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sp. (Nematoda: Habronematoidea:
Habronematidae) in Birds from the Área de
Conservación Guanacaste, Costa Rica

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TORQUATOIDES TROGONI N. SP. AND EXCISA RAMPHASTINA N. SP. (NEMATODA: HABRONEMATOIDEA: HABRONEMATIDAE) IN BIRDS FROM THE AREA DE CONSERVACION GUANACASTE, COSTA RICA

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ABSTRACT: Two new species of habronematid nematodes are described in birds from the Area de Conservacion Guanacaste, Costa Rica. *Torquatoides trogoni* n. sp., in *Trogon massena*, can be distinguished from *T. torquata*, *T. bengalensis*, and *T. crotophaga* in lacking lateral alae. Among species lacking lateral alae, the new species differs from *T. balanocephala* in having 14 versus 8–10 cephalic cuticular plaques, 21–22 versus 13–17 pairs of preanal papillae, and a beak-shaped versus U-shaped gubernaculum. The new species differs from *T. singhi* in body length, in having 21–22 versus 10 pairs of precloacal papillae, longer spicules, and larger eggs. The new species differs from *T. crotophaga*, the only other species known from Central America, in lacking lateral alae, and having 14 versus 6 cephalic cuticular plaques, 21–22 versus 17 pairs of precloacal and 3 versus 2 pairs of postcloacal papillae, and a gubernaculum. *Excisa ramphastina* n. sp., in *Ramphastos sulfuratus*, can be distinguished from *E. excisa*, *E. biloba*, *E. buckleyi*, *E. dentifera*, and *E. khalili* in having 1 lateral ala versus none, cervical papillae anterior versus posterior to the nerve ring, and asymmetrical caudal alae. *Excisa ramphastina* is similar to *E. curvata* in having cervical papillae anterior to the nerve ring but differs in having 1 lateral ala versus none, asymmetrical caudal alae, an average spicule ratio of 1:4.4 versus 1:3.3, and 4 versus 2 pairs of sessile papillae. The new species differs from *E. columbi* in having 1 versus 2 lateral alae, in the length of the spicules, in having a different spicule ratio, and in the numbers of sessile papillae.

The majority of habronematid nematodes live under the lining of the gizzard of avian hosts throughout the world. Previously, we reported 4 species representing the species-rich (>45 species) habronematid *Procymeia* Chabaud, 1958 inhabiting avian hosts from the Area de Conservacion Guanacaste (ACG), Costa Rica (Zhang et al., 2004). During June 2001 and June 2002, as part of an ongoing biodiversity inventory of the eukaryotic parasites of vertebrates inhabiting the ACG in north-western Costa Rica (<http://brooksweb.zoo.utoronto.ca/index.html>), we collected specimens of 2 previously undescribed species of habronematids, each belonging to a different, relatively species-poor genus. We describe those species herein.

MATERIALS AND METHODS

A slaty-tailed trogon, *Trogon massena* Gould, 1838, and a keel-billed toucan, *Ramphastos sulfuratus* Lesson, 1830, were collected on 8 June 2002, and on 14 June 2001, respectively, and examined for parasites. Nematodes collected from beneath the lining of the gizzard were fixed in glacial acetic acid and preserved and stored in 70% ethanol. They were later cleared in lactophenol for further examination. En face views were prepared following the protocol described by Anderson (1958). Drawings were made with a microscopy tube. Measurements (minimum, maximum, followed by mean in parentheses) are given in micrometers, unless otherwise stated. TBL = total body length.

DESCRIPTIONS

Torquatoides trogoni n. sp.

(Figs. 1–7)

Diagnosis: Body elongated, slender and medium size with fine transverse striations. Lateral alae absent. Mouth surrounded by 2 lateral pseudolabia, dorsal and ventral labia. Each pseudolabium bearing 4 spinelike teeth on its internal surface. Cuticular collar consisting of circular row of double-circular plaques posterior to labia present. Six plaques in anterior row, 14 in posterior row. Four cephalic papillae located in ventral

and dorsal anterior plaques; 1 pair of amphids in anterior lateral plaques. Buccal capsule long and cylindrical. Esophagus clearly divided into short anterior muscular part and long posterior glandular part. Muscular esophagus 3.9–4.5% (4.2%) TBL in male and 1.4–2.1% (1.7%) TBL in female; glandular esophagus 18.4–21.4% (20.2%) TBL in males and 7.9–10.3% (8.8%) TBL in females. Nerve ring at anterior part of muscular esophagus. Cervical papillae and excretory pore immediately anterior to nerve ring.

Male ($n = 4$): Body length 5.48–6.53 mm (5.97 mm). Maximum width 82–111 (94). Buccal capsule 69–93 (82) long. Muscular esophagus 216–273 (249) long and 18–23 (19) wide; glandular esophagus 1.17–1.24 mm (1.21 mm) long and 34–48 (40) wide. Nerve ring 162–180 (172) from anterior end, excretory pore 145–168 (159) from anterior end, and cervical papillae 136–155 (147) from anterior end. Posterior end of body curved. Caudal alae well developed and symmetrical, 403–483 (451) long. Tail rounded, 72–89 (77) long. Precloacal papillae 21–22 pairs and 3 pairs of postcloacal papillae, 1 pair of small papillae near tail tip. Spicules unequal and similar shaped with rounded proximal and pointed distal ends. Left spicule 274–344 (310) long. Right spicule short, 113–132 (126) long. Ratio of right spicule:left spicule 1:2.3–2.6 (1:2.5). Gubernaculum beak shaped (Fig. 4), 42–48 (45) long, 11–16 (13) wide.

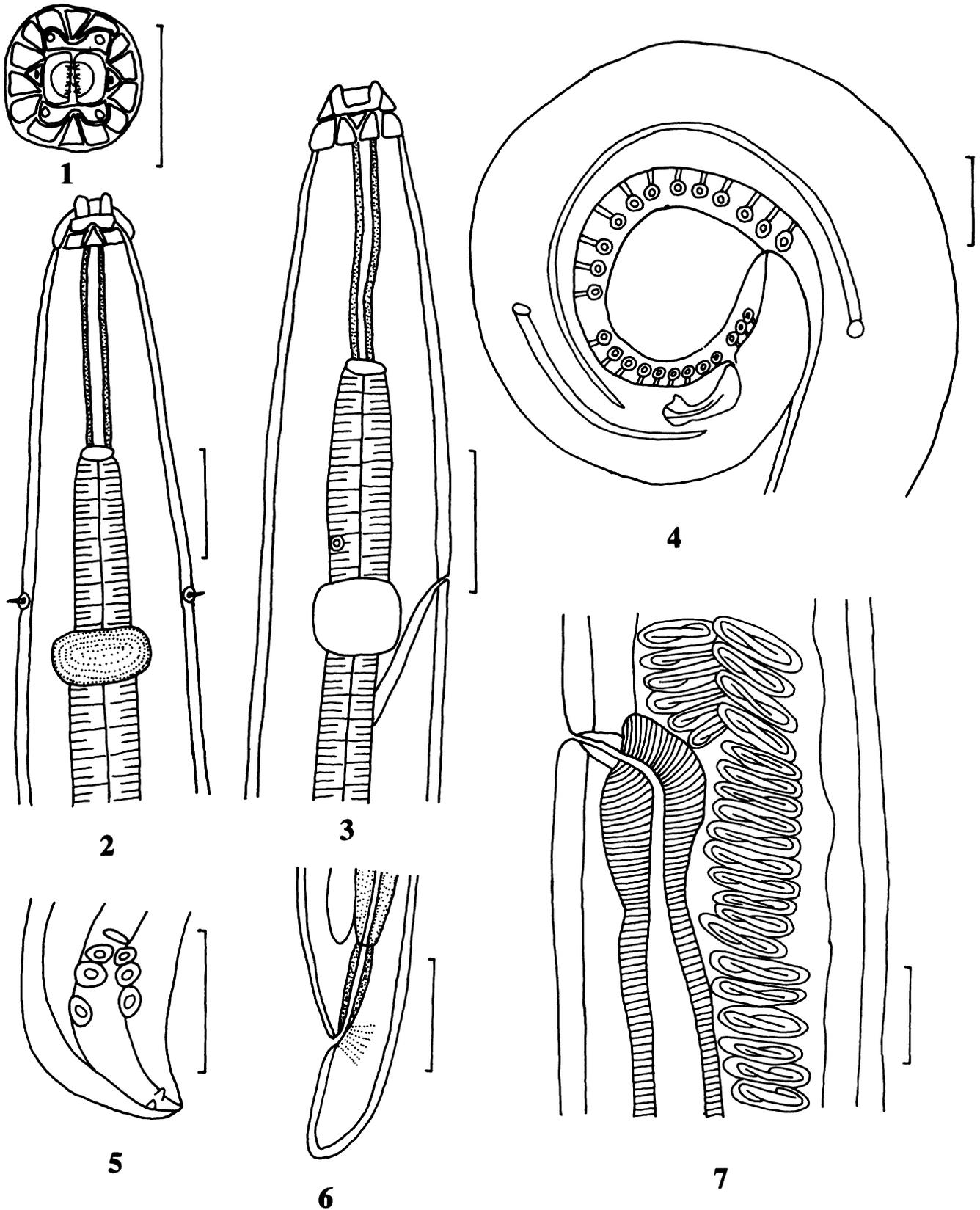
Female ($n = 10$): Body length 16.26–19.68 mm (18.60 mm). Maximum width 153–209 (179). Buccal capsule 89–106 (96) long. Muscular esophagus 269–364 (313) long and 19–28 (23) wide; glandular esophagus 1.54–1.79 mm (1.64 mm) long and 48–73 (60) wide. Nerve ring 180–225 (205) from anterior end, excretory pore 164–209 (189) from anterior end, and cervical papillae 158–184 (177) from anterior end. Vulva located near posterior third of body, 4.60–5.97 mm (5.23 mm) from posterior end, 25.6–30.6% (28.1%) TBL from posterior end. Tail short and rounded, 114–156 (133) long. Eggs long-ellipsoid, thick-shelled, embryonated, 42–48 (46) long, 10–13 (11) wide.

Taxonomic summary

Type host: *Trogon massena* Gould, 1838 (Aves: Trogoniformes: Trogonidae).

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FIGURES 1-7. *Torquatoides trogoni* n. sp. 1. Anterior extremity, en face view. 2. Anterior end of allotype female, lateral view. 3. Anterior end of allotype female, ventral view. 4. Posterior end of holotype male, lateral view. 5. Posterior extremity of holotype male, ventral view. 6. Posterior end of allotype female, lateral view. 7. Vulva region of female. Figs. 1-5, 7, Bar = 50 μ m; Fig. 6, Bar = 100 μ m.

Type locality: Estacion San Gerardo, San Gerardo, ACG, Guanacaste Province, Costa Rica, 10°52'50"N, 85°23'21"W.

Site of infection: Under the lining of the gizzard.

Prevalence: 1/1.

Intensity: 18.

Type specimens: Holotype male: USNPC 94431; allotype female: USNPC 94432; paratypes: USNPC 94433 (3 males and 13 females).

Etymology: The new species is named after its host genus.

Remarks

Members of *Torquatoides* (Williams, 1929) Inglis, 1965, including the new species, differ from other habronematids in having circular rows of cuticular plaques posterior to the labia. Seven species of *Torquatoides* have been described previously (for reviews see Pence and Casto, 1976; Nandi and Majumdar, 1989; and Vincente et al., 1995): *Torquatoides torquata* (Gendre, 1922) Inglis, 1965 in *Centropus monachus* Ruppell, 1837 from Africa; *T. balanocephala* (Gendre, 1922) Inglis, 1965 in *Merops malimbicus* Shaw, 1806 from Africa and *M. orientalis* Latham, 1802 from India; *T. bengalensis* Nandi and Majumdar, 1987 in *C. sinensis* (Stephens, 1815) Inglis, 1965 from India; *T. concephala* (Molin, 1861) Inglis, 1965 in *Piyana cayanus* (Linnaeus, 1766) (as *Cucullanus cayana*, Linnaeus, 1766) from Brazil; *T. crotophaga* (Williams, 1929) Inglis, 1965 in *Crotophaga ani* (Linnaeus, 1758) from Central America (Panama), *C. sulcirostris* and *Geococcyx californianus* from south Texas (USA), and *Guira guira* from Brazil; *T. longiovata* (Ali, 1957) Inglis, 1965 in *M. orientalis* Latham, 1802 from India; and *T. singhi* (Rasheed, 1960) Inglis, 1965 in *Dicrurus macrocercus* Vieillot, 1817 from India. Nandi and Majumdar (1987) re-described *T. balanocephala* and compared it with *T. longiovata*. They considered *T. longiovata* as synonym of *T. balanocephala*. *Torquatoides concephala* was proposed for 2 poorly described female specimens, so we consider it a species *inquirenda*. We, therefore, recognize 5 valid species.

The new species can be distinguished from *T. torquata*, *T. bengalensis*, and *T. crotophaga* in lacking lateral alae. Among the species lacking lateral alae, the new species differs from *T. balanocephala* in having 14 versus 8–10 posterior cuticular plaques, 21–22 versus 13–17 pairs of precloacal papillae, and a beak-shaped, rather than U-shaped, gubernaculum. The new species further differs from *T. singhi* in having longer bodies (males 5.48–6.53 mm long, females 16.26–19.68 mm in *T. trogoni* vs. males 2.9 mm long, females 7.52 mm long in *T. singhi*), 21–22 versus 10 pairs of precloacal papillae, longer spicules (left spicule 274–344 long, right spicule 113–132 long in *T. trogoni* vs. left spicule 107 long, right spicule 77 long in *T. singhi*), and larger eggs (42–28 × 10–13 in *T. trogoni* vs. 28 × 19 in *T. singhi*). The new species is similar to *T. crotophaga*, which is the only other species found in Central America, in the body size and shape of spicules, but differs in lacking lateral alae, and in having 14 versus 6 posterior cuticular plaques, 21–22 pairs of precloacal and 3 pairs of postcloacal papillae versus 17 pairs of precloacal and 2 pairs of postcloacal papillae, and gubernaculum rather than lacking it.

Excisa ramphastina n. sp.

(Figs. 8–16)

Diagnosis: Body medium size with distinct transverse striations. Labial region consists of 2 large pseudolabia and dorsal

and ventral labia. Pseudolabia deeply notched and divided into 3 triangular toothlike projections interlocking with their counterparts. An amphid located on base of each pseudolabium. Dorsal and ventral labia deeply notched and divided into 2 parts, each half of labium with 1 large and 1 small papilla. Only dextral lateral ala present, well developed, striated, extending from just posterior to cervical papillae to posterior to midbody, 56.8–63.3% (59.5%) TBL from anterior end. Buccal capsule cylindrical to subcylindrical. Wall of buccal capsule thickening from anterior to posterior. Esophagus clearly divided into short anterior muscular part and long posterior glandular part. Muscular esophagus 3.9–4.5% (4.1%) TBL in male; glandular esophagus 21.4–25.0% (24.0%) TBL in male. Nerve ring at level of middle of muscular esophagus. Cervical papillae anterior to nerve ring. Excretory pore immediately posterior to nerve ring.

Male ($n = 4$): Body length 10.94–12.23 mm (11.38 mm). Maximum width 274–281 (279). Lateral ala 6.45–7.26 mm (6.86 mm) long. Buccal capsule 30–38 (36) long and 10–15 (12) wide. Muscular esophagus 456–494 (470) long and 38–46 (42) wide; glandular esophagus 2.62–2.91 mm (2.73 mm) long and 110–122 (114) wide. Nerve ring 312–350 (326) from anterior end, excretory pore 418–456 (435) from anterior end, and cervical papillae 182–209 (193) from anterior end. Posterior end of body curved. Caudal alae well developed and asymmetrical, left lateral ala 951–1,252 (1,050) long, right lateral ala 682–872 (745) long. Caudal alae with longitudinal striations on ventral surface and transverse striations on dorsal surface. Ventral surface of caudal region with prominent longitudinal ridges. Tail rounded, 301–317 (309) long. Four pairs of pedunculate precloacal papillae and 2 pairs of pedunculate postcloacal papillae arranged symmetrically. Four pairs of sessile papillae located near tail tip. Spicules unequal and dissimilar. Left spicule long, 1.90–2.11 mm (2.00 mm) long, with a pointed distal end. Right spicule short, 437–475 (451) long, tip of distal end wedge shaped. Ratio of right spicule:left spicule 1:4.3–4.4 (1:4.4). Gubernaculum groove shaped, 49–53 (50) long.

Taxonomic summary

Type host: *Ramphastos sulfuratus* Lesson, 1830 (Aves: Piciformes: Ramphastidae).

Type locality: Estacion, Sector Maritza, ACG, Guanacaste Province, Costa Rica, 32°65'55"N, 37°27'68"W.

Site of infection: Under the lining of the gizzard.

Prevalence: 1/1.

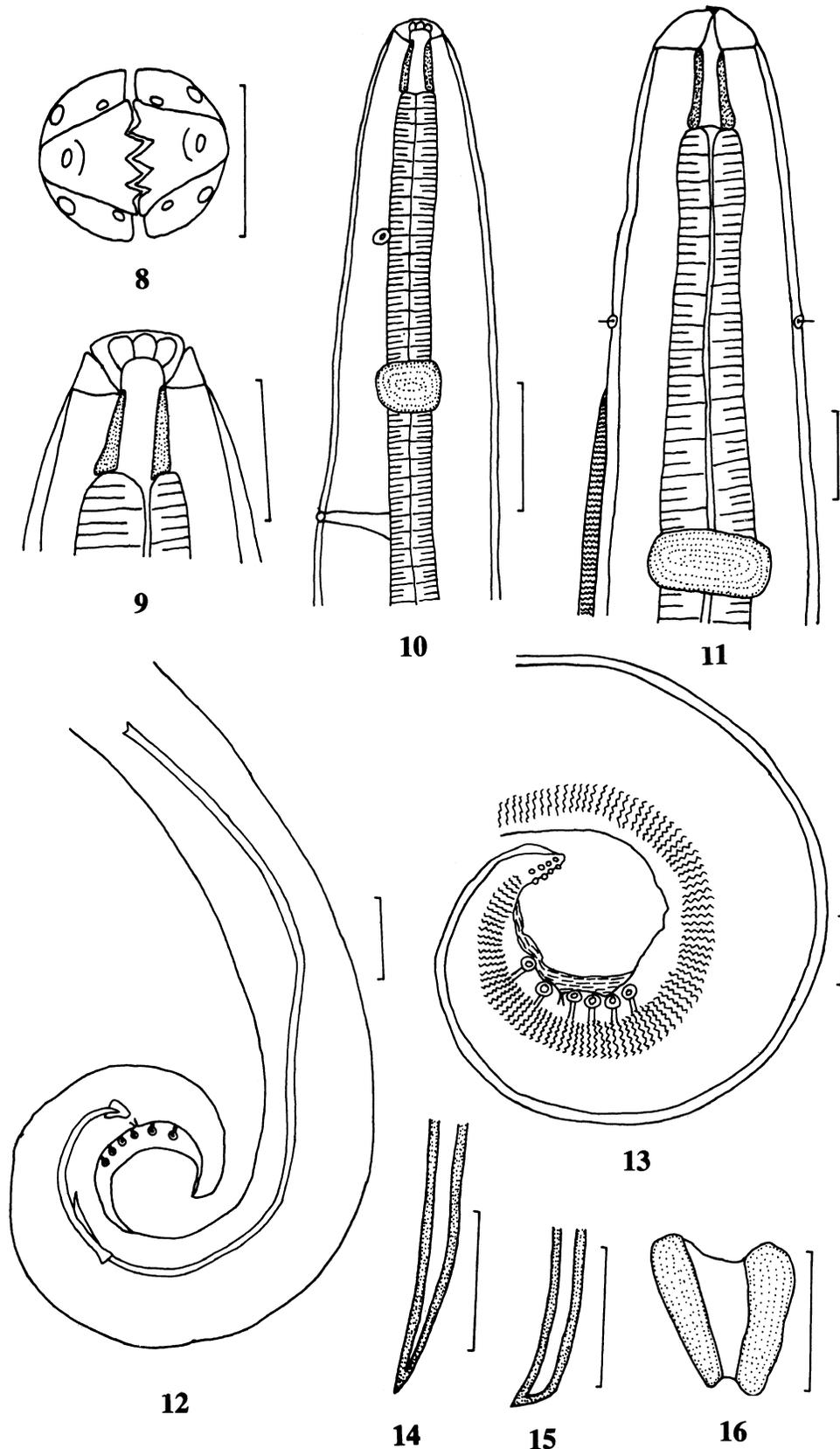
Intensity: 4.

Type specimens: Holotype male: USNPC 94424; paratypes: USNPC 94435 (3 males).

Etymology: The new species is named after its host genus.

Remarks

Members of *Excisa* Gendre, 1928, including the new species, differ from other habronematid genera in having pseudolabia surmounted by 3 large teeth that interlock with those of the opposite side. Seven species of *Excisa* have been described: *E. excisa* (Molin, 1860) Chabaud, 1958, in *Ciconia ciconia* and *Leptoptilus crumeniferus* from Africa, Europe, and Asia, and *C. maguari* from the Pantanal of Brazil; *E. dentifera* (Johnston and Mawson, 1941) Chabaud, 1958 in *Eupodotis australis* from



FIGURES 8-16. *Excisa ramphastina* n. sp. 8. Anterior extremity, en face view. 9. Anterior extremity of holotype male, lateral view. 10. Anterior region of holotype male, lateral view. 11. Anterior region of holotype male, dorsal view. 12, 13. Posterior end of holotype male, lateral view. 14. Distal end of left spicule, holotype. 15. Distal end of right spicule, holotype. 16. Gubernaculum. Figs. 8, 9, 11, 14-16, Bars = 50 mm; Figs. 10, 13, Bar = 100 mm; Fig. 12, Bar = 200 mm.

Australia; *E. khalili* (Ezzat, 1945) Ali, 1961 in *Rhinoceros bicornis* from Central Africa; *E. buckleyi* Ali, 1961 in *Dissoura episcopus* from India; *E. biloba* Mawson, 1968 in *Podargus strigoifex* and *Ninox novaeseelandiae* from Australia; *E. curvata* Jairajpuri and Siddiqi, 1971 in *Accipiter badius* from India; and *E. columbi* Gogoi and Islam, 1989 in *Columba livia domestica* from India.

Although our sample of this species contained only males, we are confident that they represent a new species. *Excisa ramphastina* can be distinguished from *E. excisa*, *E. biloba*, *E. buckleyi*, *E. dentifera*, *E. khalili*, and *E. curvata* in having 1 lateral ala rather than lacking lateral alae and in having asymmetrical caudal alae. *Excisa ramphastina* is similar to *E. curvata* in having cervical papillae anterior to the nerve ring, but, in addition to having a lateral ala and asymmetrical caudal alae, differs by having an average spicule ratio of 1:4.4 versus 1:3.3, and in having 4 rather than 2 pairs of sessile papillae near the tip of the male tail. The new species differs from *E. columbi* Gogoi and Islam, 1989 in having 1 lateral ala rather than 2 lateral alae, asymmetrical instead of symmetrical caudal alae, longer spicules (left spicule 1.90–2.11 mm long, right spicule 437–475 long in *E. ramphastina* versus left spicule 1.5 mm long, right spicule 250 long in *E. columbi*), an average spicule ratio of 1:4.4 versus 1:6, and 4 pairs of sessile papillae near the tip of the male tail rather than lacking any sessile papillae.

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