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Trophurus deboeri n. sp. from sugarcane soil in Barbados and key to the species of the genus *Trophurus* Loof, 1956 (Nemata : Belonolaimidae)

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Summary – *Trophurus deboeri* n. sp. from sugarcane soil in Barbados is characterized by a combination of characters : annulation inconspicuous, postvulval body region slightly narrower than prevulval region, basal ring extends posteriad to opposite middle of stylet, stylet knobs back-sloped, dorsal oesophageal gland slightly overlaps intestine, V = 60-66 (63), post-uterine sac about as long as diameter of body at vulva, female tail cylindroid, with terminus appearing smooth and broadly to conoid rounded and hyaline portion about one third as long as tail, postrectal diverticulum of intestine absent, caudal alae may be indented posteriorly. A key to the females and a table with diagnostic characters for the species in *Trophurus* are given, as well as an emended diagnosis for the genus.

Résumé – Trophurus deboeri *n. sp., associé à la canne à sucre à la Barbade et clé des espèces du genre* Trophurus *Loof, 1956 (Nemata : Belonolaimidae) – *Trophurus deboeri* n. sp. associé à la canne à sucre à la Barbade se distingue par la combinaison de caractères suivante : annélation non visible, région postvulvaire légèrement plus étroite que la région prévulvaire, anneau basal s'étendant jusqu'à mi-stylet ou postérieurement, boutons du stylet dirigés vers l'arrière, glande œsophagienne dorsale recouvrant l'intestin sur une courte distance, V = 60-66 (63), sac post-utérin aussi long environ que le diamètre du corps au niveau de la vulve, queue de la femelle de forme grossièrement cylindrique à portion terminale lisse, conoïde à arrondie, et à portion terminale hyaline longue d'un tiers de la longueur totale de la queue, diverticule intestinal post-rectal absent, ailes caudales parfois indentées postérieurement. Une clé des femelles et un tableau présentant les caractères diagnostiques des espèces de *Trophurus* sont donnés. La diagnose du genre est amendée.

Key-words : Nematodes, *Trophurus*, taxonomy, species key, Barbados.

Trophurus Loof, 1956 is a small cosmopolitan genus of plant-parasitic nematodes found mostly in cultivated soils. In the Caribbean and neighbouring territories *T. longimarginatus* Román, 1962 was described from soil around mahogany (*Swietenia mahagoni* (L.) Jacq.) in Puerto Rico and later reported associated with sugarcane and avocado in Guadeloupe (Scotto la Massèse, 1969) and maize in Panama (Tarjan, 1967). *T. roigi* Razjivin, O'Relly & Pérez Milian, 1973 was described from sugarcane soil in Cuba and *T. vultus* Siddiqi & Lenné, 1990 from soil around a grass, *Andropogon gayanus* Kunth, in Colombia. An apparently undescribed *Trophurus* species was reported from soil around coffee and lettuce and in forest plantations and natural grasslands in Guadeloupe, from mango soil in Marie-Galante and soil around sugarcane, *Ficus laevigata,* pangola grass (*Digitaria decumbens* Stent), avocado and bitter orange on both islands (Scotto la Massèse, 1969; Kermarrec & Scotto la Massèse, 1972 *a, b*). An unidentified *Trophurus* species found widely distributed in sugarcane fields in Barbados by Brathwaite (1976) was recently collected again on the island and is described below.

A key to the females of the species currently included in *Trophurus* is presented as well as a table with diagnostic characters and an emended diagnosis for the genus.

Specimens were extracted from the soil by the technique of Seinhorst (1962), relaxed by gradual heating in water, fixed in TAF, processed to glycerine by the slow method (Goodey, 1951) and mounted in anhydrous glycerine on Cobb aluminium slides.

Trophurus deboeri * n. sp.

(Fig. 1)

MEASUREMENTS

Females and *males :* see Table 1.

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* The species is named for its collector, Mr Harm De Boer, agronomist to the Barbados sugar industry.

Holotype (female) : L = 0.813 mm; a = 46.2; b = 5.9; c = 29.7; c′ = 2.1; V = 62.3; stylet = 15.0 µm; anterior end to metacorpus center = 67.5 µm; anterior end to excretory pore = 96.5 µm; anterior end to cardia = 138.0 µm; mid-body diameter = 17.5 µm; postvulval body diameter = 16.0 µm; anal body diameter = 13.0 µm; tail = 27.5 µm, hyaline tail = 8.5 µm; phasmids to anus = 11.5 µm.

Table 1. *Measurements of* Trophurus deboeri *n. sp. (in µm, except L in mm).*

Character	n	Females	n	Males
L	48	0.850 ± 0.05 (0.750-0.950)	23	0.756 ± 0.05 (0.656-0.856)
a	43	49.3 ± 3.4 (42.5-56.1)	23	51.9 ± 4.8 (42.3-61.5)
b	45	6.2 ± 0.4 (5.4-7.0)	23	5.6 ± 0.5 (4.6-6.6)
c	32	28.0 ± 2.2 (23.6-32.4)	17	22.7 ± 2.0 (18.7-26.7)
c′	31	2.3 ± 0.3 (1.7-2.9)	16	2.8 ± 0.3 (2.2-3.4)
V	48	63.0 ± 1.6 (59.8-66.2)	-	-
Excret. pore (% of L)	46	11.5 ± 0.7 (10.1-12.9)	21	12.2 ± 1.0 (10.2-14.2)
Stylet	43	13.6 ± 0.7 (12.0-15.0)	19	12.9 ± 1.0 (11.0-15.0)
Basal ring length	35	6.1 ± 0.4 (5.5-7.0)	14	5.8 ± 0.6 (4.5-7.0)
Labial region width	46	5.6 ± 0.4 (5.5-6.5)	22	5.4 ± 0.3 (5.0-6.0)
Excret. pore body diam.	44	16.3 ± 1.1 (14.0-18.5)	22	14.7 ± 1.0 (16.5-12.5)
Mid-body diam.	43	17.5 ± 1.1 (15.5-19.5)	23	14.8 ± 1.6 (11.5-18.0)
Postvulval body diam.	43	16.4 ± 1.0 (14.5-18.5)	-	-
Anal/cloacal body diam.	31	13.5 ± 0.7 (12.0-15.0)	16	12.1 ± 0.7 (10.5-15.0)
Ant. end to metacorpus center	48	70.7 ± 2.9 (65.0-76.5)	23	69.3 ± 3.1 (63.0-75.5)
Ant. end to excret. pore	46	97.9 ± 4.3 (89.5-106.5)	22	91.8 ± 5.3 (81.0-102.5)
Ant. end to cardia	46	138.0 ± 5.0 (128.0-148.0)	23	135.0 ± 6.4 (122.0-148.0)
Tail length	32	30.9 ± 2.8 (25.5-36.5)	17	33.2 ± 2.6 (28.0-38.5)
h	32	9.5 ± 0.9 (7.5-11.5)	15	11.9 ± 1.9 (8.0-15.5)
Phasmids to anus/cloaca	27	12.2 ± 1.8 (8.5-16.0)	7	15.0 ± 2.9 (9.0-21.0)
Spicules	-	-	10	15.0 ± 0.8 (13.5-16.5)
Gubernaculum	-	-	9	5.6 ± 0.3 (5.0-6.0)

Description

Female : Heat-relaxed body slightly curved ventrad. Postvulval body region with slightly smaller diameter than prevulval region. Annulation fine, inconspicuous except sometimes opposite oesophageal region and on tail. Lateral fields widen slightly opposite vulva and around phasmids, lateral lines evenly spaced, outer lines originate just behind basal plate, appear to close fields very near tail end, inner lines converge behind phasmids, may merge to a single line before field terminus. Lip area flat or shallowly rounded anteriorly, without transverse striae, continuous with rest of body. Cephalic framework moderately sclerotized, basal ring extends posteriad to opposite middle of stylet. Stylet cone about as long as shaft, knobs slightly to strongly backsloped. Opening of dorsal oesophageal gland 2.5 µm behind knobs. Metacorporal valve comparatively small, narrower than width across stylet knobs. Nerve ring slightly anterior to middle of isthmus. Excretory pore anterior to, or coincides with hemizonid. Oesophageal glands lobe half to nearly as long as isthmus, dorsal gland slightly overlaps anterior intestine. Vagina at a right angle to body axis, extends over about three-fifths of body diameter. Spermatheca lobed. Post-uterine sac about equal to vulval body diameter. Rectum not overlapped by intestine. Tail cylindroid, with about 30 annules visible, tail end broadly to conoid rounded, appearing smooth but very inconspicuously annulated in some specimens, terminal cuticle occupies about one third of tail length. Phasmid position variable, usually slightly before mid-tail.

Male : Similar to female except for reproductive characters and overall smaller size. Tail narrows abruptly opposite hyaline portion. Caudal alae inconspicuously crenated, posterior edge slightly indented in some specimens. All lateral lines extend onto tail or ventral lines end opposite cloacal opening. Proximal end of gubernaculum directed towards rear in some specimens.

Type locality and habitat

Sugarcane soil (vertisol group) in field Marl Hale on farm Kendal, near Church Village, Barbados. Collected by Harm De Boer, July, 1990 and January, 1991.

Type specimens

Holotype female (catalogue number 26067) and 55 female and male paratypes in the National Collection of Nematodes, Plant Protection Research Institute, Pretoria, South Africa; seven female and six male paratypes deposited in the Muséum National d'Histoire Naturelle, Laboratoire de Biologie Parasitaire, Protistologie, Helminthologie, Paris, France; six female and five male paratypes deposited in the CAB International Institute of Parasitology, St Albans, Herts, England; eight female and five male paratypes deposited in USDANC, Beltsville, Maryland, USA.

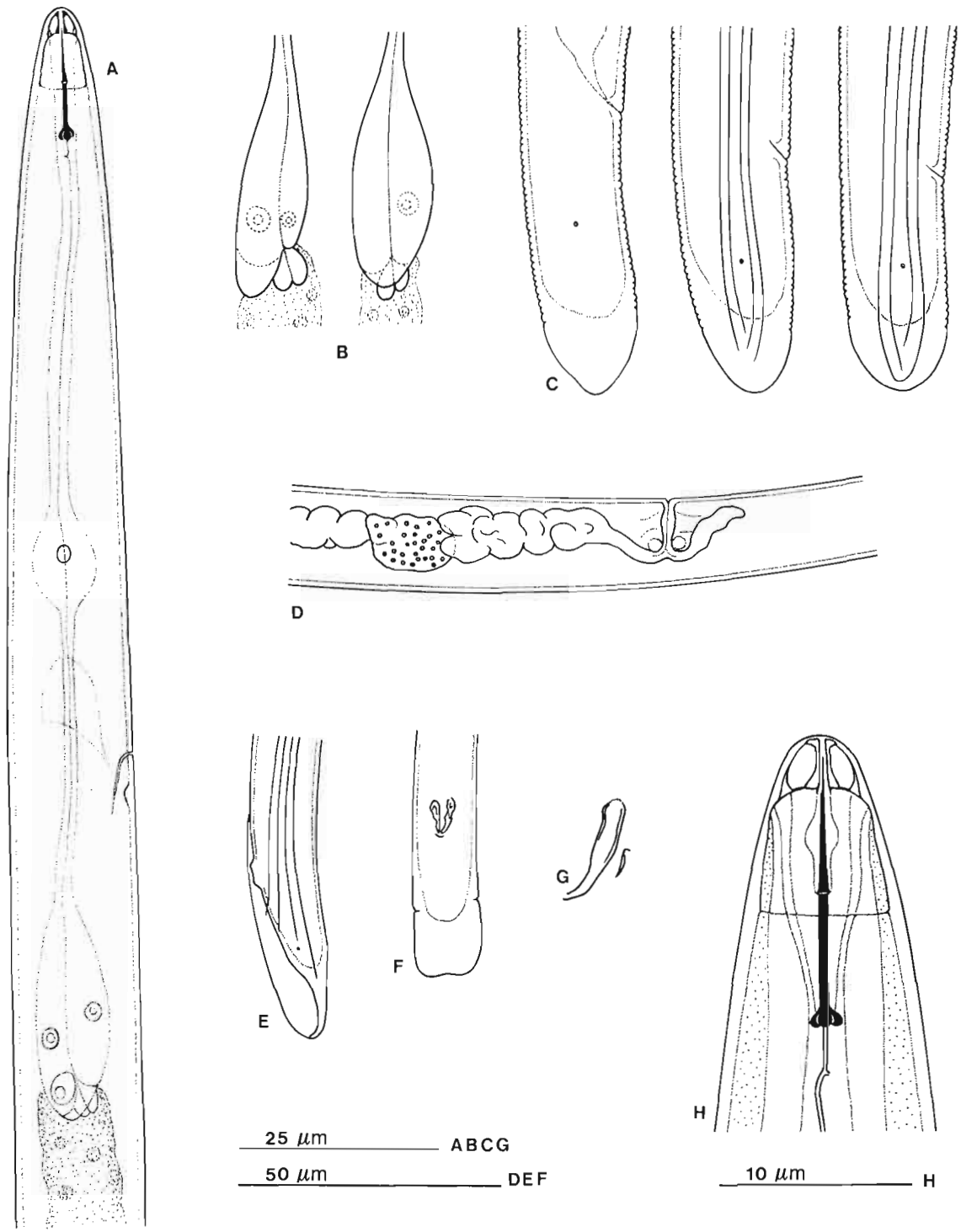

Fig. 1. Trophurus deboeri *n. sp. A : Head and oesophageal region, female; B : Oesophageal glands, female; C : Female tails, lateral; D : Vulval region; E : Male tail, lateral; F : Male tail, ventral; G : Spicule and gubernaculum; H : Head, female.*

DIAGNOSIS AND RELATIONSHIP

Trophurus deboeri n. sp. is characterized by a combination of characters : fine, inconspicuous annulation, basal ring extends posteriad to opposite mid-stylet, stylet knobs back-sloped, dorsal oesophageal gland overlaps intestine slightly, excretory pore opposite or in front of hemizonid, V = 60-66 (63), post-uterine sac about as long as width of body at vulva, postvulval body region slightly narrower than prevulval region, female tail cylindroid, terminus broadly to conoid rounded, appearing smooth, length of hyaline portion of tail about one third of tail length, intestine without postrectal diverticulum, caudal alae in some specimens slightly indented posteriorly, all lateral lines reach level of cloacal opening.

The relationship between *T. deboeri* n. sp. and the other species is shown in Table 2.

REMARKS

In addition to established characters such as the atrophied posterior genital branch, near equatorial vulva and greatly thickened terminal tail cuticle, *Trophurus* species show certain features of the cephalic framework, metacorpus, oesophageal glands, excretory pore, body shape and caudal alae that are useful for a more complete characterization of the genus. These characters have been incorporated into an emended diagnosis of *Trophurus* but are omitted from the table with diagnostic characters (Table 2) as the necessary information was not available for all the species.

Trophurus Loof, 1956 = *Clavaurotylenchus* Caveness, 1958

EMENDED DIAGNOSIS

Telotylenchinae. Body slender (a = 25-58), 0.5-1.2 mm long. Annulation fine, usually inconspicuous. Lateral fields each with four lines, not areolated. Labial region conoid, not visibly annulated, usually continuous with body contour, rarely slightly set off, in SEM face view, smooth, with labial disc and lips fused (Sher & Bell, 1974). Cephalic framework lightly to moderately sclerotized, basal ring often considerably extended towards rear. Stylet 10-21 µm long, very slender, cone needle-like anteriorly, knobs small, rounded. Excretory pore usually opposite or anterior to hemizonid. Valve of metacorpus comparatively small. Oesophageal glands lobe usually abuts, but dorsal gland may slightly overlap, intestine. Vulva just post-equatorial (V = 52-66), reproductive system monovarial, antepudendum (Maggenti, 1981), posterior genital branch atrophied to an uterine sac. Spermatheca may be lobed. Postvulval body region often slightly narrower than prevulval region. Female tail cylindroid to clavate, terminus broadly to conoid rounded, terminal cuticle conspicuously thickened in both sexes. Spicules with small vela. Gubernaculum short, simple, not protruding from cloacal opening. Caudal alae may be indented posteriorly.

TYPE SPECIES

Trophurus imperialis Loof, 1956.

OTHER SPECIES

T. deboeri n. sp.
T. impar Ganguly & Khan, 1983
T. lomus Saha, Chawla & Khan, 1974
T. longimarginatus Román, 1962
T. marathwadensis Suryawanshi, 1971
T. minnesotensis (Caveness, 1958) Caveness, 1959
= *Clavaurotylenchus minnesotensis* Caveness, 1958
T. pakendorfi De Waele & Bolton, 1988

Table 2. *Diagnostic characters for species in* Trophurus *Loof, 1956.*

	L (mm)	a	b	c	V	Styl. (µm)	Spic. (µm)	Gub. (µm)	Styl. cli.	Int. div.	Tail ter.	Tail shape	PUS
T. deboeri n. sp.	0.750-0.950	43-56	5.4-7.0	24-32	60-66	12-15	14-17	5-6	POS	ABS	SMO	CYL	as long
T. impar	0.800-0.930	52-58	6.1-6.8	30-40	54-61	12-14	-	-	LAT	PRE	SMO	CYL	longer
T. imperialis	0.840-1.200	31-44	5.7-10.3	22-32	52-60	17-21	20-26	4-10	LAT	PRE	SMO	CYL	as long
T. lomus	0.700-0.900	25-38	5.0-6.4	20-30	53-60	16-18	20-22	7-8	LAT	ABS	SMO	CYL	shorter
T. longimarginatus	0.840-1.050	41-50	6.7-7.9	26-33	54-61	14-16	11-15	3-6	LAT	?	ANN	CYL	?
T. marathwadensis	1.030-1.210	43-50	6.2-7.4	32-39	54-57	15-16	19-22	5-6	POS	ABS	SMO	CYL	as long
T. minnesotensis	0.668-0.845	26-34	5.3-6.3	17-22	56-61	14-15	20	9	POS	PRE	SMO	CYL/CLA	shorter
T. pakendorfi	0.731-0.803	42-46	5.9-6.5	30-34	57-61	12-14	18	5-6	LAT	PRE	SMO	CYL	as long
T. roigi	0.500-0.600	30-31	3.1-4.8	17-19	61-62	22	?	?	?	?	SMO	CLA	?
T. scognamiglii	0.846-1.004	32-37	5.2-6.4	21-28	55-59	14-17	22-25	9	LAT	ABS	SMO	CYL	shorter
T. sculptus	0.800-0.910	26-38	4.9-7.4	15-26	56-60	14-16	14-17	3-5	POS	ABS	SMO	CLA	longer
T. similis	0.700-1.000	40-58	5.0-7.0	18-25	53-64	9-11	16-21	6-8	LAT	ABS	SMO	CYL	shorter
T. ussuriensis	0.690-0.750	26-30	4.7-5.5	16-19	56-60	13-14	18-19	5-6	LAT	PRE	SMO	CLA	as long
T. vultus	0.520-0.670	27-36	5.0-5.8	20-26	56-60	11-14	13-15	3-4	POS	PRE	ANN	CLA	shorter

Characters abbreviations : Styl. = stylet length; Spic. = spicule length; Gub. = gubernaculum length; Sty. cli. = inclination of stylet knobs (LAT = laterad, POS = posteriad); Int. div. = postrectal intestinal diverticulum (PRE = present, ABS = absent); Tail ter. = tail terminus annulation (SMO = smooth, ANN = annulated); Tail shape : CLA = clavate, CYL = cylindroid; PUS = length of post-uterine sac in terms of vulval body diameter.

T. roigi Razjivin, O'Relly & Pérez Milian, 1973
T. scognamiglii Talamé, 1974
T. sculptus Loof, 1956
T. similis Khan & Nanjappa, 1971
T. ussuriensis Eroshenko, 1981
T. vultus Siddiqi & Lenné, 1990.

REMARKS

Trophurus resembles certain species of *Paratrophurus* Arias, 1970 in general appearance, especially in the narrow, conoid labial region and cylindroid female tail with regressed protoplasmatic contents and greatly thickened terminal cuticle. This tail form indicates a shortening of the tail, an evolutionary trend described in Tylenchina by Luc *et al.* (1987). The posteriorly indented caudal alae in some species of both genera and generally weak development or absence of the female tail terminus annules may be associated with this regression in tail length. A completely regressed posterior genital branch is considered distinctive for *Trophurus*, although Castillo *et al.* (1989) reported remnants of the posterior ovary in an undescribed species from Colombia. *Paratrophurus* is also subject to this trend, and at least two species show considerable reduction of the posterior tract (Castillo *et al.*, 1989; Kleynhans, 1992); in one of these species and in several *Trophurus* species this regression is accompanied by a slightly but distinctly reduced postvulval body diameter. *Trophurus* and several *Paratrophurus* species also share a lightly sclerotized cephalic framework, a delicate stylet with needle-like cone and a conspicuously small metacorpus valve, all considered to be ancestral characters by Luc *et al.*(1987). *Trophurus* differs from *Paratrophurus* in often having a lobed spermatheca, a non-protruding gubernaculum, small vela, and in SEM face view (lips quadrangular, set off from second labial annule, labial disc raised above lips in *Paratrophurus*).

KEY TO FEMALES OF *TROPHURUS* LOOF, 1956

1. Tail terminus distinctly annulated 2
   Tail terminus appearing smooth 3
2. Stylet knobs back-sloped, tail clavate, L = 0.520-0.670 mm ..... *T. vultus*
   Stylet knobs directed laterad, tail cylindroid, L = 0.840-1.050 mm ..... *T. longimarginatus*
3. Labial region set off from body, L = 0.500-0.600 mm, stylet length = 22 µm ..... *T. roigi*
   Labial region continuous with body, L = 0.668-1.200 mm, stylet length 9-21 µm 4
4. Postrectal intestinal diverticulum absent 5
   Postrectal intestinal diverticulum present 10
5. Stylet knobs back-sloped, post-uterine sac as long as, or longer than, vulval body diameter 6
   Stylet knobs directed laterad, post-uterine sac shorter than vulval body diameter 8
6. Tail clavate, a = 26-38, c = 15-26 ..... *T. sculptus*
   Tail cylindroid, a = 43-56, c = 24-39 7
7. Dorsal oesophageal gland overlaps intestine slightly, V = 60-66, L = 0.750-0.950 mm ..... *T. deboeri* n. sp.
   Oesophageal glands abut intestine, V = 54-57, L = 1.030-1.210 mm ..... *T. marathwadensis*
8. Stylet length = 9-11 µm, a = 40-58 ..... *T. similis*
   Stylet length = 14-18 µm, a = 25-38 9
9. Ovary with double flexure, extends to oesophageal glands ..... *T. scognamiglii*
   Ovary shorter, outstretched ..... *T. lomus*
10. Stylet length = 17-21 µm ..... *T. imperialis*
    Stylet length = 12-15 µm 11
11. Oesophageal glands overlap intestine slightly, cardia furcate, a = 52-58, tail cylindroid *T. impar*
    Oesophageal glands abut intestine, cardia not furcate, a = 26-46, tail cylindroid or clavate 12
12. Postrectal intestinal diverticulum extends past mid-tail ..... *T. minnesotensis*
    Postrectal intestinal diverticulum shorter 13
13. Tail cylindroid, a = 42-46, c = 30-34 *T. pakendorfi*
    Tail clavate, a = 26-30, c = 16-19 *T. ussuriensis*

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