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First record and a new species of *Alvinocaris* Williams & Chace, 1982 (Crustacea: Decapoda: Caridea: Alvinocarididae) from the Indian Ocean

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Abstract

A new species of the alvinocaridid shrimp genus *Alvinocaris* Williams & Chace, 1982 is described from the Solitaire hydrothermal vent field at 2606 m depth on the Central Indian Ridge. *Alvinocaris solitaire* **sp. nov.**, the first species of the genus to be recorded from the Indian Ocean, is morphologically most similar to *A. lusca* Williams & Chace, 1982 from the Galapagos Rift, East Pacific Rise. The new species is distinguished from *A. lusca* by the less produced pterygostomial angle of the carapace, the presence of small teeth on the posterolateral margin of the third pleuron, and the lack of short plumose setae on the posteromedian margin of the telson. The genetic divergence of the mitochondrial cytochrome *c* oxidase subunit I (COI) gene (600 bp) among the nine *Alvinocaris* species analyzed clearly indicates that the new taxon is distinct from the congeneric species for which genetic data are available.

Key words: *Alvinocaris solitaire*, Solitaire hydrothermal vent field, Central Indian Ridge, YK13-02 cruise

Introduction

The caridean family Alvinocarididae Christoffersen, 1986 is currently comprised of 27 described species in eight genera: *Alvinocaris* Williams & Chace, 1982, *Rimicaris* Williams & Rona, 1986, *Chorocaris* Martin & Hessler, 1990, *Opaepele* Williams & Dobbs, 1995, *Mirocaris* Vereshchaka, 1997, *Nautilocaris* Komai & Segonzac, 2004, *Shinkaicaris* Komai & Segonzac, 2005, and *Alvinocaridinides* Komai & Chan 2010. These species inhabit chemosynthetic environments (deep-sea hydrothermal vents and/or cold seeps) at depths of 252–4960 m (Nye *et al.* 2012; Lunina & Vereshchaka 2014). *Alvinocaris* is the most species-rich genus in the family, represented by 13 described species from the Atlantic and Pacific oceans (Table 1 and references therein).

Since the discovery of hydrothermal activity on the Central Indian Ridge, Indian Ocean, in 2000 (Hashimoto *et al.* 2001), several new species of decapod crustaceans have been described, viz., *Rimicaris kairei* Watabe & Hashimoto, 2002 and *Mirocaris indica* Komai, Martin, Zala, Tsuchida & Hashimoto, 2006 (Caridea: Alvinocarididae), *Munidopsis laticorpus* Cubelio, Tsuchida & Watanabe, 2008 (Anomura: Munidopsidae), and *Austinograea rodriguezensis* Tsuchida & Hashimoto, 2002 (Brachyura: Bythograeidae). During the research project "Quest for the Limit of Life (QUELLE) 2013" by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), the chemosynthetic assemblages of the recently discovered Dodo and Solitaire hydrothermal vent fields on the Central Indian Ridge (Nakamura *et al.* 2012) were investigated. Among the

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TABLE 1. List of species of *Alvinocaris* Williams & Chace, 1982 with summary of geographical and bathymetrical ranges.

Species	Distribution	References
Alvinocaris alexander Ahyong, 2009	Rumble V seamount, Brothers Caldera, Kermadec Ridge; 367–1346 m, hydrothermal vent	Ahyong (2009)
Alvinocaris brevitelsonis Kikuchi & Hashimoto, 2000	Minami-Ensei Knoll, Okinawa Trough, 705 m; hydrothermal vent	Kikuchi & Hashimoto (2000); Komai & Segonzac (2005)
Alvinocaris chelys Komai & Chan, 2010	Gueishandao, off northeastern Taiwan; 252–300 m, hydrothermal vent	Komai & Chan (2010)
Alvinocaris dissimilis Komai & Segonzac, 2005	Minami-Ensei Knoll, Okinawa Trough; 705 m, hydrothermal vent	Komai & Segonzac (2005)
Alvinocaris komaii Zelnio & Hourdez, 2009	Eastern Lau Spreading Center; 1880–2700 m, hydrothermal vent	Zelnio & Hourdez (2009)
Alvinocaris longirostris Kikuchi & Ohta, 1995	Iheya Ridge and Hatoma Knoll, Okinawa Trough; Off Hatsushima site, Sagami Bay; Brothers Caldera, Kermadec Ridge; 1053–1850 m, hydrothermal vent or cold seep	Kikuchi & Ohta (1995); Fujikura *et al.* (1995); Watabe & Miyake (2000); Ohta & Kim (2001); Webber (2004)
Alvinocaris lusca Williams & Chace, 1982	Rose Garden, Galapagos Rift; 9°N, East Pacific Rise; 2450–2520 m, hydrothermal vent	Williams & Chace (1982); Shank *et al.* (1999)
Alvinocaris markensis Williams, 1988	Mid-Atlantic Ridge; 1693–3650 m, hydrothermal vent	Williams (1988); Shank *et al.* (1999); Komai & Segonzac (2005)
Alvinocaris methanophila Komai, Shank & Van Dover, 2005	Blake Ridge Diapir; 2155 m, cold seep	Komai *et al.* (2005)
Alvinocaris muricola Williams, 1988	West Florida Escarpment, Gulf of Mexico; South Barbados; West African equatorial margin; Blake Ridge Diapir; 1697–3277 m, cold seep	Williams (1988); Komai & Segonzac (2005); Komai *et al.* (2005)
Alvinocaris niwa Webber, 2004	Rumble V seamount, Brothers Caldera, Kermadec Ridge; 360–1538 m, hydrothermal vent	Webber (2004)
Alvinocaris solitaire sp. nov.	Solitaire field, Central Indian Ridge; 2606 m, hydrothermal vent	this study
Alvinocaris stactophila Williams, 1988	Louisiana Slope, Gulf of Mexico; 534 m, cold seep	Williams (1988); Komai & Segonzac (2005)
Alvinocaris williamsi Shank & Martin, 2003	Menez Gwen, Mid-Atlantic Ridge; 850–865 m, hydrothermal vent	Shank & Martin (2003); Komai & Segonzac (2005)

peripheral vent biota, one specimen of caridean shrimp was sampled. Subsequent morphological examination of this shrimp and analyses of partial sequences of the mitochondrial COI gene have revealed that the specimen represents an undescribed species of the genus *Alvinocaris*. Here we describe and illustrate the new species, *Alvinocaris solitaire*, on the basis of this single specimen. Differentiating morphological characters and the relationship among species of *Alvinocaris* inferred from a phylogenetic analysis of the COI gene are discussed.

Material and methods

Material. The holotype was collected from the Solitaire hydrothermal vent field (19°33.413'S, 65°50.888'E, at 2606 m depth) by using a suction sampler installed on the human occupied vehicle (HOV) "Shinkai 6500". The specimen was initially frozen, and later transferred to 70% ethanol. Postorbital carapace length (cl), measured from the rostral base to the midpoint of the posterodorsal margin of the carapace, indicates specimen size. The holotype is deposited in the National Museum of Nature and Science, Tsukuba (NSMT).

Phylogenetic analyses. Genomic DNA was extracted from the holotype's pleonal muscle with the DNeasy Tissue Extraction Kit (QIAGEN, Hilden, Germany). A fragment containing a part of the mitochondrial COI gene (600 bp) was amplified by the polymerase chain reaction (PCR) using the LCO1490/HCO2198 universal primers (Folmer *et al.* 1994). Amplification was performed in 20 μℓ reaction mixtures of genomic DNA, 2 μℓ of 10×EX *Taq* buffer, 0.3 μM of dNTP mix, 20 μM of each primer, and 0.05 unit of EX *Taq* DNA polymerase (TaKaRa Bio Inc., Ohtsu, Japan). PCR reactions were carried out with an initial denaturation step at 94 °C (40 s) followed by 35 cycles consisting of a denaturation step at 94 °C (40 s), an annealing step at 50 °C (60 s), and an extension step at 72 °C (90 s). PCR products were purified using Exo-SAP-IT (United States Biochemical, Cleveland, OH). DNA sequences were determined using an ABI 3130 automated DNA sequencer (Applied Biosystems®, Life Technologies Corporation, Carlsbad, USA) with a BigDye Terminator Cycle Sequencing Kit Version 3.1 (Applied Biosystems®). The obtained sequence was edited and aligned using the computer program package MEGA 5.05 (Tamura *et al.* 2011) and corrected by visual inspection. The sequence was deposited in DDBJ/EMBL/GenBank databases (Accession number: LC007114). Neighbor-joining (NJ) and maximum likelihood (ML) trees were constructed in MEGA 5.05 with Kimura 2-parameter (K2P) distances to elucidate the phylogenetic relationship and genetic divergences between the holotype and eight *Alvinocaris* species, which are registered in GenBank (see Table 2). The alvinocaridid species *Rimicaris exoculata* Williams & Rona, 1986 and *Nautilocaris saintlaurentae* Komai & Segonzac, 2004 were used as out-group taxa in the NJ and ML analyses.

Taxonomy

Family Alvinocarididae Christoffersen, 1986

Genus *Alvinocaris* Williams & Chace, 1982

Alvinocaris solitaire sp. nov.

(Figs. 1–6)

Material examined. Holotype: RV "Yokosuka", YK 13-02 cruise, Central Indian Ridge, Solitaire hydrothermal vent field, HOV "Shinkai 6500", dive 6K#1326, 19°33.413'S, 65°50.888'E, 2606 m depth, 10 February 2013, male (cl 14.1 mm), NSMT-Cr 23748.

Description. Body (Fig. 1) moderately slender; integument thin, surface almost glabrous, shining.

Rostrum (Fig. 2A, B) directed forward, nearly straight, but distal part slightly bent, 0.60 of carapace length, slightly reaching beyond distal margin of second segment of antennular peduncle; dorsal margin nearly straight, armed with 16 teeth, including 9 teeth on rostrum proper and 7 teeth on carapace posterior to orbital margin, posteriormost tooth arising at 0.45 of carapace length (most of postrostral teeth broken at tips); ventral margin armed with 2 teeth in anterior 0.30; lateral carina distinct in proximal half, merging into orbital margin.

Carapace (Figs. 1, 2A, B) with postrostral median ridge relatively low, extending to 0.70 of carapace length, dorsal angle approximately 165°. Carapace width 0.58 of length. Orbital margin evenly concave. Antennal tooth

moderately strong; pterygostomial tooth relatively small, not exceeding beyond antennal tooth. Post-antennal groove shallow; branchial region not particularly inflated.

Eighth thoracic sternite with long median spur directed anteroventrally.

Pleon (Fig. 1) rounded dorsally. First and second pleura unarmed marginally; third pleuron with 4 (right) and 6 (left) slender teeth on posterolateral margin (Fig. 2C, D); fourth pleuron with relatively strong posteroventral tooth and additional 3 (right) and 5 (left) on posterolateral margin and 2 tiny denticles on ventral margin (Fig. 2C, D); fifth pleuron with strong posteroventral tooth and 3 additional small, slender teeth on posterolateral margin (Fig. 2C, D). Sixth abdominal somite 1.62 times longer than high, with small but distinct posteroventral tooth.

Telson (Fig. 2E) not reaching posterior margin of uropodal endopod, length 3.20 times anterior width and 4.15 times posterior width; armed with 7 dorsolateral spines on either side; posterior margin (Fig. 2F) medially shallowly concave, armed with 5 pairs of upturned spines (mesial spines unequal in length), no plumose setae medially.

Eyes (Fig. 2A, B) fused mesially; corneas globular, unfaceted, and unpigmented; demarcation between corneal region and stalk unclear; small spiniform tubercle on anterodorsal surface, directed upward.

Antennular peduncle (Fig. 2A, B) moderately stout, reaching beyond distal margin of antennal scale. First segment with conspicuous proximal tubercle on dorsal surface laterally and strong distolateral tooth; dorsal surface with distinct longitudinal groove; stylocerite sharp, reaching to distal 0.25 of second segment. Second segment 1.95 times longer than wide, with small distomesial tooth. Lateral flagellum (Fig. 1) longer than carapace; mesial flagellum somewhat longer than lateral flagellum.

Antenna (Fig. 2A, B, G) with stout basicerite bearing moderately strong ventrolateral and weak ventral teeth. Carpocerite stout, not reaching mid-length of antennal scale. Antennal scale about half length of carapace, 2.10 times longer than wide; lateral margin nearly straight; middorsal ridge on dorsal surface slightly diverging against lateral margin; distolateral tooth fairly strong, directed forward, falling short of broadly rounded distal margin of blade.

Mouthparts typical of genus (cf. Komai & Segonzac 2005). Mandible (Fig. 3A) with incisor process bearing 8 marginal teeth in left; molar process slender, rounded tip minutely setose; palp bi-articulated. Maxillule (Fig. 3B) with endopod bearing 2 minute setae on ventral surface of external lobe, internal lobe with 1 apical setulose seta. Maxilla (Fig. 3C) without distinctive features. First maxilliped (Fig. 3D) without trace of flagellum on moderately broad exopod; endopod bi-articulated, distal article very short (Fig. 3E). Second maxilliped (Fig. 3F) with endopod moderately stout; epipod subtriangular, with non-lamellate, rod-like podobranch.

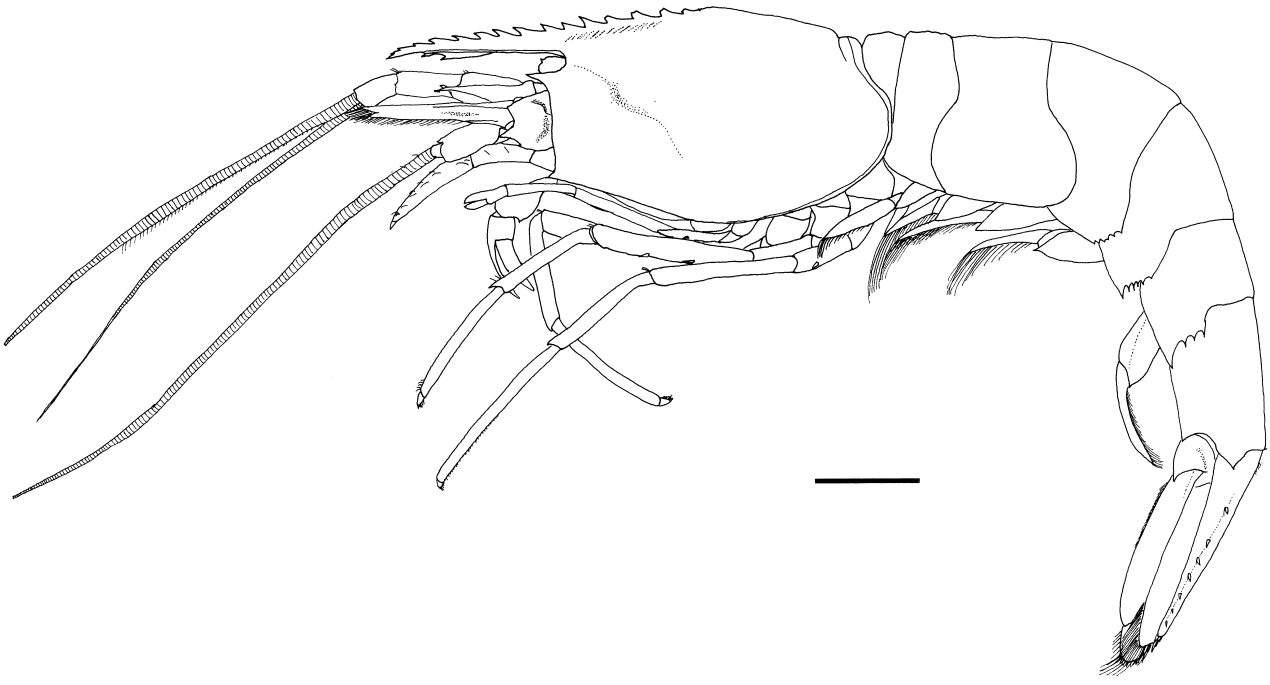

FIGURE 1. *Alvinocaris solitaire* **sp. nov.**, holotype, male (cl 14.1 mm), NSMT-Cr 23748, entire animal in lateral view. Scale bar = 5 mm.

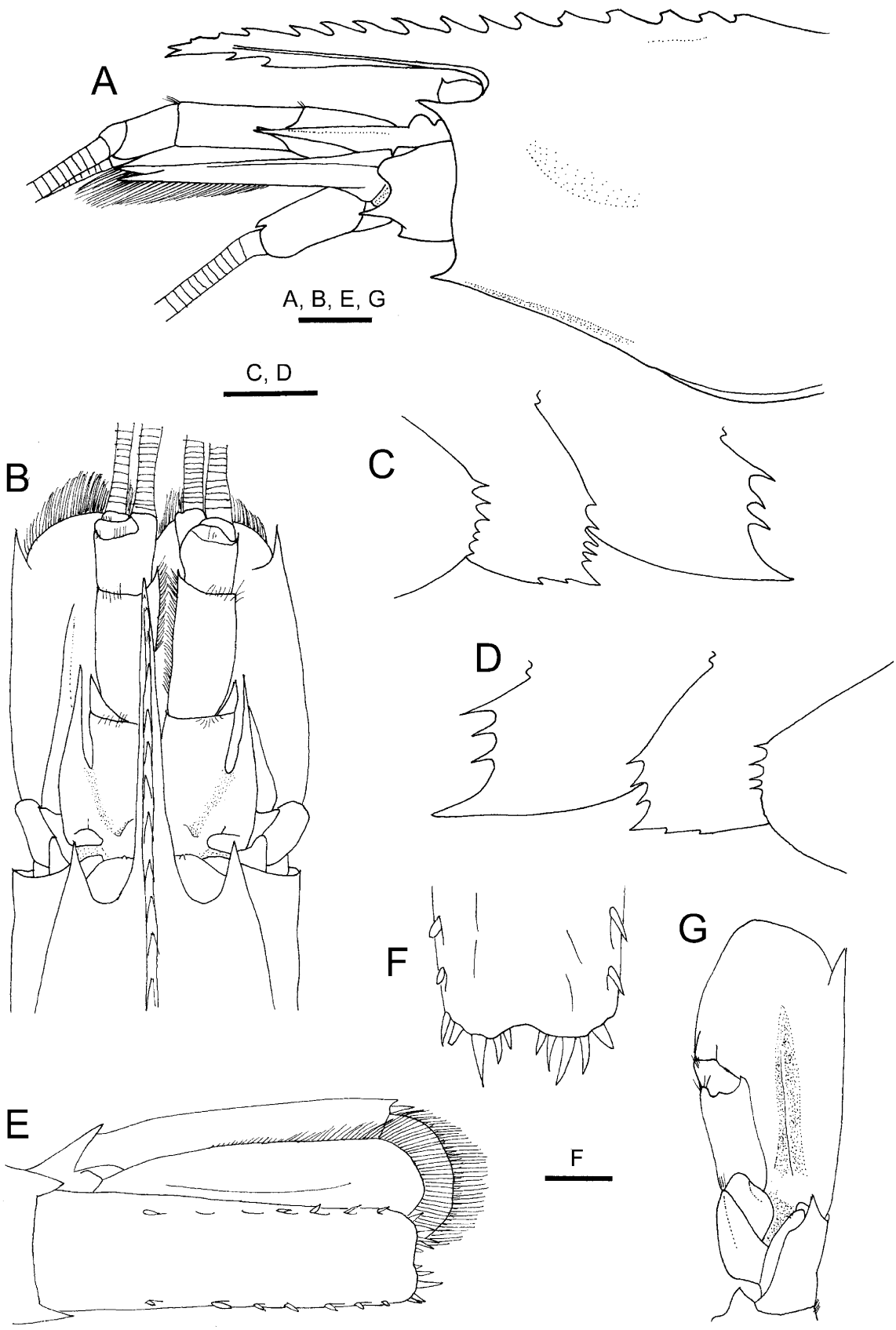

FIGURE 2. *Alvinocaris solitaire* **sp. nov.**, holotype, male (cl 14.1 mm), NSMT-Cr 23748. A, anterior part of carapace and cephalic appendages, lateral view; B. same, dorsal view; C, left third to fifth pleura of pleon, lateral view; D, right third to fifth pleura of pleon, lateral view; E, telson, dorsal view; F, posterior margin of telson, dorsal view; G, antennal scale, ventral view. Scale bars = 2 mm (A–E, G), 1 mm (F).

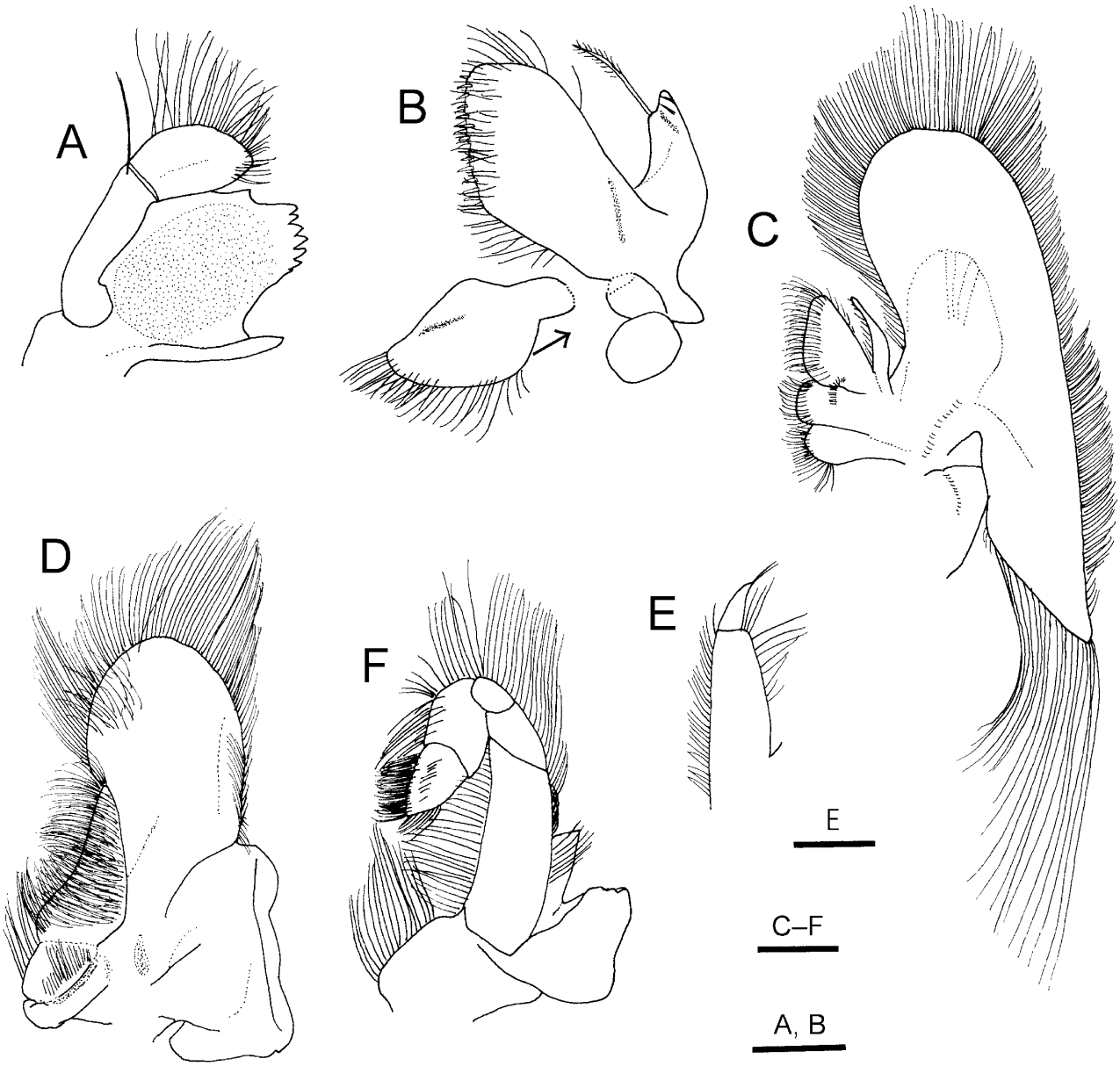

FIGURE 3. *Alvinocaris solitaire* **sp. nov.**, holotype, male (cl 14.1 mm), NSMT-Cr 23748, left mouthparts. A, mandible, inner view; B, maxillule, outer view (inset: coxal endite detached); C, maxilla, outer view; D, first maxilliped, outer view; E, endopod of first maxilliped; F, second maxilliped, outer view. Scale bars = 1 mm (C, D, F); 0.5 mm (A, B, E).

Third maxilliped (Fig. 4A) overreaching antennal scale by about half length of ultimate segment. Ultimate segment distinctly longer than penultimate segment (= carpus), trigonal in cross section, tapered distally, bearing 2 terminal spines; lateral surface longitudinally carinate, with row of setae; ventromesial surface flat, with rows of dense setae. Antepenultimate segment (fused merus, ischium and basis) flattened dorsoventrally, sinuously curved in dorsal view, bearing long marginal setae and 1 slender spine at ventrolateral distal angle. Coxa stout; epipod directed laterally, slightly bi-lobed.

First pereopod (Figs. 4B, 5A, B) reaching mid-length of ultimate segment of third maxilliped, moderately robust. Fingers elongate, curved downward and inward, opposable edges each armed with comb-like row of uniform teeth close-set against one another, teeth of fixed finger somewhat longer than those on dactylus; dactylus 4.7 times as long as palm; fixed finger; palm very short, slightly inflated, without patch of grooming setae. Carpus cup-like, 3.0 times as long as palm, distal half of flexor surface flared into prominent lateral ridge ending in strong tooth; mesial surface shallowly excavated, with grooming apparatus consisting of patch of short setae. Merus and ischium unarmed, somewhat flattened.

Second pereopod (Figs. 4C, 5C) shorter and more slender than first, reaching mid-length of antennal scale; fingers subequal to in length to palm, curved distally and cross each other when closed, each terminating in acute corneous unguis; no hiatus between fingers; opposable margins each pectinated with single row of minute corneous teeth. Carpus longer than chela. Merus and ischium obliquely articulated in lateral view; ischium armed with 1 spine ventrolaterally.

Third to fifth pereopods moderately slender, generally similar in structure but propodi becoming progressively longer from third to fifth. Third pereopod (Fig. 4D) overreaching distal margin of antennal scale by half length of propodus; dactylus (Fig. 5D) short, armed with single row of 4 accessory spinules on flexor margin and clearly demarcated unguis; propodus with slender spinules arranged in 2 rows on ventral surface; carpus shorter than propodus, unarmed; merus with 3 spines on lateral surface ventrally; ischium with 2 spines on lateral surface ventrally. Fourth pereopod (Fig. 4E) overreaching distal margin of antennal scale by 0.20 length of propodus; merus armed with 3 spines; ischium with 2 spines. Fifth pereopod (Fig. 4F) slightly reaching beyond distal margin of antennal scale by tip of propodus; propodus with numerous spiniform setulose setae on ventral surface, arranged in 3 or 4 longitudinal rows; merus spineless; ischium with 2 spines.

Male first pleopod (Fig. 5E, F) with endopod having relatively broad, distally narrowing distomesial lobe bearing 6 spiniform setae directed mesially or distomesially on mesial margin and 4 simple stiff setae on lateral margin; lateral margin of endopod proper proximal to base of distomesial lobe gently convex, with row of plumose setae; mesial margin faintly sinuous, with row of stiff setae including 4 simple stiff setae in distal half, other setae plumose. Appendix masculina on second pleopod (Fig. 5G, H) shorter than appendix interna, distally with 6 spiniform setae.

Uropods (Fig. 2E) with both rami elongate oval. Exopod slightly longer than endopod, with small movable spine just mesial to smaller distolateral tooth; dieresis sinuous.

Coloration in life. Body (Fig. 6) whitish translucent. Eye light yellow with shiny reflection.

Distribution. Known only from the type locality, the Solitaire hydrothermal vent field, Central Indian Ridge, at a depth of 2606 m.

Remarks. *Alvinocaris* is typically characterized by a slender rostrum with dorsal teeth, the well-developed postrostral ridge extending beyond the mid-length of the carapace, the dorsolateral spines on the telson arranged in a linear row, the possession of a small spiniform tubercle on the anterior surface of the eye, the dactyli of the third to fifth pereopods bearing accessory spinules arranged in a single row, and the presence of meral spines on the third and fourth pereopods (Komai & Segonzac 2005). The new species is assigned to *Alvinocaris* without hesitation on account of these characters.

Alvinocaris solitaire **sp. nov.** is morphologically most similar to *A. lusca* from the Galapagos Rift, East Pacific Rise in the shape and posterior armature of the telson: in both species, the telson is very slightly narrowed toward the posterior; the posterior margin is medially shallowly excavated and, armed with a row of spines. These two species are also similar in the length and armature of the rostrum, little elevated dorsum of the carapace and the general armature of the third to fifth pereopods. Nevertheless, the new species can be distinguished from *A. lusca* by some minor morphological differences (Williams & Chace 1982; Komai & Segonzac 2005): in *A. solitaire* **sp. nov.**, the pterygostomial tooth is weak, not exceeding the antennal tooth, whereas it is stronger and exceeds the latter in *A. lusca*; the pleuron of the third pleomere is armed with small but conspicuous teeth on the posteroventral margin in the new species, rather than unarmed in *A. lusca*; the posterior margin of the telson is devoid of setae medially in the new species, whereas there are a few short plumose setae on the medial part of the posterior margin in *A. lusca*.

Alvinocaris komaii is also similar to *A. solitaire* **sp. nov.** and *A. lusca* in the structure and armature of the telson, but it is readily distinguished from them by the stronger postrostral teeth on the carapace and the accessory spinules on the dactyli of the third to fifth pereopods arranged in two rows (Zelnio & Hourdez 2009).

Two other congeners, *Alvinocaris brevitelsonis* known from the Minami Ensei Knoll in the Okinawa Trough, Japan, and *A. stactophila* from the Gulf of Mexico, also have a row of spines, instead of plumose setae, on the posterior margin of the telson. However, in these two species, the third pleuron is unarmed; the narrowing of the telson posteriorly is more pronounced; and the posterior margin of the telson is regularly convex, without median excavation (Williams 1988; Kikuchi & Hashimoto 2000; Komai & Segonzac 2005). The new species differs further from *A. brevitelsonis* in having fewer rostral ventral teeth (2 versus 7). *Alvinocaris solitaire* **sp. nov.** contrasts with *A. stactophila* in the longer rostrum and arrangement of spines on the posterior margin of the telson.

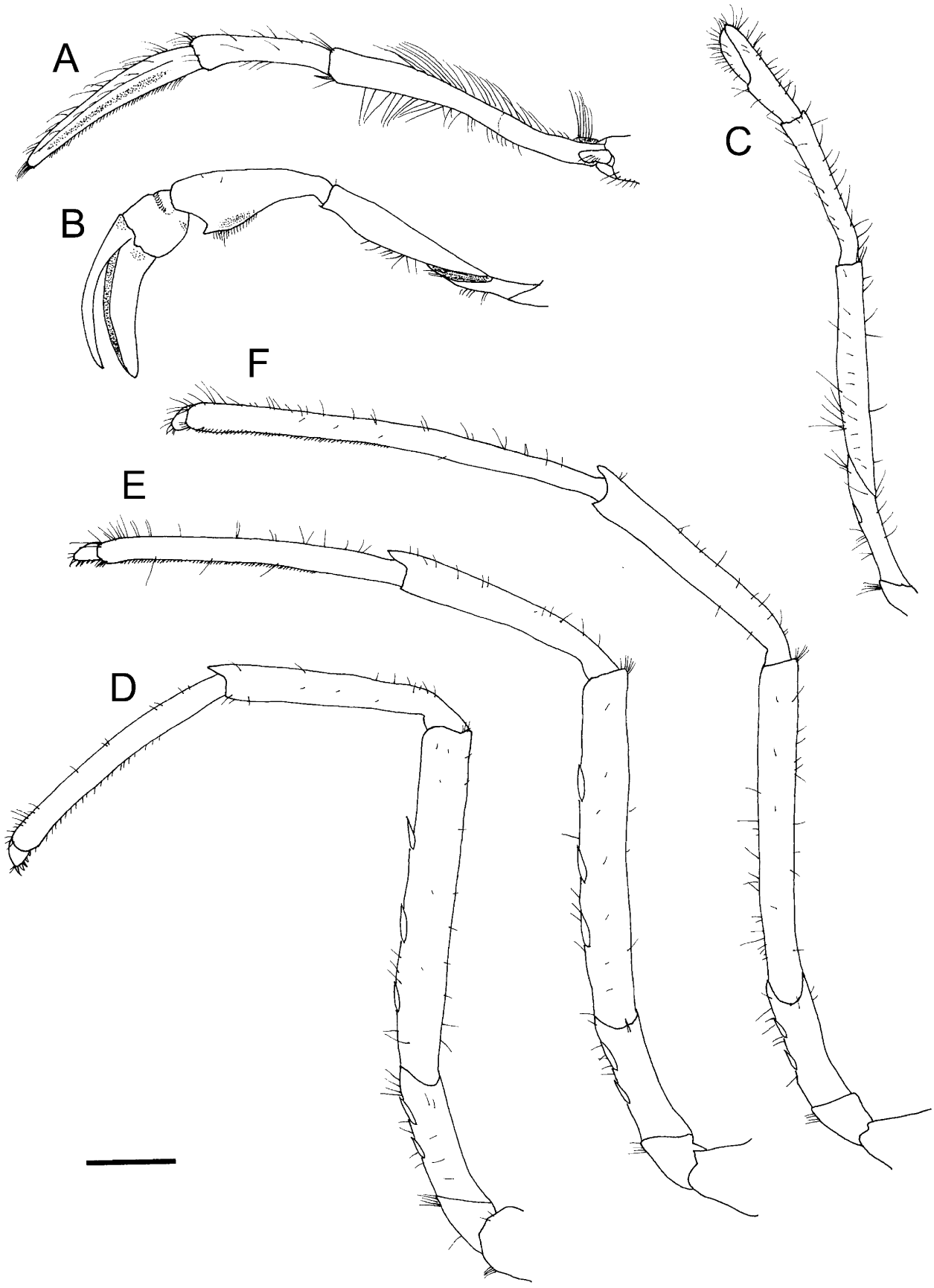

FIGURE 4. *Alvinocaris solitaire* **sp. nov.**, holotype, male (cl 14.1 mm), NSMT-Cr 23748, left thoracic appendages. A, third maxilliped, lateral view; B, first pereopod, lateral view; C, second pereopod, lateral view; D, third pereopod, lateral view; E, fourth pereopod, lateral view; F, fifth pereopod, lateral view. Scale bar = 2 mm.

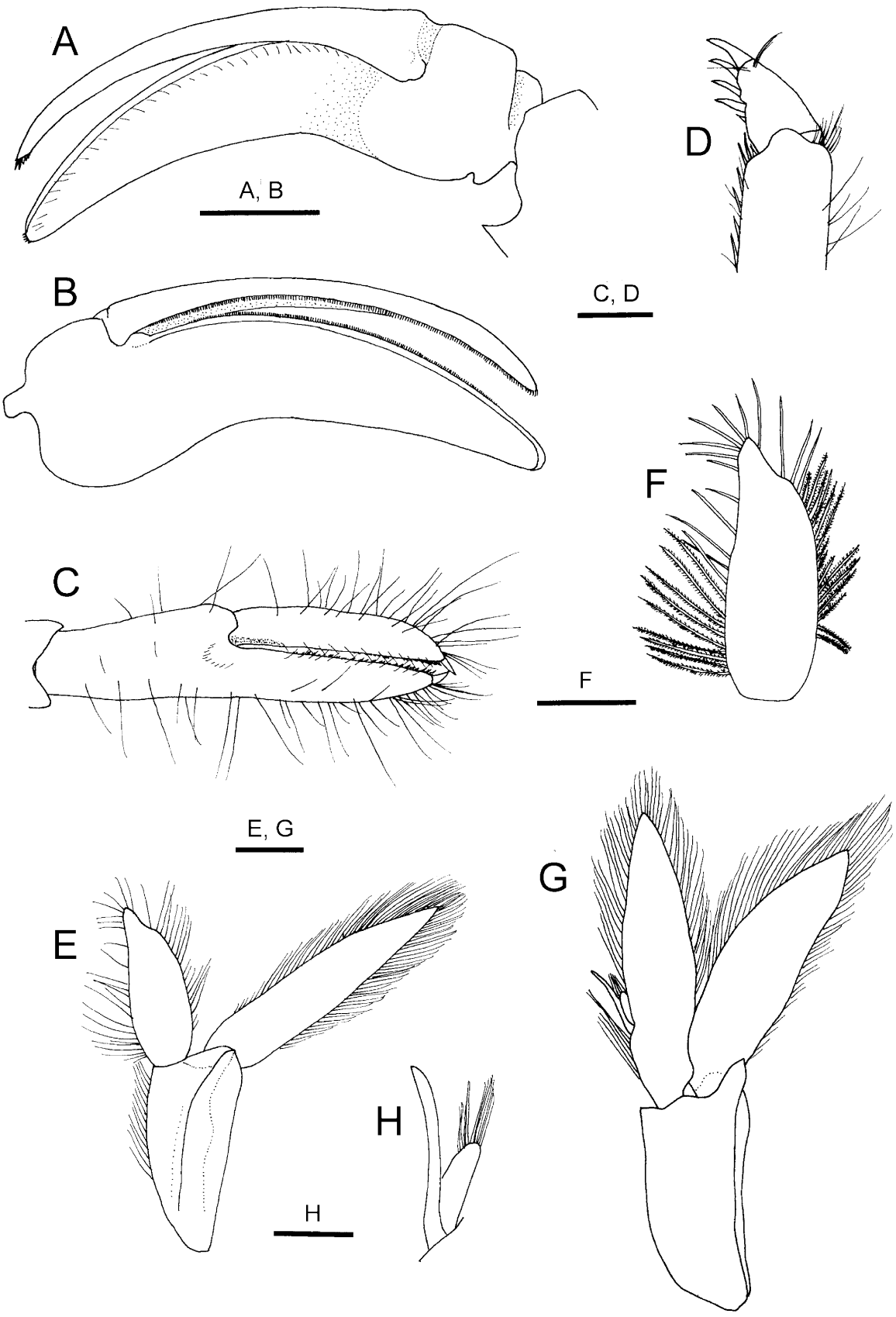

FIGURE 5. *Alvinocaris solitaire* **sp. nov.**, holotype, male (cl 14.1 mm), NSMT-Cr 23748. A, chela of left first pereopod, lateral view; B, same, mesial view; C, chela of left second pereopod, dorsal view; D, dactylus of third pereopod, lateral view; E, left first pleopod, ventral view; F, same, endopod, ventral view; G, left second pleopod, ventral view; H, appendices interna and masculina of left second pleopod, mesial view. Scale bars = 1 mm (A, B, E, G); 0.5 mm (C, D, H).

FIGURE 6. *Alvinocaris solitaire* **sp. nov.**, holotype, male (cl 14.1 mm), NSMT-Cr 23748, entire animal in lateral view.

The neighbor-joining (NJ) and maximum likelihood (ML) trees inferred from partial COI sequences (600 bp) for nine species of *Alvinocaris*, including the new species, are shown in Fig. 7.

Alvinocaris solitaire **sp. nov.** is clustered with a clade including *A. markensis*, *A. muricola*, *A. longirostris* and *A. lusca* with high bootstrap support (96% in both trees). Interspecific genetic divergence (K2P) among these nine species is summarized in Table 2. The mean value of genetic divergence observed within *Alvinocaris* was 0.135. The new species is closest to *A. muricola* and *A. markensis* genetically (0.112 and 0.114, respectively), although morphological characters do not support this close relationship. The genetic divergence between *A. solitaire* **sp. nov.** and *A. lusca* is 0.140, well supporting the differentiation of the two species. *Alvinocaris dissimilis* is most genetically divergent from *A. solitaire* **sp. nov.** (0.165). The maximum divergence within *Alvinocaris* is between *A. lusca* and *A. komaii* (0.206); *A. komaii* is clustered with the out-group species *Rimicaris exoculata* in the both trees, although the bootstrap support is weak (see also Zelnio & Hourdez 2009).

The new species represents the discovery of *Alvinocaris* from Indian-Ocean hydrothermal vents, despite extensive biological sampling in the area by previous expeditions (Hashimoto *et al.* 2001, Van Dover *et al.* 2001, Nakamura *et al.* 2012).

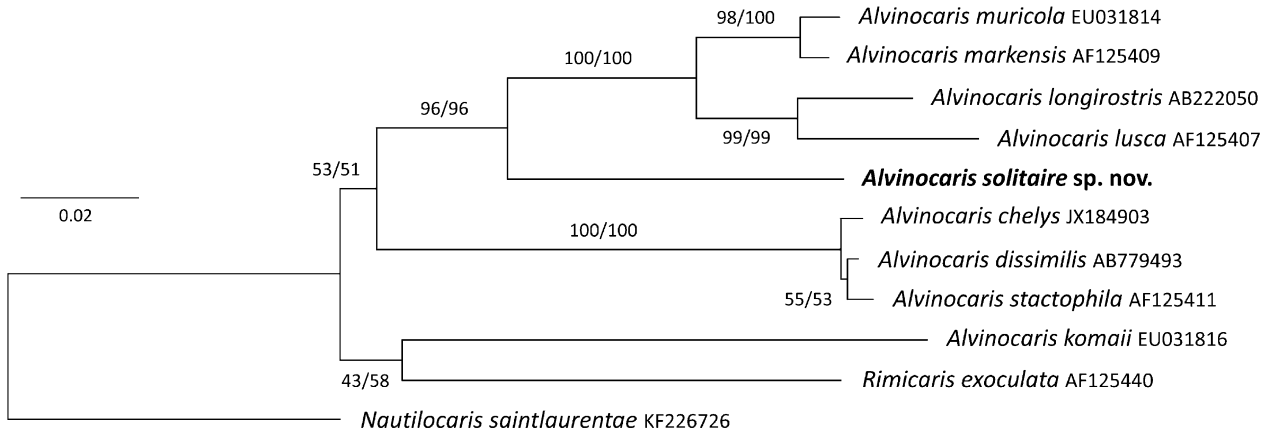

FIGURE 7. Phylogenetic relationships among *Alvinocaris solitaire* **sp. nov.** and eight species of *Alvinocaris* registered in GenBank, analyzed by maximum likelihood (ML) and neighbor-joining (NJ) methods with *Nautilocaris saintlaurentae* and *Rimicaris exoculata* as out-group taxa. Bootstrap values of ML (left) and NJ (right) are indicated above branches of clades.

TABLE 2. Genetic divergence of the mitochondrial cytochrome *c* oxidase subunit I gene among the nine species of *Alvinocaris* calculated from Kimura 2-parameter-corrected calculations.

Species	1	2	3	4	5	6	7	8
1. *Alvinocaris solitaire* **sp. nov.**								
2. *Alvinocaris muricola* EU031814	0.112							
3. *Alvinocaris markensis* AF125409	0.114	0.012						
4. *Alvinocaris longirostris* AB222050	0.129	0.063	0.059					
5. *Alvinocaris lusca* AF125407	0.140	0.072	0.070	0.050				
6. *Alvinocaris chelys* JX184903	0.163	0.154	0.159	0.180	0.189			
7. *Alvinocaris komaii* EU031816	0.163	0.177	0.177	0.193	0.206	0.191		
8. *Alvinocaris stactophila* AF125411	0.164	0.156	0.161	0.182	0.189	0.010	0.190	
9. *Alvinocaris dissimilis* AB779493	0.165	0.154	0.159	0.180	0.189	0.005	0.188	0.005

Habitat and associated species. The present specimen was collected in an assemblage of white predatory gastropods of the genus *Phymorhynchus*, which is distributed in the periphery of an actively venting area in the Solitaire hydrothermal vent field. The alvinocaridid shrimp *Mirocaris indica* and some species of polychaetes (e.g. *Archinome* sp.) and limpets (e.g. *Eulepetopsis* sp.) were collected with *A. solitaire* **sp. nov.**

Etymology. Named after the type locality, Solitaire hydrothermal vent field; used as noun in apposition. The name of the hydrothermal vent field, "Solitaire", was derived from an extinct species of an endemic bird (Rodriguez solitaire, *Pezophaps solitaria*) inhabiting Rodriguez Island (Nakamura *et al.* 2012).

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