

**Description and Larval Heteromorphism of
Hoplolaimus concaudajuvencus, n. sp.
(Nematoda: Hoplolaimidae)¹**

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Abstract: *Hoplolaimus concaudajuvencus* n. sp., of the genus *Hoplolaimus* Daday, 1905, characterized by larval heteromorphism, is described and illustrated as recovered from ryegrass/bermudagrass golf green turf in Florida. Females and males are closely related to *H. galeatus* (Cobb, 1913) Thorne, 1935, but have longer stylets with more definitely tulip-shaped stylet knobs which anteriorly tend to close upon the stylet shaft more than in *H. galeatus*. First and second-stage larvae have a conically-pointed tail unlike any known species of the genus. Subsequent stages, including females, have rounded tails essentially similar to other species of the genus and males possess the typical hoplolaimid tail and bursa. The first molt was found to occur within the egg. *Key Words:* Taxonomy, *Hoplolaimus concaudajuvencus* n. sp., Morphology, Larval heteromorphism.

In November of 1966 a moderately high population of *Hoplolaimus* Daday, 1905 was recovered along with other nematodes from a sample of golf green turf, consisting of annual ryegrass (*Lolium multiflorum* Lam.) and "Tifgreen" bermuda grass (*Cynodon dactylon* [L.] Pers.), from Pensacola, Florida. Examination of the *Hoplolaimus* specimens revealed that the adults, although closely related to *H. galeatus* (Cobb, 1913) Thorne, 1935, differed from it in certain characters. Furthermore, the tail shapes of first and second-stage larvae differed from those of its other larval stages and females and also differed from those of any other known hoplolaimid nematodes.

This paper presents a description of this new species and gives data on certain larval stages. The specific name, a Latin compound word, refers to the distinctive conically-pointed tail of the first and second-stage larvae.

Hoplolaimus concaudajuvencus,
n. sp.

Measurements (20 ♀♀, Fig. 1 A, B, and Fig. 2 J, K): Length 1.606 mm (1.120–2.041); a = 28.6 (23.9–31.9); b = 8.6 (6.3–11.0); c = 65.1 (49.5–85.9); V = 54.4% (50–57); stylet = 54.9 μ (50.4–56.6).

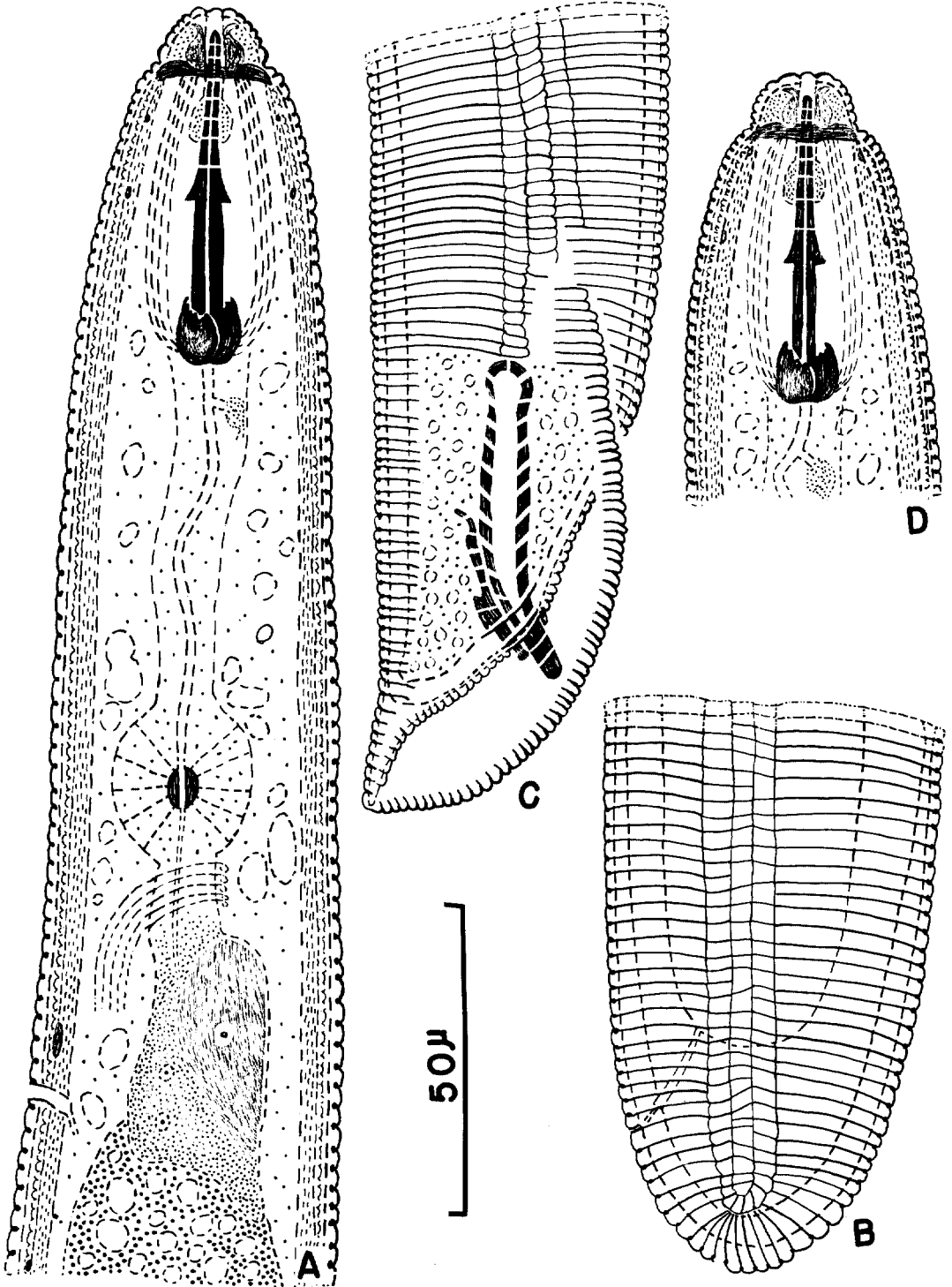
HOLOTYPE (♀): Length 1.848 mm; a = 30.8; b = 9.0; c = 66.0; V = 55%; stylet 54.3 μ; outlet of dorsal esophageal gland 5.04 μ; right phasmid 30% of body length; left phasmid 80% of body length; tail rounded, with 11 annules.

DESCRIPTION OF FEMALES: Body cylindrical, vermiform, tapering slightly at both ends. Mid-body width averaging 56 μ (44–68). Head with massive cephalic framework and markedly set off, usually bearing five to six annules with the basal one subdivided into about 36 plate-like blocks. Cuticular annulation prominent, each annule at mid-body measuring about 3 μ or slightly more; sub-cuticular annulation also quite distinct and twice as numerous as on the cuticle. Lateral field about 15 μ wide (13–19), aerolated, with four lines except in extreme anterior portion where it narrows to two before ending in vicinity of stylet. Stylet large and strong, with prominent basal knobs appearing tulip-shaped and variably dentate anteriorly.

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Outlet of dorsal esophageal gland 5.18μ ($4.48-5.60$) from base of stylet.

Metacarpus ovate with well-developed, sclerotized valve. Esophageal glands with three nuclei. Dorsal gland generally appearing more prominent and of different texture than sub-ventrals as illustrated (Fig. 1A). Length of esophagus (from anterior end to base of esophagus) 187μ ($138-235$). Distinct nerve ring encircling isthmus just posterior to metacarpus. Cephalids located in anterior portion as illustrated (Fig. 1A). Excretory pore prominent, located at level of posterior third of esophageal glands. Hemizonid large, two annules in length, and located about one to two annules in front of excretory pore. Hemizonion quite small, situated 6-12 annules behind excretory pore.

Phasmids (scutella) large and conspicuous, variable in position. Right phasmid in majority of specimens located 28% ($23-35$) of body length from anterior end, but in about 20% of specimens it was found at 80% ($78-83$) of body length. Left phasmid in majority of specimens situated at 78% ($73-85$) of body length while approximately 20% of the specimens had it at 29% ($26-33$) of the body length.

Vulva a deep and prominent transverse slit near mid-body; epiptygma small, single, and generally attached anteriorly. Ovaries two, outstretched (amphidelphic). Spermatheca round to oval, generally with many sperm (spermatozoa). Tail rounded, measuring 25μ ($18-33$) in length with 10 annules ($7-14$). Caudalid small and inconspicuous, located approximately one tail length anterior of anus.

Measurements (20 ♂♂, Fig. 1 C, D, and Fig. 2 L, M): Length 1.423 mm ($1.118-1.608$); $a = 25.9$ ($20.0-30.7$); $b = 7.2$

($6.2-8.8$); $c = 37.9$ ($33.5-45.6$); stylet 50μ ($46.5-53.8$); outlet of dorsal esophageal gland 5.7μ ($5.6-6.7$); spicules 50μ ($45-56$); gubernaculum 26μ ($23-28$).

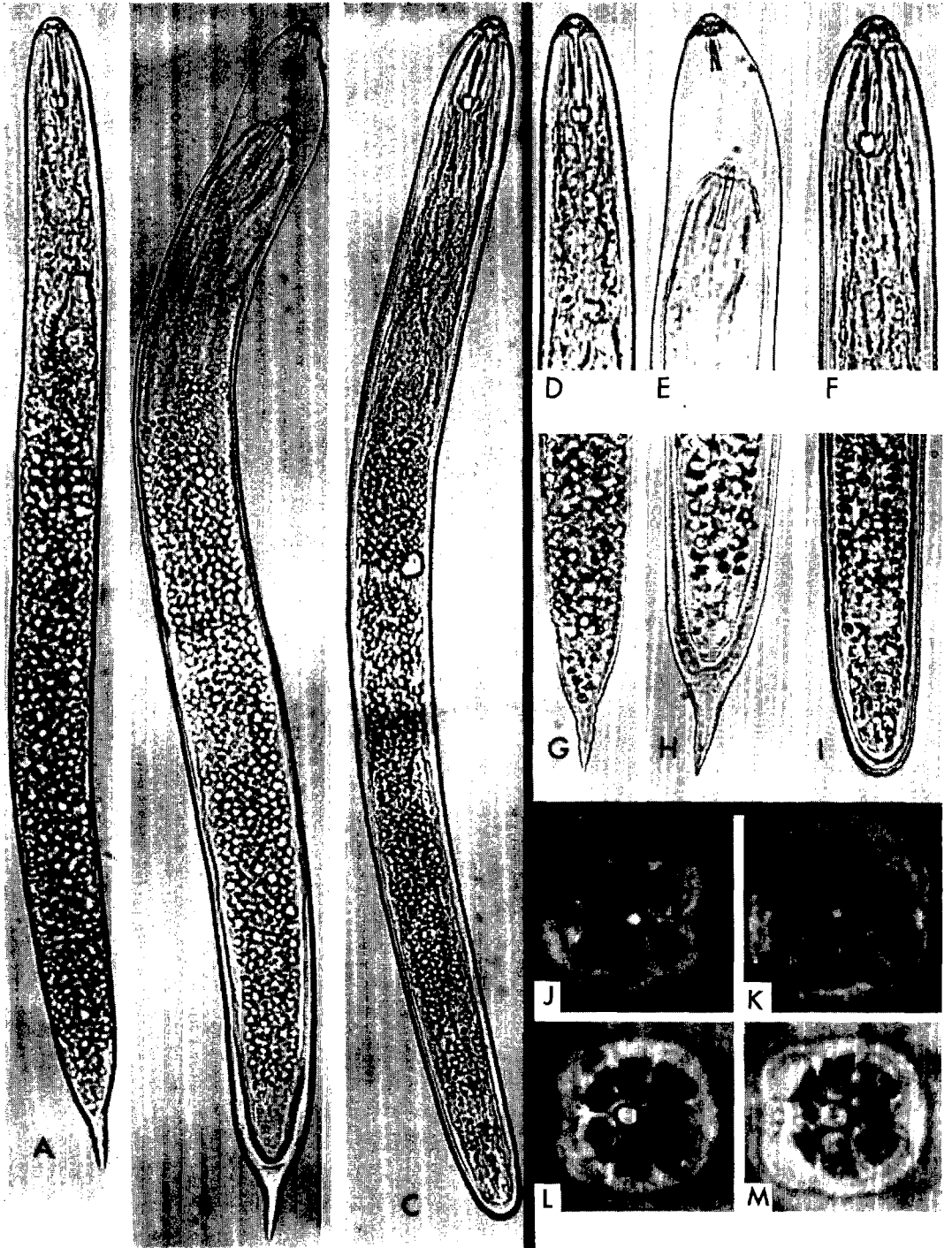
ALLOTYPE (male): Length 1.570 mm; $a = 29.8$; $b = 7.0$; $c = 41.3$; stylet 52μ ; outlet of dorsal esophageal gland 6.2μ ; spicules 55μ ; gubernaculum 27μ ; right phasmid 24% of body length; left phasmid 79% of body length from anterior end.

DESCRIPTION OF MALES: Body shape similar to female. Mid-body width averaging 54μ ($46-66$). Anterior portion essentially as in female but head generally more set off and knob-like, as illustrated (Fig. 1D). Cuticular annulation prominent with sub-cuticular annules twice as numerous as on cuticle. Lateral field aerolated, with 4 lines averaging 12.2μ ($11.2-14.0$) in width. Testis one, outstretched anteriorly. Spicules, gubernaculum and bursa large and conspicuous, appearing generally as illustrated (Fig. 1C). Tail as shown, measuring 38μ ($28-40$). Phasmids (scutella) large and conspicuous; and as in female, variable in position. Right phasmid in majority of specimens located at 31% ($23-42$) of body length while about 20% had it at 78% ($76-80$). Left phasmid situated at 79% ($74-83$) of body length in majority of specimens but seen at 31% ($28-36$) in approximately 20% of the specimens.

Measurements (20 second-stage larvae, Fig. 2 A, D, G): Length 0.283 mm ($.258-.312$); $a = 14.4$ ($10.7-15.6$); $b = 2.5$ ($2.1-3.4$); $c = 8.6$ ($7.3-10.5$); stylet 26.2μ ($24-28$); outlet of dorsal esophageal gland 2.9μ ($2.8-3.4$).

Body cylindrical, elongate, tapering at both ends. Anterior portion similar to female but much smaller. Head conically rounded with about five annules and with heavy scler-

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FIG. 1. *Hoplolaimus concaudajuvencus*, n. sp.: A. ♀ Anterior; B. ♀ Tail; C. ♂ Tail; D. ♂ Anterior.



rotization. Stylet shape essentially as in female. Body averaging $20\ \mu$ (18–25) in width; esophagus (from base of esophageal glands to anterior end) relatively long, being $115\ \mu$ (93–130). Reproductive structure represented by a gonad primordium of four cells, probably two germ cells and two epithelial cells. Lateral field with four lines, $3.2\ \mu$ (2.8–3.4) in width. Phasmids (scutella) relatively large, the right one located at 57% (51–64) of body length and left phasmid at 88% (85–91). Tail conically pointed, ending in an acute terminus. (Third-stage larvae have round tail as in female.) Length of tail $33\ \mu$ (27–38).

HOLOTYPE (♀): Collected by Norman A. Minton at Pensacola, Florida on November 6, 1966. Slide T-145t United States Department of Agriculture Nematode Collection, Beltsville, Maryland.

ALLOTYPE (♂): Slide T-146t. Same data and collection as holotype.

PARATYPES (♂♂, ♀♀, and larvae of various stages): United States Department of Agriculture Nematode Collection, Beltsville, Maryland; and California Nematode Survey Collection, Davis. Additional specimens from a greenhouse culture to Department of Nematology, University of California, Riverside.

TYPE HOST AND LOCALITY: Soil and roots of golf green turf, consisting of annual ryegrass (*Lolium multiflorum* Lam.) and "Tifgreen" bermuda grass (*Cynodon dactylon* [L.] Pers.) on the Pensacola Country Club Golf Course, Pensacola, Florida.

DIAGNOSIS: *Hoplolaimus* with above

measurements and characteristics. Differs from the most closely related described species, *H. galeatus* (Cobb, 1913) Thorne, 1935, especially by: (i) presence of conically pointed tail in first and second-stage larvae; (ii) longer stylet (averaging $54.9\ \mu$ (50.4–56.6) in females but $43\text{--}52\ \mu$ in *H. galeatus*); (iii) stylet knobs are more tulip-shaped and more dentate anteriorly, and tend to close upon the stylet shaft more than in *H. galeatus*.

DEVELOPMENT OF LARVAE (Fig. 2 A–I) AND DISCUSSION

In the initial turf sample from Pensacola, Florida, a small number of *Hoplolaimus* larvae in various stages of development were observed in addition to the adults. The larger larvae and females were seen to have a rounded tail similar to that of other species of *Hoplolaimus*. The smaller larvae, however, possessed tails that tapered markedly to a conical, acute terminus unlike any other known hoplolaim.

To provide specimens for further study, a culture of this nematode was established on the original turf from Pensacola in the greenhouse at Tifton, Georgia.

In subsequent laboratory tests with nematodes from this culture, approximately 10 days were required for hatching of eggs after oviposition in Syracuse watch glasses. The first stage larvae as seen within eggs also exhibited the conically-pointed tail. The first molt occurred within the egg, giving rise to the second-stage larvae as described above. Within a week or less after hatching, the second-stage larvae undergo a second molt,

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FIG. 2. Photomicrographs of *Hoplolaimus concaudajuvencus*, n. sp.: **A**. Second-stage larva with conically-pointed tail; **B**. Molting larva; **C**. Third-stage larva with rounded tail; **D–I**. Enlargement of anterior and posterior portions of second-stage, molting, and third-stage larva, respectively; **J**. ♀ *en face* at or near lip surface showing the six lips and hexaradiate cephalic framework underneath; **K**. ♀ *en face* at base of head showing basal labial annule and heavy cephalic framework; **L**. ♂ *en face* at or near lip surface showing the six lips; **M**. ♂ *en face* at level of basal labial annule showing the heavy, hexaradiate, cephalic framework.

which is the first outside the egg. It is during this second molt that the marked transition from pointed-tail larvae to round-tail larvae occurs. The tail clearly assumes the round shape well before the pointed-tail cuticle of the second stage is completely shed. Newly developed third-stage larvae emerge from the second molt with a round tail similar to that found in the fourth-stage larvae and adult females.

Heteromorphism of larvae has not been reported for other species of *Hoplolaimus* or related genera except the initial report by the present authors (1). A specific attempt was made to find similar pointed-tail larvae in

several samples of the closely related *H. galeatus* but none were seen. Many larvae of the various stages were observed but all had the usual round tail. The unique pointed tail of the larvae, as reported here, should be a useful supplemental diagnostic character. Probably of more lasting importance, however, may be its value as an indicator of possible phylogenetic relationships of *Hoplolaimus* to allied groups of nematodes.

LITERATURE CITED

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