

***Ceratoplectus armatus* (Bütschli, 1873) Andrassy, 1984 (Leptolaimina: Plectidae) from five sites on three continents**

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Summary. Specimens of the cosmopolitan species *Ceratoplectus armatus* from five sites on three continents are described from studies by light microscopy and one population also by scanning electron microscopy. Some new biogeographical records are provided. The populations are compared with each other and with populations previously described. Some discrepancies in morphometry and morphological characters were found between specimens of different populations, but they were mostly within the ranges established for the species. *Plectus incertus* Maiello, 1967 is suggested to be a junior synonym of *C. armatus*. The possible phylogenetic importance of *Ceratoplectus* is briefly discussed.

Key words: Australia, Brazil, *Ceratoplectus*, Kenya, morphology, *Plectus*, scanning electron microscopy, West Indies.

Ceratoplectus Andrassy, 1984 is a rather small genus with less than ten nominal species characterized i.a. by having four strong cephalic setae (horn-like) directed forward and reaching anterior to the lip region (Andrassy, 1984). *Ceratoplectus armatus* (Bütschli, 1873) Andrassy, 1984 is a cosmopolitan species found in Europe, North and South America, Africa, Asia (recently described from Japan by Khan & Araki (2001)), New Zealand and Australia (Andrassy, 1985; Zell, 1993; De Ley & Coomans, 1994). In this study, specimens of *C. armatus* were collected from sites in Kenya, two West Indian islands, Brazil, and Lizard Island (Australia). They are described from studies by light and scanning electron microscopy (SEM) and are compared with the original description and other populations of *C. armatus*.

MATERIALS AND METHODS

Nematodes were extracted by a modified Baermann funnel method (Sohlenius, 1979). They were killed by heat, fixed in cold TAF, processed to pure glycerine by a slow evaporation method and mounted in glycerine on permanent slides using paraffin wax as support for the coverslip. For SEM, specimens from Kenya were postfixed in 1% osmium tetroxide (OsO₄), transferred to pure ace-

tone through an acetone/distilled water series, critical point dried in liquid CO₂, mounted on stubs, gold-plated under vacuum to a thickness of 200 E in a sputter, and examined in a Zeiss Novascan 30 SEM at an accelerating voltage of 15 kV.

Site descriptions: Kenya, Gedi, about 20 km S of Malindi (3°14'S, 40°06'W), historical site of Gedi (ruin town); edge of parking lot in front of main entrance; litter; collected by Christer Erséus, 9 September 2000.

West Indies, U.S. Virgin Islands (18°N, 65°W), St. John, Trunk Bay Beach; dry sandy soil with litter under trees; collected by Christer Erséus, 30 October 2000.

West Indies, St. Kitts (17°N, 63°W), Turtle Beach; dry soil with litter under a tree at restaurant; collected by Christer Erséus, 26 October 2000.

Brazil, Rio de Janeiro, Ipanema (23°S, 43°W); dry sandy soil with some organic material like roots; collected by Arne Nygren, 26 August 1998.

Australia, Lizard Island (14°40.8'S, 145°26.9'E), Coconut Beach, lower part of rain-forest; dry sand with some organic material; collected by Elín Sigvaldadóttir, 4 October 1995.

DESCRIPTION

Ceratoplectus armatus (Bütschli, 1873)
Andrássy, 1984
(Fig. 1)

Measurements: See Table 1.

Female. Body shape from almost straight to strongly curved ventrad when relaxed by heat. Cuticle less than 1 μm thick; annulated, annules 0.6–0.9 μm wide. Lateral field consisting of two separate wings, together about 2.5–3.0 μm wide at midbody, occupying 15–20% of corresponding body diameter. Amphids circular, 2.5–3.0 μm wide, occupying about 20–30% of corresponding body diameter. Lip region not offset, 2.0–2.5 μm high, 8–10 μm wide. Anterior end with four strong cephalic setae with flattened base, 3–5 μm long, extending anterior to lips. Six lips, each with an inner and an outer labial sensillum; subventral and subdorsal lips separated by less elevated cuticle; lateral lips wider, each with two radial incisures as seen by SEM. Stoma 1.5–2.0 times as long as LRW, 2.0–4.0 μm wide anteriorly (lower figure when closed). Corpus cylindrical, isthmus plump, bulb with valves, cardia enveloped by intestinal tissue. Deirids setiform, in middle of lateral field. Vulva a transverse slit at midbody, vulval lips not or slightly protruding. Vagina straight or slightly curved, occupying about one-fourth to one-third of VBD, encircled by a single muscle. Reproductive system amphidelphic; ovaries reflexed, posterior ovary often extending almost to vulva. Rectum about one ABD. Tail subcylindrical, with four to six setae, often one pair subdorsal near anus, one pair subventral and a terminal subdorsal "spur" 5–7 μm from terminus. A small simple spinneret at tail end.

Male. Not found.

DISCUSSION

When Andrásy (1984, 1985) erected and revised the genus *Ceratoplectus*, he considered *Plectus arctus* Truskova, 1976 to be a junior synonym of *C. armatus*. Zell (1993) reinstated it as a valid species, *P.(C.) arctus* (Truskova, 1976) Zell, 1993, separated from *C. armatus* by the combined length of bulb and cardia (25–30 μm vs 16.5–24.0 μm). De Ley & Coomans (1994) recorded this combined length to be 19–26 μm in their material of *C. armatus* from the Galápagos Archipelago. Taking into account the possible measuring errors (due to difficulties to pinpoint the anterior end of bulb,

and tip of cardia covered by intestinal tissue), De Ley & Coomans suggested that *C. arctus* cannot be properly diagnosed by this character, and hence they accepted Andrásy's synonymisation of the two species as probably correct. Furthermore, Zell (1993) synonymised *C. amoenus* Andrásy, 1989 with *C. arctus* on the grounds that most of their characters are variable to such degree that species separation is not possible. Following their line of reasoning, De Ley & Coomans (1994) also considered *C. amoenus* as a junior synonym of *C. armatus* because this fits in with the idea that *C. armatus* is both cosmopolitan and morphologically variable. The synonymisations suggested by De Ley & Coomans were accepted by Holovachov (2001) and are also followed in this paper.

Plectus incertus was described by Maiello (1967) from the slopes of Vesuvius (Italy). The description has apparently not been noticed by subsequent authors as the species cannot be found in later revisions of plectids (Andrásy, 1984, 1985; Zell, 1993). The specimens described were compared with *C. assimilis* Bütschli, 1873, from which they were separated by a shorter body length (0.39–0.52 mm vs 0.57–0.90 mm), a smaller b-value (3.7–4.1 vs 4.2–6.0), a somewhat smaller c-value (8.5–9.0 vs 8.3–12.8), and a larger V-value (51–53% vs 47.5–51.0%). The measurements of *P. incertus*, however, closely resemble those recorded for various populations of *C. armatus* and it is suggested here that the former is considered as a junior synonym of the latter species.

The specimens described here agree with the original description of *C. armatus* (as *Plectus armatus*) except that they bear only four cephalic setae. As pointed out by Maggenti (1961) and De Ley & Coomans (1994) the six cephalic setae described and illustrated in *C. armatus* by Bütschli (1873) is apparently a flaw since such specimens have not been subsequently found.

The large number of records of *C. armatus* also entails a wide range of intraspecific variability for many morphometric and morphological characters (cf. e.g. Andrásy, 1985; Zell, 1993; De Ley & Coomans, 1994). For example, the ranges of body length in the specimens recorded by Andrásy (1985) and Zell (1993) are 330–520 μm and 284–465 μm , respectively.

The lengths of the specimens described by Mulk & Coomans (1978) from Mount Kenya exceed that of the Kenyan specimens described here ($L = 330\text{--}470 \mu\text{m}$ vs $L = 286\text{--}318 \mu\text{m}$). Only the two specimens from St. Kitts and Brazil, $L = 337 \mu\text{m}$ and $L = 347 \mu\text{m}$, respectively, fall within the range of the Mount Kenya populations.

Table 1. Measurements in μm of *Ceratoplectus armatus* (Bütschli, 1873) Andrassy, 1984 from Kenya, two islands of the West Indies, Brazil, and Lizard Island (Australia).

| Site | Kenya | US Virgin Isl. | St. Kitts | Brazil | Lizard Isl. |
|-------------------------------|----------------------|-----------------------|-------------|-------------|-------------|
| n | 4 ♀♀ | 4 ♀♀ | 1 ♀ | 1 ♀ | 1 ♀ |
| Length | 286-318 | 288-323 | 337 | 347 | 295 |
| Body diameter | 15-19 | 15-18 | 18 | 21 | 17 |
| Pharynx | 80-83 | 85-86 | 83 | 87 | 85 |
| Tail length | 36-39 | 36-39 | 37 | 31 | 33 |
| Rectum | 9.0-10.5 | 9.5-10.5 | 13.0 | 11.0 | 9.5 |
| Anal body diameter | 9.0-10.0 | 9.0-10.0 | 10.0 | 10.0 | 9.5 |
| a | 15.7-19.1 | 16.7-20.2 | 18.7 | 16.5 | 17.4 |
| b | 3.5-3.8 | 3.4-3.8 | 4.1 | 4.0 | 3.5 |
| c | 7.5-8.3 | 7.7-8.0 | 9.1 | 11.2 | 8.9 |
| c' | 3.8-4.4 | 3.8-4.4 | 3.8 | 3.2 | 3.4 |
| V | 49-51 | 49-51 | 49 | 49 | 53 |
| Distance vulva-anus/tail | 2.8-3.2 | 2.9-3.0 | 3.7 | 4.4 | 3.3 |
| Stoma | 13.5-15.5 | 14.5 | 16.5 | 16.5 | 15.5 |
| Corpus | 31-33 | 33-34 | 30 | 33 | 34 |
| Isthmus | 20-22 | 22-23 | 23 | 20 | 19 |
| Bulb (length x width) | 13.5-14.5 x 9.5-11.0 | 14.5-16.5 x 11.0-11.5 | 14.5 x 11.5 | 17.5 x 14.5 | 15.5 x 10.5 |
| Cardia | 3.0-5.0 | 3.0-5.0 | 5.0 | 8.5 | 5.0 |
| Corpus/isthmus | 1.5-1.6 | 1.4-1.5 | 1.3 | 1.7 | 1.8 |
| Amphids (from anterior end) | 6.5-7.5 | 7.5-8.5 | 6.0 | 5.0 | 7.5 |
| Deirids (from anterior end) | 58-64 | 59-61 | 63 | 64 | 67 |
| Excretory pore (fr. ant. end) | 54-57 | 55-56 | 58 | 59 | 63 |
| Deirids (% of pharynx) | 72-78 | 69-71 | 76 | 74 | 79 |
| Excretory pore (% of pharynx) | 67-69 | 65-66 | 70 | 68 | 74 |

Specimens of *C. armatus* from the South American continent (Bolivia and Peru) were described by Zell (1993) and probably also by Andrassy (1989) as *C. amoenus*. The length of the female from Brazil falls within the ranges for *C. armatus* from Bolivia and Peru ($L = 347 \mu\text{m}$ vs $L = 309-443 \mu\text{m}$), but is smaller than *C. amoenus* ($L = 347 \mu\text{m}$ vs $L = 430-450 \mu\text{m}$). The specimen from Brazil differs from the other specimens described here by a somewhat longer body ($L = 347 \mu\text{m}$ vs $L = 286-337 \mu\text{m}$), a higher c-value (11.2 vs 7.5-9.1), a smaller c'-value (3.2 vs 3.4-4.4), a larger vulva-anus/tail ratio (4.4 vs 2.8-3.7), and a longer cardia (8.5 μm vs 3.0-5.0 μm). *Ceratoplectus amoenus* was separated from *C. armatus* i.a. by a long cardial process, but its length was not given by Andrassy (1989).

The Australian Lizard Island female is much shorter than the Australian specimen described by Zell (1993) ($L = 295 \mu\text{m}$ vs $L = 332 \mu\text{m}$) and all the ratios also differ.

De Ley & Coomans (1994) described several populations of *C. armatus* from the Galápagos Archipelago extending the ranges for some characters, e.g. body length ($L = 218-378 \mu\text{m}$). The lengths of the specimens from the West Indian

islands ($L = 288-337 \mu\text{m}$) fall within that range as well as ranges established for other morphometric and morphological characters of the Galápagos populations.

Apart from having species with a worldwide distribution, the genus *Ceratoplectus* is interesting also from a phylogenetic point of view. The symmetry of its anterior end is somewhat transitional ("biradial") between the hexaradial symmetry in most species of the subfamily Plectinae Örley, 1880 and the bilateral symmetry in species of the subfamily Wilsonematinae Chitwood, 1951. The large cephalic setae in *Ceratoplectus* may have developed into the cornua of *Tylocephalus* Crossman, 1933, a possible basic genus in Wilsonematinae. This hypothesis based on morphological characters is postulated and further discussed by Holovachov *et al.* (2003). Small subunit (SSU) rRNA sequence data are, however, not congruent with the morphological hypothesis as species of Wilsonematinae seem to have diverged before species of Plectinae (De Ley *et al.*, 2002). On the other hand, the presumption that molecular data more precisely reconstruct the true phylogeny than morphological data may not always be correct (Subbotin *et al.*, 2002).

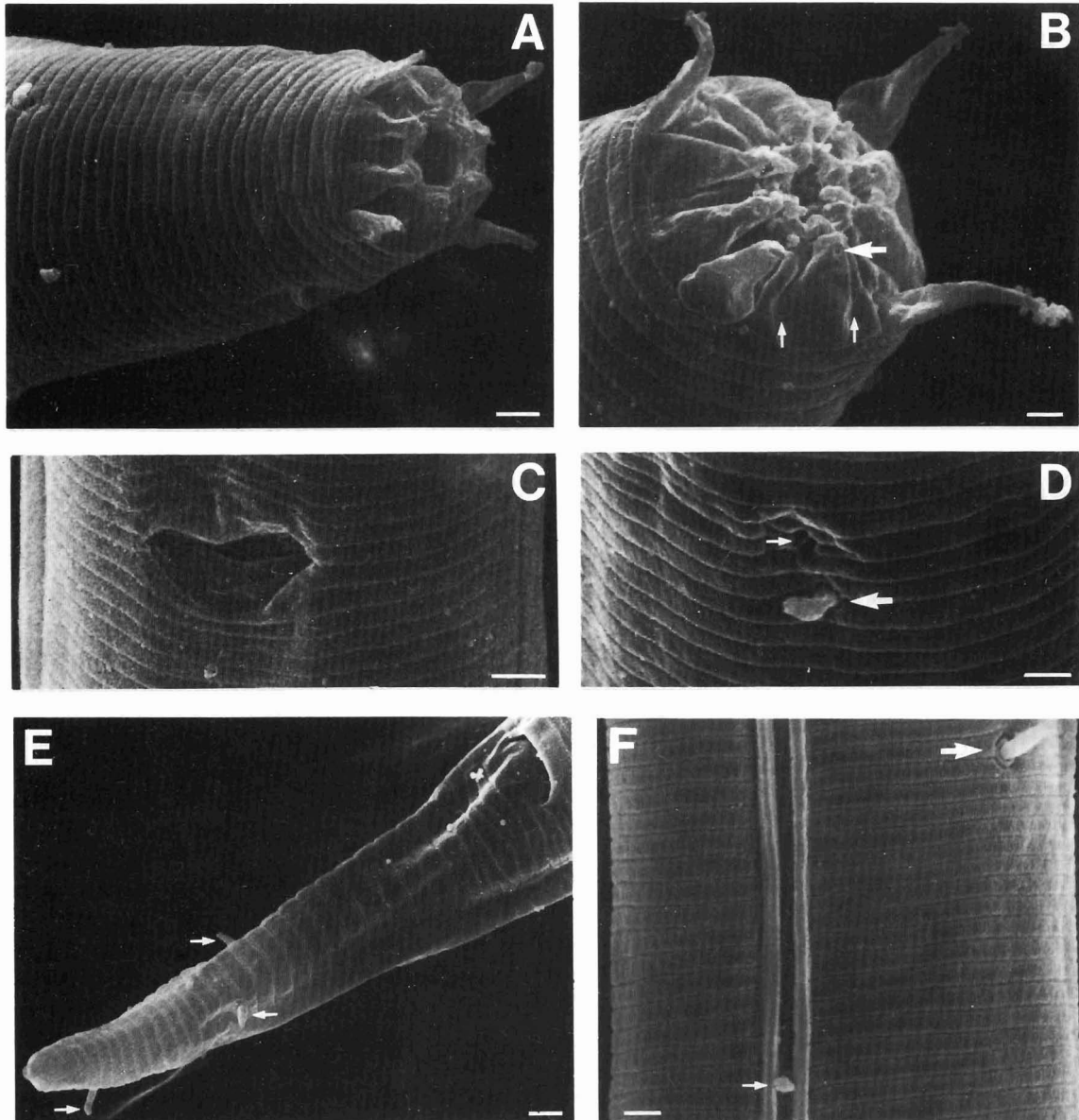


Fig. 1. *Ceratoplectus armatus* (Bütschli, 1873) Andrassy, 1984. Females from Kenya (A-F). A: Anterior end, ventral view; B: Lip region, ventral view (small arrows point at radial incisures; large arrow points at outer labial sensilla); C: Vulva; D: Excretory pore (small arrow) and ventral cervical seta (large arrow); E: Tail, subventral view (arrows point at caudal setae); F: Lateral field, deirid (small arrow) and dorsal cervical seta (large arrow). Scale bars: A, C, E – 2 μ m; B, D, F – 1 μ m.

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Boström, S. *Ceratoplectus armatus* (Bütschli, 1873) Andrásy, 1984 (Leptolaimina: Plectidae) из пяти местонахождений на трех континентах.

Резюме. Представлены данные изучения в световом микроскопе особей *Ceratoplectus armatus* из пяти местонахождений на трех континентах. Для одной из популяций представлены данные изучения в сканирующем электронном микроскопе. Представлены новые данные по биогеографии этого вида. Проведено сравнение обнаруженных популяций между собой и с ранее описанными. Были обнаружены определенные морфометрические различия между обнаруженными популяциями, но все они оказались в пределах вариабельности отмеченной для этого вида. Предлагается рассматривать *Plectus incertus* Maiello, 1967 как младший синоним *C. armatus*. Дано краткое обсуждение возможной филогенетической значимости рода *Ceratoplectus*.
