

## A new species of the freshwater crab genus *Ghatiana* Pati and Sharma, 2014 (Brachyura: Gecarcinucidae) from the Central Western Ghats, India

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### ABSTRACT

A new species of the freshwater crab genus *Ghatiana* Pati and Sharma, 2014, is recognized herein from the Karnataka State, India. *Ghatiana dvivarna* sp. nov. usually inhabits holes in the laterite rocks on the elevated mountains of the Central Western Ghats (south of Goa-Nilgiris). The predominantly white color in life and the characteristic smaller eyes relative to the orbits of the new species easily distinguish it from congeners. *Ghatiana dvivarna* sp. nov. most resembles *Ghatiana pulchra* Pati and Thackeray, 2018, but can be differentiated mainly by its relatively more slender terminal segment of the male first gonopod. *Ghatiana* currently comprises 11 species, now including *Ghatiana dvivarna* sp. nov.

### KEYWORDS

Crustacea, Decapoda, Gecarcinucoidea, Karnataka, Oriental region, taxonomy.

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## INTRODUCTION

*Ghatiana* Pati and Sharma, 2014, an Indian genus of freshwater crab of the family Gecarcinucidae Rathbun, 1904, was previously known from 10 species from the Goa, Karnataka, and Maharashtra States (Pati and Thackeray, 2018; 2021) (Fig. 1). Most of the species are found in the Northern Western Ghats (Tapi valley-Goa) and are endemic there (Pati and Pradhan, 2020; Pati and Thackeray, 2021) (Fig. 1). While only three species of *Ghatiana* are known from the Central Western Ghats (south of Goa-Nilgiris), none of the congeners are found in the Southern Western Ghats (south of Palghat gap) (Pati and Pradhan, 2020; Pati and Thackeray, 2021) (Fig. 1). In fact, *Ghatiana* is the second most species-rich genus in the Western Ghats (Pati and Pradhan, 2020; Pati and Thackeray, 2021), and many more new species of the genus are yet to be described, especially from the Central Western Ghats (S.K. Pati, unpublished data).

From the poorly explored Central Western Ghats, at least three *Ghatiana* species are known: *Ghatiana atropurpurea* Pati, Thackeray and Khaire, 2016, *Ghatiana basalticola* (Klaus, Fernandez and Yeo, 2014), and *Ghatiana rouxi* Pati and Thackeray, 2021 (Klaus *et al.*, 2014; Pati *et al.*, 2016; Pati and Thackeray, 2018; 2021; Pati and Pradhan, 2020) (Fig. 1). We recognize here a new species of *Ghatiana* based on the material recently collected from Karnataka state in the Central Western Ghats (Fig. 1). The new species, *Ghatiana divivarna* sp. nov., is unique among congeners mainly because of its predominantly white color in life (Fig. 2A, B).

Including the present new species, *Ghatiana* is currently known from 11 species, with four species from the Central Western Ghats. The Western Ghats is now home to 70 species, Karnataka to 15 species, and India to 99 species of gecarcinucid crabs (see Pati and Thackeray, 2018; 2021; Pati and Vargila, 2019; Pati *et al.*, 2019a; 2019b; Mitra, 2020; Pati and Pradhan, 2020; Raj *et al.*, 2021).

## MATERIAL AND METHODS

The type material is located in the collection of the Zoological Survey of India, Western Regional Centre, Pune, India (ZSI-WRC). The comparative material is from the ZSI-WRC and the Indian Institute of

Science, Centre for Ecological Sciences, Bangalore, India (IISc-CES).

The terminology mainly follows Ng (1988), while some terms are adopted from Guinot *et al.* (2013) and Davie *et al.* (2015). The measurements (in mm) of carapace width and carapace length are after Ng (1988). The height of the carapace (in mm) was measured between the mid-dorsal and mid-ventral surfaces up to the bottom of the thoracic sternum; whereas the measurement of the frontal width was taken between the anterolateral edges of the front in a straight line when the crab was in frontal view. All these measurement methods of carapace are consistent with the previous studies by Pati and Sharma (2014), Pati *et al.* (2016), and Pati and Thackeray (2018; 2021). The measurement method of female sternum and vulvae is after Pati (2021). The measurements and images of the male gonopods were obtained through a Leica EZ4 HD stereoscope equipped with an integrated camera and the Leica Application Suite version 4.12.0. Each of the images of the male gonopods is the result of stacking a series of photographs using the CombineZP software. Other images were mostly taken by a Canon EOS 700D digital camera. The line drawings were achieved by using the GNU Image Manipulation Program (GIMP) software (see Montesanto, 2015). All the images were further processed by Adobe® Photoshop® software.

The following abbreviations are used in the present study: CW, carapace width; CL, carapace length; CH, carapace height; FW, frontal width; coll., collected by; P3, pereiopod 3; s5, thoracic sternite 5; s6, thoracic sternite 6; s5/s6, suture between thoracic sternites 5 and 6; G1, male first gonopod; G2, male second gonopod; VD, closest distance between female vulvae; SW, maximum width of sternum.

## SYSTEMATICS

### Superfamily Gecarcinucoidea Rathbun, 1904

#### Family Gecarcinucidae Rathbun, 1904

#### *Ghatiana* Pati and Sharma, 2014

*Type species.* *Ghatiana aurantiaca* Pati and Sharma, 2014, by original designation; gender feminine.

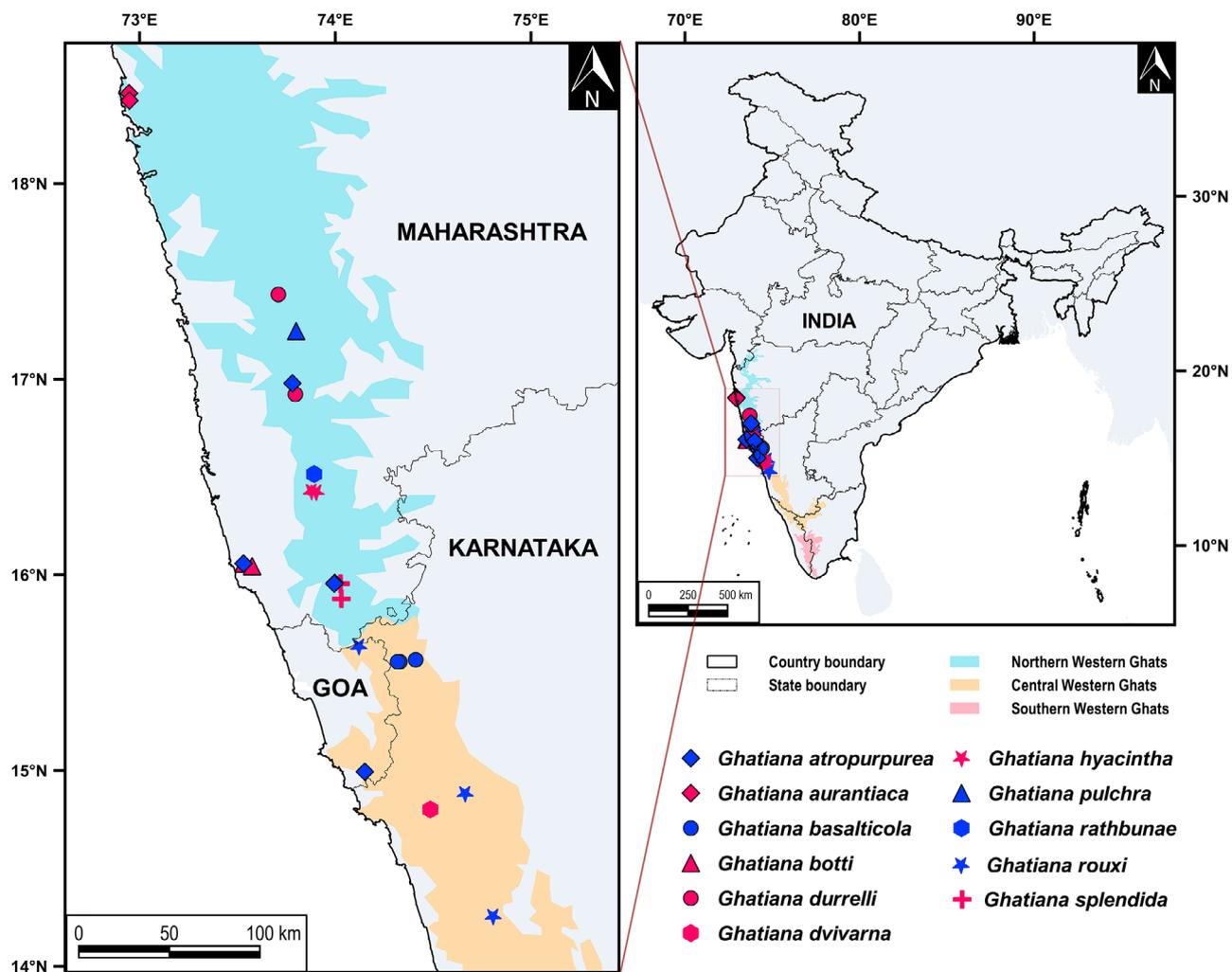


Figure 1. Map showing the distribution of known species of *Ghatiana* in the Northern- and Central Western Ghats of India.

*Remarks.* The genus is characterized by the combination of the following morphological characters: the frontal margin is relatively narrow; the first and second maxillipeds each possess a distinct flagellum on the exopod; the flagellum on the relatively longer exopod of the third maxilliped is absent; the male pleon is relatively stouter, with a relatively squarish pleonite somite 6; the male telson is elongated; G1 is relatively stouter and shorter; G2 is very short, with a very short distal segment (Pati and Thackeray, 2018; 2021).

***Ghatiana dvivarna* sp. nov.**

(Figs. 2–5, 6B, C, 7A–E)

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*Type material.* Holotype: male adult (CW 24.66 mm, CL 13.61 mm, CH 10.08 mm, FW 9.42 mm), ZSI-WRC C.2075, India, Karnataka State, Uttara Kannada District, Bare, 14.801°N 74.486°E, alt. 656 m, 7 Jul. 2021, coll. P.P. Bajantri and G.D. Hegde. Paratypes: 2 males (CW 19.16–20.37 mm, CL 10.67–11.92 mm, CH 7.58–8.60 mm, FW 6.65–7.73 mm), 1 female (CW 29.97 mm, CL 15.98 mm, CH 11.98 mm, FW 11.07 mm), ZSI-WRC C.2076, same data as holotype; 1 male (CW 19.86 mm, CL 11.29 mm, CH 8.36 mm, FW 7.82 mm), 1 female (CW 18.23 mm, CL 10.43 mm, CH 7.70 mm, FW 7.18 mm), ZSI-WRC C.2077, same data as holotype.

*Comparative material.* *Ghatiana basalticola* (Klaus, Fernandez and Yeo, 2014): male holotype (17.30 ×

10.10 mm), IISc-CES, India, Karnataka State, Belgaum District, Jiroli, Bhimagad Wildlife Sanctuary, 15.566°N 74.411°E, alt. 852 m, Sep. 2010, coll. Katrina Fernandez. *Ghatiana pulchra* Pati and Thackeray, 2018: male holotype (19.37 × 12.22 mm), ZSI-WRC C.1546, India, Maharashtra State, Satara District, Valmiki Pathaar, 17.246°N 73.800°E, alt. 1104 m, 8 Jul. 2016, coll. Tejas Thackeray.

*Type locality.* India, Karnataka State, Uttara Kannada District, Bare, 14.801°N 74.486°E, alt. 656 m.

*Diagnosis.* Carapace in adult proportionately broad (CW/CL = 1.7–1.9), strongly arched (CH/CL = 0.7) (Figs. 3A, B, 5A, B, 7B); lateral margins strongly convex (Figs. 3A, 5A, 7B); anterolateral margins relatively short, cristate (Figs. 3A, 5A, 7B); epibranchial tooth visible as weak notch (Figs. 3A, 5A); branchial regions rugose (Figs. 3A, 5A); frontal margin relatively close to anterior margin of epistome, hiding antennular fossae (Figs. 3B, 5B, 7A). Eyes small relative to orbits; each eye with relatively slender eyestalk

(Figs. 3B, 5B, 7A). First, second maxillipeds each with short flagellum on exopod; third maxilliped lacking flagellum on exopod (Fig. 4A). Chelipeds in both males and females highly unequal, with pointed fingertips (Figs. 3A–C, 5A, B, 7E); major chela with relatively slender palm (Figs. 4B, 7E); ventral margin of fixed finger and distal half of palm of major chela gently concave (Figs. 4B, 7E). Ambulatory legs relatively short (P3 length/CL = approximately 2.0) (Figs. 3A, 5A). Male pleonal somite 6 subquadrate, slightly broader than long (Figs. 3C, 4C). Male telson elongated (Figs. 3C, 4C). G1 relatively slender, almost straight; terminal segment relatively slender, straight, relatively long, approximately 0.5 times length of subterminal segment; subterminal segment relatively slender (Figs. 4D, E, 7C). G2 very short, with very short distal segment (Fig. 4F). Female pleon and telson in adult broadly subtriangular (Fig. 5C). Vulvae in adult relatively closely positioned (VD/SW = approximately 0.2), each subovate in shape, relatively large, occupying approximately 0.5 times length of s6, positioned close to s5/s6 (Figs. 5D, 7D).

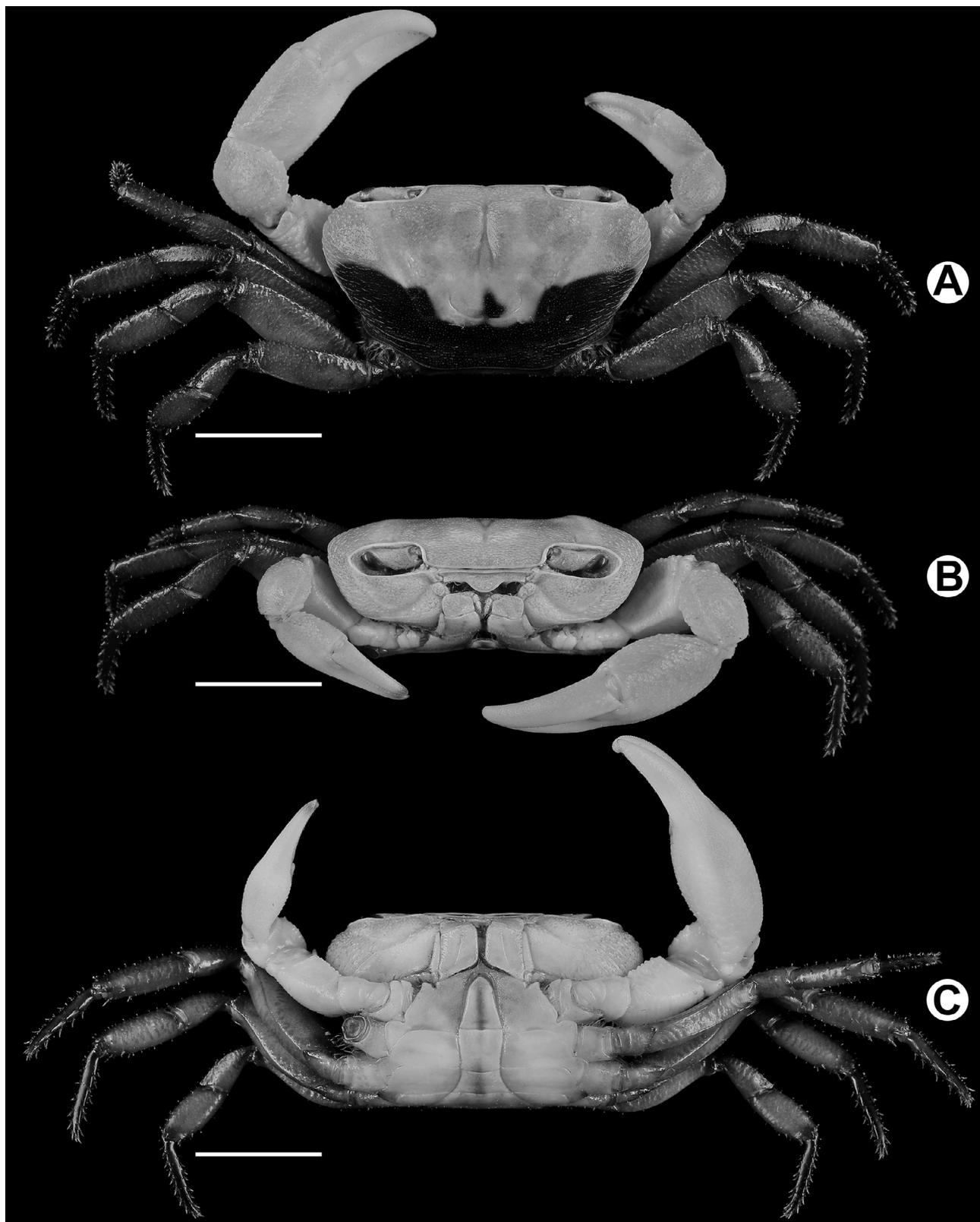


**Figure 2.** *Ghatiana divivarna* sp. nov., color in life. **A**, Holotype male (24.66 × 13.61 mm) (ZSI-WRC C.2075); **B**, paratype female (29.97 × 15.98 mm) (ZSI-WRC C.2076).

*Etymology.* The specific epithet, *divivarna*, is derived from the Sanskrit for ‘bicolor’, referring to the crab’s colour in life, which mainly consists of two colours (white and red-violet). The name is conceived here as a noun in apposition.

*Color in life.* The anterior half of the dorsal surface of the cephalothorax, the ventral surface of the cephalothorax and the chelipeds are white (Figs. 2A, B, 6B, C). The posterior half of the dorsal surface of the cephalothorax is dark purplish brown (Figs. 2A, B, 6B). The ambulatory legs are red-violet (Figs. 2A, B, 6B, C).

*Ecological notes.* The species inhabits elevated mountains of the Central Western Ghats in rocky outcrops with grassy vegetation (Fig. 6A). The holes (25–50 mm in diameter) in the laterite rocks are their natural habitat (Fig. 6B) (see [https://youtu.be/d4lf\\_DoOwtQ](https://youtu.be/d4lf_DoOwtQ)). Individuals can also take shelter underneath small boulders. These crabs are generally seen during the monsoon (June–September). They are mostly active during the twilight. As many as 30–40 crabs/500 m<sup>2</sup> can be seen during this time when the weather is very cloudy with precipitation or mist.

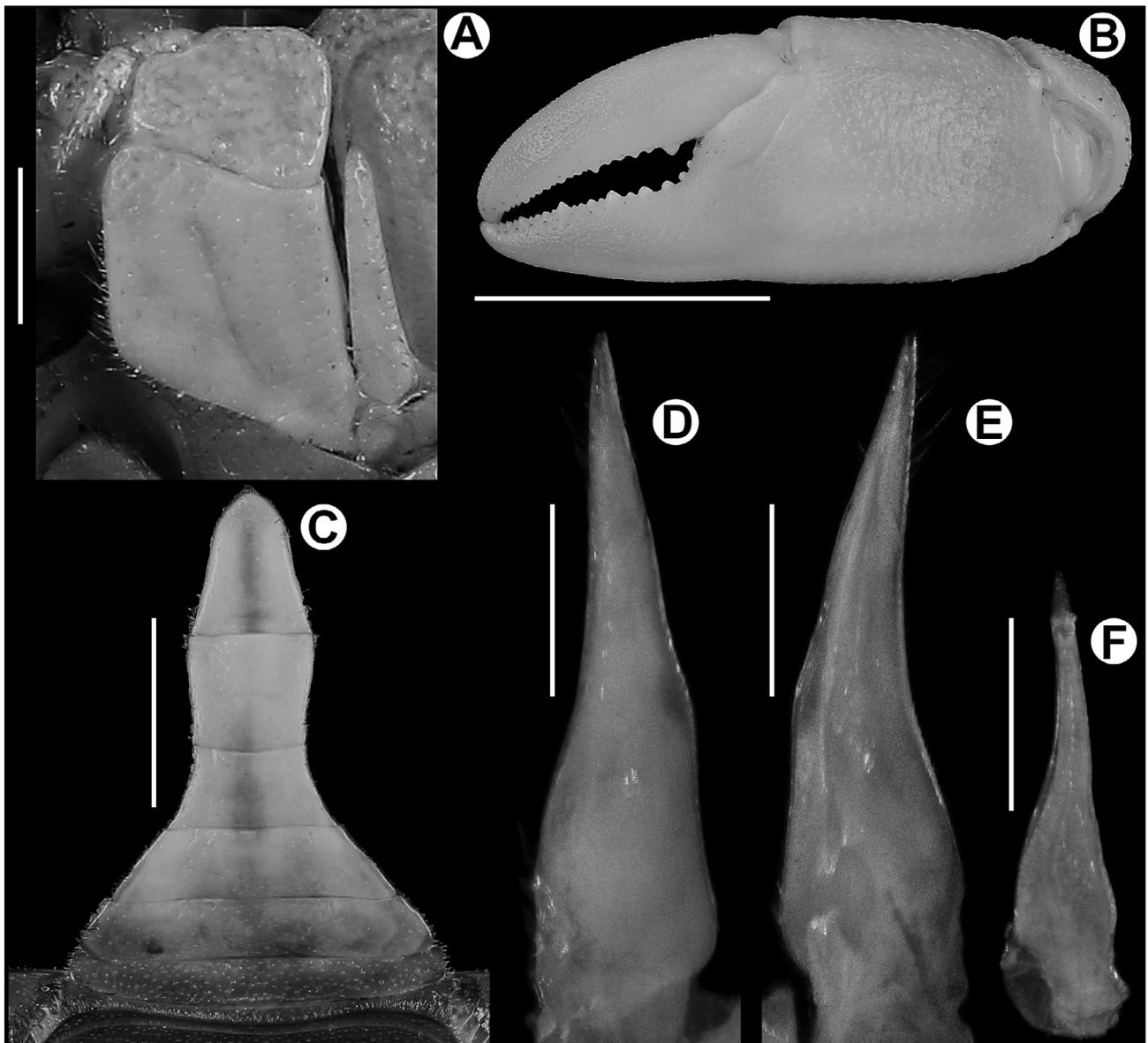


**Figure 3.** *Ghatiana divarna* sp. nov., holotype male (24.66 × 13.61 mm) (ZSI-WRC C.2075). **A**, Overall dorsal view; **B**, overall frontal view; **C**, overall ventral view. Scale bar = 10 mm.

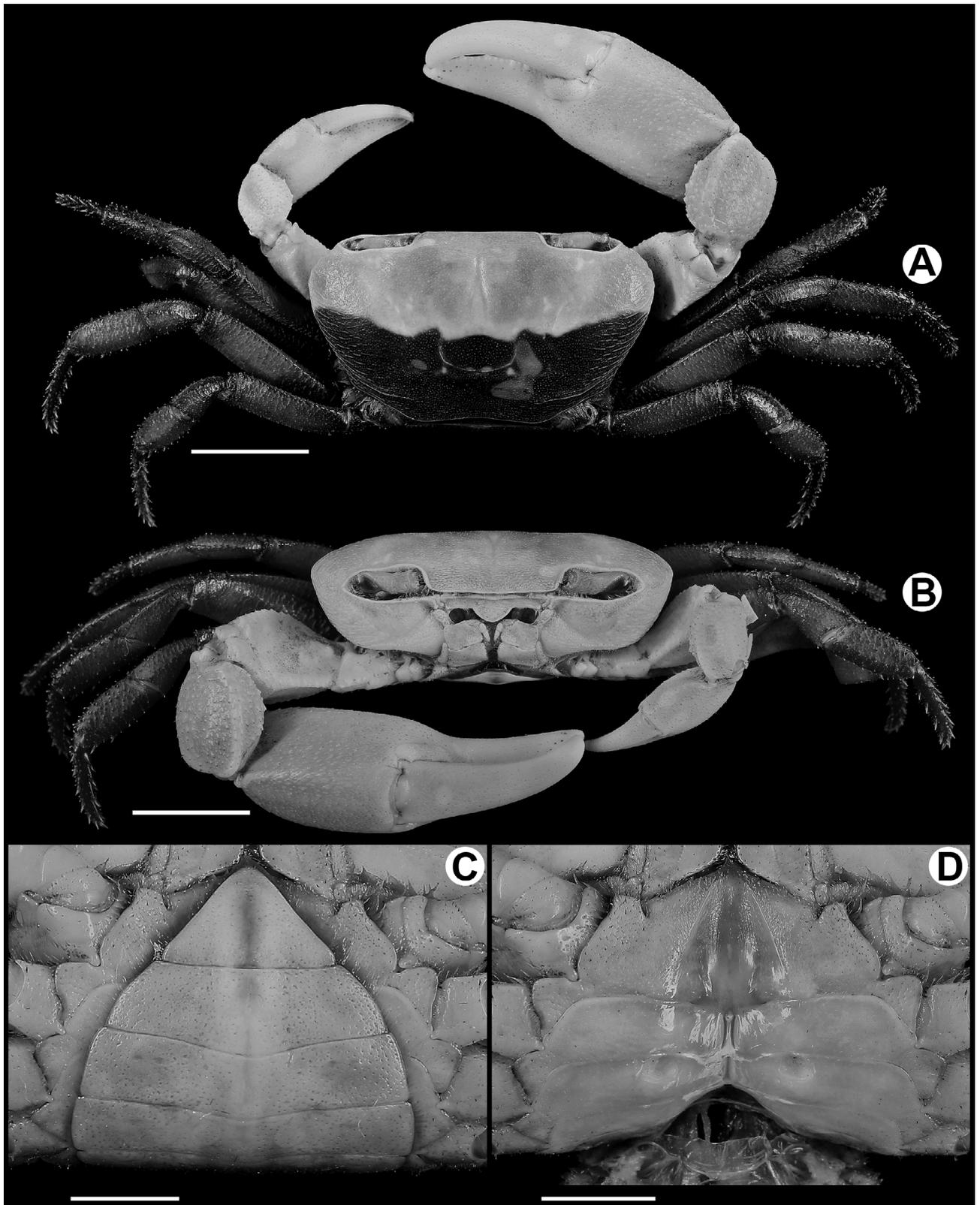
Their activities minimize when rain halts, and the crabs during this time can be found in the rocky holes filled with rainwater. Some crabs were seen eating mosses growing on laterite rocks (Fig. 6C). Females carrying juvenile crabs were observed in the rocky holes.

**Geographical distribution.** *Ghatiana dvivarna* sp. nov. is currently known only from the type locality, i.e., Bare in the Uttara Kannada District of Karnataka State, India. The type locality falls within the Central Western Ghats (Fig. 1).

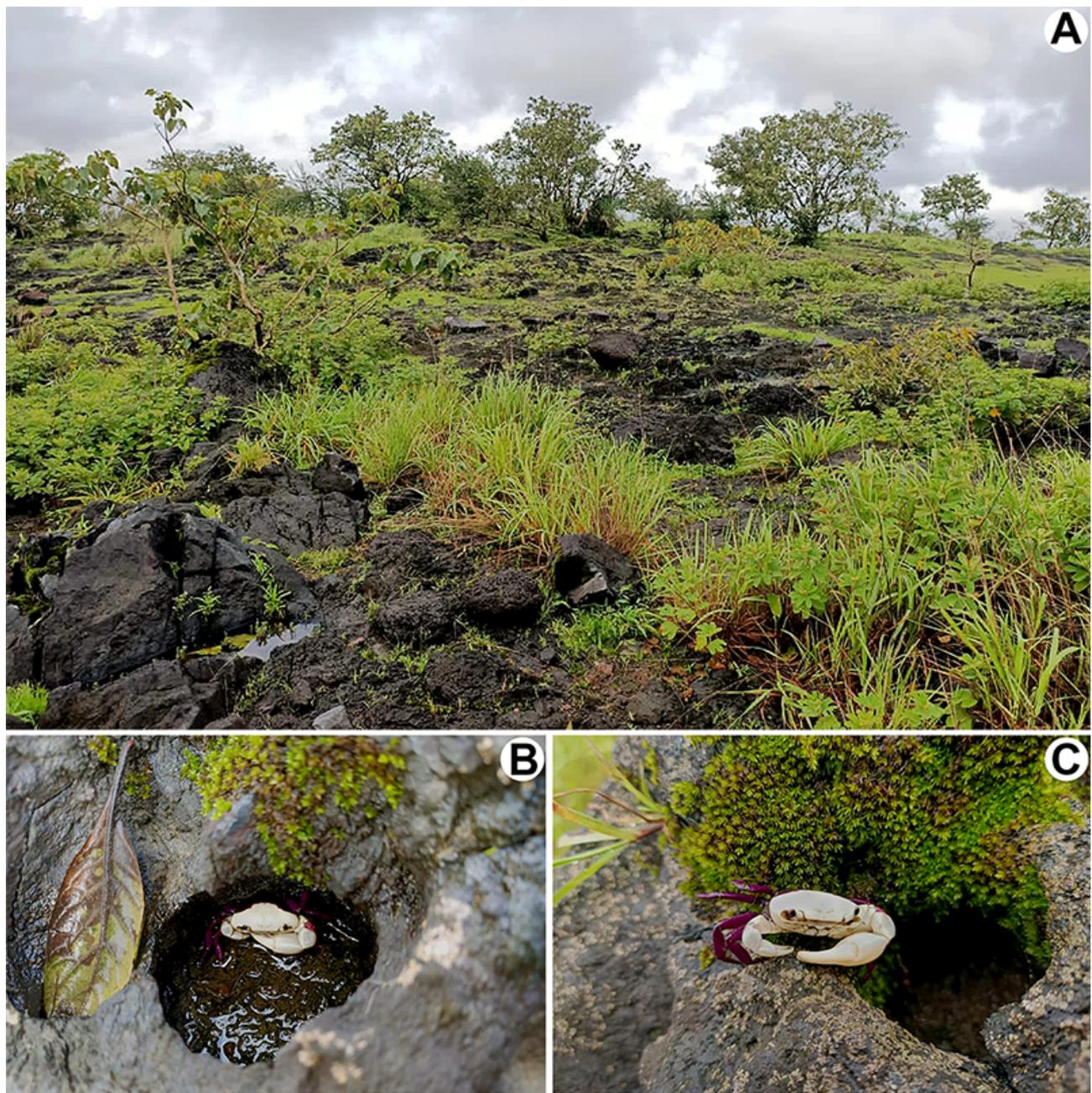
**Remarks.** All three male paratypes (ZSI-WRC C.2076, 2077) of *Ghatiana dvivarna* sp. nov. are adults but relatively smaller than the holotype male. The male paratypes are consistent with the holotype in allied diagnostic features and color in life. Both female paratypes (ZSI-WRC C.2076, 2077) are adults and possess all the non-sexually diagnostic characters as those in the holotype. The size of one the female paratypes (ZSI-WRC C.2076) is quite large, reaching about 30 mm in CW. No variation in the shape, size and position of the vulvae is observed between the female paratypes.



**Figure 4.** *Ghatiana dvivarna* sp. nov., holotype male (24.66 × 13.61 mm) (ZSI-WRC C.2075). **A**, Left third maxilliped; **B**, major or left chela in outer view; **C**, pleon and telson; **D**, left G1 in dorsal view; **E**, left G1 in ventral view; **F**, left G2. Scale bars = 10 mm (**B**), 5 mm (**C**), 2 mm (**A**), 1 mm (**D–F**).



**Figure 5.** *Ghatiana dvivarna* sp. nov., paratype female (29.97 × 15.98 mm) (ZSI-WRC C.2076). **A**, Overall dorsal view; **B**, overall frontal view; **C**, pleonal somites 4–6 and telson; **D**, thoracic sternites showing vulvae. Scale bars = 10 mm (**A**, **B**), 5 mm (**C**, **D**).

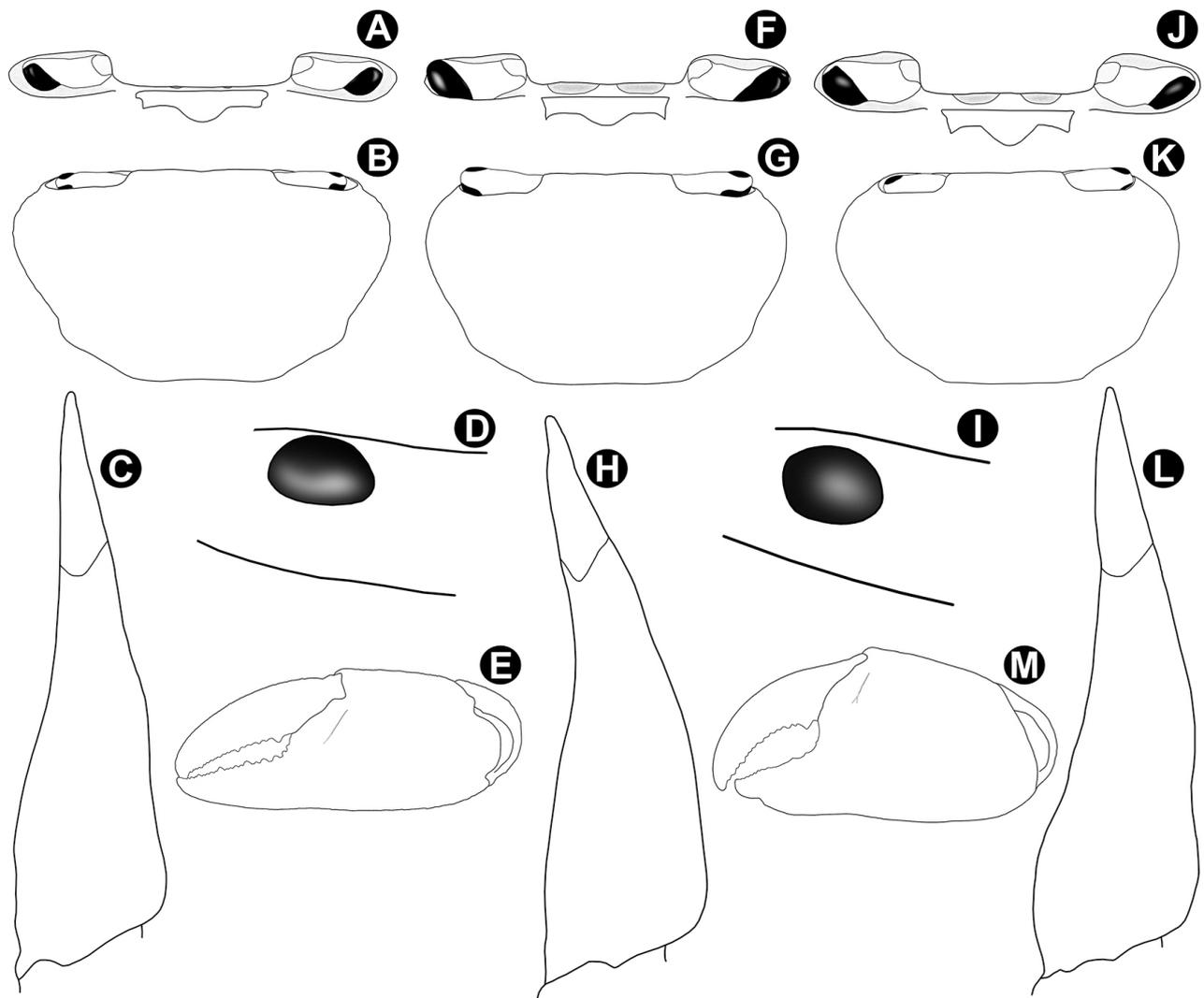


**Figure 6.** *Ghatiana divivarna* sp. nov. **A**, View of the general habitat at the type locality; **B**, a crab in its natural habitat; **C**, a crab while feeding on the mosses growing on a laterite rock.

The new species, *G. divivarna* sp. nov., is exceptional among the congeners because of its predominantly white coloration (see color in life; **Figs. 2A, B, 6B, C**) (*vs.* color in life otherwise, never so white; see Pati and Sharma, 2014: fig. 8A, B; Klaus *et al.*, 2014: fig. S1; Pati *et al.*, 2016: fig. 2A, B; Pati and Thackeray, 2018: fig. 2A–D; 2021: fig. 3A–C) and the smaller eyes relative to the orbits, with their eyestalk being relatively slender (**Figs. 3B, 5B, 7A**) (*vs.* eyes larger relative to the orbits, each eye with a relatively stouter

eyestalk; **Fig. 7E, J**; see Pati and Thackeray, 2018: figs. 3B, 4B, 5B, 6B, 7B, 8B, 9B, 10B; 2021: figs. 1C, 4C).

*Ghatiana divivarna* sp. nov. is also unique among congeners in that it has a proportionately broader carapace ( $CW/CL = 1.7\text{--}1.9$ ; **Figs. 3A, 5A, 7B**) like those of *G. basalticola* ( $CW/CL = 1.6\text{--}1.9$ ; **Fig. 7G**; see Pati and Thackeray, 2018: fig. 5A) and *G. pulchra* ( $CW/CL = 1.6$ ; **Fig. 7K**; see Pati and Thackeray, 2018: fig. 8A). The remaining species of the genus have a proportionately narrower carapace



**Figure 7.** *Ghatiana divivarna* sp. nov., holotype male (24.66 × 13.61 mm) (ZSI-WRC C.2075) (A–E); *Ghatiana basalticola* (Klaus, Fernandez and Yeo, 2014), holotype male (17.30 × 10.10 mm) (IISc-CES) (F–I); *Ghatiana pulchra* Pati and Thackeray, 2018, holotype male (19.37 × 12.22 mm) (ZSI-WRC C.1546) (J–M). A, F, J, Cephalothorax in frontal view depicting orbits, eyes, frontal margin, epistome, and antennular fossae; B, G, K, cephalothorax in dorsal view depicting overall shape; C, H, L, left G1 in dorsal view (setae excluded); D, I, left vulva on s6; E, major or left chela in outer view; M, major or right chela in outer view (horizontally flipped).

(CW/CL = 1.2–1.5; see Pati and Thackeray, 2018: figs. 3A, 4A, 6A, 7A, 9A, 10A; 2021: figs. 1A, B, 4A, B). With a broad carapace, *G. divivarna* sp. nov. morphologically resembles *G. pulchra* more than *G. basalticola* due to the nearly straight G1 that has a relatively longer terminal segment, approximately 0.5 times the length of the subterminal segment (Figs. 4D, 7C, L; see Pati and Thackeray, 2018: fig. 8I) (vs. G1 is medially distinctly curved outwards, with a relatively shorter terminal segment, approximately 0.3 times the length of the subterminal segment in *G. basalticola*; Fig. 7H; see Pati and Thackeray, 2018: fig. 5D). Additional difference is noted between *G.*

*divivarna* sp. nov. and *G. basalticola* in the shape of their vulvae, which is subovate in *G. divivarna* sp. nov. (Figs. 4D, 7D), while it is suborbicular in *G. basalticola* (Fig. 7I; see Pati and Thackeray, 2018: fig. 5H).

*Ghatiana divivarna* sp. nov. can be immediately distinguished from *G. pulchra* by the almost hidden antennular fossae due to the relatively closely located frontal margin and the anterior margin of the epistome (Figs. 3B, 5B, 7A) (vs. frontal margin is located some distance from the anterior margin of the epistome exposing the antennular fossae; Fig. 7J; see Pati and Thackeray, 2018: fig. 8B), the relatively slender palm of the major chela in adult males (Figs. 3B, 7E)

(vs. major chela in adult males has a relatively stouter palm; Fig. 7M; see Pati and Thackeray, 2018: fig. 8D), and the relatively slender terminal segment of the G1 (Figs. 3D, E, 7C) (vs. G1 terminal segment is relatively stouter; Fig. 7L; see Pati and Thackeray, 2018: fig. 8I).

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