Cairaella henrii gen. n., sp. n., a parasite of Norops trachyderma (Polychrotidae), and Ophiotaenia nicoleae sp. n. (Eucestoda: Proteocephalidea), a parasite of Thecadactylus rapicauda (Gekkonidae), in Ecuador

Sandrine C. Coquille and Alain de Chambrier

1Musée d’histoire naturelle, Département des Invertébrés, CP 6434, CH-1211 Genève 6, Switzerland; 2Université de Genève, Faculté des Sciences, Département de Zoologie et Biologie Animale, 30, quai Ernest-Ansermet, CH-1211 Genève 4, Switzerland

Key words: Eucestoda, Proteocephalidea, Cairaella henrii, Ophiotaenia nicoleae, new genus, new species, morphology, Squamata

Abstract. Cairaella henrii gen. n., sp. n. (Proteocephalidea: Proteocephalinae) is described from the intestine of Norops trachyderma (Cope) (Polychrotidae) from San Pablo de Kantesiya in Ecuador. The new genus differs from the 12 other known genera of the Proteocephalinae (and all other proteocephalidean genera) by the presence of a dense network of osmoregulatory canals situated in the cortex and by the morphology of the scolex which is flattened dorsoventrally, with elongated deeply embedded suckers possessing a well-developed circular musculature situated in the anterolateral region, and by eggs with a three-layered embryophore possessing small outgrowths on its external surface. Ophiotaenia nicoleae sp. n. is described from the intestine of Thecadactylus rapicauda (Houssy) (Gekkonidae) from San Pablo de Kantesiya in Ecuador. This new species is characterised by the testes arranged in two fields, numbering 142–204, the cirrus-sac length representing 21–33% of proglottis width, the genital pore situated in the middle of the proglottis or slightly anteriorly, and the ovary width representing 68–88% of proglottis width. It differs from 20 of 27 Ophiotaenia species parasitic in New World reptiles by the presence of an apical organ and from the remaining species by one to several other morphological characters, such as the number of testes, diameter and shape of the scolex, position of ventral and dorsal osmoregulatory canals, or the presence of a vaginal sphincter. Both taxa represent the first record of proteocephalidean tapeworms in polychrotid and gekkonid lizards, respectively.

Tapeworms of the order Proteocephalidea Mola, 1928 are frequent and widely distributed parasites of freshwater fishes, amphibians and reptiles (Rego 1994). Between 1983 and 1989, the Department of Invertebrates of the Natural History Museum in Geneva, in collaboration with the Ecuadorian Museum of Natural History, conducted a survey of the parasite fauna in Ecuador, with a main focus on reptiles and amphibians. During these investigations, Jean-Marc Touzet collected cestodes from gekkonid and polychrotid lizards in San Pablo de Kantesiya, Rio Aguarico, Ecuador. These tapeworms belong to a new genus and new species, respectively, and are described in the present paper.

MATERIALS AND METHODS

The worms were fixed immediately after dissection with 4% neutral formaldehyde solution, stained with Mayer’s haematoxylin and counterstained with 1% acidic eosin B (de Chambrier 2001). Scoleces for scanning electron microscopy (SEM) were processed as follows: worms were dehydrated in a graded ethanol series (80, 96, twice 100%), then transferred to a graded amyl acetate series, critical point-dried in CO2, sputter coated with gold and examined with a Zeiss 940A electron microscope at the Natural History Museum, Geneva. Eggs were studied in distilled water. All measurements are given in micrometres (µm) unless otherwise stated. Abbreviations used in descriptions are as follows: x – mean; n – number of measurements; CV – coefficient of variability; OV – percent of the width of ovary versus the width of the proglottis; PP – position of genital pore (cirrus pore) as % of proglottis length; PC – percent of the length of cirrus-sac versus the width of the proglottis. MHNG INVE – Natural History Museum of Geneva Invertebrate Collection; IPCAS – Institute of Parasitology, BC AS CR, České Budějovice, Czech Republic; BMNH – The Natural History Museum, London, UK.

RESULTS

Cairaella gen. n.

Proteocephalidae, Proteocephalinae. Strobila acraspe-dote, anapolytic. Testes, ovary, vitellaria, and uterus medullary. Scolex flattened dorsoventrally, with four deep elongated suckers possessing well-developed circular musculature situated in anterolateral region. Suckers deeply embedded, their base adjoining. Internal longitudinal musculature well developed. Dense network of osmoregulatory canals situated in cortex around internal...
Figs. 1–4. *Cairaella henrii* sp. n., line drawings. Fig. 1. Holotype, scolex, ventral view (MHNG INVE 18889). Fig. 2. Paratype, scolex, sagittal section; note the presence of circular musculature in anterior margin of suckers (MHNG INVE 30504). Fig. 3. Holotype, mature proglottis, ventral view (MHNG INVE 18889). Fig. 4. Paratype, gravid proglottis, dorsal view (IPCAS C-499).

**Abbreviations:** ao – apical organ; cm – circular musculature; mg – Mehlis’ gland. Scale bars: Figs. 1, 2 = 250 µm; Figs. 3, 4 = 500 µm.

longitudinal musculature. Genital pores irregularly alternating, equatorial. Vitelline follicles forming two lateral bands, more numerous posteriorly. Testes medullary, in two separate lateral fields, in one or two layers. Ovary medullary, bilobed, folliculate. Uterus ventral, with lateral diverticula. Type 1 of uterine development (see de Chambrier et al. 2004). Eggs with three-layered embryophore and with small outgrowths on its external surface. Parasites of lizards (Polychrotidae).

**Type and the only species:** *Cairaella henrii* sp. n.

**Etymology:** This genus is named in honour of Professor Janine N. Caira, University of Connecticut, USA, for her outstanding contribution to cestode systematics.

**Differential diagnosis.** *Cairaella* belongs to the Proteoecephalinae because of medullary position of testes, ovary, vitellaria and uterus (Rego 1994). The new genus differs from the 12 other recognized genera of the Proteoecephalinae (*Proteocephalus* Weinland, 1858; *Crepidobothrium* Monticelli, 1900; *Ophiotaenia* La Rue, 1911; *Deblocktaenia* Odening, 1963; *Macrobothriotaenia* Freze, 1965; *Tejidotaenia* Freze, 1965; *Brayela* Rego, 1984; *Euzetiella* de Chambrier, Rego et Vaucher, 1999; *Pseudocrepidobothrium* Rego et Ivanov, 2001; *Thaumasioscolex* Cañeda-Guzmán, de Chambrier et Scholz, 2001; *Glanitaenia* de Chambrier, Zehnder, Vaucher et Mariaux, 2004; and *Scholzia* de Chambrier,
Figs. 5–10. Cairaella henrii sp. n., line drawings. 

Fig. 5. Holotype, posterolateral part of gravid proglottis showing the network of cortical osmoregulatory canals, dorsal view (MHNG INVE 18889).

Figs. 6, 7. Paratype, cross-sections at level of cirrus-sac and ovary, respectively (MHNG INVE 60715).

Fig. 8. Holotype, vagina and cirrus-sac region, ventral view (MHNG INVE 18889).

Figs. 9, 10. Eggs drawn in distilled water, showing the three-layered embryophore and small outgrowths (MHNG INVE 23861).

Abbreviations: do – dorsal osmoregulatory canal; du – uterine diverticiles; em – embryophore; lm – internal longitudinal musculature; ln – longitudinal nerve; oc – osmoregulatory canals; oe – outer envelope; on – oncosphere; ov – ovary; ut – uterus; so – small outgrowths; vc – vaginal canal; vd – vas deferens; vi – vitelline follicles. Scale bars: Figs. 5–8 = 250 µm; Figs. 9, 10 = 50 µm.

Rego et Gil de Pertierra, 2005) by the presence of a dense network of cortical osmoregulatory canals, which is unique in proteocephalidean cestodes (Freze 1965, Schmidt 1986, Rego 1994, de Chambrier and Vaucher 1999, Rego et al. 1999, Rego and Ivanov 2001, de Chambrier et al. 2004, 2005). Furthermore, Cairaella differs from all 12 genera by the morphology of the eggs, which have a three-layered embryophore. It also differs from all but one of these genera (Thaumasioscolex from an opossum from Mexico – Cañeda-Guzmán et al. 2001) by the presence of small outgrowths covering the external surface of the embryophore. In addition, Cairaella is characterized by the morphology of its scolex, which is flattened dorsoventrally and possesses deeply embedded elongated suckers with their base ad-

joining (Fig. 2). The suckers possess well-developed circular musculature situated in the anterolateral region, which is not common characteristic among proteocephalidean cestodes, being present only in some species as, for example, in Brooksiella praeputialis (Rego, Santos et Silva, 1974) or in Proteocephalus jarara (Furmann, 1927) (see de Chambrier et al. 1991, 2004b).

Cairaella henrii sp. n. Description (based on seven specimens): Proteocephalidae, Proteocephalinae. Cestodes 17–26 mm long, up to 765 wide. Strobila acraspedote, anapolytic, consisting of 36–39 (n = 3) proglottides: 25–28 immature (up to appearance of spermatozoa in vas deferens), 3 mature (up to appearance of eggs in uterus), 7–11 pre-
gravid (up to appearance of hooks in oncospheres) and gravid proglottides.

Immature and mature proglottides wider than long to longer than wide (length:width ratio 0.11–1.69), pre-gravid and gravid proglottides longer than wide (length:width ratio 1.03–3.34). Scolex dorsoventrally flattened (Fig. 2), 85–395 (x = 390, n = 3) long and 535–650 (x = 585, n = 3) wide, much wider than neck (Figs. 11, 12) with small ovoid apical organ, 54–67 (x = 60, n = 3) long and 42 (n = 3) wide (Figs. 1, 2, 13).

Suckers uniloculate, ovoid, elongated, deeply embedded, 230–260 (x = 245, n = 12) long and 160–190 (x = 175, n = 12) wide, their base adjoining in cross-section. Sucker diameter representing 26–33% of scolex diameter (Fig. 1). Suckers with well-developed circular musculature situated in anterolateral region (Fig. 2). Proliferation zone 255–330 (x = 290, n = 3) wide.

Internal longitudinal musculature developed, represented by bundles of separated muscular fibres (Figs. 6, 7) forming anastomoses. Osmoregulatory canals forming dense network, in cortical parenchyma (Figs. 5–7), with about 20–27 longitudinal canals in the dorsal and ventral cortex.

Testes medullary, forming three groups (poral field separated to preporal and postporal groups), in one or two layers, sometimes slightly overlapping cirrus-sac, vagina, vas deferens and vitelline follicles (Figs. 3, 4), numbering 45–57 (x = 52, n = 9, CV = 7%); aporal testes 24–31 in number (x = 27); 11–17 preporal testes (x = 14); 7–12 postporal testes (x = 10). Testes spherical to
oetal canal (pars copulatrix vaginae) surrounded by chro-
fore reaching seminal receptacle. Terminal part of vagi-
terodorsal to ovarian isthmus, vaginal canal curved be-
fore degeneration of testes.

Vitelline follicles degenerate in gravid proglottides be-
proglottis length, interrupted at level of cirrus sac. Ven-
teriorly, situated near ventral side in cross sections
fields near margins of proglottides, more numerous pos-
Mehlis’ glands 110–145 (x = 135, n = 9) in diameter,
9) wide, OV = 56–64% (x = 60%; n = 9; CV = 4%).
reaching dorsal cortex (Fig. 7), 360–435 (x = 410, n =
proglottides (Figs. 4, 7), with dorsal outgrowths rarely
ducts passing between osmoregulatory canals.

Ovary medullary, bilobate, follicular in pregravid
proglottides (Figs. 4, 7), with dorsal outgrowths rarely
reaching dorsal cortex (Fig. 7), 360–435 (x = 410, n =
wide, OV = 56–64% (x = 60%; n = 9; CV = 4%).

Vitelline follicles medullary, arranged in two lateral
fields near margins of proglottides, more numerous pos-
teriorly, situated near ventral side in cross sections
(Figs. 6, 7), occupying 76–93% (x = 88%, n = 9) of
proglottis length, interrupted at level of cirrus sac. Ven-
toral follicles sometimes overlapping testes (Fig. 4).
Vitelline follicles degenerate in gravid proglottides be-
fore degeneration of testes.

Vaginal canal forming small seminal receptacle an-
terodorsal to ovarian isthmus, vaginal canal curved be-
fore reaching seminal receptacle. Terminal part of vagi-
nal canal (pars copulatrix vaginae) surrounded by chro-
morphic cells. Vagina anterior 92% or posterior 8% (n =
62), always ventral to cirrus-sac.

Primordium of uterine stem medullary, present in
immature proglottides. Formation of uterus of type 1
(see de Chambrier et al. 2004); in immature proglot-
tides, uterine stem straight, occupying entire length of
proglottis, formed by longitudinal thick band of chro-
morphic cells along midline of proglottides. Lumen of
uterus appearing in first mature proglottides (Fig. 3);
diverticula (lateral branches) formed before first eggs
appear in uterine stem. In pregravid proglottides, eggs
completely filling uterine stem and thick-walled diver-
ticula. In gravid proglottides, diverticula occupying up
to 73% (n = 13) of proglottis width; 13–17 (x = 15, n =
diameter; oncosphere spherical to oval, 11–12 in
diameter (n = 6), with three pairs of hooks, 7–8 long
(Figs. 9, 10). Eggs increase in size during intrauterine
development. External surface of embryophore bearing
small flattened outgrowths (Figs. 9, 10).

Type host: Norops trachyderma (Cope, 1876) (Squa-
mata, Polychrotidae) (common name: common forest
anole).

Type locality: San Pablo de Kantesiya, Río Aguarico,
Ecuador (0°15’S, 76°26’W), 13.02.1988.

Site: First quarter of intestine, immediately after stomach.

Prevalence: 13% (3 of 23).

Type material: Holotype MHNG INVE 18889 (field
number Ec 4222) (1 slide); 3 paratypes MHNG INVE
60713 (1 slide), 60715 (6 slides, 1 whole mounted and 5
cross-sections); IPCAS C-499 (1 slide); BMNH 2008.5.
20.1 (1 cross-section from the paratype 60715) (all field
number Ec 4222); 1 paratype MHNG INVE 30504, San
Pablo de Kantesiya, Río Aguarico, Ecuador, 22.02.1988 (8
slides, 1 whole mounted and 7 cross-sections) (field num-
ber Ec 4375).

Voucher material: 1 specimen used for SEM,
MHNG INVE 60716 (field number Ec 4222); 4 specimens
in vials, MHNG INVE 60717 (field number Ec 4222); 1
specimen, MHNG INVE 23861, San Pablo de Kantesiya,
Río Aguarico, Ecuador, 9.02.1988 (5 slides, 1 whole
mounted and 4 cross-sections) (field number Ec 4111).

Etymology: The species has been named in honour of
Henri Coquille (Geneva), first author’s father.

Remarks. The presence of a three-layered embry-
phore similar to that described above has already been
observed in Ophiotenia alessandrae Marsella et de
Structures similar to the numerous outgrowths on the
external surface of the embryophore of Cairaella henrii
are observed in some proteocephalidean cestodes paras-
itic in terrestrial vertebrates, such as Vauceriella
bichetti de Chambrier, 1987 from a tropidophid snake
(Figs. 15–17), Nomimoscolex touzeti de Chambrier et
Vachuer, 1992 from a Neotropical frog, Proteocephalus
azevedoi de Chambrier, Vachuer et Renaud, 1992 from a
Neotropical venomous snake, or Thaumasioscolex
didelphidis Cañeda-Guzmán, de Chambrier et Scholz,
2001 from a Mexican marsupial (de Chambrier 1987, de
Chambrier and Vachuer 1992, de Chambrier et al. 1992,
Cañeda-Guzmán et al. 2001).

The presence of a network of osmoregulatory canals
in the cortex is very rarely observed in the Cestoda.
Osmoregulatory canals in cestodes usually consist of a
pair of ventral and a pair of dorsal canals situated in the
medullary parenchyma (Fuhrmann 1933, Wardle and
McLeod 1952). The number of canals increased in a few
groups, as in some cyclophyllideans (e.g. six canals in
Fimbriaria Froelich, 1802, 11 in Fimbriariae Fuhr-
mann, 1932 and up to 20 in Raillietina vigintivasus
(Skryabin, 1914) – Joyeux and Baer 1961), but remain
all situated in the medullary parenchyma. In some cases,
longitudinal canals are interconnected by numerous
transverse canals (Ligula Bloch, 1782, Schistocephalus
Creplin, 1829, Eubothrium Nybelin, 1920). In Diphyllo-
bothrium Cobbold, 1858, however, the network expands...
from the medulla to the cortex (Joyeux and Baer 1961). Markowski (1952a, b) observed a cortical network of osmoregulatory canals, similar to those observed in Cairaella henri, in several species of Diphyllobothrium, e.g., *D. hians* (Diesing, 1850) (fig. 30 in Markowski 1952a), *D. quadratum* (Linstow, 1892), *D. lashleyi* (Leiper et Atkinson, 1914), and also in Bayliissiella tecta (Linstow, 1892).

In the Proteocephalidea, the wall of dorsal canals is thicker than that of the ventral ones. In *C. henrii* (Figs. 5–7) and in *Diphyllobothrium hians* (fig. 30 – Markowski 1952a), the canals situated in the medulla are thicker than the ones in the cortex. This may indicate that cortical canals of these species are homologous to the ventral ones which were originally located in the medulla.

Within the Proteocephalidea, the development of a network of osmoregulatory canals within the cortex has only been observed in Nomimoscolex touzeti de Chambrier and Vaucher, 1992, a parasite of *Ceratophrys cornuta* (L.) in Ecuador, which possesses five main longitudinal canals on each side of proglottides connected by numerous transverse canals (see figs. 4–6, 8 in de Chambrier and Vaucher 1992) in the ventral cortex. In *C. henrii*, the network is composed of 20–27 main longitudinal canals, connected by numerous transverse canals, situated all around and exterior to the longitudinal internal musculature (Figs. 6, 7). The presence of such a network occupying the whole cortical parenchyma represents a unique feature within the Proteocephalidea and is also very rare within the Cestoda.

**Ophiotaenia nicoleae** sp. n. Figs. 18–24

**Description** (based on 2 specimens): Proteocephalidae, Proteocephalinae. Cestodes 230–515 mm long, up to 2.2 mm wide. Strobila acraspedote, anapolytic, consisting of 322–381 (n = 2) proglottides: 248–302 immature (up to appearance of spermatozoa in vas deferens), 7–32 mature (up to appearance of eggs in uterus), 42–72 pregravid (up to appearance of hooks in oncospheres) and gravid proglottides.

Immature and mature proglottides wider than long to longer than wide (length:width ratio 0.19–2.4), pregravid and gravid proglottides longer than wide (length:width ratio 1.8–3.25). Scolex 325–340 in diameter and 265–275 long, with apical organ 22–38 long and 22–26 wide. Proliferation zone narrower than scolex, 245–270 wide. Suckers anterolateral, uniloculate, spherical to ovoid, 128–150 (x = 137, n = 8) long and 106–128 (x = 117, n = 8) wide. Sucker diameter representing 33–42% of scolex diameter (Fig. 18).

Internal longitudinal musculature well-developed, composed of a layer of fine bundles of separated muscular fibres forming anastomoses (Figs. 21, 22). Osmoregulatory canals situated at 20–25% of proglottis width from lateral margin, separating longitudinally each testis fields in two bands (Figs. 19, 20, 23). Ventral canals much wider than dorsal ones. Dorsal canals situated more medially than ventral one.

Testes mediulary, forming two longitudinal lateral fields in one (rarely two) layer, not overlapping cirrus-sac, vagina and vas deferens (Figs. 20, 23), numbering 142–204 (x = 176, n = 17, CV = 12%); aporal testes 68–104 in number (x = 89); preporal testes 37–61 (x = 46); postporal testes 29–52 (x = 41). Testes spherical to oval, 45–83 (x = 63, n = 20) long, 35–74 (x = 54, n = 20) wide, barely reaching vitelline follicles laterally, not present near anterior and posterior margin (Figs. 19, 20), still present in gravid proglottides.

Cirrus-sac elongated, thick-walled, 315–565 (x = 430, n = 17, CV = 16%) long and 100–185 (x = 145, n = 17, CV = 17%) wide (Fig. 23); PC 21–33% (x = 26%, n = 17, CV = 13%). Cirrus length representing up to 70% of cirrus-sac length. Posterior part of cirrus very long and coiled. Vas deferens strongly coiled, situated between proximal part of cirrus sac and midline of proglottides, wider in its terminal part (Figs. 20, 23).

Genital atrium deep, genital pores alternating irregularly, usually situated in middle of proglottis length (equatorial) or slightly anteriorly; PP = 34–53% (x = 47%, n = 17, CV = 9%). Genital ducts passing between osmoregulatory canals (Fig. 20).

Ovary mediulary, bilobed, follicular, 850–1,605 (x = 1,190, n = 17) wide, OV = 68–88% (x = 75%; n = 17, CV = 6%) (Figs. 20, 22). Mehlis’ glands 95–130 (x = 110, n = 17, CV = 9%) in diameter, representing 5–10% of proglottis width (Figs. 19, 20, 22).

Vitelline follicles mediulary, arranged in two lateral ventral fields near margins of proglottides, slightly more numerous posteriorly, occupying 78–96% (x = 91%; n = 23) of proglottis width, interrupted at level of cirrus sac and vagina (Figs. 19–23). Vagina anterior 72% or posterior 28% (n = 23) to cirrus-sac. Terminal part of vaginal canal (pars copulatrix vaginae) surrounded by ring-shaped muscular sphincter (Fig. 23). Vaginal canal slightly curved just before reaching seminal receptacle. Seminal receptacle situated dorsal to ovarian isthmus.
Table 1. Proteocephalidean cestodes parasitic in reptilian hosts in the New World (in **bold**, the species possessing an apical organ).

<table>
<thead>
<tr>
<th>Parasite species</th>
<th>Host species</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ophiotaenia agkistrodonis</em> (Harwood, 1933)</td>
<td><em>Akgistrodon piscivorus</em> (Linace)</td>
<td>Brazil</td>
</tr>
<tr>
<td><em>Ophiotaenia avanasi</em> (Santos et Tay-Son Rosal, 1973)</td>
<td><em>Liothpis miliaris</em> (Linace)</td>
<td>Brazil</td>
</tr>
<tr>
<td><em>Ophiotaenia azevedoi</em> (de Chambrier et Vaucher, 1992)</td>
<td><em>Bothrops jararaca</em> (Wied)</td>
<td>Brazil</td>
</tr>
<tr>
<td><em>Ophiotaenia barbouri</em> Viguereas, 1934</td>
<td><em>Tretanorhinus variabilis</em> Dumb., Bib. et Dum.</td>
<td>Cuba</td>
</tr>
<tr>
<td><em>Ophiotaenia calmetti</em> (Barrois, 1898)</td>
<td><em>Bothrops lanceolatus</em> (Linace)</td>
<td>Martinique</td>
</tr>
<tr>
<td><em>Ophiotaenia catalysii</em> (de Chambrier et Vaucher, 1992)</td>
<td><em>Bothrops jararaca</em> (Wied)</td>
<td>Brazil</td>
</tr>
<tr>
<td><em>Ophiotaenia crotaloides</em> Lopez-Neyra et Diaz-Ungria, 1958</td>
<td><em>Crotalus durissus terrificus</em> (Laurenti)</td>
<td>Venezuela</td>
</tr>
<tr>
<td><em>Ophiotaenia elongata</em> Fuhrmann, 1927</td>
<td><em>Bothrops jararaca</em> (Wied)</td>
<td>Brazil</td>
</tr>
<tr>
<td><em>Ophiotaenia euceti</em> (de Chambrier et Vaucher, 1992)</td>
<td><em>Bothrops jararaca</em> (Wied)</td>
<td>Brazil</td>
</tr>
<tr>
<td><em>Ophiotaenia faranciae</em> MacCallum, 1921</td>
<td><em>Parancia abacura</em> Holbrook</td>
<td>USA</td>
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<tr>
<td><em>Ophiotaenia flavu</em> Rudin, 1917</td>
<td><em>Coluber sp.</em></td>
<td>Brazil</td>
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<tr>
<td><em>Ophiotaenia giberti</em> Ammann et de Chambrier, 2008</td>
<td><em>Thamnodynastes pallidus</em> (Linace)</td>
<td>Paraguay</td>
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<tr>
<td><em>Ophiotaenia grandis</em> La Rue, 1911</td>
<td><em>Akgistrodon piscivorus</em> (Linace)</td>
<td>USA</td>
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<td><em>Ophiotaenia habanensis</em> Freze et Rýšavý, 1976</td>
<td><em>Tropidophis parvulis</em> (Gundlach)</td>
<td>Cuba</td>
</tr>
<tr>
<td><em>Ophiotaenia hyalina</em> Rudin, 1917</td>
<td>*Coluber sp. (presumably <em>Liothpis</em>)</td>
<td>Brazil</td>
</tr>
<tr>
<td><em>Ophiotaenia jarara</em> Fuhrmann, 1927</td>
<td><em>Bothrops jararaca</em> (Wied)</td>
<td>Brazil</td>
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<td><em>Ophiotaenia joanae</em> (de Chambrier et Paulino, 1997)</td>
<td><em>Xenodon neuwiedi</em> Grünther</td>
<td>Brazil</td>
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<td><em>Ophiotaenia lactea</em> (Leidy, 1855)</td>
<td><em>Natrix sipedon</em> (Linace)</td>
<td>USA</td>
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<td><em>Ophiotaenia macrochothria</em> Rudin, 1917</td>
<td><em>Elaps corallinus</em> Merrem</td>
<td>Brazil</td>
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<td><em>Ophiotaenia marenzelleri</em> (Barrois, 1898)</td>
<td><em>Akgistrodon piscivorus</em> (Linace)</td>
<td>USA</td>
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<tr>
<td><em>Ophiotaenia micrurica</em> (Shoop et Corkum, 1982)</td>
<td><em>Micrurus diastema</em> Dum., Bib. et Dum.</td>
<td>Mexico</td>
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<td><em>Ophiotaenia nattereri</em> (Parona, 1901)</td>
<td><em>Coluber sp.</em></td>
<td>Brazil</td>
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<tr>
<td><em>Ophiotaenia paraguayensis</em> Rudin, 1917</td>
<td><em>Hydromynastes gigas</em> (Dum., Bib. et Dum.)</td>
<td>Paraguay</td>
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<td><em>Ophiotaenia perspica</em> La Rue, 1911</td>
<td><em>Natrix rhombifer</em> (Hallowell)</td>
<td>USA</td>
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<td><em>Ophiotaenia racemosa</em> (Rudolphi, 1819)</td>
<td><em>Coluber sp.</em></td>
<td>Brazil</td>
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<td><em>Ophiotaenia sanbernardinensis</em> Rudin, 1917</td>
<td><em>Heliscops leptodinus</em> (Schlegel)</td>
<td>Paraguay</td>
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<tr>
<td><em>Ophiotaenia variabilis</em> (Brooks, 1978)</td>
<td><em>Natrix cyclonae</em> (Dum., Bib. et Dum.)</td>
<td>USA</td>
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Table 2. Proteocephalidean species parasitic in Sauria (Lacertilia) in the World.

<table>
<thead>
<tr>
<th>Parasite species</th>
<th>Host species</th>
<th>Region</th>
</tr>
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<tbody>
<tr>
<td><em>Acanthotaenia</em> von Linstow, 1903</td>
<td><em>Varanus sp.</em></td>
<td>New Guinea</td>
</tr>
<tr>
<td>A. biori (Ratz, 1900)</td>
<td><em>Varanus salvator</em> (Laurenti)</td>
<td>Philippines</td>
</tr>
<tr>
<td>A. dailey Schmidt et Kunz, 1974</td>
<td><em>Varanus salvator</em> (Laurenti)</td>
<td>Philippines</td>
</tr>
<tr>
<td>A. gracilis (Beddard, 1913)</td>
<td><em>Varanus varius</em> (White)</td>
<td>Australia</td>
</tr>
<tr>
<td>A. shipleyi Linstow, 1903</td>
<td><em>Varanus salvator</em> (Laurenti)</td>
<td>South-East Asia</td>
</tr>
</tbody>
</table>

| K. frezen Schmidt et Kunz, 1974 | *Varanus salvator* (Laurenti) | Philippines |
| K.𝙻accefera (Ratz, 1900) | *Varanus sp.* | New Guinea |
| K. sanguindui (Caster, 1943) | *Varanus komodoensis* Ouwens | Indonesia |
| K. tidswelli (Johnston, 1909) | *Varanus varius* (White) | Australia |
| K. varia (Beddard, 1913) | *Varanus varius* (White) | Australia |

| O. striata (Johnston, 1914) | *Lialis burtonii* Gray | Australia |
| O. amphibiolori (Nybelin, 1917) | *Pogona barbara* (Cuvier) | Australia |
| O. greeri (Bursey, Goldberg et Kraus, 2006) | *ophylophorus aignanus* (Boulenger) | Papua New Guinea |

| R. beddardi (Woodland, 1925) | *Varanus bengalensis* (Daudin) | India |
| R. nilotica (Beddard, 1913) | *Varanus niloticus* Linnaeus | North Africa |
| R. woodlandi (Moghe, 1926) | *Varanus bengalensis* (Daudin) | India |

| T. appendiculata (Baylis, 1947) | *Tupinambis nigrofasciatus* (Spix) | Dutch Guyana |

Primordium of uterine stem medullary, present in immature proglottidies. Formation of uterus of type 1 (see de Chambrier et al. 2004): in immature proglottidies, uterine stem straight, occupying almost entire length of proglottis, formed by longitudinal thick column of chromophilic cells along midline of proglottidies (Fig. 19). Lumen of uterus appearing in first mature proglottidies. Diverticula (lateral branches) formed before first eggs appear in uterine stem. In pregravid proglottidies, eggs completely filling uterine stem and thick-walled diverticula. In gravid proglottidies, diverticula occupying up to 66% of proglottis width; 13–27
(x = 19, n = 30, CV = 15%) lateral branches on each side (Fig. 20). Longitudinal slit-like ventral uterine opening observable in some terminal proglottides.

Eggs with hyaline outer envelopes, 105–145 in diameter (Fig. 24). Embryophore spherical, bilayered. First layer 32–36 in diameter, with two discrete polar swellings; second layer 18–24 in diameter; oncosphere spherical to oval, 11–13 in diameter, with three pairs of hooks, 6–7 long (Fig. 24).

**Type host:** Thecadactylus rapicauda (Houttuyn, 1782) (Squamata, Gekkonidae); common name: turnip-tailed gecko.

**Type locality:** San Pablo de Kantesiya, Río Aguarico, Ecuador (0°15’S, 76°26’W).

**Site of infection:** Intestine.

**Prevalence:** 22% (2 of 9).

**Type material:** Holotype MHNG INVE 18676, San Pablo de Kantesiya, Rio Aguarico, Ecuador, 23.2.1985, 1 entire specimen in 5 whole mounts (field number Ec 244). Paratypes MHNG INVE 18678, San Pablo de Kantesiya, Rio Aguarico, Ecuador, 25.9.1986, 4 whole mounts, 12 cross-sections and BMNH 2008.5.20.2, 1 cross-section (both field number Ec 2199).

**Etymology:** The species has been named in honour of Nicole Coquille (Geneva), first author’s mother.

**Differential diagnosis.** The present species is placed in Ophiotaenia La Rue, 1911 (subfamily Proteocephalinae) because of the medullary position of the vitellaria, unarmed scolex, shape of uniloculate suckers, and the presence of an apical organ (Table 1). Of the seven representatives of Ophiotaenia parasitizing reptiles and amphibians, the eggs of O. nicoleae can be distinguished from all but one of them, because of the position of the embryophore layer of those species is distinct, presenting different diameters (Rego and de Chambrier 1995). We recently observed the eggs possess polar swellings, but this is likely due to the presence of an internal polar structure of different diameters (Rego and de Chambrier 1995). We also observed similar species in Brooyschla praeputialis (Rego, Santos et Silva, 1974) (de Chambrier et al. 2004) and in Rudolphiella spp. (Gil de Perttierra and de Chambrier 2000). However, the embryophore layer of those species is distinct, presenting an elongated polar wall. Furthermore, the outer envelope of these species possesses elongated projections (Gil de Perttierra and de Chambrier 2000).

Proteocephalidean cestodes are not common parasites of lizards (Sauria; Lacertilia). They are represented by 17 currently recognized species (see Table 2) and belong to the following genera of two subfamilies: Ophiotaenia La Rue, 1911; Tejidotaenia Freze, 1965 (Proteocephalinae); Acanthotaenia von Linstow, 1903; Kapsulotaenia Freze, 1965; and Rostellotaenia Freze, 1963 (Acanthotaeniinae) (Freze 1965, Schmidt 1986). Both species described above represent the first records of proteocephalideans in gekkonid and polychrotid lizards, respectively. Previously, only Harwood (1932) reported an immature specimen of Proteocephalus sp. from Anolis carolinensis from Texas, North America.

**Remarks.** Ophiotaenia nicoleae is the first proteocephalidean cestode found in a gekkonid lizard. It should be noted that its strobila is very long (reaching up to 515 mm) in comparison with the total length of the host (max. 220 mm) (Rösler 1995).

The position of the osmoregulatory canals, which overlap and separate longitudinally the testicular fields, is not common in Ophiotaenia. Judging from the original descriptions and drawings, only 3 out of 27 Ophiotaenia species parasitic in snakes of the New World, namely O. azevedoi, O. euzeti, and O. gilberti, harbour this character. Since this character is constant, it represents a good discriminative feature, as already pointed out for Nomimoscolex Woodland, 1934 by de Chambrier et al. (2006).

The eggs of O. nicoleae possess discrete polar swellings on the external surface of the embryophore, which is rare in the Proteocephalidea. Similar structures were already observed in Proteocephalus azevedoi de Chambrier, Vacher et Renaud, 1992 and in Nomimoscolex touzeti de Chambrier et Vacher, 1992 (de Chambrier and Vacher 1992, de Chambrier et al. 1992). In Pseudocrepidobothrium eirasi (Rego et de Chambrier, 1995), the eggs possess polar swellings, but this is likely due to the presence of an internal polar structure of different diameters (Rego and de Chambrier 1995). We also observed similar species in Brooyschla praeputialis (Rego, Santos et Silva, 1974) (de Chambrier et al. 2004) and in Rudolphiella spp. (Gil de Perttierra and de Chambrier 2000). However, the embryophore layer of those species is distinct, presenting an elongated polar wall. Furthermore, the outer envelope of these species possesses elongated projections (Gil de Perttierra and de Chambrier 2000).

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