

CARIDINA ZEBRA, A NEW SPECIES OF FRESHWATER ATYID SHRIMP
(CRUSTACEA: DECAPODA) FROM NORTHEASTERN QUEENSLAND RAINFOREST

JOHN W. SHORT

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A new species of freshwater atyid shrimp, *Caridina zebra*, from high altitude (>400 m) rainforest, northeastern Queensland, is described and illustrated. It is allied to the *typus* species-group, characterized by a short, dorsally unarmed rostrum and most closely resembles the wide-ranging species, *C. typus* H. Milne Edwards, 1837. Morphology of the rostrum and telson, and the large size of developed ova (1.1 mm length), a feature indicative of abbreviated or direct larval development readily distinguish it from *C. typus*. A distinctive black and white banded pattern distinguishes *C. zebra* from all known Indo-West Pacific species. □ *Crustacea, Atyidae, Caridina, new species, northeastern Australia, freshwater, rainforest, taxonomy, biology, survival status.*

John W. Short, Queensland Museum, PO Box 3300, South Brisbane, Queensland 4101, Australia

Australian species of *Caridina* were last revised by Riek (1953) who recorded 7 species: *C. gracilirostris* De Man, 1892; *C. indistincta* Calman, 1926; *C. mccullochi* J. Roux, 1926; *C. nilotica* (P. Roux, 1833); *C. serratirostris* De Man, 1892; *C. thermophila* Riek, 1953; and *C. typus* Milne Edwards, 1837. These are primarily lowland species, although *C. serratirostris* and *C. typus* occur at moderate elevations in northeastern Queensland. High altitude species have previously been described from New Caledonia (J. Roux, 1926a; Holthuis, 1970) and Fiji (Choy, 1983, 1984) in the Southwest Pacific Region.

Caridina zebra sp.nov. was first collected by Dr S. Bunn and Mr M. Bray, Griffith University during a limnological study for the proposed Tully-Millstream hydroelectric scheme in 1990. Material from the upper Tully and Herbert R. catchments brought to the Queensland Museum for identification showed affinities with *C. typus*, but the distinctive unarmed rostrum and large eggs immediately suggested that the species was new. A Queensland Museum expedition to the area (November, 1992) yielded further material and habitat information. Distinctive colour in life confirmed its new species status.

Further material was examined from the Queensland Fisheries Johnstone Rivers Survey at the invitation of Mr Warren Lee Long, Northern Fisheries Research Centre, Cairns. Two additional specimens were later discovered in the Queensland Museum collection, mis-identified as *C. typus*.

MATERIAL AND METHODS

All material examined is deposited in the Queensland Museum collection. Measurements were made with the aid of a stereo microscope and vernier callipers or an eyepiece micrometer. A camera lucida was used for the line drawings.

Physico-chemical habitat data were obtained using a TPS LC82 dissolved oxygen meter, mercury thermometer, Merck Universalindikator pH 0-14 paper, and an Aquasonic water hardness test kit. Altitudes were estimated from the Australia 1:100 000 topographic survey map series R631. The classification of rainforest types follows Webb & Tracey (1981).

Cuticle spination and setation terminology follows Felgenhauer (1992). In particular, 'hamate setae' (stout, modified setae) have been classified as spines or spinules by previous atyid workers. The term 'spine' is restricted here to large cuticular processes without a basal socket formed by folding or extrusion of the epidermis (e.g. the antennal spine). Generally setae are easily distinguished by the presence of a well-defined basal socket and often the integument is of different appearance to the surrounding cuticle (i.e. more sclerotinous or less pigmented). Developed ova are defined by the presence of eye spots. Ovigerous females are explicitly recorded whereas non-ovigerous specimens are recorded simply as 'females'.

Abbreviations used in text: QM, Queensland Museum; OCL, carapace length measured from orbital margin to dorsolateral invagination of

posterior margin; TBL, total body length from orbital carapace margin to tip of telson; P, pereopod; Pl, pleopod.

***Caridina zebra* sp.nov.**
(Figs 1-4)

MATERIAL EXAMINED

HOLOTYPE: QM W18718, ♂ (3.4 mm OCL), O'Leary Ck, 17°50.7'S, 145°37.7'E, fringing simple notophyll vine forest, altitude c.750 m, water depth 0.1-0.5 m, scoop-netted, 06/11/1992, J. Short, P. Davie.

ALLOTYPE: QM18719, ovig. ♀ (5.0 mm OCL), same data as holotype.

PARATYPES: QM W18120, 2♂♂ (2.9, 3.4 mm OCL), 13 ovig. ♀♀ (4.0-4.9 mm OCL), 10♀♀ (3.5-4.8 mm OCL), same data as holotype; QM W18131, 3♂♂ (3.2-3.8 mm OCL), ovig. ♀ (4.3 mm OCL), ♀ (3.3 mm OCL), same locality data as holotype, 0.5-1.5 m, trapped, 07/11/1992, J. Short, P. Davie; QM W18719, ♀ (5.0 mm OCL), same data as holotype; QM W18124, ♂ (3.4 mm OCL), 2 ovig. ♀♀ (4.3, 4.4 mm OCL), Tully R. nr Old Culpa, 17°55.5'S, 145°37.6'E, fringing simple notophyll vine forest, altitude c.720 m, water depth 1.0 m, scoop-netted, 06/11/1992, J. Short, P. Davie; QM W18127, 5♂♂ (3.6-3.9 mm OCL), ovig. ♀ (4.6 mm OCL), 3♀♀ (3.7-4.3 mm OCL), same data as W18124; QM W19158, 24♂♂ (3.1-4.2 mm OCL), 9 ovig. ♀♀ (4.4-5.0 mm OCL), 29♀♀ (3.1-4.7 mm OCL), Cardwell Ra., 18°01'S, 145°37'E, small headwater creek, fringing disturbed simple notophyll vine forest, altitude c.900 m, netted, 07/11/1992, J. Short, P. Davie.

ADDITIONAL MATERIAL: QM W17117, ♂ (3.6 mm OCL), Koolmoon Ck, 17°44'S, 145°33'E, fringing complex notophyll vine forest, altitude c.750 m, 25/07/1990, S. Bunn, M. Bray; QM W17119, 3♂♂ (3.9-5.1 mm OCL), ♀ (5.5 mm OCL), Koolmoon Ck, 17°44'S, 145°34'E, 25/07/1990, S. Bunn, M. Bray; QM W17116, 2♂♂ (3.2, 3.3 mm OCL), ♀ (3.7 mm OCL), Blunder Ck, 17°46'S, 145°32'E, fringing complex notophyll vine forest, altitude c.750 m, 28/11/1990, S. Bunn, M. Bray; QM W17118, ♂ (2.8 mm OCL), 2 ovig. ♀♀ (3.8, 4.5 mm OCL), 2♀♀ (4.0 mm OCL), same locality and habitat data as W18124, 28/11/1990, S. Bunn, M. Bray; QM W18841, ♂ (4.5 mm), Thiaki Ck, 17°24.9'S, 145°35.3'E, altitude c.750 m, water depth 0.2 m, electro-fished, 1992, Queensland Fisheries Johnstone Rivers Survey; QM W3078, 2♂♂ (3.8, 4.7 mm OCL), Atherton, from tap water, 14/05/1962, Department of Primary Industries; QM W18720, ♂ (3.9 mm OCL), 2♀♀ (4.3, 4.5 mm OCL), small creek c.6 km SW of Malanda, 17°22.7'S, 145°33.6'E, fringing *Brachiaria mutica* (Para Grass), water depth 0.2-1.5 m, altitude c.750 m, electro-fished, 1992, Queensland Fisheries Johnstone Rivers Survey; QM W18722, 12♂♂ (3.6-4.0 mm OCL), 5 ovig. ♀♀ (4.6-5.2 mm OCL), 10♀♀ (3.8-5.4 mm OCL), Goolagan Ck, 17°36.3'S, 145°45.5'E, fringing complex mesophyll vine forest, altitude c.400 m, electro-

fished, 1992, Queensland Fisheries Johnstone Rivers survey; QM W18725, 13♂♂ (3.2-4.8 mm OCL), 16♀♀ (3.8-6.1 mm OCL), same data as W18841.

DESCRIPTION OF MALE HOLOTYPE

Cephalothorax. Rotund, breadth c.0.7 X OCL, depth c.0.9 X OCL; glabrous; smooth. Rostrum short, c.0.4 X OCL, reaching intermediate segment of antennular peduncle; unarmed; non-setose; acuminate; elongate triangular in dorsal view, dorsal carina poorly developed, slightly convex, commencing slightly behind orbit, lateral carinae strongly expanded, ventral carina obsolete. Carapace with inferior orbital margin produced, obtuse, strongly revolute; postantennal margin markedly concave, acute at junction with inferior orbit (developed as antennal spine in some paratypes); pterygostomial angle bluntly angular, well produced. Eyes with cornea large, globular, well-pigmented, hemispherical, peduncle short, broad. Stylocerite well developed, acute, slightly shorter than basal antennular segment; anterolateral spine on basal antennular peduncle segment well developed, reaching proximal half of second peduncular segment. Scaphocerite broad, mesial lamina margin strongly convex; distolateral spine well developed, about level with distal margin of antennular peduncle, distal lamina ovate (distomesially produced in some paratypes). Branchial formula typical for genus. Epipods on P1 - P4 well developed.

Mouthparts. Mandibles dimorphic; left mandible the more developed, corpus large, robust, with broad multi-cuspidate incisor process, molar process ridged, patch of long setae between incisor and molar processes; right mandible with narrow, multi-cuspidate incisor process, molar process narrow, elongate, ridged, patch of long setae between molar and incisor processes. Maxilla with broad, setose palp; basal endite elongate with row of mesial hamate setae decreasing in size distally; coxal endite large, rounded. Maxilla with well-developed, setose palp; basal endite elongate, densely setose mesially; coxal endite rounded, setose mesially; scaphognathite elongate, anterior lobe rounded, fringed with long setae, posterior lobe tapered, bearing long setae at tip. First maxilliped with elongate setose palp; basal endite elongate, setose; coxal endite setose mesially; exopod well developed, caridean lobe large, elongate. Second maxilliped with ischium and basis fused; flagellum very long, slender; dactylus with mesial margin slightly concave, densely setose; propodus sub-rectangular, mesial margin with long setae; carpus, merus and is-



FIG.1. *Caridina zebra* sp.nov., QM W18718, ♂ holotype (3.4 mm OCL). Alcohol preserved.

chium sparsely setose; coxa setose, medially produced; podobranch well developed, with branchial lamella. Third maxilliped with terminal segment reaching distal antennal peduncle, compressed, unguiculate, slightly uncinuate, about equal to penultimate segment in length, with longitudinal row of small hamate setae distally, closely-spaced transverse rows of long simple setae proximally, exopod flagellum clearly exceeding ischiomerus in length; ischiomerus and basis fused.

Pereiopods. P1 failing to reach distal antennal peduncle, propodus length slightly more than twice manus width, manus proximo-laterally produced (strongly produced in large paratypes); fingers short, robust, about equal in length to manus, setal brushes well developed; carpus distinctly shorter than chela, articulating with ventral propodus, excavated disto-dorsally, dorsal projection setose; merus broad, compressed, distinctly longer than carpus and chela. P2 more elongate than P1; reaching slightly beyond antennal peduncle; propodus length about twice manus width; fingers short, robust, slightly longer than manus, setal brushes well developed; carpus distinctly longer than chela, about equal in length to merus, subconical; merus compressed, about equal in length to carpus. P3 reaching beyond distal scaphocerite; dactylus c.0.2 X propodus length, armed with row of five robust, hamate

setae; posterior margin of propodus bearing numerous small hamate setae; carpus with well developed distal projection, posterior surface with transverse rows of hamate setae, lateral margin with few hamate setae, much shorter than propodus and merus; merus the longest segment, slightly bowed, with few hamate setae along posterior margin.

P4 similar to P3, just failing to reach distal scaphocerite margin. P5 reaching past antennal peduncle but clearly failing to reach distal scaphocerite margin; dactylus unguiculate, compressed, about one quarter length of propodus, posterior margin with comb row of numerous hamate setae gradually increasing in length distally; carpus slightly less than half propodus length, bearing well developed distal projection and large distal hamate seta; merus slightly shorter than propodus, with few large hamate setae.

Abdomen. Well developed, c.2.9 X OCL; rotund; glabrous; smooth. P11 with well developed appendix interna arising from sub-distal endopod; endopod compressed, elongate, narrowing distally, width less than half length, margins setose.

Appendix masculina on P12 arising near base of endopod along with appendix interna, elongate but clearly shorter than endopod, anterior face and tip setose, apical setae hamate; endopod and

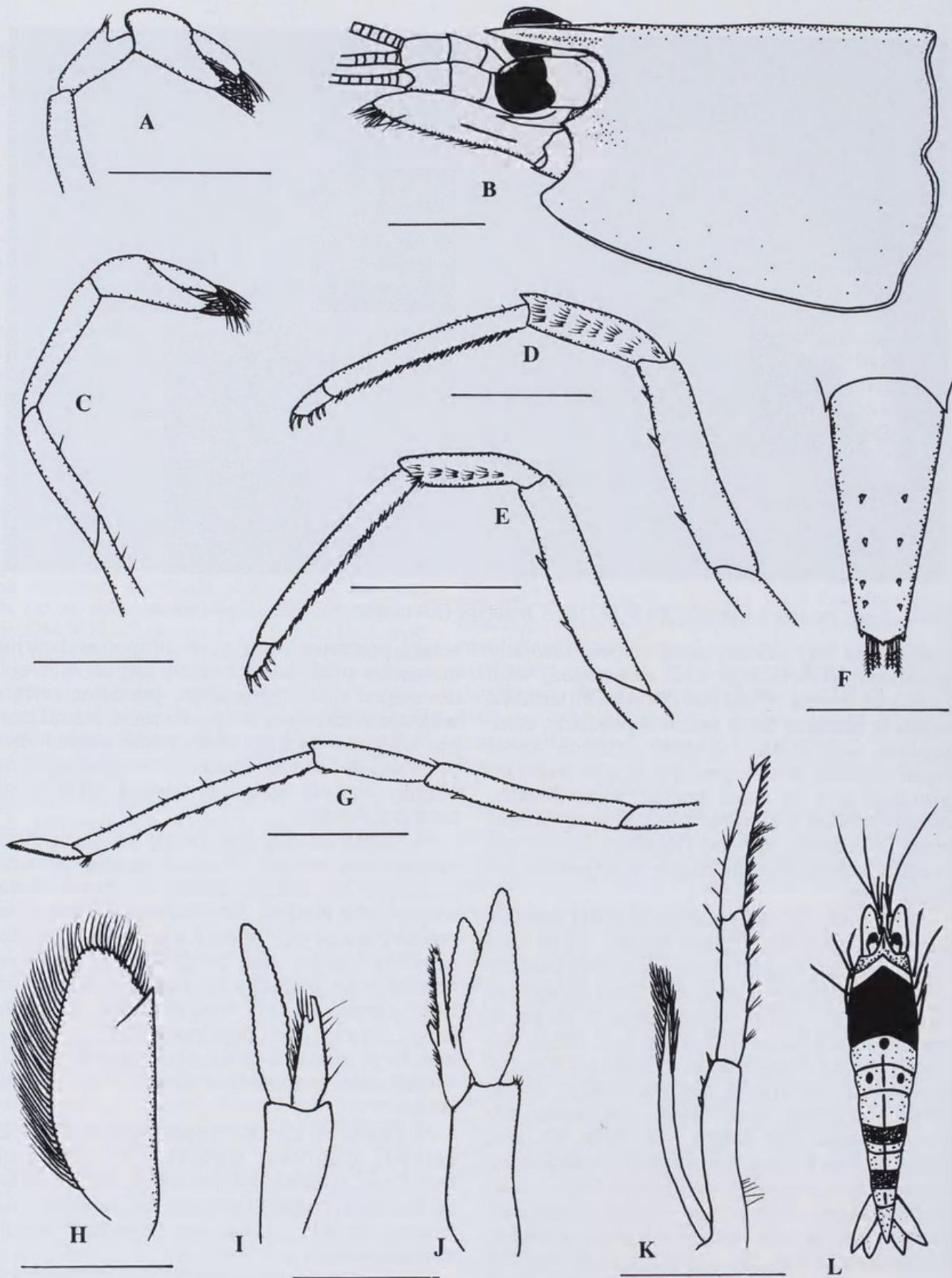


FIG.2. *Caridina zebra* sp.nov., ♂ holotype, A. first pereiopod. B. dorsolateral view of cephalothorax. C. second pereiopod. D. third pereiopod. E. fourth pereiopod. F. telson. G. fifth pereiopod. H. scaphocerite. I. first pleopod. J. second pleopod. K. third maxilliped. L. chromatophore pattern. Scale lines 1 mm.

exopod elongate, ovate. Dorsal telson with four pairs of small, stout hamate setae (4-5 pairs in paratypes) located in distal two-thirds; posterior margin angular, with small acute median projection, laterally spinate, with small inner hamate seta, sublaterally with pair of long pappose setae, submedially with two pairs of shorter pappose setae. Uropods distinctly longer than telson; diaeresis on exopod bearing numerous small hamate setae, 16 setae on diaeresis of right exopod, left exopod damaged (19/16 setae on allotype; paratypes 10-18 setae, \bar{x} =14.9, n = 30).

COLOUR

Dorso-anterior carapace with narrow, v-shaped, transverse, white band immediately followed by much broader, transverse, black band terminating at posterior carapace margin; anterior abdomen marked with medial blotch, followed by pair of submedial blotches, posterior abdomen with two broad, well separated, transverse, dark bands. Strength of chromatophore pattern variable; most developed on light-coloured, sandy substrates, poorly developed on dark substrates.

BIOLOGY

Lotic freshwater, low to strong flow, rocks/sand/silt/bedrock substrates, generally with leaf litter and fallen timber, water clarity high, macrophytes absent to abundant, fringing rainforest (complex mesophyll to simple notophyll vine forest) or *Brachiaria mutica* (Para Grass) in anthropically disturbed areas, altitude 400-900 m. Recorded physico-chemical tolerances: pH 5.5, hardness <10 ppm, water temperature 18-20°C, DO₂ 5.8-6.0 ppm.

Developed ova large, maximum recorded length 1.1 mm, and few, 55 ova on allotype. Maximum recorded size of males 5.1 mm OCL, 17.3 mm TBL; maximum recorded size of females 5.5 mm OCL, 18.4 mm TBL; minimum recorded size of ovigerous females 3.8 mm OCL, 14.5 mm TBL.

Caridina zebra is active and very conspicuous during daylight, particularly on sandy substrates, where the banded chromatophore pattern is generally most developed. At the most elevated site sampled (c.900 m), fish predators and crustacean competitors appeared to be absent. The

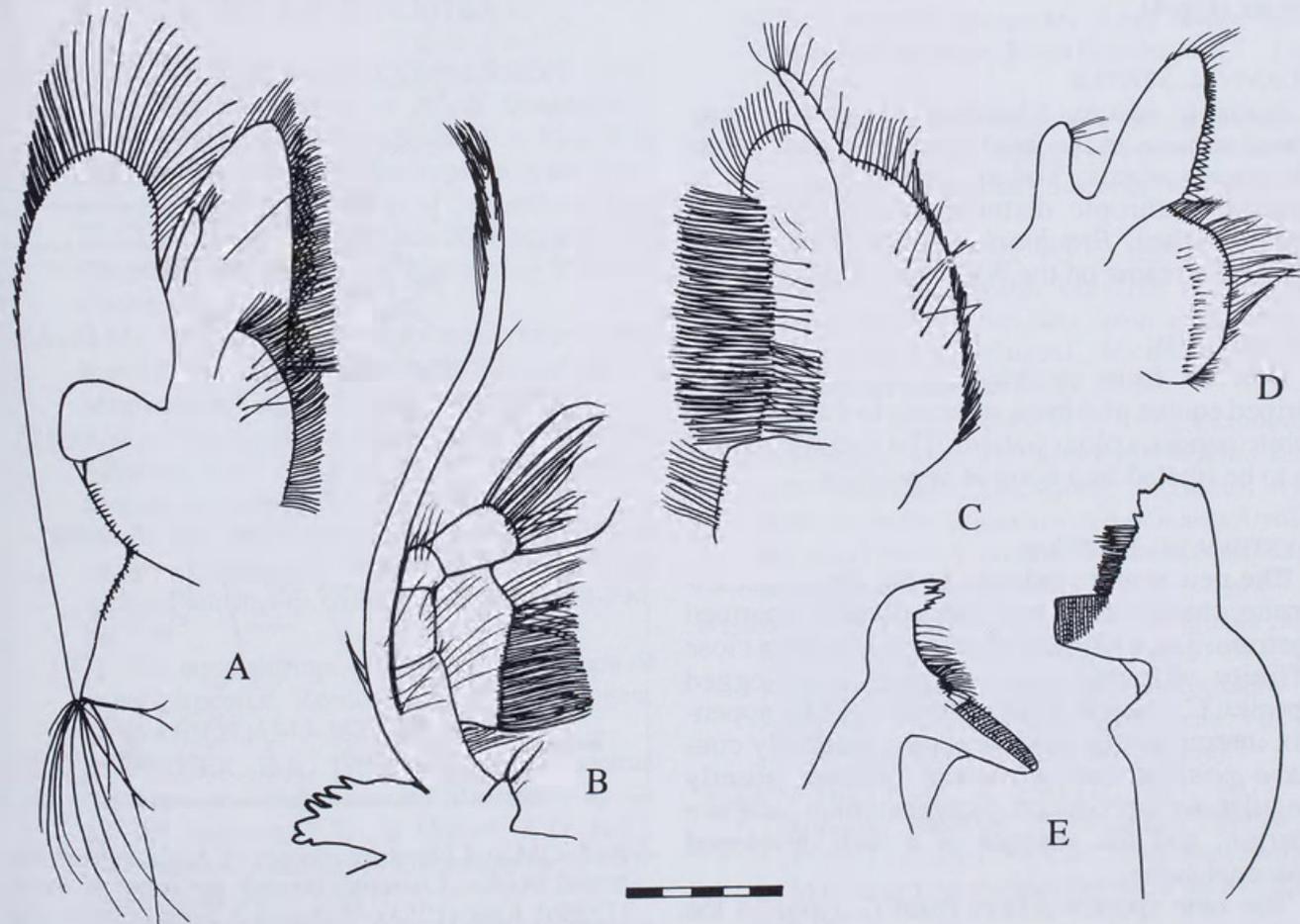


FIG.3. *Caridina zebra* sp.nov., ♂ holotype, A. maxilla. B. second maxilliped. C. first maxilliped. D. maxillula. E. mandibles. Scale divisions 0.1 mm.

population density at this locality was high, around 100 individuals/m².

The species appears to be directly associated with lotic, high elevation, rainforest streams. Despite moderately intensive sampling, the species could not be located in Nitchaga Ck, an open forest tributary of the Tully R. above Tully Falls. This stream dries to a series of still pools during severe drought periods (as in November 1992 when sampled) in direct contrast to rainforest tributaries at higher elevations, which have permanent flow.

The striking colour pattern of *C. zebra* and its probable highly-abbreviated or direct development indicates high potential as an aquarium species.

At the type locality *C. zebra* is sympatric with *Cherax parvus* and *Euastacus yigara* (Short & Davie, 1993), and an undescribed species of *Macrobryachium*.

DISTRIBUTION

Recorded from the upper Tully, Herbert (Blunder Ck), Johnstone and Barron R. catchments (Fig.4).

SURVIVAL STATUS

Probably secure. Abundant in pristine, rainforest streams in the headwaters of four separate drainage systems. The species also appears to tolerate anthropic disturbance and occurs in heavily silted, *Brachiaria mutica* (Para Grass) infested streams on the Atherton Tableland.

ETYMOLOGY

Derived from an Abyssinian name for the striped equine of Africa, referring to the black and white banded colour pattern. The specific epithet is to be treated as a noun in apposition.

SYSTEMATIC POSITION

The new species belongs to the *typus* species-group, characterized by a short, dorsally unarmed rostrum. The following characters suggest a close affinity with the wide-ranging, small-egged species, *C. typus* H. Milne Edwards, 1837: appendix interna on the first pleopods; markedly concave postantennal carapace margin; bluntly angular, well-produced, pterygostomial carapace margin; and the absence of a well developed antennal spine.

The new species differs from *C. typus* in the following features: rostrum with an obsolete ventral carina, strongly expanded lateral carinae, and poorly-developed, feebly-convex, dorsal

carina; angular posterior telson margin (rather than rounded margin) with three pairs of pappose setae (rather than five); and developed ova large (up to 1.1 mm in length) and few (55 ova on allotype).

DISCUSSION

Caridina zebra is the fourth, high altitude species of *Caridina* described from the Southwest Pacific Region. Other species include: *C. fijiana* Choy, 1983; *C. imitatrix* Holthuis, 1970; *C. nudirostris* Choy, 1984; and *C. devaneyi* Choy, 1991. In common with many high altitude shrimps, the limited number and large size of the developed ova (> 1.0 mm length), suggests direct or abbreviated larval development (Choy, 1991).

Queensland Museum and literature records of Atyidae from the humid tropics are shown in

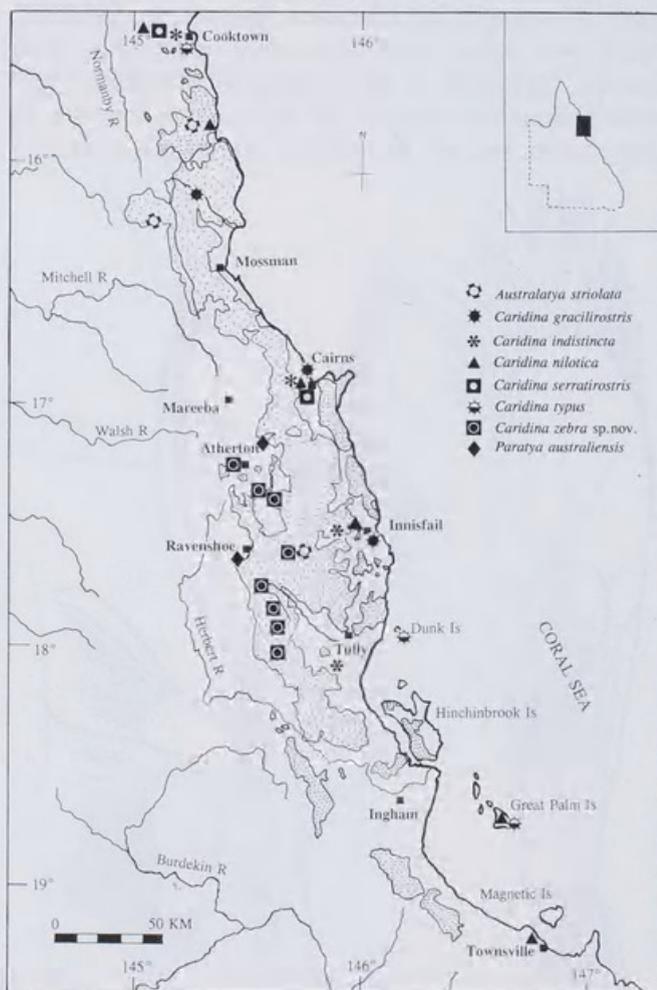


FIG.4. QM and literature records of Atyidae from the humid tropics. Literature records are those of Roux (1926b), Riek (1953), Williams & Smith (1979) and Smith & Williams (1982). Stippling indicates major rainforest areas (Australian Heritage Commission, 1986).

Fig.4. A large part of the region has not been adequately surveyed for atyid shrimps and previous records are largely the result of incidental collecting. Apart from *C. zebra*, only *Australatya striolata* (McCulloch & McNeill, 1923) and *Paratya australiensis* Kemp, 1917, are known from high elevation areas. *C. zebra* is the only species endemic to rainforest of the humid tropics.

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Dr Stuart Bunn and Mr John Marshall, Griffith University brought specimens of *C. zebra* to my attention. Mr Warren Lee Long of the Northern Fisheries Research Centre, Cairns allowed access to the Johnstone Rivers Survey material and donated representative specimens to the QM. Peter Davie encouraged this work and allocated QM resources to the 1992 Tully River expedition. Satish Choy and Peter Davie provided constructive criticism of the manuscript. The photograph was printed by Gary Cranitch.

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