



A NEW GENUS AND SPECIES OF CARIDEAN SHRIMP (CRUSTACEA: DECAPODA: ALVINOCARIDIDAE) FROM NORTH ATLANTIC HYDROTHERMAL VENTS

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Iorania concordia gen. nov., sp. nov. (Crustacea: Decapoda) belonging to the family Alvinocarididae is described from the Mid Atlantic Ridge, TAG location (26°09'N 44°50'W). The taxonomic position in the family and distinguishing characters (rostrum, armature of telson, form of first maxilliped) of the new genus are presented, and a possible evolutionary feeding hierarchy within the family is suggested. A key is given to the genera of the Alvinocarididae.

INTRODUCTION

Collections from hydrothermal vents of the Mid Atlantic Ridge in 1994 have yielded new taxa of hydrothermal shrimps. The first was placed in the new genus within the Bresilioidea (Vereshchaka, in press). The second species is here placed in another new genus within the Alvinocarididae. These are extremely abundant in the area, comprising (together with *Rimicaris exoculata* Williams & Rona, 1986) the main bulk of the biomass of the hydrothermal area of the northern Mid Atlantic Ridge vents such as TAG and Broken Spur. The newly described shrimps aggregate near the black smokers, and their general appearance resembles young specimens of *R. exoculata*. This is a possible explanation of why these new shrimps, so strikingly different in the morphology of appendages from the other genera of hydrothermal shrimps, have not been recorded before in this well-studied area. The discovery of these new taxa has been made possible by the use of deep-sea manned submersibles which have allowed shrimps to be sampled directly from their aggregations where they are abundant.

MATERIAL AND METHODS

Present material was taken during the 34th cruise of RV 'Akademik Mstislav Keldysh', conducted as a part of the British-Russian Programme BRAVEX-94, August - October 1994, with the use of two deep-sea manned submersibles 'Mir 1' and 'Mir 2' in two locations of the Mid Atlantic Ridge: TAG (~26°N) and Broken Spur (~29°N).

Shrimps were collected using slurp-guns installed on the submersibles and a special trap that acted as a pump (detailed description see Vinogradov & Vereshchaka, 1995). Mesh size in the slurp-gun containers and in the 'pump-trap' ranged from 0.3 to 1.0 mm. Immediately after retrieval all specimens were sorted, measured, and fixed in 80% alcohol.

SYSTEMATICS

Order DECAPODA Latreille, 1802

Suborder NATANTIA Boas, 1880

Infraorder CARIDEA Dana, 1852

Superfamily BRESILIODEA Calman, 1896

Family ALVINOCARIDIDAE Christoffersen, 1986

Alvinocarididae: Christoffersen, 1986: 273; Segonzac et al., 1993: 535; Vereshchaka, in press.

Bresiliidae: Williams & Chace, 1982: 145; Kensley, 1983: 2 (part); (part) Williams & Rona, 1986: 460 (part); Williams, 1988: 263 (part); Wicksten, 1989: 671 (part); Martin & Hessler, 1990: 2 (part); Chace, 1992: 70 (part); Holthuis, 1993: 69; Vinogradov & Vereshchaka, 1995: 18 (part).

Family diagnosis

Rostrum when present denticulate or smooth; exopods rudimentary on maxilliped 3 and lacking on pereopods; no pereopodal epipods; arthrobranchs at maxilliped 3 to pereopod 4; appendix interna developed in pleopods 2–4.

Includes *Alvinocaris* Williams & Chace, 1982; *Chorocaris* Martin & Hessler, 1990; *Rimicaris* Williams & Rona, 1986; *Iorania*, gen. nov.

Iorania gen. nov.

Type species: *Iorania concordia* sp. nov. (by monotypy).

Genus description

Integument firm. Rostrum smooth, lacking teeth, tip acute or rounded. Carapace flattened and rounded, pterygostomial and branchial regions enormously expanded; no antennal and pterygostomal spines, no trace of hepatic groove (Figure 1A); last thoracic sternite with strong medial tooth between coxae of fifth pereopods. Abdomen without dorsal carina, distally tapering, 2.2 times as long as carapace (including telson); sternite of somite 5 with strong medial tooth. Telson bearing 8–9 pairs of dorsolateral spines, posterior margin armed with one medial tooth and several pairs of longer spines.

Eyes with exposed parts not fused, cornea rounded, without facets and pigment (Figure 1B). Antennular peduncle with stylocerite long and acute. Antennal scaphocerite distally rounded, distolateral spine rudimentary.

Mandibular incisor process bearing six terminal and one subterminal teeth; palp two-segmented. First maxilla with both endites subequal in size; palp with rounded tip, distal plumose setae subterminal. Second maxilla with distal endite ~1.5 times as long as each of subequal proximal endites, subtriangular; palp overlapping distal endite; scaphognathite elongate, distally narrowing, with terminal setae on posterior lobe as long as scaphognathite.

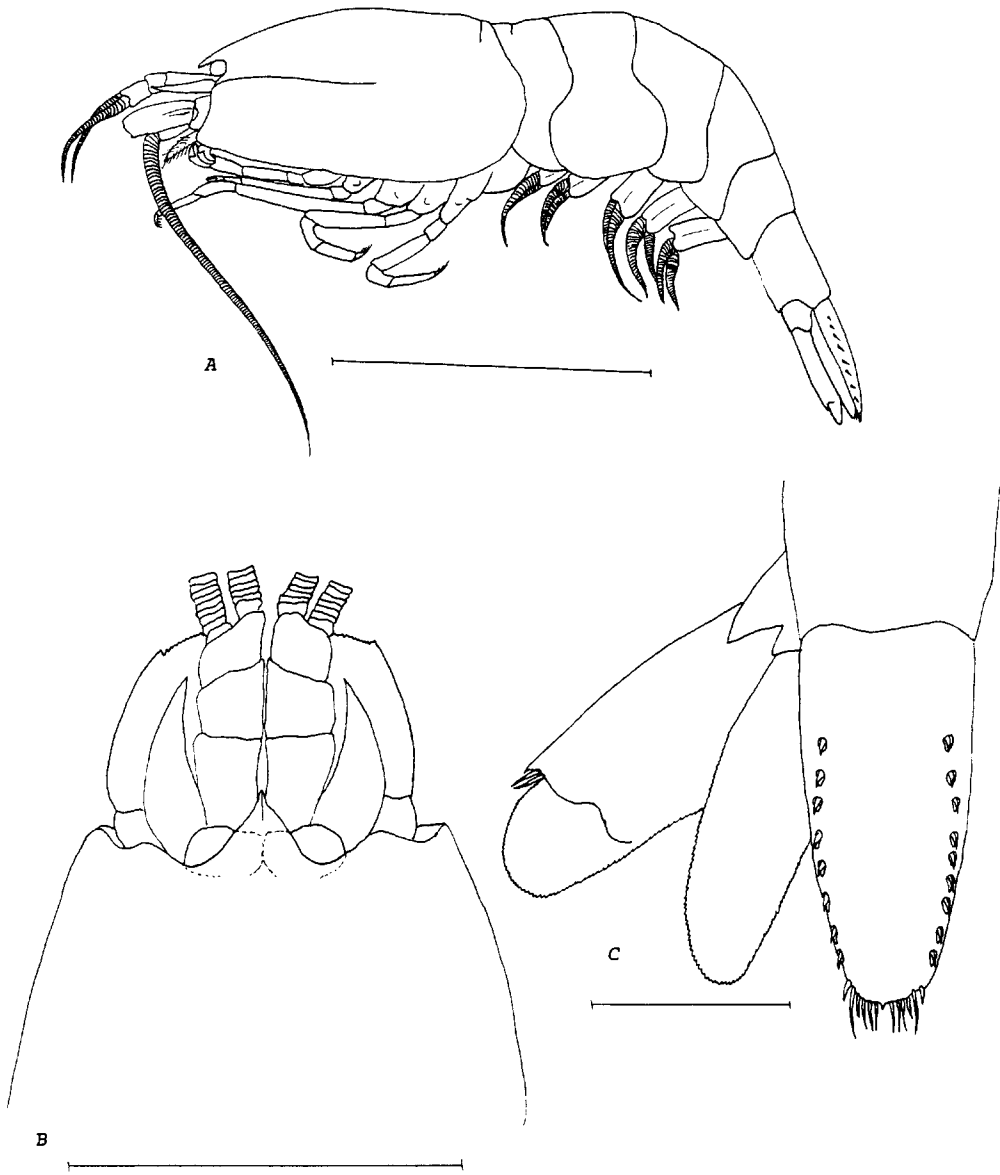


Figure 1. *Iorania concordia*, female holotype: (A) lateral view; (B) anterior region, dorsal view; (C) telson and uropods, dorsal view. Scale bars: (A) 10 mm; (B) 5 mm; (C) 2 mm.

First maxilliped 1.5 times as long as wide and much overlapped by extremely long and narrow lash; palp two-segmented; epipod subtriangular, larger than endites. Second maxilliped flattened, with rudimentary lash at base; exopod long and narrow, shorter than epipod. Third maxilliped long and slender, ischium and merus fused; exopod spur-like.

First pereopods with chelae nearly twice as long as wide, with cutting teeth subterminally positioned along prehensile edge, no gape present. Second pereopod with chela not much more slender than first, no gape present. Third to fifth pereopods similar in form and size to each other, with propodus bearing several transverse rows of spines, dactylus armed with one terminal and several subterminal ungues.

Pleurobranchs progressively increasing in size posteriorly, all arthrobranchs subequal in size.

Pleopods with appendix interna small in first to third pleopods and of usual size in fourth and fifth pleopods.

Uropodal exopod bearing two movable spines longer than and medial to small distolateral tooth (Figure 1C).

Etymology

The generic name is derived from the name of the Institute of Oceanology, Russian Academy of Sciences (usually abbreviated as IO RAN), that has made invaluable contributions in the studies on the ocean abyss since its organization in 1949. Gender feminine.

Iorania concordia sp. nov.

Bresiliidae sp. nov. no. 2: Vinogradov & Vereshchaka, 1995: 18.

Material

TAG location, 26°09'N 44°50'W, point 'D', 15 m to the south-west from the point 'O', depth 3650 m; slurp-gun sample, DRSV 'Mir', station 3415 and retrieved 24 September 1994.

Holotype

Female. Carapace length 8.4 mm; total length 27.0 mm. Paratypes, all adult females: carapace length 8.0 mm (3), 8.1 mm (3), 8.2 mm (2), 8.3 mm (1), 8.4 mm (3), 8.5 mm (3), 8.6 mm (4), 8.7 mm (1), 8.8 mm (2), 8.9 mm (2), 9.0 mm (3), 9.1 mm (1), 9.2 mm (2). All specimens are kept in the collection of the Oceanology Institute, Moscow, Russia. To be transferred from the collection are the following paratypes: one female, Zoological Museum of University of Copenhagen; one female, Museum National d'Histoire Naturelle, Paris, France; one female, Nationaal Natuurhistorisch Museum, Leiden, Netherlands.

Carapace 0.6 times as high and 0.8 times as wide as long; rostrum subtriangular in cross-section, tapering distally; blunt dorsal carina hardly visible along $\frac{1}{6}$ carapace length.

Abdomen 4.7 times as long as wide; pleura in abdominal somites 1–4 broadly rounded, in fourth and fifth somites with blunt posterior angles; sixth somite 1.3 times as long as high, no posterodorsal spine present. Telson elongate, 2.9 times as long as wide in its widest proximal part, latter 1.6 times as wide as distal part; eight pairs of movable dorsolateral spines present on left side, nine spines present on right side, each spine positioned in deep depression; posterior margin armed with medial short acute tooth (no trace of juncture with telson) and six pairs of longer movable spines (Figure 1C).

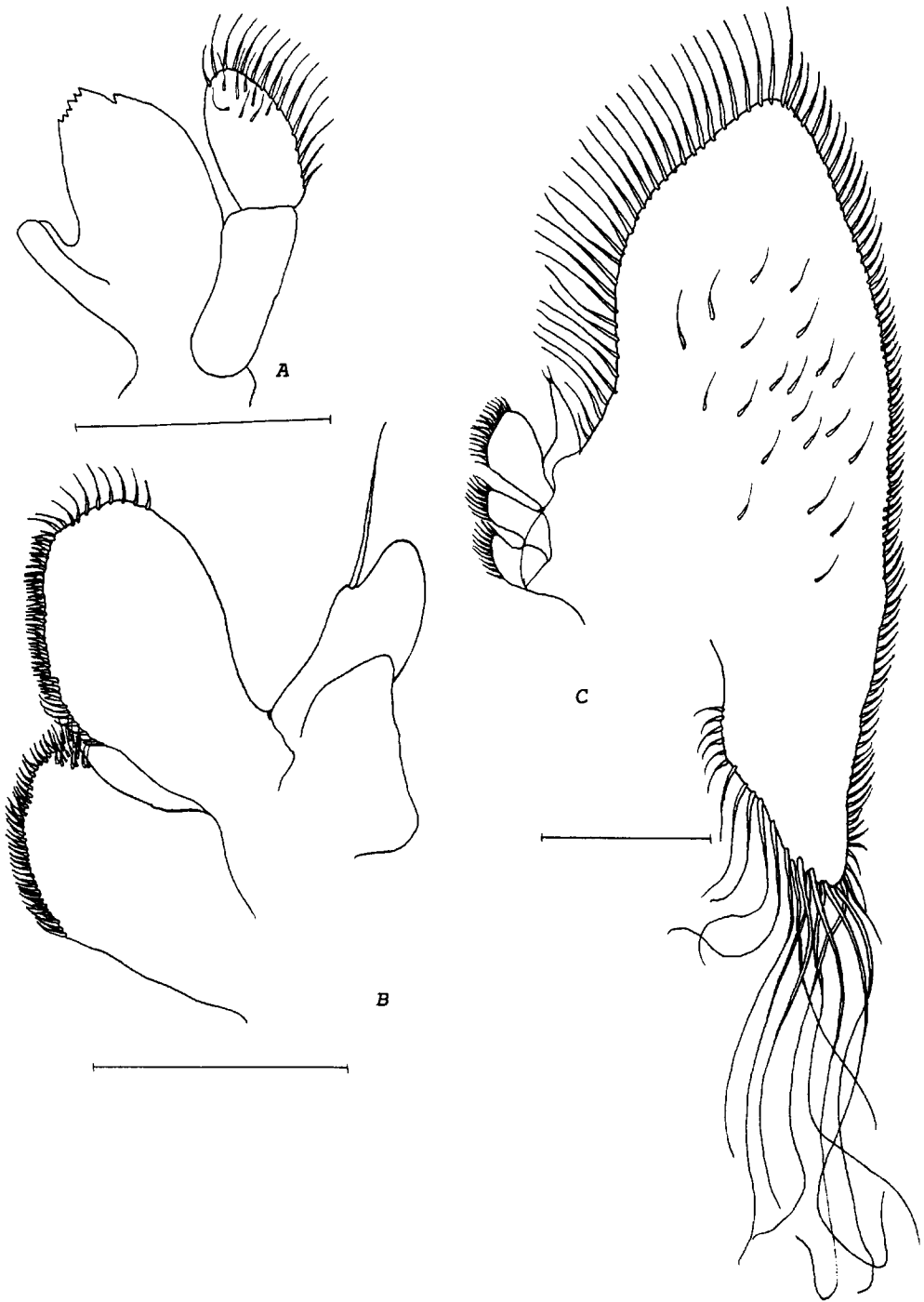


Figure 2. *Iorania concordia*, female holotype: (A) right mandible; (B) right first maxilla; (C) right second maxilla. Scale bars: (A-C) 0.5 mm.

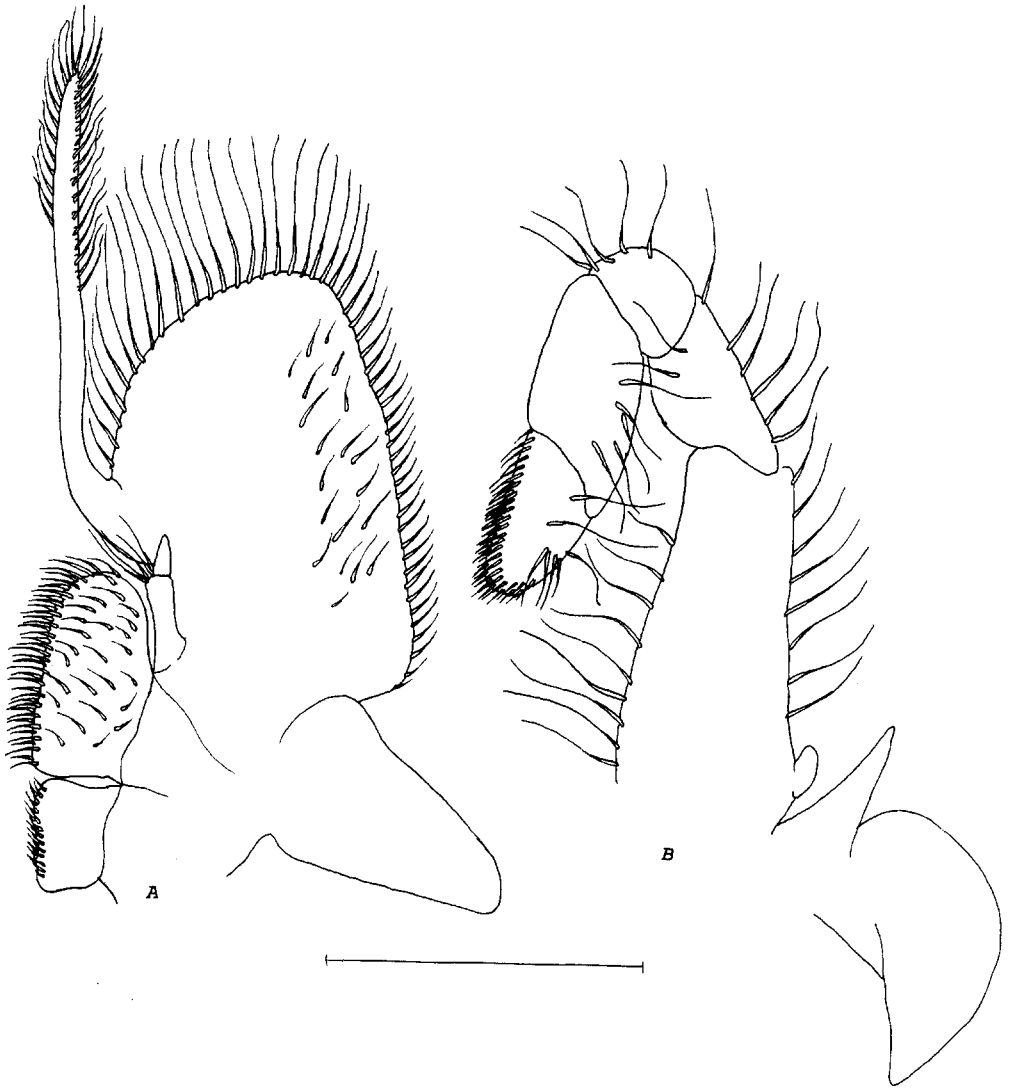


Figure 3. *Iorania concordia*, female holotype: (A) right first maxilliped; (B) right second maxilliped. Scale bar: 1 mm.

Eyes without tubercles, medially fused under carapace, diameter of their rounded exposed parts reaching 5% of carapace length; antennular peduncle (Figure 1B) slightly overlapping scaphocerite; stylocerite with tip directed medially, reaching as far as end of second peduncular segment; basal peduncular segment with blunt carina and lateral depression along entire dorsal margin; length ratio of peduncular segments 1-2-3 measured on their medial margins ~5:3:2, respectively. Antennal scale 1.4 times as long as wide, distolateral spine blunt and inconspicuous, anterior margin of scaphocerite broadly rounded; antennal peduncle 0.6 times as long as scaphocerite, flagellum 1.4 times as long as carapace.

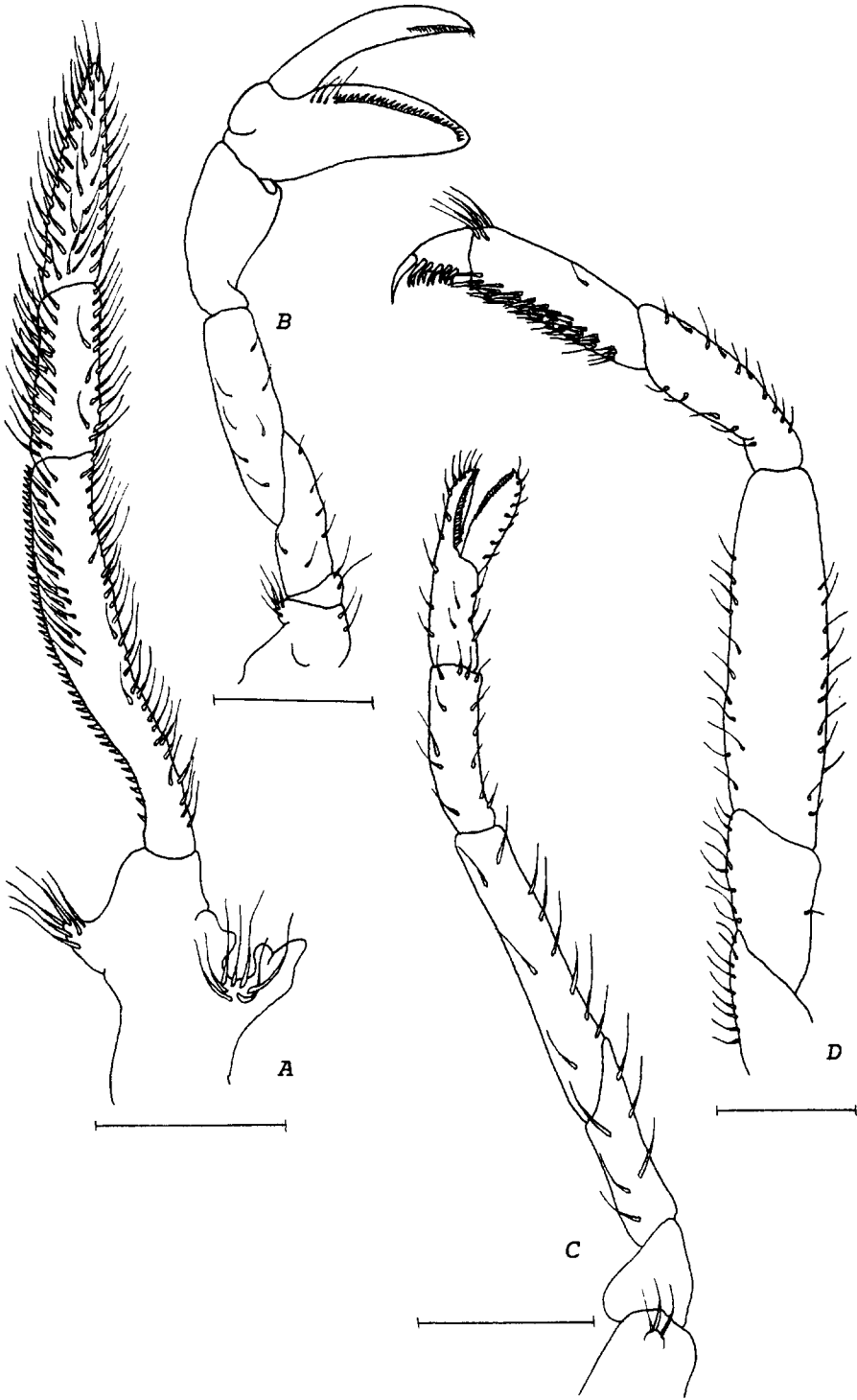


Figure 4. *Iorania concordia*, female holotype: (A) right third maxilliped; (B) right first pereopod, (C) right second pereopod, (D) right third pereopod. Scale bars: (A–D) 1 mm.

Mandibles (Figure 2A) with incisor processes as long as and 3.5 times as broad as molar process; palp with distal segment 0.8 times as long as proximal segment and bearing plumose setae, densest on its half distal part. First maxilla with distal endite 1.7 times as long as wide, proximal endite 1.6 as long as wide if straightened and bearing an aggregation of setae at tip (Figure 2B); palp with distal plumose seta 0.7 times as long as palp; epipod 0.9 times as long as palp. Second maxilla (Figure 2C) with scaphognathite clothed with plumose setae; rounded anterior lobe 1.2 times as long as wide, and narrow subtriangular posterior lobe 1.6 times as long as wide.

First maxilliped clothed by long plumose setae, as long as lash bearing two rows of plumose setae on dorsal and ventral sides (Figure 3A) overlapped by palp bearing two rows of setae on its dorsal and ventral sides; palp short, two-segmented, proximal segment 2.1 times as long as proximal segment and bearing several plumose setae in distal part; distal endite 2.0 times as long as proximal endite, epipod 1.5 times as long as wide. Second maxilliped (Figure 3B) covered with plumose setae, with lash as long as wide; distal segment separated from penultimate by oblique suture, bearing dense group of strong setae along its medial side and transverse row of plumose setae on flexor margin; epipod 1.7 times as long as wide and 1.7 times as long as exopod. Third maxilliped (Figure 4A) with ischium-merus covered with strong short spines along their entire inner side; dense plumose setae along propodus, carpus, and distal part of ischium-merus; ischium-merus 2.3 times and propodus 1.3 times as long as carpus, respectively.

First pereopod (Figure 4B) with ischium and merus separated by oblique junction and covered with scattered long plumose setae along their ventral and dorsal sides; carpus curved at one sixth of its proximal side; cutting teeth positioned far from prehensile edge, their tips not projecting beyond edge; teeth not dense and directed obliquely distad, movable finger directed inward; propodus flattened, bearing several setae in proximal part of cutting edge; width of fixed finger in lateral view nearly 2.6 times that of dactylus; ischium 0.7 times, merus 1.2 times, propodus and dactylus 1.4 times as long as carpus, respectively. Second pereopod (Figure 4C) covered with long setae; ischium and merus separated by oblique junction; chela with fingers subequal in size and armed with rows of spines directed distad; Ischium 0.8 times, merus 1.7 times, propodus 1.2 times, and dactylus 0.6 times as long as carpus, respectively. Third pereopod with basis and ischium setose along ventral margin, merus and carpus setose on both ventral and dorsal margins; propodus bearing ten transverse rows of unguis on flexor margin and several distal setae on opposite margin; dactylus with strong distal unguis and five transverse rows of smaller unguis on flexor margin; ischium 0.7 times, merus 1.8 times, propodus 1.0 times, and dactylus 0.3 times as long as carpus, respectively. Fourth and fifth pereopods similar in size and form to third pereopod.

Arthrobranchs similar in form and size; dorsal and ventral rami almost symmetrical. First to fifth pleurobranchs 1.2 times, 1.6 times, 2.1 times, 2.3 times, and five times as long as arthrobranchs, respectively; ventral rami subequal to dorsal rami in first and second pairs, about 1.5 times as long as dorsal rami in third and fourth pairs, and nearly twice as long as dorsal rami in fifth pair.

First pleopods with exopod 2.3 times as long as endopod, second to fifth pleopods with both rami subequal.

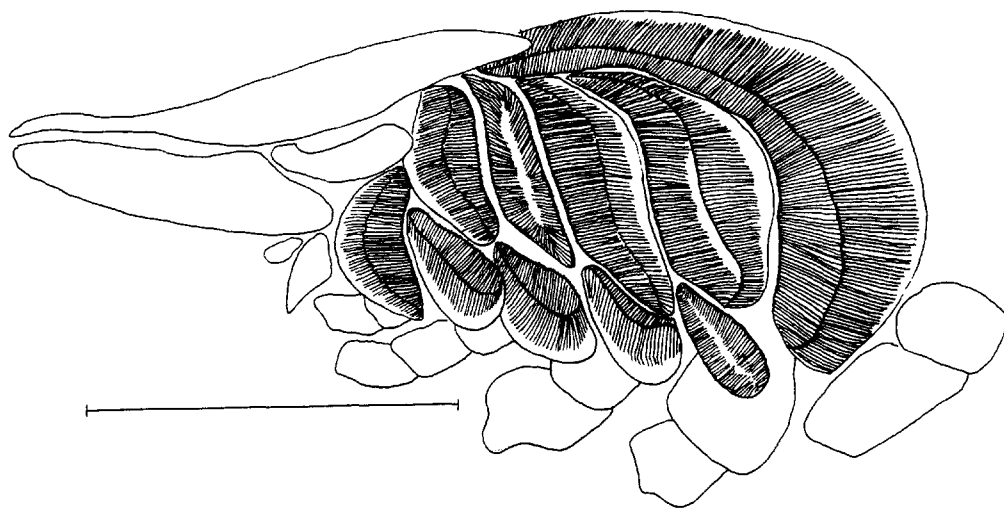


Figure 5. *Iorania concordia*, female holotype: thorax with carapace removed showing branchia, left lateral view. Scale bar: 3 mm.

Uropodal exopod 3.2 times and endopod 2.8 times as long as basipod; exopod 2.5 times as long as wide, with distinct diaeresis, each of movable spines nearly three times as long as distolateral tooth; endopod 2.8 times as long as wide.

Etymology

The name alluding to the shape of the first maxilliped which resembles agreeing person voting for by show of hands, from the Latin *concoro* (agreeing).

Colour. Pinkish in freshly dead specimens brought to the surface.

Variations. Form of rostrum variable: tip may be acute or rounded; acute form, as in holotype, is rather rare (holotype was selected because of its good preservation). Number of dorsolateral spines on telson is variable between specimens and between left and right margins (as in holotype, eight on left side and nine on right side) ranging from 7 to 10.

Remarks. According to the visual observations and sampling, *Iorania concordia* lives mainly in the black smokers and shimmering waters, being the second most abundant dominant species in the Atlantic hydrothermal communities after *Rimicaris exoculata*. Preliminary analysis of the gut contents shows abundance of black sulphide particles. Plumose setae densely covering mouthparts from second maxilla to second maxilliped, bear voluminous colonies of the *Thiotrix*-like bacteria. The information presented is evidence that the new genus, like *R. exoculata*, lives mainly on the bacterial chemosynthetic production, part of which is obtained from its own mouthparts. Additional quantitative information about the micro-scale distribution can be found in Vinogradov & Vereshchaka (1995) where *Iorania concordia* was regarded as sp. nov. no. 2.

DISCUSSION

Iorania differs from all other alvinocaridid genera in having an enormously developed lash on the first maxilliped instead of inconspicuous rudiments. It also differs from *Alvinocaris* Williams & Chace, 1982 in having a rudimentary flattened toothless rostrum compressed dorsoventrally and in lacking a pterygostomal spine; from *Rimicaris* Williams & Rona, 1986 and from *Chorocaris* Martin & Hessler, 1990 in having posterior telson spines instead of setae; from *Rimicaris* in having a small distolateral scaphocerite tooth and eyes not much fused and separated in dorsal view.

Alvinocaris has the general form of a benthopelagic shrimp and shows the first step towards the adaptation to the hydrothermal mode of life. *Iorania* demonstrates strict adaptations to life in the black smokers: very smoothed body contours, rudimentary rostrum, strong pereopods 3–5 to attach body to the substratum and withstand rapid water currents. The long, well developed lash on the first maxilliped lost by the other genera within the family, may be inherited from an ancestor. A third stage of adaptation is represented in the genus *Chorocaris*, with much more expanded and setose second maxilla and first maxilliped, and with posterior telson spines replaced by plumose setae; all of these characters allow possible cultivation of chemotrophic bacteria that may provide part of the dietary needs. A still further stage of these adaptations is represented in the genus *Rimicaris* with extremely expanded mouthparts, fused eyes lacking pigment, and without a trace of distolateral spine on the scaphocerite; the body became completely smooth and appendages strong enough to live in the sites with high current velocities in order to provide bacteria with maximal sulphur supply and thus a food supply for the shrimp, probably, limited to these bacteria.

Key for the genera of the Alvinocarididae

- | | | |
|---|---|--------------------|
| 1 | Posterior telson margin armed only with spines, without plumose seta | 2 |
| — | Posterior telson margin armed with plumose setae | 3 |
| 2 | Rostrum long, compressed laterally; pterygostomal spine present;
lash on first maxilliped rudimentary | <i>Alvinocaris</i> |
| — | Rostrum short, compressed dorsoventrally, without teeth; pterygostomal
spine absent; lash on first maxilliped well developed | <i>Iorania</i> |
| 3 | Short rostrum present; exposed eyes separated from each other;
distolateral spine present on scaphocerite | <i>Chorocaris</i> |
| — | Rostrum absent; exposed eyes fused and not separated from each
other; distolateral spine absent on scaphocerite | <i>Rimicaris</i> |

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