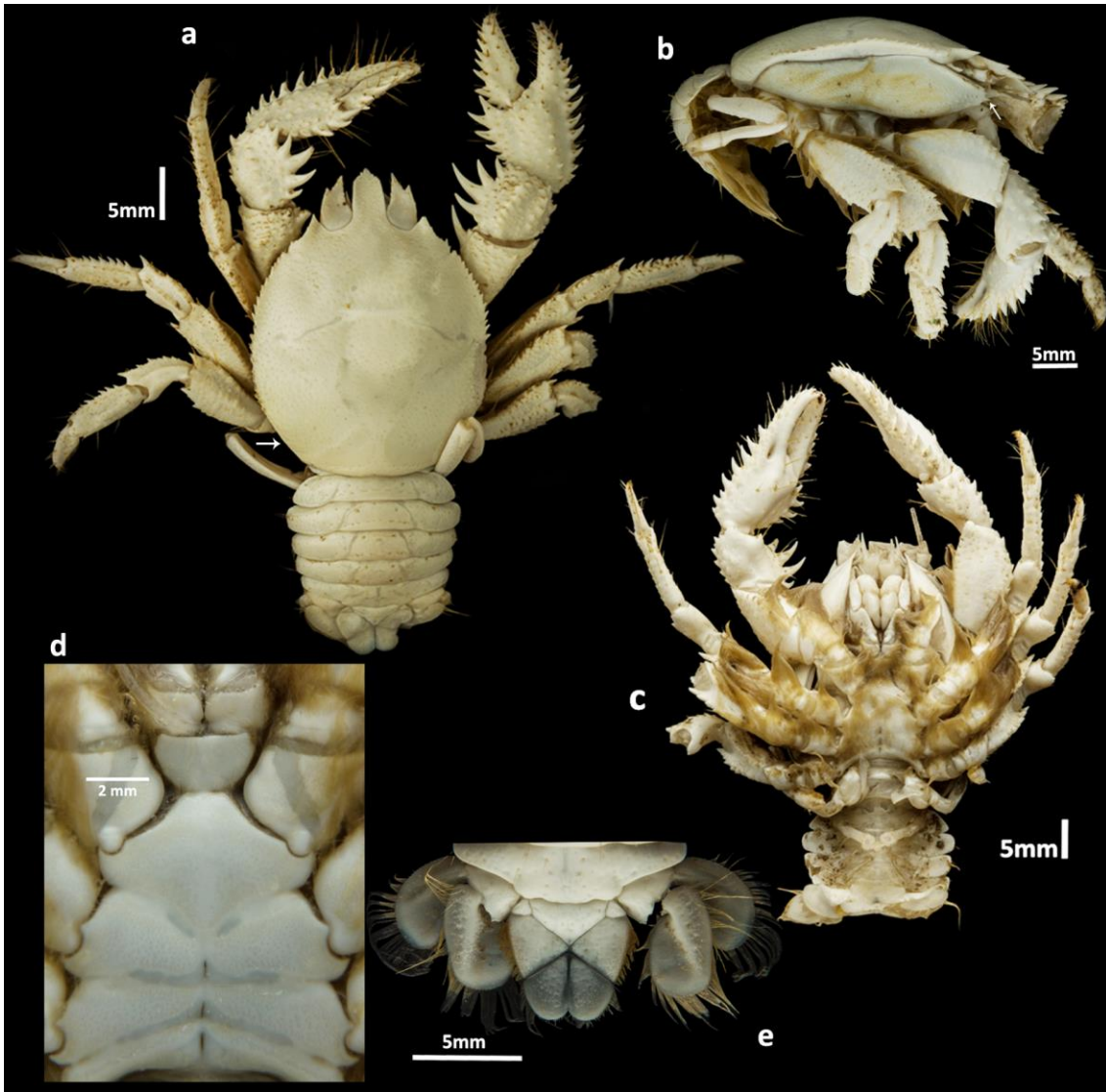
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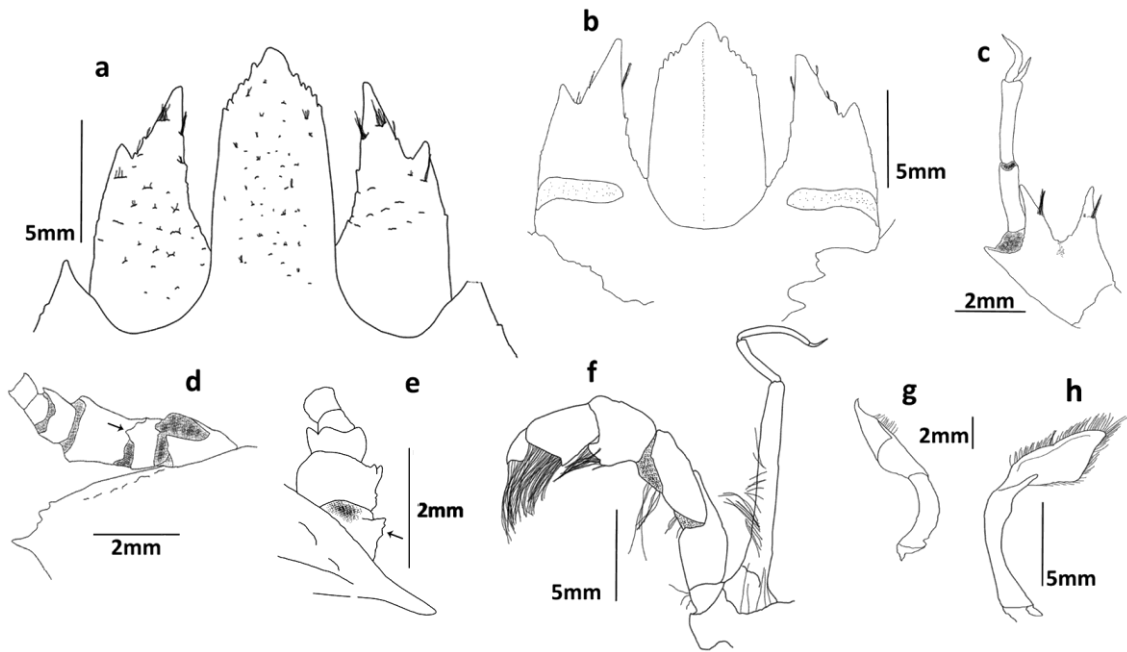
## Figure captions



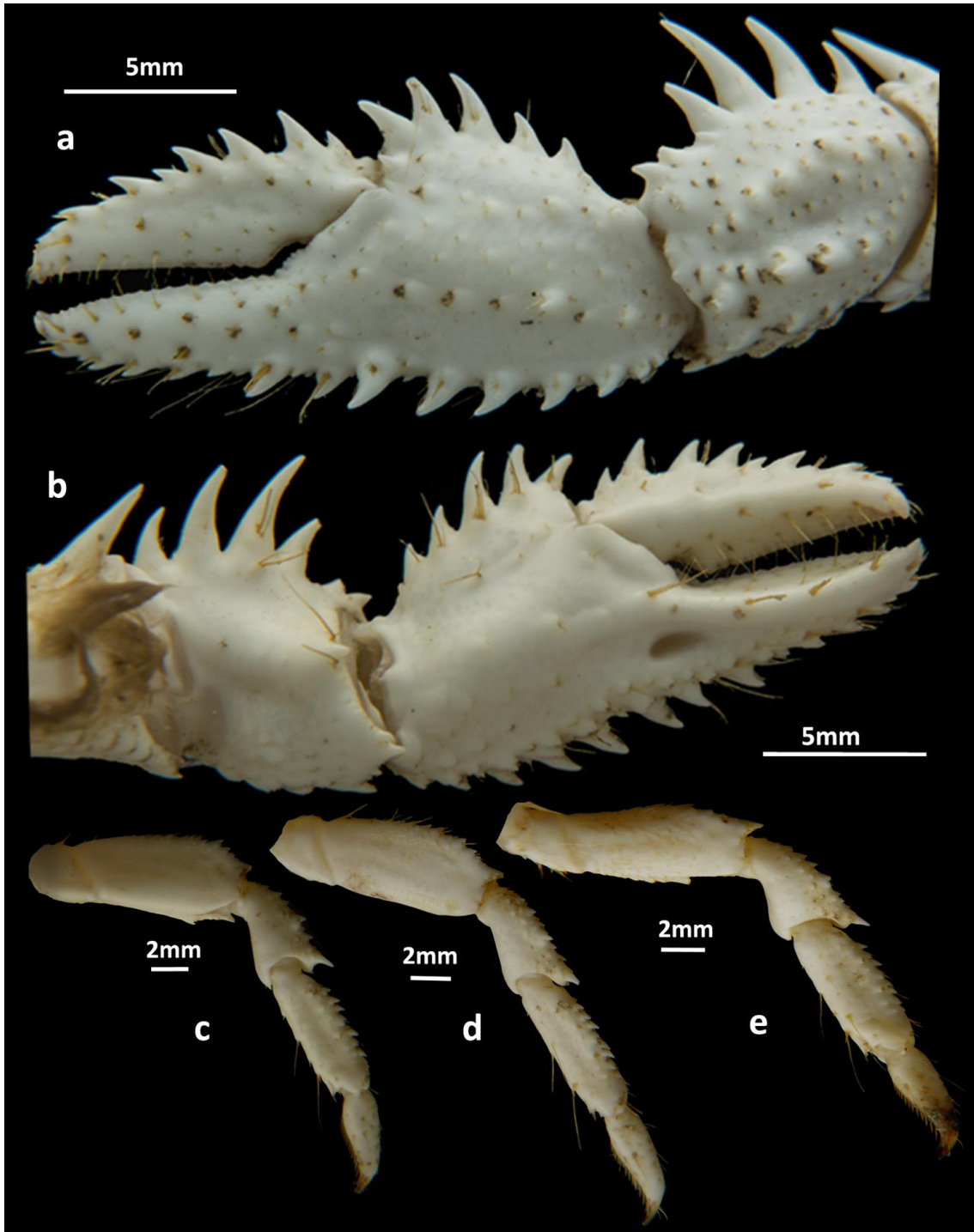
**Fig. 1** Map indicating the known geographical distribution of *Shinkaiia crosnieri* Baba & Williams, 1998. Symbols in red denote hydrothermal vent environment, those in blue denote cold-seep environment. \* – type locality; ♠ – present study area; ● – hydrothermal vent location; ○ – cold-seep location



**Fig. 2** *Shinkaia crosnieri* Baba & Williams, 1998. NIO1013/22: Female (PCL 22.81 mm, CW 19.7 mm), Bay of Bengal, India. **a** habitus, dorsal view; **b** habitus, lateral view; **d** thoracic sternum, ventral view. Male (PCL 17.88 mm, CW 16.5 mm), Bay of Bengal, India. **c** habitus, ventral view; **e** telson and uropods, external view



**Fig. 3** *Shinkaia crosnieri* Baba & Williams, 1998. NIO1013/22: Female (PCL 22.81 mm, CW 19.7 mm), Bay of Bengal, India. **a** rostrum, dorsal view; **b** rostrum, ventral view. Male (PCL 17.88 mm, CW 16.5 mm), Bay of Bengal, India. **c** left antennule, ventral view; **d** left antenna, lateral view; **e** right antenna, ventral view; **f** left third maxilliped, ventral view; **g** left G1; **h** left G2



**Fig. 4** *Shinkaia crosnieri* Baba & Williams, 1998. NIO1013/22: Male (PCL 17.88 mm, CW 16.5 mm), Bay of Bengal, India. **a** left P1 chela and carpus, lateral view; **b** left P1 chela and carpus, ventral view; **c** left P2, lateral view; **d** left P3, lateral view; **e** left P4, lateral view