

# New species of *Bakeria* (Nematoda; Strongylida; Molineidae), new species of *Falcaustra* (Nematoda; Ascaridida; Kathlaniidae) and other helminths in *Cnemaspis mcguirei* (Sauria; Gekkonidae) from Peninsular Malaysia

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## Abstract

Two new nematode species, *Bakeria schadi* sp. nov. and *Falcaustra malaysiia* sp. nov. from the gastrointestinal tract of McGuire's rock gecko, *Cnemaspis mcguirei* (Sauria: Gekkonidae) collected in Peninsular Malaysia are described. The two species now assigned to *Bakeria* are separated on the bases of male bursa type and location of the excretory pore: type II in *B. schadi* sp. nov. and type I in *B. bakeri*; location of excretory pore, anterior to nerve ring in *B. schadi* sp. nov. and posterior to nerve ring in *B. bakeri*. *Falcaustra malaysiia* sp. nov. is most similar to *F. chabaudi*, *F. concinnae*, *F. condorcanquii*, *F. barbi*, *F. dubia*, and *F. tchadi* in that these 7 species possess 1 pseudosucker, 1 median papilla plus 10 pairs caudal papillae, and spicules with lengths between 1 and 2 mm. *F. barbi* and *F. tchadi* lack adcloacal papillae; the remaining 5 species possess 1 pair of adcloacal papillae. *Falcaustra chabaudi* is known from Nearctic salamanders; *F. concinnae* from Nearctic turtles; *F. condorcanquii* from Neotropical frogs, *F. dubia* from Oriental frogs, and *F. malaysiia* sp. nov. from Oriental geckos. Two additional species of Nematoda were found, *Cosmocerca ornata* and *Meteterakis singaporensis*. *Cnemaspis mcguirei* represents a new host record for *Cosmocerca ornata* and *Meteterakis singaporensis*.

## Keywords

Nematoda, Molineidae, *Bakeria schadi* sp. nov., Kathlaniidae, *Falcaustra malaysiia* sp. nov., Sauria, Gekkonidae, *Cnemaspis mcguirei*, Peninsular Malaysia, *Cosmocerca ornata*, *Meteterakis singaporensis*

## Introduction

McGuire's rock gecko, *Cnemaspis mcguirei* Grismer, Grismer, Wood and Chan, 2008, ranges from Gunung Besar in southern Thailand south through the hilly terrain associated with the Banjaran Bintang to northwest Peninsular Malaysia (Grismer *et al.*, 2008, 2010). To our knowledge, there are no helminthological reports for this species. The purpose of this paper is to describe 2 new species of Nematoda harbored by *C. mcguirei* and to provide an initial helminth list for this host.

## Materials and Methods

Twelve specimens of *Cnemaspis mcguirei* were borrowed from La Sierra University Herpetology Collection (LSUHC 8855, 8858, 9029–9033, 9140, 9209, 9848, 11013; mean snout-vent length,  $50.3 \pm 9.0$  mm, range 30–62) and examined for helminths. The body cavity of each lizard was opened by a longitudinal ventral incision and the gastrointestinal tract was removed by cutting across the esophagus and rectum. The stomach, small intestine, and large intestine were examined separately for helminths. Nematodes were placed in lacto-phe-

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nol, allowed to clear, and examined using a light microscope. Drawings were made with the aid of a microprojector. Measurements are in  $\mu\text{m}$  with mean  $\pm$  1 SD and range in parenthesis, unless otherwise stated. Selected helminths were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland.

## Results

Four species of Nematoda, *Cosmocerca ornata* (Dujardin, 1845), *Meteterakis singaporensis* (Sandosham, 1954), an undescribed species of *Bakeria* (Moravec and Sey, 1986, subg.), and an undescribed species of *Falcaustra* Lane, 1915 were found. Site of infection, number of helminths, prevalence, mean intensity and range are given in Table I. Selected helminths were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland (Table I). Description of the 2 new species follows.

### *Bakeria schadi* sp. nov. (Figs 1–13)

Description: Molineidae (Skrjabin and Schulz, 1937) Durette-Desset and Chabaud, 1977; *Bakeria* (Moravec and Sey, 1986, subg.) Ben Slimane, Chabaud and Durette-Desset, 1996. Small, slender cylindrical nematodes, sexually dimorphic, males approximately two-thirds length of female. Cephalic region with transversely striated cuticular inflation. Mouth with 3 simple inconspicuous lips, dorsal lip with 2 sessile papillae, each ventrolateral lip with 1 ventral sessile papilla, 1 lateral amphid. Anterior end of esophagus with distinct short muscular pharynx. Synlophe (studied in transverse section, 1 female, 1 male): cuticle with parallel, longitudinal, cuticular crests separated by 8–10 longitudinal lines (mini-crests); occasional line broken and replaced by another line. Excretory pore surrounded by raised circular cuticular disk, positioned anterior to nerve ring. Cervical alae present beginning midway between posterior end of cephalic inflation, extending posteriorly approximately 350 in males (greatest width 18) and approximately 500 in females (greatest width 24) and continuing to end of body as prominent lateral crest.

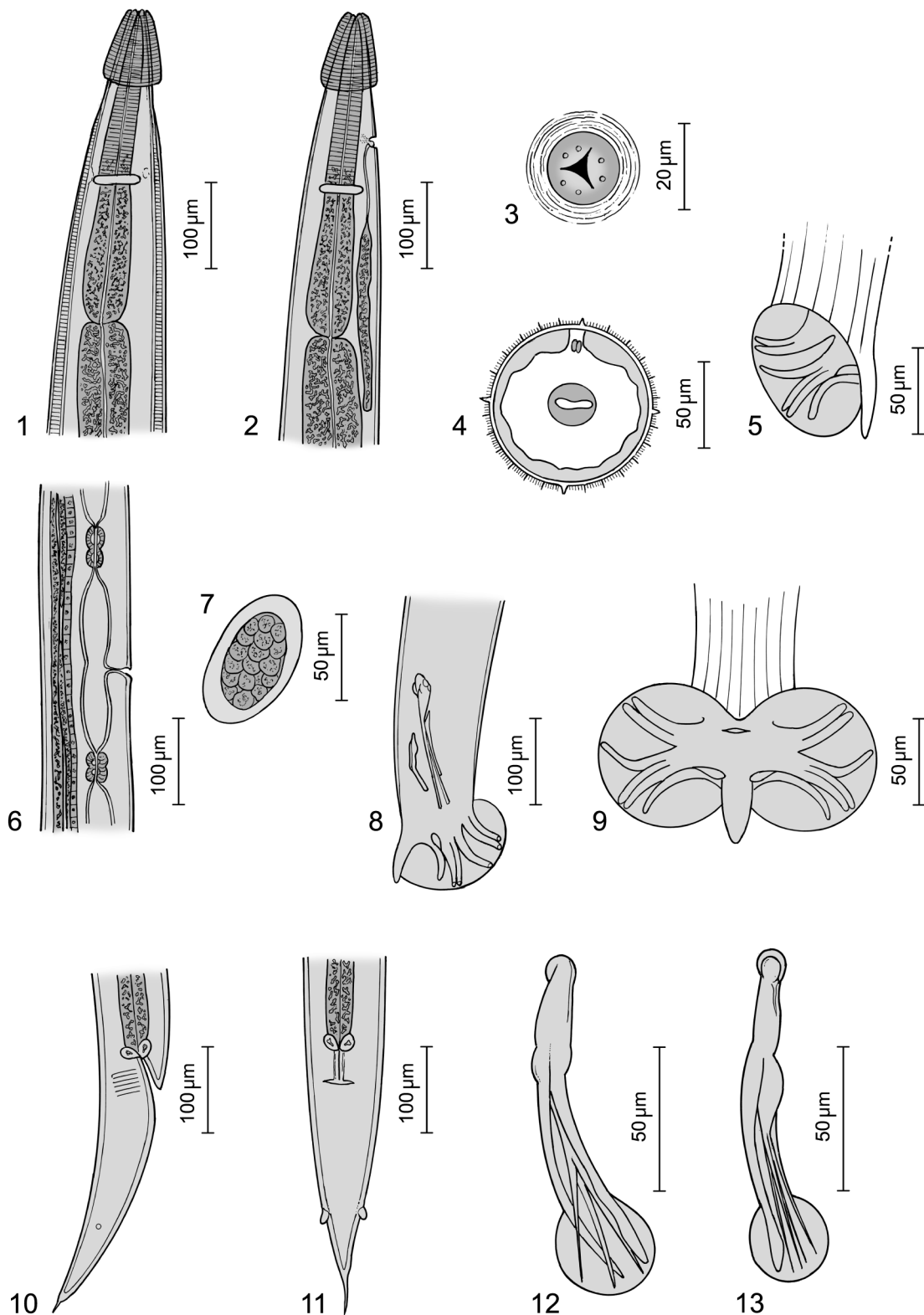
Male (holotype and 9 paratypes): Length  $5.70 \pm 0.57$  mm ( $4.86$ – $6.53$  mm); width at level of spicules  $73 \pm 7$  ( $64$ – $85$ ). Anterior end with simple cuticular inflation,  $93 \pm 4$  ( $85$ – $98$ )

in length, with slight transverse striations, rising approximately 15 above body wall. Cuticle with approximately 20 conspicuous uninterrupted longitudinal crests at level of esophageointestinal junction. Crests without reinforcement, evenly spaced, beginning just behind cephalic inflation and terminating slightly anterior to bursa; longitudinal lines between crests visible throughout length of body. Cervical alae with distinct transverse striations. Claviform esophagus  $333 \pm 11$  ( $311$ – $348$ ),  $34 \pm 5$  ( $27$ – $40$ ) in greatest width. Excretory pore  $136 \pm 4$  ( $131$ – $143$ ) and nerve ring  $180 \pm 13$  ( $165$ – $207$ ) from anterior end, respectively. Bursa bilobed,  $73 \pm 5$  ( $67$ – $79$ ) in length, type II (see Ben Slimane *et al.*, 1996), ribs 6 and 8 with independent origin, rib 8 in contact with rib 6 along its midsection, distal end free, not reaching edge of bursal membrane. Ribs 2 and 3 attached throughout, reaching edge of bursal membrane; ribs 4–6 with common origin, 4 separating from ribs 5 and 6, turning cephalad, reaching edge of bursal membrane; ribs 5 and 6 remaining together turning caudad and reaching edge of bursal membrane. Dorsal ray undivided, conical,  $47 \pm 4$  ( $43$ – $55$ ) in length, arising in common base with ribs 4–6. Origin of rib 8 on and perpendicular to dorsal ray. Spicules equal, well sclerotized,  $125 \pm 6$  ( $116$ – $134$ ) in length; distal ends forming 5 processes, 4 sharply pointed, 1 blunt, surrounded by cuticular membrane visible on evaginated spicules (Type Oriento-Ethiopian of Ben Slimane *et al.*, 1996). Gubernaculum present,  $64 \pm 4$  ( $58$ – $73$ ) in length, approximately 5 in width in lateral view; dorsal aspect of gubernaculum with membranous ala and more heavily sclerotized than ventral portion. Sclerotized parts of spicules and gubernaculum orange-brown in color. Single tubular testis reflexed just posterior to esophagus and eventually terminating at end of first body quarter.

Female (allotype and 9 paratypes; all gravid): Length  $8.65 \pm 0.73$  mm ( $7.04$ – $9.60$ ), width at vulva  $121 \pm 7$  ( $110$ – $129$ ). Simple cephalic cuticular inflation  $106 \pm 8$  ( $92$ – $116$ ) in length, rising approximately 18 above body wall. Cuticular crests evenly spaced, approximately 30 in number at level of esophageointestinal junction, arising just posterior to cephalic inflation and terminating on tail; longitudinal lines also arise in cervical region and continue to tail. Cervical alae with distinct transverse striations. Lateral crest arising at posterior end of cervical alae remaining prominent to end of body. Claviform esophagus  $355 \pm 11$  ( $336$ – $372$ ) in length,  $41 \pm 5$  ( $36$ – $49$ ) in greatest width. Excretory pore  $138 \pm 6$  ( $128$ – $146$ ) and nerve

**Table I.** Site of infection, number of helminths, prevalence, mean intensity and range of infection for 4 endoparasitic species in *Cnemaspis mcguirei* from Peninsular Malaysia

Helminth	Site of Infection	Number	Prevalence	Mean	Range	USNPC
<i>Bakeria schadi</i> sp. nov.	Small intestine	38	12/12 (100%)	$3.2 \pm 3.3$	1–13	108113
<i>Cosmocerca ornata</i> (Dujardin, 1845)	Large intestine	5	3/12 (25%)	$1.7 \pm 0.6$	1–2	108114
<i>Falcaustra malaysiiaia</i> sp. nov.	Small intestine	3	3/12 (25%)	$1.0 \pm 0$	–	108052
<i>Meteterakis singaporensis</i> (Sandosham, 1954)	Large intestine	24	3/12 (25%)	$8.0 \pm 6.1$	1–12	108115



**Figs 1–13.** *Bakeri schadi* sp. nov. 1. Female anterior end, dorsal view. 2. Female anterior end, lateral view. 3. Female, en face view. 4. Synlophe in transverse section, posterior to oesophageal-intestinal junction. 5. Male, posterior end, lateral view. 6. Female, vulvar region, lateral view. 7. Egg. 8. Male posterior end with gubernaculum and spicules. 9. Male, posterior end, ventral view. 10. Female, posterior end, lateral view. 11. Female, posterior end, ventral view. 12. Spicule, lateral view. 13. Spicule, ventral view

ring  $174 \pm 7$  (159–183) from anterior end, respectively. Conical tail  $224 \pm 10$  (207–238) in length, terminus a flexible cuticular filament  $26 \pm 4$  (21–33) long. Pendulant phasmids, dorsolateral in placement,  $82 \pm 5$  (73–92) from posterior end of tail. Vulva transverse slit, lips slightly salient, anterior lip with short, rounded beaklike protrusion, postequatorial,  $2.87 \pm 0.27$  (2.56–3.52) from posterior end. Vagina vera short, approximately 60 in length, enters vestibule,  $270 \pm 31$  (244–336) in length at its midpoint. Sphincter,  $83 \pm 9$  (73–98) long, at junction of vestibule and uterus. Uterus amphidelphic, ovaries extending toward respective ends then turning back on themselves, anterior ovary ending in first quarter of body, posterior ovary after reflexation passing anteriorly past vestibule to end in second quarter of body. Eggs  $72 \pm 4$  (67–76) long,  $48 \pm 2$  (43–49) wide; oval in outline, thin-shelled, embryonated.

Type host: *Cnemaspis mcguirei* Grismer, Grismer, Wood and Chan, 2008, McGuire's rock gecko, Gekkonidae. Symbiotype: LSUHC 9031; collection date 16 June 2008.

Type locality: Bukit Larut, Perak State, West Malaysia ( $4^{\circ}47'0''\text{N}$ ,  $100^{\circ}45'0''\text{E}$ ; elev. 1250 m).

Site of infection: Small intestine.

Type specimens: Holotype male, USNPC 108012; allotype female, USNPC 108013; paratypes 9 males, 9 females, USNPC 108014.

Etymology: The new species is named in honor of Dr. G. A. Schad, in recognition of his helminthological work in Indonesia.

#### Remarks

Moravec and Sey (1986) in a study of microhylid frogs from Papua New Guinea discovered a nematode that except for the presence of a gubernaculum, all other morphological characters were typical of the genus *Oswaldocruzia* and they assigned their specimens to *Oswaldocruzia*. However, because Moravec and Sey (1986) considered the presence of a gubernaculum to reflect a certain phylogenetic distance from the typical specimens assigned to *Oswaldocruzia*, they created a subgenus, *Bakeria*, to accommodate their specimens. Ben Slimane *et al.* (1996) in their review of trichostrongylid parasites of amphibians and reptiles reassigned some species originally assigned to *Oswaldocruzia* and in doing so emended the subgenus *Bakeria* to genus *Bakeria* reasoning that the presence of a gubernaculum and a distinct spicule morphology justified the creation of a new genus.

*Bakeria* and *Oswaldocruzia* are separated on the basis of presence or absence of a gubernaculum; present in *Bakeria* and absent in *Oswaldocruzia*. Otherwise, species of these two genera are quite similar and the morphology of the caudal bursa is described using the same terminology. The two species assigned to *Bakeria* are separated on the bases of male bursa type and location of the excretory pore: type II in *B. schadi* n. sp. and type I in *B. bakeri*; location of excretory pore, anterior to nerve ring in *B. schadi* n. sp. and posterior to nerve ring in *B. bakeri*.

#### *Falcaustra malaysiaia* sp. nov. (Figs. 14–24)

Description: Cosmocercidae (Railliet, 1916, subfam.) Travassos, 1925; *Falcaustra* Lane, 1915. Medium-sized nematodes, body cylindrical, tapering posteriorly, truncate anteriorly. Cuticle with fine, regular transverse striations. Mouth opening triangular, surrounded by 3 large lips, each with 2 forked papillae. One amphid on each ventrolateral lip. Additional cephalic papillae absent. Esophagus with inflated isthmus and posterior spherical bulb. Tail conical in both sexes.

Male (holotype and paratype in parentheses): Length 8.9 mm (8.3 mm); width 383 (281) at level of esophageal-intestinal junction. Cuticle with fine transverse striations of approximately 3 wide. Vestibule length 34 (37), pharynx length 110 (116), corpus length 1,352 (1,390), corpus width 64 (58), isthmus length 159 (171), isthmus width 67 (67), bulb length 159 (183), bulb width 146 (140). Nerve ring 332 (330) and excretory pore 1,428 (1,377) from anterior end, respectively. Spicules similar, equal, 1,367 (1,310) in length, distal ends pointed, narrow lateral alae from near distal end to proximal end. Spicules not heavily sclerotized, 3 wave-like bends of shaft. Gubernaculum 73 (73) in length. Tail 306 (287) in length. Single median papilla immediately anterior to cloaca. Ten pairs of caudal papillae: 3 pairs precloacal; 1 pair adcloacal; 6 pairs post cloacal, 4 pairs ventrolateral in position, 2 lateral pairs. Phasmids open midway between lateral papillae. Single precloacal pseudosucker present, center of pseudosucker 1,600 (1,475) from posterior end. Precloacal area with 28 (27) oblique muscle bands in a single field beginning near the posterior edge of pseudosucker and extending to level of median papillae; 18 (18) radially arranged muscle bands supporting pseudosucker.

Female (based on allotype): Length 10.9 mm; width 332 at level of esophageal-intestinal junction. Cuticle with fine transverse striations of approximately 3 wide. Vestibule length 31, pharynx length 110, corpus length 1,683, corpus width 67, isthmus length 183, isthmus width 79, bulb length 159, bulb width 156. Nerve ring 357 and excretory pore 1,658 from anterior end, respectively. Tail 281 in length. Vulva a transverse, non-salient slit, 4.34 mm from posterior end; ovijector with weakly developed muscular walls approximately 300 in length, directed anterodorsally and giving rise to 2 opposing uteri. Uteri lying within second and third quarters of body; anterior ovary occupying second quarter of body, folding back upon itself twice; posterior ovary occupying third quarter, folding back upon itself once. Eggs oval, 58 x 46, thin shelled unembryonated.

Type host: *Cnemaspis mcguirei* Grismer, Grismer, Wood and Chan, 2008, McGuire's rock gecko, Gekkonidae, Symbiotype: LSUHC 9029; collection date 16 June 2008.

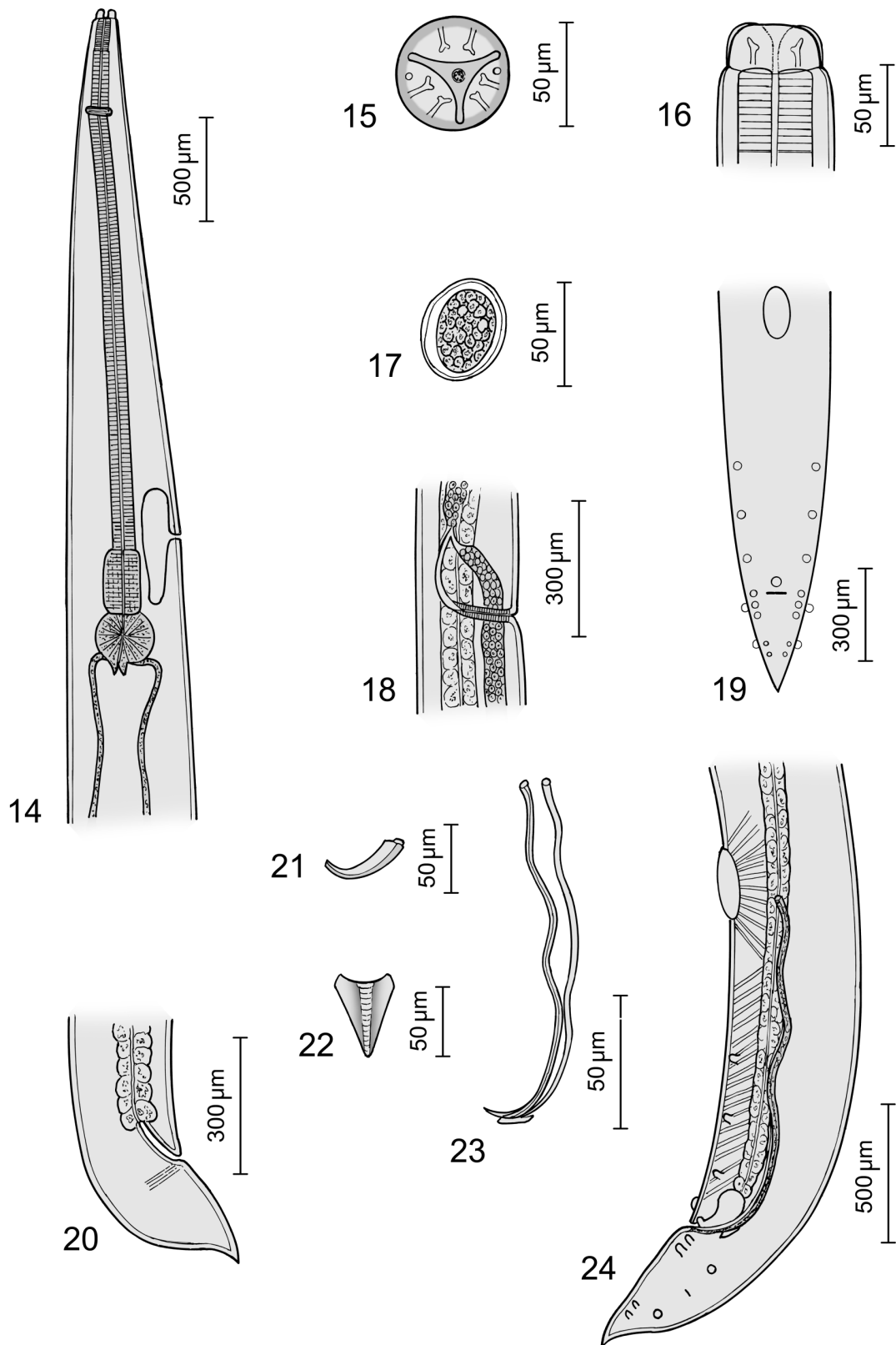
Type locality: Bukit Larut, Perak State, West Malaysia ( $4^{\circ}47'0''\text{N}$ ,  $100^{\circ}45'0''\text{E}$ ; elev. 1250 m).

Site of infection: Small intestine.

Type specimens: Holotype male, USNPC 108050; allotype female, USNPC 108051; paratype male, USNPC 108052.

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**Figs 14–24.** *Falcaustra malaysiaia* sp. nov. **14.** Female, anterior end, lateral view. **15.** Female, en face view. **16.** Female, anterior end, dorsal view. **17.** Egg. **18.** Female, vulvar region, lateral view. **19.** Male, posterior end, diagrammatic, ventral view. **20.** Female, posterior end, ventral view. **21.** Gubernaculum, lateral view. **22.** Gubernaculum, ventral view. **23.** Spicules, gubernaculum, lateral view. **24.** Male, posterior end, lateral view.

**Table II.** Selected characteristics of male individuals of species of *Falcaustra* spp.

Realm		Type host Pseudosucker (mm)	Body length (mm)	Spicule length	Papillae pattern*	
<b><i>Falcaustra</i> spp.</b>						
<b>Australian</b>						
	<i>F. batrachiensis</i> Bursey, Goldberg and Kraus, 2008	frog	16.0–26.0	1.37–1.61	8 – 2 – 6 + 1	five–six
	<i>F. fordoniae</i> (Jones, 1978) Baker, 1987 = <i>Spiromoura fordoniae</i> Jones, 1978	snake	9.1–10.9	0.68–0.77	6 – 6 – 8 + 1	absent
	<i>F. elseyae</i> (Johnston and Mawson, 1941) Chabaud and Golvan, 1957 = <i>Spiromoura elseyae</i> Johnston and Mawson, 1941	turtle	18.2–20.8	1.65	none observed	absent
	<i>F. papuensis</i> Bursey, Goldberg and Kraus, 2007	lizard	5.3–7.6	0.56–0.71	6 – 6 – 8 + 1	one
	<i>F. simpsoni</i> (Johnston and Mawson, 1944) Chabaud and Golvan, 1957 = <i>Spiromoura hylae</i> Johnston and Simpson, 1942, preoccupied = <i>Spiromoura simpsoni</i> Johnston and Mawson, 1944	frog	13.0–13.5	2.00	8 – 0 – 12 + 1	one
	<i>F. tannaensis</i> Bursey, Goldberg, Hamilton and Austin, 2010	lizard	11.0–14.5	2.43–2.68	8 – 2 – 10 + 1	one
<b>Ethiopian</b>						
	<i>F. golvani</i> Chabaud and Brygoo, 1957	frog	8.5–11.5	1.20–1.30	8 – 2 – 10 + 1	absent
	<i>F. guiersi</i> Vassiliades, 1973	fish	10.0	1.54	12 – 6 – 8 + 1	one
	<i>F. hexapapillata</i> (Khalil, 1962) Vassiliades and Troncy, 1973 = <i>Spiromoura hexapapillata</i> Khalil, 1962	fish	6.2–6.7	1.18–1.27	12 – 6 – 8 + 1	one
	<i>F. hinkeli</i> Jackson, 2000	frog	4.6–10.1	0.39–0.52	10 – 0 – 12 + 1	absent
	<i>F. pelusios</i> Baker, 1983	turtle	12.2–13.8	0.63–0.75	12 – 0 – 8 + 1	one
	<i>F. petrei</i> (Khalil, 1970) Vassiliades, 1973 = <i>Spiromoura petrei</i> Khalil, 1970	fish	7.8–9.5	0.73–0.79	6 – 0 – 14 + 1	one
	<i>F. piscicola</i> (Linstow, 1907) Inglis, 1959 = <i>Spiromoura congolense</i> Taylor, 1925 = <i>Nematoxys piscicola</i> Linstow, 1907	fish	13.0–17.0	0.51–0.60	6 – 0 – 16 + 1	absent
	<i>F. puylaerti</i> Jackson, 2000	frog	4.3–7.8	0.12–0.16	10 – 0 – 12 + 1	absent
	<i>F. similis</i> Moravec and Van As, 2004	fish	7.0–12.6	0.42–0.54	6 – 2 – 14 + 1	one
	<i>F. straeleni</i> Campana–Rouget, 1961	fish	8.5–11.8	0.60	6 – 0 – 14 + 1	one
	<i>F. sudanensis</i> (Khalil, 1962) Vassiliades and Troncy, 1973 = <i>Spiromoura sudanensis</i> Khalil, 1962	fish	5.0–7.1	0.75–0.90	6 – 0 – 12 + 1	one
	<i>F. tchadi</i> Vassiliades and Troncy, 1973	fish	11.5	1.05	6 – 0 – 14 + 1	one
	<i>F. therezieni</i> Petter, 1979	fish	7.2–11.6	0.40–0.60	6 – 2 – 14 + 1	absent
	<i>F. tricirratu</i> s (Linstow, 1901) Baker 1987 = <i>Oxysoma tricirratum</i> Linstow, 1901	turtle	17.0	0.95	0 – 0 – 12 + 1	absent
	<i>F. verbekei</i> Campana–Rouget, 1961	fish	10.5–11.5	0.35–0.42	6 – 0 – 14 + 1	absent
<b>Nearctic</b>						
	<i>F. affinis</i> (Leidy, 1856) Harwood, 1932 = <i>Spiromoura affine</i> Leidy, 1856 = <i>Falcaustra chapini</i> Boulenger, 1923	turtle	8.6–10.3	0.80	6 – 2 – 12 + 1	absent

= <i>Spiromoura spiculata</i> Reiber, Byrd and Parker, 1940					
= <i>Spiromoura hylae</i> Reiber, Byrd and Parker, 1940					
<i>F. catesbeianae</i> Walton, 1929	frog	3.5–4.0	0.30–0.33	6 – 0 – 14 + 2	one
<i>F. chabaudi</i> Dyer, 1973	salamander	13.7–14.1	1.21–1.34	6 – 2 – 12 + 1	one
<i>F. chelydrae</i> Harwood, 1932	turtle	10.0–12.5	3.4–3.9	6 – 0 – 14	one
<i>F. concinnae</i> Mackin, 1936	Turtle	8.7–13.4	1.07–1.15	6 – 2 – 12 + 1	one
<i>F. inglisi</i> (Anderson, 1964), Baker, 1980	frog	14.2–15.3	1.20–1.31	8 – 2 – 8	absent
= <i>Oxysomatium inglisi</i> Anderson, 1964					
<i>F. longispicula</i> Walton, 1927	turtle	7.2–8.0	1.20–1.21	6 – 4 – 12 + 1	absent
<i>F. lowei</i> Bursey and Goldberg, 2001	frog	8.5–10.5	0.51–0.56	6 – 6 – 8 + 1	one
<i>F. mexicana</i> Chabaud and Golvan, 1957	salamander	11.5–13.4	0.49–0.51	4 – 6 – 8 + 1	one
= <i>Spiroura cryptobranchi</i> Walton, 1930 sensu Bravo Hollis and Caballero, 1940					
= <i>Falcaustra mascula</i> (Rudolphi, 1819) sensu Dyer and Brandon, 1973					
<i>F. plethodontis</i> Baker, Goater and Esch, 1987	salamander	3.9–4.3	0.11–0.13	10 – 0 – 10 + 1	absent
<i>F. pretiosa</i> (Ingles, 1935) Freitas and Lent, 1941	frog	12.5–19	0.81–0.87	12 – 0 – 12 + 1	absent
= <i>Spiromoura pretiosa</i> Ingles, 1935					
<i>F. procera</i> (Canavan, 1929) Harwood, 1932	turtle	8.7–13.7	0.97	6 – 0 – 14 + 1	absent
= <i>Spiromoura procera</i> Canavan, 1929					
<i>F. ranae</i> (Walton, 1941) Chabaud and Golvan, 1957	frog	10.8	0.53	6 – 4 – 10 + 1	two
= <i>Spiromoura ranae</i> Walton, 1941					
<i>F. rankini</i> (Walton, 1941) Chabaud and Golvan, 1957	frog	20.3	1.65	6 – 8 – 6 + 1	absent
= <i>Spiromoura rankini</i> Walton, 1941					
<i>F. wardi</i> (Mackin, 1936) Freitas and Lent, 1941	turtle	6.8–8.4	0.33–0.37	6 – 6 – 10 + 1	one
= <i>Spiromoura wardi</i> Mackin, 1936					
<i>F. washingtonensis</i> Bursey and Aker, 2001	salamander	13.5–19.0	0.54–0.59	6 – 2 – 12 + 1	absent
<b>Neotropical</b>					
<i>F. belemensis</i> Baker and Bain, 1981	lizard	6.8	0.31	6 – 0 – 14 + 1	absent
<i>F. caballeroi</i> Chabaud and Golvan, 1957	frog	10.5	1.06	8 – 0 – 6	absent
= <i>Dibulbiger longispiculis</i> Caballero, 1935					
<i>F. condorcanquii</i> Ibanez and Cordova, 1976	frog	6.9–9.9	0.77–1.13	6 – 2 – 12 + 1	one
<i>F. costaricae</i> Bursey, Goldberg and Miller, 2004	lizard	5.7–7.9	0.51–0.56	10 – 0 – 12 + 1	absent
<i>F. guanacastensis</i> Bursey and Brooks, 2011	turtle	10.4–12.5	2.43–2.62	6 – 6 – 8 + 1	absent
<i>F. guatamalana</i> (Caballero, 1953) Chabaud and Golvan, 1957	frog	9.5–10.9	0.77–0.80	10 – 0 – 8	absent
= <i>Spiromoura guatamalana</i> Caballero, 1953					
<i>F. intermedia</i> (Caballero, 1939) Freitas and Lent, 1941	turtle	10.0	1.07	6 – 6 – 6 + 1	one
= <i>Spiromoura intermedia</i> Caballero, 1939					
<i>F. mirandafroesi</i> (Fortes, 1981) Fortes and Hoffman, 1995	fish	8.0–11.0	0.68–0.75	not stated	absent
= <i>Spiromoura mirandafroesi</i> Fortes, 1981					
<i>F. mascula</i> (Rudolphi, 1819) Freitas and Lent, 1941	snake	8.3–9.3	0.43–0.47	6 – 2 – 12	one
= <i>Ascaris mascula</i> Rudolphi, 1819					
= <i>Ascaris leptodactyla</i> Parodi in Savazzini, 1930					
= <i>Florencoia mascula</i> (Rudolphi, 1819) Travassos, 1919					
= <i>Florencoia nitida</i> Travassos, 1920					
<i>F. pumacahuai</i> Ibanez and Cordova, 1976	fish	7.9–8.3	0.29–0.36	6 – 2 – 12 + 1	one
<i>F. sanjuanensis</i> Gonzalez, Sanabria and Quiroga, 2013	frog	11.2–13.5	0.45–0.68	6 – 4 – 12 + 1	one

<i>F. tiahuanaguensis</i> Ibanez and Cordova, 1976	fish	5.9–7.5	0.28–0.37	6–4–4	one
<i>F. tikasinghi</i> (Schoenecker, Schmidt and Everard, 1977) Baker and Bain, 1981	turtle	13.0–14.0	0.53–0.57	10–0–12+1	absent
Baker and Bain, 1981 <i>Spironoura tikasinghi</i> Schoenecker, Schmidt and Everard, 1977					
<b>Oriental</b>					
<i>F. andrias</i> (He, Liu and Ma, 1992) Liu, Zhang and Zhang, 2011	salamander	5.5–7.8	0.48–0.57	6–4–12+1	one
= <i>Spironoura tikasinghi</i> Schoenecker, Schmidt and Everard, 1977	x				
<i>F. annandalei</i> (Baylis and Daubney, 1922) Chabaud and Golvan, 1957	turtle	15.5–15.9	2.20–2.30	12–0–8+1	one
= <i>Zanclaphorus annandalei</i> Baylis and Daubney, 1922					
<i>F. barbi</i> Baylis and Daubney, 1922	fish	15.2–16.5	1.13	6–0–14+1	one
= <i>Spironoura kalasiensis</i> Karve and Naik, 1951					
= <i>Spironoura sudanensis</i> Khalil, 1962					
<i>F. bengalensis</i> Manna and Mahapatra, 1989	turtle	12.7–13.5	0.45–0.51	8–0–38	absent
<i>F. brevicaudatum</i> (Khan and Yaseen, 1969) Soota, 1983	fish	10.2–11.5	1.77	10–2–8	one
= <i>Kathlania brevicaudatum</i> Khan and Yassen, 1969					
<i>F. chauhani</i> (Soota, 1975) Petter, 1979	fish	7.7–10.8	0.41–0.44	6–6–8+1	absent
= <i>Spironoura chauhani</i> Soota, 1975					
<i>F. chengguensis</i> (He, Liu and Ma, 1992) Liu, Zhang and Zhang, 2011	salamander	7.4–10.7	0.57–0.73	6–6–8/10+1	one
= <i>Spironoura chengguensis</i> He, Liu and Ma, 1992					
<i>Falcaustra chiloscyllii</i> (Thwaite, 1927) Soota, 1983	fish	8.3–10.0	2.0–2.6	12–0–10	one
= <i>Kathlania chiloscyllii</i> Thwaite, 1927					
<i>F. desilvai</i> Bursey, Goldberg and Bauer, 2009	lizard	6.3–8.0	0.96–1.05	12–2–10+1	absent
<i>F. dubia</i> Yuen, 1963	frog	13.5–14.0	1.54–1.69	6–2–12+1	one
<i>F. duyagi</i> (Tubanqui and Villaamil, 1933) Freitas and Lent, 1941	turtle	11.5–13.0	0.75–0.90	10–0–10+1	two–three
= <i>Spironoura duyagi</i> Tubanguai and Villaamil, 1933					
<i>F. falcata</i> (Linstow, 1906) Lane, 1915	turtle	13.0–14.0	0.35–0.45	4–2–14+1	absent
= <i>Oxysoma falcata</i> Linstow, 1906					
= <i>Oxysoma kachugae</i> Steward, 1914					
= <i>Spironoura brevispiculata</i> Baylis, 1935					
<i>F. fernandoi</i> (Sathananthan, 1972) Baker, 1987	turtle	7.0	1.70–1.80	6–6–8+1	absent
= <i>Spironoura fernandoi</i> Sathananthan, 1972					
<i>F. fopingensis</i> (He, Liu and Ma, 1992) Liu, Zhang and Zhang, 2011	salamander	7.0–9.4	1.44–1.85	10–0–14+1	one
= <i>Spironoura fopingensis</i> He, Liu and Ma, 1992					
<i>F. greineri</i> Bursey and Kinsella, 2003	turtle	14.0–17.5	1.07–1.33	6–0–14+1	absent
<i>F. heosemydis</i> Bursey, Goldberg and Miller, 2004	turtle	13.2–14.7	0.79–0.89	10–0–12+1	absent
<i>F. kalasiensis</i> (Karve and Naik, 1951) Vassiliades and Troncy, 1973	fish	11.4–11.7	0.45–0.55	6–0–14+1	one
= <i>Spironoura kalasiensis</i> Karve and Naik, 1951					
<i>F. kaverii</i> (Karve and Naik, 1951) Vassiliades and Troncy, 1973	fish	13.7–15.5	2.00–2.23	6–2–14+ 1	
= <i>Spironoura kaverii</i> Karve and Naik, 1951					



= <i>Spironoura chenguensis</i> He, Liu and Ma, 1992					
<i>F. donanaensis</i> Hidalgo-Vilal, Ribas, Florencio, Perez-Santigosa and Casanova, 2006	turtle	7.9–14.7	1.24–1.44	6 – 2 – 12	absent
<i>F. fopingensis</i> (He, Liu and Ma, 1992) Liu, Zhang and Zhang, 2011	salamander	7.0–9.4	1.44–1.85	10 – 0 – 14 + 1	one
= <i>Spironoura fopingensis</i> He, Liu and Ma, 1992					
<i>F. geoclemydis</i> (Wang, Zhao, Wang and Zhang, 1979) Baker, 1987	turtle	9.28–9.48	0.29–0.30	6 – 2 – 10	absent
= <i>Spironoura geoclemydis</i> Wang, Zhao, Wang and Zhang, 1979					
<i>F. japonensis</i> (Yamaguti, 1935) Freitas and Lent, 1941	turtle	7.5–10.0	1.20–1.30	6 – 6 – 10 + 1	one–two
= <i>Spironoura japonensis</i> Yamaguti, 1935					
<i>F. lambdiensis</i> Seurat, 1918	turtle	11.4	1.32	10 – 2 – 10 + 1	absent
<i>F. odaiensis</i> Hasegawa and Nishikawa, 2009	salamander	7.5–12.5	0.54–0.74	6 – 6 – 8 + 1	three to five
<i>F. pectinospiculata</i> (Koo, 1939) Chabaud and Golvan, 1957	toad	13.1–17.5	1.80–2.85	6 – 4 – 10 + 1	absent
= <i>Spironoura pectinospiculata</i> Koo, 1939					
<i>F. putianensis</i> (Wang, 1981) Baker, 1987	frog	5.6–6.4	0.56–0.64	6 – 0 – 14	one
= <i>Spironoura putianensis</i> Wang, 1981					
<i>F. sinensis</i> Liu, Zhang and Zhang, 2011	turtle		19.2–21.4	3.84–4.74	12 – 0 – 8 + 1
<i>F. stellionis</i> (Chatin, 1875) Chabaud and Golvan, 1957	lizard	male unknown, species inquirende			
= <i>Spirura stellionis</i> Chatin, 1875					
<i>F. wuyiensis</i> (Wang, 1981) Baker, 1987	frog	15.3–18.8	0.38–0.56	6 – 6 – 8 + 1	absent
= <i>Spironoura wuyiensis</i> Wang, 1981					
*precloacal – adcloacal – postcloacal + median					

Etymology: The new species is named for the locality of collection.

#### Remarks

The structure of the oesophagus of *F. malaysiia* sp. nov. allows its assignment to the family Kathlaniidae Lane, 1914, subfamily Kathlaniinae Lane, 1914. Lane (1915) described the posterior portion of the oesophagus to be hourglass shaped; Chitwood and Chitwood (1974) consider the isthmus in kathlaniid nematodes to be “subspheroid”. The subspheroid nature of the isthmus is evident in *F. malaysiia* sp. nov. (Fig. 14).

Species of *Falcaustra* are distinguished on the basis of characteristics of the male: most often the number and arrangement of caudal papillae, length of spicules, and presence or absence of a pseudosucker (Burse and Brooks, 2011). Species of *Falcaustra* are listed in Table 2. *Falcaustra malaysiia* sp. nov. is most similar to *F. barbi*, *F. chabaudi*, *F. concinnae*, *F. condorcanquii*, *F. dubia*, and *F. tchadi* in that these 7 species possess 1 pseudosucker, 1 median papilla plus 10 pairs caudal papillae, and spicules with lengths between 1 and 2 mm (Table II). *F. barbi* and *F. tchadi* lack adcloacal papillae; the remaining 5 species possess 1 pair of adcloacal papillae. Of these 5 species, the oesophageal isthmus of *F. chabaudi* is unique in that it has two regions, an anterior widened subspheroid region and a pos-

terior narrowed cylindrical region, thus the subspheroid region is separated from the oesophageal bulb. In *F. concinnae*, *F. condorcanquii*, *F. dubia* and *F. malaysiia* sp. nov. the subspheroid region is separated from the oesophageal bulb by a crease. In these 4 species, the post cloacal papillae consist of 4 ventral pairs, 2 pairs near the cloaca and 2 pairs near the tail tip, and 2 lateral pairs. In *F. condorcanquii* and *F. dubia* the lateral pairs occur at a level posterior to the second ventral pair and anterior to the third ventral pair; while in *F. concinnae* and *F. malaysiia* sp. nov. the lateral pairs occur at a level anterior to the second ventral pair and even with the third ventral pair. The spicules of *F. concinnae* are alate, straight and heavily sclerotized, the spicules of *F. malaysiia* are analate, wavy and not heavily sclerotized. Additionally, *F. barbi* is known from Oriental fish; *F. chabaudi* from Nearctic salamanders; *F. concinnae* from Nearctic turtles; *F. condorcanquii* from Neotropical frogs; *F. dubia* from Oriental frogs; *F. tchadi* from Ethiopian fish; and, *F. malaysiia* sp. nov. from Oriental geckos.

#### Discussion

To our knowledge, there is no previous report on helminths from *C. mcguirei*; thus, the parasite list currently is *Bakeri schadi*, *Cosmocerca ornata*, *Falcaustra malaysiia* and *Meteterakis singaporensis*. Currently, the 2 new species are

unique to *C. mcguirei*. *Cosmocerca ornata* is a widely distributed Palearctic species found in anurans and reptiles; a host list was provided by Yildirimhan *et al.* (2009). Five additional host records have since been reported, namely, Turkish worm lizard, *Blanus strauchi*, from Turkey (Düßen *et al.*, 2010); Mao-Son frog, *Hylarana masonensis*, from Vietnam (Bursey and Goldberg, 2011); Tavas frog, *Rana tavasensis*, from Turkey (Düßen, 2012); and ornamented pygmy frog, *Microhyla fissipes* and dark-sided chorus frog, *Microhyla heymonsi*, from Taiwan (Norval *et al.*, 2013). *Meteterakis singaporensis* was originally described as *Africana singaporensis* by Sandosham (1954) from *Bufo melanostictus* (currently *Dutaphrynus melanostictus*) collected in Singapore, but was reassigned to its current position by Inglis (1958). It is currently only known from a Malayan toad, *D. melanostictus*, and skink, *Mabuya multifasciata* (currently *Eutropis multifasciata*) (Sandosham, 1954; Singh, 1967).

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