A New Kelp Crab Species of the Genus Pugettia
(Crustacea: Decapoda: Brachyura: Epialtidae) from Shandong Peninsula, Northeast China

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A new kelp crab species of the genus Pugettia Dana, 1851 from Shandong Peninsula, north China is described and illustrated. Pugettia longipes n. sp. resembles P. ferox Ohtsuchi and Kawamura, 2019 and P. quadridens (De Haan, 1837), but can be distinguished by many morphological and morphometric characters. These include the shape of the basal antennal article, shorter cheliped merus, longer ambulatory legs (first legs longer than chelipeds in merus length), the structure of male first gonopod, and the different ontogenetic patterns of changes in the male chelae. A taxonomic key to all the upper subtidal species of Pugettia distributed in East Asian waters and P. longipes n. sp. is also provided.

Key Words: kelp crab, Pugettia, new species, Northeast China, ontogenetic stages, taxonomy.

Introduction

The spider crab genus Pugettia Dana, 1851 (Family Epialtidae MacLeay, 1838) includes 21 species from both the east and west coasts of the North Pacific and the Tasman Seamounts (Ng et al. 2008; Wicksten and Stachowicz 2013; Ohtsuchi et al. 2014; Lee et al. 2017; Ohtsuchi and Kawamura 2019). In East Asian waters, this genus is represented by 12 species (Griffin and Tranter 1986; Komatsu 2011; Ohtsuchi et al. 2014; Ohtsuchi and Kawamura 2019).

Recently, a taxonomic revision of P. quadridens (De Haan, 1837) and P. intermedia Sakai, 1938 by the first author resulted in P. ferox Ohtsuchi and Kawamura, 2019 being found. The authors also revisited many previous studies in the East Asian waters, and clarified the historical confusion regarding P. quadridens not only in relation to congeners, but also to various species of different majoid genera (Ohtsuchi and Kawamura 2019).

In Chinese waters, Pugettia is represented by five species: P. ferox, P. incisa (De Haan, 1837), P. intermedia, P. marisinica Takeda and Miyake, 1972, and P. quadridens (Griffin and Tranter 1986; Ohtsuchi and Kawamura 2019). Our re-examination of the Pugettia specimens preserved in the Institute of Oceanography, Chinese Academy of Science, Qingdao (IOCAS) resulted in the finding of another Pugettia species, which cannot be identified with any known species of this genus. In this paper, we describe and illustrate this species as a new species, and provide a taxonomic key to all the shallow water Pugettia species distributed in East Asian waters.

Materials and Methods

The newly examined specimens in this study are deposited in the IOCAS. The morphological terms and abbreviations essentially follow Davie et al. (2015) and Ohtsuchi and Kawamura (2019): CW, maximum carapace width excluding epibranchial spines; ChH, maximum chela height; ChL, maximum chela length (along lower margin); PCL, maximum carapace length excluding pseudorostral spines; HpL/PoL, hepatic lobe length/postorbital lobe length ratio; PRL, pseudorostral spine length; PW3, PW6, pleon width at proximal margin of pleomeres 3, 6, respectively. Other abbreviations used in the text: P1–5, the first to fifth pereiopods (the cheliped and the first to fourth ambulatory legs), respectively; G1 and G2, the first and second gonopods, respectively. The terms used to identify the growth phase of each specimen follows the concept of “ontogenetic stages” (cf. Ohtsuchi and Kawamura 2019).

All the measurements were made by referring to Ohts-
chi and Kawamura (2019), using digital vernier calipers to 0.1 mm, and are given as mean with standard deviation. All the statistical analyses were performed using R version 3.5.1. (R Core Team 2018) to test both intra- and interspecific morphometric differences.

For comparative purposes, the following specimens deposited in the National Museum of Nature and Science, Tokyo (NSMT), Natural History Museum and Institute, Chiba (CBM), and Ryukyu University Museum, Fujukan (RUMF), and University of the Ryukyus were examined.

Pugettia quadridens: 1 male (PCL 18.3×CW 14.1 mm), 1 ovigerous female (17.0×13.3 mm) (CBM-ZC 14873), turfs of Gelidium elegans Kützing 1868, near low tidal mark, Oarai, the Kashima Sea, 8 May 2012, hand, coll. N. Ohtsuchi and S. Houki; 2 males (18.9×15.0, 19.6×15.0 mm), 2 ovigerous females (17.4×13.5, 18.0×15.3 mm), 1 female with a rhizocephalan parasite (17.6×13.6 mm) (CBM-ZC 14874), 1 male (19.4×15.1 mm), 1 ovigerous female (21.0×16.6 mm) (NSMT-Cr 26063), Ahnfeltia paradoxa turfs, intertidal, Inubosaki, Chiba, 9 May 2012, hand, coll.
Pugettia ferox Ohtsuchi and Kawamura, 2019: Holotype, male (40.0×32.1 mm) (NSMT-Cr 26069), 2–4 m, Akahama, Otsuchi Bay, Iwate, 14 February 2017, SCUBA+hand, coll. K. Nakamoto; allotype, female (27.9×22.6 mm) (NSMT-Cr 26070), boulder zone, 5 m, off Horai-jima Islet, Otsuchi Bay, 27 February 2013, SCUBA+hand, coll. K. Fukuda; paratype, 1 male (30.7×26.3 mm) (NSMT-Cr 26071), boulder zones, 5 m, Akahama, Otsuchi Bay, Iwate, 24 January 2017, SCUBA+hand, coll. K. Nakamoto; paratypes, 3 males (22.8×18.3–39.3×33.9 mm) (NSMT-Cr 26073), 2 m, Akkeshi Bay, Hokkaido, 1 September 2012, baited trap, coll. S. Houki and K. Fukuda; 3 males (17.9×13.9–32.0×25.9 mm), 1 female (28.4×23.7 mm) (RUMF-ZC 4981), off Aikappu, Akkeshi Bay, Hokkaido, 9 September 2015, epibenthic sled, coll. T. Yorisue, S. Hamano, H. Katsuragawa and R. Yoshida; 3 males (22.1±17.8–25.5×1.5 mm), 1 female (19.9×16.0 mm), 1 ovigerous female (19.1×15.6 mm) (CBM-ZC 14881), 5 m, boulder zone, Tomarihama, the Oshika Peninsula, 9 July 2011, SCUBA, coll. T. Kawamura and N.-I. Won; 1 female (10.1×7.2 mm), 4 ovigerous females (16.7×12.7–21.0×17.8 mm) (RUMF-ZC 4977), red algal turfs, 4–5 m, same locality, 24 August 2011, SCUBA+air-lifting sampler, coll. N. Ohtsuchi; 7 males (12.5×9.1–23.6×19.3 mm) (NSMT-Cr 26075), near low tidal mark, Nagasaki, Iwaki, Fukushima, 2 February 2017, hand, coll. N. Ohtsuchi; 4 males (10.1×7.4–15.8×12.1 mm) (MBM 160513), Kongtong Island, Yantai, Shandong, North China, 7 April 1951; 1 ovigerous female (18.0×14.2 mm) (MBM 160494), Yantai, 1 July 1957, coll. Yang Jing; 1 female (20.2×15.3 mm) (MBM 160497), Xisha-wang, Yantai, 22 March 1975; 1 male (23.2×18.5 mm) (MBM 160514), locality not recorded (but probably from North China), 12 February 1960; 1 male (20.3×15.5 mm), 1 female (20.4×18.8 mm) (MBM 160515), Changxing Island, 6 October 1956, coll. Fangzeng Sun.

Fig. 2. Pugettia longipes n. sp. Carapace, right lateral view. A, holotype, male (MBM 188862), 17.3×13.0 mm, Shandong, Northeast China; B, allotype, female (MBM 188863), 15.1×10.7 mm, same locality.
Taxonomy

Family **Epialtidae** MacLeay, 1838

[Japanese name: Mogani-ka]

Genus **Pugettia** Dana, 1851

[Japanese name: Mogani-zoku]

**Pugettia longipes** n. sp.

[New Japanese name: Ashi-naga-yotsuha-mogani]

(Figs 1, 2, 3A, 4–6, 7A–C, 8A–C, 9A–B, 10, 11)

**Pugettia quadridens** (non De Haan, 1837): Shen 1937: 287–289, text fig. 5b, c, e, h.

Materials examined. Holotype: male (17.6×12.9 mm) (MBM 188862), Kong tong Island, Yantai, Shandong, North China, 7 April 1951. Allotype: female (15.1×10.7 mm) (MBM 188863), same locality and date as holotype. Paratypes: 3 males (12.9×9.3–14.1×10.2 mm) (MBM 188864), 2 females (13.3×10.3, 18.3×13.7 mm) 2 ovigerous females (11.9×8.2, 13.7×10.5 mm) (MBM 188866), same locality and date as holotype.

Non-type: 1 male (13.6×9.3 mm) (MBM 188867), same data as holotype.

Description. Male. Full-grown specimens (PCL 12.9–17.6 mm, n=3). Carapace (Fig. 1A) pyriform, 1.4 longer than width (mean PCL/CW±SD=1.4±0.0); surface smooth to naked eyes but closely covered with microscopic, apically flattened setae; gastric, cardiac, branchial, intestinal regions unclearly separated from each other. Gastric region (Fig. 2A) moderately elevated, sometimes anteriorly with short, oblique row of hooked setae on either side of midline (Figs 1A, 2A; mostly abraded in holotype); mesogastric, metagastric, both protogastric regions each with rudimentary protuberance (protogastric ones much closer to mesogastric one than to metagastric one) (Fig. 1A). Cardiac, branchial regions (Figs 1A, 2A) moderately elevated; mesobranchial region weakly elevated, never higher than gastric region (Fig. 2A), with two rudimentally tubercles apically (lateral one larger than mesial one); metabranchial region faintly elevated, with low protuberance medially. Intestinal region (Figs 1A, 2A) moderately elevated, separated from cardiac region, with large, low protuberance apically.

Pseudorostrum widely divergent with angles of 45–60°. Pseudorostral spine (Figs 1, 2A, 3A) 0.3 as long as PCL (PRL/PCL=0.3 in holotype; mean PRL/PCL±SD=0.3±0.0), each with two rows of dense, hooked setae on proximal half dorsally, with single row of simple, long setae on proximal half mesially; lateral margins divergent. Front (Figs 1, 3A) with median, longitudinal groove on dorsal surface. Preorbital spine (Figs 1A, 2A, 4A) triangular, compressed dorsoventrally, directed anterolaterally, acuminate at tip. Supraorbital groove (Figs 1A, 4A) elevated distolaterally, distinct from pseudorostral frontal, gastric regions (Figs 1A, 3A), lateral margin sinuous (or indistinctly truncated subproximally). Eyes (Figs 3, 4) large, eyestalk less than half of lateral margin in width (Fig. 4). Orbital hiatus

![Fig. 3. Comparison of frontal view of carapace. A, Pugettia longipes n. sp., holotype, male (MBM 188862), 17.3×13.0 mm, Shandong, Northeast China; B, P. ferox Ohtsuchi and Kawamura, 2019, paratype, male (NSMT-Cr 26071), 30.7×26.3 mm, Akkeshi, Hokkaido; C, P. quadridens (De Haan, 1837), male (NSMT-Cr 26059), 27.3×22.4 mm, Miura Peninsula, Sagami Bay.](image)

![Fig. 4. Pugettia longipes n. sp. holotype, male (MBM 188862), 17.3×13.0 mm, Shandong, Northeast China. A, B, anterior part of carapace, in dorsal (A) and ventral view (B).](image)
A new Pugettia species from Northeast China (Figs 1A, 4A) deep, round concavity. Postorbital lobe (Figs 1A, 4A) large, broad triangular, compressed dorsoventrally, directed anteriorly, slightly incurved distally, acute apically, shorter than preorbital spine, without depression basally (Fig. 2A). Hepatic lobe (Figs 1, 4) broad, triangular, compressed dorsoventrally, 2.3–3.0 times longer than postorbital lobe (HPL/PCL = 3.0 in holotype; mean HPL/POL ± SD = 2.6 ± 0.3), directed anterolaterally, acuminate at tip, separated from postorbital lobe by shallow, lateral concavity; posterior margin slightly concave; slope line from gastric region to hepatic lobe tip nearly straight (Fig. 3A). Anterolateral carapace margin (Figs 1A, 2A) with small patch of rows of hooked setae; lateral surface inferior to anterolateral margin with rudimentary tubercle. Epibranchial spine (Fig. 1A) slightly longer than, or as long as postorbital lobe, distinctly shorter than hepatic lobe, directed anterolaterally, slightly incurved, obtuse at tip, positioned at posterior 0.4 of postorostral carapace length (ESL/PCL = 0.4 in holotype; mean ESL/PCL ± SD = 0.4 ± 0.0), confluent to posterolateral carapace margin at base. Posterolateral carapace margin (Fig. 1A) faintly convex. Posterior carapace margin (Fig. 1A) weakly projected, rounded.

Subhepatic region (Figs 1B, 2A) without sparse, hooked setae. Pterygostomial region not prominently inflated, with four papilliform tubercles along pleural suture. Anterolateral angle of buccal frame (Fig. 2A) subrectangular, produced anteriorly, not overlapped by anterolateral angle of third maxilliped merus when closed.

Basal antennal article (Fig. 4B) smooth on surface, bearing low, blunt longitudinal ridge mesial to midline; anterior margin triangular, tip anterior to distolateral angle; distolateral angle moderately produced into small tooth directed anterolaterally; lateral margin extended laterally, concave, proximal end protruded roundly (sometimes with tubercle), with low tubercle basally. Antennal peduncle (Figs 1B, 2B) consisting of two articles flattened dorsoventrally; penultimate article (Fig. 4B) dilated laterally, distal end almost twice broader than proximal end; ultimate article (Figs 1B, 2B) two-thirds of penultimate article in length, compressed, slightly broadened distally; tip exceeding apex of pseudoros-
Third maxilliped (Figs 1B, 5F). Ischium with shallow, broad, longitudinal groove medially. Merus with dilated, faintly upturned anterolateral angle. Exopod dilated laterally, immediately narrowed in distal one-third, mesial margin without subacute angle.

Thoracic sternum (Figs 1B, 5A, B). Sternite 2 with pair of small depression anteriorly. Sternites 3–4 distinctly rimed anterolaterally, slightly ridged medially; sterno-pleonal cavity with sparse, long setae on anterolateral margins (Fig. 5B).

Pleon (Figs 1B, 5B) with six pleomeres and telson; pleomeres 3–6 functionally fused, each defined by distinct suture, gradually decreasing in width. Pleomere 3 broadest, lateral margins arcuate; pleomere 4 trapezoid, shorter than fifth in midline length; pleomere 5 trapezoid; pleomere 6 also trapezoid, 0.6 of pleomere 3 in proximal width (PW6/PW3 = 0.6 in holotype; mean PW6/PW3 ± SD = 0.6 ± 0.0); telson triangular, length as long as proximal width.

Chelipeds (Figs 1, 6) subequal in size and shape. Ischium (Fig. 1B) weakly swollen ventrally in distal half; mesial margin obtusely ridged, with pointed tip; distolateral lobe distinct, compressed, rounded apically. Merus (Fig. 6A–C) prismatic, length about three (2.7–3.2) times longer than width (length/height = 2.7 in holotype; mean length/height ± SD = 3.0 ± 0.0), relative length against postpseudorostral carapace length 0.4–0.5 (length/PCL = 0.5 in holotype; mean length/PCL ± SD = 0.5 ± 0.0); dorsal surface (Fig. 6D) with indistinct longitudinal keel in proximal 0.8, with three or four, low, lamellate teeth, distalmost largest; outer surface (Fig. 6E) rugose, with obtuse longitudinal ridge, unarmed; ventral surface (Fig. 6F) smooth, with blunt ridge bearing three, low, broad teeth, proximalmost largest; inner surface (Fig. 6G) unarmed, depressed medially. Carpus (Fig. 6A–C) moderately inflated, with indistinct ridge on upper surface; lower surface irregularly rugose (Fig. 6C); inner margin obtusely crested, with prominent proximal lobe (Fig. 6A); outer margin obtusely ridged, entire (Fig. 6B, C). Chelae (Fig. 7A) more than twice (2.3–2.4) longer than height (ChL/ChH = 2.3 in holotype; mean ChL/ChH ± SD = 2.4 ± 0.1); palms moderately expanded, upper margin crested, lower margin obtuse; immovable, movable fingers with low, broad teeth in almost entire length; fingers narrowly gaping in almost entire length (when closed).

Ambulatory legs (Figs 1, 8A–C) decreasing in length posteriorly, surface generally smooth to naked eyes but closely covered with microscopic plate setae. Meri subcylindrical, weakly compressed in P2, each with indistinct, upper distal tubercle (Fig. 8A), about eight times (length/height = 8.2 in holotype; mean length/height ± SD = 7.9 ± 0.3) longer than height in P2, almost five times (5.1 in holotype; 5.3 ± 0.2) in P3, more than four times (4.1 in holotype; 4.4 ± 0.1) in P4, four times (4.0 in holotype; 4.0 ± 0.0) in P5. Carpi each with
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Shallow, medial depression on extensor surface, most distinct in P2 (Figs 1A, 8B). Propodi compressed in P2, weakly compressed in P3–5, with setal tufts on proximal 0.8 on flexor margin in P2, 0.6 in P3–5 (Figs 1A, 8C). Dactyls each with two rows of large, calcareous spines on flexor surface (Fig. 8A, C).

Shaft of G1 (Fig. 9) slender, straight, trilobate in distal one-fourth, three lobes similar in length; dorsal lobe triangular, with rounded tip, somewhat longer than ventral lobe, weakly curved mesially (Fig. 9A); ventral lobe triangular, with subacute tip (Fig. 9B); mesial lobe triangular, with rounded tip, projecting anterolaterally, weakly twisted proximally, directed downwards, crossing dorsal lobe in lateral view (Fig. 9A); mesial, lateral margins from dorsal lobe to ventral lobe strongly concave medially; lateral margin with small, lobular projection near dorsal lobe basis (Fig. 9A, B). Shaft of G2 stout, narrowed distally, truncated apically; apex with triangular, subacute projection.

Adolescent males. Based on two specimens (PCL 13.6, 14.1 mm, n=2) (Fig. 10). Pseudorostral spine longer than in

Fig. 7. Left chela in outer view. A–C, Pugettia longipes n. sp.: A, holotype, full-grown male (MBM 188862), 17.3×13.0 mm, Shandong, North China; B, paratype, adolescent male (MBM 188864), 14.1×10.2 mm, same locality; C, allotype, full-grown female (MBM 188863), 15.1×10.7 mm, same locality; D–F, P. ferox Ohtsuchi and Kawamura, 2019: D, holotype, full-grown male (NSMT-Cr 26069), 40.0×32.1 mm, Otsuchi Bay, Japan; E, adolescent male (RUMF-ZC 4981), 31.5×25.8 mm, Akkeshi Bay, Hokkaido; F, allotype, full-grown female (NSMT-Cr 26070), 27.9×22.6 mm, Otsuchi Bay; G–I, P. quadridens (De Haan, 1837): G, full-grown male (NSMT-Cr 26062), 27.4×23.3 mm, Miura Peninsula; H, adolescent male (NSMT-Cr 26064), 18.5×14.2 mm, Boso Peninsula; I, full-grown female (NSMT-Cr 26060), 21.8×18.2 mm, Miura Peninsula.
full-grown specimens (PRL/PCL=0.3) (Fig. 10 vs. Fig. 1). Chelae relatively short (ChL/ChH = 2.8, 2.9), both fingers uniformly dentate (Fig. 7B vs. Fig. 7A). Cheliped merus relatively shorter than in full-grown specimens (0.4 PCL vs. 0.5 PCL) (Fig. 10 vs. Fig. 1). Shaft of G1 completely folded, apically trilobate as in full-grown individuals.

**Female.** Full-grown specimens (PCL 13.8–18.3 mm, n = 5) including allotype (Fig. 11). Carapace relatively less elongate than in male (mean PCL/CW±SD = 1.3±0.0), more rounded than males due to elevated hepatic region (Figs 2B, 11A vs. Figs 1A, 2A). Mesobranchial regions elevated more distinctly than in males (Fig. 2A vs. Fig. 2B). Hepatic lobe acuminated at tip, incurved distally, relatively longer (mean HpL/Pol±SD=2.9±0.3), less laminate than in males (Figs 2B, 11A vs. Figs 2A, 1A); slope line from gastric region to hepatic lobe tip uneven. Pseudorostral spine relatively shorter than in males (mean PRL/PCL±SD=0.2±0.0 vs. 0.3±0.0) (Fig. 11A vs. Fig. 1A). Cheliped merus shorter, more slender than in full-grown males (mean length/PCL±SD=0.4±0.0 versus 0.5±0.0; mean length/height±SD=3.8±0.5 vs. 3.1±0.3) (Fig. 11A vs. Fig. 1A). Chelae more slender than in males, almost three times (2.9–3.0) longer than height (mean ChL/ChH±SD=2.9±0.0 vs. 2.4±0.1) (Fig. 7C vs. Fig. 7A), cutting edges uniformly dentated, without gapes when closed (Fig. 7C). Pleon (Fig. 11B) with six, functionally fused pleomerites, telson. Gonopore (Fig. 5C–E) comma-shaped, oblong in lateral two-thirds, elongate in mesial one-third.

**Variation.** Shapes and fusion degree of the postorbital and hepatic lobes are varied individually rather than ontogenetically (Figs 1A, 10, 11A). Hpl/Pol increases from 1.6 to 3.0 generally in relation to size growth (Figs 1A, 10, 11A). Distolateral angle of basal antennal article varies in length and sharpness (Figs 1B, 11B).

**Remarks.** The present new species closely resembles *Pugettia ferox* and *P. quadridens*. Shared characters with *P. ferox* include: acute, triangular preorbital spine as long as postorbital lobe; sinuous lateral margin of supraorbital cave;
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Orbital hiatus appeared as broad concavity; shallow concavity on lateral margin between postorbital and hepatic lobes; basal antennal article clearly separated from suborbital region by basal protrusion on lateral margin; small, lobular projection at basis of G1 dorsal lobe (cf. Ohtsuchi and Kawamura 2019: figs 28 A, 33A–G). *Pugettia longipes* n. sp. and *P. quadridens* shares the following features: smooth carapace surface covered with microscopic, apically-flattened setae; rows or groups of hooked setae on carapace which can be absent in male specimens; rudimentary tuberculation on gastric, branchial regions; long, broad, basally inflated hepatic lobe; secondary sexual difference in the relative length of pseudorostral spines (only in the full-grown stage) (cf. Ohtsuchi and Kawamura 2019: figs 2–13). However, these species can be distinguished from each other by the morphological differences discussed below.

**Fig. 9.** Male first gonopods (G1) in lateral (A, C, E) and mesial view (B, D, F). A, B, *Pugettia longipes* n. sp., holotype, full-grown male (MBM 188862), 17.3×13.0 mm, Shandong, North China; C, D, *P. ferox* Ohtsuchi and Kawamura, 2019, paratype, full-grown male (NSMT-Cr 26071), 30.7×26.3 mm, Otsuchi Bay, Japan; E, F, *P. quadridens* (De Haan, 1837), full-grown male (NSMT-Cr 26061), 23.8×18.6 mm, Miura Peninsula, Japan.
The pseudorostrum is more divergent in *P. longipes* n. sp. (divergent angle = 45–60°) than in *P. ferox* and *P. quadridens* (30–40°) at least when compared among full-grown individuals (Fig. 3; cf. Ohtsuchi and Kawamura 2019: figs 3A, B, D, E, 26A, 34A, 37A, C, F, G).

The pseudorostral spine is relatively longer in *P. longipes* n. sp. (Figs 1, 10B, C) than in *P. ferox* when compared among males (PRL/PCL: 0.3 ± 0.0 in *P. longipes* n. sp. vs. 0.2 ± 0.0 in *P. ferox*) (Ohtsuchi and Kawamura 2019: figs. 26, 35, 36), and relatively longer than in *P. quadridens* when compared among adolescent males (0.3 ± 0.0 in *P. longipes* n. sp. vs. 0.2 ± 0.0 in *P. quadridens*) (Ohtsuchi and Kawamura 2019: figs 3, 10). See also Ohtsuchi and Kawamura (2019: table 1).

The anterolateral margin of gastric region is poorly defined, and the slope from protogastric region to hepatic lobe tip is almost straight in males of *P. longipes* n. sp. (Fig. 3A). On the other hand, the anterolateral margin of gastric region weakly demarcated, and the slope is shallowly concave or weakly sinuous in both males and females of *P. quadridens* and *P. ferox* (Fig. 3B, C). This character is unique to *P. longipes* n. sp. among all the extant western Pacific *Pugettia*.

The supraorbital eave is deeply demarcated from the frontal region by a groove in *P. longipes* n. sp. (Figs 1, 10B, C) than in *P. ferox* when compared among males (PRL/PCL: 0.3 ± 0.0 in *P. longipes* n. sp. vs. 0.2 ± 0.0 in *P. ferox*) (Ohtsuchi and Kawamura 2019: figs. 26, 35, 36), and relatively longer than in *P. quadridens* when compared among adolescent males (0.3 ± 0.0 in *P. longipes* n. sp. vs. 0.2 ± 0.0 in *P. quadridens*) (Ohtsuchi and Kawamura 2019: figs 3, 10). See also Ohtsuchi and Kawamura (2019: table 1).

The lateral margin of the basal antennal article being clearly separated from the suborbital region at the basis distinguishes *P. longipes* n. sp. and *P. ferox* from *P. quadridens*, in which the article is confluent to the suborbital region (Fig. 4B versus Ohtsuchi and Kawamura 2019: figs 4B, 28B).

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teeth in *P. ferox* (Fig. 7D).

The cheliped merus is shorter than the P2 merus in *P. longipes* n. sp. in any of the ontogenetic stages (Figs 1, 10, 10), whereas in *P. quadridens* and *P. ferox*, the P2 merus is significantly longer than the cheliped merus only in full-grown males (Fig. 13, Tukey-Kramer HSD test, \( p < 0.01 \)). It should also be remarked that the cheliped merus is relatively shorter in *P. longipes* n. sp. than in *P. quadridens* and *P. ferox* when compared among full-grown males (mean length/ PCL±SD: 0.5±0.0 in *P. longipes*; 0.6±0.0 in *P. quadridens* and *P. ferox*) (Fig. 1A vs. Ohtsuchi and Kawamura 2019: figs 3A, 26A) (Tukey-Kramer HSD, \( p < 0.01 \)).

The tri-dentate longitudinal ridge on the dorsal surface of the cheliped merus is more lamellar in *P. longipes* n. sp. (Fig. 6F) than in the other two species (cf. Ohtsuchi and Kawamura 2019: figs 5E, 29E). The distalmost tooth is mod-
Pugettia longipes

Fig. 12. Comparison of the relationships between relative length of hepatic lobe (HPL/PoL) against postrostral carapace length (PCL) among *P. quadridens* (De Haan, 1837), *P. ferox* Ohtsuchi and Kawamura, 2019, and *P. longipes* n. sp. (modified after Ohtsuchi and Kawamura 2019: fig. 39).

Table 1. Comparison of proportional length (length/height) of cheliped and ambulatory legs meri among *P. longipes* n. sp., *P. ferox* Ohtsuchi & Kawamura, 2019, and *P. quadridens* (De Haan, 1837).

|               | *P. longipes* | *P. ferox* | *P. quadridens* |
|---------------|---------------|------------|-----------------|
|               | n = 3         | n = 7      | n = 7           |
| P1            | 3.1 ± 0.3a    | 2.7 ± 0.1b | 2.4 ± 0.1c      |
| P2            | 7.9 ± 0.3a    | 6.3 ± 0.9b | 5.7 ± 0.3c      |
| P3            | 5.4 ± 0.2a    | 4.4 ± 0.6b | 3.7 ± 0.2c      |
| P4            | 4.4 ± 0.2a    | 3.7 ± 0.4b | 3.2 ± 0.1c      |
| P5            | 4.0           | 3.5 ± 0.5  | 3.1 ± 0.2       |
| Adolescent    | n = 2 (1 in P2, 5) | n = 7 | n = 4           |
| P1            | 3.0 (median)  | 2.8 ± 0.1  | 2.9 ± 0.1       |
| P2            | 8.2           | 5.5 ± 0.7  | 4.7 ± 0.1       |
| P3            | 5.7 (median)  | 3.9 ± 0.3  | 3.2 ± 0.1       |
| P4            | 4.2 (median)  | 3.3 ± 0.3  | 2.9 ± 0.1       |
| P5            | 3.9           | 3.1 ± 0.3  | 2.8 ± 0.1       |
| Full-grown female | n = 5      | n = 8      | n = 7           |
| P1            | 3.8 ± 0.5a    | 2.9 ± 0.2b | 2.6 ± 0.1c      |
| P2            | 7.8 ± 0.8b    | 5.0 ± 0.6b | 4.3 ± 0.4c      |
| P3            | 5.1 ± 0.5a    | 3.7 ± 0.5b | 3.2 ± 0.3c      |
| P4            | 3.8 ± 0.4a    | 3.1 ± 0.2b | 2.7 ± 0.2c      |
| P5            | 3.7 ± 0.3a    | 3.0 ± 0.4b | 2.7 ± 0.1c      |

Means in the same row followed by different small letters are significantly different from each other (Tukey Kramer HSD test, p<0.05).

In each ambulatory leg, the relative length of the merus compared to PCL is greater in *P. longipes* n. sp. than in the other two species when compared among the same ontogenetic stages (Tukey-Kramer HSD test, p<0.05) (Fig. 13). All the ambulatory legs have meri that are much more slender in *P. longipes* n. sp. than in the other two species (Table 1). For example, the P2 merus is much more slender in *P. longipes* n. sp. than in the other two species when compared among the same ontogenetic stages (Tukey-Kramer HSD test, p<0.05) (Fig. 13).

The absence of a small, lobular projection at the G1 dorsal margin of G1 apex (higher than mesial margin), distinguish *P. quadridens* from both *P. longipes* n. sp. and *P. ferox* (Fig. 9). In the latter two species, the mesial margin of the G1 apex is continuous to the upper margin of the ventral lobe (Fig. 9A), but it is distinct in *P. ferox* (Fig. 9C). See also Ohtsuchi and Kawamura (2019: figs 9A–D, 33A–G).

Shen (1937) provided a comparison table between *P. minor* Ortmann, 1893 and *P. quadridens* based on some specimens from Kiachow Bay (=Jiazhou Bay), Shandong, northern China. Although we have no opportunity to examine his specimens in the present study, his *P. quadridens* should be attributed to our new species, since it shows the proportionally long hepatic lobe [estimated HPL/PoL = 3.8 in 17.3 mm PCL, based on text fig. 5b in Shen (1937)] and the characteristic structure of G1 (Shen 1937: text-fig. 5b, 5c).
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c, e, h). The shape of the basal antennal article must have belonged to the same specimen as previous characters, but unfortunately, it cannot be referred to any known species of *Pugettia* because its basis was incompletely drawn (Shen 1937: text fig. 5c). The transverse ridge on the thoracic sternum was not found in our specimens, but this is not a useful character: in some *Pugettia*, the sternite 1 is slightly depressed anteriorly and the boundary between sternites 1 and 2 appears as if there is a transverse ridge in some cases (Figs 1B, 5A). Despite many previous records of *Pugettia* in Northeast Asian waters (see Discussion in Ohtsuchi and Kawamura 2019), we found no further records of *P. longipes* n. sp. at least based on the figures and drawings. If possible, however, it is worth re-examining the non-figured specimens examined in these previous studies.

**Distribution.** This species is at present known only from the both northern and southern coast of Shandong Peninsula, Northeast China (Shen 1937; this study). Although habitat and depth were not recorded, our specimens were likely collected from shallow water because they were originally preserved in the same glass jar with *P. ferox* (MBM 160513), which is known mainly from depths shallower than 20 m (Ohtsuchi and Kawamura 2019).

**Etymology.** This species was named "longipes" alluding to their long, ambulatory legs.

**Key to Shallow Water (<20 m) Species of the Genus Pugettia in East Asian Waters**

1. Cardiac, branchial regions elevated conically. Postorbital lobe strongly bent downwards on lateral margin, completely fused with lamellar hepatic lobe. Cheliped merus faintly elevated in outer surface, almost triangular in cross section. Ambulatory legs propodi strongly compressed. Mesial lobe of G1 distinctly short. ....... *P. incisa* [Japanese name (hereafter JN): Yahazu-mo-gani]
   — Caradiac, branchial regions elevated roundedly. Postorbital lobe not markedly bent downwards on lateral margin, fused basally with distally spiniform hepatic lobe. Cheliped merus distinctly elevated in outer surface, rectangular in cross section. Ambulatory legs propodi subcylindrical. Mesial lobe of G1 long. ........ 2

2. Lateral margin of basal antennal article not separated at basis from suborbital region. Ambulatory legs meri with faint, upper distal tubercle in extensor margin; carpi with faint, median depression on extensor surface. G1 mesial lobe projected nearly perpendicular to carapace length. Postorbital lobe slightly compressed dorsoventrally, mesially-inclined triangular, directed anteriorly, with apex slightly incurved. Hepatic lobe much longer than postorbital lobe. Found from mud, gravel, rock bottom. ............... *P. pellucens* Rathbun, 1932 [JN: Ko-yotsuha-mo-gani]  
   — Pseudorostral spines 0.24–0.39 as long as postrostral carapace length. Postorbital lobe compressed dorsoventrally, isoseciles triangular, directed anterolaterally. Hepatic lobe as long as or longer than postorbital lobe. Found from small red algal turfs. ............... *P. vulgaris* Ohtsuchi, Kawamura, and Takeda, 2014 [JN: Arasaki-mo-gani]

3. Gastric region with four rudimentary or distinct tubercles. Mesobranchial region elevated roundly with two or three tubercles of variable distinctness. Cheliped merus dorsal surface obtusely ridged, not crested, with non-lamellar, rather spiniform teeth. ........... 4
   — Gastric region with no visible tubercles. Mesobranchial region not markedly elevated. Cheliped merus dorsal surface with distinctly ridged, crested, with three lamellar teeth. ............... 6

4. Posterior end of hooked setae rows on gastric region posterior to basis of hepatic lobe. Posterior end of supraorbital cave lateral margin truncate. Orbital hiatus deep, rectangular concavity. Posterior margin of hepatic lobe bent laterally. Mesial lobe of G1 elongate, projected anteriorly. Female gonopore elongate. ............... *P. intermedia* Sakai, 1938 [JN: Yotsuha-modoki]
   — Posterior end of rows of hooked setae on gastric region much anterior to basis of hepatic lobe. Posterior end of supraorbital cave lateral margin rounded. Orbital hiatus deep, broad concavity. Posterior margin of hepatic lobe bent laterally. Mesial lobe of G1 moderately long, projected anteriorly obliquely. Female gonopore comma-shaped. ............... 5

5. The slope from hepatic region to hepatic lobe tip shallowly concave or weakly sinusus. Basal antennal article basally with acute protrusion. P2 merus five to seven times longer than height, shorter than cheliped merus in full-grown males. Mesial margin of G1 apex distinct from mesial margin of ventral lobe. ............... *P. ferox* Ohtsuchi and Kawamura, 2019 [JN: Oh-yotsuha-mo-gani]
   — The slope from hepatic region to hepatic lobe tip almost straight. Basal antennal article basally with round protrusion. P2 merus eight times longer than height, longer than cheliped merus in any ontogenetic stages. Mesial margin of G1 apex continuous to mesial margin of ventral lobe. ............... *P. quadridens* Ohtsuchi, Kawamura, and Takeda, 2014 [JN: Ashinaga-yotsuha-mo-gani]  
   — Pseudorostral spines 0.36–0.47 as long as postrostral carapace length. Postorbital lobe slightly compressed dorsoventrally, mesially-inclined triangular, directed anteriorly, with apex slightly incurved. Hepatic lobe much longer than postorbital lobe. Found from mud, gravel, rock bottom. .......... *P. intermedia* Sakai, 1938 [JN: Yotsuha-modoki]  
   — Pseudorostral spines 0.24–0.39 as long as postrostral carapace length. Postorbital lobe compressed dorsoventrally, isoseciles triangular, directed anterolaterally. Hepatic lobe as long as or longer than postorbital lobe. Found from small red algal turfs. .......... *P. vulgaris* Ohtsuchi, Kawamura, and Takeda, 2014 [JN: Arasaki-mo-gani]
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