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TWO SPECIES OF *ACUARIA* BREMSER, 1811 (NEMATODA: ACUARIOIDEA: ACUARIIDAE) IN PASSERINE BIRDS FROM THE AREA DE CONSERVACION GUANACASTE, COSTA RICA

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ABSTRACT: Two species of *Acuaria* were collected from passerine birds from the Area de Conservacion Guanacaste, Costa Rica. *Acuaria mayori* Lent, Freitas and Proenca, 1945, was collected from *Myiarchus nuttingi*. Specimens from Costa Rica differ from the original description by having a spicule ratio of 1:1.5–1.7 versus 1:1.43–1.47, as well as shorter spicules and female tails. *Acuaria wangi* n. sp. in *Hylophylax naevioides* and *Gymnopithys leucaspis* resembles *A. alii*, *A. crami*, *A. cyanocitta*, *A. minuta*, *A. pattoni*, and *A. cissae* by having cordons extending posteriorly to the anterior portion of the glandular esophagus. The new species differs from *A. alii* by having 4 pairs of preanal and 6 pairs of postanal papillae rather than 2 pairs of preanal and 7 pairs of postanal papillae, a shorter left spicule, a spicule ratio of 1:1.6–1.8 versus 1:1.1 and in having spicules with blunt rather than pointed distal ends. *Acuaria crami* and *A. minuta* differ from *A. wangi* by having 7 pairs of postanal papillae and spicule ratios of 1:1.6–1.8 versus 1:1.3 in *A. crami* and 1:1.1 in *A. minuta*; in addition, *A. minuta* has spatulate-shaped spicules and a tricupsid-shaped distal end of the right spicule. The new species can be distinguished from *A. pattoni* by having a longer left spicule and a spicule ratio of 1:1.6–1.8 versus 1:1 and from *A. cissae* by having a shorter left spicule and a spicule ratio of 1:1.6–1.8 versus 1:2.5–2.7. *Acuaria wangi* is similar to *A. cyanocitta*, which has similarly shaped spicules, including a very pointed distal end of the left spicule, but differs in body length, in having shorter spicules, in the arrangement of postanal papillae, and in having smaller eggs.

Acuaria Bremser, 1811, is the most species-rich genus of acuariid nematodes, with more than 70 nominal species (Sherwin and Schmidt, 1988). All but 1 known species inhabit passerine birds, the exception being *A. upupa* Rasheed, 1960, from the coraciiform bird, *Upupa epops*, from India (Mawson, 1972). Bremser (1811) proposed *Acuaria* without designating a type species. Of the 14 species he included in *Acuaria*, *Spiroptera anthuris* Rudolphi, 1819, is regarded as the type species for *Anthuris* Rudolphi, 1819, by absolute tautonomy and by Rudolphi's original intentions, but Rudolphi admitted that *Anthuris* was *Acuaria* Bremser, 1811, renamed; hence, the type species *A. anthuris* is the type species of *Acuaria* (Cram, 1927). Skrjabin et al. (1965) regarded *Cheilospirura* Diesing, 1861, as a synonym of *Acuaria*, but Chabaud (1975) considered *Cheilospirura* a valid genus.

During June 2001 and January 2002, as part of an ongoing biodiversity inventory of the eukaryotic parasites of vertebrates inhabiting the Area de Conservacion Guanacaste (ACG) in northwestern Costa Rica (http://brooksweb.zoo.utoronto.ca/index.html), 2 species of *Acuaria* were collected from passerine birds. We describe both in this article.

MATERIALS AND METHODS

Nutting's flycatchers, *Myiarchus nuttingi* Ridgway, 1883 (n = 5), spotted antbirds, *Hylophylax naevioides* (Lafresnaye, 1847) (n = 23), and bicolored antbirds, *Gymnopithys leucaspis* (Sclater, 1885) (n = 7) were collected in June 2001 and January 2002 and examined for parasites. Nematodes collected from beneath the lining of the gizzard were fixed in glacial acetic acid and preserved in 70% ethanol. They were later cleared in lactophenol for further examination. Drawings were made with the aid of a drawing tube. Measurements (range, followed by mean in parentheses) are given in micrometers unless otherwise stated.

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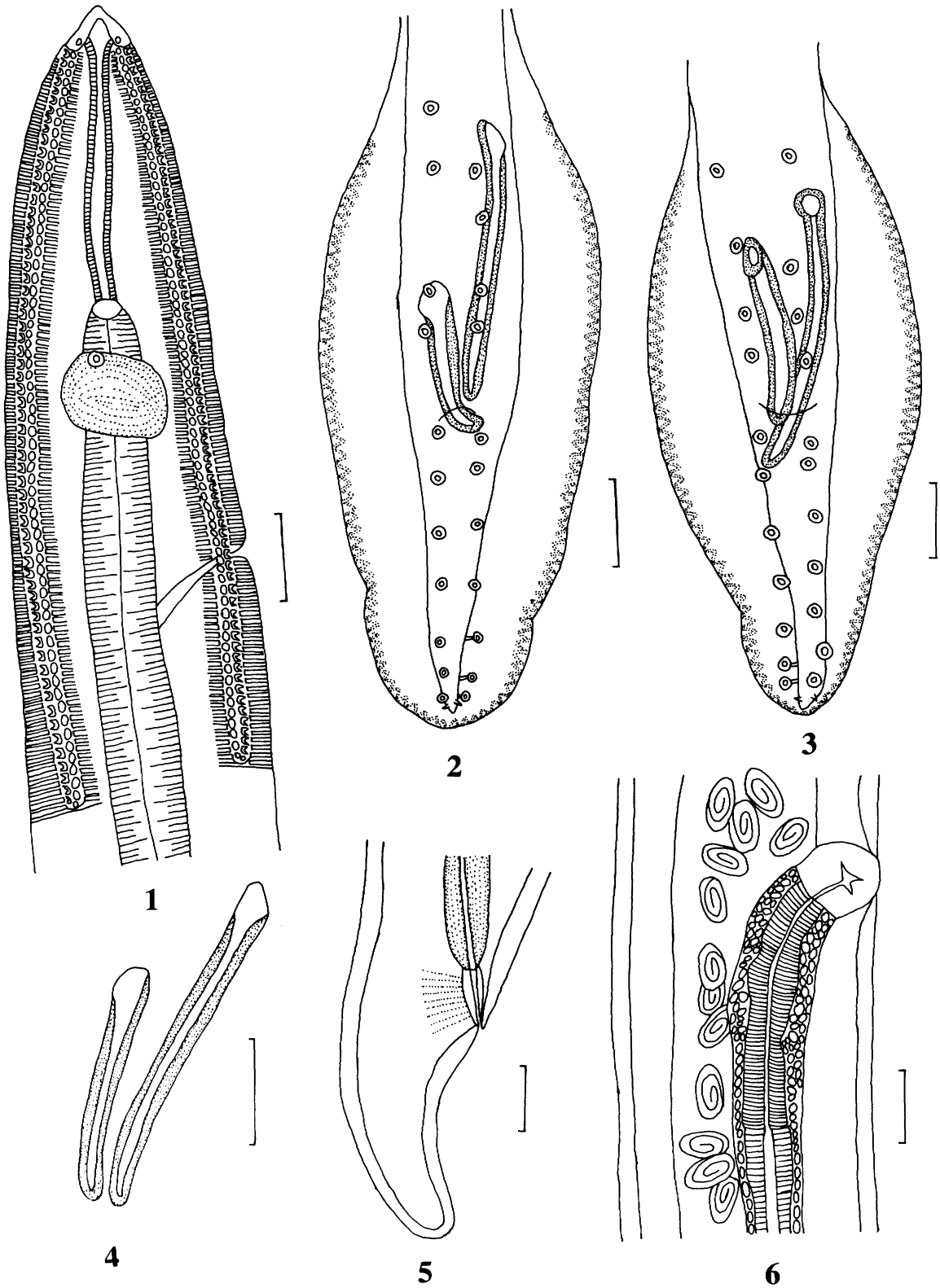
DESCRIPTION

Acuaria mayori Lent, Freitas and Proenca, 1945
(Figs. 1–6)

Diagnosis: Body small with transverse striations. Two pseudolabia lateral to mouth, each bearing a pair of large cephalic papillae and 1 inconspicuous amphid. Cordons straight, nonanastomosing, and nonrecurrent, originating at dorsal and ventral sides of oral opening, continuing posteriorly to middle of muscular esophagus, 3.2–4.8% (4.0%) total body length (TBL) in male and 1.9–2.7% (2.4%) TBL in female. Buccal capsule long and slender, transversely striated. Esophagus clearly divided into short anterior muscular part and long posterior glandular part. Muscular esophagus 4.0–5.6% (5.2%) TBL in male and 2.2–3.4% (2.7%) TBL in female; glandular esophagus 9.8–12.7% (11.4%) TBL in male and 4.8–5.8% (5.2%) TBL in female. Nerve ring located at the level of the anterior end of the muscular esophagus. Cervical papillae located at the same level as nerve ring. Excretory pore immediately posterior to nerve ring.

Male (n = 7): Body length 5.427–7.452 mm (6.808 mm). Maximum width 111–148 (131). Cordons 239–323 (275) long. Buccal capsule 114–156 (134) long. Muscular esophagus 266–429 (355) long and 30–38 (34) wide; glandular esophagus 646–893 (778) long and 49–61 (56) wide. Nerve ring 171–209 (188) from anterior end, excretory pore 255–289 (268) from anterior end, and cervical papillae 167–213 (188) from anterior end. Posterior end of body curved. Caudal alae well developed, 311–396 (348) long, and 38–60 (48) wide. Tail bluntly rounded, 162–178 (169) long. Eleven pairs of caudal papillae, 4 pairs preanal and 7 pairs postanal. Spicules subequal and similar, with rounded distal end. Left spicule 163–186 (179) long, 12.9–16.1 (15.9) wide at base of proximal end. Right spicule 102–123 (111) long, 12.9–19.3 (16.1) wide at base of proximal end. Ratio of right spicule–left spicule 1:1.5–1.7 (1:1.6).

Female (n = 7): Body length 13.84–22.03 mm (18.74 mm). Maximum width 163–192 (173). Cordons 368–518 (444) long. Buccal capsule 143–182 (159) long. Muscular esophagus 441–597 (509) long and 32–57 (45) wide; glandular esophagus 799–



FIGURES 1–6. *Acuaria mayori* Lent, Freitas and Proenca, 1945. **1.** Anterior region of female, lateral view. **2–3.** Posterior end of male, ventral view. **4.** Spicules. **5.** Posterior end of female, lateral view. **6.** Vulva region of female, lateral view. Bars = 50 μm.

1,254 (975) long and 48–87 (74) wide. Nerve ring 200–247 (227) from anterior end, excretory pore 292–353 (329) from anterior end, and cervical papillae 205–258 (227) from anterior end. Didelphic. Vulva near the middle of body, 6.74–10.37 mm (9.31 mm) from anterior end, 46–58.4% (49.6%) TBL from anterior end. Tail short and rounded, 129–179 (148) long. Eggs ellipsoid, thick shelled, embryonated, 31.3–38.6 (34.0) long by 18.4–23.9 (20.6) wide.

Taxonomic summary

Host: Myiarchus nuttingi (Aves: Passeriformes: Tyrannidae).

Localities: Cafetal, Sector Santa Rosa, ACG, Guanacaste Province, Costa Rica, 10°51′19″N, 85°36′39″W. Quebrada Costa Rica, Sector Santa Rosa, ACG, Guanacaste Province, Costa Rica; 10°49′39″N, 85°38′12″W, new locality.

Site of infection: Under the lining of the gizzard.

Prevalence: Forty percent (2 of 5 birds).

Intensity: Two males and 9 females in 1 host, and 5 males and 1 female in the second host.

Voucher specimens: USNPC 93584, 93585.

Remarks

Acuaria mayori Lent, Freitas and Proenca, 1945, was first described in *Cyanocorax chrysops* (Vieillot, 1818) from Paraguay and has since been reported in *Sporophila caerulescens caerulescens* (Vieillot, 1823) and *Cyanocorax cyanomelas* (Wied, 1821) from Brazil (Pinto et al., 1993, 1997). The present specimens are similar to *A. mayori* in cordon length, number and arrangement of male caudal papillae, and spicule shape but differs from the original description and previous reports by having a spicule ratio of 1:1.5–1.7 versus 1:1.43–1.47, as well as shorter spicules (left spicule 163–186 vs. 190–230; right spicule 102–123 vs. 130–160) and female tails (129–179 vs. 170–230). This is the first report of *A. mayori* from Costa Rica, and *M. nuttingi* is a new host record.

Acuaria wangi n. sp.

(Figs. 7–11)

Diagnosis: Body small with transverse striations. Two pseudolabia lateral to mouth, each bearing a pair of large cephalic papillae and 1 inconspicuous amphid. Cordons straight, nonanastomosing, and nonrecurrent, originating at dorsal and ventral sides of oral opening, continuing posteriorly to anterior part of glandular esophagus, 15.5–19.8% TBL. Buccal capsule long and slender, transversely striated. Esophagus clearly divided into short anterior muscular part and long posterior glandular part. Muscular esophagus 10.5–11.5% (11%) TBL in male and 6.7–10.3% (8.3%) TBL in female; glandular esophagus 26.5–29.3% (28.1%) TBL in male and 15.5–27.7% (19.7%) TBL in female. Nerve ring located at level of anterior end of muscular esophagus. Cervical papillae immediately anterior to nerve ring. Excretory pore posterior to nerve ring.

Male (n = 4): Body length 4.212–4.884 mm (4.645 mm). Maximum width 133–185 (170). Cordons 786–951 (868) long. Buccal capsule 137–156 (146) long. Muscular esophagus 486–524 (511) long and 30–53 (41) wide; glandular esophagus 1.159–1.425 mm (1.306 mm) long and 76–99 (86) wide. Nerve ring 182–205 (198) from anterior end, excretory pore 263–285 (273) from anterior end, and cervical papillae 148–171 (159) from anterior end. Caudal alae well developed, 247–285 (271) long, and 32–37 (34) wide. Tail bluntly rounded, 133–152 (143) long. Ten pairs of caudal papillae, 4 pairs of preanal and 6 pairs of postanal papillae (1 male had only 4 pairs of postanal papillae) (Fig. 9). Postanal papillae divided into 2 groups, each group includes 3 pairs of papillae (Fig. 8). Spicules subequal but dissimilar. Left spicule long and slender, 190–209 (199) long, 9.7–12.9 (10.9) wide at base of proximal end, with a pointed distal end. Right spicule short and thick, 103–129 (116) long, 16.1–22.5 (18.9) wide at base of proximal end, with a rounded distal end. Ratio of right spicule:left spicule 1:1.6–1.8 (1:1.7).

Female (n = 9): Body length 6.80–10.04 mm (8.59 mm). Maximum width 205–311 (251). Cordons 1.26–1.85 mm (1.55 mm) long. Buccal capsule 144–190 (162) long. Muscular esophagus 623–844 (711) long and 49–65 (53) wide; glandular esophagus 1.48–1.88 mm (1.69 mm) long and 72–103 (83) wide. Nerve ring 197–266 (224) from anterior end, excretory pore 293–380 (324) from anterior end, and cervical papillae 171–228 (201) from anterior end. Didelphic. Vulva just posterior to middle of body, 3.56–5.64 mm (4.63 mm) from anterior end, 51–57% (54%) TBL from anterior end. Tail short and rounded, 141–179 (157) long. Eggs ellipsoid, thick shelled, embryonated, 31–37 (36) long by 18–22 (20) wide.

Taxonomic summary

Type host: Hylophylax naevioides (Aves: Passeriformes: Formicariidae).

Other host: Gymnopithys leucaspis (Aves: Passeriformes: Formicariidae).

Type locality: Estación 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: In *H. naevioides*, 17.4% (4 of 23 birds). In *G. leucaspis*, 14.3% (1 of 7 birds).

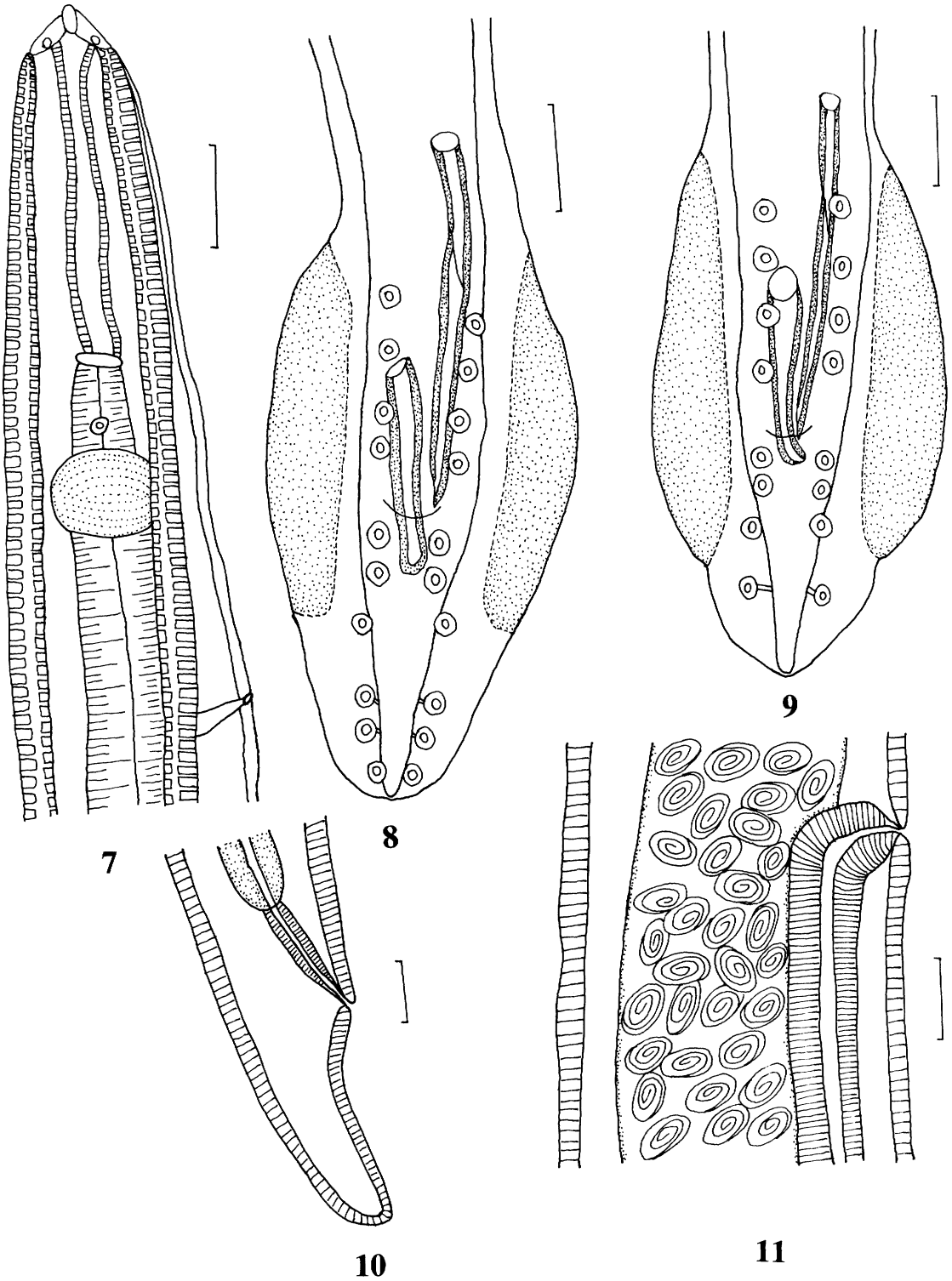
Intensity: Range in *H. naevioides*, 1–4; in *G. leucaspis*, 2.

Type specimens: Holotype, USNPC 93544; allotype, USNPC 93545; paratypes, USNPC 93546, 93547, 93548, 93549, 93550.

Etymology: The new species is named after Professor Puqing Wang, Laboratory of Parasitology, Fujian Normal University, People's Republic of China, for his contribution to the fauna and taxonomy of nematodes.

Remarks

By having cordons extending posteriorly to the anterior portion of the glandular esophagus, *A. wangi* resembles *A. alii* Rasheed, 1960, in *Acridotheres ginginianus* (Latham, 1790) from India, *A. crami* Rasheed, 1960, in *Saxicola caprata caprata* (Linnaeus, 1766) from India (probably not the correct host identification as *S. c. caprata* occurs only in Luzon, Philippines), *A. cyanocitta* (Boyd, 1956) in *Cyanocitta cristata* (Linnaeus, 1758) from the United States, *A. minuta* Williams, 1929, in *Quiscalus quiscala aeneus* (this host record is also doubtful because *Q. q. aenus* (Linnaeus, 1758) is not a valid name and authority combination; *Q. q. quiscala* (L., 1758) is the type by tautonomy, and *Q. aeneus* Ridgway, 1869, has been synonymized with *Q. q. versicolor* (Vieillot, 1819) from the



FIGURES 7–11. *Acuaria wangi* n. sp. **7.** Anterior region of female, lateral view. **8–9.** Posterior end of male, ventral view. **10.** Posterior end of female, lateral view. **11.** Vulva region of female, lateral view. Bars = 50 μm.

United States, *A. pattoni* Williams, 1929, in *Sturnella neglecta* (Audubon, 1844) from the United States, and *A. cissae* Wang, 1976, in *Cissa e. erythrorhyncha* (Boddaert, 1783) from China. Other members of the genus either have very short cordons, extending to the part of muscular esophagus, or longer cordons, extending behind the glandular esophagus or to the posterior part of body.

The new species, however, differs from *A. alii* in having 4 pairs of preanal and 6 pairs of postanal rather than 2 pairs of preanal and 7 pairs of postanal papillae, a longer left spicule

(190–209 vs. 110), a different spicule ratio (1:1.6–1.8 vs. 1:1.1), and a right spicule with a blunt rather than pointed distal end. The new species can be distinguished from *A. crami* and *A. minuta* by its possession of 6 pairs of postanal papillae and a different spicule ratio (1:1.6–1.8 vs. 1:1.3 in *A. crami* and 1:1.1 in *A. minuta*); in addition, *A. minuta* has spatulate-shaped spicules and a tricuspid-shaped distal end of the right spicule. The remaining 3 species resemble *A. wangi* by possessing 4 preanal and 6 postanal papillae. Of these, the new species can be distinguished from *A. pattoni* by having a longer left spicule (190–209 vs. 156) and a spicule ratio of 1:1.6–1.8 versus 1:1 and from *A. cissae* by having a shorter left spicule (190–209 vs. 268–280) and a spicule ratio of 1:1.6–1.8 versus 1:2.5–2.7. *Acuaria wangi* is related to *A. cyanocitta*, which has similarly shaped spicules, including a very pointed distal end of the left spicule and a similar spicule ratio (1:1.6–1.8 vs. 1:1.4–1.6), but the new species differs in body length (male 4.2–4.9 mm long and female 6.8–10.0 mm long in *A. wangi* vs. male 7.5–10.0 mm long and female 12.8–18.4 mm long in *A. cyanocitta*), in having shorter spicules (left spicule 190–209 vs. 315–370; right spicule 103–129 vs. 220–230), in the arrangement of postanal papillae (2 groups vs. 3 groups), and in having smaller eggs (31–37 long by 18–22 wide vs. 42 long by 24 wide).

DISCUSSION

Acuaria mayori was collected only from dry forest sites (Cafetal, Quebrada Costa Rica), whereas *A. wangi* occurred in a wet forest site (Estación San Gerardo). These are sites with abundant running water and associated riparian vegetation. *Acuaria mayori* was collected at the beginning of the wet season (5 and 7 June 2001), whereas *A. wangi* was collected at the beginning of the wet season (13–14 June 2001 in *H. naevioides* and *G. leucaspis*) and at the beginning of the dry season (13 January 2002 in *H. naevioides*).

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