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A new species of *Fizesereneia* Takeda & Tamura, 1980 (Crustacea: Brachyura: Cryptochiridae) from the Red Sea and Oman

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Abstract

A new species of cryptochirid crab, *Fizesereneia panda* van der Meij, is described and illustrated based on specimens collected from the scleractinian corals *Lobophyllia* cf. *hemprichii* and *L*. cf. *corymbosa* from the Farasan Banks, Farasan Islands, and the reefs off Thuwal in the Saudi Arabian Red Sea, and from *Symphyllia recta* from reefs in the Gulf of Oman. This is the second cryptochirid species with the Red Sea as type locality. It can be separated from its congeners by the subrectangular carapace, raised midline and the complete division of the carapace depressions, and reddish black colour pattern of these concavities in live specimens. This new species is the seventh assigned to *Fizesereneia*. A DNA barcode for the new species has been deposited in GenBank.

Key words: DNA barcoding, gall crabs, host specificity, Lobophylliidae, Saudi Arabia, Scleractinia, taxonomy

Introduction

Gall crabs (Cryptochiridae) occur on coral reefs worldwide. Cryptochirids are mostly found in tropical reef corals, but several species have been described from deep water corals (e.g., Kropp & Manning 1996). Most gall crabs have been described from rather few areas where gall crab specialists worked (Guam, Japan, Vietnam), although they have been reported from most regions in the world, including the Pacific coast of Mexico (Hernández *et al*. 2013), Saint Helena in the Atlantic Ocean (den Hartog 1989), and northern Borneo (van der Meij & Hoeksema 2013). Yet, most reefs have not been sampled for gall crabs, resulting in patchy known distribution ranges for most species (Kropp 1990a).

To date, only one gall crab species has been described from the Red Sea: *Cryptochirus coralliodytes* Heller, 1861. Simon-Blecher & Achituv (1997) reported *C*. *coralliodytes* from the Gulf of Eilat inhabiting the former faviid genera *Favia* Milne Edwards, 1857 [= *Dipsastrea* Blainville, 1830], *Favites* Link, 1807, *Goniastrea* Milne Edwards & Haime, 1848, and *Platygyra* Ehrenberg, 1834. Based on the host specificity of gall crabs, however, it is likely that some of these host corals were inhabited by other gall crab species (Kropp 1990a, van der Meij unpublished data). Two additional cryptochirid species have been recorded from the Gulf of Eilat: *Hapalocarcinus marsupialis* Stimpson, 1859, from *Stylophora pistillata* Esper, 1797 (Abelson *et al*. 1991) and *Fungicola fagei* (Fize & Serène, 1956), from *Pleuractis granulosa* (Klunzinger, 1879) (Kramarsky-Winter *et al*. 1995). The latter record, based on the host coral, should possibly be attributed to *F. syzygia* van der Meij, 2015. The only two species recorded to date from Saudi Arabia are *H. marsupialis*, which was recorded from Lidth [= Al Lith] and Djedda [= Jeddah] (Balls 1924), and *Neotroglocarcinus dawydoffi* (Fize & Serène, 1956) (van der Meij & Reijnen 2014). Outside of the Gulf of Eilat, the Red Sea is a relatively understudied coral reef ecosystem, and non-coral invertebrates are particularly underrepresented in recent coral reef literature from the Red Sea (Berumen *et al*. 2013).

During a biodiversity research cruise in the Saudi Arabian part of the Red Sea, gall crabs were collected from a

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wide range of coral hosts. An undescribed species of the genus *Fizesereneia* Takeda & Tamura, 1980 was collected from the scleractinian genus *Lobophyllia* de Blainville, 1830, and described below as *Fizesereneia panda* van der Meij **sp. nov.** The new species is the seventh assigned to the genus.

Methodology

Gall crabs were collected in the southern Saudi Arabian Red Sea from Al Lith to Jizan in March 2013, with some additional sampling conducted in Oman in May 2008 and offshore of Thuwal, in the central Saudi Arabian Red Sea, in March 2013 and November 2014 (Fig. 1). Scleractinians corals were searched for galls and pits, photographed, and subsequently split with hammer and chisel. Gall crab specimens were preserved in 80% ethanol after being photographed with a digital SLR camera equipped with macro lens. The material (including holotype) is deposited in the collections of Naturalis Biodiversity Center in Leiden, the Netherlands (formerly Rijksmuseum van Natuurlijke Historie, collection coded as RMNH.Crus.D), paratypes are deposited in the collections of the King Abdullah University of Science and Technology (Thuwal, Saudi Arabia, collection coded as SAI)) and in the Florida Museum of Natural History, University of Florida (Gainesville, USA, collection coded as UF Arthropoda). Host corals were identified following Scheer & Pillai (1983) and Sheppard & Sheppard (1991). Drawings were made with a stereomicroscope with camera lucida. The chelipeds were drawn with the outer surface of the manus parallel to the plane of the paper, which somewhat distorts the other segments. The terms for carapace shape follow Zayasu *et al*. (2013). Carapace lengths (CL) and widths (CW) were measured using an eyepiece micrometre. All descriptions of colour patterns are based on pictures of live specimens.

Abbreviations used: CL, carapace length; CW, carapace width (at widest point); MXP, maxilliped; ovig., ovigerous; P, pereiopod; G1, male gonopod 1. Carapace measurements are given as CL × CW, in mm.

Taxonomy

Family Cryptochiridae Paul′son, 1875

Genus *Fizesereneia* Takeda & Tamura, 1980

Fizesereneia Takeda & Tamura, 1980: 137
Fizeserenia—Kropp & Manning, 1987: 2 [erroneous spelling]

Type species. *Troglocarcinus heimi* Fize & Serène, 1956, subsequent designation by Kropp (1990b)

Type locality. Nha Trang, Vietnam

Remarks. The genus *Fizesereneia* presently includes six species: *Fizesereneia heimi* (Fize & Serène, 1956), *F. stimpsoni* (Fize & Serène, 1956), *F. ishikawai* Takeda & Tamura, 1980, *F. latisella* Kropp, 1994, *F. tholia* Kropp, 1994, and the recently described *F. daidai* Zayasu, 2013. The location of the holotypes of *Troglocarcinus heimi* and *T. stimpsoni* are unknown according to Kropp (1990a). The holotypes of the other *Fizesereneia* species are available in the collections of the National Museum of Nature and Science, Tokyo (*F. ishikawai*, *F. daidai*), the National Museum of Natural History, Smithsonian Institution, Washington D.C. (*F. latisella*), and the Muséum national d'Histoire naturelle, Paris (*F. tholia*).

Fizesereneia panda van der Meij sp. nov.

(Figs 2–6)

Type locality. Atlantis Shoal, Farasan Banks, Saudi Arabia (18.1917 N, 41.1138 E)

Coral host of holotype. *Lobophyllia* cf. *hemprichii* (Ehrenberg, 1834)

DNA barcoding. A sequence of the Folmer region of COI of the holotype (partially, Folmer *et al*. 1994) has been deposited in GenBank under accession number KM491175.

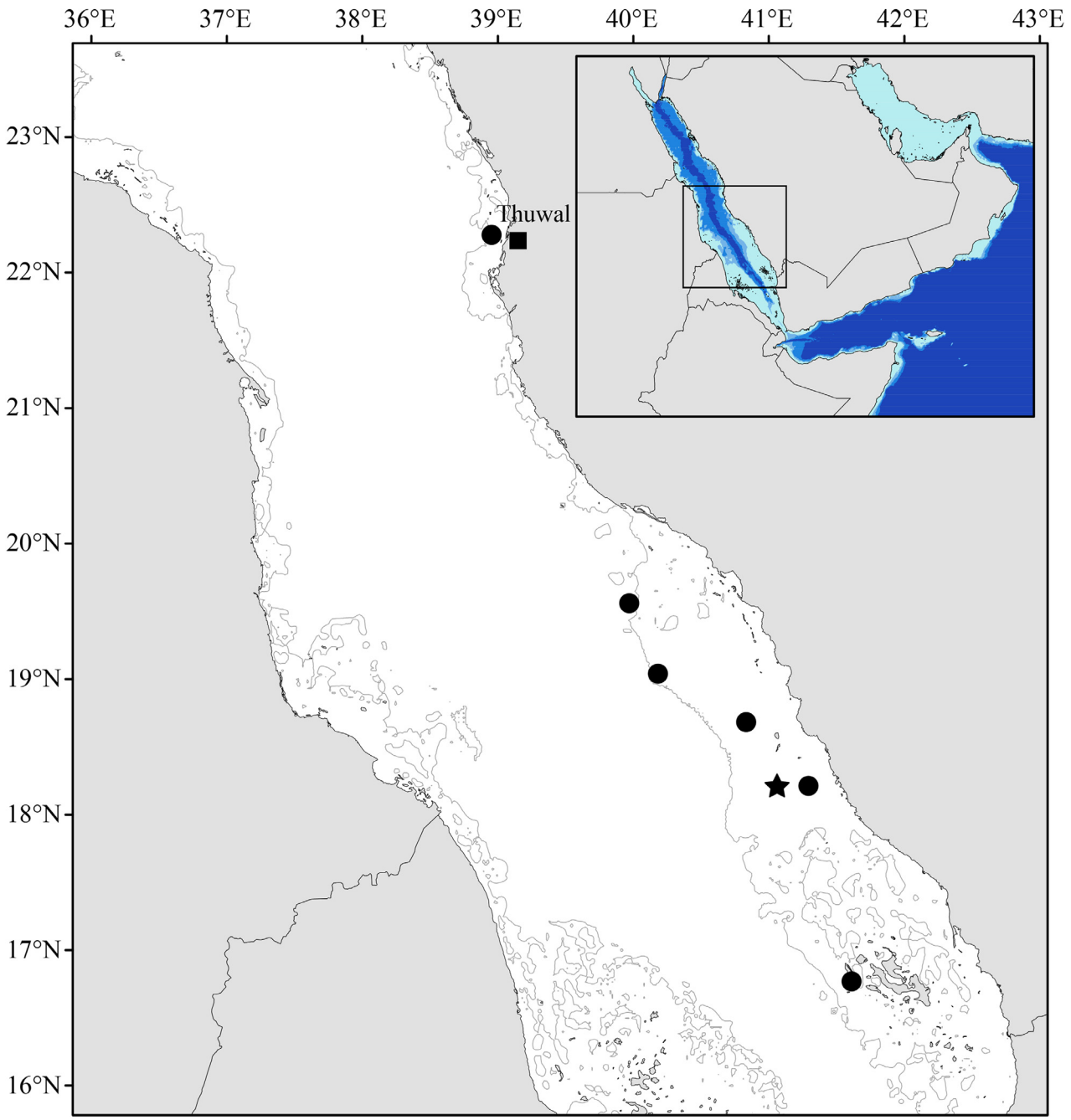

FIGURE 1. Map of the collection sites in the Saudi Arabian Red Sea. The star indicates the type locality of *Fizesereneia panda* **sp. nov.**, dots indicate the other Red Sea localities where *F. panda* **sp. nov.** was collected. One sample was collected in the Gulf of Oman (not on map).

Type material. Holotype: RMNH.Crus.D.54425, 1 ovig. female (4.2 × 3.6) on *Lobophyllia* cf. *hemprichii*, 7.iii. 2013, ca. 10 m, leg. SET van der Meij; allotype: RMNH.Crus.D.54424, 1 male (4.2 × 3.2) on *Lobophyllia* cf. *hemprichii*, 7.iii.2013, ca. 10 m, leg. SET van der Meij. Paratypes: King Abdullah University of Science and Technology: SAI-001, Al-Fahal S, off Thuwal (22.2465 N 38.9592 E), 2 m, 9.xi.2014, 1 ovig. female on *Lobophyllia corymbosa* (coll. nr. SA1916), leg. SET van der Meij; UF Arthropoda 40384 (ex RMNH.Crus.D.54465), Marca I, Farasan Banks (18.2206 N 41.3244 E), ca. 10 m, 6.iii.2013, 1 non-ovig. female (4.3 × 3.4) on *Lobophyllia hemprichii*, leg. SET van der Meij.

Other material. ***Saudi Arabia.*** RMNH.Crus.D.54449, Pelican (Ablo) I., Farasan Banks (18.6595 N 40.8270 E), 5 m, 5.iii.2013, 1 non-ovig. female on *Lobophyllia corymbosa*, leg. SET van der Meij; RMNH.Crus.D.54386, Shi'b Ammar, Farasan Banks (19.5707 N 40.0088 E), 7 m, 3.iii.2013, 1 ovig. female on *Lobophyllia corymbosa*,

leg. SET van der Meij; RMNH.Crus.D.54490, Dolphen Lagoon, offshore of Farasan Banks (19.0005 N 40.1481 E), 0–3 m, 4.iii.2013, 2 ovig. female, 1 non-ovig. female on *Lobophyllia corymbosa*, leg. SET van der Meij; RMNH.Crus.D.54390, Marca Isl. II, Farasan Banks (18.2089 N 41.3346 E), 5–10 m, 7.iii.2013, 1 non-ovig. female on *Lobophyllia* cf. *hemprichii*, leg. SET van der Meij; RMNH.Crus.D.54387, Naf Shuma, Farasan Is. (16.7527 N 41.6049 E), 9.iii.2013, 2 ovig. female (1 damaged) on *Lobophyllia* cf. *corymbosa*, leg. SET van der Meij; RMNH.Crus.D.56801, Abu Gishaa, off Thuwal (22.2552 N 39.0235 E), 15 m, 10.xi.2014, 2 ovig. females on *Lobophyllia corymbosa*, leg. SET van der Meij; RMNH.Crus.D.56802, Tahlah, off Thuwal (22.2739 N 39.0503 E), 13 m, 13.xi.2014, 1 ovig. female on *Lobophyllia* cf. *corymbosa*, leg. SET van der Meij. ***Oman.*** UF Arthropoda 20378, off Bandar Al-Khayran, Gulf of Oman (ca. 23.52 N 58.73 E), 6–9 m, 1 ovig. female (damaged), 1 male on *Symphyllia recta*, 23.v.2008, leg. M Malay.

Description female holotype. Carapace (Fig. 2A) subrectangular, longer than broad, CL 1.2 times longer than CW; greatest width of carapace where posterior margin of depression meets lateral carapace margin; dorsal surface convex in lateral view, deflected anteriorly (Fig. 2B). The anterior depressions divided completely into two concavities by median longitudinal ridge, armed with numerous spines crudely arranged in two rows; scattered spines on the margins of the depressions; carapace depressions smooth. Frontal margin armed with anteriorly directed spines. Frontal margin on ventral side features two substantial spines (Fig. 2C). Posterior half of dorsum smooth; cardio-intestinal region slightly outlined by shallow furrow; pterygostomial region is separated from the carapace by a membrane.

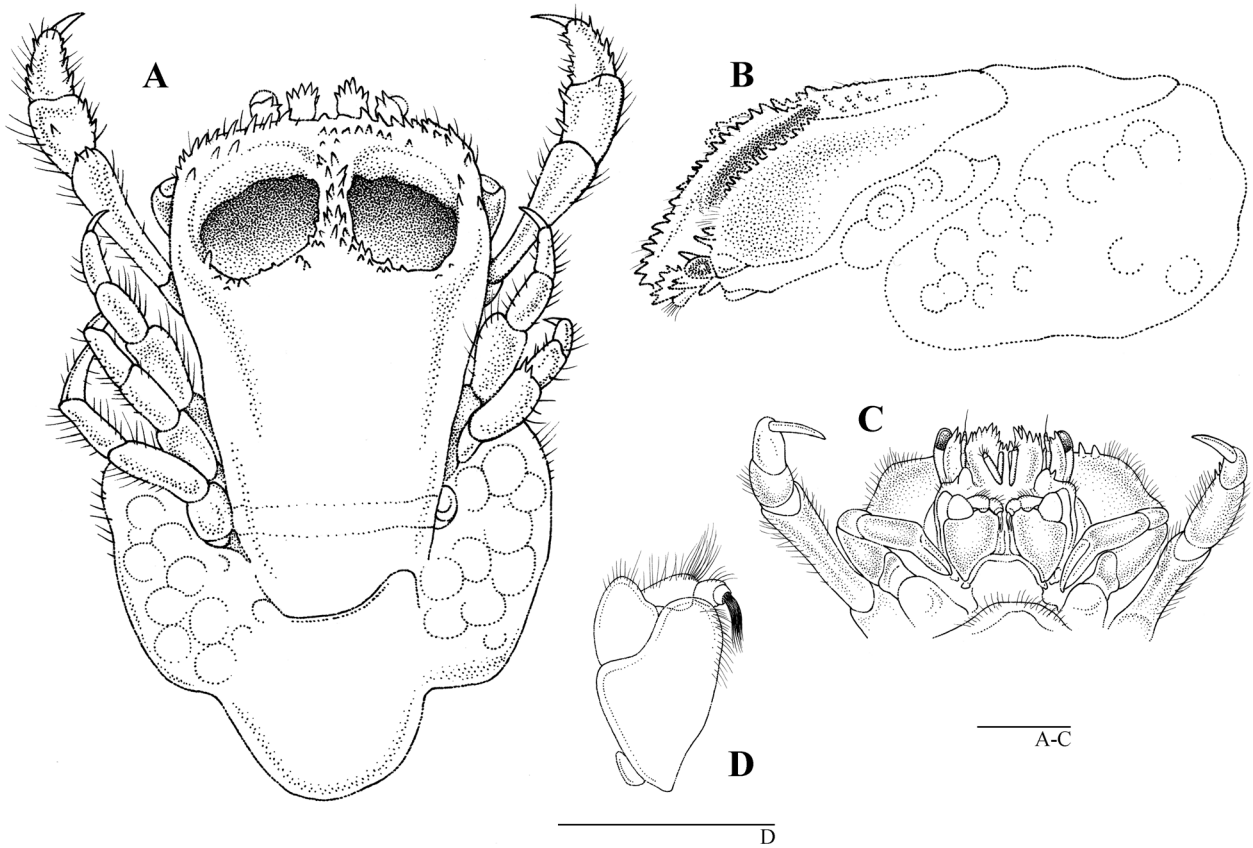

FIGURE 2. A–D, Holotype *Fizesereneia panda* **sp. nov.** (RMNH.Crus.D.54425). A, habitus, dorsal view; B, carapace, lateral view; C, anterolateral margin of carapace, ventral view; D, MXP3. Scale bars 1 mm.

Ocular penduncles with two spines on distal margin, cornea elliptical, longer than broad; antennule same length as ocular penduncles; antennal segment two longer than broad, slightly extending beyond eyestalk, distal margin with several lateral spines.

MXP3 (Fig. 2D) exopod subrectangular, reaching approx. 1/3 length of ischium; ischium subtriangular, smooth, mesial and distal margin straight, anteromesial lobe with few setae; anterolateral margin of merus with few setae; distal portion of carpus with long setae; dactylus with bundle of long setae.

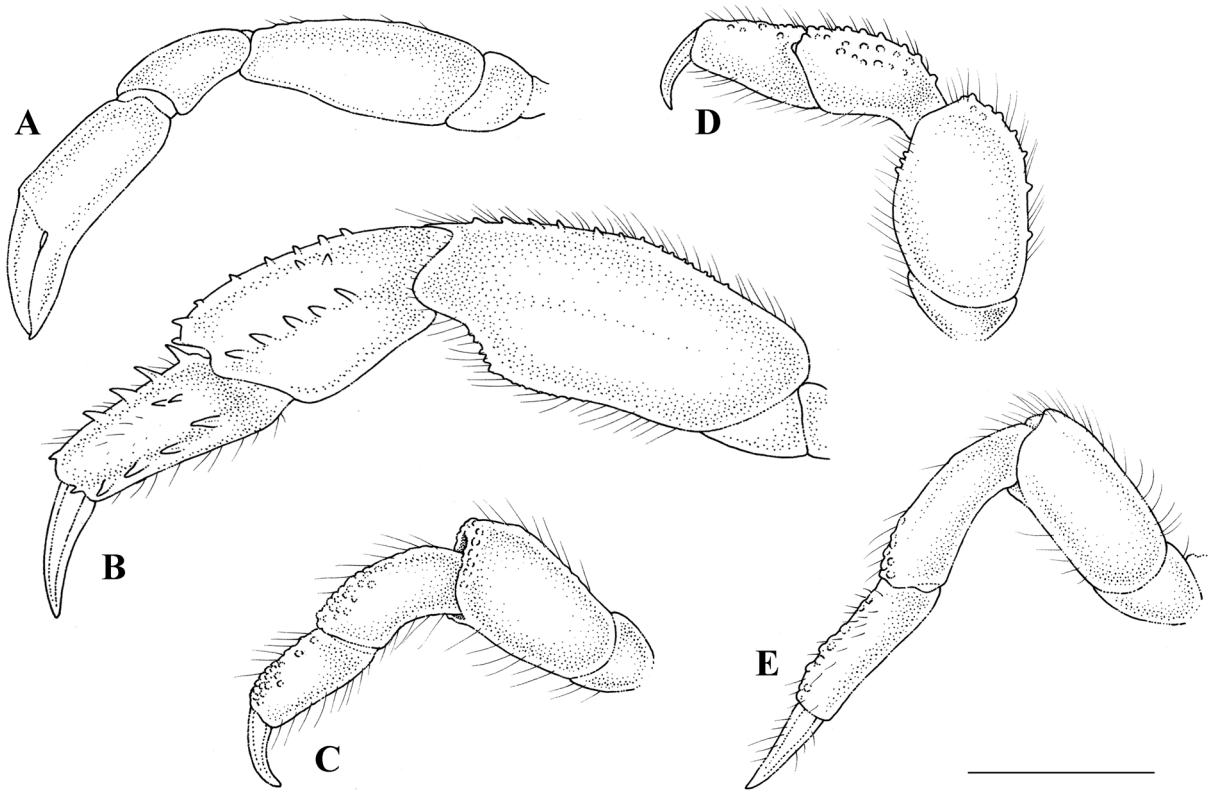

FIGURE 3. A–E, Holotype *Fizesereneia panda* **sp. nov.** (RMNH.Crus.D.54425). A, left P1 (cheliped); B, left P2; C, left P3; D, left P4; E, left P5. Scale bar 1 mm.

P1 (chelipeds, Fig. 3A) slender, smooth; ischium length ¾ height; merus length three times height, with few scattered short setae; carpus length twice height; propodus about same length as merus, fingers slender, mesial surfaces of fingers smooth, cutting edge entire, tips of fingers slightly crossing.

P2 (Fig. 3B) longer, coarser than P1; ischium without setae; merus stout, slightly bent, few and small conical tubercles on distal half of dorsal surface, simple short setae on lateral and dorsal surface; joint between merus, carpus not extending more than at right angle; carpus 2/3 length of merus, surface smooth except for conical tubercles crudely arranged in two rows, no setae; propodus as long as carpus, surface smooth except for conical tubercles crudely arranged in two rows, fine setae on lateral and dorsal surface, dactylus half-length of propodus, smooth, sharp, slightly curved ventrally.

P3 (Fig. 3C) ischium with few setae; merus length twice height, rounded, tubercles and simple setae on dorsal surface, few small tubercles on distal half of lateral surface, simple setae along distal half of lateral surface; joint between merus, carpus not extending more than at right angle; carpus and propodus of equal length, rounded tubercles on dorsal surface, simple setae on lateral and dorsal surface; dactylus half-length of propodus, smooth, sharp, curved ventrally.

P4 (Fig. 3D) ischium with few setae; merus length twice height, small rounded tubercles close to joint with carpus, simple setae on dorsal and lateral surface; joint between merus, carpus not extending more than at right angle; carpus and propodus of equal length, rounded tubercles on dorsal surface, simple setae on lateral and dorsal surface; dactylus half-length of propodus, smooth, sharp, curved ventrally.

P5 (Fig. 3E) ischium with few setae; merus, carpus, propodus of equal length, all with simple setae; joint between merus, carpus not extending more than at right angle; carpus and propodus with rounded tubercles on dorsal surface; dactylus half-length of propodus, smooth, sharp, straight.

P3, P4 decreasing in size from P2. P5 right sampled for DNA analysis.

Pleon (= abdomen) enlarged, lateral margin fringed with setae.

Anterior margin thoracic sternites 1–3 almost straight (Fig. 6B).

Gonopore (vulva); reniform, size almost half the height of sternite 6 (examined in paratype UF Arthropoda 40384).

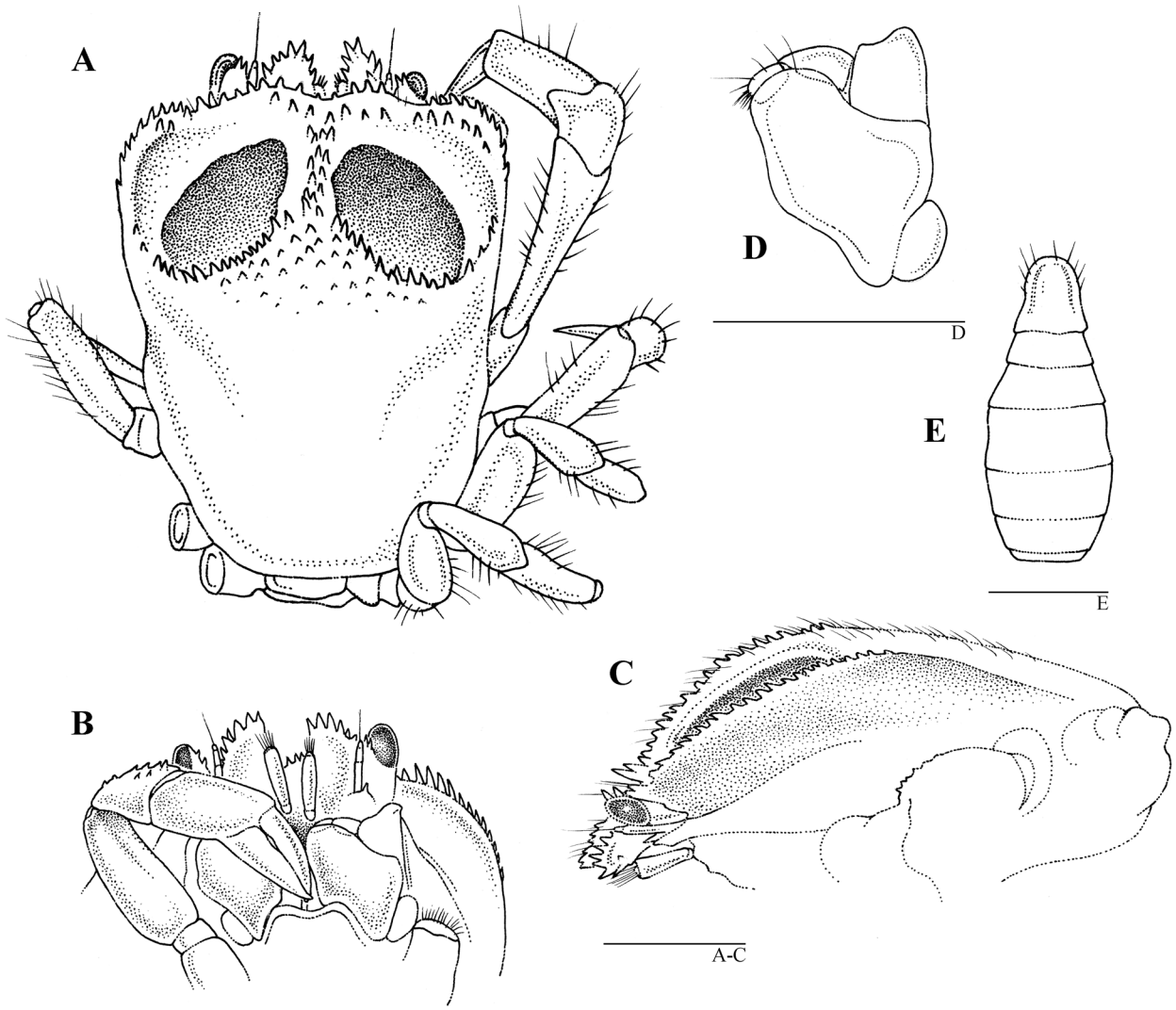

FIGURE 4. A–E, Allotype *Fizesereneia panda* **sp. nov.** (RMNH.Crus.D.54424). A, habitus, dorsal view; B, anterolateral margin of carapace, ventral view; C, carapace, lateral view; D, MXP3; E, abdomen. Scale bars 1 mm.

Description male allotype. Generally similar to holotype, differences as outlined below. Carapace (Fig. 4A) subrectangular, CL 1.3 times longer than CW (Fig. 4C). The anterior depressions divided completely into two concavities by median longitudinal; numerous spines on the margins of the depressions. Posterior half of dorsum smooth.

Ocular penduncles with small spines on distal margin, cornea elliptical, longer than broad; antennal segment extending beyond eyestalk (Fig. 4B).

MXP3 (Fig. 4D) exopod subrectangular, reaching approx. ½ length of ischium; ischium, smooth, mesial and distal margin slightly curved; anterolateral margin of merus with indentation; propodus with scattered setae; dactylus with bundle of short setae.

P1 (chelipeds, Fig. 5A) slender, smooth; merus length two times height; carpus with short spines on dorsal surface; propodus about same length as merus, fingers slender, mesial surfaces of dactyl with slight tooth.

P2 (Fig. 5B) longer, coarser than P1; ischium without setae; merus slender, simple short setae on lateral and dorsal surface; carpus ½ length of merus, slightly bent, few spiny tubercles on dorsal surface, few setae; propodus length twice height, surface smooth except for spiny tubercles on dorsal surface, fine setae on lateral and dorsal surface, dactylus smooth, sharp, slightly curved ventrally.

P3 (Fig. 5C) merus length three times height, simple setae on lateral and dorsal surface; carpus bent with few setae; propodus tapering towards dactyl, simple setae on lateral and dorsal surface; dactylus smooth, sharp, curved ventrally, few setae.

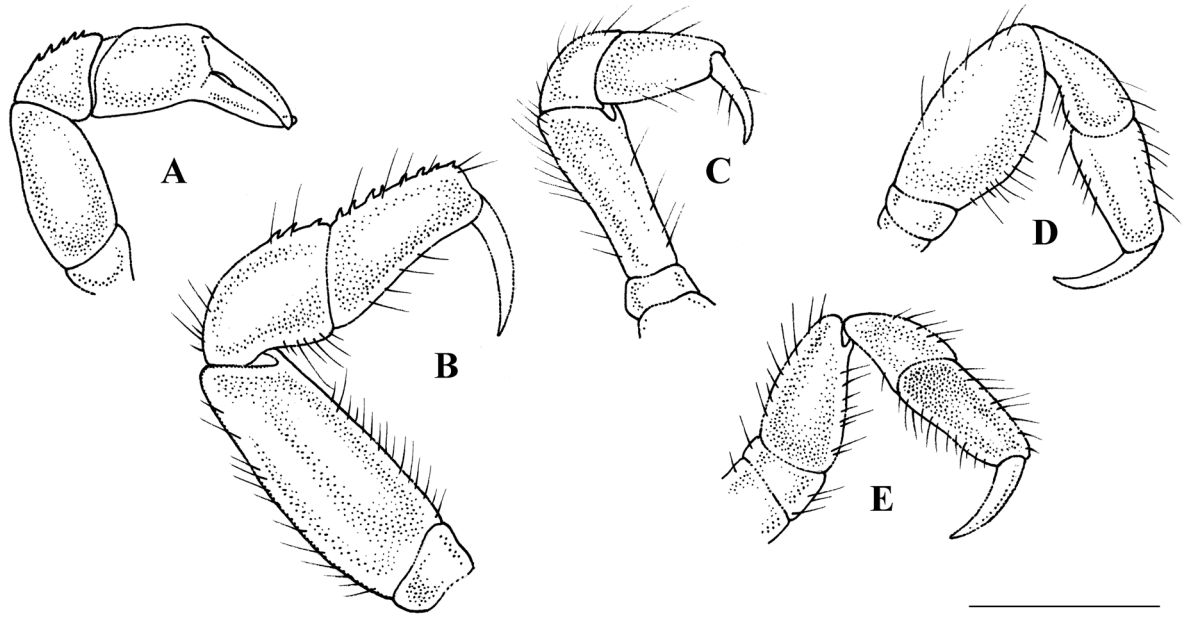

FIGURE 5. A–E, Allotype *Fizesereneia panda* **sp. nov.** (RMNH.Crus.D.54424). A, right P1 (cheliped); B, right P2; C right P3; D, right P4; E, right P5. Scale bar 1 mm.

P4 (Fig. 5D) merus slightly rounded, simple setae on dorsal and lateral surface; carpus and propodus with simple setae on lateral and dorsal surface; dactylus smooth, sharp, curved ventrally.

P5 (Fig. 5E) ischium with few setae; merus length twice height, simple setae on dorsal and lateral surface; carpus 2/3 of propodus length, simple setae on lateral and dorsal surface; dactylus, smooth, sharp, curved.

P3–5 roughly of equal size. P1–2 left missing, P4–5 left sampled for DNA analyses.

Anterior margin of thoracic sternites 1–3 slightly concave (Fig. 6D). Abdomen bowling pin-shaped, longest and widest at 4th segment; telson rounded with few setae (Fig. 4E).

Gonopod; G1: slightly curved, tapering, apex pointed. Lateral margin with short, non-plumose simple setae, medial margin without setae.

Colour. Holotype (Fig. 6A–B): posterior 2/3 of the anterior depressions on the carapace have a black blotch with a reddish hue, whereas the remaining 1/3 is off-white. Several light blue spots are visible at the junction of the dark and off-white patterns. Remaining part of carapace translucent whitish-beige with a few scattered faint red spots on the posterior side of the carapace and brood pouch. All pereiopods translucent, P1 with many scattered brown spots and a few white spots, P2 more white than P3–5. Colour of MXP3 like P1. Antennules translucent with scattered white spots. Eyes reddish-brown with some white. Allotype (Fig. 6C–D)—differs from the holotype in the following—posterior 2/3 of the anterior depressions on the carapace have a deep red, almost black blotch, while the remaining 1/3 of the concavity is a soft yellow. Where the dark pattern meets the soft yellow a wine-red margin is visible. Remaining part of carapace translucent bluish-grey, with some scattered red spots, especially on the posterior side of the carapace and around the concavities. P1 with scattered white and brown spots, P2–5 with faint soft yellow bandings. Eyes red with some white.

Variation. *Fizesereneia panda* **sp. nov.** females show little morphological variation. There is some variation in colour pattern in live specimens. The size of the dark blotches in the carapace depressions varies but covers at least 2/3 of the concavities. Reddish hue of these blotches is more intense in some specimens. Several females lack the light blue spots of the holotype, whereas in other females the light part of the concavities appears more soft yellow. The male specimen of *F. panda* **sp. nov.** from Oman has mixed olive green and light blue spots on the overall reddish-black colour of the depressions.

Remarks. In *Fizesereneia heimi* and *F. stimpsoni* the anterior carapace depression is divided into two concavities by a median longitudinal ridge armed with spines, whereas it is incompletely divided in *F. latisella*, *F. ishikawai* and *F. tholia* (Fize & Serène 1957, Takeda & Tamura 1980, Kropp 1994). The division of the depression in *F. daidai* is variable, but it is incomplete in most individuals (Zayasu *et al*. 2013). The degree of division of the concavity is stronger in *F. panda* **sp. nov.** (females and males) than in any other *Fizesereneia* species, including *F.*

heimi and *F. stimpsoni*. In addition, the median longitudinal ridge in *F. panda* **sp. nov.** is "raised", whereas in the other two species the ridge is less pronounced. Based on the degree of division of the concavities, *Fizesereneia panda* **sp. nov.** is most similar to *F. heimi* and *F. stimpsoni*. The new species can be distinguished from these two species by its carapace shape and the colour pattern of the concavities. The carapace shape of *F. heimi* is roughly hexagonal (widest near the middle of the lateral margin), of *F. stimpsoni* subquadrangular (widest across the anterior margin, narrower posteriorly), whereas the carapace of *F. panda* **sp. nov.** is subrectangular (greatest width at the intersection of the posterior margin of the anterior depression with the lateral margin). The concavities of female *F. heimi* are predominantly brown-grey, and the concavities of male *F. heimi* are emerald green with some darker spots or lines. Female and male *F. panda* **sp. nov.** have dark reddish black blotches in the concavities. *Fizesereneia panda* **sp. nov.** can be distinguished from *F. stimpsoni* by the marbled pattern of the concavities in the latter (visible even in specimens in ethanol). Additionally, *F. stimpsoni* has only been recorded from the coral genus *Acanthastrea* (Fize & Serène 1957; Zayasu *et al*. 2013), whereas *F. panda* **sp. nov.** is associated with *Lobophyllia* and *Symphyllia*.

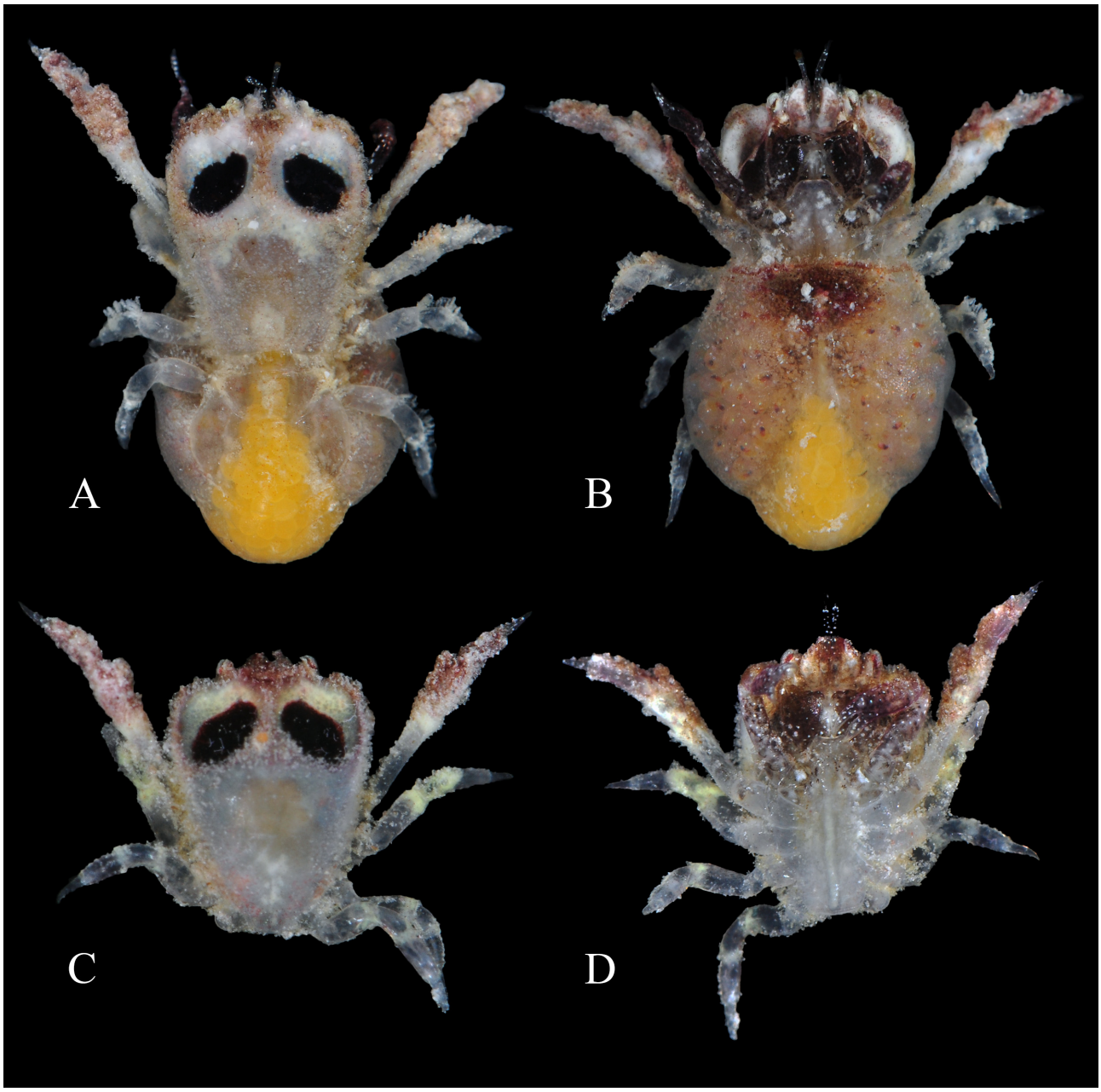

FIGURE 6. A–D, *Fizesereneia panda* **sp. nov.**, colouration in life. A, B, holotype RMNH.Crus.D.54425 (carapace 4.2 × 3.6),, dorsal (A) and ventral (B) view. C, D, allotype RMNH.Crus.D.54424 (carapace 4.2 × 3.2), dorsal (A) and ventral (B) view. Photos by A. Anker and P.L. Norby.

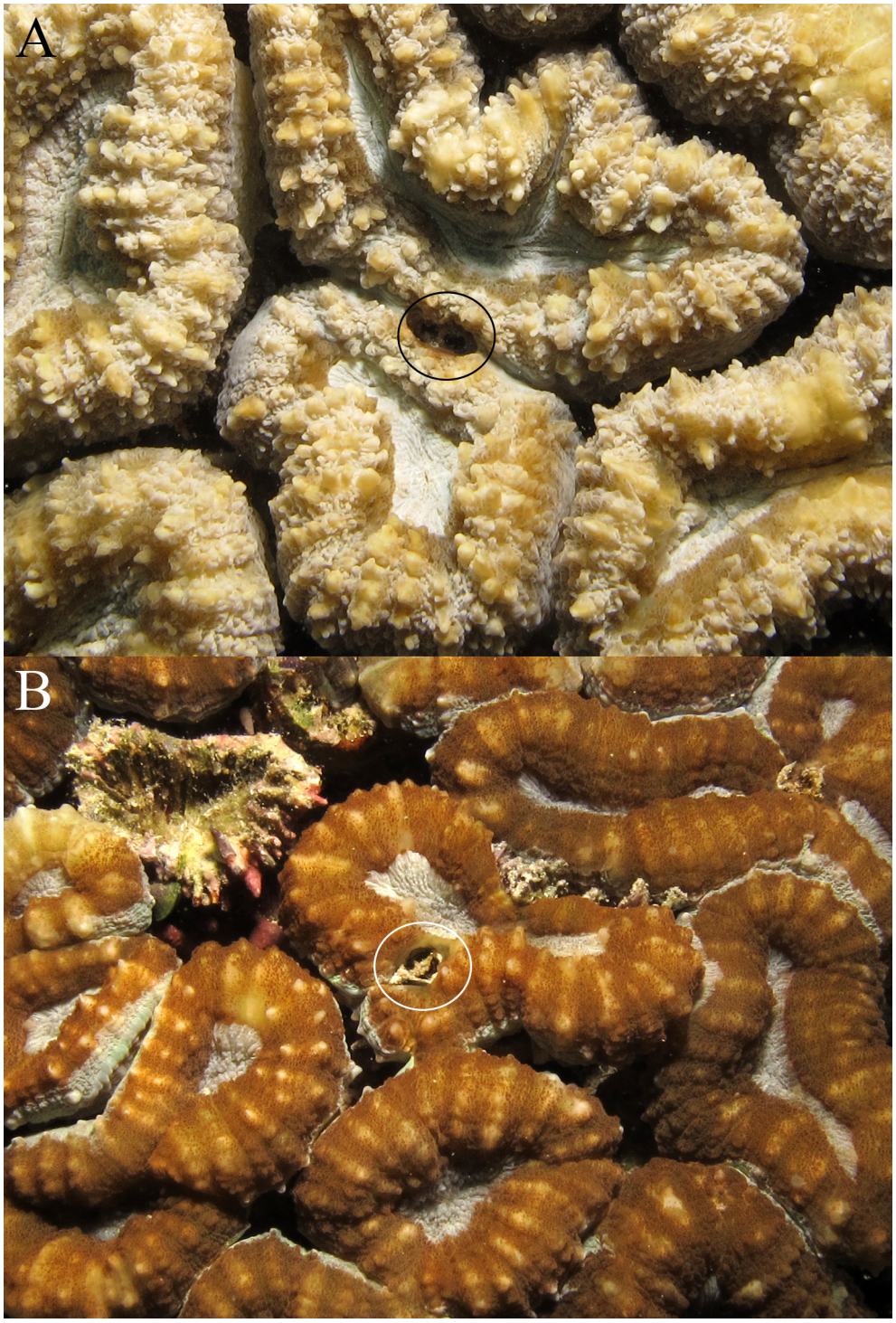

FIGURE 7. A–B, *Fizesereneia panda* **sp. nov.** (A, RMNH.Crus.D.54386; B, RMNH.Crus.D.54449) (circled) in *Lobophyllia corymbosa*. Photos by S.E.T. van der Meij, not to scale.

Coral hosts (Fig 6A–B). So far, *Fizesereneia* has only been found in association with Indo-Pacific coral species belonging to the Lobophylliidae Dai & Horng, 2009 (previously classified as Mussidae Ortmann, 1890, a family now restricted to the Atlantic (Budd *et al*. 2012)). The coral hosts for this new gall crab species are identified as *Lobophyllia* cf. *corymbosa* (Forsskål, 1775) and *L*. cf. *hemprichii*, (Ehrenberg, 1834) based on Scheer & Pillai (1983) and Sheppard & Sheppard (1991), and as *Symphyllia recta* (Dana, 1846) based on Claereboudt (2006). Scheer & Pillai (1983) in their Red Sea study distinguished *Lobophyllia corymbosa* by its mostly monocentric corallites, from the mostly phacelomeandroid *L*. *hemprichii* but considered them potentially

synonymous. They did not document the lobophyllid genus *Symphyllia* in the Red Sea. Sheppard & Sheppard (1991) discussed *Symphyllia erythraea* (Klunzinger, 1879), *S. radians* (Milne Edwards & Haime, 1849), and *Lobophyllia corymbosa* and *L. hemprichii* in the Red Sea. *Symphyllia erythraea* and *S. radians* are fully meandroid and not easy to confuse with *Lobophyllia*. Arrigoni *et al*. (2012) found *L. hemprichii*, *L. corymbosa* and *S. radians* to be genetically very closely related, while *S. erythraea* is distinct and basal to the *Symphyllia*-*Lobophyllia* clade.

Host specificity of *Fizesereneia* species appears to be less strict than that of species of some other gall crab genera, but this is possibly influenced by difficulties in host coral identification. So far, only *Fizesereneia daidai* and *F. stimpsoni* show strict host associations, respectively with the genera *Micromussa* and *Acanthastrea* (Fize & Serène 1957; Zayasu *et al*. 2013).

Distribution. Currently known from the Farasan Banks and Islands and the reefs off Thuwal in the Saudi Arabian part of the Red Sea (Fig. 1) and from off Bandar Al-Khayran in the Gulf of Oman. This is the first record of *Fizesereneia* from this area, a genus heretofore recorded from Vietnam, Indonesia, Japan, Australia, and Micronesia (Kropp 1990a).

Etymology. This species is named *panda* owing to the dark colour pattern of its anterior carapace concavities, which resemble the dark spots around the eyes of the giant panda *Ailuropoda melanoleuca* (David, 1869) (Mammalia, Ursidae).

Acknowledgements

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