A new genus of entoniscid isopod (Crustacea: Peracarida: Bopyroidea) parasitic on common intertidal shore crabs from the Ryukyu Islands, Japan, with a new distributional record of *Kepon grapsi* (Nobili, 1905) (Bopyridae) nov. comb.

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**Abstract.**— Two species of bopyroid isopods are first reported on crabs collected from rocky beaches of Yoron Island, middle part of Ryukyu Islands, Japan. A bopyrid, *Kepon grapsi* (Nobili, 1905) nov. comb., is recorded based on both sexes obtained from the branchial chambers of *Grapsus tenuicrustatus* (Herbst) (Grapsidae); the genus *Lobocepon* Nobili, 1905 is synonymized with *Kepon* Duvernoy, 1840. The finding of *K. grapsi* nov. comb. in the present study represents the first record from Japan. An entoniscid, *Allocancrion yunnu* gen. et sp. nov., is described on the basis of the adult females, males, and epicaridium larvae from visceral cavities of *Plagusia squamosa* (Herbst) (Plagusiidae). *Allocancrion* gen. nov. is similar to *Cancrion* but it is differentiated from it by the male lacking pereopod 6 and the epicaridium larva with a very short, unmodified, pereopod 6.

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**Key words:** *Allocancrion, endoparasite, Grapsidae, Isopoda, new species, Plagusiidae, Ryukyus*

**Introduction**

Members of the superfamilies Bopyroidea Rafinesque, 1815 and Cryptoniscoidea Kossmann, 1880 are commonly referred to as epicaridean isopods and are a major group of parasites on various crustaceans, using them as intermediate and definitive hosts (Williams & Boyko 2012). Currently Bopyroidea is considered monophyletic and consists of Bopyridae Rafinesque, 1815, Entoniscidae Kossmann, 1881, and Ionidae H. Milne Edwards, 1840 based on analysis of 18S rDNA (Boyko et al. 2013). Adults of most Bopyridae and all Ionidae are ectoparasites in the branchial chambers of decapods, while those of Entoniscidae are endoparasites of decapod visceral cavities. Species in all three families have three larval stages (epicaridium, microniscus, and cryptoniscus) before becoming juveniles (Boyko & Williams 2009; Boyko et al. 2013). Epicaridium and cryptoniscus larvae are known as free-swimming stages but microniscus larvae, the second developmental stage, are found feeding on hemolymph while attached on free-living copepods that serve as intermediate hosts (e.g., Williams & Boyko 2012; McDermott et al. 2020). Currently, 637 species in 169 genera of bopyrids, 8 species in 1 genus of Ionidae, and 36 species in 16 genera of entoniscids are recognized (Boyko et al. 2008 onwards; Boxshall & Hayes 2019). In this paper, two bopyroids are reported infesting two species of common shore crabs in the intertidal zone of the Ryukyu Islands, Japan: *Kepon grapsi* (Nobili, 1905) nov. comb. (Bopyridae), newly re-
corded from Japan, and Allocancrion yunnu gen. et sp. nov. (Entoniscidae). Based on a detailed study of the bopyrid specimens, Lobocepon Nobili, 1905 is synonymized with Kepon Duvernoy, 1840.

Materials and Methods

Crabs were collected from intertidal rocky shores of Yoron Island, Ryukyu Islands, southern Japan during low tide at slack time. In the laboratory, isopods were removed from crabs’ gill chambers and body cavities, fixed in 80% ethanol, and preserved in 99% ethanol for future molecular work.

For morphological study, selected specimens were dissected by a sharpened tungsten needle under a dissecting microscope and examined. Dissected small parts and appendages were soaked in lactophenol for 24 hours, then observation was performed based on the modified version of the wooden slide method of Humes & Gooding (1964). Illustrations were made with the aid of a drawing tube mounted on a biological microscope (Olympus BX53). Subsequently, the original drawings were edited in Adobe Photoshop (Adobe Systems, San Jose, CA). The carapace length (CL) and width (CW) of hosts were measured using calipers. Identification of hosts were based on Wada (1995). Isopods were measured from anterior end to posterior (TL) and sizes were reported as range followed by mean and standard deviation in parentheses. Types and other examined specimens are deposited in the crustacean collection of the National Museum of Nature and Science, Tsukuba, Japan (NSMT). Terminology follows that of Williams & Boyko (2016) and McDermott et al. (2019).

Taxonomic Account

Family Bopyridae Rafinesque, 1815
[Japanese name: Ebi-yadori-mushi-ka]

Subfamily Keponinae Boyko, Moss, Williams & Shields, 2013
[New Japanese name: Kani-yadori-ebi-yadori-mushi-aka]

Kepon Duvernoy, 1840: 598–603.—Duvernoy, 1841: 110–122, pl. 4B.
Lobocepon Nobili, 1905: 504–505.—Shiino, 1936a: 161–163.

Remarks

As pointed out by Nierstrasz & Brender à Brandis (1931) and Shiino (1936a), Kepon and Lobocepon share many characters in common. The only character that Shiino (1936a) regarded as possibly separating the two genera was that the endopods of the pleopods in the type species of Kepon, K. typus Duvernoy, 1840, are approximately the same length as the exopods (fide Bonnier, 1900) whereas in the type species of Lobocepon, L. grapsi Nobili, 1905, the endopods are smaller than the exopods and of a different shape (rounded with distally tapered digitate tips). Our specimens show that the endopods are much shorter than the exopods on all pleopods, but the endopods are similar in shape to the exopods and have digitations all along the margins. Duvernoy’s (1841: pl. 4B, fig. 11; reprinted in Bonnier, 1900: fig. 44) illustrations show that the immature female (which he erroneously labeled as the male) has biramous pleopods but he drew the adult female as if the pleopods were uniramous and described them as having only one branch in the text, which either means that the endopods are lacking in the adult females (very unlikely) or that they are present but much smaller than the exopods and not drawn by Duvernoy (1841), possibly because he did not recognize them as distinct from the exopods.

Bonnier (1900) considered Duvernoy’s (1840, 1841) descriptions and illustrations to
be in error and assumed that the pleopodal endopods and exopods were subequal in length. However, this assumption was contradicted by Giard (1906), who discussed the identity of the host of K. typus and placed the species in Grapsicepon Giard and Bonnier, 1887 without comment, presumably because of the reduced nature of the pleopodal endopods in both K. typus and G. messoris (Kossmann, 1880), the type species of Grapsicepon, as well as their similar grapsoid hosts. Of course, if K. typus was congeneric with Grapsicepon, then the correct name for the genus would be Kepon, which has priority, not Grapsicepon, but there are many differences between K. typus and species of Grapsicepon, including the lack of the tubercles on the coxal plates in any Grapsicepon species as well as the females’ distinctly ovate body shape.

Currently, three species are recognized in the genus Kepon, but the globular coxal plates of the type species are not present on the other two congeneres: K. halimi Stebbing, 1910 and K. orientalis Markham, 1985. Additionally, in contrast to the bodies of K. halimi and K. orientalis being asymmetrically curved to the left or right, those of K. grapsi nov. comb. and K. typus are symmetrical or only slightly curved (see Stebbing 1910; Markham 1985). Based on characters of both the females and males, neither K. halimi (from a Halimus; Majidae) nor K. orientalis (from a Metaplex; Varunidae) belong in Kepon. From Stebbing’s (1910) description of K. halimi, it is not clear why he placed his species in Kepon; he also obscured a considerable number of characters by giving only a figure (pl. 11B) of the ventral body of the female, albeit incorrectly labeling it in the figure caption as being a dorsal view. For K. orientalis, the characters given by Markham (1985) that purportedly place it in Kepon agree more with placement in Dactylokepon Stebbing, 1910. Overall, both K. halimi and K. orientalis share more characters, such the female and male habitus form, coxal plate and pleopod structure, and male pleotelson shape, with some species of Dactylokepon, than with any other genus. Dactylokepon, however, may not be monophyletic (e.g., D. marchadi Bourdon, 1967a and D. holthuisi Bourdon, 1967b differ in several characters from the type species, D. richardsonae Stebbing, 1910) and many species in this genus are in need of reexamination and redescription. Given that K. halimi and K. orientalis share more characters with species of Dactylokepon than Kepon, it is more parsimonious to make Kepon monophyletic by moving these two species into Dactylokepon pending revision of the latter genus, as D. halimi (Stebbing, 1910) nov. comb. and D. orientalis (Markham, 1985) nov. comb. The identity of the Lobocepon sp. juvenile female reported infesting a Grapsus grapsus (Linnaeus, 1758) from Pacific Nicaragua by Markham (2002) is uncertain. The coxal plates show no sign of tubercles but the juvenile female drawn by Duvernoy (1841) is not very detailed and the condition of these structures cannot be ascertained. The rounded shapes of the pleopodal endopods of the juvenile female from Nicaragua are similar to those shown by Shiino (1936a) for K. grapsi, but both are rather dissimilar to those reported by Nobili (1905) and from the present specimens. For now, Markham’s (2002) record should be considered a possible Kepon juvenile, although this genus has never been reported with certainty from the eastern Pacific.

**Kepon grapsi** (Nobili, 1905) nov. comb.  
[New Japanese name:  
Kani-yadori-ebi-yadori-mushi]  
(Figs. 1F–H, 2, 3)

**Lobocepon grapsi** Nobili, 1905: 505–507, fig 6.—Nierstrasz & Breder à Brandis, 1923: 81 (list).—Shiino, 1936a: 163–165, fig 1.—Bourdon, 1968: 406 (list).—Markham, 2002: 335 (list).—Boyko, 2004: 677 (mention).
Fig. 1. Fresh coloration of host crabs and parasites, opened circles indicate positions of parasites. A, female of *Grapsus tenuicrustatus* (Herbst) infested by *Kepon grapsi* (Nobili, 1905) nov. comb. in left gill chamber; B, protruded carapace of same host; C, female of *K. grapsi* nov. comb. attached on carapace of same host; D, male of *Plagusia squamosa* (Herbst) infested by three females of *Allocancrion yunnu* gen. et sp. nov. in the visceral cavity; E, transformed carapace of *P. squamosa* due to infestation of *A. yunnu*. Arrowheads indicate cephalic spines, left side shifted forward; F, female of *K. grapsi* nov. comb., NSMT-Cr 28338, habitus, dorsal; G, same, habitus, ventral with adult male, NSMT-Cr 28338; H, adult male of *K. grapsi* nov. comb., NSMT-Cr 28338, habitus, dorsal; I, holotype mature female of *A. yunnu* gen. et sp. nov. with hood, NSMT-Cr 28344, habitus, right lateral; J, same, left lateral. Scale bars: A, D, 20 mm; B, F, G, I, J, 5 mm; C, 10 mm; E, 7 mm; H, 1 mm.
Fig. 2. *Kepon grapsi* (Nobili, 1905), nov. comb., adult female, NSMT-Cr 28337, pr1–7 = pereopods 1–7, pl = pleural lamella, ex = exopod, en = endopod, ur = uropod. A, habitus, dorsal; B, same, ventral; C, rostral and oral areas, ventral; D, left antennule, ventral; E, left antenna, ventral; F, ventral surface of fourth article of left antenna; G, left maxilliped, ventral; H, outer lobe of left barbula, ventral; I, left oostegite, dorsal; J, right pereopod 1, outer; K, right pereopod 2, outer; L, left pleopod 1, posterior; M, pleomere 5 and pleotelson, ventral. Scale bars: A, B, 2 mm; C, G, I, L, M, 1 mm; D, 100 µm; E, 200 µm; F, 10 µm; H, 500 µm; J, K, 300 µm.
Material examined

1 adult female and 1 adult male (NSMT-Cr 28337), ex right branchial chamber of *Grapsus tenuicrustatus* (Herbst, 1783) (Grapsidae) (female, 34.65 mm CL × 37.52 mm CW, non-ovigerous), Mugiya (27°1’N, 128°26’E), Yoron Island, Amami Islands, Japan, 17 May 2019, leg. D. Uyeno; 1 adult female and 1 adult male (NSMT-Cr 28338), ex left branchial chamber of *G. tenuicrustatus* (female, 39.41 mm CL × 41.66 mm CW, non-ovigerous, Fig. 1A, B), Mugiya (27°1’N, 128°26’E), Yoron Island, Amami Islands, Japan, 17 May 2019, leg. D. Uyeno; 1 adult female and 1 adult male (NSMT-Cr 28339), ex left branchial chamber of *G. tenuicrustatus* (female, 40.20 mm CL × 43.56 mm CW, non-ovigerous, Fig. 1C), Mugiya (27°1’N, 128°26’E), Yoron Island, Amami Islands, Japan, 17 May 2019, leg. D. Uyeno; 1 adult female and 1 adult male (NSMT-Cr 28340), ex left branchial chamber of *G. tenuicrustatus* (male, 24.06 mm CL × 26.87 mm CW), Mugiya (27°1’N, 128°26’E), Yoron Island, Amami Islands, Japan, 17 May 2019, leg.
TWO BOPYROIDS FROM THE RYUKYUS

D. Uyeno; 2 adult females and 2 adult males (NSMT-Cr 28341), ex left and right branchial chambers of *G. tenuicrustatus* (sex unknown, 39.12 mm CL × 44.30 mm CW), Maehama Beach (27°1′N, 128°26′E), Yoron Island, Amami Islands, Japan, 14 May 2017, leg. D. Uyeno; 1 adult female (NSMT-Cr 28342), ex right branchial chamber of *G. tenuicrustatus* (male, 30.33 mm CL × 35.56 mm CW), Mugiya (27°1′N, 128°26′E), Yoron Island, Amami Islands, Japan, 12 May 2018, leg. D. Uyeno; 1 adult female and 1 adult male (NSMT-Cr 28343), ex right branchial chamber of *G. tenuicrustatus* (male, 25.80 mm CL × 28.70 mm CW), Maehama Beach (27°1′N, 128°26′E), Yoron Island, Amami Islands, Japan, 12 May 2018, leg. D. Uyeno et al., K. Fukushima, and T. Kaneko.

**Description**

**Adult female.** Body (Fig. 2A, B) oval, 9.81–18.08 (14.13 ± 2.86) mm long, slightly asymmetrical, widest at pereomere 4, 8.44–13.87 (10.72 ± 2.12) mm long, 1.16–1.40 (1.32 ± 0.08) times as long as wide (n = 8).

Head ovoid, bilobed dorsally, wider than long, 2.60–3.78 (3.15 ± 0.43) × 3.57–5.13 (4.26 ± 0.58) mm, developed frontal lamina present (Fig. 2C). Eyes absent. Antennule (Fig. 2D) with three articles, each with tufts of setae on distal margin of articles. Antenna (Fig. 2E) with five articles, covered with numerous scales on distal margins of articles. Antenna (Fig. 2E) with five articles, covered with numerous rows of small scales (Fig. 2F), setae on distal margins of distalmost four articles. Maxilliped (Fig. 2G) with subrectangular anterior lobe bearing unsegmented palp; posterior lobe triangular bearing long spur with digitated processes on margins (part of barbula). Barbula (Fig. 2H) represented by two lobes with digitate margins.

Pereon with seven pereomeres (Fig. 2A). Pereomeres 1–4 with well-developed globular coxal plates thickly covered with tubercles; coxal plate of pereomere 5 small, bearing tubercles sparsely. Oostegites enclosing brood pouch (Fig. 2B); oostegite 1 with ovate anterior lobe with rounded tip, posterior lobe with irregular digitated processes on dorsal surface (Fig. 2I); posterior half of oostegites 4 and 5 covered with numerous tubercles on ventral surfaces (Fig. 2B). Pereopods 1–7 subequal, distinctly segmented (Fig. 2J, K); carpus bearing ventrodorsal setal cluster; propodus bearing scales on ventrodorsal part; dactylus with blunt apex.

Pleon with five pleomeres and pleotelson (Fig. 2A, M), distinctly segmented. Pleomeres 1–5 (Fig. 2M, L) bearing pleopods with long exopods and short endopods plus uniramous elongate lateral plates; both rami of pleopods and lateral plates with digitate lateral margins; pleotelson bearing uniramous, foliose uropods with highly digitate lateral margins (Fig. 2M).

**Adult male.** Body (Fig. 3A) 2.99–4.27 (3.59 ± 0.55) mm long, widest at pereomere 3 or 4, 1.09–1.85 (1.38 ± 0.25) mm long (n = 7).

Head (Fig. 3A, B) subovoid, wider than long, 0.45–0.73 (0.56 ± 0.10) × 0.92–1.08 (0.98 ± 0.06) mm, distinctly articulated from pereomere 1. Eyes posterolaterally positioned on cephalon. Antennule (Fig. 3B, D) with three articles, each with tufts of setae on distal margin of articles. Antenna (Fig. 3B, E) with five articles, covered with numerous marginal scales (Fig. 3E); setae on distal margins of distalmost four articles.

Pereon with seven pereomeres (Fig. 3A); pereomere 7 with medioventral tubercle (Fig. 3C). Pereopods (Figs. 3F, G), subequal in size, all articles distinctly separated except merus incompletely fused to carpus; merus, carpus, propodus, and dactylus with ventrodorsal setal clusters; ventrodorsal margin of ischium, merus, carpus, propodus, and dactylus with rows of scales; dactylus of pereopods 1 larger than those of others.

Pleon with five pleomeres and pleotelson (Fig. 3A, C), distinctly segmented, 0.84–1.58 (1.20 ± 0.31) mm long. Pleomere 1 with conical medioventral tubercle; pleopods 1–5 repre-
Presented by ventrolateral hemispherical swellings; pleotelson bilobed with anal cone.

**Infestation**

Females were attached in the branchial chambers of host crabs and faced the posterior end of hosts (Fig. 1C). Males were attached on the ventral side of the oostegites of females (Fig. 1G). The carapaces of infested hosts were swollen on the infested side (Fig. 1A, B). Four of seven host specimens were females but all were non-ovigerous.

**Remarks**

*Kepon grapsi* (Nobili, 1905) nov. comb. was originally described as the type species of the genus *Lobocepon* Nobili, 1905 on the basis of both sexes collected from Tami Island, Papua New Guinea, on the host *Grapsus grapsus* (Linnaeus) (Nobili 1905). Subsequently, this bopyrid was reported from Lansu, Taiwan, also from *G. grapsus* (Shiino 1936a). However, as noted by Markham (2002), the host for both these records was most likely *G. tenuicrustatus*, the same host as reported for the present specimens, as Papua New Guinea and Taiwan are outside the range of *G. grapsus* sensu stricto. Shiino (1936a) stated that the female specimen from Taiwan showed a morphological difference of the pleopods from that in the original description (endopod much shorter than exopod vs. both rami equal in length). All nine female specimens collected from the Ryukyu islands in this study have endopods smaller than the exopods (Fig. 2D, M). The coxal plates of pereomere 5 of the female bear tubercles in contrast to previous descriptions where it was described as having a smooth surface (see Nobili 1905; Shiino 1936a).

Family Entoniscidae Kossmann, 1881

*Allocancrion gen. nov.*

**Allocancrion yunnu** sp. nov., by present designation.

**Diagnosis**

Mature female with body U-shaped, bending dorsally at boundary of pereomere and pleomere. Head oval with two bulbous cephalic lobes; two pairs of antennal lobes and paired maxillipeds present. Maxillipeds uniramous, composed of coxa and lamellar exopod. Pereon with four pairs of ventrolateral ovarian processes but without ventral processes; pereopods not observed. Oostegite 1 well developed, trilobate, composed of ascendant lobe, elongate transverse lobes, and large recurrent lobe; all lobes uniramous. Oostegites 2 to 5 fused into single large membranous flap covering oostegite 1. Pleon not distinctly segmented, oval bulbous heart on dorsal surface of pleomere 3, five pairs of uniramous pleopods; pleomeres 1 to 3 with pair of pleural lamellae, all lamellae folded with crispate margins; pleopods 1 to 4 with oval lobes; pleopod 5 represented by small lobe. Terminal pleomere with two pairs of tapered projections.

Adult male with ovoid head, incompletely fused to pereomere 1. Eyes posterolaterally situated on cephalon. Antennule represented by bulbous lobe with cluster of setae. Antenna absent. Maxilliped a conical projection with apical element. Pereon with seven pereomeres; first five pereomeres each with pair of pereopods. Pereopods increasing in size posteriorly; basis, ischium, merus, carpus, propodus, and dactylus distinctly separated; merus with conical ventrodistal element; dactylus represented by conical process. Pereomere 7 with pair of lateral gonopores. Pleon with five pleomeres...
and pleotelson; pleopods absent; pleotelson with pair of tapering lateral lobes without uropods.

Epicaridium larva with ovoid head bearing antennule, antenna, mandible, maxilla, and maxilliped. Antennule with three articles, distinctly segmented. Antenna elongate with six articles. Mandible 2-segmented; distal article represented by blade with serrated tip. Maxilla slender with apical long seta. Maxilliped with two apical setae. Pereon with six pairs of pereopods. Pereopods 1 to 6 subequal in size with all articles distinctly separated except carpus fused to propodus. Pereopod 6 with small dactylus incompletely fused to propodus/carpus. Pleon with six pleomeres and pleotelson. Five pairs of uniramous pleopods; protopod with setae at tip of extended inner margin; exopod cylindrical with distal setae. Terminal pleomere with biramous uropods; peduncle with stout seta on posterolateral corner; exopod and endopod subequal in length with two setae each and sharp processes on distal tip.

**Remarks**

Currently 11 genera are known in the subfamily Entioninae: *Achelion* Hartnoll, 1966, *Cancrion* Giard & Bonnier, 1887, *Entione* Kossmann, 1881, *Entionella* Miyashita, 1941, *Micippion* Shiino, 1942, *Pinnixion* McDermott, Williams & Boyko, 2019, *Pinnotherion* Giard & Bonnier, 1889, *Portunion* Giard & Bonnier, 1886, *Priapion* Giard & Bonnier, 1888, *Tiarion* Shiino, 1942, and *Xanthion* Shiino, 1942 (Boyko et al. 2008 onwards); these are mainly differentiated based on characters of the adult females (e.g., Giard & Bonnier 1887, 1888; Miyashita 1941; Shiino 1942; Hartnoll 1966; McDermott et al. 2019). Females of *Allocancrion* gen. nov. are distinguishable from those in all known genera except *Cancrion* by having the pereon with pairs of lateral ovarian processes and without unpaired ventral or dorsal processes. The new genus is similar to *Cancrion* but differs by having the adult male possessing only five pereopods and the epicaridium larvae with pereopod 6 of approximately the same length as pereopods 1 to 5 whereas males of *Cancrion* spp. have six pairs of pereopods and the epicaridium larvae have a much longer pereopod 6 (i.e., basis, ischium, and merus greatly elongate).

**Etymology**

The new generic name is a combination of *Allo-* , meaning “other” and *Cancrion* with which it shares similar morphology of the females. The gender is masculine.

*Allocancrion yunnu* sp. nov.

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[New Japanese name: Yunnu-kani-yadori-mushi]

(Figs. 1I, J, 4, 5)

**Type material**

Holotype: mature female (NSMT-Cr 28344), ex body cavity of *Plagusia squamosa* (Herbst, 1790) (Plagusiidae) (male, 30.63 mm CL x 32.15 mm CW, Fig. 1E), Maehama Beach (27°1′N, 128°26′E), Yoron Island, Amami Islands, Japan, 18 May 2019, leg. D. Uyeno. Allotype: male (NSMT-Cr 28345), collection data same as holotype. Paratypes: 2 adult males (NSMT-Cr 28346), collection data same as holotype; 3 females (NSMT-Cr 28347), ex body cavity of *P. squamosa* (male, 39.81 mm CL x 41.44 mm CW, Fig. 1D), Maehama Beach (27°1′N, 128°26′E), Yoron Island, Amami Islands, Japan, 18 May 2019, leg. D. Uyeno; 11 epicaridium larvae (NSMT-Cr 28348), ex brood pouch of holotype adult female.

**Description of holotype mature female**

Body (Figs. 1I, J, 4A, B) recurved, U-shaped, 1.70 mm long. Head ovate with two bulbous cephalic lobes (Fig. 4A). Two pairs of slender antennal lobes; inner lobe wider than outer lobe (Fig. 4C, D). Maxilliped uniramous, rep-
Fig. 4. *Allocancrion yunnu* gen. et sp. nov., mature female, NSMT-Cr 28344, ce = cephalic lobe, pl1–3 = pleural lamellae 1–3, he = heart, ai = inner antennal lobe, ao = outer antennal lobe, mxc = coxa of maxilliped, mxe = exopod of maxilliped, al = ascendant lobe, tl = transverse lobe, rl = recurrent lobe, p1–5 = pleopods 1–5. A, habitus, right lateral; B, same, left lateral; C, head, anterior; D, head, left lateral; E, right oostegite 1, right lateral; F, pleon, ventral; G, terminal pleomere, ventral, plll = posterolateral lobe. Scale bars: A, B, 3 mm; C, D, 1 mm; E, 2 mm; F, 1 mm; G, 500 µm.
represented by bean shaped coxa and lamellar exopod (Fig. 4C, D). Pereon with four pairs of ventrolateral ovarian processes; first, second, and fourth pairs hemispherical; third pair large, bean shaped; pereopods not observed (Fig. 4A, B). Oostegite 1 (Fig. 4E) well developed, composed of three uniramous lobes: ascendant lobe short; transverse lobes elongate; recurrent lobe largest, folded. Oostegites 2 to 5 fused into single large, membranous flap covering oostegite 1 (Fig. 1I, J).

Pleon unsegmented with oval bulbous heart on dorsal surface of pleomere 3; five pairs of uniramous pleopods present (Fig. 4B, F): pleomeres 1 to 3 with pair of pleural lamellae, lamellae folded with crispate margins; pleopods 1 to 4 represented by thin oval lobes (Fig. 4F); pleopod 5 represented by small lobe (Fig. 4F, G). Terminal pleomere (Fig. 4F, G) with pair of posterolateral lobes and two pairs of tapered projections.

**Description of allotype adult male**

Body (Fig. 5A, B) 1.70 mm long, widest at pleomere 5, 0.69 mm long. Head (Fig. 5A, B) ovoid, wider than long, 0.12 × 0.26 mm, incompletely fused to pleomere 1. Eyes posterolaterally situated on cephalon. Antennule (Fig. 5C) represented by bulbous lobe with 16 setae. Antenna absent. Oral cone covered with scales (Fig. 5C). Maxilliped represented by conical projection with pointed apical element (Fig. 5C).

Pereon with seven pleomeres, five pairs of pereopods on pleomeres 1 to 5 (Fig. 5A, B); pleomere 7 wider than long, 0.18 × 0.43 mm,
with pair of gonopores on posterolateral corners of ventral side (Fig. 5D). Pereopods (Figs. 5B, E) increasing in size posteriorly; all articles distinctly separated; merus with conical ventrodistal element; carpus and propodus covered with rows of small setules; dactylus represented by conical process.

Pleon with five pleomeres and pleotelson (Fig. 5A, B), 0.74 mm long; pleopods absent. Pleomeres with small denticles on ventral surface; pleotelson with pair of tapering lateral lobes, without uropods.
Variability
Morphology of female paratypes as for holotype; body length 9.45–22.47 (16.53 ± 6.58) (n = 2). Morphology of male paratypes as for allotype; measurements of body parts (n = 2): body length, 1.45–1.65 (1.55 ± 0.14), maximum width at pereomere V, 0.51–0.66 (0.59 ± 0.11); head wider than long, 0.11–0.12 (0.12 ± 0.01) × 0.22–0.29 (0.25 ± 0.05); pereomere VII wider than long, 0.14 (0.14 ± 0) × 0.31–0.43 (0.37 ± 0.08); pleon length 0.60–0.66 (0.63 ± 0.04).

Description of epicaridium larva
Body (Fig. 6A, B) tear-drop shaped, 0.38–0.41 (0.39 ± 0.01) mm long (n = 6).
Head ovoid with rounded anterior margin. Antennule (Fig. 6B, C) with three articles, distinctly segmented; proximal article with distal seta; middle article with five setae; distal article with two stout elements and four setae. Antenna (Fig. 6B, D) elongate with six articles; first to third articles unarmed; fourth article with two setae; fifth article with distal process; distal article with lateral expansion and one two-segmented long and three unsegmented short setae. Mandible (Fig. 6E) with two articles; distal article represented by blade with serrated tip. Maxilla (Fig. 6F) rod-shaped, with single long seta. Maxilliped (Fig. 6G) with two apical setae.
Pereon with seven pereomeres (Fig. 6A) bearing six pairs of pereopods. Pereopods (Fig. 6H–J) subequal in size with all articles distinctly separated except carpus fused to propodus; basis and ischium elongate, unarmed; merus small, unarmed; propodus/carpus enlarged with multifid setae on ventromedial margin and ventrodistal margin; dactylus of pereopods 1 to 5 slender, slightly curved. Pereopod 6 (Fig. 6J) with pointed dorsal process on merus; propodus/carpus with ventral setae and dorsal process with basal setae; small dactylus incompletely fused to propodus/carpus with basal setae.

Pleon with six pleomeres (Fig. 6A, B) and pleotelson. Five pairs of uniramous pleopods (Fig. 6B, K); protopod with two setae at tip of extended inner margin; exopod cylindrical with four distal setae. Pleotelson with biramous uropods (Fig. 6 L); peduncle with stout seta, apical flagellum on posterolateral corner; exopod and endopod rod shaped, subequal in length, each with two setae and three sharp processes on distal tip.

Infestation
Females were found in the visceral cavities of their hosts with males attached on the surface of the females. The carapaces of infested hosts are swollen such that the positions of the eye and first cephalic spine are shifted forward (Fig. 1D, E).

Etymology
The specific name “yunnu” refers to the local word for the type locality, Yoron Island.

Discussion
Allocancrion gen. nov. is closely related to Cancrion because the female has pairs of lateral ovarian processes but lacks unpaired ventral or dorsal processes. Cancrion was originally established based on Cancrion cancrorum (Müller, 1864) and other two species, C. floridus Giard & Bonnier, 1887 and C. miser Giard & Bonnier, 1887 by Giard & Bonnier (1887). The genus name was actually first referred to in Giard & Bonnier (1886) but it was a nomen nudum as no available species were unconditionally included in it at that time (Boyko et al. 2008 onwards). Cancrion was stated by Shiino (1942) as having the following characters (slightly modified): 1) female with more than two pairs of dorsal ovarian processes but without ventral ones; 2) marsupium incompletely closed, with oostegite 2 covering only the basal part of oostegite 1; 3) pleural lamellae of the female folded in first two pleomeres, folded or
simple in succeeding two; 4) cephalon of male distinctly separated or fused with pereomere 1; 5) pleon of male without ventromedian spine; 6) pereopod 6 of epicaridium larvae much longer than others, strongly prehensile, and with propodus bearing well-developed terminal process. Most genera of the subfamily Entioninae are defined on the basis of female characters, especially by the presence or absence of ovarian processes, with only a few genera distinguished using characters of the male and epicaridium larva (see Shiino 1942). Allocancrion yunnu gen. et sp. nov. differs from Cancrion spp. in the male having only five pairs of pereopods and the epicaridium larva not having an elongate pereopod 6; the female morphology is otherwise very similar to those in species of Cancrion. All seven known species of Cancrion are also distinguished based mainly on female characters (see Müller 1871; Giard & Bonnier 1887; Pearse & Walker 1939; Shiino 1942; Shields & Earley 1993), but some species lack information on males and epicaridium larvae (i.e., C. needleri was described only based on the female; C. floridus and C. miser lack epicaridium larval data). Furthermore, as Shields & Earley (1993) discussed, there are several species of Cancrion in need of re-description. It is necessary to redefine Cancrion with the extensive work in the future.

Because all females of Grapsus tenuicrustatus infested by Kepon grapsi nov. comb. were non-ovigerous, the parasites may affect their hosts’ reproductivity. There is a similar possibility of host castration for Allocancrion yunnu sp. nov. but further evidence for or against this is needed and might be revealed by additional field surveys. Based on the present study, it is known that there are at least 15 species in 13 genera of Keponinae and nine species in eight genera of Entioninae in Japanese waters (e.g., Shiino 1934, 1936a, b, 1937, 1942, 1950, 1951, 1954, 1958; Miyashita 1941; present study). Even though the waters around the Ryukyu Islands are known for their high biodiversity, the bopyroid fauna is still poorly known. In Keponinae and Entioninae, there are records of only two and one species, respectively (i.e., Megacepon goetici (Shiino, 1934) from Amami Island and K. grapsi nov. comb. and A. yunnu sp. nov. both from Yoron Island) (Shiino 1939: present study). It is expected that many unreported bopyroids, including undescribed species, will be discovered from future reaearch in the Ryukyu Islands.

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\section*{Literature Cited}

Bonnier, J., 1900. Contribution a l’étude des épicarides. Les Bopyridae. Travaux de la Station Zoologique de Wimereux, 8: 1–475, pls. 1–41.

Bourdon, R., 1967a. Sur trois nouveaux Bopyri-
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daе du Sénégal. Bulletin de l’Institut Fondamental d’Afrique Noire, Sér. A, 29: 107–122.

Bourdon, R., 1967b. Sur deux nouveaux épicroidi des (Isopoda) parasites de crustacés décapodes. Zoologische Mededelingen 42: 167–174.

Bourdon, R., 1968. Les Bopyridae des mers Européennes. Mémoires du Muséum National d’Histoire Naturelle, Série A, Zoologie, 50: 77–424.

Boxshall, G., & Hayes, P., 2019. Biodiversity and Taxonomy of the Parasitic Crustacea. In: N. J. Smit, N. L. Bruce, & K. A. Hadfield, (eds.), Parasitic Crustacea, Springer Nature Switzerland AG, Cham, pp. 73–134.

Boyko, C. B., 2004. The Bopyridae (Crustacea: Isopoda) of Taiwan. Zoological Studies 43: 677–703.

Boyko, C. B., Bruce, N. L., Hadfield, K. A., Merrin, K. L., Ota, Y., Poore, G. C. B., Taiti, S., Schotte, M., & Wilson, G. D. F., (eds.) 2008 onwards. World Marine, Freshwater and Terrestrial Isopod Crustaceans database. Accessed at http://www.marinespecies.org/isopoda on 2020–05–08.

Boyko, C. B., Moss, J., Williams, J. D., & Shields, J. D., 2013. A molecular phylogeny of Bopyroidea and Cryptoniscoidea (Crustacea: Isopoda). Systematics and Biodiversity, 11: 495–506.

Boyko, C. B., & Williams, J. D., 2009. Crustacean Parasites as Phylogenetic Indicators in Decapod Evolution. In: J. W. Martin, K. A. Crandall, & D. L. Felder, (eds.), Decapod Crustacean Phylogenetics, CRC Press, FL, pp. 197–220.

Codreanu, R., Codreanu, M., & Pike, R. B., 1960. Sur un nouveau type d’Entoniscien, Diogenion vermiforme n. g. n. sp., parasite du Pagure Diogenes senex Heller de la mer rouge. Comptes rendus des séances de l’Académie des Sciences. 251: 439–441.

Duvernoy, M., 1841. Sur un nouveau genre de l’ordre des Crustacés Isopodes et sur l’espèce type de ce genre, le Képone Type. Annales des Sciences Naturelles, Zoologie, ser. 2, 15: 111–122, pl. 4B.

Giard, A., 1906. Sur le Grapsicepon typus Duvernoy, parasite de Grapsus strigosus Herbst. Comptes Rendus des Séances et Mémoires de la Société de Biologie 58: 704–706.

Giard, A., & Bonnier, J., 1886. Sur le genre Entione Kossmann. Comptes Rendus Hebdomadaires des Séances de L’Académie des Sciences, 103: 645–647.

Gaird, A., & Bonnier, J., 1887. Contributions à l’Étude des Bopyriens. 272 pp, pls. 10. Lille: Imprimerie L. Danel.

Hartnoll, R. G., 1966. A new entoniscid from Jamaica (Isopoda, Epicaridea). Crustacea, 11: 45–52.

Humes, A. G., & Gooding, R. U., 1964. A method for studying the external anatomy of copepods. Crustacea, 6: 238–240.

Kossmann, R., 1881. Die entonisciden. Mittheilungen aus der Zoologischen Station zu Neapel, 3: 149–169, pls. 8–9.

Markham, J. C., 1985. Additions to the bopyrid fauna of Thailand. Zoologische Verhandelingen, 224: 1–63.

Markham, J. C., 2002. A new species of Leidya Cornalia and Panceri, 1861, and the first record of the genus Lobocepon Nobili, 1905, both from the eastern Pacific Ocean, with a review of the parasites of grapsid crabs.
worldwide (Isopoda, Bopyridae, Ioninae). In: E. Escobar-Briones, & F. Alvarez, (eds.), Modern Approaches to the Study of Crustacea, New York, Kluwer Academic/Plenum Publishers, pp. 328–338.

McDermott, J. J., Williams, J. D., & Boyko, C. B., 2019. A new genus and species of parasitic isopod (Bopyroidea: Entoniscidae) infesting pinnotherid crabs (Brachyura: Pinnotheridae) on the Atlantic coast of the USA, with notes on the life cycle of entoniscids. Journal of Crustacean Biology 40: 97–114.

Miyashita, Y., 1941. Observations on an entoniscid parasite of Eriocheir japonicus de Haan, Entionella fluviatilis n. g., n. sp. Japanese Journal of Zoology, 9: 251–267, pl. 3.

Müller, F., 1864. Für Darwin. 91 pp. Wilhelm Engelmann, Leipzig.

Müller, F., 1871. Bruckstücke zur Naturgeschichte der Bopyriden. Jenaische Zeitschrift für Naturwissenschaft, 6: 53–73, pls. 3–4.

Nierstrasz, H. F., & Brender à Brandis, G. A., 1923. Die isopoden der Siboga-Expedition. II. Isopoda genuina. I. Epicaridea. Siboga-Expedition 32b: 57–121, pls. 4–9.

Nierstrasz, H. F., & Brender à Brandis, G. A., 1931. Papers from Dr. Th. Mortensen’s Pacific Expedition 1914–16. LVII. Epicaridea II. Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i København, 91: 147–226, pl. 1.

Nobili, G., 1905. Decapodi e isopodi della Nuova Guinea Tedesca raccolti dal Sign. L. Biró. Annales Historico-Naturales Musei Nationalis Hungarici, 3: 480–507, pls. 12–13.

Pearse, A. S., & Walker, H. A., 1939. Two parasitic isopods from the eastern coast of North America. Proceedings of the United States National Museum, 87: 19–23.

Shields, J. D., & Earley, C. G., 1993. Cancrion australiensis new species (Isopoda: Entoniscidae) found in Thalamita sima (Brachyura: Portunidae) from Australia. International Journal of Parasitology, 23: 601–608.

Shiino, S. M., 1934. Bopyrids from Tanabe Bay II. Memoirs of the College of Science, Kyoto University, Series B, 9: 257–287.

Shiino, S. M., 1936a. Bopyrids from Shimoda and other districts. Records of Oceanographic Works in Japan, 8: 161–176.

Shiino, S. M., 1936b. Bopyrids from Tanabe Bay, III. Memoirs of the College of Science, Kyoto Imperial University (B), 11: 157–174.

Shiino, S. M., 1937. Bopyrids from Tanabe Bay, IV. Memoirs of the College of Science, Kyoto Imperial University (B), 12: 479–493.

Shiino, S. M. 1939. Bopyrids from Kyusyu and Ryukyu. Records of Oceanographic Works in Japan, 10: 79–99.

Shiino, S. M., 1942. On the parasitic isopods of the family Entoniscidae, especially those found in the vicinity of Seto. Memoirs of the College of Science, Kyoto Imperial University, Series B, 17: 37–76.

Shiino, S. M., 1950. Notes on some new bopyrids from Japan. Mie Medical Journal, 1: 151–167.

Shiino, S. M., 1951. Some bopyrid parasites found on the decapod crustaceans from the waters along the Mie Prefecture. Report of the Faculty of Fisheries, Prefectural University of Mie, 1: 26–40.

Shiino, S. M., 1954. A new fresh-water entoniscid isopod, Entionella okayamaensis n. sp. Report of Faculty of Fisheries, Prefectural University of Mie, 1: 239–246.

Shiino, S. M., 1958. Note on the bopyrid fauna of Japan. Report. Faculty of Fisheries. Prefectural University of Mie. 3: 29–73.

Stebbing, T. R. R., 1910. No. VI.—Isopoda from the Indian Ocean and British East Africa. Transactions of the Linnean Society of London, 2nd Series, Zoology, 14: 83–122, pls. 5–11.

Wada, K. 1995. Brachyura. In: S. Nishimura, (ed.), Guide to Seashore Animals of Japan with Color Pictures and Keys, Vol, II, Hokiusha, Osaka, pp. 379–418.[in Japanese]

Williams, J. D., & Boyko, C. B., 2012. The global diversity of parasitic isopods associated with crustacean hosts (Isopoda: Bopyroidea and Cryptoniscoidea). PLoS ONE, 7(4): e35350.
Williams, J. D., & Boyko, C. B., 2016. Abdominal bopyrid parasites (Crustacea: Isopoda: Bopyridae: Athelginae) of diogenid hermit crabs from the western Pacific, with descriptions of a new genus and four new species. Raffles Bulletin of Zoology, 64: 33–69.

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