

Notes on the genus *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae). 1. *Ilyocryptus plumosus* sp.n., a primitive Neotropical member of the *I. spinifer*-group

Заметки о роде *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae). 1. *Ilyocryptus plumosus* sp.n., примитивный неотропический вид из группы *I. spinifer*

Alexey A. Kotov¹ & Pavel Štifter²
А. А. Котов и П. Штифтер

¹A. N. Severtsov Institute of Ecology and Evolution, Leninsky Prospect 33, Moscow 119071 Russia. E-mail: golokot2000@mail.ru.
Институт проблем экологии и эволюции им. А. Н. Северцова РАН, Ленинский проспект 33, Москва 117071 Россия.

²Smetanova 25, Benátky nad Jizerou 29471 Czech Republic. E-mail: stifter@benatky.cz.

KEY WORDS: Cladocera, Anomopoda, *Ilyocryptus*, morphology, systematics, America, Neotropics.

КЛЮЧЕВЫЕ СЛОВА: ветвистоусые ракообразные, Cladocera, Anomopoda, *Ilyocryptus*, морфология, систематика, Америка, неотропическая зона.

ABSTRACT. *Ilyocryptus plumosus* sp. n., a Neotropical member of *I. spinifer*-group (Cladocera: Anomopoda: Ilyocryptidae), is described from Venezuela and Nicaragua. The most specific character of *I. plumosus* sp.n. is the primitive state of the setae at the posterior margin of valves, which lack spine-like setules. This is a rare species, distributed in Central America and northern South America.

РЕЗЮМЕ. *Ilyocryptus plumosus* sp.n., неотропический вид группы *I. spinifer* (Cladocera: Anomopoda: Ilyocryptidae), описан из водоемов Венесуэлы и Никарагуа. Наиболее специфическим признаком *I. plumosus* sp.n. является примитивное строение щетинок на заднем крае створок, сетулы на которых совершенно не модифицированы. Это — редкий вид, распространенный в Центральной и Южной Америке (по крайней мере в северной части последней).

Introduction

Recently, Kotov & Williams [2000] and Kotov & Dumont [2000] revised the *Ilyocryptus spinifer* species group (Cladocera: Anomopoda: Ilyocryptidae) and demonstrated that *I. spinifer* Herrick, 1882 is a widely distributed species with significant morphological variability among populations. Only a single other species from the *I. spinifer* group, *I. timmsi* Kotov & Dumont, 2000 from two localities in Queensland, North Australia, is known.

I. spinifer is the most common species of the genus in the tropics and subtropics of all continents [Kotov & Dumont, 2000], and in the southern half of the Nearctic zone [Kotov et al., 2002]. Our examination of additional samples from different continents resulted in the

finding of numerous populations of this species, not seen by Kotov & Williams [2000] and Kotov & Dumont [2000]. At the same time, we found a new species from the *I. spinifer* group in Venezuela and Nicaragua, which differs from *I. spinifer* s. str. in a series of important morphological traits. The aim of this communication is to describe this new species as *Ilyocryptus plumosus* sp.n.

Material and methods

Animals were isolated from the samples under a stereomicroscope, washed in commercial detergent, washed in distilled water, and examined for morphometry. The following measurements (based on 8 adult parthenogenetic females from type locality) were made, see a scheme of these measurements in Kotov et al. [2002]: body length (BL), height (BH) and width (BW); head length (HL) and width (HW); eye diameter (ED); valve length (VL); number of marginal elements (NE); number of setae in antero-ventral bunch (NB); number of setae with single basal spines (NS); maximal length of a seta on antero-ventral (AV) and postero-ventral valve portion (PV); postabdomen length (from base of claw to base of postabdominal setae) (PL) and height (PH); anus length (AN), length of preanal part of postabdomen (PR); number of preanal teeth or/and clusters of teeth (NT); number of big paired spines of distal part (NP); number of large (NL), medium-sized (NM) and rudimentary (NR) lateral setae; postabdominal claw length (CL); length of more distal (DS) and more basal spine (BS) on base of claw; number of distal denticles on claw (DD); rudimentary additional denticles on middle part of claw (AD); postabdominal

("natatorial") seta length (SN); length of the basal segment of postabdominal seta (BA); antenna I length (AL), maximal diameter (DA) and its proximal segment length (PS); length of antenna II (without apical setae) (SL); length of exopod apical spine (AS), length of endopod apical spine (AP); length of third exopod segment (TH) and of spine on its second segment (SE); maximal length of apical swimming seta (SW) of second antennae, length of distal (DI) and proximal (PX) lateral swimming seta on antennal exopod. After that, some relative parameters were calculated for each animal, as applied in a series of previous publications [Kotov & Dumont, 2000; Kotov et al., 2002].

Results

Ilyocryptus plumosus sp.n.

Figs 1–19.

MATERIAL. Holotype a parthenogenetic ♀, 770 µm, with label "*Ilyocryptus plumosus* sp.n., 1 parth. ♀ from experimental module in Mantecal, Venezuela, coll. 28.xi.1985 by W. Vásquez, HOLOTYPE", deposited at the invertebrate collection of the Zoological Museum of Moscow State University, MGU Ml 32. Paratypes: 9 parthenogenetic ♀♀, MGU Ml 33.

OTHER MATERIAL STUDIED. VENEZUELA: Several ♀♀ from ponds in Mantecal, coll. in 1977–1981 by E. Zoppi de Roa, slides AAK-SL-004-005 in personal collection of AAK. NICARAGUA: A single ♀ from Río Tipitapa, coll. in 14.ii.1985 by N.N. Smirnov, slide AAK-SL-006.

TYPE LOCALITY. A flooded savannah in the Mantecal Experimental Module (7°35'N, 69°10'W), near Mantecal, Venezuela. The locality was described by Jiménez & Zoppi de Roa [1987] and Zoppi de Roa & Vásquez [1991]. The type series was collected in 28.xi.1985 by W. Vásquez.

DESCRIPTION. ADULT PARTHENOGENETIC FEMALE. *General.* In lateral view, body subovoid, of medium height for the genus (BH/BL = 0.68–0.75 in adults, 0.65–0.69 in juveniles), maximum height in posterior half (Fig. 1). Dorsal margin almost straight, postero-dorsal angle expressed. In anterior view, body rhomboid-ovoid, relatively compressed laterally (Fig. 2), BW/BL = about 0.5, with a distinct dorsal keel, although not too high as in *I. spinifer*. Moulting incomplete, reticulation well-expressed on head shield and valves.

Head relatively small for the genus (HL/BL = 0.28–0.33), its ventral margin in posterior part with prominent basis for antennae I, labrum base surrounded with a low fold (Fig. 3). In ventral view head shield triangular-ovoid, relatively narrow (HW/BL = about 0.3), with prominent fornicies (Fig. 4). Dorsal head pore located on a low prominence (Fig. 1, arrow). Compound eye of common size for genus (ED = 22–25 µm), ocellus small, subovoid.

Labrum subquadrangular in lateral view, with a distinct medial projection in its basal portion (Fig. 3, arrow). In ventral view, labrum wide, with lateral projections on each side in medial portion, two rows of setules on each side in its distal portion, latero-distal angles relatively smooth (Fig. 4, arrow).

Valves subovoid, VL/BL = 0.80–0.83. Numerous setae along free margin (NE = 50–54), four anteriormost setae protruding sparsely, following with a bunch (NB=4–5) of closely located setae, some of them specially long (AV/BL=0.27–0.32), the first seta in bunch protruding posterior (Fig. 5, arrow). Setae in middle of ventral margin short, while setae in postero-ventral region long (PV/BL = 0.20–0.25), seta at

posterior margin with long setules, lacking of any spine-like setules (NS = 0), in contrast to the majority of *ilyocryptids*.

Abdomen dorsally with cross rows of setules, a long projection on the first segment (Fig. 7, arrow).

Postabdomen of medium size for the genus, PL/BL = 0.48–0.55 (Fig. 7), narrow (PH/PL = 0.38–0.43), height maximal in basal portion. Anus small (AN/PL = 0.11–0.13), opens somewhat closely to base than to distal extremity, no spinules on its internal wall were found. Preanal margin short (PR/PL = 0.34–0.37), with a row of regularly located, relatively small, not numerous teeth, somewhat bent toward distal portion (NT = 9–12) (Fig. 8). Small denticles near preanal teeth. Small groups of spinules on lateral faces of postabdomen basally. A row of very numerous and small paired spines starts on postanal margin and continues up to distal boundary of preanal margin (NP = 17–20). Large lateral setae (NL = 3–4) markedly (in 5–7 times) longer than paired spines, the proximalmost lateral seta largest, located on postanal margin far from anus. On the distal part of postabdomen, the row of lateral setae fluently turned into the group of middle-sized setae (NM = 3–6), the latter, more distally, into group of rudimentary setae (NR = 3–7).

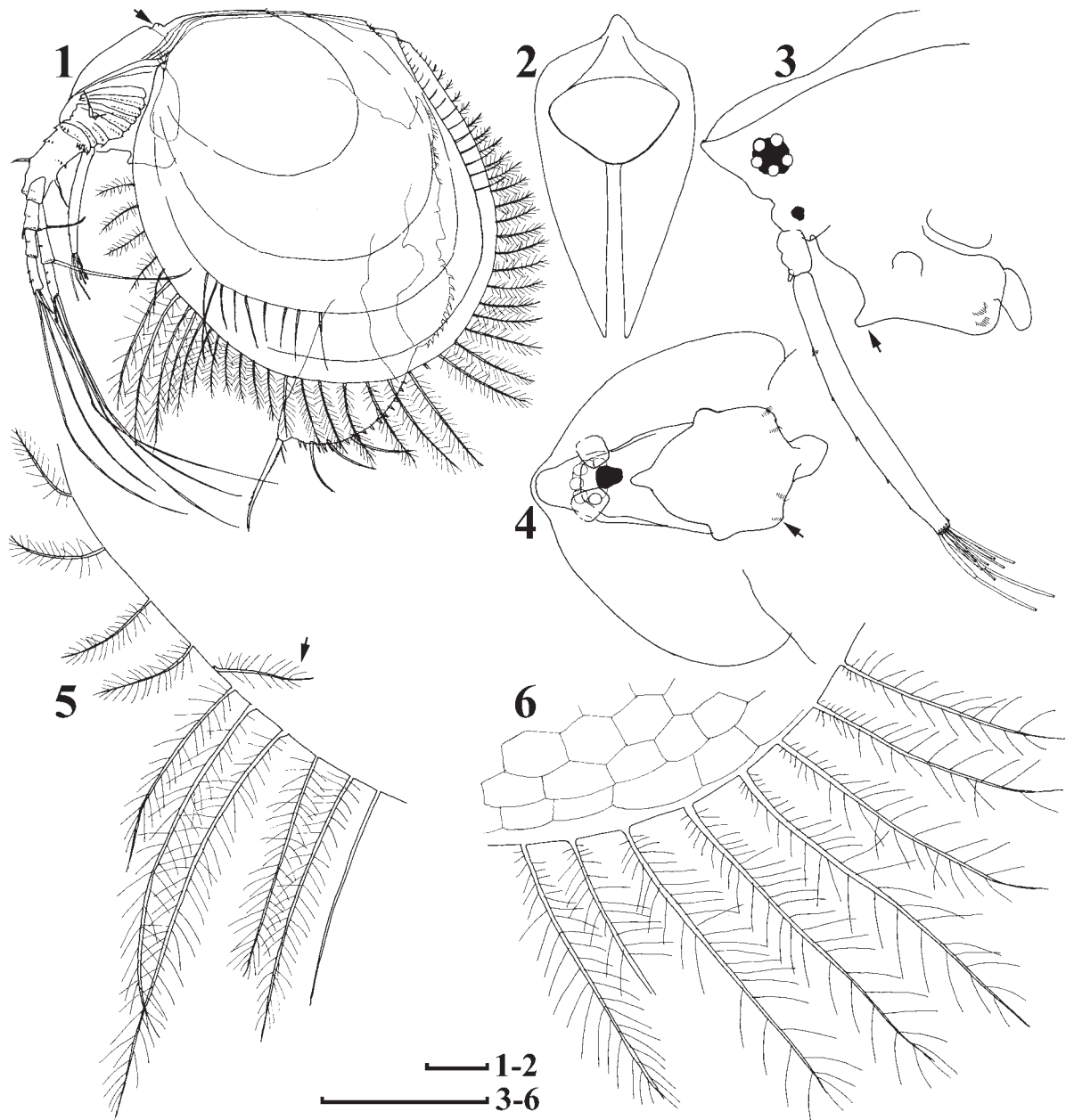
Postabdominal claw relatively long (CL/PL = 0.38–0.44), slightly bent distally (Fig. 9). There are two pectens of setules along dorsal margin, with a very small gap between them, setules in the second pecten thicker than those in first pecten. There are relatively strong denticles in distal portion of claw ventrally, while additional denticles in middle of claw not found (DD = 2–5, AD=0). Two spines on the base of each claw dorsally, basal one specially shorter and thinner than distal one (DS/BS = 1.7–2.3). A group of short setules on claw base ventrally (Fig. 9, arrow).

Postabdominal seta slightly longer than postabdomen, although its length varies greatly among individuals (SN/PL = 1.04–1.10), its basal segment somewhat shorter than distal one (BA/SN = 0.41–0.44), the latter with long, rare hairs.

Antenna I remarkably long and thin for *Ilyocryptus* (AL/BL = 0.24–0.27; DA/AL = 0.08–0.10), slightly curved (Fig. 10). Bases of antennae I not compressed against each other. Proximal segment short (PS/AL = 0.14–0.15), with a well-expressed finger-like projection (Fig. 10, arrow), and low hillocks. Distal segment cross with rows of denticles, distal end truncated, without hillocks. Nine aesthetascs, two of them longer than the rest.

Antenna II (Fig. 11) long for the genus (SL/BL = 0.45–0.48), coxal part with two sensory setae of somewhat differing size. Distal sensory seta on basal segment long, slender, as in *I. spinifer*, distal burrowing spine shorter than distal sensory seta, robust, with short setules distally (Fig. 12). Antennal branches elongated, on all segments, there are well-developed denticles around distal segment ends, and groups of similar denticles in middle part (Figs 13, 14). Swimming setae 0-0-0-3/1-1-3, spines 0-1-0-1/0-0-1. Apical swimming setae very long (SW/BL = 0.61–0.70), bisegmented, distal segments without hooks on tips, unilaterally armed with short setules (Figs 15, 16). Proximal lateral swimming seta markedly shorter than distal lateral swimming seta, although their relative size significantly variable (PX/DI = 0.38–0.57), both setulated similarly to apical setae, but with hooks on tips (Figs 17, 18). Spine on apical segment of endopod shorter than that on exopod (AS/AP = 1.07–1.14), both slightly curved. Spine on second segment of exopod shorter than half of third segment (SE/TH = 0.36–0.45), setulated distally.

Limbs: As in *I. spinifer*. A single seta on outer distal lobe of limb I. A large, bisegmented seta near ejector hooks,



Figs 1–6. *Ilyocryptus plumosus* sp.n., parthenogenetic ♀♀ from experimental module in Mantecal, Venezuela, coll. 28.11.1985 by W. V6squez: 1, 2 — holotype in lateral and anterior view; 3, 4 — head in lateral and ventral view; 5, 6 — setae at antero-ventral and postero-ventral portion of valve. Scale 100 μ m.

Рис. 1–6. *Ilyocryptus plumosus* sp.n., парthenогенетические ♀♀ из экспериментального модуля в Мантекале, Венесуэла, собранные 28.11.1985 В. Васкесом: 1, 2 — голотип, вид сбоку и спереди; 3, 4 — голова, вид спереди и снизу; 5, 6 — щетинки на переднебрюшном и заднебрюшном крае створок. Масштаб 100 μ m.

a gnathobase I as a naked hillock without setae. No beating seta near gnathobase III. Filter plate V with 4 setae. Limb VI as a triangular plate with six bunches of 2–4 relatively stout setules (Fig. 19).

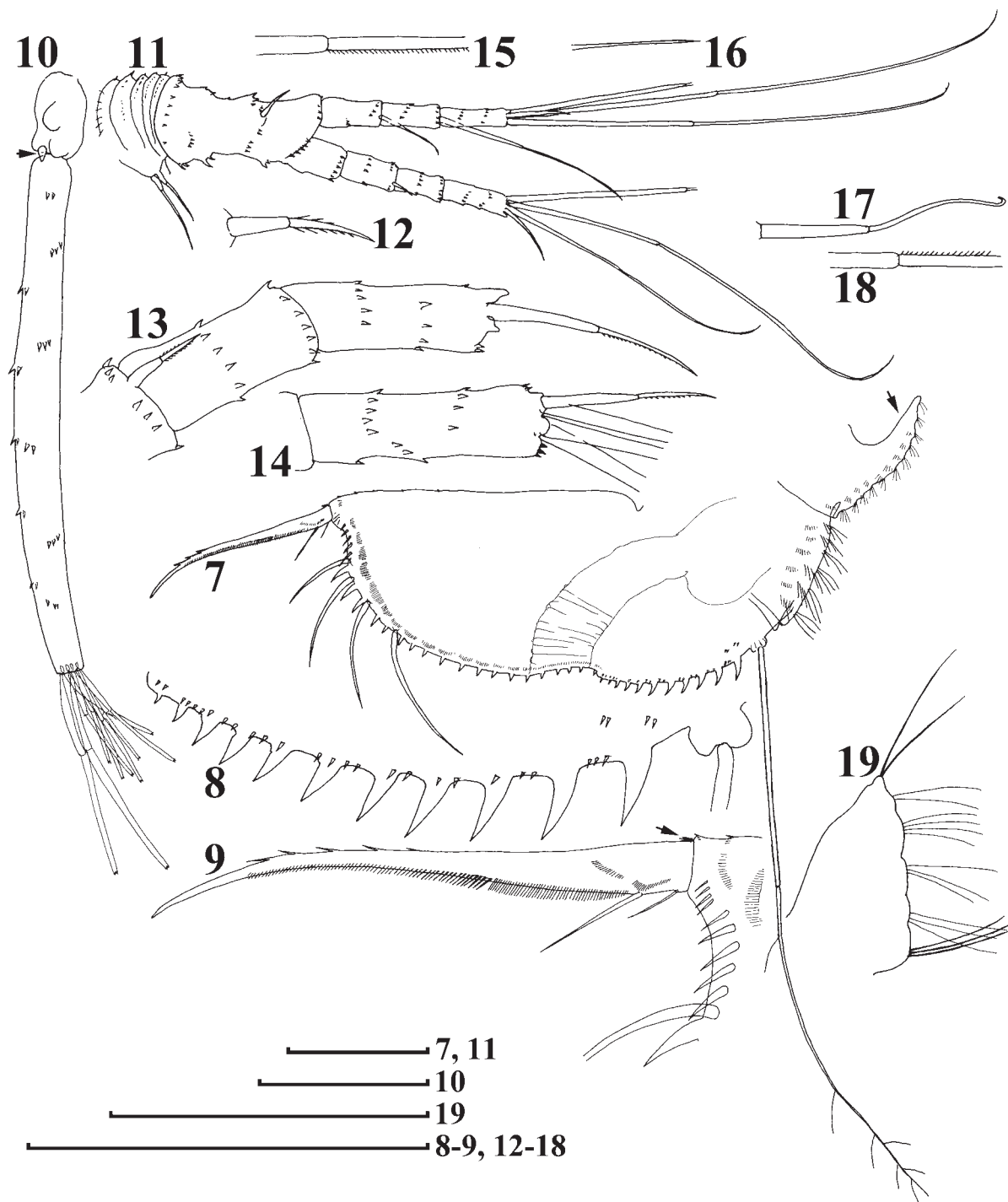
EPHIPPIAL FEMALE. Body shape similar to that in parthenogenetic ♀, moulting complete. Ehippium with two eggs, central part of ehippium expanded, forming an egg chamber. Surface of ehippium with meshes, a low depres-

sion in the middle of each mesh, while margins are inflated and additionally chitinized.

MALE. Unknown.

SIZE. Holotype 770 μ m, parthenogenetic ♀♀ from type locality 415–770 μ m ($n = 12$), ehippial female 700 μ m ($n = 1$).

ETYMOLOGY. From (*L.*) *plumosus*, "feathered", referring to the feathered setae at the posterior margin of carapace, lacking spine-like setules.



Figs 7–19. *Ilyocryptus plumosus* sp.n., parthenogenetic ♀♀ from experimental module in Mantecal, Venezuela: 7, 8 — postabdomen and its preanal margin; 9 — postabdominal claw; 10 — antenna I; 11 — antenna II; 12 — distal burrowing spine; 13, 14 — distal portions of exopod and endopod; 15, 16 — middle and distal portion of apical swimming seta; 17 — basal lateral seta; 18 — distal lateral seta; 19 — limb VI. Scale 100 µm.

Рис. 7–19. *Ilyocryptus plumosus* sp.n., партеногенетические ♀♀ из экспериментального модуля в Мантекале, Венесуэла: 7, 8 — постабдомен и его преанальный край; 9 — постабдоминальные коготки; 10 — антенна I; 11 — антенна II; 12 — дистальный шип; 13–14 — дистальная часть экзоподита и эндоподита; 15, 16 — средняя и дистальная часть апикальной плавательной щетинки; 17 — базальная латеральная щетинка; 18 — дистальная латеральная щетинка; 19 — нога VI. Масштаб 100 µm.

Table 1. Morphological differences between three known species of *I. spinifer* species group. Pluses mark presumable apomorphies.Таблица 1. Морфологические различия между видами группы видов *I. spinifer*. Плюсами помечены предполагаемые апоморфии.

Character	<i>I. spinifer</i>	<i>I. timmsi</i>	<i>I. plumosus</i> sp.n.
Body strongly compressed laterally, with high dorsal keel	+	+	-
Setae at posterior margin of valve with wider base bearing a single, stout, spine-like setule	+	+	-
Postanal teeth large	+	+	-
Setules in second pecten on postabdominal claw thicker than in first pecten	-	-	+
A large gap between first and second pectens of setules on dorsal side of postabdominal claw	-	+	-
A projection on apical segment of exopod large, triangular	-	+	-
On antenna II spine on the second exopod segment longer than half of third segment	+	+	-
Setules along one side of lateral swimming seta of antenna II longer than diameter of seta	-	+	-
Adult female very large	+	-	-

DIAGNOSIS OF PARTHENOGENETIC FEMALE.

Body subovoid, dorsal margin almost straight, postero-dorsal angle expressed, dorsal keel distinct, although not too high as in *I. spinifer*, moulting incomplete. Valves with distinct reticulation, four anteriormost setae protruding sparsely, posteriorly to them, a bunch of 4–5 closely located setae. Each seta at posterior margin with long setules, lacking of any spine-like setules. Postabdomen with height maximal in basal portion, anus opens somewhat closely to base than to distal extremity, no spinules on its internal wall. Preanal margin with a row of regularly located, relatively small teeth, somewhat bent toward distal portion. Small groups of spinules on lateral sides of postabdomen basally. Paired spines start on postanal margin and continue up to distal boundary of preanal margin, large lateral setae markedly longer than paired spines, the proximalmost lateral seta largest, located on postanal margin far from anus. On postabdominal claw, there are two pectens of setules along dorsal margin, with small gap between them, setules in the second pecten thicker than those in first pecten, ventrally relatively strong denticles in distal part of claw. Two spines on the base of each claw dorsally, basal one especially thin. A group of short setules on the claw base ventrally. Postabdominal seta slightly longer than postabdomen, its basal segment with rare, long hairs. Antenna I long and thin, its proximal segment with a distinct finger-like projection and low hillocks, distal segment with rows of denticles, distal end without hillocks. Antenna II with two sensory setae of somewhat differing size its coxal part. Distal sensory seta long, distal burrowing spine short, robust. Apical swimming setae long, their distal segments without hooks on tips, unilaterally armed with short setules. Proximal lateral swimming seta greatly shorter than distal lateral swimming seta, both setulated analogously to apical setae, but with hooks on tips. Spine on second segment of exopod shorter than half of third segment. A single seta on outer distal lobe of limb I. A large, bisegmented seta near ejector hooks, a gnathobase I as a naked hillock without setae. No beating seta near gnathobase III. Filter plate V with 4 setae. Limb VI as a triangular plate with six bunches of 2–4 relatively stout setules.

Ehippial female bearing two eggs, ehippium expanded, with additional inflated meshes.

Size up to 770 μm .

DIFFERENTIAL DIAGNOSIS. *I. plumosus* sp.n. is a member of *I. spinifer*-group, see diagnosis of this group in Kotov & Dumont [2000]; see Table 1 for its differences from other members of this group.

DISTRIBUTION. *I. plumosus* sp.n. is known from a single locality in Venezuela and a single locality in Nicaragua. So, it is distributed in Central and (at least) northern part of South America. This species is remarkably more rare than its closest relative, *I. spinifer*.

BIOLOGY. We have information only about the Experimental Module in flooded savannah in Mantecal, Venezuela. There *I. plumosus* sp.n. co-occurs with several other anomopod species, including two other species of the genus, *I. spinifer* and *I. paranaensis*, at altitude 79 m.a.s.l., depth 0.3–2 m, water temperature 26–33°C, conductivity 110–140 $\mu\text{S/cm}$, pH 4.8–6.0 [Jiménez & Zoppi de Roa, 1987; Zoppi de Roa & Vásquez, 1991; E. Zoppi de Roa, pers. comm.].

Discussion

The most specific trait of *I. plumosus* sp.n. is the plesiomorphic state of the setae at the posterior margin of valves, without wider base and lacking of any spine-like setules. Among previously studied ilyocryptids, analogous setae are characteristic only for *I. elegans* Paggi, 1992, which is apparently the most primitive species among all recent ilyocryptids [Kotov & Elías-Gutiérrez, 2002]. In *I. acutifrons* Sars, 1862 setules on these setae are not modified also, but the trunks of the setae are remarkably inflated (see Alonso [1996]), so, these setae are quite specialized.

At the same time, *I. plumosus* sp.n. is the closest relative of *I. spinifer*, which is quite specialized species, having also (1) a relatively compressed body and developed dorsal keel; (2) the basalmost lateral seta located on postanal margin of the postabdomen far from anus; (3) a very long antenna I supplied with rows of denticles; (4) a long antenna II with very long apical swimming setae; (5) hooks on tips of lateral swimming setae; (6) limb I lacking of a seta near ejector hooks;

and a (7) limb VI with six bunches of few setules. Among the characters listed above, 1–2 and 4–7 are apparently synapomorphies of these species.

We regard *I. plumosus* **sp.n.** as the most primitive member of *I. spinifer* group, because it has a series of apparently plesiomorphic traits: (1) weak dorsal keel and less compressed body; (2) no spine-like setules on the setae at the posterior margin (see above); (3) relatively small preanal teeth on the postabdomen as compared with two other species. In contrast, thick setules in the second pecten on postabdominal claw in *I. plumosus* **sp.n.** are autapomorphic.

Our finding of this new species demonstrates again that ilyocryptids of the world are not studied sufficiently. At this moment, only three *spinifer*-like species are known, but we think that there is a chance to find new members of this group.

ACKNOWLEDGEMENTS. We are very grateful to Prof. N.N. Smirnov for help at different phases of our work, Prof. D. J. Taylor for edition of an earlier draft, Prof. E. Zoppi de Roa and Dr W. Vásquez for the samples with this species and information on localities, Dr D. Ivanov (Zoological Museum of Moscow State University, Russia) for efforts to deposit types to the Museum collections. This work is supported by the Russian Foundation for Basic Research (grant

03-04-48879 for AAK) and US National Science Foundation grant PEET (DEB-0331095).

References

- Alonso M. 1996. Crustacea, Branchiopoda. Fauna Iberica. Vol. 7. Madrid, CSIC Publ. 486 p.
- Jiménez B., Zoppi de Roa E. 1987. Reproductive variations of cladocerans in grasslands periodically flooded for irrigation in Mantecal, Venezuela // *Hydrobiologia*. Vol.145. P.293–298.
- Kotov A.A., Dumont H.J. 2000. Analysis of the *Ilyocryptus spinifer* s. lat. species group (Anomopoda, Branchiopoda), with description of a new species // *Hydrobiologia*. Vol.428. P.85–113.
- Kotov A.A., Elías-Gutiérrez M. 2002. Phylogeny of the *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae): a synthesis of cladistic and numerical analyses, and evolutionary ('orthodoxal') interpretation of results // VIth International Symposium on Cladocera, Wierzba, Poland, 19–23 August 2002. Abstracts. P.36.
- Kotov A.A., Williams J.L. 2000. *Ilyocryptus spinifer* Herrick 1882 (Anomopoda, Branchiopoda): a redescription based on North American material and designation of a neotype from Minnesota // *Hydrobiologia*. Vol.428. P.67–84.
- Kotov A.A., Elías-Gutiérrez M., Williams J.L. 2002. A preliminary revision of *sordidus*-like species of *Ilyocryptus* Sars, 1862 (Anomopoda, Branchiopoda) in North America, with description of *I. bernerae* n. sp. // *Hydrobiologia*. Vol.472. P.141–176.
- Zoppi de Roa E., Vásquez W. 1991. Additional cladoceran records for Mantecal and new for Venezuela // *Hydrobiologia*. Vol.225. P.45–62.