

CARIDINA SEMIBLEPSIA, A NEW SPECIES OF TROGLONIC SHRIMP (CRUSTACEA: DECAPODA: ATYIDAE) FROM HUNAN PROVINCE, CHINA

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ABSTRACT. - A new species of troglonic freshwater atyid shrimp, *Caridina semiblepsia* from a limestone cave in Hunan Province, China is described and illustrated. *Caridina semiblepsia* can be distinguished from other species of the genus *Caridina* by the following diagnostic characters: pyriform eyes, reduced eyestalk, rudimentary retinal pigmentation, presence of epipods on the first four pairs of pereopods, short, dorso-ventrally flattened and somewhat elevated rostrum, distinctive pereopodal morphology, distinctive shape and spination of its posterior telsonic margin and the presence of an appendix interna on the endopod of the first male pleopod. Four species of obligate troglonic atyid shrimps (*C. ablepsia*, *C. semiblepsia*, *Typhlocaridina lanceifrons* and *T. liui*), characterised by their partially or completely unpigmented eyes, are now known from China. The phylogenetic relationship, cave habitat and conservation aspects of the species are discussed.

INTRODUCTION

On May 17, 1989 numerous specimens of a new atyid shrimp were collected from freshwater streams in the Dongpaoshan Cave, a karst cavern in the Hunan Province, China. This cavern is situated in the middle of Wuling Mountain, 4 km north east of the city of Baojing (ca. 28°44'N, 109°39'E, altitude 300 m). Dongpaoshan Cave contains numerous limestone stalactites and stalagmites of a variety of shapes and colours, and is of major public attraction. Within the cave, a 10 m long spring-fed stream originates from one side of the terrace and flows into another underground stream, a tributary of the Youshui River. The spring-fed stream is 0.2-0.8 m wide, 0.3-0.5 m deep and has a velocity of 0.3-0.6 ms⁻¹. The adjoining stream into which it flows is relatively slow flowing (0.2-0.3 ms⁻¹), 4-15 m wide, 1-2.5 m deep and has a silty sand bed. Water temperature ranges 17-19°C. This tributary of the Youshui River water is normally clear but becomes silty and turbid when it rains. The actual source and length of this tributary are not known. The vertical distance from the cave's entrance to the underground streams is about 70 m.

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The new species of atyid shrimp inhabits the underground stream and adjacent channel. It can be readily seen moving about slowly in the illumination of the electrical lights installed inside the cave. Other fauna caught with the shrimp included *Neocaridina denticulata sinensis* (Kemp, 1918), another (as yet unidentified) species of *Caridina* and tadpoles of an unidentified species of frog, all of which had whitish bodies but normal eyes, suggesting their facultative troglonic nature.

When kept in a glass aquarium the troglonic shrimps preferred to stay solitarily in darkness under pebbles rather than in groups amongst aquatic plants as in the case of normal epigeal atyid shrimps.

The holotype has been deposited in the Hunan Agricultural University (HAU) and representative paratypes have been deposited in the Shanghai Fisheries University (SFU). Arrangements have been made to have some type specimens deposited in the Zoological Reference Collection (ZRC), Department of Zoology, National University of Singapore.

Abbreviations used are CL for the post-orbital carapace length measured from dorsolateral invagination of posterior margin to orbital margin, RL for the pre-orbital rostral length measured from orbital margin of carapace to tip of rostrum and TL for the total body length from tip of telson to orbital margin of carapace. Epicuticular spination and setal terminology follows that of Felgenhauer (1992).

TAXONOMY

FAMILY ATYIDAE DE HAAN, 1849

Caridina semiblepsia, new species

(Figs. 1-4, Tables 1, 2)

Material examined. - Holotype - 1 adult female (22.8 mm TL, 6.9 mm CL, 1.4 mm RL) (HAU 89-05-01), Dongpaoshan Cave (ca. 28°44'N, 109°39'E), Hunan Province, China, coll. Z. L. Guo, 17 May, 1989.

Allotype - 1 adult male (24.5 mm TL, 7.1 mm CL, 1.9 mm RL) (HAU 89-05-02), same data as holotype.

Paratypes - 1 ovigerous female, 9 females (HAU) (17.9-25.4 mm TL), 9 males (HAU) (21.1-23.7 mm TL), 2 females (SFU), 2 males (SFU), same data as holotype.

Description. - Body small, subcylindrical; males in collection reach 24.5 mm in total body length (TL), females reach 25.6 mm TL.

Carapace (Figs. 1A-C, 2A). Glabrous; rostrum short, 0.15-0.25 of carapace length (CL), length 2.6-4.1 times height, curves downwards, tip sometimes curved upwards, reaching tip of basal antennular segment, unarmed (27.6%) or 1-13 dorsal rostral teeth (72.4%, N=29), 0-2 situated behind posterior orbital margin, setose, 0-6 ventral rostral teeth, placed distally if present; lateral carina divides rostrum into two unequal parts, continues posteriorly to orbital margin. Antennal spine short, strong, placed below lower orbital angle. Pterygostomian angle obtuse; pterygostomian spine absent.

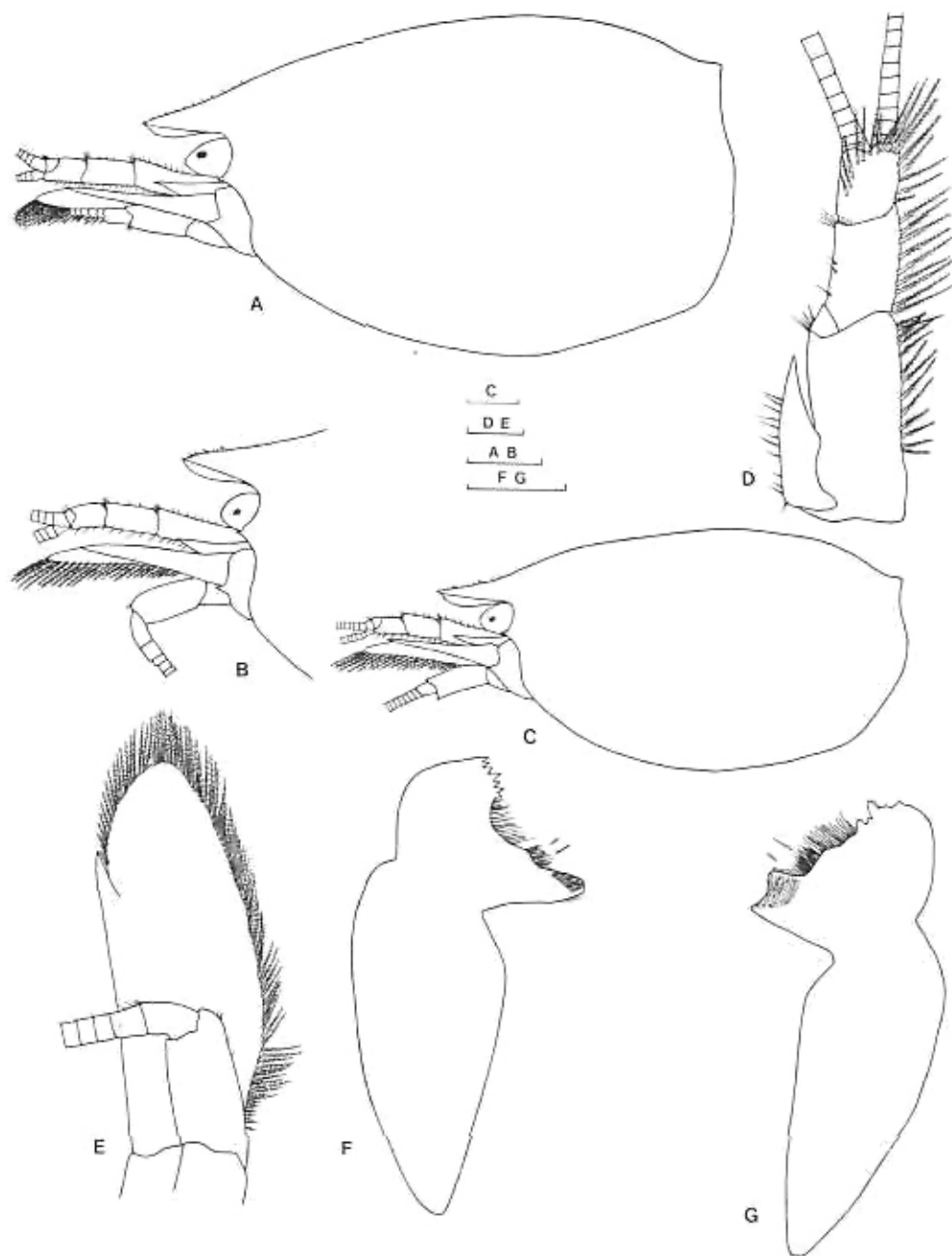


Fig. 1. *Caridina semiblepsia*, new species. A, holotype female, cephalothorax; B, paratype female, rostral region; C, paratype female, cephalothorax; D, antennule; E, antenna; F, right mandible; G, left mandible. Scale bars: 1 mm (A-C), 0.4 mm (D,E), 0.5 mm (F,G).

Eyes (Figs. 1A-C, 2A). On reduced stalk, pyriform; corneal surface rounded; red pigmentation poor, confined to small rounded (0.12-0.28 mm diameter) spot on outer anterolateral margin.

Antennule (Fig. 1D). Peduncle not reaching beyond scaphocerite; stylocerite 0.68-0.78 as long as proximal segment; anterolateral angle of proximal segment acute, reaches about 0.27 of intermediate segment; intermediate segment 0.60 as long as proximal segment, about 1.5 as long as distal segment; all segments with submarginal plumose setae; distal segment fringed laterally and apically with plumose setae.

Antenna (Fig. 1E). Peduncle about 0.42 as long as scaphocerite; scaphocerite slightly longer than antennular peduncle, outer margin straight to slightly concave, asetose, ends in strong subapical spine, length 2.7-2.9 times width, proximal lamella and interior margin with plumose setae.

Mandibles (Fig. 1F, G). Without palp. Right mandible with about 7 strong, sharp incisor teeth laterally; medially two groups of setae, one group with about 16 hamate setae, other group with about 56 finer straight plumose setae; molar process ridged. Left mandible with 5-6 strong teeth; three groups of setae medially, reducing in size towards ridged molar process.

Maxillula (Fig. 2B). With simple palp, slightly expanded distally, with long plumose setae distally, few simple setae proximally; lower lacinia with broadly rounded margin, bears several rows of plumose and simple setae; upper lacinia broadly elongate, inner edge straight, with several rows of strong spiniform, hamate, denticulate and plumose setae, outer and lower inner margins with plumose setae.

Maxilla (Fig. 2C). With slender tapering palp, shorter than upper endite cleft, naked; upper and middle endite with simple, hamate, plumose and denticulate setae; lower endite with hamate setae; scaphognathite with regular row of long plumose setae on distal margin, with shorter simple ones continuing down proximal triangular process which distally has numerous long simple setae, some with prominent dilation at base.

First maxilliped (Fig. 2D). With broadly triangular lamellar palp, ending in pointed tip, margins with plumose setae; ultimate and penultimate segments of endites indistinctly divided; inner margin of ultimate segment with long denticulate setae; flagellum of exopod distinct, well developed, with plumose setae; caridean lobe narrow, with plumose setae.

Second maxilliped (Fig. 2E). Endopod with fused dactylar and propodal segments; inner margins of remaining three proximal segments with long setae of various types; exopod long, narrow with plumose setae proximally.

Third maxilliped (Fig. 2F). Reaches to beyond tip of antennular peduncle; endopod three-segmented, length of basal segment 6.2-6.6 times width, with few hamate setae on distal outer margin; length of penultimate segment 8.0-8.4 times width, 0.81-0.85 times as long as basal segment, with transverse rows of spiniform hamate setae; distal segment about 0.93 times as long as penultimate segment, ends in large claw-like apical hamate seta surrounded by simple and plumose ones, behind which there are about 7-9 hamate setae on distal third of posterior margin, clump of serrate and pappose setae proximally; exopod reaches to about 0.33 of second segment of endopod, distal margin with long plumose setae.

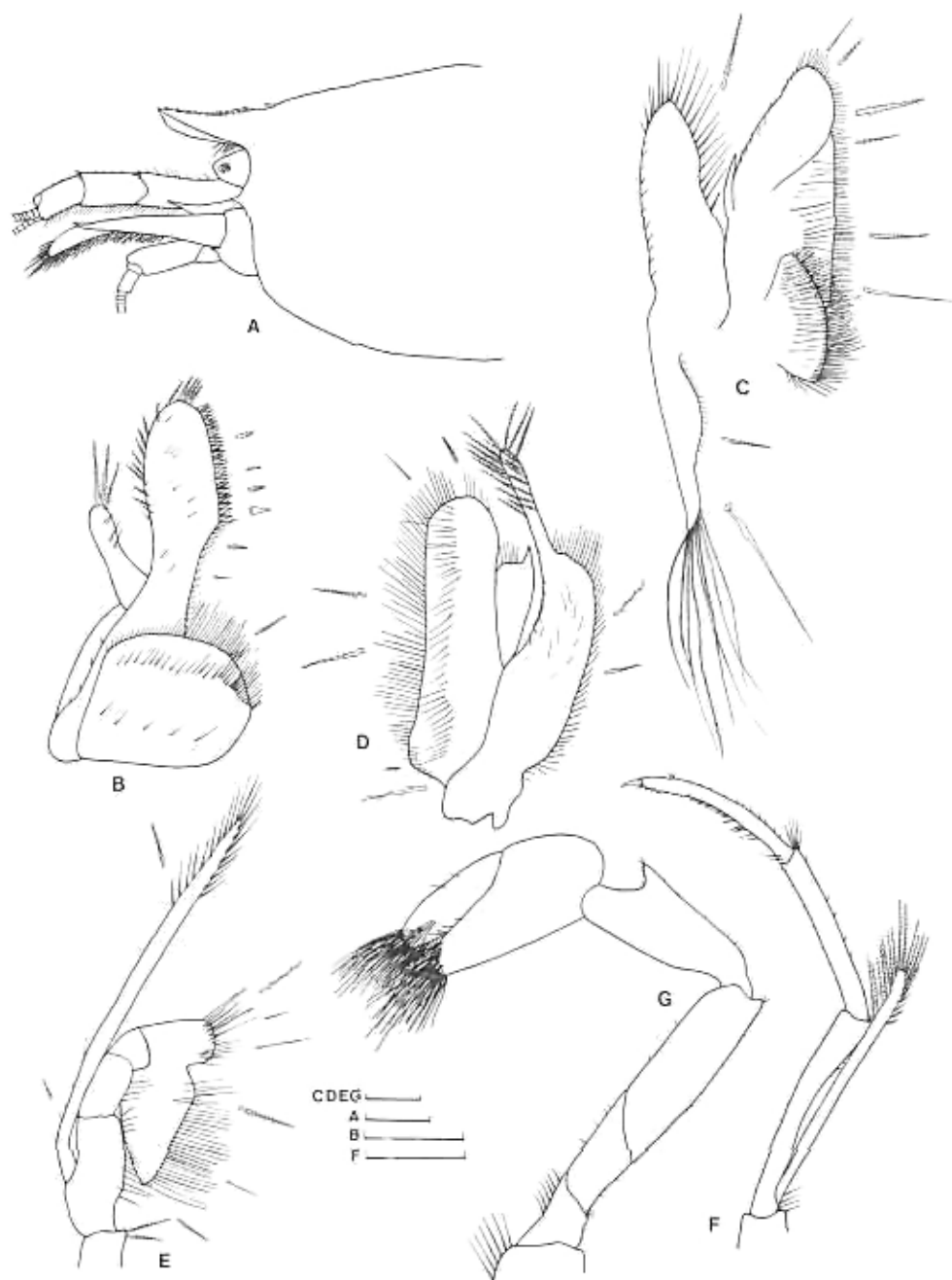


Fig. 2. *Caridina semiblepsia*, new species. Paratype male. A, rostral region; B, maxillula; C, maxilla; D, first maxilliped; E, second maxilliped; F, third maxilliped; G, first pereiopod. Scale bars: 1 mm (A,F), 0.5 mm (B), 0.4 mm (C-E, G).

First pereiopod (Fig. 2G). Reaches tip of eyes; chela length 1.8-2.5 times width; movable finger length 3.3-4.4 times width, 1.3-1.8 times as long as palm; finger tips rounded, without hooks, setal brushes well developed; carpus attached to chela ventrally, excavated distodorsally, carpus length 1.9-2.8 times width, 0.85-1.30 times as long as chela, 0.80-1.00 times as long as merus; merus narrower than carpus; ischium 0.33-0.39 times as long as merus; epipod present.

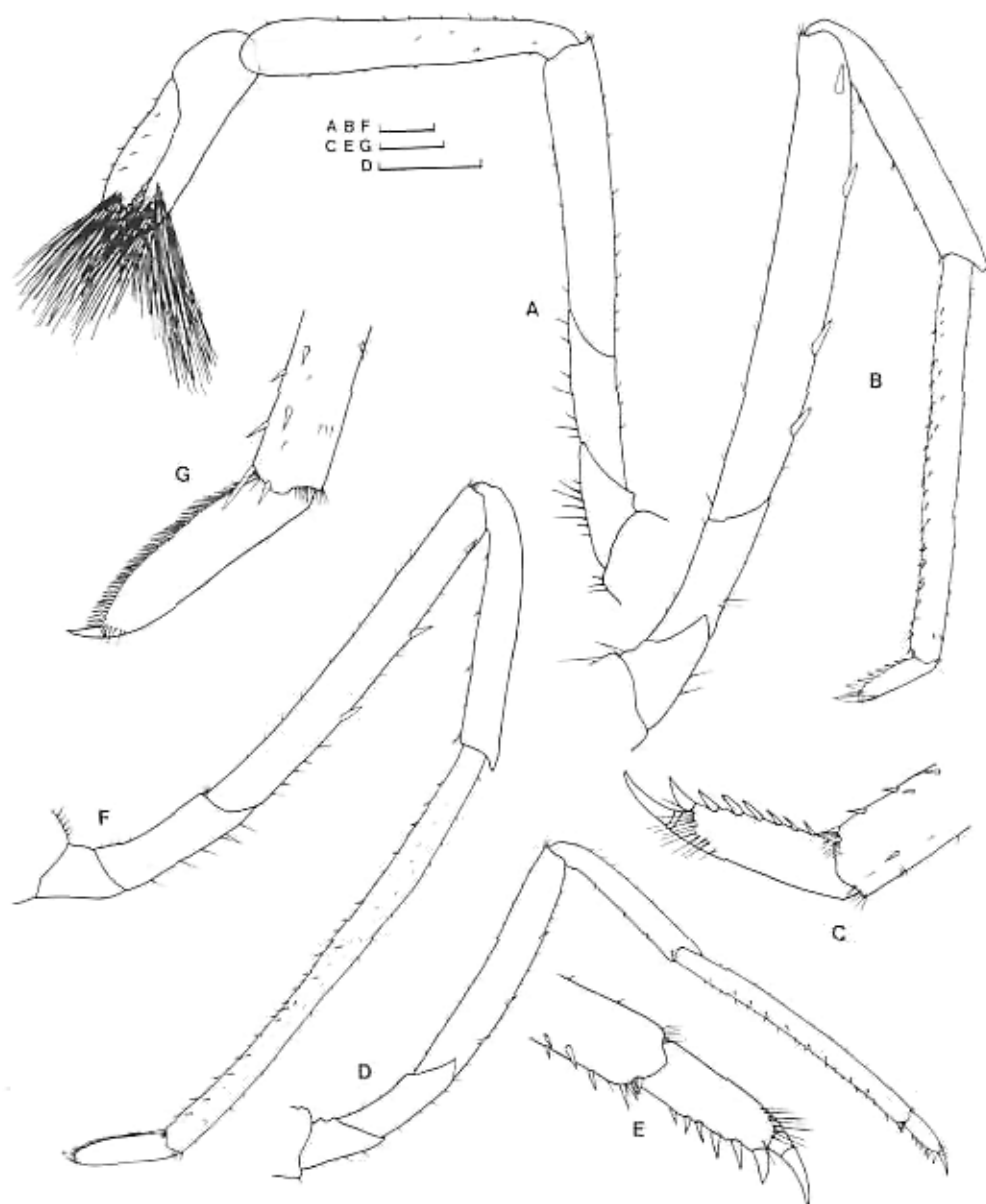


Fig. 3. *Caridina semiblepsia*, new species. Holotype female. A, second pereiopod; B, third pereiopod; C, dactylus of third pereiopod; D, fourth pereiopod; E, dactylus of fourth pereiopod; F, fifth pereiopod; G, dactylus of fifth pereiopod. Scale bars: 1 mm (D), 0.4 mm (A,B,F), 0.2 mm (C,E,G).

Second pereiopod (Fig. 3A). Reaches tip of second segment of antennular peduncle, more slender and longer than first pereiopod; chela length 2.3-2.9 times width; movable finger 4.0-5.7 times as long as wide, 1.7-2.4 times as long as palm, finger tips without hooks, setal brushes well developed; carpus 1.4-1.7 times as long as chela, 0.91-1.10 times as long as merus, length 5.0-5.7 times width, slightly excavated distally; ischium 0.42-0.46 times as long as merus; epipod present.

Third pereiopod (Fig. 3B, C). Over-reaches antennular peduncle tip by about 0.33 distal propodus; dactylus length 2.5-3.7 times width, ending in prominent claw-like hamate seta surrounded by simple setae, behind which posterior margin bears 4-7 shorter spiniform hamate setae; propodus length 10.0-14.8 times width, 4.9-5.6 times dactylus length, posterior margin and lateral surface bearing two rows of small spiniform hamate setae; carpus 0.61-0.79 times as long as propodus, distal projection well developed, posterior and lateral surfaces with up to 8 small hamate setae; merus 1.5-2.1 times as long as carpus, with 3-4 strong, movable spiniform hamate setae along posterior margin; ischium 0.20-0.27 times as long as merus; epipod present.

Fourth pereiopod (Fig. 3D, E). Reaches tip of second segment to tip of third segment of antennular peduncle, morphology similar to that of third pereiopod. Dactylus length 2.4-3.5 times width, ending in prominent claw-like hamate seta and 4-7 (commonly 6) shorter spiniform hamate setae along posterior margin; propodus length 11.0-15.0 times width, 5.1-6.8 times as long as dactylus, bearing two rows of hamate setae along posterior and lateral surfaces; carpus 0.52-0.72 times as long as propodus, with up to 5 small hamate setae along posterior and lateral surfaces; merus about 1.4-1.8 times as long as carpus, with 3-4 spiniform hamate setae on latero-posterior margin; ischium 0.27-0.30 times as long as merus; epipod present.

Fifth pereiopod (Fig. 3F, G; 4A, B). Reaches tip of second segment to tip of third segment of antennular peduncle. Dactylus length 3.2-4.2 times width, ending in claw-like apical hamate seta, bearing comb-like row of 30-52 hamate setae on posterior margin; propodus length 11.2-15.9 times width, 4.5-6.0 as long as dactylus, bearing two rows of 13-20 short hamate setae on posterior margin; carpus 0.50-0.58 times as long as propodus, bearing 2-8 short hamate setae, distal projection well developed; merus distinctly shorter but broader than propodus, bearing 2-4 large spiniform hamate setae; ischium about 0.32 as long as merus, with simple setae; epipod absent.

Abdomen. Well developed, rotund, glabrous, 1.73-1.97 times as long as carapace (CL); sixth abdominal segment 0.31-0.50 times as long as carapace (CL).

First pleopod (Fig. 4C, D). Endopod of adult male 2.1-2.5 times proximal width, about half as long as exopod, trapezoidal, a little wider proximally, tip acutely or broadly rounded, inner border bearing numerous spine-like hamate setae, outer border with long marginal plumose setae; appendix interna well developed, arising from distal part of endopod, half its length over-reaching tip of endopod, numerous retinacula at tip.

Second pleopod (Fig. 4E). Endopod of adult male about 0.90 times as long as exopod, inner border near base with long marginal and submarginal hamate setae; appendix interna long, reaches beyond middle of appendix masculina, with many retinacula distally; appendix masculina rod-shaped, bearing two rows of long hamate setae distally and on inner lateral margin.

Telson (Fig. 4F). 0.34-0.45 as long as carapace (CL), equal to or just shorter than sixth abdominal segment, tapering posteriorly, ending in rounded margin, dorsal surface with 4-7 pairs of short hamate setae including a pair on postero-lateral angle; posterior margin with 3-4 pairs of intermediate plumose setae, outer ones usually shorter and thinner, all distinctly shorter than lateral pair; uropods distinctly longer than telson; diaeresis on exopod with 9-13 small hamate setae.

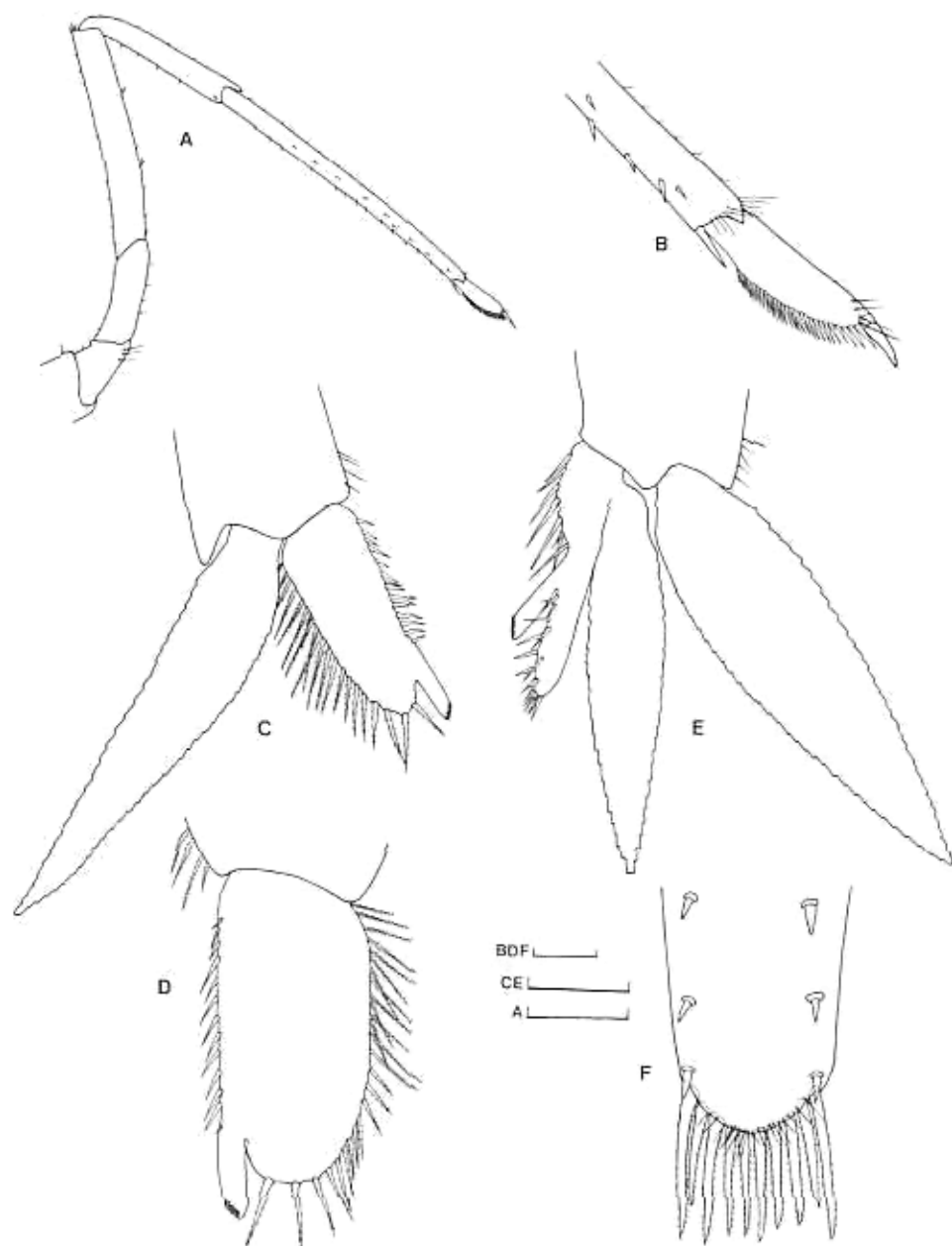


Fig. 4. *Caridina semiblepsia*, new species. Paratype male. A, fifth pereopod; B, dactylus of fifth pereopod; C, first pleopod of male; D, endopod of first male pleopod; E, second pleopod of male; F, dorso-posterior region of telson. Scale bars: 1mm (A), 0.5 mm (C,E), 0.2 mm (B,D,F).

TABLE 1. Length (L) and width (W), in mm, of pereiopod segments of type specimens of *Caridina semiblepsia*, new species. P1-P5, pereiopods 1-5.

| | Dactylus | | Propodus | | Carpus | | Merus | | Ischium | |
|-----------------|----------|------|----------|------|--------|------|-------|------|---------|------|
| | L | W | L | W | L | W | L | W | L | W |
| HOLOTYPE FEMALE | | | | | | | | | | |
| P1 | 0.86 | 0.27 | 1.41 | 0.69 | 1.28 | 0.63 | 1.27 | 0.37 | 0.48 | 0.32 |
| P2 | 0.91 | 0.23 | 1.31 | 0.59 | 2.18 | 0.38 | 2.11 | 0.35 | 0.90 | 0.28 |
| P3 | 0.45 | 0.15 | 2.51 | 0.20 | 1.59 | 0.23 | 3.19 | 0.36 | 0.63 | 0.31 |
| P4 | 0.46 | 0.15 | 2.64 | 0.19 | 1.54 | 0.23 | 2.65 | 0.27 | 0.72 | 0.27 |
| P5 | 0.60 | 0.17 | 3.05 | 0.23 | 1.64 | 0.27 | 2.50 | 0.28 | 0.80 | 0.31 |
| ALLOTYPE MALE | | | | | | | | | | |
| P1 | 0.74 | 0.18 | 1.23 | 0.50 | 1.17 | 0.50 | 1.29 | 0.32 | 0.50 | 0.31 |
| P2 | 0.89 | 0.18 | 1.19 | 0.48 | 1.72 | 0.30 | 1.79 | 0.27 | 0.82 | 0.24 |
| P3 | 0.49 | 0.14 | 2.38 | 0.19 | 1.80 | 0.25 | 2.82 | 0.39 | 0.77 | 0.36 |
| P4 | 0.49 | 0.14 | 2.59 | 0.20 | 1.73 | 0.30 | 2.62 | 0.39 | 0.79 | 0.34 |
| P5 | 0.59 | 0.14 | 3.09 | 0.20 | 2.11 | 0.32 | 2.92 | 0.38 | 0.96 | 0.37 |

TABLE 2. Comparison of some morphometric characters of *Caridina semiblepsia*, new species, *C. ablepsia*, *C. lanceifrons*, *Typhlocaridina lanceifrons* and *T. liui*. am/ai, ratio of appendix masculina and appendix interna lengths on second male pleopod; C1, carpus of first pereiopod; C2, carpus of second pereiopod; D3, dactylus of third pereiopod; D5, dactylus of fifth pereiopod; H1, chela of first pereiopod; H2, chela of second pereiopod; P3, propodus of third pereiopod; P5, propodus of fifth pereiopod; L, length; W, width.

| | <i>C. lanceifrons</i> | <i>C. semiblepsia</i> | <i>C. ablepsia</i> | <i>T. lanceifrons</i> | <i>T. liui</i> |
|-------------------|--------------------------|--------------------------|--------------------------|-----------------------|------------------|
| Habitat | epigean | trogion | trogion | trogion | trogion |
| Retinal pigment | normal | reduced | absent | absent | reduced |
| C1L/C1W | 1.3 | 1.9-2.8 | 1.6-2.3 | 1.7 | 2.3 |
| H1L/H1W | 2.0 | 1.8-2.5 | 2.1-2.9 | 1.6 | 1.6 |
| C2L/C2W | 3.5-4.0 | 5.0-7.5 | 4.3-5.6 | 2.0 | 4.3 |
| H2L/H2W | 2.5 | 2.3-2.8 | 2.3-3.8 | 1.5 | 2.1 |
| D3L/D3W | 4.0 | 2.5-3.7 | 2.4-2.9 | 3.7 | 4.7 |
| D5L/D5W | 3.2 | 3.2-4.2 | 3.2-3.9 | 4.4 | 5.9 |
| P3L/D3L | 3.5-4.0 | 4.9-5.6 | 5.4-7.5 | 3.2-3.5 | 3.0 |
| P5L/D5L | 4.0 | 4.5-6.0 | 4.8-5.7 | 3.4-4.0 | 3.2 |
| Rostral teeth | 3-4) $\frac{16-23}{2-5}$ | 0-2) $\frac{0-13}{0-6}$ | 1-9) $\frac{10-24}{2-8}$ | 5-7) $\frac{0}{0}$ | 5) $\frac{6}{0}$ |
| D3 spination | 5-6 | 4-7 | 4-6 | 4 | 3 |
| Diaeresis | 15-19 | 9-13 | 9-13 | 8-11 | 10-11 |
| am/ai | ca. 2 | < 2 | ca. 2 | ca. 1 | ca. 1 |
| Egg diameter (mm) | 0.56-0.61 x 0.74-0.84 | 1.06-1.15 x 1.37-1.71 | not known | not known | not known |

Egg size. Eggs with undeveloped embryos (eyes not visible) large, measuring 1.06-1.15 x 1.37-1.71 mm; few in number (only 7 in one female).

Colouration. When alive, body is opaque whitish and eyes are reddish; colouration is lost soon after death; body becomes milky white and eyes become colourless on preservation.

Etymology. - Describes the state of the eyes, with only rudimentary retinal pigmentation. It is used as a noun in apposition.

Remarks. - Although *C. semiblepsia*, new species, closely resembles *C. ablepsia* Guo, Jiang & Zhang, 1992, in eye morphology and habitat characteristic (degenerated eyes, troglonic habitat, with type localities only 25 km apart) it seems to have closest phylogenetic affinity with *C. lanceifrons* Yu, 1936. It differs from this species in the following features: live body colouration (opaque whitish versus translucent brown); degenerated eyes, larger eggs (ca. 1.1 x 1.5 mm versus 0.6 x 0.8 mm), rostrum with less dorsal teeth (0-13 versus 16-23) with fewer placed behind the orbital margin (0-2 versus 3-4), less setae on the uropodial diaeresis (9-13 versus 15-19) and relatively slender carpus on the first two pereopods. *C. semiblepsia* can be separated from the other described troglonic species using a combination of characteristics given in Table 2.

Caridina semiblepsia is the fourth troglonic species of atyid shrimp to be reported from China, the others being *Typhlocaridina lanceifrons* Liang & Yan, 1981, *T. liui* Liang & Zhou, 1993 and *Caridina ablepsia* Guo, Jiang & Zhang, 1992. The generic status of *Typhlocaridina liui* is dubious. Its description by Liang & Zhou (1993) and our examination of the single female specimen strongly indicate that the species belongs to the genus *Caridina*. *T. lanceifrons* Liang & Yan, 1981, however, seems to have been correctly placed in this different genus.

The four described troglonic species exhibit different levels of eye degeneration, in terms of the shortening of the eyestalk, the corneal surface becoming more acute and the reduction in retinal pigmentation (Table 2). This suggests that the degenerative process is gradual. Normal-eyed species found in troglonic habitats (e.g. *Caridina cavernicola* Liang & Zhou, 1993 and *C. guangxiensis* Liang & Zhou, 1993) may be regarded as facultative troglonic species while those with completely degenerated eyes (e.g. *Caridina ablepsia* and *Typhlocaridina lanceifrons*) may be regarded as obligate troglonic species. As for those species with partially degenerated eyes (such as *C. semiblepsia*, new species, and *T. liui*) it is suggested that they be regarded as obligate troglonic species until such time that evidence to the contrary is found.

The survival of *C. semiblepsia*, new species, and other troglonic fauna and flora may be under threat. Many caves and their associated water bodies are being opened up as tourist attraction and are artificially lit for long hours. The impact of such disturbances on the flora and fauna are likely to be significant. Careful conservation and management consideration should be given before exposing such unique and fragile habitats to artificial conditions and the human disturbance.

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