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Two New Species of Crayfish of the Genus *Cherax* (Crustacea, Decapoda, Parastacidae) from Western and Eastern Indonesian New Guinea †

Christian Lukhaup [1,*], Rury Eprilurahman [2] and Thomas von Rintelen [3]

[1] Independent Researcher, 66999 Hinterweidenthal, Germany
[2] Animal Systematics Laboratory, Department of Tropical Biology, Faculty of Biology, Universitas Gadjah Mada, Jl. Teknika Selatan, Sekip Utara, Yogyakarta 55281, Indonesia; rurybiougm@ugm.ac.id
[3] Museum für Naturkunde—Leibniz Institute for Evolution and Biodiversity Science, Invalidenstraße 43, 10115 Berlin, Germany; thomas.vonrintelen@mfn.berlin
* Correspondence: craykeeper@gmx.de
† urn:lsid:zoobank.org:pub:9AC7BBF5-CA21-4105-BDB0-FC17794AF481.

Abstract: Two new species of the genus *Cherax* are described and illustrated. *Cherax rayko* n. sp., endemic to the Bian River drainage basin in the Muting District, in the northern part of the Merauke Regency, South Papua, Indonesia, is described, figured, and compared with its closest relatives, *Cherax alyciae*, Lukhaup, Eprilurahman & von Rintelen, 2018, and *Cherax peknyi* Lukhaup & Herbert, 2008. The new species may be easily distinguished from both by the shape of the rostrum, the shape of the chelae, the shape of the scaphocerite, and the coloration. *Cherax phing* n. sp., endemic to the Kali Ombak River drainage basin in the western part of the Kepala Burung (Vogelkop) Peninsula, Southwest Papua, Indonesia, is described, figured, and compared with its closest relatives, *Cherax pulcher* Lukhaup, 2015a, *Cherax boesemani* Lukhaup & Pekny, 2008, *Cherax wagenknechtae* Lukhaup and Eprilurahman, 2022, and *Cherax gherardii* Patoka, Bláha & Kouba, 2015. The new species may be easily distinguished from the latter species by the shape of the chelae, rostrum, and body and by the coloration. A molecular phylogeny based on a mitochondrial gene fragment, 16S, supports the morphology-based description of the two new species, which can also be clearly distinguished by sequence differences.

Keywords: morphology; molecular phylogeny; freshwater; New Guinea; taxonomy

Citation: Lukhaup, C.; Eprilurahman, R.; von Rintelen, T. Two New Species of Crayfish of the Genus *Cherax* (Crustacea, Decapoda, Parastacidae) from Western and Eastern Indonesian New Guinea. *Arthropoda* **2024**, *2*, 264–293. https://doi.org/10.3390/arthropoda2040019

Academic Editor: Sammy De Grave

Received: 18 October 2024
Revised: 11 December 2024
Accepted: 16 December 2024
Published: 20 December 2024

1. Introduction

The crayfishes of the island of New Guinea of the genus *Cherax*, which is a species-rich taxon occurring in Indonesia (Papua), Papua New Guinea, and Australia, were extensively studied by Holthuis [1–6], with additions by Lukhaup and Pekny [7,8], Lukhaup and Herbert [9], Lukhaup [10], Lukhaup et al. [11–13], Patoka et al. [14–16], and Lukhaup and Eprilurahman [17].

Nevertheless, over the last two decades, there has been an increasing number of colorful crayfish specimens, presumed to be a further undescribed species, sold from New Guinea in the ornamental fish trade in Europe and Asia under the names *Cherax* "tiger" and "zebra". These have been exported to many countries in Europe and East Asia and recently also to the USA and Canada. While they are clearly a species of *Cherax*, their exact provenance could not be ascertained, with dealers claiming they came from Merauke (Southwest Papua) and other places in the area that could not be confirmed. In the present contribution, this species is described as new to science, and it is established that it is in fact native and endemic to the Bian River drainage basin in the Muting District, in the northern part of the Merauke Regency.

Cherax rayko n. sp. is genetically and morphologically most similar to *Cherax alyciae* Lukhaup et al., 2018 [13], endemic to creeks in the Digul River drainage basin in the eastern

part of the Boven Digoel Regency, Papua, Indonesia, and to *Cherax peknyi* Lukhaup & Herbert, 2008 [9], from the Fly River drainage basin, in the Western Province of Papua New Guinea.

In January 2016, the first author received a picture of an undescribed crayfish from Heiko Bleher, a well-known fish collector and explorer, which he photographed on one of his trips to the Lake Ajamaru region. Unfortunately, no exact location was provided for this crayfish. Shortly afterwards, the first author showed the picture to Liauw Pauw Phing, who advised his crayfish search team in Sorong, West Papua, to find the crayfish that was believed to inhabit some rivers north of Lake Ajamaru in the Hutan District, Tambrauw Regency (pers. comm. to first author by Heiko Bleher).

In 2020, Mr. Phing and his team were able find the crayfish in the Kali Ombak River, which is close to the Seni Village, Hutan District, Tambrauw Regency. The crayfish were shipped to Aquarium Dietzenbach and Christian Lukhaup by Mr. Phing and his team. Here, this species is also described as new to science.

2. Materials and Methods

Cherax rayko n. sp. were collected from creeks in the Bian River drainage basin in the Muting District, in the neighborhood of the village Muting (Table 1). According to the dealer, several people in the village collect these crayfish for the pet trade. After collection, they are kept for several days in cages in the river before the dealer picks them up and brings them to Merauke, from where they are shipped to Jakarta and then to Europe. We received several animals from one of these shipments. Holotypes and allotypes were photographed and kept alive in indoor tanks until samples were obtained for DNA analysis.

Samples of *Cherax phing* sp.nov., *C. pulcher*, *C. boesemani*, *C. wagenknechtae*, *C. woworae*, and *C. gherardii* were collected from creeks in West Papua and Papua Provinces (Table 1). Holotypes and allotypes were photographed and kept alive in indoor tanks until samples were obtained for DNA analysis.

After this procedure, the animals were preserved in 70% ethanol. Morphometric parameters of all individuals were taken using an electronic digital caliper with an accuracy of 0.1 mm. For the molecular analyses, sequences from an additional ten species of *Cherax* and from two other parastacid genera used as outgroups were downloaded from GenBank (see Table 1).

All studied material has been deposited at the Museum Zoologicum Bogoriense (=*Bidang Zoologi*) Research Centre for Biosystematics and Evolution (=*Pusat Riset Biosistematika dan Evolusi*), National Research and Innovation Agency (=BRIN), Jalan Raya Jakarta-Bogor Km 46 Cibinong 16911, Indonesia (MZB), and the Museum für Naturkunde, Leibniz Institute for Evolution and Biodiversity Science, Berlin (ZMB).

DNA was purified from about 2 mm^3 of muscle tissue with a Qiagen QiaCube using the manufacturer's protocol. The polymerase chain reaction (PCR) was used to amplify a mitochondrial gene fragment, a ~535 bp region of the 16S ribosomal RNA gene (16S) using primers 1471 and 1472 [18].

The PCR was performed in 25 µL volumes containing 1x Taq buffer, 1.5 mM $MgCl_2$, 200 µM each dNTP, 1 U Taq polymerase, ca. 50–100 ng DNA, and ddH2O. After an initial denaturation step of 3 min at 94 °C, the cycling conditions were 35 cycles at 94 °C for 35 s, 50 °C for 60 s, and 72 °C for 90 s, with a final elongation step of 5 min at 72 °C. The same primers were used in PCR and sequencing. The PCR products were sent to Macrogen Europe for the purification and cycle sequencing of both strands of each gene.

The sequences were aligned with MAFFT using the G-INS-i strategy suitable for thorough alignments of sequences with global homology [19]. The resulting alignment had a length of 542 bp. To determine the best substitution model for Bayesian information analyses (see below), hierarchical likelihood ratio tests were carried out with jModelTest [20] (24 models tested). Based on the Akaike Information Criterion and the Bayesian Inference Criterion, the HKY + G model was chosen.

Table 1. Material studied with GenBank accession numbers. Sequences of species represented by more than one sequence are listed consecutively, as labeled in Table 1.

Species	Location (Adjusted to the Current Regional Division)	GenBank Acc. NO. 16S	Sources
Cherax boesemani	Ajamaru Lake, Maybrat Regency, Southwest Papua, Indonesia; 1°17′19.97″ S, 132°14′49.14″ E; 23 January 2016	KY654089 KY654090	Lukhaup et al., 2017 [12]
Cherax alyciae	Unnamed creek, Boven Digoel Regency, South Papua, Indonesia; 7 December 2016	MH457588 MH457589 MH457590	Lukhaup et al., 2018 [13]
Cherax communis	Paniai Lake, Paniai Regency, Central Papua, Indonesia	MH457602	Lukhaup et al., 2018 [13]
Cherax gherardii	Pet trade	KU821417	Blaha et al., 2016 [21]
Cherax holthuisi	Uter-Aitinjo Lake, Maybrat Regency, Southwest Papua, Indonesia	KU821433	Blaha et al., 2016 [21]
Cherax misolicus	Misool Island, Raja Ampat Regency, Southwest Papua, Indonesia (Leiden Museum)	KJ920813	Eprilurahman et al. (unpublished)
Cherax monticola	Baliem River, Wamena, Jayawijaya Regency, Highland Papua, Indonesia	KF649851 KJ920818	Gan et al., 2014 [22]
Cherax mosessalossa	Klademak Creek, Sorong City, Southwest Papua, Indonesia; 0°52′23.59″ S, 131°16′24.40″ E; 26 January 2016	MH457594 MH457595	Lukhaup et al., 2018 [13]
Cherax paniaicus	Tage Lake, Paniai Regency, Central Papua, Indonesia	KJ920830	Eprilurahman et al. (unpublished)
Cherax peknyi	Unnamed creek, tributary of Fly River, Papua New Guinea	MH457591 MH457592 MH457596	Lukhaup et al., 2018 [13]
Cherax phing n. sp.	Unnamed creek, Klasabun River drainage basin, Sorong Regency, Southwest Papua, Indonesia; 1°02′41.8″ S, 132°15′51.9″ E; January 2020	PQ777188 PQ777189 PQ777190	This study
Cherax pulcher	Hoa Creek (Teminabuan District), South Sorong Regency, Southwest Papua, Indonesia; 1°28′32.73″ S, 132°3′54.94″ E; 23 January 2016	KY654088	Lukhaup et al., 2017 [12]
Cherax rayko n. sp.	Unnamed creek of Bian River drainage basin, Muting District, Merauke Regency, South Papua, Indonesia; January 2015	PQ777193 PQ777194 PQ777195	This study
Cherax snowden	Oinsok (Ainsok River drainage basin), Southwest Papua, Indonesia; 1°11′40,07″ S, 131°50′1.14″ E; 24 January 2016	KY654087	Lukhaup et al., 2017 [12]
Cherax sp. A	Mogoi, West Papua, Indonesia; September 2020	PQ777191 PQ777192	This study
Cherax sp. B	Misool Barat, Raja Ampat, Southwest Papua, Indonesia	PQ777185 PQ777186 PQ777187	This study
Cherax wagenknechtae	Along banks of unnamed creek of the Klasabun River drainage basin, Sorong Regency, Southwest Papua, Indonesia; 1°15′59.91″ S, 131°18′21.29″ E; 2016	OP737872 OP737873	Lukhaup and Eprilurahman, 2022 [17]
Cherax warsamsonicus	Small tributary to Warsamson River, Sorong Regency, Southwest Papua, Indonesia; 0°49′16.62″ S, 131°23′3.34″ E; 20 January 2016	KY654091	Lukhaup et al., 2017 [12]
Cherax woworae	Teminabuan District, South Sorong Regency, Southwest Papua, Indonesia	OQ474905 OQ474906	Patoka et al., 2023 [15]
Engaeus strictifrons	Crawford River, Victoria, Australia	AF492812	Munasinghe et al., 2003 [23]
Euastacus bispinosus	Crawford River, Victoria, Australia	AF492813	Munasinghe et al., 2003 [23]

Phylogenetic trees were reconstructed by maximum parsimony (MP) using the heuristic search algorithm, as implemented in PAUP* [24], with gaps treated as the fifth base. Support for nodes was estimated by bootstrap analysis (1000 bootstrap replicates with 10 random addition sequence replicates each). Maximum likelihood (ML) analyses were run with IQ-TREE [25] using W-IQ-TREE [26], and branch support was obtained through the implemented ultrafast bootstrap (10,000 replicates [27]). In addition, Bayesian inference was employed to infer phylogeny by using MrBayes 3.2.7 [28]. The MCMCMC algorithm was run with four independent chains for 20,000,000 generations, samplefreq = 500, and burnin = 25%, using the models specified above. Genetic distances were calculated using MEGA 11.0.13 [29].

All new sequences have been deposited in GenBank (see Table 1).

Systematics.

Parastacidae Huxley, 1879 [30].
Genus *Cherax* Erichson, 1846 [31].

***Cherax rayko* n. sp.**

Figures 1–5.

Material examined. Holotype: male (MZB Cru 5792), under rocks and among roots and in debris along banks of unnamed creek of the Bian River drainage basin in the Muting District, South Papua, Indonesia. Coll. local people. January 2015. Crayfish were sent to us by KKCrayfish Farm in Jakarta. Allotype: female (MZB Cru 5793), same data as holotype. Paratypes: 5 males and 4 females (MZB Cru 5794); 4 males and 2 females (ZMB 33408); same data as holotype.

Figure 1. *Cont.*

Figure 1. *Cherax rayko* n. sp. (**A**) Holotype male (MZB Cru 5792), Bian River drainage basin in the Muting District, West Papua, Indonesia. (**B**) Idem, side view. (**C**) Female, same data as holotype.

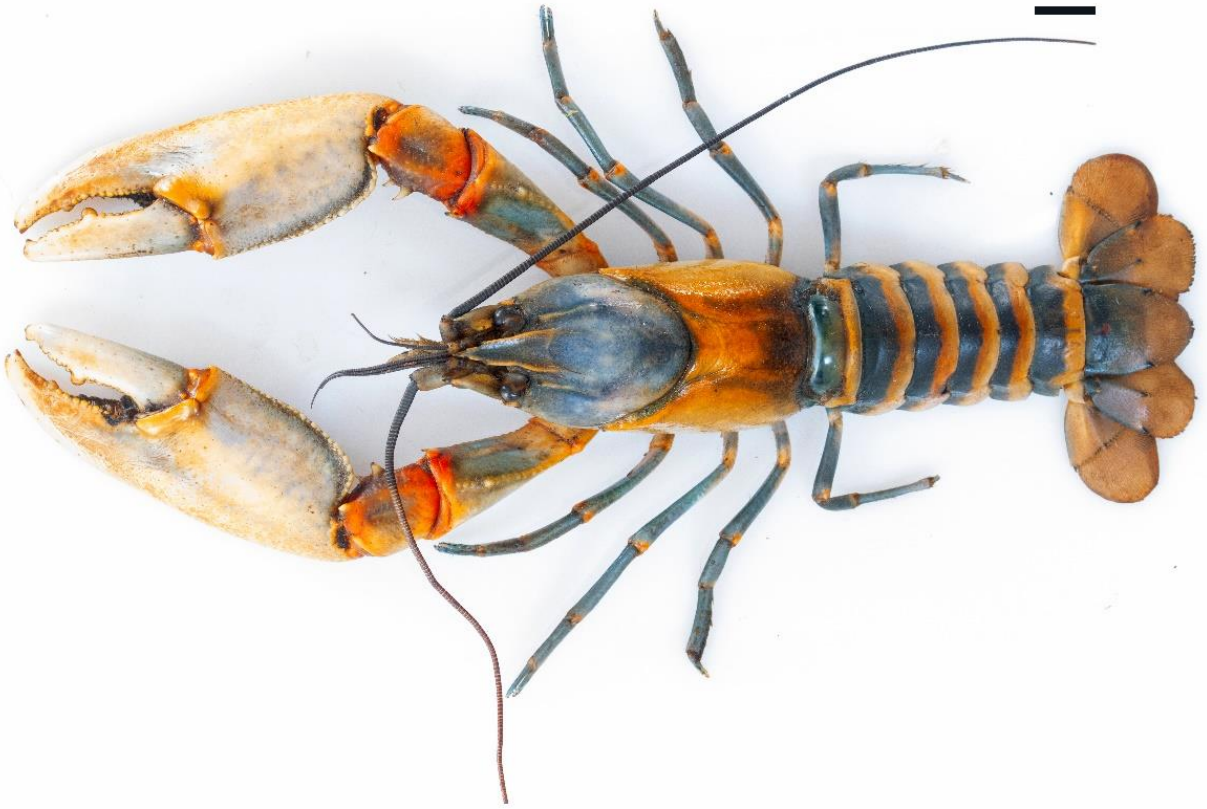

Figure 2. *Cherax rayko* n. sp., holotype male (MZB Cru 5792). Scale bar: 10 mm.

Figure 3. *Cont.*

Figure 3. Right chela of *Cherax rayko* n. sp., holotype male (MZB Cru 5792). (**A**) Dorsal view. (**B**) Ventral view. Scale bar: 10 mm.

Diagnosis. Carapace surface smooth; one small spine and two granules posterior to cervical groove on lateral carapace present. Eyes large, pigmented. Cornea as broad as eyestalk. Rostrum triangular in shape with elevated, thickened margins, non-setose. Rostral margins with two prominent teeth. Rostral carinae prominent. Postorbital ridges prominent with one acute spine at anterior terminus. Propodal cutting edge with short setae in posterior part and one large tubercle. Chelipeds white and blueish, sometimes blue. Other walking legs blue-gray. Carapace usually blue and orange to yellow; pleon with orange-yellowish lateral stripes on a dark green or blackish background.

Description of male holotype (Figures 1A,B, 2, 3, and 4A,B). Body and eyes pigmented. Eyes not reduced. Body subovate, slightly compressed laterally. Pleon narrower than cephalothorax (width 23.3 mm and 26.2 mm, respectively). Rostrum (Figure 4A) broad in shape, reaching the end of ultimate antennular peduncle and about 2.5 times as long as wide (width 6.9 mm at base, length 15.7 mm). Margins slightly elevated continuing in rostral carinae on carapace, almost straight in basal part, distal third, pointing upwards at angle of approximately 45°. Acumen with anteriorly orientated spine. A few scattered hairs present on anterior third of rostrum.

Rostral carinae extending as slight elevations posteriorly on carapace terminating at half of postorbital ridges. Postorbital ridges well developed, terminating in spiniform tubercle anteriorly, fading at half of occipital carapace length, posteriorly. Postorbital ridges about 2/3 of CL. Cervical and branchiocardiac grooves distinct, non-setose; 1 small spine and 2–3 granules present at middle part behind cervical groove on lateral sides of carapace. Carapace (57.9 mm) surface smooth; anterior margin strongly produced; rounded upper margin directed inward.

Areola smooth; length, 19.5 mm; narrowest width, 8.1 mm. Length of areola 33.6% of total length of carapace (57.9 mm).

Scaphocerite (Figure 4B), broadest at posterior third, convex in distal part becoming narrower in basal part; thickened lateral margin terminating in corneous spine, slightly overreaching ultimate segment of antennular peduncle. Left scaphocerite 12.4 mm long and 4.1 mm wide. Proximal margins setose. Antennulae and antennae typical for genus. Antennae slightly longer than body. Antennular peduncle reaching acumen; antennal peduncle slightly overreaching apex of scaphocerite. Antennal protopodite smooth, without spine, with row of hairs on inner margin; basicerite with one lateral and one ventral spine.

Mouthparts typical for genus. Epistome with subcordiform cephalic lobe anteriorly bearing lanceolate cephalomedian projection constricted at base. Lateral margins of lobe not thickened; each lateral margin with a group of very small tubercles separated by a smooth region. Central part smooth, not pitted, excavate. Eyes rather large; cornea globular, darkly pigmented, nearly as long as eyestalk; eyestalk slightly narrower than cornea.

First pereopods (Figure 3A,B) equal in form, chela, gaping. Right cheliped 63.0 mm long, 13.5 mm high, and 24.0 mm wide. Left chelae 63.2 mm long and 13.8 mm high, 23.8 mm wide, strongly compressed. Fingers shorter than palm (right dactylus 29.9 mm long). Dactylus broad at base (10.2 mm), tapering slightly towards tip.

Figure 4. *Cont.*

Figure 4. *Cherax rayko* n. sp., holotype male (MZB Cru 5792). (**A**) Dorsal view of cephalothorax. Scale bar: 10 mm. (**B**) Scaphocerite. Scale bar: 10 mm.

Figure 5. *Cherax rayko* n. sp., allotype female (MZB Cru 5793). Scale bar: 10 mm.

Tip with sharp, corneous, hooked tooth pointing outwards at an angle of 10°. Cutting edge of dactyl with continuous row of small granular teeth posteriorly and one prominent larger tooth at middle of cutting edge. Ventral and dorsal surface of movable finger smooth with scattered punctuation. Ventral posterior half of cutting edge with dense setae reaching from base to prominent larger tooth. Fixed finger smooth, scattered punctuation, triangular, merging gradually into palm, ending in sharp, corneous, hooked tooth, parallel to *x*-axis of finger. Tips of fingers slightly cross when fingers clasp. Upper surface of palm practically smooth, slightly pitted, more densely pitted at margins. Fixed finger slightly broader than dactyl at base (11.3 mm). Dense, short setae present in posterior ventral part of fixed finger, reaching from palm to about half of cutting edge. Cutting edge of fixed finger with row of rather small granular teeth at posterior half and one prominent larger one at first third. Outer lateral margin of chelae smooth. Row of 23–24 mesial probodal granules at dorsolateral margin. Dorsolateral margins elevated.

Dorsal surface of carpus (17.1 mm) smooth, with slight excavation in middle part and with a well-developed mesial carpal spine. Ventral carpal surface margins slightly elevated, non-setose, and with fovea; inner margin with well-developed ventral carpal spine and a prominent ventromesial carpal spine oriented at an angle of approx. 45°.

Merus (25.5 mm) laterally depressed in basal part; surface smooth; small dorsal meral spine present. Inner ventrolateral margin densely covered with small granules; three ventral meral spines present, one at mid-length, other in middle of anterior part, and third on distal ventrolateral inner margin.

Ischium (16.1 mm) smooth with two small spines at ventrolateral inner margin.

Second pereopods reaching anteriorly to approximately mid-length of scaphocerite. Propodus (13.7 mm) and dactylus (6.9 mm) slightly longer than fixed finger (6.5 mm), of same height. A few scattered short setae present on dactyl and fixed finger. Cutting edge of dactyl and propodus with row of dense, short setae. Carpus (10.7 mm), smooth, slightly pitted. Merus (28.3 mm); ischium (8.5 mm) about one-third as long as merus.

Third pereopods overreaching second pereopods by length of finger of second pereopods. Fingers shorter than palm.

Fourth pereopods reaching distal margin of scaphocerite. Dactylus (5.2 mm) with corneous tip. Short, scattered setae present. Propodus (11.1 mm) more than twice as long as dactylus, somewhat flattened, carrying many stiff setae on lower margin. Merus (14.7 mm) slightly longer than propodus.

Fifth pereopods similar to fourth, slightly shorter.

Dorsal surface of pleon smooth, with scattered pits; abdominal segments (1–5) with short setae present on caudal margins of segment. Pleon length 65.9 mm.

Telson with posterolateral spines; dense short setae present in posterior third. Posterior margins setose. Uropodal protopod with two distal spines on mesial lobe. Exopod of uropod with transverse row of posteriorly directed diminutive spines ending in one more prominent spine, posteriorly directed on outer margin of mesial lobe. Terminal half of exopod with small spines and short hairs, slightly corrugated. Endopod of uropod smooth. Short, scattered hairs present on posterior third of dorsal exopod. Posterolateral spine on outer margin present. Second spine on medial dorsal surface present, directed posteriorly.

Description of female allotype (Figure 5). Chela of first pereopods equal, 2.4 times as long as broad (33.7 mm and 13.7 mm, respectively). Mesial margin of palm slightly elevated, forming slender serrated ridge with row of 15–16 small granular teeth. Cutting edge of dactylus with 10–11 rather small granular teeth. Cutting edge of fixed finger with 11–12 small granules. Small scattered short setae visible along ventral cutting edges of chelae, denser and longer in ventral posterior area. Tips of fingers slightly cross when fingers clasp, not gaping. Rostrum broad in shape, reaching the end of ultimate antennular peduncle. Margins slightly elevated continuing in rostral carinae on carapace, almost straight in basal part, distal third, pointing upwards at angle of approximately 45°. Acumen with anteriorly orientated spine. A few scattered hairs present on anterior third of rostrum. Cervical groove distinct, non-setose; three small granules present. Cephalothorax just

slightly wider than pleon (widths 17.7 mm and 18.0 mm, respectively). Same color pattern as in males. Size 90 mm.

Size. The biggest male examined is the holotype, and it has a carapace length of 57.9 mm and a total length of 123.8 mm. The other males have a total length of between 82.1 mm and 122.9 mm; the allotype has a carapace length of 56.6 mm and a total length of 90.0 mm. The other females have a total length of between 96.4 mm and 79.2 mm (n = 11).

Color. The living animals (Figure 1A–C) are colored as follows. Individuals of *Cherax rayko* sp.nov. usually have white to creamy and sometimes blueish-white chelae; the cephalon is blueish fading to creamy-white ventrolaterally. Rostral margins are usually orange. The thorax is usually orange to yellow, fading to a creamy-yellow ventrolaterally. Chelae are creamy with blue becoming blueish-gray to the outer lateral margin. In some individuals, the chelae can be bright blue or grayish-blue. The pleon is usually dark green or blackish-green with broad orange to yellowish stripes. Females: same color as males, sometimes less intense with smaller chelae.

Molecular phylogenetic results. *Cherax rayko* n. sp. forms a highly supported, distinct clade that is the sister species to *C. alyciae* with moderate support; both species are in turn sister to *C. peknyi* (Figure 6). The clade comprising these three species is highly supported and very distinct; its next relatives are *C. communis* and *C. panaicus* (which are sister groups with high support) and *C. monticola* and *C. misolicus*. The relationship of these four species to the clade containing *Cherax rayko* n. sp. is unresolved. *Cherax rayko* n. sp. is well isolated from *C. alyciae* and *C. peknyi* with a sequence divergence (*p*-distance, 16S) of 1.3–1.5% and 2.4–2.9%, respectively, supporting the morphology-based description of *C. rayko* as a new species. *Cherax rayko* n. sp. is genetically and morphologically most similar to *C. alyciae* Lukhaup et al., 2018 [1], endemic to creeks in the Digul River drainage basin in the eastern part of the Boven Digoel Regency, Papua, Indonesia, and to *Cherax peknyi* from the Fly River drainage basin, in the Western Province of Papua New Guinea.

Systematic position. Holthuis [1] in his publication on the New Guinea *Cherax* considered that the species should be placed into two groups, one with the rostral and median carinae absent or weakly developed and referred to as the *Cherax* group following the characteristics of the type species, *C. preissii* (Erichson, 1846) [31] from southwest Australia, and the other group containing species that have the rostral and sometimes the median carina well developed and referred to as the *Astaconephrops* group with Nobili's (1899) [32] *Astaconephrops albertisii* as the type. Newly described species have been placed into one or the other of the two subgenera [6,7,9,11,14]. Munasinghe et al. [33,34], Austin [35], and Austin and Knott [36], however, identified three lineages with different geographic ranges within *Cherax* based on molecular genetics and phylogenetic studies. These consist of a southwestern group, an eastern group, and a northern group. While support for the latter group, however, was based on only very limited sampling (e.g., single samples of *C. quadricarinatus*, *C. rhynchotus*, and *C. peknyi* in the Munasinghe et al. study [23]), a later study by Blaha et al. [20] confirmed these results based on a more extensive dataset. These findings suggest that the division of *Cherax* into two subgenera, as conceived by Holthuis and subsequent authors dealing with New Guinea crayfish, has to be reconsidered, as pointed out by Crandall and De Grave [37]. Based on these studies [20,23,32,33], *Cherax rayko* n. sp. clearly belongs to the northern species group lineage, now consisting of 28 species.

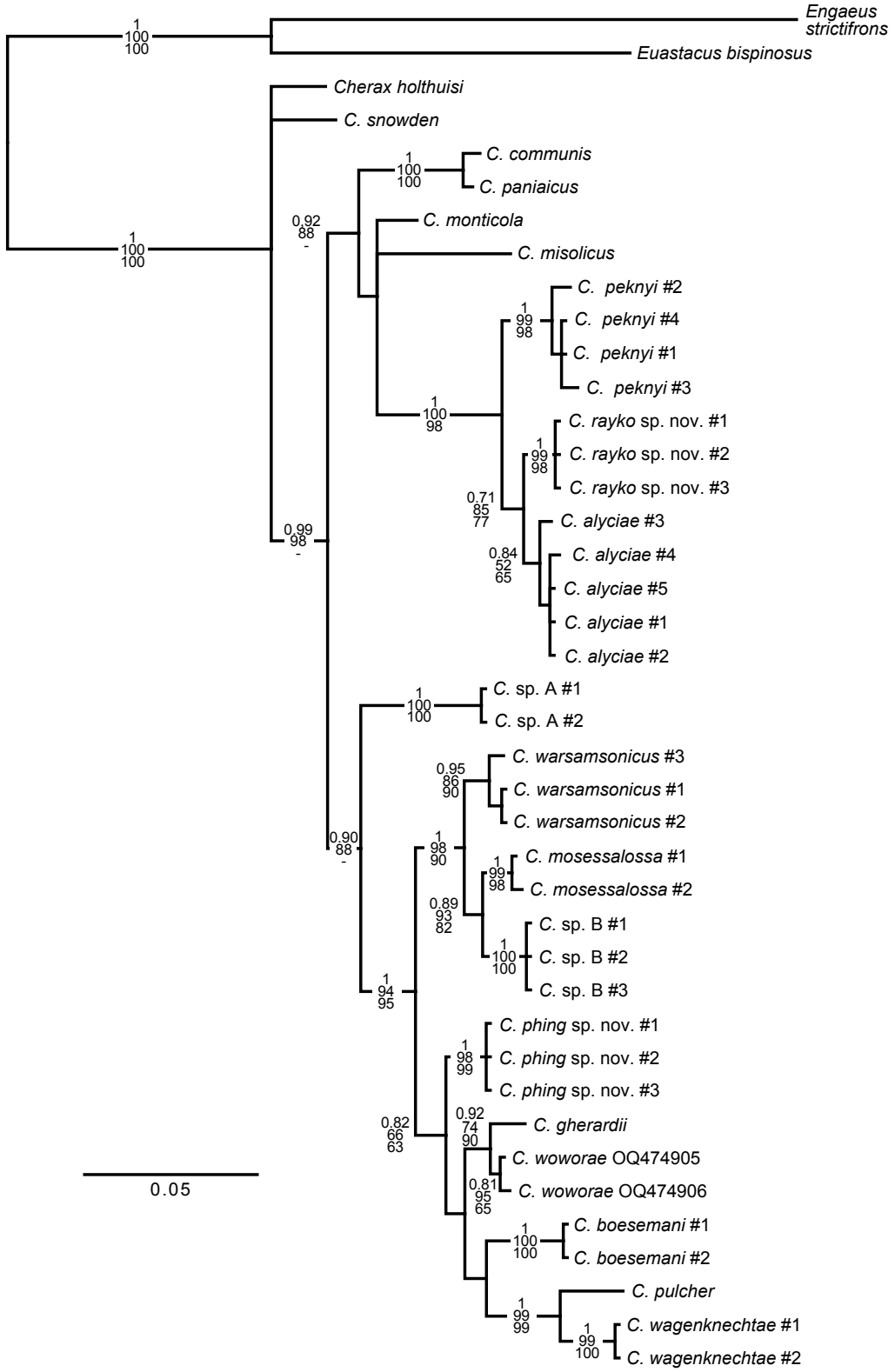

Figure 6. Phylogenetic relationships of *C. phing* n. sp. and *C. rayko* n. sp. within the northern New Guinea *Cherax* lineage, reconstructed by BI analyses of the 16S rRNA mitochondrial gene fragment. Numbers on branches show, from top, Bayesian posterior probabilities (>0.7) and ML/MP bootstrap values (>50). An asterisk indicates nodes with full support (1/100/100) in all analyses. The scale bar indicates the substitution rate. See Table 1 for information on the sequenced specimens.

3. Systematic Remarks

In comparison to all species of the northern group, the new species, *C. rayko* n. sp., is most similar to *C. peknyi* and *C. alyciae*. *Cherax rayko* n. sp. may be easily distinguished from both species by using sequence divergence, by the coloration and pattern of live individuals, by the shape of the chelae, and by the shape of the rostrum.

Cherax rayko n. sp. differs from *C. peknyi* in the following characters: the size, shape of the chelae, shape of the body, and coloration. Catchers also presented some other color forms that are genetically and morphologically very close to *Cherax rayko* n. sp., claiming they are from the Wanggo, Bian, and Kumbe Rivers in the Merauke Regency.

Size comparison. In C. *rayko* n. sp., the biggest males reach up to 130 mm (n = 300); the biggest male in C. *peknyi* is the holotype with 92 mm (n = 120), while the biggest males in *C. alyciae* reach 123 mm (n = 124).

Coloration comparison. *C. rayko* n. sp., *C. peknyi*, and *C. alyciae* (Figure 7). Individuals of *Cherax rayko* n. sp. from the Bian River drainage basin in the Muting District usually have white to creamy and sometimes blueish-white chelae; the cephalon is blueish fading to creamy-white ventrolaterally. The rostral margins are usually orange. The thorax is usually orange to yellow, fading to a creamy-yellow ventrolaterally. The chelae are creamy with blue, becoming blueish-gray to the outer lateral margin. In some individuals the chelae can be bright blue or grayish-blue. The pleon is usually dark green or blackish-green with broad orange to yellowish stripes.

The coloration of *C. peknyi* is as follows. The chelae are red to orange, fading to pinkish-white anteriorly; the distal tip is blueish-gray. The legs (except for first pair) are greenish-gray with orange joints. The cephalic region is greenish-gray, fading to a yellowish-green laterally; the dorsal thoracic region is brown-orange, fading to yellow laterally and becoming cream ventrolaterally. The pleon is green with broad yellow bands. The telson is green, becoming yellow to orange mesolaterally. The distal margin of the tail fan is pale orange.

In *C. alyciae*, the chelae are light to dark blue with white margins and a white patch. The anterior part is usually dark blue, more intensely colored. The corneous tooth on the tip of the fingers is orange. The cephalothorax is bright blue, dorsally more intense from purple to greenish-blue, fading ventrally to light blue. The joints between the propodus and carpus and between the carpus and merus are bright orange-red. Segments of the pleon are dark blue to black; the lateral pleura is lighter, becoming blueish-green. There are light blue transverse bands in the posterior part of each pleonary somite. The walking legs are light blue with orange joints. The distal margin of the tail fan is creamy-orange to orange. Some animals are darker and differ in the coloration of the chelae. The chelae are dark blue to black, becoming orange-red at the outer lateral margin. The dorsolateral margins are light blue. These males usually also have orange or yellow rostral margins.

Chelae comparison (Figure 8A–F). In *C. rayko* n. sp., the movable finger is usually as long as the dorsolateral margin of the palm. No soft patch is present on the outer margin. In total, 23–24 mesial probodal granules are present at the dorsolateral margin. Dense, short setae are present on the ventral part of the fixed finger and palm. In *C. alyciae*, the movable finger is about one-third shorter than the dorsolateral margin of the palm. A soft patch at the outer margin of the palm is present in males. The dorsolateral margins of the palm are just slightly elevated, with a row of 12–15 rather weakly developed granules present. Scattered, short setae are present on the ventral part of the fixed finger and palm. In *C. peknyi*, the carpus with the mesiolateral part is slightly elevated to form a slender serrated ridge with row of 16–18 small, blunt spines. The movable finger is about one-third longer than the dorsolateral margin of the palm. Dense, long setae are present on the ventral part of the fixed finger and palm.

Rostrum comparison (Figure 9A–C). The rostrum of *C. rayko* n. sp. is broad at the base, and at about one-third of the length, it bends inwards. The rostrum of *C. alyciae* is rather straight and triangular-shaped, while the rostrum of *C. peknyi* is clearly bent outwards at the middle part.

Figure 7. Coloration comparison of *Cherax rayko* n. sp. with *C. peknyi* and *C. alyciae.* (**A**) *Cherax rayko* n. sp. from Muting. (**B**) *C. peknyi* from the type locality close to Kiunga, PNG. (**C**,**D**) *C. alyciae* from Boven Digoel Regency, West Papua, Indonesia.

C. rayko n. sp. has 4–5 small granules at the middle part behind the cervical groove on the lateral side of the carapace, while *C. peknyi* has 3–4 anteriorly directed spines present, and *C. alyciae* has six tiny and weakly developed tubercles there.

Cherax rayko n. sp. is found in the Bian River drainage basin in the Muting District in South Papua, Indonesia, while *C. peknyi* is known to be present in the Fly River floodplain and in the foothills of the mountains near the provincial capital of Kiunga, Western Province, Papua New Guinea. *C. alyciae* is found in creeks and rivers of the Digul River drainage basin in the eastern part of the Boven Digoel Regency, Papua, Indonesia (Figure 10).

Etymology. *Cherax rayko* n. sp. is named after Rayko Eloy Lukhaup, the son of the first author. Rayko was very present in the process of the description, providing love and understanding.

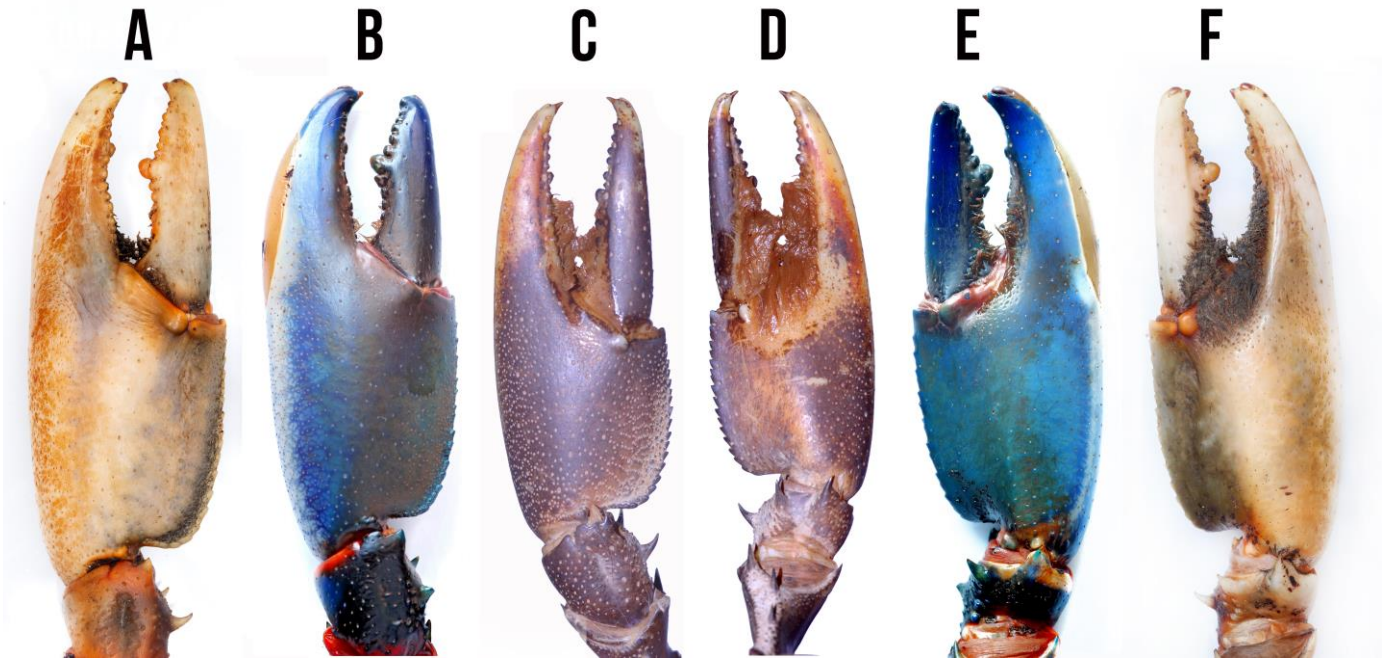

Figure 8. Chelae comparison of *C. rayko* n. sp. (**A**,**F**) with *C. peknyi* (**C**,**D**) and *C. alyciae* (**B**,**E**).

Ecology. It is endemic to the Bian River drainage basin and its tributaries. One of the creeks harboring these crayfish is shallow (20–100 cm) with a moderate flow. The temperature is around 25–26 °C. In most parts, no water plants are present. The substrate of the creek is silt or sand and soil mostly covered with silt and detritus. Crayfish hide in short burrows in the riverbank, under larger rocks, or in detritus that is present in all the parts of the creek. The creek is surrounded by forest. To improve the knowledge of the distribution of this species, more field surveys will be necessary.

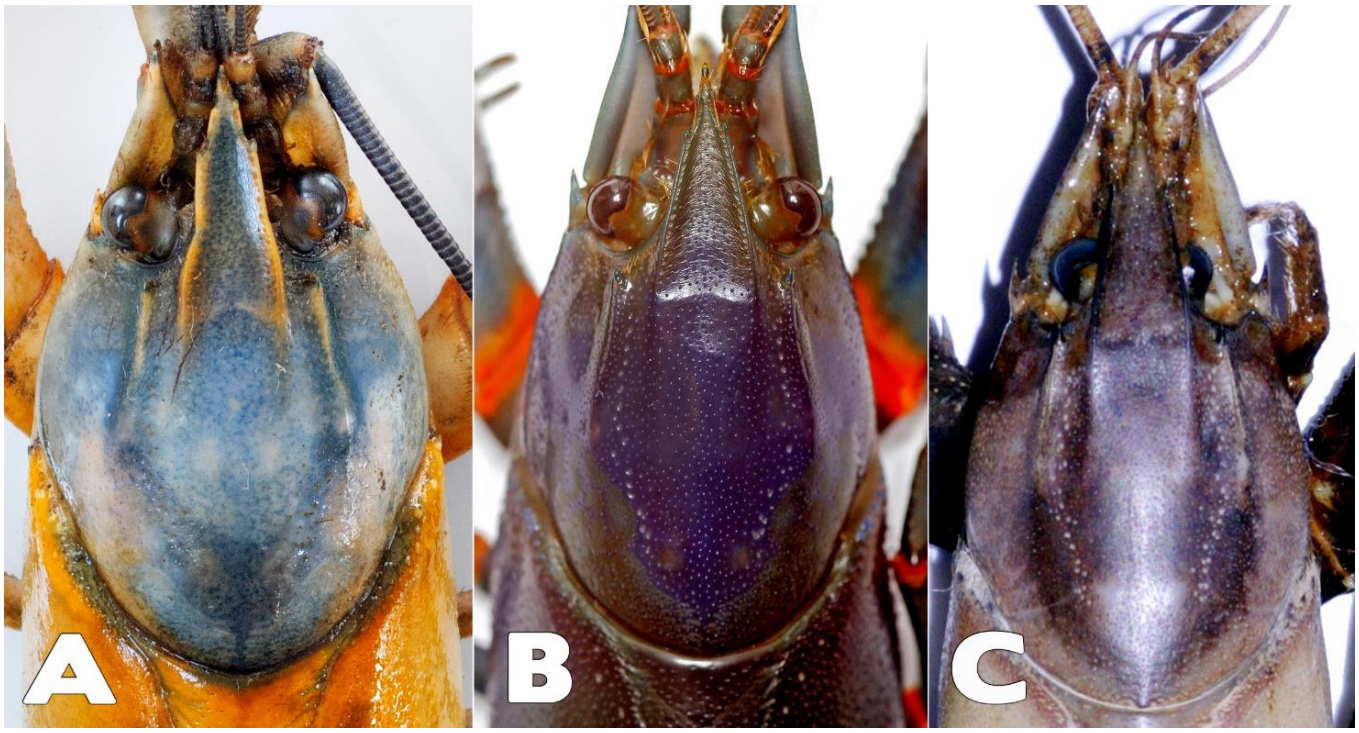

Figure 9. Rostrum comparison of *C. rayko* n. sp. (**A**) with *C. peknyi* (**C**) and *C. alyciae* (**B**).

Common name. As the common name for this crayfish, we propose the Tiger Crayfish, as it is already available under this name in the pet trade.

***Cherax phing* n. sp.**

Figures 11–14.

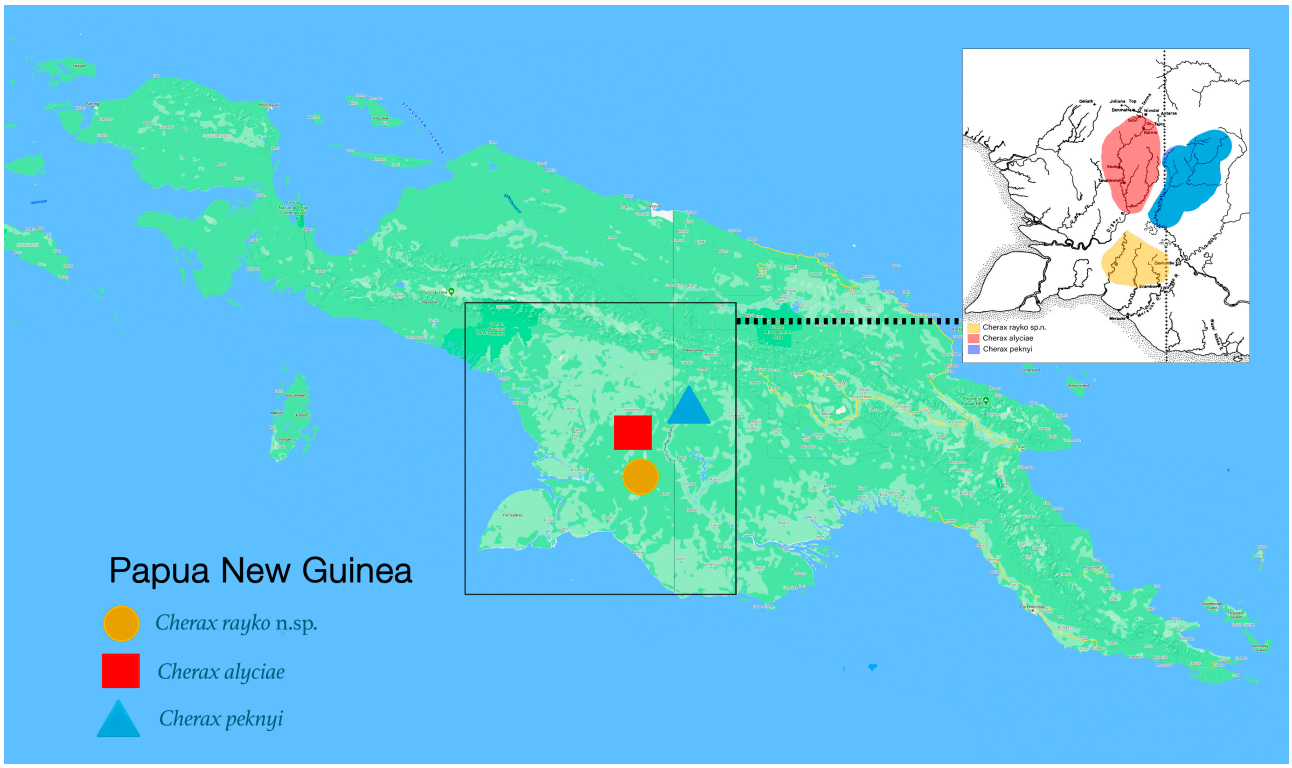

Figure 10. New Guinea with the distribution of *C. rayko* sp.nov, *C. alyciae*, and *C. peknyi*.

Material examined. Holotype: male (MZB Cru 5795), under rocks and among roots and in debris along banks of unnamed creek of the Kali Ombak River drainage basin, West Papua, Indonesia. Coll. Jumrah Sukawati, Ripa Maricel Nicolae, and local people. January, 2020. GPS (1°02′41.8″ S, 132°15′51.9″ E). Crayfish samples sent to us by KKCrayfish in Jakarta. Allotype: female (MZB Cru 5796), same data as holotype. Paratypes: six males, four females (MZB Cru 5797); four males, three females (ZMB 33781); same data as holotype.

Diagnosis. Carapace surface smooth; three bigger spines and one small posterior to cervical groove on lateral carapace present. Eyes large, pigmented. Eyestalk slightly narrower than cornea. Rostrum lance-shaped with elevated, thickened margins, non-setose. Rostral margins with three prominent teeth on one side and two on the other. Posterior extensions of the rostral margins prominent. Postorbital ridges prominent with one acute spine at anterior terminus. Uncalcified patch on lateral margin of chelae of adult male, white, translucent. Propodal cutting edge with very few short setae in posterior part and one larger tubercle. Chelae dark blue, becoming whitish pale to creamy in the lateral part. Fixed finger and dactyl with hooked dark orange tips anteriorly. Dorsolateral margins of chelae slightly elevated in posterior third, same color as chelae. Other walking legs blueish, becoming creamy-blue posteriorly. Carapace blueish to green-creamy, and pleon blue-greenish with horizontal creamy bands.

Figure 11. *Cherax phing* n. sp., holotype male (MZB Cru 5795). Scale bar: 10 mm.

Description of male holotype (Figures 11 and 12A–C). Body and eyes pigmented. Eyes not reduced, rather large; cornea globular, darkly pigmented, nearly as long as eyestalk; eyestalk slightly narrower than cornea. Body subovate, slightly compressed laterally. Pleon narrower than cephalothorax (width 25.7 mm and 28.6 mm, respectively). Rostrum (Figure 12C) broad in shape, reaching end of ultimate antennular peduncle and about two times as long as wide (width 6.8 mm at base, length 13.05 mm). Margins slightly elevated, continuing in rostral carinae on carapace, almost straight in basal part, distally tapering towards apex. Lateral rostral margin bearing three prominent teeth in distal half on one side and two on the other side, pointing upwards at angle of approximately 45°. A few scattered short hairs present between the distal teeth and the acumen. Acumen with anteriorly orientated spine.

Rostral carinae extending as slight elevation posteriorly on carapace terminating at ending of postorbital ridges. Postorbital ridges well developed, terminating in spiniform tubercle anteriorly, fading at half of occipital carapace length, posteriorly. Postorbital ridges about one-sixth of CL. Cervical and branchiocardiac grooves distinct, non-setose; three small spines and one small tubercle present. Carapace surface smooth; ventrolateral margins rounded, slightly elevated.

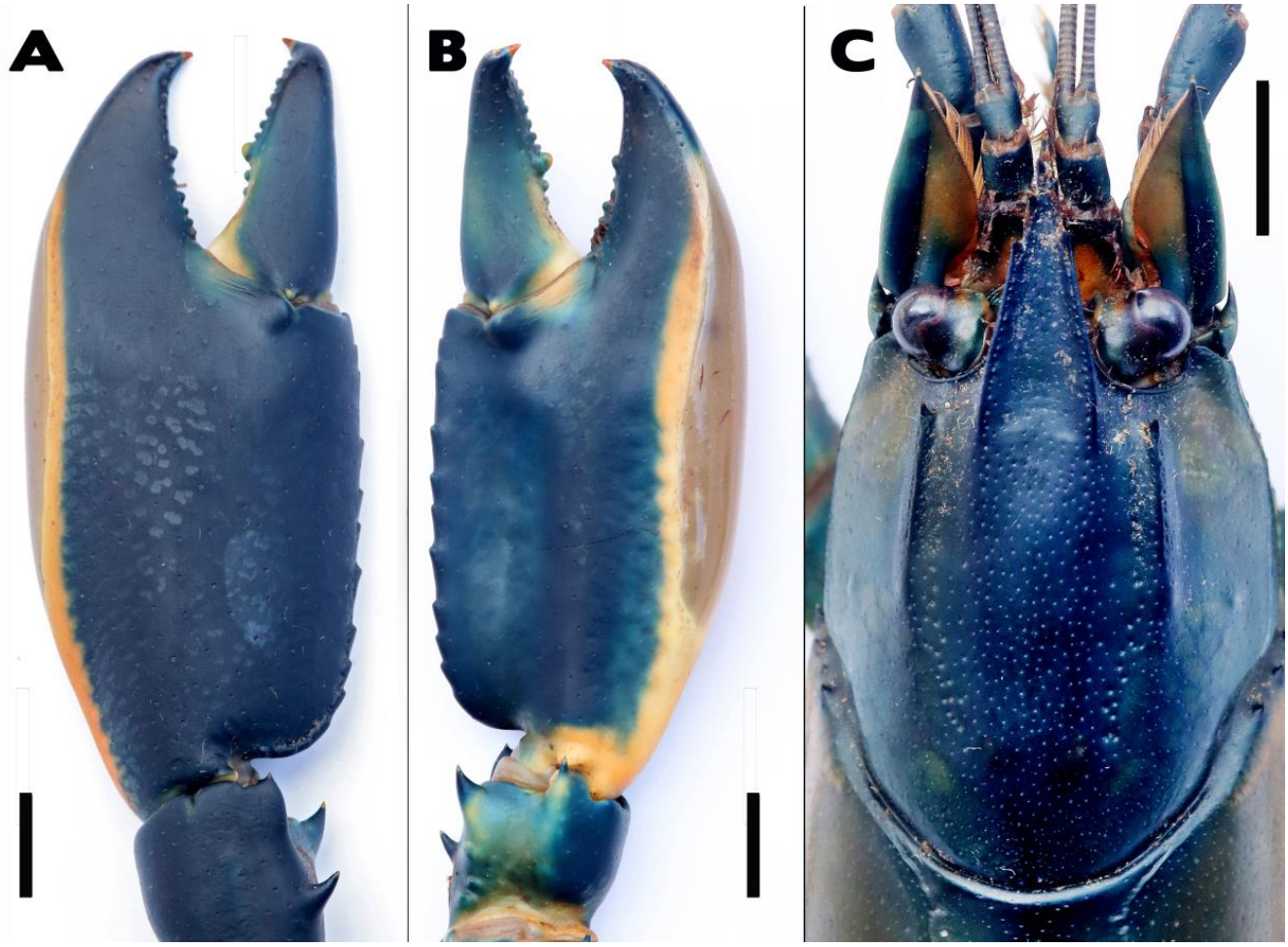

Figure 12. *Cherax phing* n. sp., holotype male (MZB Cru 5795). (**A**) Dorsal view of left chelae. (**B**) Ventral view of left chelae. (**C**) Dorsal view of carapace. Scale bar: 10 mm.

Areola length, 21.7 mm; narrowest width, 10.3 mm. Length of areola 34.3% of total length of carapace (63.1 mm). Sparsely pitted.

Scaphocerite broadest at posterior third, convex in distal part, becoming narrower in basal part; thickened lateral margin terminating in corneous spine, slightly overreaching ultimate segment of antennular peduncle. Right scaphocerite 15.0 mm long and 5.1 mm wide. Rounded inner margin strongly covered by setae. Antennulae and antennae typical for genus. Antennae slightly longer than body. Antennular peduncle slightly overreaching acumen; antennal peduncle slightly overreaching tip of apex of scaphocerite. Antennal protopodite smooth, no spine, with row of hairs on inner margin; basicerite with one lateral and one ventral spine.

Mouthparts typical for the genus. Epistome with subcordiform cephalic lobe anteriorly bearing lanceolate cephalomedian projection constricted at base. Lateral margins of lobe not thickened; each lateral margin with two groups of 10–12 tubercles separated by the smooth central part. Central part smooth, not pitted, excavate.

Figure 13. *Cherax phing* n. sp., allotype female (MZB Cru 5796). Scale bar: 10 mm.

Figure 14. *Cont.*

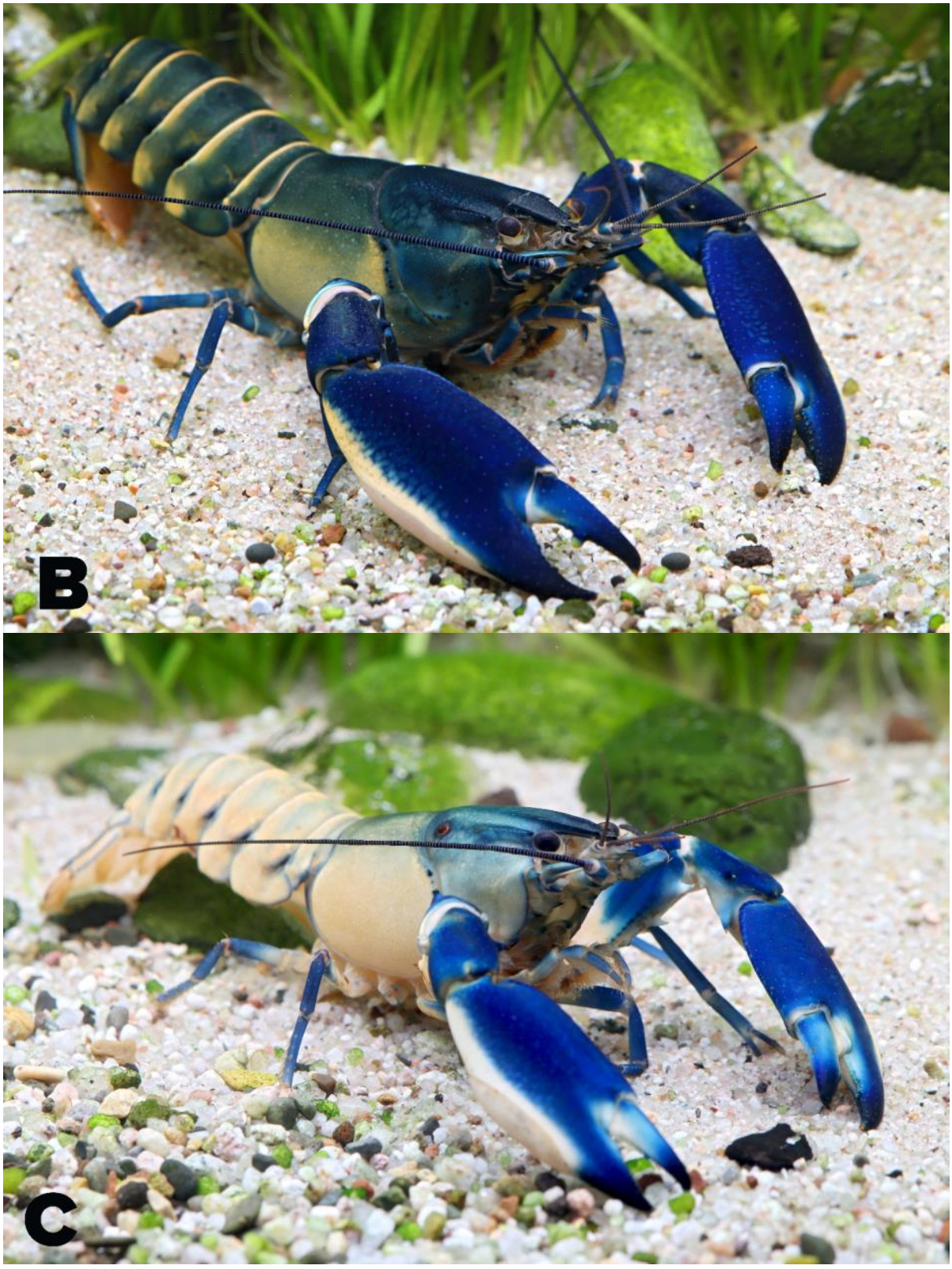

Figure 14. *Cherax phing* n. sp., Kali Ombak River drainage basin. (**A**) Paratype male (MZB Cru 5797). (**B**) Paratype male color variation. (**C**) Paratype male color variation.

First pereopods equal in form, chela gaping. Right chela 65.0 mm long, 12.7 mm high, and 26.5 mm wide. Left chelae (Figure 12A,B) 65.1 mm long and 13.1 mm high, 25.9 mm wide, strongly compressed. Fingers shorter than palm (right dactylus 21.5 mm long). Dactylus broad at base (11.6 mm), tapering slightly towards tip.

Tip with sharp, corneous, hooked tooth pointing outwards at an angle of about 45°. Cutting edge of dactyl with continuous row of 9–10 small granular teeth and 1 slightly larger tooth at middle of cutting edge. Ventral and dorsal surface of movable finger smooth with scattered punctuation. No setae present. Fixed finger smooth, scattered punctuation, triangular, merging gradually into palm, ending in sharp, corneous tip. Tips of fingers slightly cross when fingers clasp. Upper surface of palm practically smooth, slightly pitted, more densely pitted at margins. Fixed finger broader than dactyl at base (13.4 mm). Very few scattered short setae present in posterior ventral part of fixed finger, reaching from base to about one-third of fixed finger. Cutting edge of fixed finger with row of 4–5 rather small granular teeth at posterior half and 1 larger one at mid-length. Outer lateral margin of chelae with swollen soft and uncalcified patch (37.7 mm on the right chelae and 40.7 mm on the left chelae). Row of 9–10 mesial granules at dorsolateral margin. Dorsolateral margins elevated in the posterior third.

Dorsal surface of carpus (21.3 mm) smooth, with slight excavation in middle part and with a well-developed mesial carpal spine. Ventral carpal surface distal margins slightly elevated, non-setose and with fovea; proxilateral margin with well-developed ventral carpal spine and a prominent ventromesial carpal spine oriented at an angle of approximately 45°.

Merus (31.3 mm) laterally depressed in basal part; surface smooth; small dorsal meral spine present. Inner ventrolateral margin with 8–9 small granules; three ventral meral spines present, one at mid-length, other in middle of anterior part, and third on distal ventrolateral inner margin.

Ischium (17.0 mm) smooth with one to two small spines at ventrolateral inner margin.

Second pereopods reaching anteriorly to approximately corneus spine of scaphocerite. Finger (7.5 mm) slightly longer than palm (4.6 mm), of same depth. A few scattered short setae present on dactyl and fixed finger. Cutting edge of fixed finger and carpus with row of dense, short setae. Propodus, 15.3 mm. Carpus, 12.0 mm, smooth, slightly pitted, slightly longer than propodus. Merus (20.4 mm) 1.7 times longer than carpus. Ischium (10.0 mm) about half as long as merus.

Third pereopods overreaching second by length of finger of second pereopods. Fingers shorter than palm.

Fourth pereopods slightly overreaching distal margin of scaphocerite. Dactylus with corneous tip. Short scattered setae present. Propodus (13.0 mm) more than 3 times as long as dactylus (4.0 mm), 1.6 times as long as carpus (8.0 mm); somewhat flattened, with many stiff setae on lower margin. Merus just slightly longer than propodus.

Fifth pereopods similar to fourth, slightly shorter.

Dorsal surface of pleon smooth, with scattered pits; abdominal segments (3–5) with short setae present on caudal margins of segment.

Telson with posterolateral spines; dense short setae present in posterior third. Posterior margins setose. Uropodal protopod with two distal spines on mesial lobe. Exopod of uropod with transverse row of posteriorly directed diminutive spines ending in one more prominent spine, posteriorly directed on outer margin of mesial lobe. Terminal half of exopod with small spines and short hairs, slightly corrugated. Endopod of uropod smooth. Short, scattered hairs present on posterior third of dorsal exopod. Posterolateral spine on outer margin present. Second spine on medial dorsal surface present, directed posteriorly.

Description of female allotype (Figure 13). Chela of first pereopods equal, 2.7 times as long as broad (30.0 mm and 10.9 mm, respectively). No soft patch in distal lateral margin of the chelae of females observed (n = 18). Mesial margin of palm slightly elevated, forming slender serrated ridge with row of 7–8 small granular teeth. Cutting edge of dactylus with 7–8 rather small granular teeth. Cutting edge of fixed finger with 10–11 small granules. Small scattered short setae visible along ventral cutting edges of chelae, denser and longer in ventral posterior area. Tips of fingers slightly cross when fingers clasp, not gaping. Cervical groove distinct, non-setose. Pleon just slightly wider than cephalothorax (widths 19.3 mm and 18.3 mm, respectively). Same color pattern as in males.

Size. The biggest male examined is the paratype with a carapace length of 75.5 mm and a total length of 160 mm; the holotype male has a total length of 136.4 mm, and the other animals have a total length of between 78.5 mm and 139.5 mm; the allotype has a carapace length of 42.6 mm and a total length of 94.0 mm (n = 18).

Color. The living animals (Figure 14A–C) are colored as follows. Chelae dark blue, becoming whitish pale to creamy in the lateral part. Fixed finger and dactyl with hooked dark orange tips anteriorly. Soft patch creamy-whitish. Dorsolateral margins of chelae slightly elevated in the posterior third, same color as chelae. Other walking legs blueish, becoming creamy-blue posteriorly. Carapace blueish to green-creamy, and pleon blue-greenish with horizontal creamy bands. Distal margin of tail fan brownish-red to orange. Females: same color as males, sometimes less intense. Some individuals show less blue-green on the carapax and pleon and are more creamy colored.

Molecular phylogenetic results. *C. phing* n. sp. is part of a weakly supported clade also comprising *C. gherardii*, *C. woworae*, *C. boesemani*, *C. pulcher*, and *C. wagenknechtae* (Figure 6). This clade is a sister group to a highly supported clade comprising *C. warsamsonicus*, *C. mosessalossa*, and a probably undescribed species of *Cherax*. *C. phing* n. sp. is well isolated from its closest relatives with a sequence divergence (*p*-distance) of 3.2% (*C. gherardii*), 2.2–2.4% (*C. woworae*), 3.9% (*C. boesemani*), 4.7% (*C. pulcher*), and 4.7% (*C. wagenknechtae*), supporting the morphology-based description of *C. phing* n. sp. as a new species.

Systematic position. *C. phing* sp. n. belongs to the northern species group lineage, now consisting of 28 species (please see the respective section for *C. rayko* n. sp. above for details).

Systematic Remarks

In comparison to all species of the northern group, the new species, *C. phing* n. sp., is most similar to the crayfish of the *C. boesemani* group including *C. boesemani*, *C. pulcher*, *C. wagenknechtae*, *C. gheradiae*, *C. woworae*, and two undescribed species in this group. *C. boesemani* is a species that is known from the Ajamaru Lake and surrounding creeks. *C. wagenknechtae* is known to be endemic to the drainage basins of the Beraur and Klasabun Rivers in the Western part of the Kepala Burung (Vogelkop) Peninsula, while *C. pulcher* is found in Hoa Creek and some other nameless creeks in and around Teminabuan. *C. gherardiae* Patoka et al. (2015) [6] is described as endemic to the Ajamaru Lake but we cannot confirm this information. In our expedition in 2010, we found this species in creeks on the road between Ajamaru and Teminabuan. No animals of this species were found in Ajamaru Lake at the time of our expedition, and the locals did not identify it from the lake either. As far as we know, the catchers deliberately spread false information to protect the fishing grounds, as the crayfish are sold to the pet trade. *C. woworae* was described from creeks close to the city of Teminabuan. In our expedition, we found it more south of the city of Teminabuan. In Teminabuan, just *C. pulcher* is present. *Cherax phing* n. sp. may be easily distinguished from the crayfish of the *Cherax boesemani* group by the coloration and pattern of live individuals, the shape of the chelae, the shape of rostrum, and using sequence divergence.

C. phing n. sp. differs from *C. boesemani* in the following characters: the shape of the chelae (Figure 15) and the coloration (Figure 16). While *C. phing* n. sp. has dark blue chelae, a blueish to green-creamy carapax, and a blue-greenish pleon with horizontal creamy bands, *C. boesemani* is usually purple-reddish with some black, sometimes blueish-orange, blue, or purplish-blue. In general, *C. boesemani* can vary in coloration depending on what river in the Ajamaru area they originate from. The palm is about 3 times longer than the dactyl in *C. phing* n. sp., while the palm in *C. boesemani* is about 3.5 longer than the dactyl. There is a row of 8–10 mesial granules at the dorsolateral margin of the chelae in *C. phing* n. sp., while there are 13–15 in *C. boesemani*. The dorsolateral margins are elevated in the posterior third in *C. phing* n. sp., while in *C. boesemani*, they are elevated in the posterior half. Three small spines and one small tubercle are present in the cervical groove in *C. phing* n. sp., while there are usually 0–2 spines present in *C. boesemani.*

Figure 15. Chelae comparison. (**A**) *C. phing* n. sp. from Kali Ombak drainage basin. (**B**) *C. boesemani* from Ajamaru Lake. (**C**) *C. wagenknechtae* from Beraur River drainage basin. (**D**) *C. pulcher* from Hoa Creek in Teminabuan. (**E**) *C. woworae.* (**F**) *C. gherardii*.

C. phing n. sp. differs from *C. wagenknechtae* in the shape of the chelae (Figure 15), the shape of the rostrum (Figure 17), and the coloration (Figure 16). While *C. phing* n. sp. has dark blue chelae, a blueish to green-creamy carapace, and a blue-greenish pleon with horizontal creamy bands, *C. boesemani* is usually purple-reddish with some black, sometimes blueish-orange, blue, or purplish-blue. *C. wagenknechtae* males from the Klasabun River drainage basin have light to dark red chelae with pink or creamy dorsolateral margins and a white patch. The anterior part is usually dark blue or black, more intensely colored. The corneous tooth on the tip of the fingers is orange. The cephalothorax is bright red to dark red to black, dorsally more intense, fading ventrally to light red or creamy. Segments of the pleon are dark red to bright red; the lateral pleura is lighter, becoming creamy-red. The walking legs are blue or gray-blue. The distal margin of the tail fan is brownish-red to orange. Animals from the village of Klamono (Beraur River drainage basin) differ in the coloration of the chelae. The chelae are dark blue to black, sometimes creamy-blue. The dorsolateral margins are light, creamy. These males usually also have orange or yellow rostral margins. The dorsolateral margins of the chelae are elevated in the posterior third in *C. phing* n. sp., while they are elevated in three-quarters of *C. wagenknechtae.* The granules of the dorsolateral margins of the chelae are very prominent in *C. wagenknechtae*, while in *C. phing* n. sp., they are smaller. Usually, 12–13 are present in *C. wagenknechtae*, while 8–10 are present in *C. phing* n. sp. The rostrum of *C. wagenknechtae* is clearly bent outwards at the base, while it is more straight in *C. phing* n. sp. The spines on the rostrum are more prominent in *C. wagenknechtae*.

Cherax phing n. sp. differs from *C. pulcher* in the shape of the chelae, the shape of the rostrum, and the coloration (Figures 15–17).

The dorsolateral margins of the chelae are elevated in the posterior third in *C. phing* n. sp., while they are elevated in three-quarters of *C. pulcher.* The granules of the dorsolateral margins of the chelae are prominent in *C. wagenknechtae*, while in *C. phing* n. sp., they are smaller; usually, 10–12 are present in *C. wagenknechtae*, while 8–10 are present in *C. phing* n. sp. The rostrum of *C. wagenknechtae* clearly reaches or overreaches the end of the ultimate antennular peduncle, while in *C. phing* n. sp., it reaches about the end of the first antennular peduncle.

The coloration of *C. pulcher* is as follows. The chelae are light blue to dark blue, becoming white on the outer lateral margins. The elevated dorsolateral margins are blue. The anterior part of the cephalothorax is pinkish to strikingly pink, fading laterally to a greenish-gray. The dorsal pleon is dark blue to black, becoming pinkish-gray and pinkish at the margins. Older individuals are usually darker blue in coloration. As the distribution area of *Cherax pulcher* is very restricted, not many color variations of this species are known.

Cherax phing n. sp. differs from *Cherax gherardii* in the shape of the rostrum, the shape of the chelae, and the coloration (Figures 15–17). The rostrum is 3.6 times as long as broad in *C. gherardii* versus 1.7–2.1 times in *C. phing* n. sp. The first chelae are 2.6–3.4 times as long as broad in *C. gherardii* versus 2.3–2.7 times as long as broad in *C. phing* n. sp. The coloration of *C. gherardii* is dark brown, marbled on the sides of the carapace with pale brown spots. The cervical groove and the distal end of the carapace are orange. The pleon has a prominent orange spot on both lateral sides on each pleomere. The soft distal part of the caudal fan is orange. The chelipeds are blue with orange joints; the palm of the propodus is blue in the basal part and pale in the distal part. The fingers are orange; the distal third is black with orange tips.

C. phing n. sp. differs from *C. woworae* in the shape of the rostrum, the shape of the chelae, and the coloration (Figures 15–17). The rostrum is 2.0–2.5 times as long as broad in *C. woworae* versus 1.7–2.1 times in *C. phing* n. sp. The first chelae are 2.1–2.5 times as long as broad in *C. woworae* versus 2.3–2.7 times as long as broad in *C. phing* n. sp. The background color is steel blue, marbled on the carapace sides with numerous tiny pale spots. The soft distal part of the caudal tail fan is orange. The chelipeds are steel blue with pale joints. The palm of the chelae is steel blue.

Etymology. *C. phing* n. sp. is named in honor of Liauw Pauw Phing, a crayfish enthusiast, for his noteworthy contribution to the knowledge of the crayfish of Papua.

His continuing effort to search and find unknown species is very needed work for our better understanding of the crayfish of this region.

Ecology. *C. phing* n. sp. is endemic to the Kali Ombak River drainage basin in the western part of the Kepala Burung (Vogelkop) Peninsula, Southwest Papua, Indonesia (Figure 18). One of the creeks harboring these crayfish is clear and shallow (0.2–1 m) with a fast to moderate flow and has a pH of approximately 5.5. The temperature is around 23–24 °C. In most parts, no water plants are present. The substrate of the creek is rocky or sandy, with some parts covered with silt and detritus (Figure 19). Crayfish hide in short burrows in the riverbank, under larger rocks, or in detritus that is present in all the parts of the creek. Big males have been observed as active during the day. In some villages, these crayfish are harvested for food by locals, but it seems that, even if they are collected for the pet trade and in some villages for human consumption, the population is stable. The creek is surrounded by dense forest. To improve the knowledge of the distribution of this species, more field surveys will be necessary.

Common name. As a common name for this crayfish, we propose the Green Hornet Crayfish, as it is already available under this name in the pet trade.

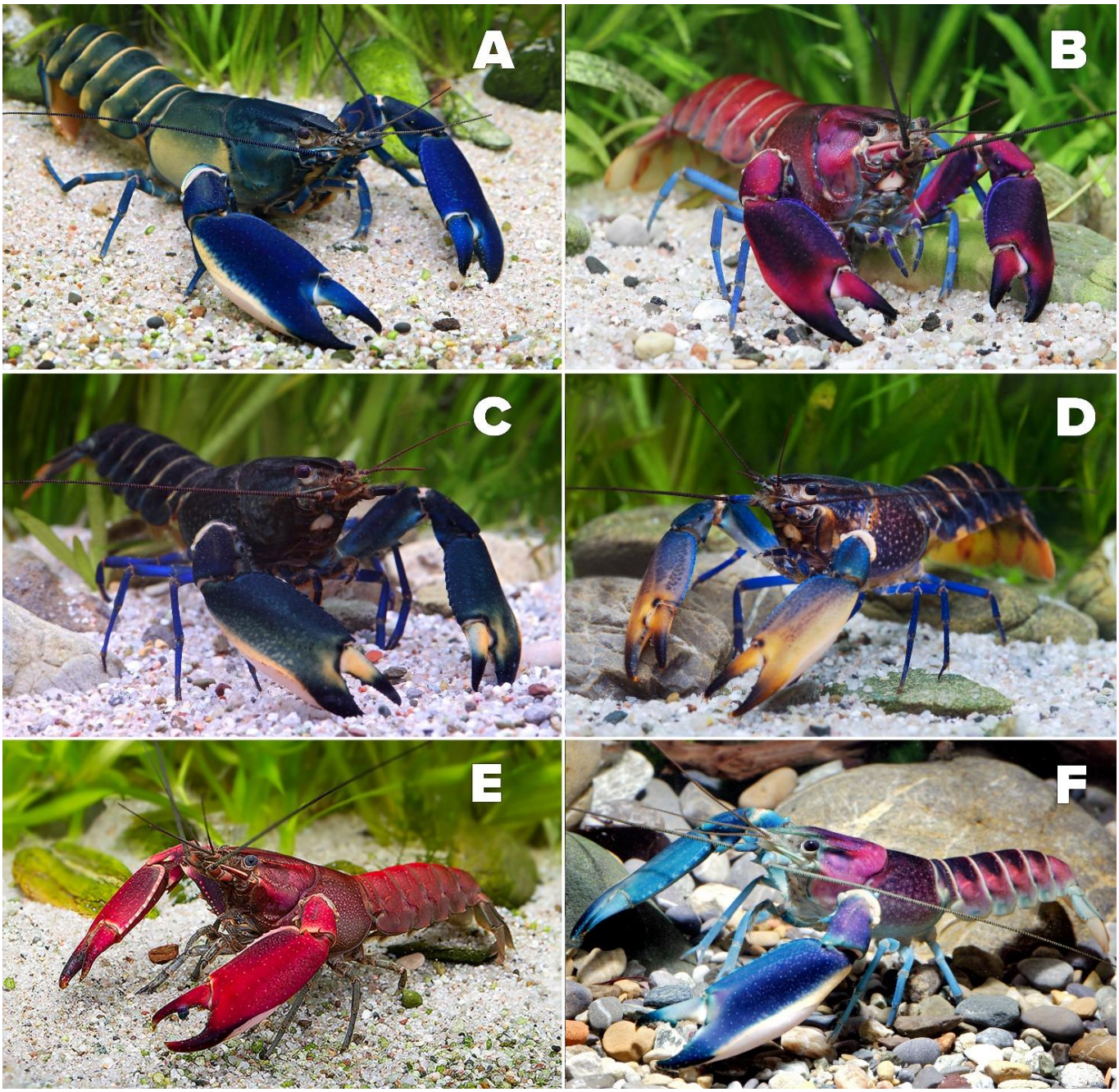

Figure 16. Coloration comparison. (**A**) *C. phing* n. sp. with (**B**) *C. boesemani* from Ajamaru Lake, (**C**) *C. woworae*, (**D**) *C. gherardii*, (**E**) *C. wagenknechtae* from Beraur River drainage basin, and (**F**) *C. pulcher* from Hoa Creek in Teminabuan.

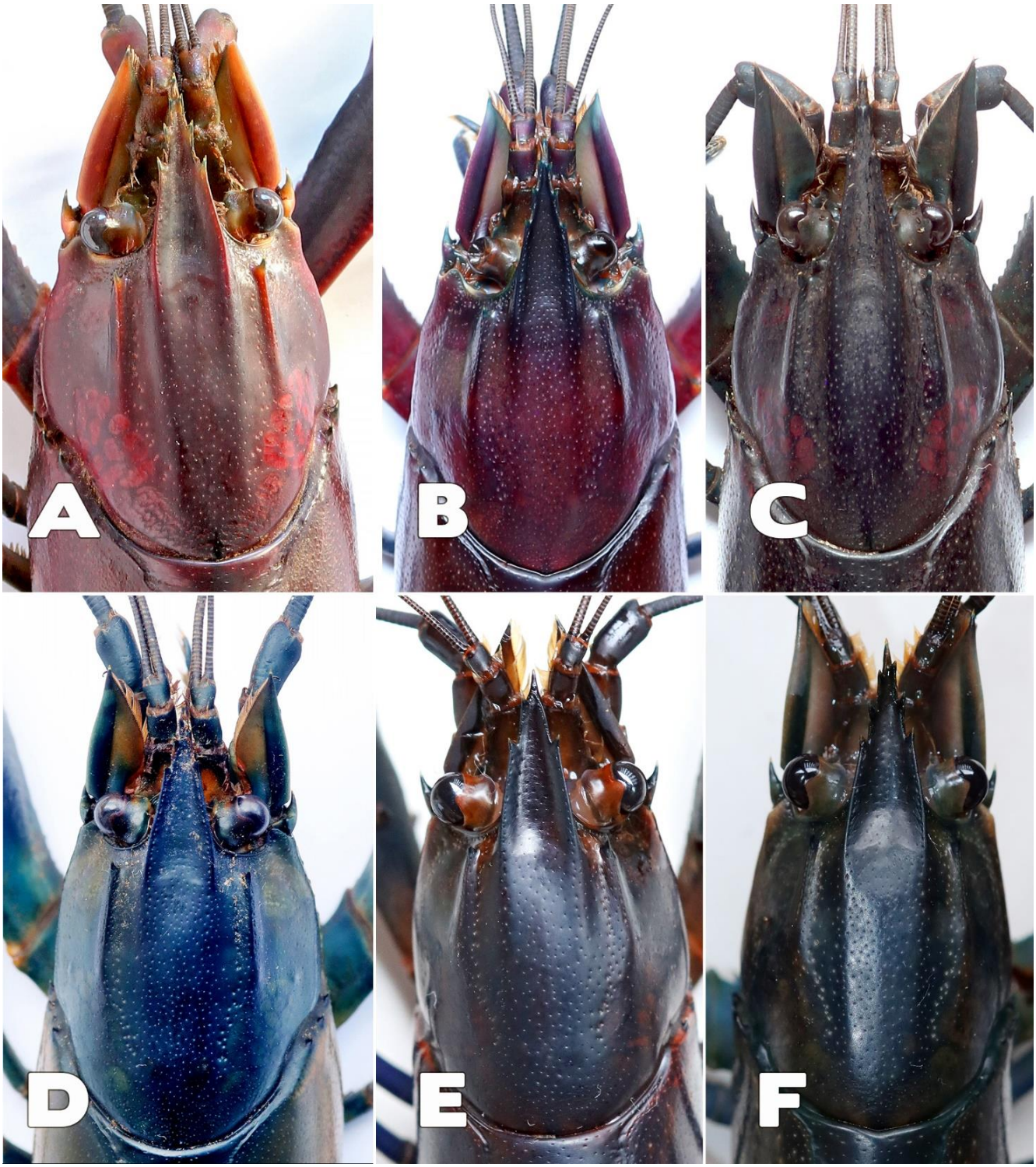

Figure 17. Rostrum comparison. (**A**) *C. wagenknechtae* from Beraur River drainage basin. (**B**) *C. boesemani* from Ajamaru Lake. (**C**) *C. pulcher* from Hoa Creek in Teminabuan. (**D**) *C. phing* n. sp. from Kali Ombak drainage basin. (**E**) *C. gherardii*. (**F**) *C. woworae*.

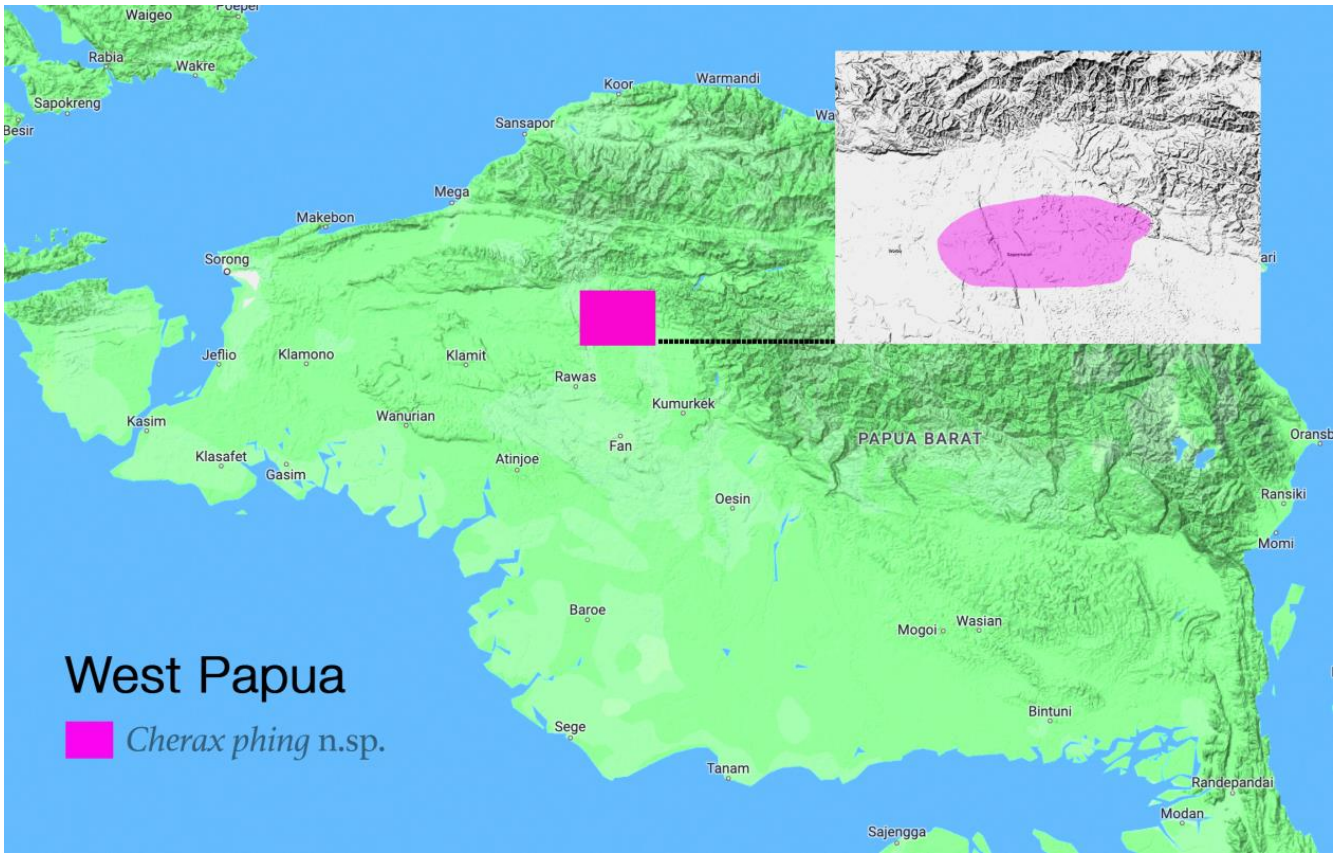

Figure 18. The Bird's Head Peninsula, West Papua, Indonesia, with the Kali Ombak River drainage basin, the type locality of *C. phing* n. sp.

Figure 19. Kali Ombak River, habitat of *C. phing* n. sp.

Author Contributions: Conceptualization, C.L.; methodology, C.L. and T.v.R.; data analysis, C.L., R.E. and T.v.R., writing—original draft preparation, C.L.; writing—review and editing, C.L., R.E. and T.v.R.; visualization, C.L. and T.v.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The new sequences have been made available in GenBank, other data are available upon request from the first author.

Acknowledgments: Aquarium Dietzenbach is thanked for bringing *C. rayko* n. sp. to our attention and helping to import the species. We are grateful to Irianto Wahid and Liauw Pauw Phing for helping us to obtain the species and for information about the species location. Heiko Bleher is thanked for bringing *C. phing* n. sp. to our attention. Liauw Pauw Phing is thanked for helping to collect the species and for sending it to us. We would like to thank Aquarium Dietzenbach for helping to obtain the species. Daisy Wowor is thanked for her cooperation.

Conflicts of Interest: The authors declare no conflict of interest.

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