

# ***Longidorus grandis* n. sp. and *L. paralongicaudatus* n. sp. (Nematoda: Longidoridae), Two Parthenogenetic Species from Arkansas<sup>1</sup>**

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**Abstract:** Two new parthenogenetic species of *Longidorus* were found in Arkansas. *Longidorus grandis* n. sp. is characterized by its body (5.80–8.24 mm), slightly offset head, head width 20–27 µm, odontostyle 86–100 µm, guide ring 26–35 µm posterior to the anterior end, short conoid to mammiliform tail. *Longidorus grandis* n. sp. is similar to *L. vineacola* Sturhan & Weischer, 1964; *L. lusitanicus* Macara, 1985; *L. edmundsi* Hunt & Siddiqi, 1977; *L. kuiperi* Brinkman, Loof & Barbez, 1987; *L. balticus* Brzeski, Peneva & Brown, 2000; *L. closelongatus* Stoyanov, 1964; and *L. seinhorsti* Peneva, Loof & Brown, 1998. *Longidorus paralongicaudatus* n. sp. is characterized by its body length (2.60–5.00 µm), anteriorly flattened and offset head region 13–18 µm wide, odontostyle length 92–127 µm, guide ring 21–30 µm posterior to the anterior end, tail elongate-conical, and  $c' = 1.2$ –2.6. *Longidorus paralongicaudatus* n. sp. most closely resembles *L. longicaudatus* Siddiqi, 1962; *L. socialis* Singh & Khan, 1996; *L. juvenilis* Dalmasso, 1969; and *L. curvatus* Khan, 1986.

**Key words:** Arkansas, *Longidorus grandis* n. sp., *Longidorus paralongicaudatus* n. sp., morphology, new species, SEM, taxonomy.

In a survey of Arkansas ecotypes and study of *Longidorus* species, two undescribed parthenogenetic species collected from the rhizosphere of hardwood trees were found and herein are described as new species. *Longidorus grandis* n. sp. was identified from four Arkansas locations (Table 1). *Longidorus paralongicaudatus* n. sp. was identified from 23 locations in Arkansas (Table 4), two in Georgia, one in Iowa, and one in Tennessee (Table 5).

## **MATERIALS AND METHODS**

**Sampling:** The soils sampled were primarily sandy-sandy loam from a depth of 10 to 40 cm of the rhizosphere of hardwood trees growing along stream banks (Table 1).

**Nematode, extraction, fixing, and mounting:** Soil was suspended in water and poured through an 850-µm-pore sieve to remove plant debris and a 75-µm-pore sieve to extract the nematodes. Nematodes caught on the 75-µm-pore sieve were separated from soil by sucrose centrifugal-flotation (specific gravity = 1.167, 568g sucrose in 1 liter water) (Jenkins, 1964). Nematodes were killed and fixed by the slow addition of boiling water until the volume of solution containing the nematodes was doubled, then formalin (37%) was added to make the final concentration 2%. The nematodes were processed to glycerin by a modification of Seinhorst's rapid method (1959) and permanently mounted on 25 × 75-mm microscope slides.

**Morphometrics:** Specimens were examined using a Nikon Optiphot II compound microscope with Nomarski interference contrast at powers up to ×1000 magnification. Drawing and measurements were made using a Nikon drawing tube. Tail measurements followed the

guidelines given by Zullini et al. (2001). All measurements are in micrometers. Morphometric data were processed using Excel (Ye, 1996) and expressed as mean ± standard deviation (minimum to maximum). A population is defined herein as the same species from the same site, regardless of host.

**Scanning electron microscopy:** Fresh nematode specimens for scanning electron microscopy (SEM) were killed by heat relaxation, fixed in Karnovsky's fixative for 2 hours, washed in two changes of 0.05 M cacodylate buffer (pH 7.2) for 20 minutes, rinsed with distilled water twice, fixed with equal volume of 0.1 M cacodylate and 2% osmium for 2 hours, dehydrated in a graded ethanol series of 30%, 50%, 70%, 80%, 95%, and 100% with 10 minutes in each solution, repeated three times in 100% ethanol, and then dried in hexamethyldisilazane for 5 minutes three times. The nematodes were mounted on SEM stubs using toluene-adhesive tape, sputter coated with approximately 300 Å of gold, and examined with an ISI-60 SEM at 15 kv.

**Hierarchical cluster analysis:** The morphometric characters used are L, distance of vulva from anterior end, head width, odontostyle length, guide ring position from anterior end, esophagus length, body width, tail length, and anal body width. Hierarchical cluster analysis was performed with the JMP 4.02 program (SAS Institute, Cary, NC). The populations and their measurements of the two new species are listed in Tables 2, 6, and 7. The morphometric measurements of all 131 *Longidorus* species are from published sources, and values were from the means of paratypes or holotype of the original species descriptions. This analysis can use only one value per character. We chose to use original description mean values when available, holotype values when mean values were not available.

## **SYSTEMATICS**

### ***Longidorus grandis* n. sp. (Figs. 1–2)**

**Measurements:** See Tables 2–3.

**Description: Females:** Body spiral upon heat relaxation, tapering toward both ends, cuticle appears smooth as

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TABLE 1. Population numbers, associated plants, and locations of *Longidorus grandis* n. sp. from Arkansas.

Population number	Associated plant	Locality
Long-119	Osage orange	County Road 62, Illinois River Bridge, Washington County
Long-148	Elm, Osage orange, sycamore, willow	Osage Creek, Highway 412, Carroll County
Long-151	Elm, hackberry, red bud	Crooked Creek, Yellville, Marion County
Long-201	Black cherry, river cane	Big Piney Creek Access Area, Highway 164, Pope County

seen by light microscope (LM), with fine transverse striae as seen by SEM, 2–3  $\mu\text{m}$  thick along the body. Lateral hypodermal chords visible throughout the length of the body, about a third of the corresponding body diameter wide. Head region flattened, definitely offset, neck contour extends posteriorly. Head region 20–26  $\mu\text{m}$  wide, labial sensilla normal for the genus as seen by SEM. Amphidial pouches symmetrically bilobed, slightly indented, and extend about 70% of the distance to the guide ring. Odontostyle long and slender, odontophore base not flanged. Guide ring 5  $\mu\text{m}$  wide. Nerve ring wide, just behind the odontophore

base. Esophagus dorylaimoid with cylindrical basal esophageal bulb 109–118  $\mu\text{m}$  long, 20–26  $\mu\text{m}$  wide in paratypes, with the normal arrangement of one dorsal gland nuclei (26–31%) and two subventral nuclei (SV1 50–57%, SV2 52–59%). Cardia conoid at the junction of the esophageal bulb with the intestine, surrounded by intestinal tissue. Reproductive system amphidelphic, didelphic, with reflexed ovaries. Anterior reproductive system 400–920  $\mu\text{m}$  long, posterior reproductive system 380–740  $\mu\text{m}$  long in paratypes. Vulva a transverse slit (only seen obliquely). Vagina perpendicular to body axis with thickened cuticular lining, extending to half

TABLE 2. Morphometrics<sup>1</sup> of *Longidorus grandis* n. sp. female holotype, paratypes (Long-148), and other Arkansas populations.

Population number	Holotype	Female paratypes	Long-119	Long-151	Long-201
N	1	20	1	3	11
L (mm)	5.79	6.75 $\pm$ 0.54 (6.1–8.24)	7.93	6.87 $\pm$ 0.59 (6.42–7.54)	6.58 $\pm$ 0.33 (6.10–7.15)
a	129.6	135.1 $\pm$ 9.8 (115.6–152.5)	240.3	140.2 $\pm$ 11.3 (128.4–150.8)	139.8 $\pm$ 17.6 (117.3–172.5)
b	14.4	16.7 $\pm$ 1.6 (13.0–19.6)	24.4	17.7 $\pm$ 3.6 (14.9–21.8)	17.1 $\pm$ 2.4 (12.5–20.8)
c	178.1	200.8 $\pm$ 27.0 (145.8–255.2)	233.2	184.6 $\pm$ 22.8 (164.6–209.4)	168.5 $\pm$ 15.1 (148.3–202.9)
c'	1.1	1.0 $\pm$ 0.1 (0.7–1.2)	0.9	0.9 $\pm$ 0.1 (0.8–1.0)	1.0 $\pm$ 0.1 (0.9–1.1)
G1%	10.4	8.7 $\pm$ 1.7 (6.9–13.8)	13.5	7.7 $\pm$ 2.6 (4.8–9.7)	8.2 $\pm$ 2.8 (3.8–12.8)
G2%	9.3	8.8 $\pm$ 2.0 (6.8–12.6)	31.4	7.8 $\pm$ 2.3 (5.2–9.6)	7.9 $\pm$ 2.2 (3.9–10.9)
V	48.6	48.0 $\pm$ 1.1 (41.1–52.4)	51.5	48.8 $\pm$ 0.9 (48.1–49.8)	48.3 $\pm$ 1.3 (46.2–50.5)
H%	49.1	39.2 $\pm$ 7.1 (29.44–57.1)	32.4	38.4 $\pm$ 2.4 (35.9–40.5)	39.2 $\pm$ 4.1 (31.6–45.9)
Odontostyle	86.0	90.4 $\pm$ 3.1 (86.0–96.0)	90.0	93.3 $\pm$ 3.5 (90.0–97.0)	90.9 $\pm$ 6.9 (77.0–100.0)
Odontophore	58.0	59.8 $\pm$ 3.2 (54.0–66.0)	65.0	58.7 $\pm$ 4.2 (54.0–62.0)	65.5 $\pm$ 5.3 (58.0–74.0)
Total stylet	144.0	150.2 $\pm$ 2.7 (146.0–156.0)	155.0	152.0 $\pm$ 7.0 (144.0–157.0)	156.5 $\pm$ 8.8 (143.0–172.0)
Guide ring from anterior end	28.0	28.3 $\pm$ 2.1 (26.0–35.0)	30.0	28.7 $\pm$ 1.2 (28.0–30.0)	27.5 $\pm$ 1.1 (26.0–29.0)
Head width	21.0	21.2 $\pm$ 1.0 (20.0–24.0)	21.0	26.0 $\pm$ 3.6 (22.0–29.0)	26.5 $\pm$ 0.9 (25.0–28.0)
Body width	44.7	50.0 $\pm$ 2.9 (45.7–56.8)	33.0	49.0 $\pm$ 1.7 (47.0–50.0)	47.5 $\pm$ 4.9 (40.0–54.0)
Tail length	32.5	34.0 $\pm$ 3.4 (30.0–50.0)	34.0	37.3 $\pm$ 1.5 (36.0–39.0)	39.2 $\pm$ 2.4 (34.0–42.0)
ABW	30.5	36.9 $\pm$ 3.4 (28.4–42.6)	36.0	41.3 $\pm$ 4.2 (38.0–46.0)	40.3 $\pm$ 1.2 (39.0–43.0)
Hyaline tail tip	10.1	13.2 $\pm$ 2.4 (10.2–20.3)	11.0	14.3 $\pm$ 0.6 (14.0–15.0)	15.4 $\pm$ 1.7 (12.0–18.0)

<sup>1</sup> All measurements except length in micrometers.

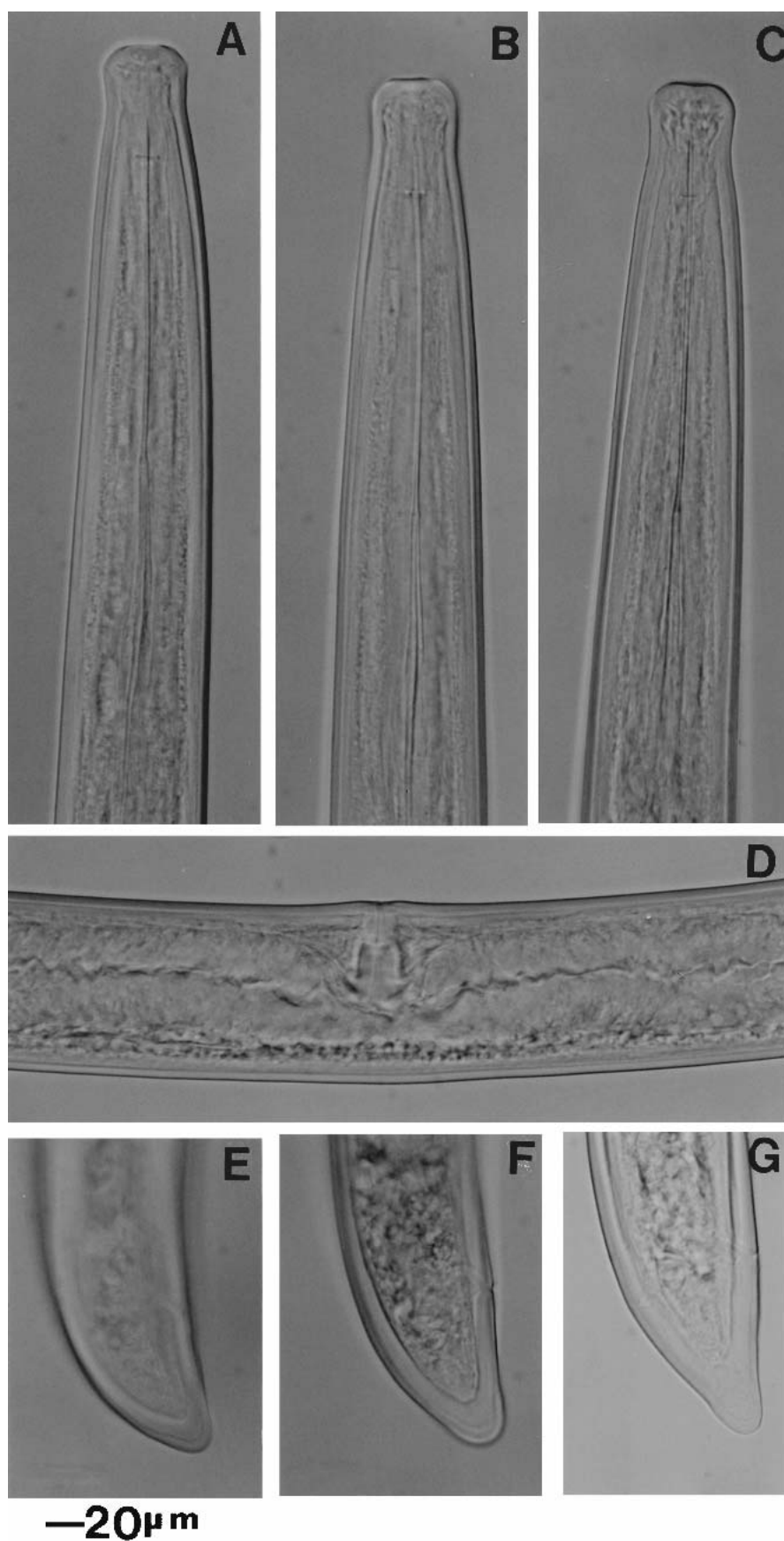


FIG. 1. Photographs A, D, E) *Longidorus grandis* n. sp. holotype. A–C) Female head region. D) Vulva region. E–G) Female tail region.

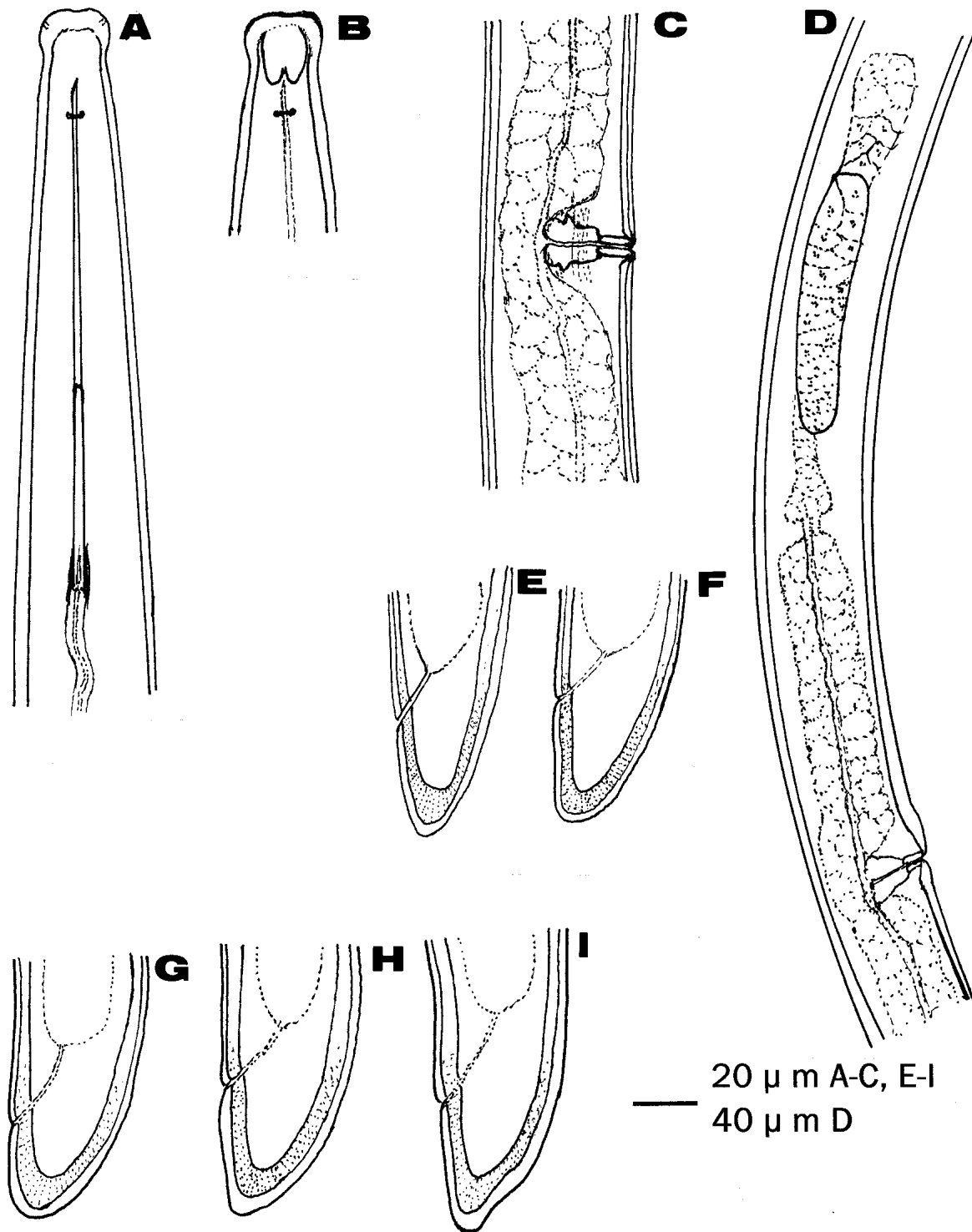


FIG. 2. Drawings A-I) *Longidorus grandis* n. sp. from paratypes. A) Female anterior end. B) Amphid region. C) Vulval region. D) Female anterior genital system. E) Third-stage juvenile tail. F) Fourth-stage juvenile tail. G-I) Female tail variation.

the body width. Anterior uteri 154–290  $\mu\text{m}$  long, posterior uteri 173–294  $\mu\text{m}$  long. Sperm not observed in the uteri or oviducts. Prerectum 284–585  $\mu\text{m}$  long. Tail short, short conoid to mammiliform, convex dorsally and less so ventrally with rounded terminus. Hyaline region 10–20  $\mu\text{m}$ .

*Males*: Not found.

*Juveniles*: Morphologically similar to adult but smaller (Table 3; Fig. 2). Only the third- and fourth-stage juveniles have been identified (Fig. 3).

#### *Type locality and habitat*

Sandy soil around American elm (*Ulmus americana* L.), Osage orange (*Maclura Pomifera* (Raf. Schneid.),

TABLE 3. Morphometrics<sup>1</sup> of *Longidorus grandis* n. sp. juveniles (Long-148).

Stage	J3	J4
<i>n</i>	1	8
L (mm)	2.554	4.13 ± 0.67 (2.73–4.76)
<i>a</i>	74.0	100.6 ± 11.8 (82.5–118.9)
<i>b</i>	10.1	12.7 ± 2.6 (8.1–16.0)
<i>c</i>	66.2	109.7 ± 19.9 (79.1–130.2)
<i>c'</i>	1.5	1.2 ± 0.1 (1.1–1.4) (1.2)
Odontostyle length	67.0	75.6 ± 4.4 (67.0–79.2)
Replacement odontostyle	81.2	94.4 ± 3.8 (87.3–99.5)
Guide ring from anterior end	22.33	24.1 ± 1.6 (21.3–25.4)
Head width	16.2	18.1 ± 1.4 (16.2–20.3)
Esophagus length	251.7	329.9 ± 40.5 (276.1–406.0)
Mid-body width	34.5	41.1 ± 5.5 (30.5–48.7)
Tail length	38.6	37.1 ± 2.8 (34.5–42.6)
ABW	26.4	30.6 ± 2.2 (26.4–33.5)
Hyaline tail tip	8.1	10.3 ± 0.9 (9.1–12.2)

<sup>1</sup> All measurements except length in micrometers.

sycamore (*Platanus occidentalis* L.), willow (*Salix* L.) by the bank of Osage Creek, Highway 412, Carroll County, Arkansas. Collected by R. T. Robbins and Weimin Ye on 16 May 2000 and 20 September 2001 (population Long-148). Global positional system coordinates: N36°11.601; W93°25.123.

#### *Type specimens*

Holotype female (slide number T566t), deposited in the Nematology Laboratory Collection, USDA, ARS, Beltsville, Maryland. Two paratype females are deposited in each of the following collections: Department of Nematology, University of California, Riverside; Department of Nematology, University of California, Davis; CABI Bioscience, UK Centre, Surrey, UK; Department of Nematology, Agricultural University, Wageningen, the Netherlands; and the Institute of Parasitology Collection, Moscow, Russia. All remaining paratype material is deposited in the Nematology Laboratory, USDA, ARS, Beltsville, Maryland.

#### *Etymology*

The Latin adjective “grandis” refers to the long body size of the species.

#### *Diagnosis*

*Longidorus grandis* is characterized by its long body (6.10–8.24 mm long), slightly expanded lips, head width 20–29 µm, odontostyle 77–100 µm, guide ring

TABLE 4. Population numbers, associated plants, and locations of *Longidorus paralongicaudatus* n. sp. collected from Arkansas.

Population number	Associated plant	Location
Long-17	Japanese holly	Little Rock, Pulaski County
Long-26	Unidentified plant	Van Buren, Crawford County
Long-67	Sweet gum	Pine Tree, St. Francis County
Long-72	White oak	Beaver Lake, Hickory Creek Park, Benton County
Long-74	Hackberry, maple	Crooked Creek, Yellville, Marion County
Long-78	Unidentified plant	Ozarks, Washington County
Long-89	Osage orange, sycamore, willow	Osage Creek, Highway 412, Carroll County
Long-91	Hickory	Illinois River, Robinson Road Bridge, Washington County
Long-93	Sassafras	Lake, Crowley's Ridge State Park, Greene County
Long-110	Grape	Crowley's Ridge State Park, Greene County
Long-132	Grape	Caddo River below Lake De Gray, Hot Spring County
Long-135	Ash	Ouachita River (Hwy 270 Bridge), Montgomery County
Long-137	Elm, maple, oak	Illinois River Bridge, County Road 62, Washington County
Long-143	Birch, black walnut, blackberry, elm, hickory, maple	Frog Bayou, Highway 162, south of Alma, Crawford County
Long-153	Elm, oak	Des Arc, Bayou, near Floyd, White County
Long-155	Birch, oak, sweet gum, sycamore	Little Red River, South Fork, Clinton, Van Buren County
Long-207	Hackberry, ivy	Arkansas River, Haroldton Access, Van Buren, Crawford County
Long-208	Black walnut	Wilson Park, Fayetteville, Washington County
Long-209	Birch	East Cadron Creek, Highway 107 Bridge, Faulkner County
Long-210	Unidentified plant	Beaver Lake, Fulton's cabin, Benton County
Long-213	Birch, black cherry, catapla, river cane, white oak	Big Piney Creek Access Area, Highway 164, Pope County
Long-219	Ash	Village Creek State Park, Big Ben Trail, Cross County
Long-220	Grape, pecan	Toad Suck Park, Perry County

TABLE 5. Populations collected from outside of Arkansas identified as *Longidorus paralongicaudatus* n. sp. used in this study.

Population number	Associated plant	Location
Long-34	Mixed hardwood	Warren County, Tennessee
Long-52	<i>Quercus alba</i>	Iowa
Long-237	Pecan	Albany, Georgia
Long-238	Pecan	Byron, Georgia

26–35  $\mu\text{m}$  posterior to the head end, short, short conoid to mammiliform tail. The code for identifying the new species using the polytomous key of Chen et al. (1997) is: A23-B45-C23-D3-E2-F34-G234-H12-I1.

*Relationships*

*Longidorus grandis* n. sp. is similar to *L. vineacola* Sturhan & Weischer (1964) from Germany; *L. lusitanicus* Macara, 1985 from Portugal; *L. edmundsi* Hunt & Siddiqi, 1977 from St. Lucia; *L. kuiperi* Brinkman, Loof & Barbez, 1987 from the Netherlands; *L. balticus*

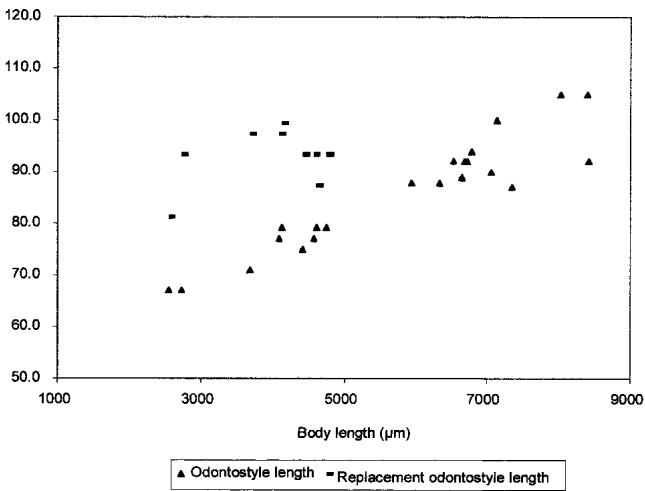


FIG. 3. Scatter plot of odontostyle length and replacement odontostyle length against body length of *Longidorus grandis* n. sp. juveniles and females (Long-148).

TABLE 6. Morphometrics of the holotype and paratypes of *Longidorus paralongicaudatus* n. sp. and comparison with closely related species.

Character	Long-137 Holotype	Long-137 Paratypes	<i>L. longicaudatus</i> Siddiqi, 1962	<i>L. longicaudatus</i> Long-16	<i>L. juvenilis</i> Dalmasso, 1969	<i>L. socialis</i> Singh & Khan, 1996	<i>L. curvatus</i> Khan, 1986
N	1	26	5	5	10	11	12
L (mm)	3.80	3.62 $\pm$ 0.33 (3.01–4.37)	2.25–3.00	3.01 $\pm$ 0.21 (2.82–3.35)	3.32 (2.80–3.61)	3.40–4.03	3.05–3.45
a	88.6	89.1 $\pm$ 7.6 (74.6–107.7)	73–80	77.2 $\pm$ 7.0 (69.5–85.1)	84.2 (76–90)	62.4–89.3	68.7–91.9
b	9.2	11.1 $\pm$ 2.4 (7.4–16.3)	7–8.2	9.9 $\pm$ 1.3 (8.6–12.0)	10.69 (9.8–11.9)	7.7–13.0	8.1–12.1
c	74.4	79.2 $\pm$ 10.6 (61.9 $\pm$ 103.3)	40–50	48.1 $\pm$ 3.7 (42.7–52.3)	64.7 (51–78)	55.8–72.4	55–68.5
c'	1.9	1.8 $\pm$ 0.2 (1.5–2.0)	2.8–3.2	3.0 $\pm$ 0.2 (2.8–3.4)	2.21 (1.8–2.9)	2.0–2.4	3
G1%	7.0	7.4 $\pm$ 2.8 (5.0–15.5)		7.2 $\pm$ 1.2 (6.3–9.4)			
G2%	6.4	6.7 $\pm$ 1.9 (4.6–13.3)		6.3 $\pm$ 0.9 (5.0–7.6)			
V	44.0	46.4 $\pm$ 2.2 (43.1–50.6)	44–47.6	46.1 $\pm$ 1.9 (44.3–48.1)	47.8 (46–50)	47.6–51.6	45.5–51.1
H%	27.8	28.9 $\pm$ 3.0 (22.7–35.0)		19.8 $\pm$ 3.3 (16.4–25.0)	30*	38.2	
Odontostyle	103.5	104.1 $\pm$ 3.4 (96.4–113.7)	92–100	99.2 $\pm$ 4.4 (96.0–104.0)	66 (64–68)	96–110	82–98
Odontophore	58.9	60.3 $\pm$ 2.0 (56.8–65.0)	46–51	50.4 $\pm$ 3.6 (46.0–54.0)	47 (40–54)	40–50	44–55
Total stylet	162.4	164.4 $\pm$ 3.8 (156.3–172.6)		149.6 $\pm$ 6.7 (142.0–158.0)	113 (106–121)		
Guide ring from anterior end	26.4	24.6 $\pm$ 1.3 (20.3–26.4)	21–24	24.5 $\pm$ 0.7 (24.0–25.5)	22 (20–24)	30–36	32–36
Head width	14.2	14.7 $\pm$ 0.9 (13.2–16.2)	12*	13.8 $\pm$ 0.4 (13.0–14.0)	11*	13	12
Body width	42.6	40.6 $\pm$ 2.2 (34.5–44.7)	33*	38.0 $\pm$ 2.6 (35.5–40.5)	39 (33–40)	40.5	38.5*
Tail length	50.8	46.0 $\pm$ 4.2 (36.5–52.8)	66*	62.6 $\pm$ 3.0 (59.0–67.0)	51 (45–55)	60	53*
ABW	26.4	26.3 $\pm$ 1.7 (22.3–29.4)	18*	20.5 $\pm$ 1.0 (20.0–22.0)	23 (19–25)	30	18*
Hyaline tail tip length	14.2	13.3 $\pm$ 1.5 (10.2–16.2)	12*	12.4 $\pm$ 2.2 (10.0–16.0)	16*	26*	28.6*

<sup>1</sup> All measurements except length in micrometers.

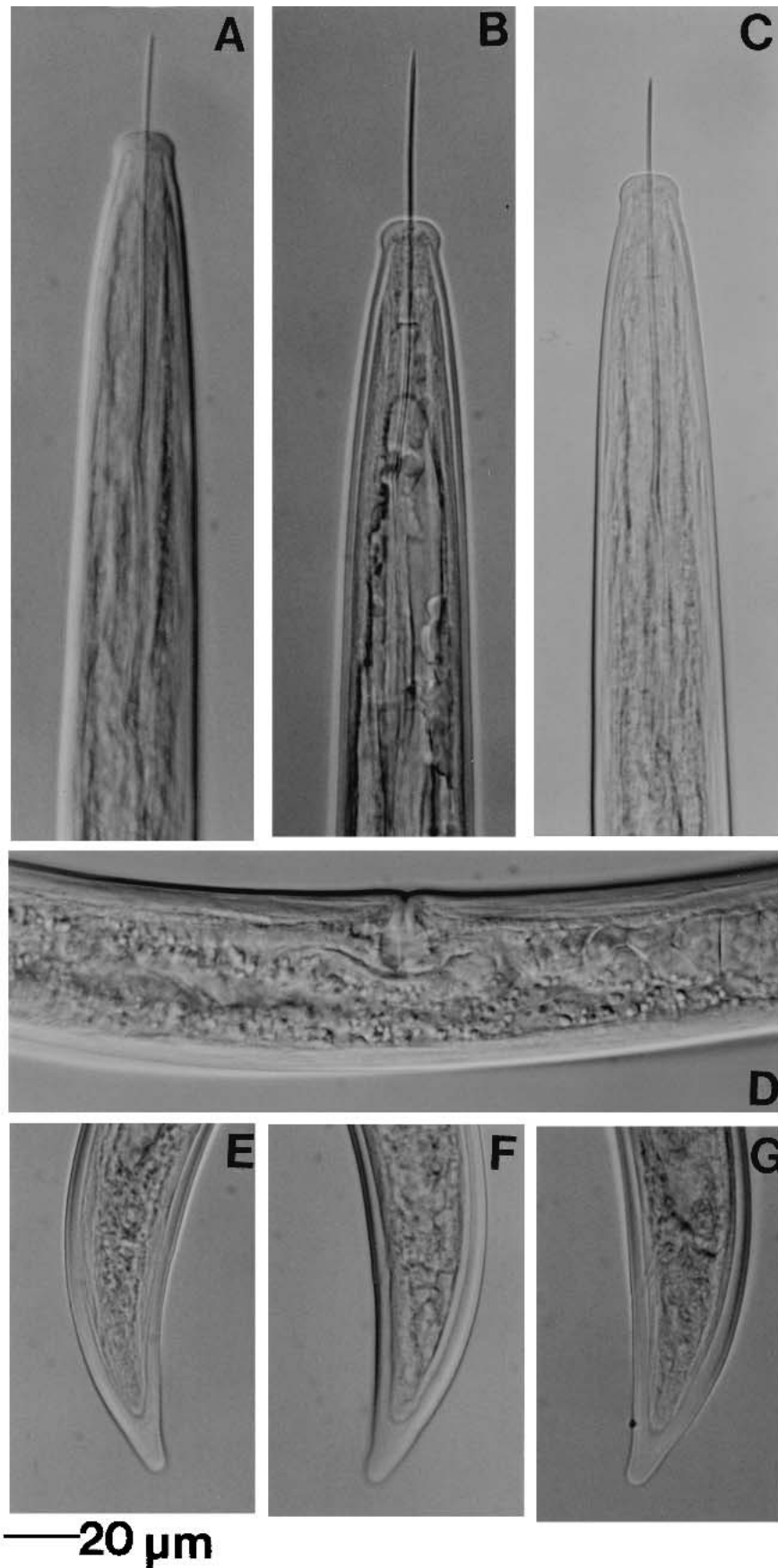


FIG. 5. Photographs A, D, E) *Longidorus paralongicaudatus* n. sp. holotype. A–C) Female anterior end. D) Vulva region. E–G) Female tail variation.

TABLE 7. Morphometrics of *Longidorus paralongicaudatus* n. sp. females from Arkansas locations.

Character	Long-17	Long-26	Long-67	Long-72	Long-78	Long-89	Long-91
N	27	1	1	13	4	1	2
L (mm)	3.65 ± 0.31 (3.14–4.57)	3.25	3.60	3.20 ± 0.22 (2.89–3.52)	4.16 ± 0.68 (3.45–5.00)	4.09	3.85 ± 0.35 (3.60–4.10)
a	88.7 ± 5.7 (77.3–100.1)	84.8	90.0	85.6 ± 7.1 (72.3–95.5)	99.3 ± 14.0 (84.2–111.3)	81.8	87.4 ± 2.4 (85.7–89.1)
b	11.4 ± 1.6 (8.6–14.1)	14.0	11.6	12.3 ± 2.6 (7.4–17.5)	12.4 ± 3.6 (8.6–17.2)	9.7	10.1 ± 2.7 (8.2–12.1)
c	70.2 ± 5.9 (59.0–83.8)	58.0	76.6	58.5 ± 7.0 (48.8–76.5)	80.3 ± 10.6 (69.0–94.3)	81.8	68.3 ± 8.8 (62.1–74.5)
c'	2.0 ± 0.2 (1.7–2.4)	2.2	2.0	2.2 ± 0.2 (1.9–2.6)	2.0 ± 0.1 (1.9–2.1)	1.8	2.2 ± 0.1 (2.1–2.2)
G1%	6.8 ± 2.3 (4.0–14.9)	—	6.3	8.3 ± 2.3 (5.6–11.9)	5.9 ± 0.6 (5.2–6.5)	2.5	7.8
G2%	7.2 ± 2.8 (4.4–15.3)	—	6.8	7.9 ± 2.1 (4.2–10.5)	7.8 ± 3.3 (4.1–10.4)	3.5	7.1
V	44.1 ± 1.6 (41.2–48.2)	46.8	44.4	47.5 ± 1.4 (45.0–50.0)	46.0 ± 1.6 (44.5–48.0)	45.7	44.8 ± 0.5 (44.4–45.1)
H%	24.9 ± 3.1 (19.9–30.1)	25.9	21.3	22.3 ± 1.8 (19.3–26.1)	29.2 ± 5.4 (21.3–33.3)	24.0	25.6 ± 2.8 (23.6–27.6)
Odontostyle	98.4 ± 3.3 (91.8–104.1)	105.6	112.0	110.0 ± 3.9 (105.0–117.0)	123.8 ± 3.0 (120.0–127.0)	114.0	111.5 ± 3.5 (109.0–114.0)
Odontophore	56.0 ± 3.0 (47.5–62.3)	47.6	56.0	60.1 ± 9.0 (50.0–75.0)	68.8 ± 9.4 (60.0–80.0)	60.0	63.5 ± 2.1 (62.0–65.0)
Total stylet	154.4 ± 4.9 (144.2–162.3)	153.2	168.0	171.7 ± 8.9 (161.0–182.0)	192.5 ± 9.0 (185.0–205.0)	174.0	175.0 ± 1.4 (174.0–176.0)
Guide ring from anterior end	24.9 ± 1.0 (23.0–27.9)	26.9	30.0	24.8 ± 1.3 (23.0–27.0)	28.5 ± 1.9 (26.0–30.0)	28.0	28.5 ± 2.1 (27.0–30.0)
Head width	14.0 ± 0.7 (13.1–14.8)	13.5	15.0	14.5 ± 0.8 (13.0–16.0)	15.0 ± 0.0 (15.0–15.0)	16.0	15.0 ± 0.0 (15.0–15.0)
Body width	40.8 ± 2.3 (36.1–45.9)	38.3	40.0	37.5 ± 3.0 (32.0–41.0)	42.5 ± 8.7 (31.0–52.0)	50.0	44.0 ± 2.8 (42.0–46.0)
Tail length	52.2 ± 4.4 (42.6–62.3)	56.0	47.0	55.1 ± 4.4 (46.0–63.0)	51.8 ± 4.3 (47.0–57.0)	50.0	56.5 ± 2.1 (55.0–58.0)
ABW	25.6 ± 1.8 (23.0–32.8)	25.0	23.0	25.1 ± 1.0 (24.0–27.0)	26.3 ± 1.7 (24.0–28.0)	28.0	26.0 ± 0.0 (26.0–26.0)
Hyaline tail tip length	12.6 ± 1.9 (8.2–16.4)	14.5	10.0	12.2 ± 0.8 (11.0–14.0)	15.3 ± 3.8 (10.0–19.0)	12.0	14.5 ± 2.1 (13.0–16.0)

Brzeski, Peneva & Brown, 2000 from Bulgaria; *L. closelongatus* Stoyanov, 1964 from Bulgaria; and *L. seinhorsti* Peneva, Loof & Brown, 1998 from the Netherlands. *Longidorus grandis* n. sp. differs from *L. vineacola* by its expanded head region, short mammiliform tail, and parthenogenetic reproduction. *Longidorus grandis* n. sp. differs from *L. balticus*, *L. edmundsi*, and *L. kuiperi* by its slightly offset head, more posterior guide ring (26–35 µm in *L. grandis* n. sp., 24–29 µm in *L. balticus*, 23–25 µm in *L. edmundsi*, and 24–29 µm in *L. kuiperi*), and parthenogenetic reproduction vs. amphimictic reproduction. It also differs from *L. kuiperi* in amphid shape. It differs from *L. lusitanicus* by its wider head (20–29 µm vs. 12–22 µm), amphid shape, mammiliform tail vs. rounded tail, and parthenogenetic reproduction vs. amphimictic reproduction. It differs from *L. closelongatus* by its shorter odontostyle (77–100 µm vs. 107–120 µm) and short mammiliform tail vs. rounded tail. It differs from *L. seinhorsti* by its shorter odontostyle (77–100 µm vs. 113–128 µm), greater c value (146–255 µm vs. 113–140 µm), and parthenogenetic reproduction vs. amphimictic reproduction.

#### Distribution

Four populations of *L. grandis* were found associated with hardwood trees in various places in Arkansas (Table 1).

#### Hierarchical cluster analysis

The dendrogram obtained from the hierarchical cluster analysis by Average method from all 131 published *Longidorus* species showed that all three populations of *L. grandis* tested are in the same cluster and are most closely related with *L. lusitanicus* Macara, 1985 (Fig. 4). A portion of the above dendrogram (Fig. 4) shows other closely related species to be *L. closelongatus* Stoyanov, 1964; *L. seinhorsti* Peneva, Loof & Brown, 1999; *L. edmundsi* Hunt & Siddiqi, 1977; and *L. kuiperi* Brinkman, Loof & Barbez, 1987.

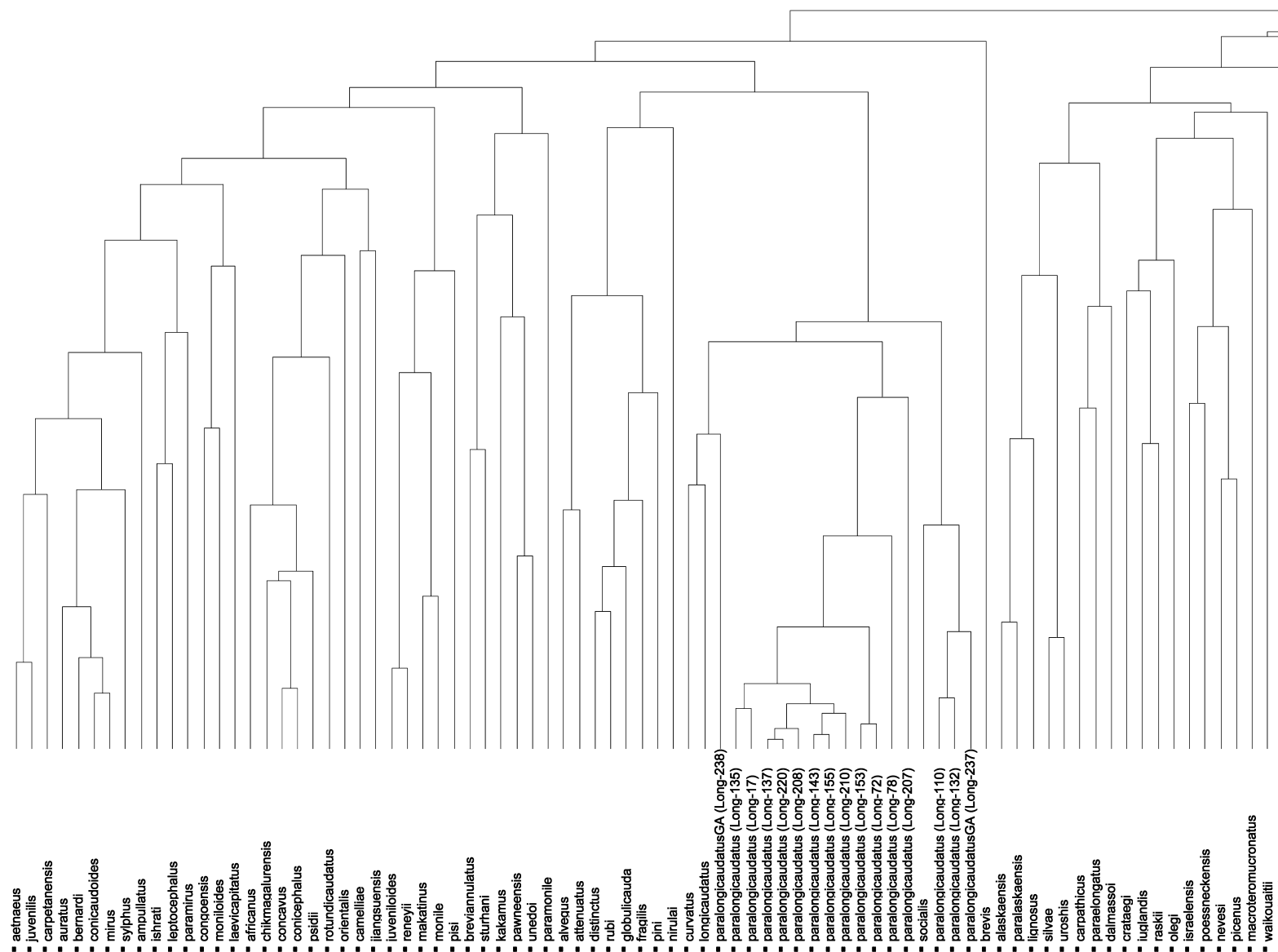
*Longidorus paralongicaudatus* n. sp.  
(Figs. 5–7)

*Measurements:* See Tables 6, 7, and 8.

*Description: Females:* Body curved ventrad upon heat



FIG. 4. Hierarchical cluster dendrogram (average) of all published *Longidorus* species with *L. grandis* sp. and *L. paralongidorus* n. sp.



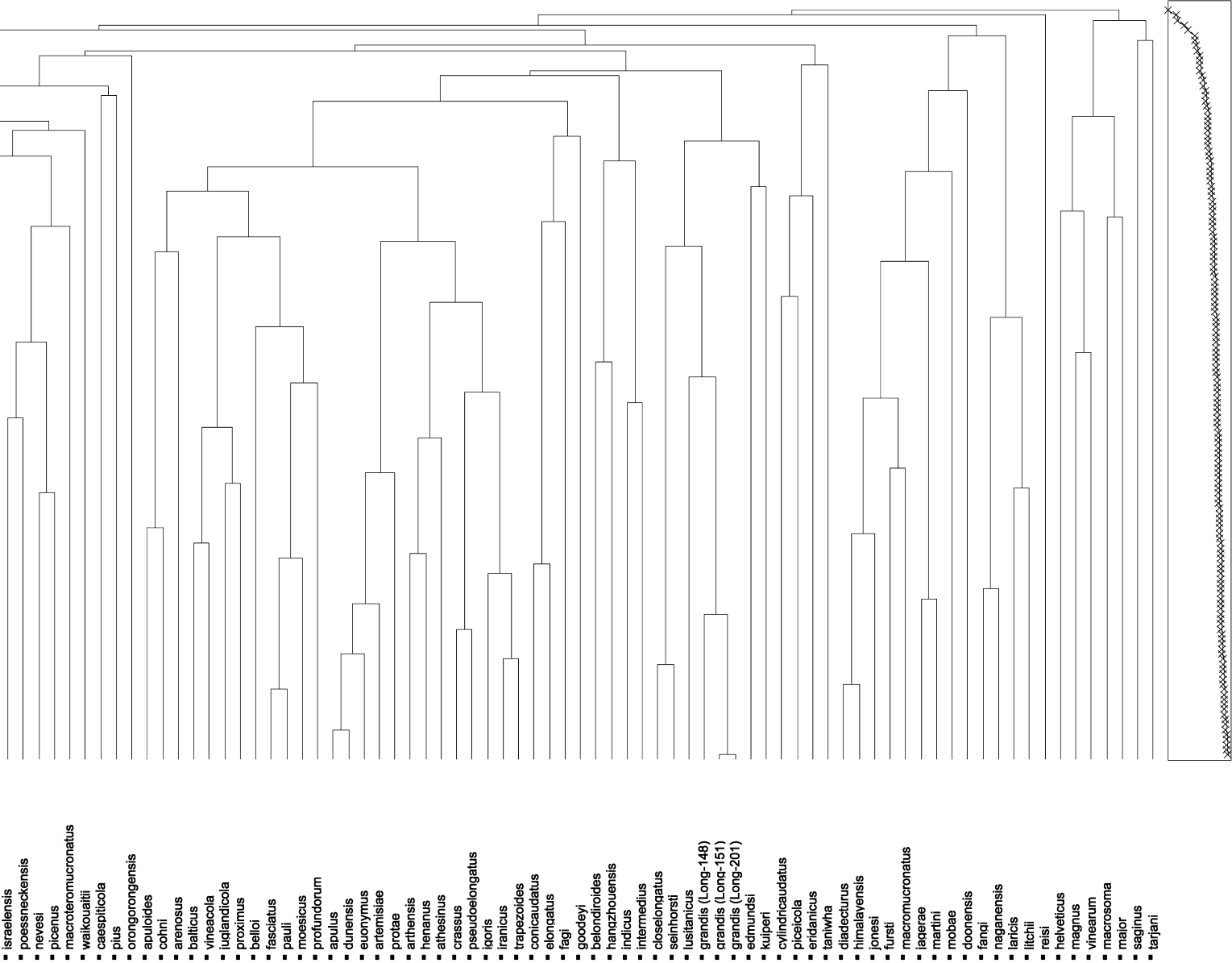


TABLE 7. Continued

Character	Long-93	Long-153	Long-155	Long-207	Long-208	Long-209	Long-210
N	2	4	6	3	4	1	4
L (mm)	2.82 ± 0.20 (2.82–3.10)	3.44 ± 0.19 (3.20–3.66)	3.71 ± 0.32 (3.37–4.25)	3.67 ± 0.30 (3.64–3.70)	3.48 ± 0.24 (3.25–3.71)	4.35	3.63 ± 0.18 (3.43–3.87)
a	70.5 ± 0.0 (70.5–70.5)	80.0 ± 5.9 (72.7–87.1)	86.7 ± 9.0 (77.5–101.2)	91.1 ± 3.7 (87.4–94.9)	84.0 ± 8.7 (77.4–96.5)	92.6	77.3 ± 5.4 (73.0–84.1)
b	7.9 ± 0.2 (7.9–8.2)	12.0 ± 1.6 (11.0–14.5)	11.6 ± 4.4 (8.9–20.5)	8.3 ± 0.6 (7.9–9.0)	10.4 ± 2.0 (9.0–13.3)	11.8	11.1 ± 3.4 (8.7–13.5)
c	49.5 ± 3.2 (44.9–49.5)	65.0 ± 5.5 (57.1–69.4)	72.1 ± 4.9 (66.9–78.7)	75.4 ± 1.3 (74.0–76.5)	75.3 ± 8.0 (65.6–82.4)	80.6	76.1 ± 8.9 (68.6–86.0)
c'	2.4 ± 0.1 (2.4–2.5)	2.0 ± 0.1 (1.9–2.0)	1.9 ± 0.1 (1.8–2.0)	1.9 ± 0.1 (1.7–2.0)	1.9 ± 0.2 (1.6–2.0)	1.9	1.7 ± 0.1 (1.7–1.9)
G1%	5.7 ± 1.1 (5.7–7.3)	5.6 ± 1.6 (4.4–6.7)	5.3 ± 1.6 (3.1–7.5)	7.9 ± 4.7 (4.6–11.3)	14.4 ± 2.4 (12.3–17.0)	14.9	5.3 ± 1.0 (4.4–6.6)
G2%	2.1 ± 2.5 (2.1–5.6)	6.7 ± 0.2 (6.6–6.9)	7.5 ± 2.0 (5.4–10.6)	5.5 ± 0.6 (5.1–5.9)	16.0 ± 4.6 (12.3–21.2)	9.1	4.5 ± 1.3 (2.6–5.7)
V	45.0 ± 1.1 (43.5–45.0)	45.7 ± 0.4 (45.3–46.2)	44.1 ± 0.9 (42.9–45.1)	45.4 ± 3.7 (42.2–49.5)	47.1 ± 1.6 (45.4–48.8)	41.4	46.3 ± 1.2 (43.4–48.1)
H%	24.6 ± 2.0 (21.7–24.6)	27.1 ± 4.7 (21.4–32.7)	26.7 ± 3.8 (19.6–30.6)	28.1 ± 2.8 (26.0–31.3)	23.0 ± 2.0 (20.0–24.4)	25.9	27.7 ± 1.4 (26.4–29.5)
Odontostyle	118.0 ± 0.7 (117.0–118.0)	108.3 ± 4.0 (104.0–113.0)	108.0 ± 5.1 (103.0–117.0)	107.0 ± 3.6 (103.0–110.0)	103.3 ± 3.8 (98.0–107.0)	110.0	108.8 ± 1.9 (106.0–110.0)
Odontophore	80.0 ± 10.6 (65.0–80.0)	61.8 ± 2.5 (59.0–65.0)	57.3 ± 3.8 (52.0–62.0)	59.3 ± 6.0 (53.0–65.0)	58.3 ± 6.9 (50.0–67.0)	64.0	52.0 ± 1.8 (50.0–54.0)
Total stylet	198.0 ± 11.3 (182.0–198.0)	170.0 ± 2.4 (167.0–172.0)	165.3 ± 7.0 (158.0–174.0)	166.3 ± 4.7 (161.0–170.0)	161.5 ± 3.3 (157.0–165.0)	174.0	160.8 ± 3.6 (156.0–164.0)
Guide ring from anterior end	27.0 ± 0.7 (27.0–28.0)	25.5 ± 1.3 (24.0–27.0)	27.2 ± 1.2 (26.0–29.0)	25.7 ± 0.6 (25.0–26.0)	27.5 ± 1.7 (25.0–29.0)	25.0	27.0 ± 0.8 (26.0–28.0)
Head width	14.0 ± 2.1 (14.0–17.0)	15.0 ± 1.4 (14.0–17.0)	15.0 ± 0.6 (14.0–16.0)	15.7 ± 0.6 (15.0–16.0)	15.0 ± 0.8 (14.0–16.0)	15.0	13.9 ± 0.3 (13.5–14.0)
Body width	40.0 ± 2.8 (40.0–44.0)	43.0 ± 1.2 (42.0–44.0)	43.0 ± 4.4 (39.0–49.0)	40.3 ± 1.5 (39.0–42.0)	41.8 ± 5.6 (34.0–47.0)	47.0	47.0 ± 1.4 (46.0–49.0)
Tail length	57.0 ± 8.5 (57.0–69.0)	53.0 ± 2.9 (49.0–56.0)	51.3 ± 2.2 (49.0–54.0)	48.7 ± 1.2 (48.0–50.0)	46.5 ± 5.1 (40.0–51.0)	54.0	48.0 ± 4.2 (44.0–53.0)
ABW	24.0 ± 2.8 (24.0–28.0)	26.8 ± 1.0 (26.0–28.0)	27.0 ± 1.8 (24.0–29.0)	26.0 ± 2.0 (24.0–28.0)	25.0 ± 0.0 (25.0–25.0)	29.0	27.5 ± 1.9 (26.0–30.0)
Hyaline tail tip length	14.0 ± 0.7 (14.0–15.0)	14.3 ± 1.7 (12.0–16.0)	13.7 ± 1.9 (10.0–15.0)	13.7 ± 1.2 (13.0–15.0)	10.8 ± 1.9 (8.0–12.0)	14.0	13.3 ± 1.0 (12.0–14.0)

relaxation, usually C-shaped, tapering toward both extremities. Cuticle smooth as seen by LM, with fine transverse striae as seen by SEM, two layers each about 2 µm thick at vulva region. Head region low, anteriorly flattened, definitely offset. Amphidial pouches bilobed, symmetrical, indented deeply, and extend about 75% of the distance to the guide ring. Nerve ring about 30 µm posterior to the odontophore base. Odontostyle slender, odontophore base not flanged. Guide ring 20–30 µm posterior to the anterior end, 4 µm in diam. Basal esophageal bulb 75–93 µm long, 16–20 µm wide, with nuclei as normal for the genus: DN = 26–33%, SV1 = 45–58%, SV2 = 49–63%. Reproductive system amphidelphic, didelphic, with reflexed ovaries, anterior reproductive system 165–540 µm long, posterior reproductive system 160–430 µm long. Vulva not elevated. Vagina perpendicular to body axis with thickened cuticle lining, encircled by a muscular band at junction with uterus. Uteri short (47–81 µm long). Sperm not observed in genital tract. Tail elongate conical, bent ventrad. Hyaline region 10–19 µm long.

*Males:* Not found in type location. Two males were

found in population Long-17. Similar to female, but body more curved near the posterior end. Reproductive system occupying 35% of the body length, 0.92–1.15 mm long. Spermatozoa oval, about 3 µm long. An adanal pair and 10–12 ventromedian supplements present, copulatory muscles conspicuous in the adanal region (Table 8; Figs. 6A–C, 7K).

*Juveniles:* Four juvenile stages are presumed present, based on the length and position of the odontostyle and replacement odontostyle (Table 9, Fig. 8). The first-stage juvenile was not found. The replacement odontostyle present at some distance from the odontophore in the three juvenile stages observed. Similar to females in general body and tail shape, but smaller (Table 9, Fig. 7E–G).

#### *Type locality and habitat*

Sandy soil around American elm (*Ulmus americana* L.), maple (*Acer* L.), and oak (*Quercus* L.) trees (population Long-137) by County Road 62 Bridge, Illinois River, Washington County, Arkansas. Collected by R. T. Robbins and Weimin Ye on 15 June 1999 (population

TABLE 7. Continued

Character	Long-220	Long-34	Long-52	Long-237	Long-238
N	3	7	4	4	5
L (mm)	3.39 ± 0.14 (3.26–3.54)	3.25 ± 0.31 (2.80–3.79)	3.30 ± 0.11 (3.16–3.43)	2.96 ± 0.27 (2.75–3.32)	3.11 ± 0.28 (2.80–3.35)
a	81.5 ± 5.3 (75.8–86.3)	77.2 ± 9.9 (62.2–94.6)	77.9 ± 3.8 (73.0–82.2)	61.7 ± 2.3 (58.5–63.8)	63.9 ± 8.2 (50.9–72.8)
b	10.4 ± 0.7 (9.8–11.1)	10.1 ± 2.0 (7.2–12.7)	9.8 ± 0.7 (8.8–10.2)	9.3 ± 1.9 (7.9–12.1)	12.1 ± 2.7 (9.7–15.8)
c	71.4 ± 4.0 (68.1–75.8)	59.7 ± 6.1 (52.4–68.5)	69.9 ± 12.6 (59.6–88.0)	49.1 ± 6.9 (39.4–55.0)	55.1 ± 9.0 (45.9–68.8)
c'	1.7 ± 0.2 (1.5–1.8)	2.3 ± 0.2 (2.0–2.5)	1.8 ± 0.2 (1.5–1.9)	2.3 ± 0.3 (1.9–2.7)	2.4 ± 0.5 (1.6–2.7)
G1%	7.5 ± 1.7 (6.4–9.5)	8.8 ± 2.3 (5.7–11.9)	7.3 ± 1.5 (5.8–9.0)	8.2 ± 1.8 (6.5–10.0)	9.3 ± 1.8 (7.6–11.6)
G2%	5.2 ± 1.2 (3.9–6.3)	8.3 ± 2.9 (5.3–12.9)	7.3 ± 0.8 (6.3–8.2)	6.2 ± 1.4 (5.1–7.8)	9.9 ± 2.4 (7.1–12.1)
V	46.8 ± 0.6 (46.3–47.5)	44.9 ± 1.7 (42.6–46.8)	48.7 ± 0.8 (47.9–49.8)	47.3 ± 1.5 (45.8–49.1)	47.1 ± 1.7 (45.1–49.3)
H%	25.1 ± 2.0 (22.9–26.9)	22.3 ± 5.5 (16.1–30.8)	25.8 ± 4.5 (20.8–31.6)	22.0 ± 3.3 (18.6–26.5)	22.1 ± 1.0 (20.7–23.0)
Odontostyle	101.3 ± 3.1 (98.0–104.0)	101.1 ± 6.3 (95.0–112.0)	95.3 ± 3.0 (92.0–99.0)	105.0 ± 4.2 (99.0–108.0)	114.3 ± 6.7 (110.0–124.0)
Odontophore	59.0 ± 3.5 (55.0–61.0)	58.4 ± 4.1 (54.0–64.0)	67.3 ± 3.1 (64.0–70.0)	54.5 ± 4.2 (50.0–60.0)	51.5 ± 6.9 (43.0–58.0)
Total stylet	160.3 ± 2.3 (159.0–163.0)	159.6 ± 4.1 (155.0–166.0)	145.8 ± 33.6 (96.0–169.0)	159.5 ± 2.4 (158.0–163.0)	165.8 ± 5.0 (159.0–171.0)
Guide ring from anterior end	24.3 ± 1.5 (23.0–26.0)	24.3 ± 1.1 (23.0–26.0)	25.0 ± 1.8 (23.0–27.0)	24.3 ± 1.0 (23.0–25.0)	25.0 ± 1.9 (22.0–27.0)
Head width	15.0 ± 0.0 (15.0–15.0)	13.7 ± 0.6 (12.5–14.0)	14.3 ± 0.5 (14.0–15.0)	13.8 ± 0.5 (13.0–14.0)	13.6 ± 0.5 (13.0–14.0)
Body width	41.7 ± 1.2 (41.0–43.0)	42.4 ± 4.0 (35.5–47.0)	42.5 ± 3.3 (40.0–47.0)	48.0 ± 2.9 (45.0–52.0)	49.0 ± 5.2 (42.0–55.0)
Tail length	47.7 ± 4.5 (43.0–52.0)	54.6 ± 4.8 (49.0–62.0)	48.3 ± 7.3 (38.0–54.0)	61.3 ± 9.4 (50.0–70.0)	57.0 ± 5.2 (48.0–61.0)
ABW	27.7 ± 1.5 (26.0–29.0)	24.1 ± 1.1 (23.0–26.0)	27.3 ± 1.0 (26.0–28.0)	27.3 ± 3.2 (25.0–32.0)	24.4 ± 3.6 (22.0–30.0)
Hyaline tail tip length	12.0 ± 1.7 (11.0–14.0)	12.0 ± 2.3 (10.0–16.0)	12.3 ± 1.3 (11.0–14.0)	13.5 ± 3.1 (11.0–18.0)	12.6 ± 1.1 (11.0–14.0)

<sup>1</sup> All measurements except length in micrometers.

Long-137). Global positional system coordinates: N36°01.498; W94°19.286.

#### Type specimens

Holotype female (slide number T567t) deposited in the Nematology Laboratory Collection, USDA, ARS, Beltsville, Maryland. Two paratype females are deposited in the following collections: Department of Nematology, University of California, Riverside; Department of Nematology, University of California, Davis; CABI Bioscience, UK Centre, Surrey, UK; Department of Nematology, Agricultural University, Wageningen, the Netherlands; and Institute of Parasitology Collection, Moscow, Russia. All remaining paratypes and the non-type males are deposited in the Nematology Laboratory Collection, USDA, ARS, Beltsville, Maryland.

#### Etymology

In the name *L. paralongicaudatus* n. sp. *para* means “near” referring to *L. longicaudatus*, to which it is closely related morphologically.

#### Diagnosis

*Longidorus paralongicaudatus* n. sp. differs from other species of the genus in the following combination of characters: Small body size 2.90–5.00 mm long, head region low, anteriorly flattened, offset, 13–17 µm wide. Odontostyle 92–127 µm long, guide ring 20–30 µm posterior to the head end, tail elongate conical,  $c' = 1.5$ –2.6, and parthenogenetic reproduction. The code for identifying the new species using the polytomous key of Chen et al. (1997) is: A345-B23-C12-D2-E2-F12-G12-H56-I12.

#### Relationships

*Longidorus paralongicaudatus* n. sp. most closely resembles *L. longicaudatus* Siddiqi, 1962 described from South Carolina, USA; *L. socialis* Singh & Khan, 1996 described from India; *L. juvenilis* Dalmasso, 1969 described from France; and *L. curvatus* Khan, 1986 described from India. *Longidorus paralongicaudatus* n. sp. differs from *L. longicaudatus* by its longer body (2.82–5.00 mm vs. 2.25–3.00 mm), smaller  $c'$  ( $c' = 1.2$ –2.6 vs.

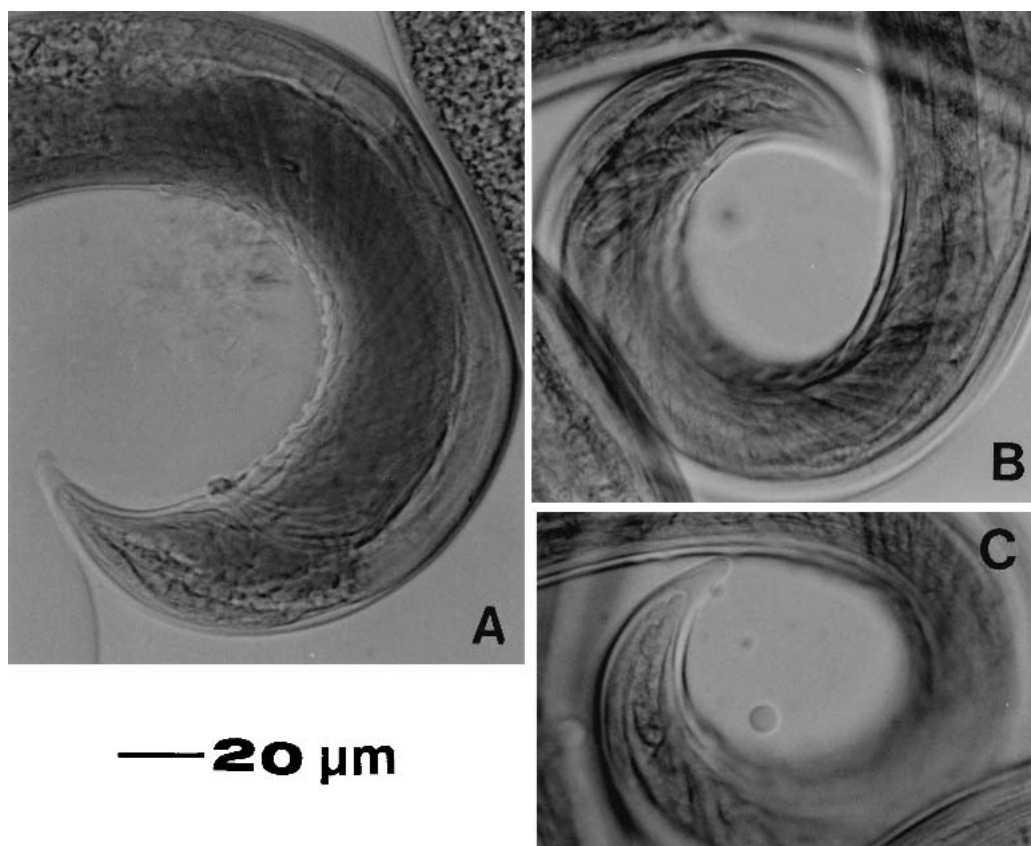


FIG. 6. Photographs A–C) male tail region *Longidorus paralongicaudatus* n. sp. (population Long-17). A) Specimen 1. B) Specimen 2. C) Showing tail tip of Specimen 2.

2.8–3.2), odontostyle generally longer (92–127  $\mu\text{m}$  vs. 92–100  $\mu\text{m}$ ), distance to guide ring (20–30  $\mu\text{m}$  vs. 21–24  $\mu\text{m}$ ), greater body width (30–55  $\mu\text{m}$  vs. 33  $\mu\text{m}$ ), greater anal width (22–33  $\mu\text{m}$  vs. 18  $\mu\text{m}$ ). *Longidorus paralongicaudatus* n. sp. can be differentiated from *L. socialis* and *L. curvatus* by its offset head vs. continuous head, a more anteriorly located guide ring (20–30  $\mu\text{m}$ ) vs. a more posteriorly located guide ring (30–36  $\mu\text{m}$  in *L. socialis*, 32–36  $\mu\text{m}$  in *L. curvatus*). It differs from *L. juvenilis* by its longer odontostyle, 92–127  $\mu\text{m}$  vs. 64–68  $\mu\text{m}$  in *L. juvenilis*.

#### Distribution

Twenty-three populations of *L. paralongicaudatus* were found associated with hardwood in various places in Arkansas (Table 5) and four populations from Georgia (2), Tennessee (1), and Iowa (1) (Table 6).

#### Hierarchical cluster analysis

The dendrogram obtained from the hierarchical cluster analysis by Average method from all 131 published *Longidorus* species (unpubl. data) showed 14 populations of *L. paravineicola* n. sp. from Arkansas and 2 populations from Georgia demonstrated that *L. curvatus*, *L. longicaudatus*, and *L. socialis* are in the same cluster with our species (Fig. 4). A portion of the above dendrogram (Fig. 4) shows other closely related species

to include *L. curvatus*, *L. longicaudatus*, and *L. socialis*. The dendrogram shows *L. paralongicaudatus* n. sp. populations to be quite variable; the reasons for these variations are not known but could be due to geographical differences, host differences, or even small specific differences.

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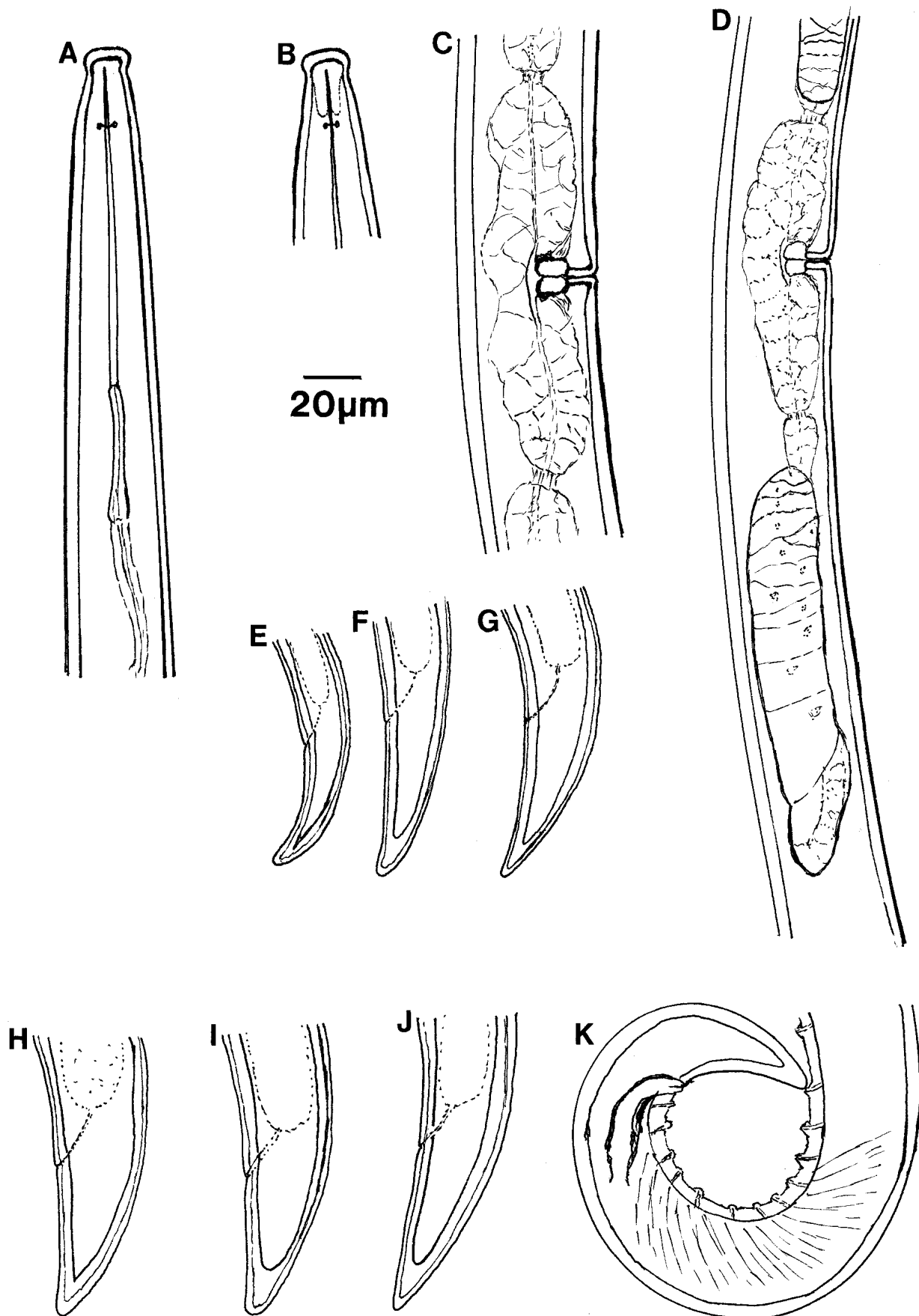


FIG. 7. Drawings A–J) *Longidorus paralongicaudatus* n. sp. from paratypes. A) Female anterior end. B) Amphid region. C) Vulval region. D) Female anterior genital system. E) Second-stage juvenile. F) Third-stage juvenile tail. G) Fourth-stage juvenile tail. H–J) Female tail variation. K) Male tail (population Long-17).

TABLE 8. Morphometrics of *L. paralongicaudatus* n. sp. males from Arkansas.

Character	Long-17
n	2
L (mm)	2.95 ± 0.44 (2.92–2.99)
a	76.7 ± 1.1 (76.0–77.5)
b	9.0 ± 0.3 (8.8–9.2)
c	57.2 ± 0.5 (56.9–57.5)
c'	1.9 ± 0.0 (1.8–1.9)
H%	20.6 ± 1.8 (19.3–21.9)
T%	34.9 ± 4.6 (31.6–38.1)
Odontostyle	100.8 ± 1.1 (100.0–101.6)
Odontophore	54.9 ± 1.1 (54.1–55.7)
Total stylet	155.7 ± 0.0 (155.7–155.7)
Guide ring from anterior end	25.5 ± 1.3 (24.6–26.4)
Head width	13.9 ± 0.0 (13.9–13.9)
Body width	38.5 ± 1.1 (37.7–39.3)
Spicules	35.3 ± 1.2 (34.4–36.1)
Supplements	12.0 ± 1.4 (11.0–13.0)
Tail length	51.7 ± 1.2 (50.8–52.5)
ABW	27.9 ± 0.0 (27.9–27.9)
Hyaline tail tip	10.7 ± 1.2 (9.8–11.5)

<sup>1</sup> All measurements except length in micrometers.TABLE 9. Morphometrics of *Longidorus paralongicaudatus* n. sp. paratype juveniles (population Long-137).

Stage	J2	J3	J4
n	2	6	5
L	1.20 ± 0.16 (1.09–1.31)	1.79 ± 0.38 (1.55–2.53)	2.70 ± 0.26 (2.33–2.97)
a	53.7 ± 0.2 (53.6–53.8)	62.1 ± 6.4 (54.6–73.3)	70.7 ± 3.9 (67.5–77.1)
b	6.8 ± 0.8 (6.2–7.3)	7.9 ± 1.8 (5.3–9.6)	10.1 ± 1.7 (8.2–12.5)
c	28.8 ± 2.8 (26.8–30.8)	35.6 ± 2.8 (31.8–39.0)	52.7 ± 4.1 (45.9–56.3)
c'	2.7 ± 0.3 (2.5–2.9)	2.7 ± 0.4 (2.4–3.6)	2.1 ± 0.1 (2.0–2.3)
Odontostyle length	63.9 ± 1.4 (62.9–65.0)	76.8 ± 0.8 (75.1–77.1)	91.4 ± 0.0 (91.4–91.4)
Replacement odontostyle	78.2 ± 1.4 (77.1–79.2)	89.0 ± 3.0 (85.3–91.4)	100.7 ± 3.7 (97.4–105.6)
Guide ring from anterior end	15.7 ± 0.7 (15.2–16.2)	16.6 ± 3.2 (10.2–18.3)	21.9 ± 1.2 (20.3–23.3)
Head width	9.1 ± 0.0 (9.1–9.1)	11.7 ± 3.7 (10.2–19.3)	12.4 ± 0.5 (12.2–13.2)
Esophagus length	176.6 ± 2.9 (174.6–178.6)	233.5 ± 51.6 (162.4–292.3)	272.0 ± 41.0 (203.0–312.6)
Mid-body width	22.3 ± 2.9 (20.3–24.4)	28.6 ± 3.0 (26.4–34.5)	38.2 ± 2.6 (34.5–40.6)
Tail length	41.6 ± 1.4 (40.6–42.6)	50.1 ± 7.7 (44.7–65.0)	51.2 ± 2.6 (46.7–52.8)
ABW	15.7 ± 2.2 (14.2–17.3)	18.4 ± 0.4 (18.3–19.3)	24.4 ± 1.2 (23.3–26.4)
Hyaline tail tip	7.6 ± 2.2 (6.1–9.1)	8.3 ± 1.0 (7.1–10.2)	12.0 ± 2.5 (10.2–16.2)

<sup>1</sup> All measurements except length in micrometers.

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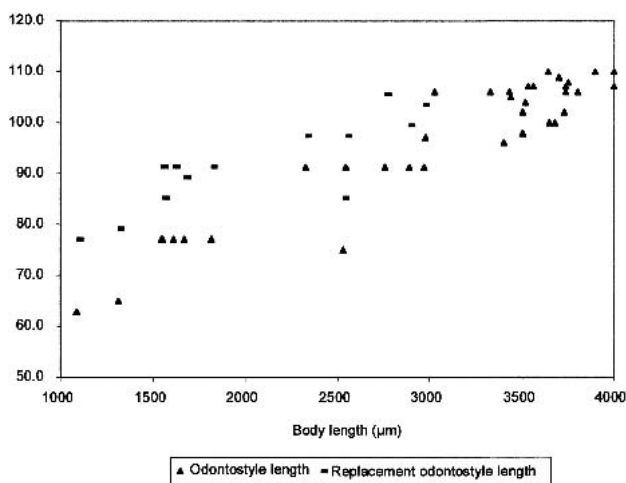
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FIG. 8. Scatter plot of odontostyle length and replacement odontostyle length against body length of *Longidorus paralongicaudatus* n. sp. juveniles and females (Long-137).