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A new species of the genus *Indochinamon* Yeo & Ng, 2007 (Crustacea: Brachyura: Potamoidea: Potamidae) from northern Vietnam

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Abstract. A new species of potamid freshwater crab, *Indochinamon chuahuong*, is described from Ha Noi, northern Vietnam. The new species can be distinguished from all other *Indochinamon* species by a suite of characters, including a carapace broader than long; an anterolateral margin that is convex and distinctly serrated; longer ambulatory legs than its congeners; and the terminal segment of the male first gonopod being curved outwards, with a very low dorsal flap.

Key words. Vietnam, Crustacea, Brachyura, Potamidae, new species, taxonomy

INTRODUCTION

The potamid genus *Indochinamon* Yeo & Ng, 2007, consists of 33 species of freshwater crabs living in montane streams in China, northern Vietnam, Laos, Thailand, Myanmar and northeastern India (Wood-Mason, 1871; Rathbun, 1904; Alcock, 1909; Pretzmann, 1966; Dang, 1967; Dai et al., 1975; Dang, 1975; Dai et al., 1980; Dai & Chen, 1985; Ng & Naiyanetr, 1993; Dai & Bo, 1994; Dai, 1995; Dai & Cai, 1998; Yeo & Ng, 1998, 2007; Brandis, 2000; Naiyanetr; 2001; Naruse et al., 2011). Species diversity is highest in China (14 species), followed by Vietnam (9 species), Myanmar (5 species), India, Thailand and Laos (3 species each country, respectively). The distributions of most species are highly localised across the Indo-Burma region (Cumberlidge et al., 2009), with only four species with wide distributions (*I. andersonianum* (Wood-Mason, 1871) and *I. hispidum* (Wood-Mason, 1871) from China and Myanmar; and *I. jinpingense* (Dai, 1995) and *I. tannanti* (Rathbun, 1904) from China and Vietnam. Nine species of *Indochinamon* have been found in Vietnam: *I. orleansi* (Rathbun, 1904), *I. tannanti* (Rathbun, 1904), *I. kimboiense* (Dang, 1967), *I. mieni* (Dang, 1967), *I. jinpingense* (Dai, 1995), *I. cua* (Yeo & Ng, 1998), *I. bavi* Naruse, Nguyen & Yeo, 2011, *I. dangi* Naruse, Nguyen & Yeo, 2011, and *I. phongnha* Naruse, Nguyen & Yeo, 2011 (Yeo & Ng, 2007; Dang & Ho, 2012).

A new species of *Indochinamon* was discovered during a 2014 biodiversity survey of streams on a limestone mountain in Ha Noi, Vietnam, and is described herein. The new species possess the main characteristics of the genus *Indochinamon* that are: a carapace slightly broader than long; epigastric cristae are well developed; postorbital cristae are not confluent with epibranchial tooth; flagellum of the exopod of third maxilliped is well developed; suture between sternites 2 and 3 distinct; male abdomen narrowly triangular; G1 terminal segment usually relatively short, conical, groove for G2 marginal; subterminal segment broad; G2 distal segment distinctly longer than half the length of the basal segment (Yeo & Ng, 2007). The new species appears to have a highly localised distribution and can be distinguished from congeners by a suite of morphological characteristics.

MATERIAL AND METHODS

Specimens were collected from Chua Huong (= Perfume Pagoda), Huong Son commune, My Duc district, Ha Noi, Vietnam (Fig. 1) and were preserved in 70–95% ethanol and illustrated with the aid of a drawing tube attached to a stereomicroscope. Materials examined are deposited in the Institute of Ecology and Biological Resources (IEBR), Vietnam Academy of Science and Technology (VAST).

The abbreviations CW and CL are used for the carapace width and length, respectively; G1 and G2 are for the male first and second gonopods, respectively. Measurements (in millimetres) are of carapace width and length (CL), respectively. Terminology used herein follows Ng (1988).

TAXONOMY

Family Potamidae Ortmann, 1896

Subfamily Potamiscinae Ortmann, 1896 (sensu Yeo & Ng, 2003)

Indochinamon Yeo & Ng, 2007

Indochinamon chuahuong, new species
(Figs. 2–5)

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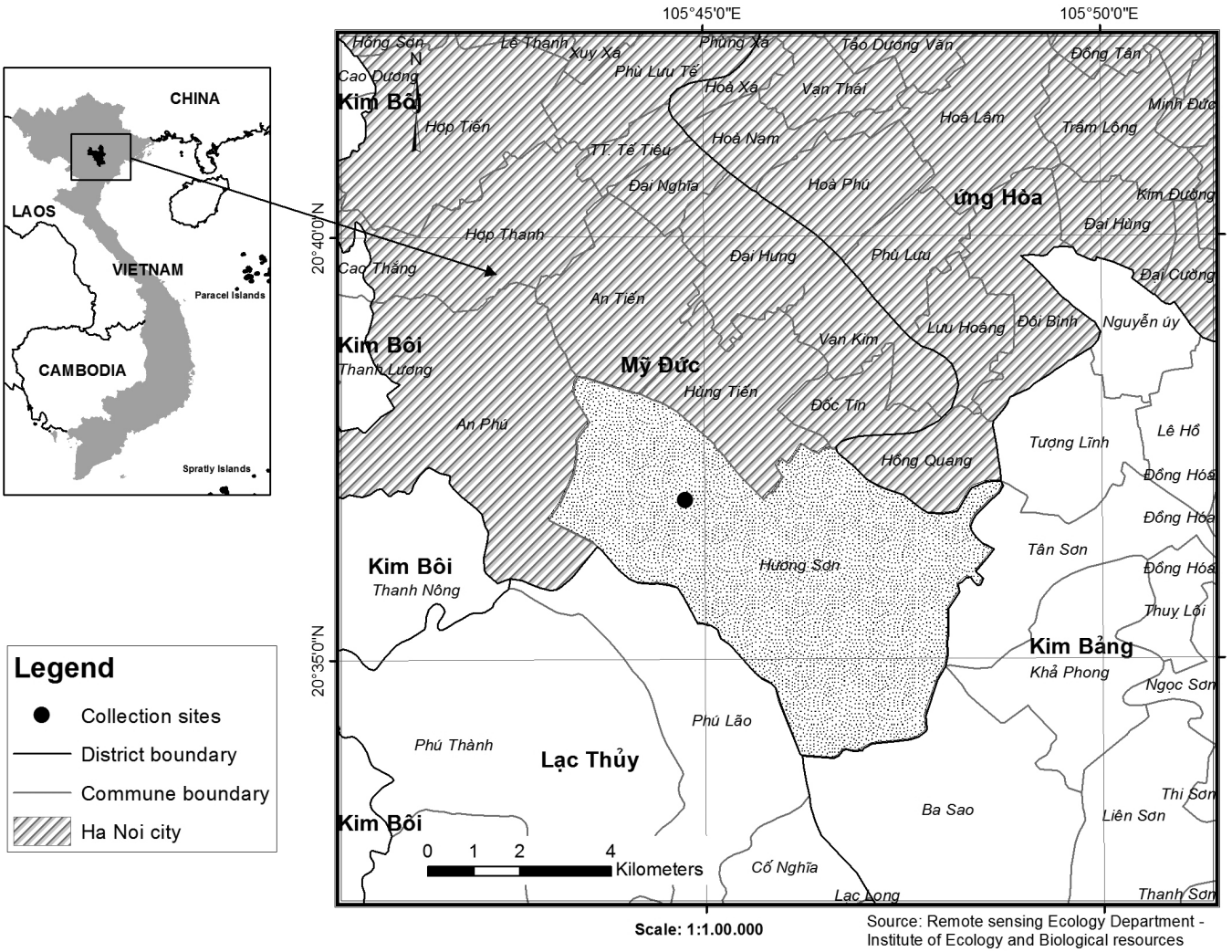

Fig. 1. Collection site of *Indochinamon chuahuong*, new species.

Material examined. Holotype - male (76.1 × 53.0 mm) (IBER-FC ICx01), Huong Pagoda, Huong Son commune, My Duc district, Ha Noi province, Vietnam, 20°37'3.8"N 105°44'30.0"E, coll. local collector, 10 May 2014.

Paratypes – 2 males (71.4 × 51.1 mm, 72.1 × 51.1 mm) (IBER-FC ICx02–03), 1 female (59.8 × 43.3 mm) (IEBR-FC ICx04), same data as holotype.

Comparative material. *Indochinamon bavi* Naruse, Nguyen & Yeo, 2011: 3 males (59.9 × 57.8 mm, 50.6 × 38.9 mm, 50.0 × 38.4 mm) (IEBR-FC IBx01–03), Ba Vi National Park, Ha Noi, Vietnam, coll. local collector, 8 November 2013; *I. dangi* Naruse, Nguyen & Yeo, 2011: 1 male (52.02 × 39.03 mm) (IEBR-FC IDx01), Dien Bien province, Vietnam, coll. Pham The Cuong, 5 October 2014; *I. kimboiense* (Dang, 1975): 1 male (69.8 × 51.6 mm) (IEBR-FC IKx01), Ngoc Son, Ngo Luong, Lac Son commune, Hoa Binh province, Vietnam, coll. Pham The Cuong, 5 October 2014; *I. phongnha* Naruse, Nguyen & Yeo, 2011: 7 males (80.30 × 58.9 mm, 73.1× 53.0 mm, 62.5 × 46.5 mm; 58.8 × 43.5 mm, 54.5 × 41.4 mm, 52.8 × 40.2 mm, 51.5 × 39.8 mm) (IEBR-FC IPx01–03, Phong Nha – Ke Bang National Park, Quang Binh province, Vietnam, coll. Do Van Tu, 24 April 2014. *I. tannanti* (Rathbun, 1904): 2 males (51.2 × 38.9 mm, 47.6 × 35.2 mm) (IEBR-FC ITx01–02, Da Bac District, Hoa Binh province, Vietnam, coll. Do Van Tu, 14 May 2015.

Diagnosis. Carapace broader than long (mean 1.4 times), anterolateral margin convex, distinctly serrated; the brachial region slightly swollen when viewed dorsally. Ambulatory legs relatively long. G1 broad, gently sinuous; terminal segment relatively short, about 0.4 times the length of the subterminal segment, about 3.3 times longer than broad, distally curved outwards, outer margin swollen at base, with very low, narrow dorsal flap.

Description. Carapace broader than long, CW ca. 1.4 times CL, low, dorsal surface glabrous; carapace regions well-defined; cervical groove shallow; epigastric cristae distinct, rugose, not sharp, separated by a distinct groove which opens up into inverted V-shape posteriorly, separated from postorbital cristae by very short, shallow groove; postorbital cristae weakly granulose, gently sloping posterolaterally before breaking up into faint granules before the epibranchial tooth; regions behind epigastric and postorbital cristae with weak rugae and granules (Fig. 2A, B). Frontal to orbital margins gently sinuous, frontal region weakly granular. Supra- and infraorbital margins interrupted just below external orbital angle, weakly granulated; orbital region

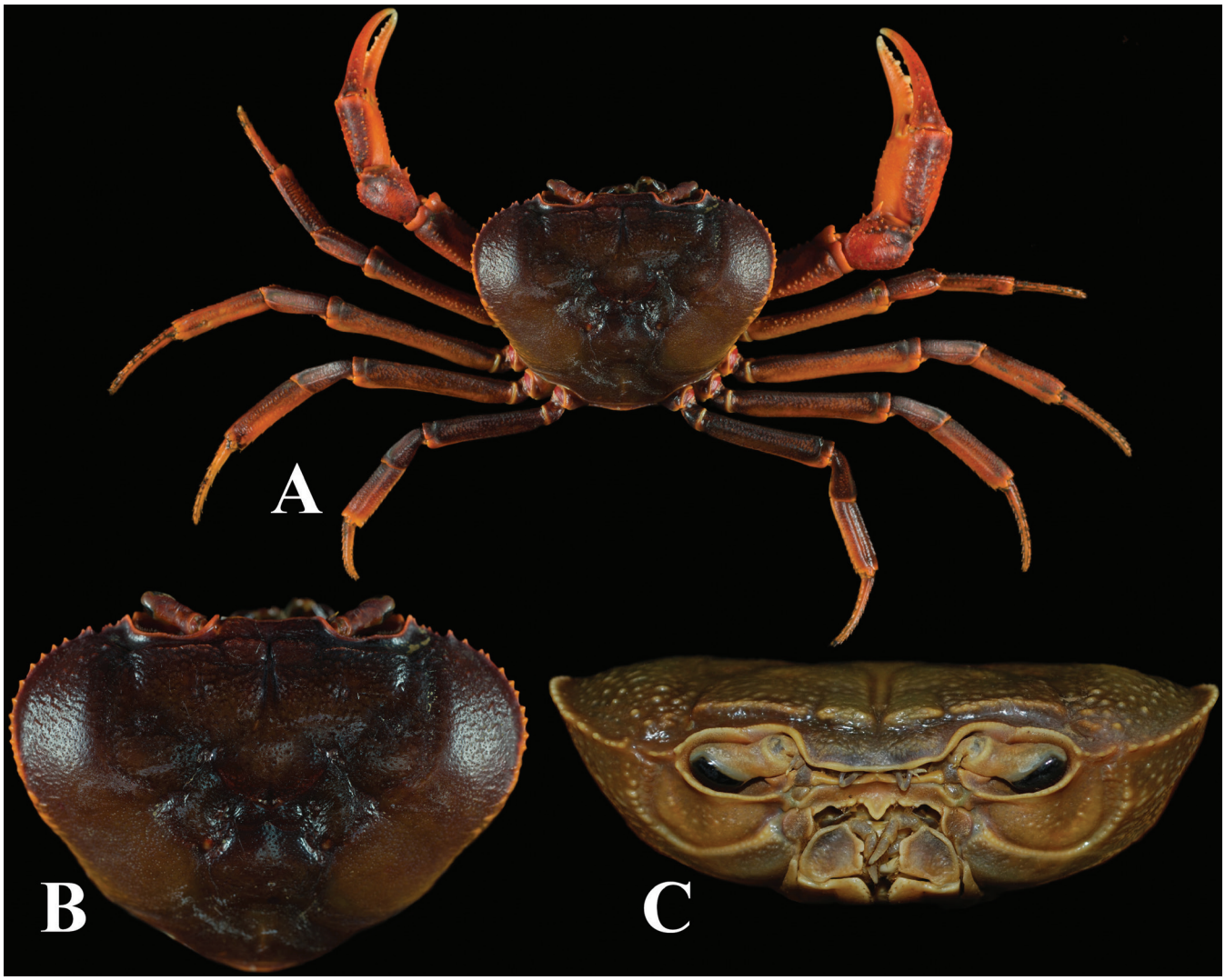

Fig. 2. *Indochinamon chuahuong*, new species, holotype male (76.1 × 53.0 mm) (IBER-FC IC×01), Huong Pagoda, Huong Son commune, My Duc district, Ha Noi province, Vietnam. A, overall habitus; B, dorsal view of carapace; C, frontal view of carapace.

smooth; suborbital region with few granules; brachial region slightly swollen when viewed dorsally (Fig. 2A, 2B); subhepatic and subbranchial regions slightly rugose (Fig. 2B, C). External orbital angle relatively broadly triangular, outer margin serrated; epibranchial tooth small but prominent, sharp; anterolateral margin convex, distinctly serrated, distinctly cristate; posterolateral margins strongly convergent posteriorly; branchial regions granulose to slightly rugose (Fig. 2B, C). Posterior margin of epistome with 3 lobes, median longest, triangular, lateral lobes lined with granules (Fig. 2C).

Ischium of third maxilliped rectangular, about 1.6 times longer than broad, vertical sulcus well defined; merus squarish with concave outer surface, about 0.5-0.6 times the length of the ischium; exopod longer than ischium, exceeding upper edge of ischium but not reaching midpoint of merus, with well-developed flagellum, about 0.4 times the width of the merus (Fig. 3B).

Male cheliped carpus with rugose outer surface, inner part covered with rounded forward-directed granules, weakly rugose; not distinctly swollen; fingers as long as palm, slightly hook-shaped distally, cutting edge regularly lined with teeth, without distinct gap when closed (Fig. 3C).

Ambulatory legs glabrous, relatively long, slender; second pair longest, dactylus long, slender, approximately long as propodus, about 6.5 times longer than proximal width, with low, sharp ridge; merus of first, second, third and fourth pairs about 4.3, 5.9, 5.4, 5.0 times longer than wide, respectively (Fig. 2A).

Suture between sternites 2 and 3 complete, distinct, gently curves upward medially; suture between sternites 3 and 4 not discernible (Fig. 3A). Male sternoabdominal cavity reaching imaginary line joining median points of cheliped bases (Fig. 3A). Male abdomen narrowly triangular; telson longer than width, lateral margin very slightly concave, tip rounded, slightly longer than somite 6; somite 6 with lateral margins convex; lateral of margins of somites 4 to 5 straight; lateral margins of somite 3 gently convex (Fig. 3A).

G1 broad, gently sinuous (Fig. 4A, C, E). Terminal segment relatively short, subcylindrical, about 0.4 times the length of the subterminal segment, 3.3 times longer than broad;

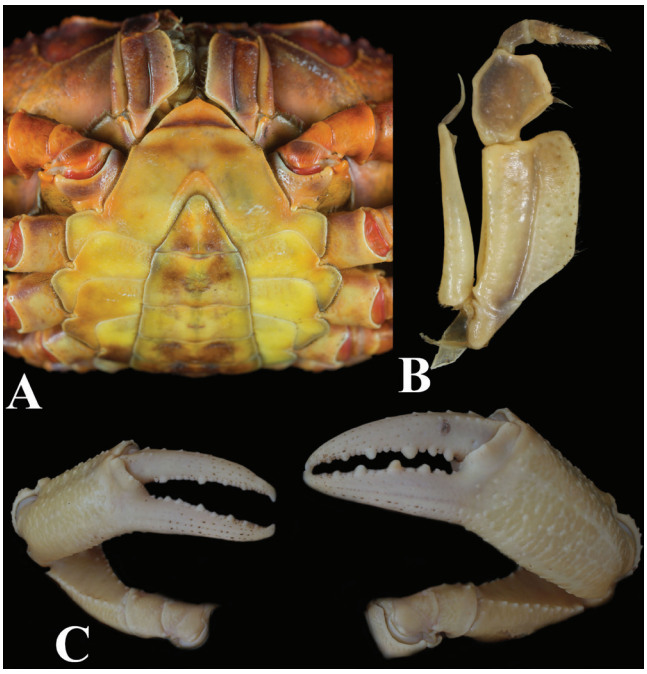

Fig. 3. *Indochinamon chuahuong*, new species, holotype male (76.1 × 53.0 mm) (IBER-FC IC×01), Huong Pagoda, Huong Son commune, My Duc district, Ha Noi province, Vietnam. A, ventral view showing anterior thoracic sternum and abdomen; B, left third maxilliped; C, chela outer view.

distally curved outwards, tapering distally, distinct ventral distal opening, swelling on outer margin at base when viewed ventrally (Fig. 4B, D, F); groove for G2 on dorso-lateral surface medially, dorsal flap (protuberance of ventral outer surface) very low, visible from dorsal view, about 0.3 times the length of terminal segment; subterminal segment broad, with distinct subrectangular cleft on subdistal outer margin of dorsal surface, distal part of outer margin weakly concave (Fig. 4B, D, F). G2 longer than G1, flagellum curving outwards, U- shaped, distal segment distinctly longer than half the length of the basal segment; outer margin of basal segment expanded (Fig. 4G, H).

Size. This species is quite large, with the largest recorded male specimens measuring 76.1× 53.0 mm. From what has been published, *Indochinamon chuahuong* is one of largest freshwater crabs known from Vietnam (Yeo & Ng, 2007; Nasure et al., 2011; Dang & Ho, 2012).

Etymology. The new species is named after the type locality, Chua Huong. The name is used as a noun in apposition.

Live coloration. The dorsal carapace, chelipeds and walking legs are mostly dark orange (Fig. 2A).

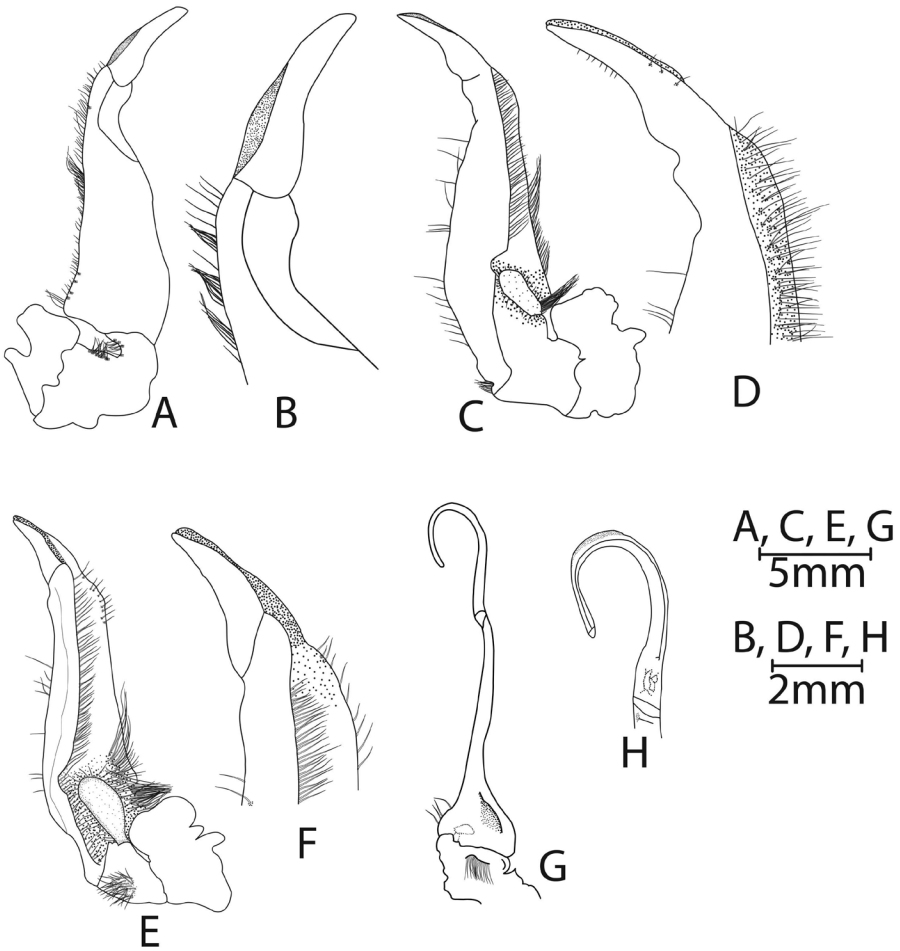

Fig. 4. *Indochinamon chuahuong*, new species, holotype male (76.1 × 53.0 mm) (IBER-FC IC×01), Huong Pagoda, Huong Son commune, My Duc district, Ha Noi province, Vietnam. A, ventral view of left G1; B, ventral view of distal part of left G1; C, dorsal view of left G1; D, dorsal view of distal part of left G1; E, lateral view of left G1; F, lateral view distal part of left G1; G, dorsal view of left G2; H, left G2 of terminal segment.

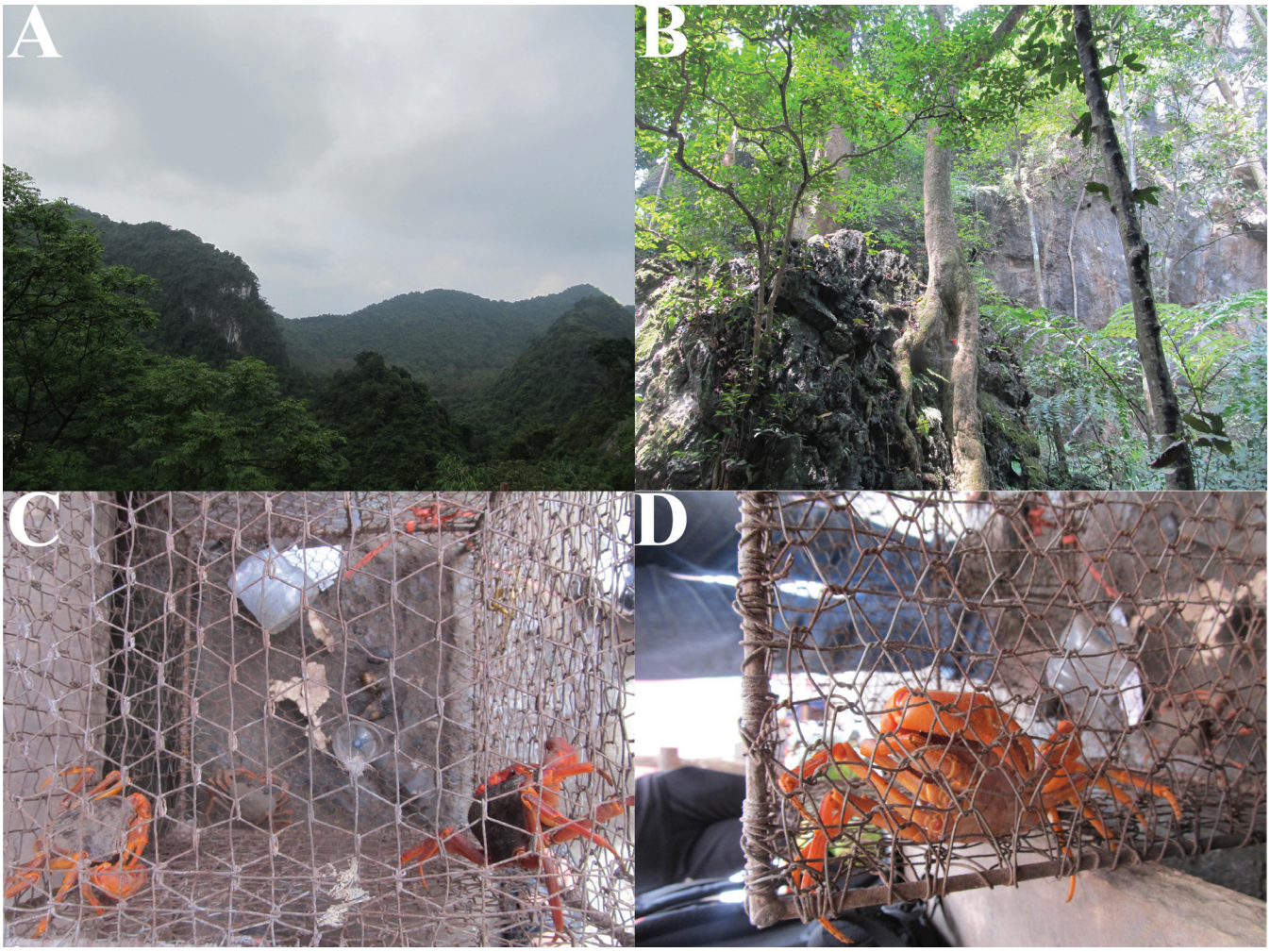

Fig. 5. A, B, a habitat in Huong Pagoda, Huong Son commune, My Duc district, Ha Noi province, Vietnam; C, D, *Indochinamon chuahuong*, new species, in a cage being offered for sale to tourists.

Remark. This new species can be separated from congeners by a suite of characteristics, including broader carapace; distinctly serrated, convex anterolateral margin; long ambulatory legs; G1 terminal segment curved outwards, with very low dorsal flap visible only from dorsal. Nevertheless, the most important characters that distinguish the new species from the other species of the genus *Indochinamon* are the prominently serrated anterolateral margins and the distinctly long ambulatory legs. Only four species of *Indochinamon* (*I. chuahuong*, *I. bavi*, *I. kimboiense* and *I. phongnha*) possess a dorsal flap (protuberance of ventral outer surface) at the terminal segment of the G1. However, *I. chuahuong* can be distinguished from the other three species by a combination of morphological characters (Table 1).

Carapace margin and longer legs of *I. chuahuong* are similar to *Kanpotamon duangkhaei* Ng & Naiyanetr, 1993 from northern Thailand. However, the shape of the G1 terminal segment differs in *K. duangkhaei* in the distinct bulbous structure on the proximal part of the G1's outer margin. In addition, the suture between sternites 2 and 3 are gently concave in *K. duangkhaei* while convex in *I. chuahuong*.

Habitat. *Indochinamon chuahuong* was collected from an innominate limestone mountain in a forest near the center of Chua Huong (Fig. 5A, B). This new species is believed to be semi-terrestrial, as it has been collected in wet forest habitats distant from local streams.

Conservation status. Recent surveys indicate that *I. chuahuong* has a highly-localised distribution in the limestone forests of Chua Huong, which are not in a protected area and thus deforestation is still ongoing (unpublished data). This species could not be found in other regions of northern Vietnam during our surveys. The extent of occurrence was estimated lower than 20,000 km^2. In addition, *I. chuahuong* is harvested by local people to sell as food and pets to tourists (Fig. 5C, D). Therefore, this species should be considered at least as Vulnerable (VU) on the IUCN Red List Categories and Criteria (IUCN, 2012) due to its highly-localised range, deforestation of its habitat, and the presumed impact of over-harvesting for tourism.

Table 1. Morphological comparison between *Indochinamon chuahuong* new species, and *I. bavi*, *I. kimboiense* and *I. phongnha*

Character	*I. chuahuong*	*I. bavi*	*I. kimboiense*	*I. phongnha*
Carapace	CW 1.4 times CL; region well-defined (Fig, 2A, B).	CW 1.3 times CL; region relatively well-defined (Naruse et al., 2011; Fig. 4a).	CW 1.3 times CL; region poorly defined (Naruse et al., 2011; Fig. 1a).	CW 1.3 times CL; region well-defined (Naruse et al., 2011; Fig. 7a).
Anterolateral margin	Strongly convex laterally, strongly serrated, distinctly cristate (Fig. 2A, B).	Moderately convex, serrated, weakly cristate (Naruse et al., 2011; Fig. 1a).	Convex, distinctly serrated, distinctly cristate (Naruse et al., 2011; Fig. 1a).	Strongly convex laterally, serrated, weakly cristate (Naruse et al., 2011; Fig. 7a).
Suborbital region	With few granules (Fig. 2C).	Smooth, without granules (Naruse et al., 2011; Fig. 5a).	With many granules (Naruse et al., 2011; Fig. 1b).	With many granules (Naruse et al., 2011; Fig. 8a).
Ambulatory legs	Relatively long (about 1.7 times longer than carapace width), slender; merus of first, second, third and fourth pair about 4.3, 5.9, 5.4, 5.0 times, respectively, longer than wide (Fig. 2A).	Relatively short (about 1.3 times longer than carapace width), stout; merus of first, second, third and fourth pair about 2.9, 3.7, 3.6, 2.9 times, respectively, longer than wide (comparative material).	Relatively short (about 1.3 times longer than carapace width), stout; merus of first, second, third and fourth pair about 2.9, 3.1, 3.0, 2.9 times, respectively, longer than wide (comparative material).	Relatively short (about 1.3 times longer than carapace width), stout; merus of first, second, third and fourth pair is about 2.6, 3.1, 3.1, 2.8, respectively, longer than wide (comparative material).
Male telson	Triangular, with gently concave lateral margins (Fig. 3A).	Narrowly triangular, with distinctly concave lateral margins (Naruse et al., 2011; Fig. 4b).	Broadly triangular, with slightly concave lateral margins (Naruse et al., 2011; Fig. 1b).	Narrowly triangular, with distinctly concave lateral margins (Naruse et al., 2011; Fig. 7b).
G1 terminal segment	Distally curved outwards, about 3.3 times longer than broad, 0.4 times length of subterminal segment; dorsal flap easily visible from dorsal view (Fig 4A–F).	Curved outwards; about 3.7 time longer than broad, 0.3 times length of subterminal segment; dorsal flap indiscernable from dorsal view (Naruse et al., 2011; Fig. 3d, e).	Slightly curved outwards; about 3.1 time longer than broad, 0.4 times length of subterminal segment; dorsal flap visible from dorsal view Naruse et al., 2011; Fig. 3a, b).	Curved outwards; about 3.4 times longer than broad, 0.3 times length of subterminal segment; dorsal flap slightly visible medially from dorsal view (Naruse et al., 2011; Fig. 9a, b).

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