October 2004

# New species of *Cinclotaenia* Macy, 1973 (Cyclophyllidea: Dilepididae) from *Cinclus leucocephalus* Tschudi (Passeriformes: Cinclidae) in Bolivia

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*J. Parasitol.*, 90(5), 2004, pp. 1073–1084


# NEW SPECIES OF *CINCLOTAENIA* MACY, 1973 (CYCLOPHYLLIDEA: DILEPIDIDAE) FROM *CINCLUS LEUCOCEPHALUS* TSCHUDI (PASSERIFORMES: CINCLIDAE) IN BOLIVIA

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ABSTRACT: Two new species of *Cinclotaenia* (Cyclophyllidea: Dilepididae) are described from the small intestine of *Cinclus leucocephalus* (Aves: Passeriformes: Cinclidae) collected in the Yungas region of Bolivia. *Cinclotaenia minuta* n. sp. is characterized by possessing a minute strobila with a maximum body length of 1.58 mm, consisting of 5–10 proglottids, 19–22 rostellar hooks with lengths from 16 to 17 μm, 12–17 testes per proglottid, and eggs forming packets without filaments. *Cinclotaenia boliviensis* n. sp. has bandlike strobila with a length up to 26 mm with 67–74 proglittids, 22 rostellar hooks with length 39–42 μm, 43–68 testes, and eggs forming packets possessing long filaments. The systematic position in *Cinclotaenia* of cestodes lacking filaments on the egg packets is confirmed. This is the first record of species of *Cinclotaenia* in dippers from Bolivia and also the first report of cestodes from *Cinclus* sp. in the Neotropical Region.

Members of the Cinclidae, commonly called dippers or water ouzels, occupy suitable habitat near and around primary streams and lakes in mountainous areas on all continents except Australia and Antarctica. *Cinclus cinclus* Linnaeus, 1758 is most widespread, with disjunct populations occurring in Northern Africa, Europe, and Asia. *Cinclus pallasii* Temminck, 1820 occurs in eastern and southeastern Asia whereas *Cinclus mexicanus* Swainson, 1827 occurs in America from the sub-Arctic in Alaska, south into northern Panama and possibly northeastern Venezuela. Two species are known from the Neotropical Region, including *Cinclus leucocephalus* Tschudi, 1844 with a distribution extending from Venezuela southward through the Andes into central Bolivia and *Cinclus schulzi* Cabanis, 1883 occupying a small range in the Yungas of southern Bolivia and northern Argentina (Brewer, 2001).

Cinclids possess an extremely specific cestode fauna (Oshmarin, 1968; Spasskaya and Spasskii, 1977; Georgiev and Genov, 1985; Macko et al., 2003) with all described species up to the present assignable to the Dilepididae. Macy (1973) first described *Cinclotaenia filamentosa* Macy, 1973 from *C. mexicanus* collected on and near streams flowing into the Columbia River in the Cascade Range of northern Oregon. He described this species and created a new monotypic genus mostly on the basis of the structure of the uterus with ripe eggs being held in ''packets,'' each containing 8–12 eggs, and each packet supporting numerous long and thin filaments.

Subsequently, Spasskaya and Spasskii (1977) erected *Borgarenkolepis* Spasskaya and Spasskii, 1977 for the dilepidids from dippers in the Palearctic. Species that were allocated to this genus included the type species, *Borgarenkolepis tarnogradskii* (Dinnik, 1927), *Borgarenkolepis cincli* Spasskaya and Borgarenko in Spasskaya and Spasskii, 1977, *Borgarenkolepis dehiscens* (Krabbe, 1879), and *Borgarenkolepis polyarthra* (Krabbe, 1882). Georgiev and Genov (1985) found that the type species of *Cinclotaenia* and *Borgarenkolepis* were very similar, including the presence of egg packets in both; and they synonymized the genera, transferring *B. tarnogradskii* to *Cinclotaenia* and considering *B. cincli*, *B. dehiscens*, and *B. polyarthra* as species incertae sedis. Bona (1994) adopted this generic synonymy and placed *B. dehiscens* in *Cinclotaenia* on the basis of his observations. Recently, 2 additional species of *Cinclotaenia* were described (Macko and Špakulová, 2002; Špakulová et al., 2002), including *Cinclotaenia georgievi* Macko and Špakulová, 2002 from *C. cinclus* in Slovakia and Bulgaria and *Cinclotaenia paradehiscens* Špakulová, Macko & Macková, 2002 from the same host species in Slovakia. Macko and Špakulová (2002) and Macko et al. (2003) also considered *B. cincli* and *B. polyarthra* as species incertae sedis. Georgiev and Genov (1985) analyzed the published records of dilepidid species originally described from dippers that have been reported from other families of birds and considered most of doubtful validity.

At present, no information exists on the parasites of dippers in the Neotropical Region. The present article contains the descriptions of 2 unknown species of dilepidid cestodes collected from *C. leucocephalus* in Bolivia.

## MATERIALS AND METHODS

### Collection locality

During an extensive survey of the parasites of mammals of Bolivia (Anderson, 1997; Gardner and Pérez-Ponce de León, 2002), 1 of us (S.L.G.) recovered a single individual dipper (*C. leucocephalus*) that had been caught in a mist net that was being used to capture bats early on the morning of 3 August 1992 at Rio Aceromarca, Departamento de La Paz, Bolivia.

Immediately upon capture, the bird was killed with chloroform, examined for parasites, and prepared as a museum specimen. The air sacs and pleural and peritoneal cavities were opened and examined for parasites, and the intestines were removed, placed in a dish of saline, opened longitudinally, and transferred to cool distilled water for a few minutes. After the cestodes were relaxed, the larger specimens were removed and fixed in hot 10% buffered formalin solution. Minute cestodes from the duodenum were fixed directly in the vial in hot 10% buffered formalin. All material was transported and stored until examination in snap-cap vials in 10% buffered formalin solution. In the laboratory, specimens were removed using a stereo dissecting microscope, washed in water, and transferred to 70% ethanol. Specimens were stained in iron acetocarmine, dehydrated in an ethanol series, cleared in eugenol, and mounted in Canada balsam. Some scolices or entire specimens were mounted in Berlese medium to facilitate adequate observations of rostellar hooks, cirrus armament, and embryonic hooks. Ripe eggs were studied in both whole mounts of stained cestodes and temporary mounts of dissected gravid proglottids in distilled water. Details on the number of specimens and structures measured are given in the text about each species.

Holotype specimens were deposited in the Parasite Collection of the Harold W. Manter Laboratory of Parasitology, the University of Ne-

Received 9 September 2003; revised 12 March 2004; accepted 16 March 2004.
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braska–Lincoln (HWML), paratypes were deposited in the HWML, U.S. National Parasite Collection, Beltsville, Maryland (USNPC), and The Natural History Museum, London, U.K. (BMNH). Some paratypes were retained in the collection of the senior author.

Measurements of the testes, vas deferens, cirrus sac, vitellarium, ovary, vagina, and seminal receptacle were taken only from fully developed mature proglottids. Mensural data are presented as range, mean in parentheses, and number of measurements or counts taken (n). Measurements are given in micrometers unless otherwise stated. Terms used for developmental stages of proglottids correspond to those previously defined by Georgiev and Vaucher (2001).

## DESCRIPTION

### *Cinclotaenia minuta* n. sp.

(Figs. 1–8)

Body minute (Fig. 1), when fully developed 0.85–1.58 mm (1.26 mm, n = 7) long. Strobila wedge shaped, consisting of 5–10 (8, n = 7) proglottids, e.g., 3 juvenile, 2 premature, 3 mature, 1 postmature, and 1 gravid proglottid. Maximum width at pregravid and gravid proglottids, 360–560 (430, n = 12). Scolex well outlined from strobila by narrower neck, with maximum diameter at level of suckers, 210–250 (229, n = 11); anterior part of scolex protruded (Fig. 2). Rostellar apparatus musculoglandular. Rostellum elliptical to fungiform, 70–84 (76, n = 7) long, with maximum diameter of 32–41 (38, n = 9) at hook crown, with thick walls consisting mostly of circular musculature; glandular cells present within rostellum. Rostellar pouch thin walled, elliptical, 118–179 (147, n = 8) long, reaching level almost at posterior margin of suckers with maximum width about middle, 68–93 (81, n = 10); filled with intensely stained glandular tissue (Fig. 2). Rostellar hooks 20–22 (n = 9) in number, situated in 2 regular rows; 19 hooks only in 1 specimen. Anterior hooks (Fig. 3) 16–17 (n = 6) long, posterior hooks (Fig. 4) 16–17 (n = 4) long; no difference in shape of anterior and posterior hooks observed. Suckers round, with apertures directed anterodorsally and anteroventrally, with diameter 98–118 (112, n = 24); their musculature moderately developed. Neck distinct, 73–131 (98, n = 12) wide at narrowest part; first proglottids appearing at 68–143 (92, n = 10) from posterior margins of suckers. Ventral osmoregulatory canals 3–6 (n = 10) in diameter, forming transverse anastomosis along posterior margin of each proglottid. Dorsal osmoregulatory canals 1–3 (n = 10) in diameter. Proglottids craspedote, usually wider than long at all developmental stages except gravid, which might be almost as long as wide; occasionally, mature proglottids slightly longer than wide. Genital pores irregularly alternating, situated in anterior third of lateral margin of mature and far anterior in gravid proglottids. No genital papilla. Genital atrium (Fig. 6) simple, infundibular, surrounded by intensely stained cells. Genital ducts usually passing dorsally to osmoregulatory canals, occasionally in same strobila, also passing between osmoregulatory canals.

Testes 12–17 (14, n = 20) in number, forming compact group posterior to vitellarium and ovary situated in posterior half to two thirds of median field. In some proglottids, testes may overlap vitellarium and posterior margins of ovary (Fig. 5). Maximum diameter of fully developed testes 46–63 (55, n = 12). Vas deferens diameter 4–7 (6, n = 12), forming coils in median field near anterior margin of proglottid; glandular prostate cells not observed. Cirrus sac usually situated slightly oblique in proglottid, elliptical, thick walled, 72–93 by 23–34 (83 by 29, n = 12), overlapping or crossing about its middle poral osmoregulatory canals; in some proglottids, when cirrus fully evaginated (Fig. 7), cirrus sac oval, measuring 59–72 by 27–39 (65 by 34, n = 5). Internal vas deferens forming several coils in aporal half of cirrus sac (Figs. 5, 6). Evaginated cirrus cylindrical, unarmed, with diameter 11–13 (n = 11).

Vitellarium median, reniform to oval, lobed, 48–88 (66, n = 12) wide. Ovary bilobed, consisting of deep, almost transverse lobes; 2 lobes connected by wide isthmus; occupying entire width of median field, 147–273 (202, n = 12) wide. Mehlis' gland globular, 20–38 (23, n = 12) in diameter, not distinct in some proglottids. Seminal receptacle oval, extending from level of aporal end of cirrus sac to Mehlis' gland, 61–122 by 36–59 (78 by 43, n = 12) when filled (Figs. 5, 6). Vagina opens posteriorly to male pore and passing posteriad to cirrus sac; copulatory part thick walled, lumen with diameter 4–9 (6, n = 12), surrounded by cellular sleeve with diameter 11–16 (13, n = 12).

Uterine development rapid. Uterus first appearing as a transversely elongate sac occupying whole median field, its lateral branches may slightly pass into lateral fields; ventral to degenerating ovary and vitellarium; uterine wall forming deep diverticula. Fully developed uterus thick walled; walls of diverticula creating impression for compartmentalization of organ (Fig. 7). Eggs forming egg packets, each containing 10–18 eggs (Figs. 7, 8). Outer envelope thin, with irregular shape, often not distinct in whole mounts; diameter of eggs in whole mounts 29–38 (33, n = 20), in distilled water 46–60 (53, n = 20). Embryophores thick walled, spherical, with diameter 23–29 (28, n = 20). Oncospheres oval, with diameter 16–19 (18, n = 20). Embryonic hooks of central pair 8–10 (n = 10) long, of lateral pairs 6–8 (n = 10).

#### Taxonomic summary

*Type host: Cinclus leucocephalus* Tschudi, 1844 (Aves: Passeriformes: Cinclidae) (1 individual).

*Site of infection:* Anterior one third of small intestine (duodenum).

*Symbiotype* (see Frey et al., 1992). *Holosymbiotype: Cinclus leucocephalus* Tschudi, 1844. Female. Museo Nacional de Historia Natural, La Paz, Bolivia, Colección Boliviana de Fauna, Catalog no. 2439. Collected on 3 August 1992. Field collection no. SED751 (by Susan E. Davis), necropsy by S.L.G. (SLG-230-92).

*Type locality:* Rio Aceromarca, Departamento de La Paz, Bolivia, 16°19′S, 67°53′W, elevation 2,990 m.

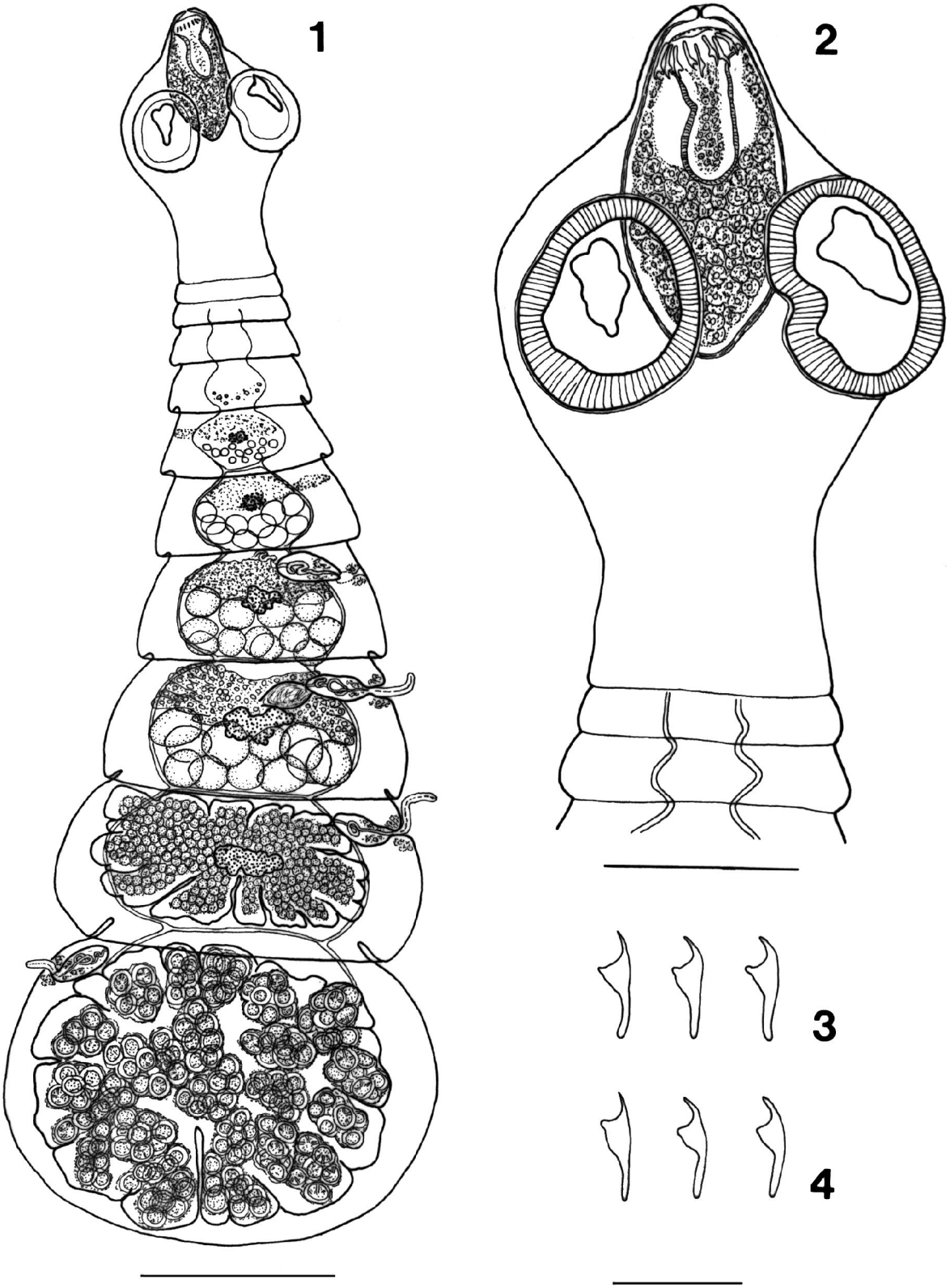
*Specimens studied:* Twenty-one specimens from duodenum (mostly fragmented during isolation), including 7 entire specimens, 10 stained scolices, 4 scolices in Berlese medium, and 13 stained strobilar fragments.

*Specimens deposited:* Holotype HWML 45725; Paratypes HWML 45726–45736; MHNG (INVE) 35061–35063.

*Etymology:* The species name refers to the size of the organism, which is extremely small.

#### Diagnosis

*Cinclotaenia minuta* n. sp. resembles a group of species within the genus that are characterized by rather short rostellar hooks (less than 20 μm), including *C. filamentosa* from the Nearctic




FIGURES 1–4. *Cinclotaenia minuta* n. sp. **1.** General view. **2.** Scolex. **3.** Anterior rostellar hooks. **4.** Posterior rostellar hooks. Bar = 250 μm (Fig. 1), 100 μm (Fig. 2), and 20 μm (Figs. 3, 4).

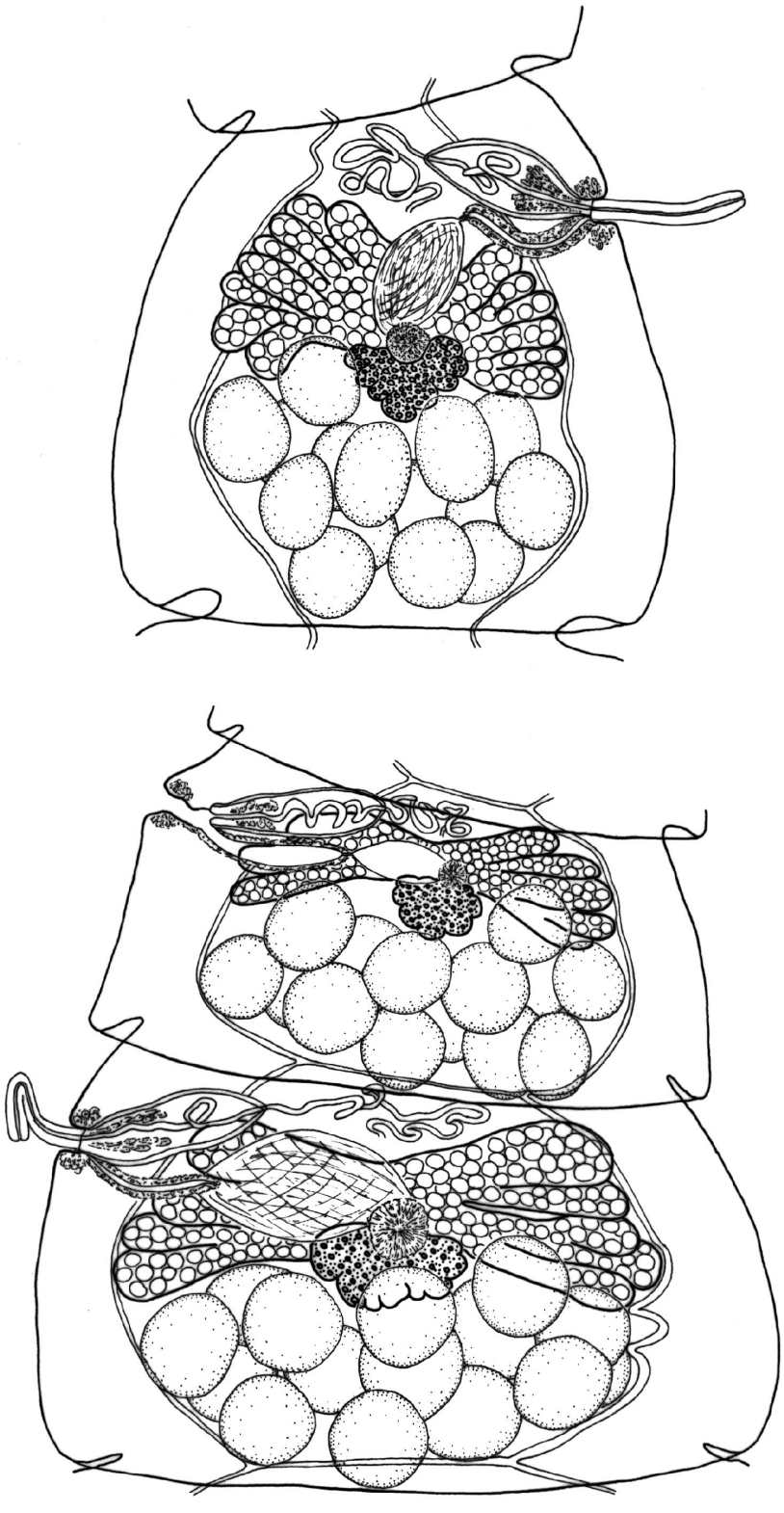
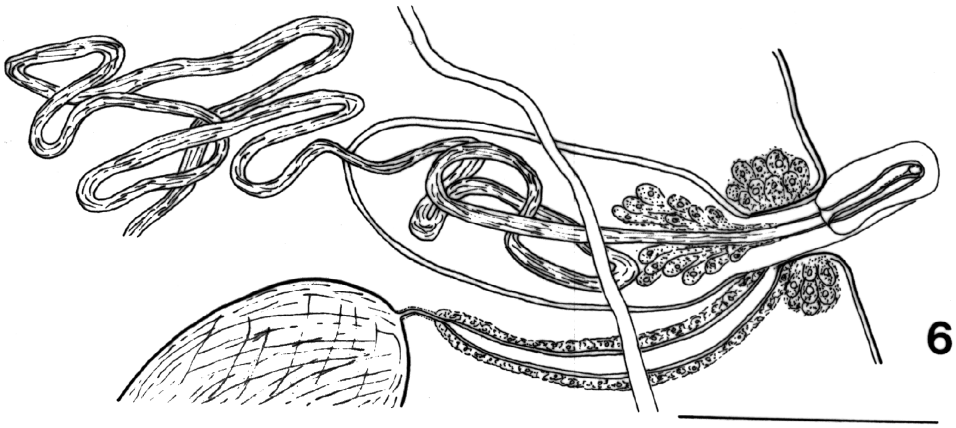
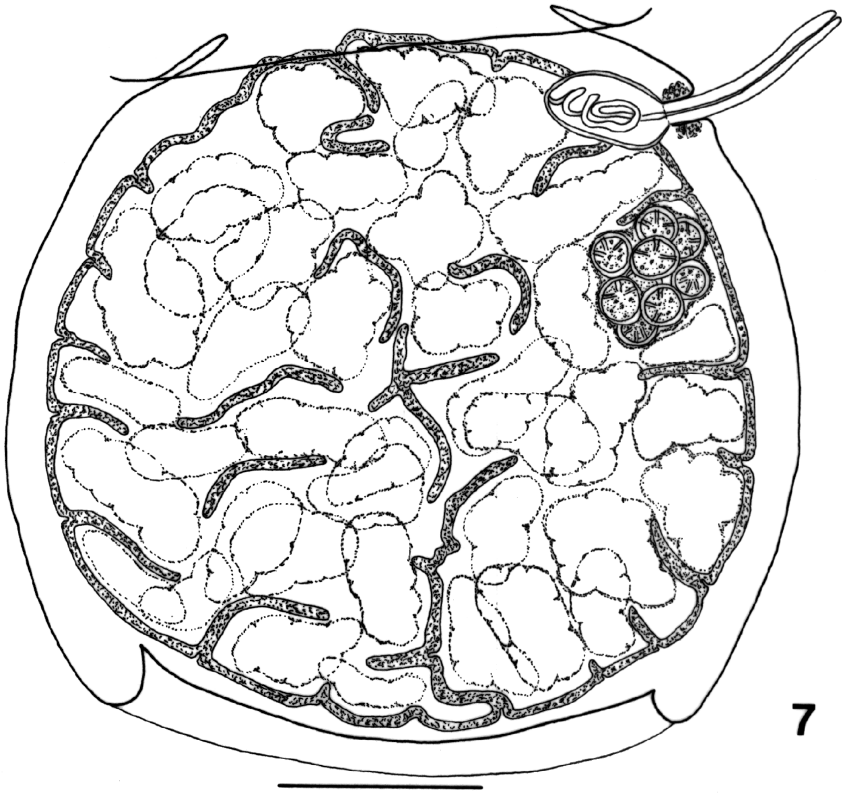
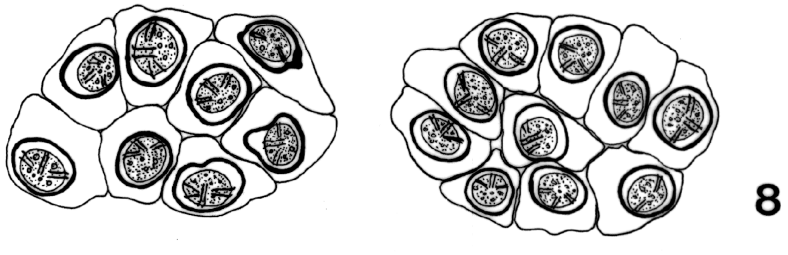


FIGURE 5. *Cinclotaenia minuta* n. sp. Mature proglittids. Bar = 100 μm.




FIGURES 6–8. *Cinclotaenia minuta* n. sp. **6.** Genital ducts in mature proglottid. **7.** Gravid proglottid. **8.** Egg packets examined in distilled water. Bar = 50 μm (Fig. 6) and 100 μm (Figs. 7, 8).

TABLE I. Comparison of mensural and meristic data for *Cinclotaenia* spp. possessing rostellar hooks shorter than 20 μm.

| Species: | *Cinclotaenia filamentosa* | | *Cinclotaenia dehiscens* | | *Cinclotaenia paradehiscens* | *Cinclotaenia minuta* | |
|---|---|---|---|---|---|---|---|
| Host: | *Cinclus mexicanus* | | *Cinclus cinclus* | | *Cinclus cinclus* | *Cinclus leucocephalus* | |
| Locality: | Oregon, USA | | Slovakia | Bulgaria | Slovakia | Bolivia | |
| Literature source: | Macy (1973) | | Špakulová et al. (2002) | Georgiev & Genov (1985) | Špakulová et al. (2002) | Present study | |
| Character | Range | Mean | Range | Range | Range | Range | Mean |
| Length (mm) | 4.3–13 | — | 5.2–8.8 | 5.76–9.03 | 22–32 | 0.85–1.58 | 1.26 |
| Width (mm) | 1.37–1.65 | 1.55 | 0.679–0.975 | 0.666–0.970 | 1.2–1.9 | 0.36–0.56 | 0.43 |
| Proglottids: number | 27–46* | — | — | 66–87 | — | 5–10 | 8 |
| Scolex: diameter | 440–620 | 520 | 214–366 | 304–400 | 193–327 | 210–250 | 229 |
| Rostellum | | | | | | | |
| Length | — | — | 100–131 | 100–131 | — | 70–84 | 76 |
| Width | — | — | 36–44† | 50–56 | 23–24 | 32–41 | 38 |
| Rostellar pouch | | | | | | | |
| Length | — | — | 165–195 | 175–287 | 152 | 118–179 | 147 |
| Width | — | — | 93–124 | 150–156 | 117 | 68–93 | 81 |
| Suckers: diameter | 236–260 | 248 | 117–166 | 160–193 | 96–178 | 98–118 | 112 |
| Rostellar hooks | | | | | | | |
| Number | 20–21 | — | 19–21 | 17–22 | 17–19 | 19–22 | — |
| Length of anterior hooks | about 15‡ | — | 16.5–17 | 17–18‡ | 17–18 | 16–17 | — |
| Length of posterior hooks | about 15‡ | — | 15–16 | 17–18‡ | 16–17 | 16–17 | — |
| Testes: number | 20–27 | — | 20–30 | 18–29 | 21–45 | 12–17 | 14 |
| Cirrus sac | | | | | | | |
| Length | 150–225 | 186 | 260–283 | 87–120 | 205–290 | 72–93 | 83 |
| Width | 36–45 | 43 | 41–45 | 20–25 | 21–56 | 23–34 | 29 |
| Vitellarium: diameter | 186–273 | 231 | — | — | 217–297 | 48–88 | 66 |
| Seminal receptacle | | | | | | | |
| Length | 150–210 | 166 | 176–193 | 57–68 | 162–234 | 61–122 | 78 |
| Width | 21–33 | 28 | 58–76 | 33–57 | 69–128 | 36–59 | 43 |

* Calculated on the basis of the following original data: 20–29 ''immature'', 5–13 ''mature'', and 2–4 ''gravid'' proglottids (Macy, 1973).
† Exceptionally, 30–53.
‡ Lengths of anterior hooks and posterior hooks not separately given.

and *Cinclotaenia dehiscens* and *C. paradehiscens* from dippers in the Palearctic Region (Table I); however, *C. minuta* can be recognized as distinct from the 3 species mentioned above by possessing a very small body, not exceeding 2 mm in length. The shortest length reported for a gravid specimen of *C. filamentosa* was 4.3 mm reaching a maximum length of 13 mm (Macy, 1973). The strobila of *C. minuta* consists of a very small number of proglottids (5–10) and exhibits a very rapid maturation (Fig. 1). In contrast, the other 3 species are characterized by bandlike strobila containing numerous proglottids (Table I). In addition, *C. minuta* differs from the other 3 species by having fewer testes and a smaller cirrus sac (Table I).

### *Cinclotaenia boliviensis* n. sp.

(Figs. 9–16)

Body elongate, when fully developed 20–26 mm (22.5 mm, n = 3) long, consisting of 67–74 (71, n = 3) proglottids. Maximum width of whole specimens at pregravid proglottids, 1.20–1.44 mm (1.32 mm, n = 3). Gravid fragments 1.40–1.64 mm (n = 2) wide. Scolex well outlined from strobila by narrower neck, with maximum diameter at level of suckers, 371–411 (n = 2); anterior part of scolex protruded. Rostellar apparatus musculoglandular. Rostellum mushroom shaped, 215–228 (n = 2) long, with maximum diameter of 103–108 (n = 2) at hook crown; rostellar walls thick, consisting mostly of circular musculature; numerous glandular cells within rostellum. Rostellar pouch thin walled, elliptical, 255–295 (n = 2) long, extending posteriad to level at beginning of neck; maximum width about middle of pouch, 148–157 (n = 2); filled with intensely stained, strongly developed glandular tissue (Fig. 9). Rostellar hooks 22 (n = 3) in number, situated in 2 regular rows. Anterior hooks 39–42 (41, n = 10) long, length of blade 11–12 (n = 10). Posterior hooks 39–42 (41, n = 8) long, length of blade 11–12 (n = 10). No difference in shape of anterior and posterior hooks. Suckers round, 143–170 (155, n = 8) in diameter, apertures directed anterodorsally and anteroventrally; musculature of suckers moderately developed. Neck distinct, 201–224 (n = 2) wide at narrowest part; first proglottids appearing at 160–220 (n = 2) from posterior margins of suckers. Ventral osmoregulatory canals with diameter of 29–38 (34, n = 10) in mature proglottids, forming transverse anastomosis along posterior margin of each proglottid. Dorsal osmoregulatory canals 6–13 (8, n = 10) in diameter. Proglottids craspedote, usually wider than long at all developmental stages (Figs. 12, 14, 15). Genital pores irregularly alternating, mostly in short series, e.g., . . . 1, 5, 1, 4, 1, 1, 7, 1, or . . . 2, 1, 2, 2, 4, 2, 4, 2, 1, 1, 1, 2, 2, 3, situated in anterior half of lateral margin of mature and far anterior in gravid proglottids, respectively (Figs. 12, 15). Genital atrium 16–27 (23, n = 10) deep, with infundibular orifice and cylindrical proximal part 14–23 (17, n = 10) in diameter; situated on tall, well-expressed genital papilla with walls containing strongly developed musculature and glandular cells. Genital ducts passing between osmoregulatory canals (n = 17).

Testes 43–68 (57, n = 10) in number, arranged in 2 or 3 layers, forming compact group in posterior half of median field, posteriorly to vitellarium and ovary; occasionally overlapping vitellarium and posterior margins of ovary (Fig. 12); maximum diameter of fully developed testes 81–98 (87, n = 10). External vas deferens with diameter 11–15, forming coils in poral half of median field near anterior proglottid margin; prostate cells not seen. Cirrus sac oblique, elongate-elliptical, thin walled, 174–228 by 36–49 (201 by 45, n = 17), situated mostly in poral part of lateral field, often overlapping poral osmoregulatory canals; aporal part sometimes slightly situated in median field; intensely stained cells in poral part of cirrus sac. Internal vas deferens slightly coiled (Figs. 12, 13). Cirrus cylindrical, 61–63 (n = 3) long, 14–16 (15, n = 7) in diameter with slightly tapering tip, unarmed.

Vitellarium disposed porally, reniform to U shaped, deeply lobed, 142–163 (149, n = 10) wide. Ovary bilobed, consisting of long, almost transverse, digitiform lobes, often connected by distinct anastomoses, i.e., organ assuming reticulate appearance; 2 wings connected by wide isthmus; occupying entire width of median field, distal parts of lateral lobes overlapping osmoregulatory canals. Mehlis' gland globular, with diameter 20–24 (22, n = 10). Seminal receptacle thin walled, oval, dorsal to ovary, extending from level of cirrus sac antiporal end to poral half of vitellarium; when filled 143–241 by 98–156 (196 by 137, n = 14) (Figs. 12, 13). Vagina opening posteriorly to opening of cirrus sac and passing posteriorly to it; copulatory part with thick-walled lumen with diameter 6–8 (7, n = 10), surrounded by cellular sleeve; diameter of copulatory part 22–29 (25, n = 10). Conductive part thin and short, often coiled.

Uterus first appearing ventrally to vitellarium, ovary, and testes as a reticular structure occupying whole median field; its lateral branches passing into lateral fields. With degeneration of male and female gonads and further uterine development, uterus becoming divided into many compartments (Fig. 14); uterine wall forming deep diverticula; at this stage, eggs not forming packets. Fully developed uterus thick walled, with strongly developed uterine epithelium (Fig. 15). Fully developed eggs forming egg packets (Fig. 16), each containing 12–32 eggs. Outer envelope thin, provided with long filaments 370–390 in length (not distinct in whole mounts). Embryophore consisting of granular external layer and refractive oval layer with diameter 24–29 (27, n = 10). Oncosphere spherical to slightly oval, 16–21 (19, n = 10) in diameter. Embryonic hooks of central pair 13–14 long, of lateral pairs 9–10 long.

#### Taxonomic summary

*Type host: Cinclus leucocephalus* Tschudi, 1844 (1 individual).

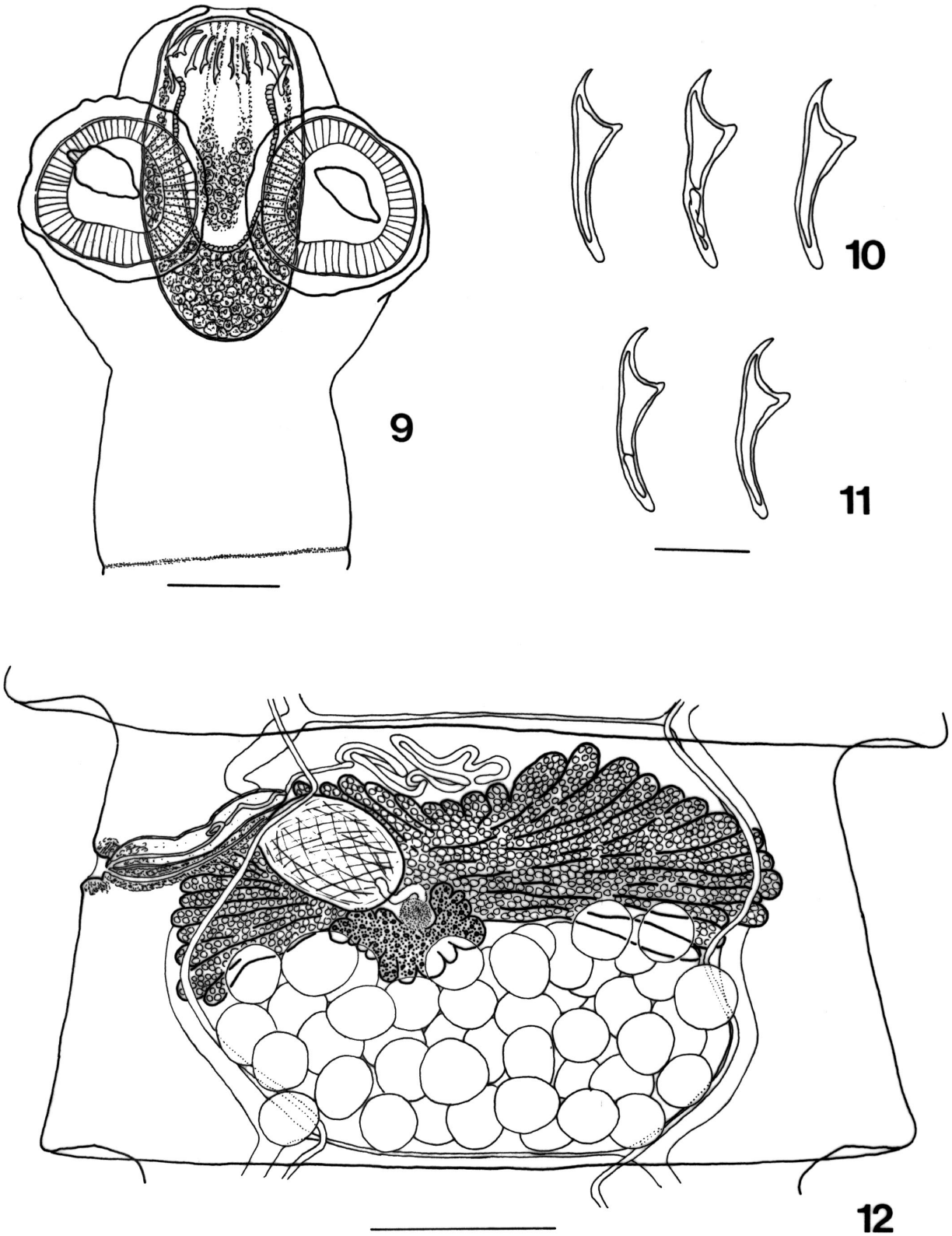
*Site of infection:* Anterior one third of small intestine (duodenum).

*Type locality:* Rio Aceromarca, Departamento de La Paz, Bolivia, 16°19′S, 67°53′W, elevation 2,990 m.

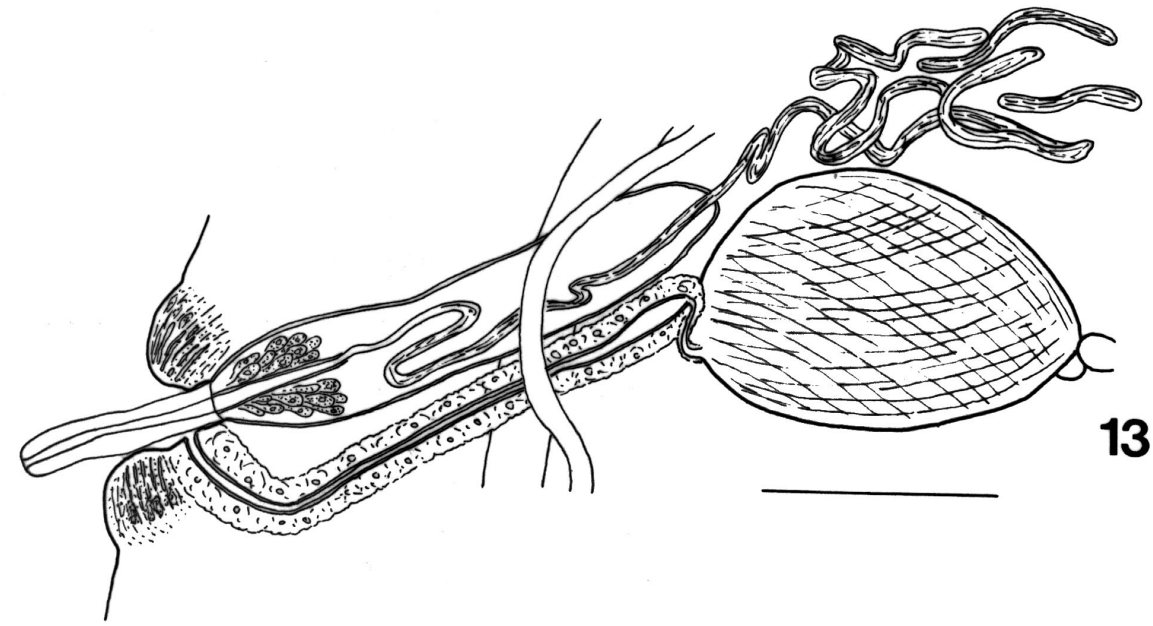
*Symbiotype* (see Frey et al., 1992). *Holosymbiotype: Cinclus leucocephalus* Tschudi, 1844. Female. Museo Nacional de Historia Natural, La Paz, Bolivia, Colección Boliviana de Fauna Catalog no. CBF2439. Collected on 3 August 1992. Field collection no. SED751 (by Susan E. Davis), necropsy by S.L.G. (SLG-230-92).

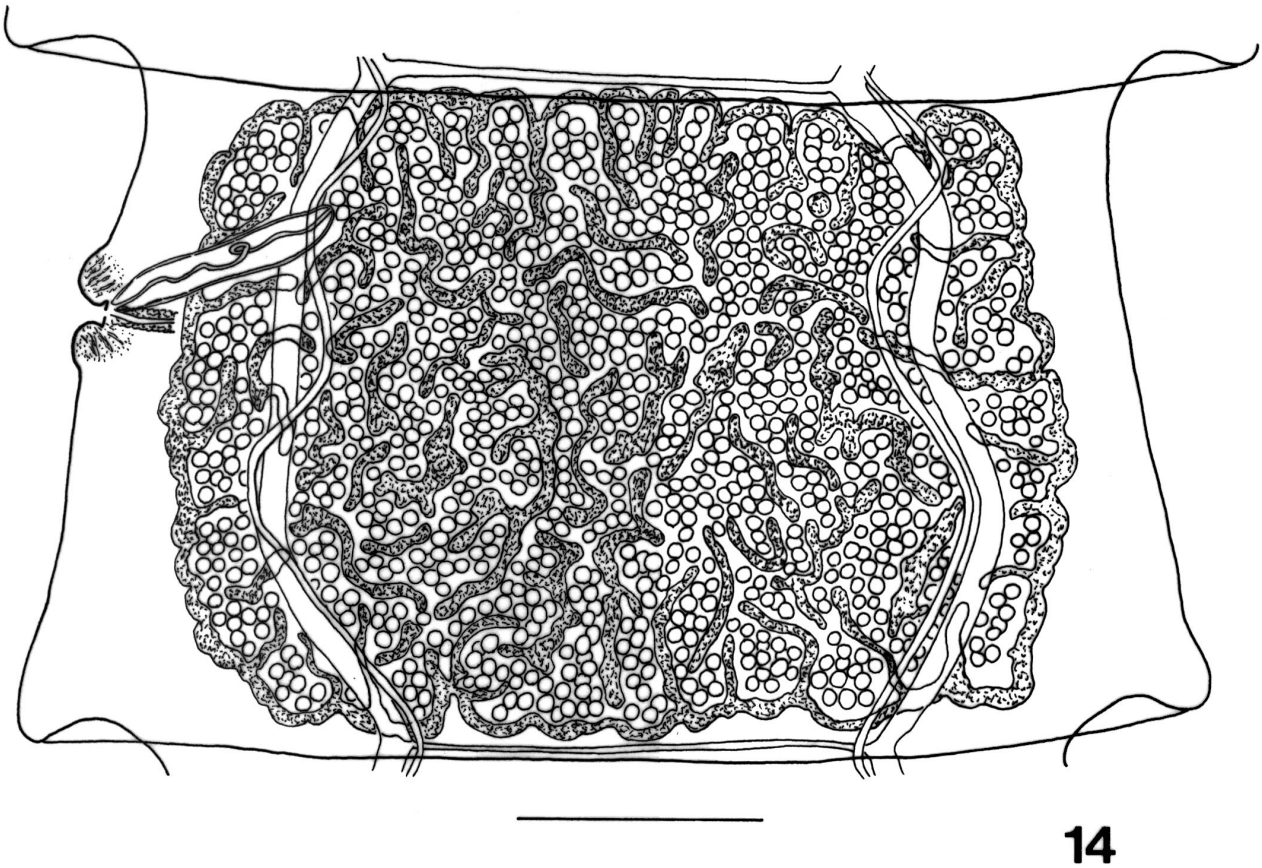
*Specimens studied:* Three specimens from duodenum, stained and mounted on glass slides as whole mounts (last proglottids pregravid); 1 scolex mounted on a slide in Berlese medium; 2 detached fragments consisting of gravid proglottids.

*Specimens deposited:* Holotype HWML 45719; Paratypes HWML 45720–45724.

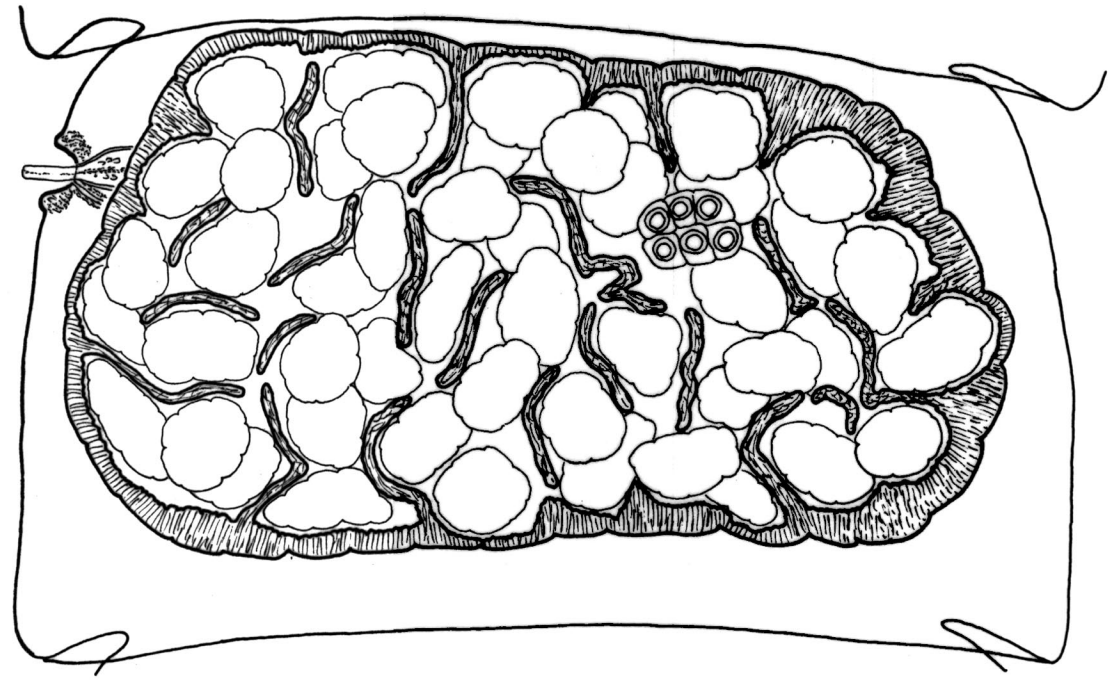


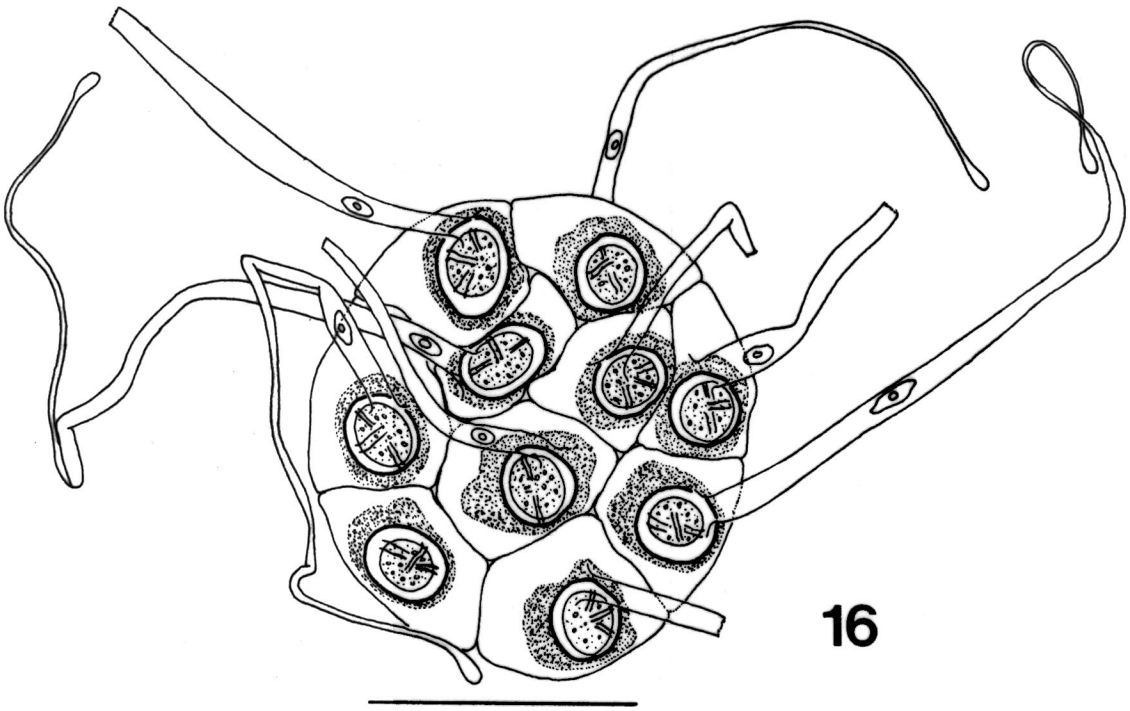

FIGURES 9–12. *Cinclotaenia boliviensis* n. sp. **9.** Scolex. **10.** Anterior rostellar hooks. **11.** Posterior rostellar hooks. **12.** Mature proglottid. Bar = 100 μm (Fig. 9), 20 μm (Figs. 10, 11), and 250 μm (Fig. 12).




FIGURES 13–14. *Cinclotaenia boliviensis* n. sp. **13.** Genital ducts in mature proglottid. **14.** Pregravid proglottid. Bar = 100 μm (Fig. 13) and 250 μm (Fig. 14).




FIGURES 15–16. *Cinclotaenia boliviensis* n. sp. **15.** Gravid proglottid. **16.** Egg packets examined in distilled water. Bar = 250 μm (Fig. 15) and 100 μm (Fig. 16).

*Etymology:* The species name refers to Bolivia, the country in which it was first found.

## Diagnosis

The new species can be diagnosed by the length of the strobila, the length and the shape of rostellar hooks, and the disposition of the internal organs in mature proglottids, *C. boliviensis* n. sp. appears closely related to the Palearctic species *Cinclotaenia tarnogradskii* and *C. georgievi. Cinclotaenia boliviensis* can be distinguished from both these species in that the rostellar hooks of the new species are longer (Table II) and *C. boliviensis* has well-expressed muscular genital papilla (Fig.

TABLE II. Comparison of ranges of mensural and meristic data on dilepidid cestodes of dippers having rostellar hooks longer than 25 μm.

| Species: | *Cinclotaenia tarnogradskii* | *Cinclotaenia georgievi* | | *"Borgarenkolepis" cincli* | *Taenia* (s.l.) *polyarthra* | *Cinclotaenia boliviensis* n. sp. |
|---|---|---|---|---|---|---|
| Host: | *Cinclus cinclus* | *Cinclus cinclus* | | *Cinclus pallasii* | *Cinclus cinclus* | *Cinclus leucocephalus* |
| Locality: | Bulgaria | Slovakia | Bulgaria | Tadzhikistan | Central Asia | Bolivia |
| Literature source: | Georgiev & | Macko & | Georgiev & | Spasskaya & | | |
| Character | Genov (1985) | Špakulová (2002) | Genov (1985) | Spasskii (1977) | Krabbe (1882) | Present study |
| Length (mm) | 23–27 | up to 54.8 | 23–24 | 10–15 | 20 | 20–26 |
| Width (mm) | 1.11–1.52 | 1.5 | 1.42–1.54 | 1 | 3 | 1.40–1.64 |
| Proglottids: number | 96–107 | — | 95–115 | about 50 | — | 67–74 |
| Scolex: diameter | 300–387 | 320–476 | 293–450 | 290 | — | 371–411 |
| Rostellum | | | | | | |
| Length | 137–190 | — | 107–175 | 175 | — | 215–228 |
| Width | 65–100 | 102–105 | 105–118 | 95 | — | 103–108 |
| Rostellar pouch | | | | | | |
| Length | 137–268 | 203–244 | 187–250 | 210 | — | 255–295 |
| Width | 95–125 | 102–163 | 130–137 | 125 | — | 148–157 |
| Suckers: diameter | 88–112 | 119–163 | 93–150 | 135 | — | 143–170 |
| Rostellar hooks | | | | | | |
| Number | 18–20 | 23–27 | 23–27 | 20 | 20 | 22 |
| Length of anterior hooks | 33–37* | 30.5–36* | 33–37* | 29–30* | 26* | 39–42 |
| Length of posterior hooks | 33–37* | 30.5–36* | 33–37* | 29–30* | 26* | 39–42 |
| Testes: number | 40–57 | 24–51 | 40–52 | 10–12 | — | 43–68 |
| Cirrus sac | | | | | | |
| Length | 175–193 | 200–351 | 188–200 | 185–220 | — | 174–228 |
| Width | 25 | 34–52 | 50–52 | 40–50 | — | 36–49 |
| Vitellarium: diameter | 100–187 | 179–362 | 112–212 | — | — | 142–163 |
| Seminal receptacle | | | | | | |
| Length | 194–237 | 90–176 | 177–200 | 110 | — | 143–241 |
| Width | 112–119 | 70–96 | 88–112 | 60 | — | 98–156 |

* Lengths of anterior hooks and posterior hooks not separately given.

13), which has not been described for the other 2 species (Spasskaya and Spasskii, 1977; Georgiev and Genov, 1985; Macko and Špakulová, 2002). In addition, *C. boliviensis* can be recognized as distinct in having a longer rostellum, a larger rostellar pouch, and a much greater number of testes (Table II).

*Cinclotaenia boliviensis* can be recognized as distinct from the 2 species of dilepidids from dippers that have an uncertain generic allocation, i.e., *B. cincli* and *Taenia* (s.l.) *polyarthra*, by having a greater number and size of rostellar hooks and a greater number of testes (Table II) (Georgiev and Genov, 1985; Macko and Špakulová, 2002; Macko et al., 2003).

## DISCUSSION

After the establishment of *Cinclotaenia* (for *C. filamentosa*) by Macy (1973), its definition has been emended several times (Georgiev and Genov, 1985; Bona, 1994; Špakulová et al., 2002; Macko et al., 2003). The presence of filaments on the egg packets in fresh–living specimens, as described by Macy (1973) for *C. filamentosa* and confirmed by Georgiev and Genov (1985) for *C. tarnogradskii*, has always been an essential element of the generic diagnosis. Recently, Špakulová et al. (2002) described the formation of egg packets in *C. dehiscens* and *C. paradehiscens* but did not observe filaments. Because specimens that they studied were derived from preserved material only, they noted, with some uncertainty, the absence of filaments on the egg packets. Our observations on gravid proglottids of *C. minuta*, dissected in distilled water, showed the absence of filaments on the egg packets (Fig. 8). The same method as applied to *C. boliviensis* revealed the presence of filaments (Fig. 16). Therefore, we confirm the amendment of the generic diagnosis proposed by Špakulová et al. (2002). The peculiarity of the structure of the uterus was emphasized in previous studies (Georgiev and Genov, 1985; Bona, 1994; Špakulová et al., 2002; Macko et al., 2003). At present, we cannot add to the interpretations made by these authors.

Until now, species of *Cinclotaenia* were only known from *Cinclus* spp. from the Holarctic Region (Macy, 1973; Spasskaya and Spasskii, 1977; Georgiev and Genov, 1985; Macko and Špakulová, 2002; Špakulová et al., 2002). This study provides the first record of species of *Cinclotaenia* from the Neotropical Region. Because species of *Cinclus* appear to be monophyletic (Sibley and Monroe, 1990; Brewer, 2001), this host–parasite system appears to be very suitable for a detailed study of tapeworm–avian coevolution and biogeography.

## ACKNOWLEDGMENTS

We thank the mammal collection crew of 1992 including S. Anderson, S. V. Brant, J. Salazar-Bravo, S. Davis, M. Blair, and J. Dunnum. We also thank the staff and students of the Colección Boliviana de Fauna of the Museo Nacional de Historia Natural, La Paz, for assistance with all phases of collecting and logistics. This work was supported by United States National Science Foundation Grants BSR8612329, BSR9024816, DEB9496263, DEB9631295 to S.L.G., BSR8408923 to T. L. Yates, and BSR8316740 to S. Anderson. We are grateful to P. Nikolov for reading the manuscript. Thanks also to Agustín Jiménez-Ruiz for lab assistance.

## LITERATURE CITED

ANDERSON, S. 1997. Mammals of Bolivia, taxonomy and distribution. Bulletin of the American Museum of Natural History **231:** 1–652.

BONA, F. V. 1994. Family Dilepididae Railliet & Henry, 1909. *In* Keys to the cestode parasites of vertebrates, L. F. Khalil, A. Jones, and R. A. Bray (eds.). CAB International, Wallingford, U.K., p. 443–554.

BREWER, D. 2001. Wrens, dippers and thrashers. Yale University Press, New Haven, Connecticut, p. 199–207.

FREY, J. K., D. W. DUSZYNSKI, W. L. GANNON, T. L. YATES, AND S. L. GARDNER. 1992. Designation and curation of type host specimens (Symbiotypes) for new parasite species. Journal of Parasitology **78:** 930–932.

GARDNER, S. L., AND G. PÉREZ-PONCE DE LEÓN. 2002. *Yungasicola travassosi* gen. n., sp. n. (Digenea: Dicrocoeliidae: Eurytrematinae) from two species of grass mice of the genus *Akodon* Meyen (Rodentia: Muridae) from the Yungas of Bolivia. Comparative Parasitology **69:** 51–57.

GEORGIEV, B. B., AND T. GENOV. 1985. Taxonomy and morphology of cestodes, parasites of *Cinclus cinclus* L. in Bulgaria. Parasitologia Hungarica **18:** 49–62.

———, AND C. VAUCHER. 2001. Revision of the genus *Parvirostrum* Fuhrmann, 1908 (Cestoda, Cyclophyllidea, Paruterinidae). Systematic Parasitology **50:** 13–29.

KRABBE, H. 1882. Nye Bidtrag til Kundskab om Fuglenes Bændelorme. Det Videnskabelige Selskabs Skrifter, 6. Række, naturvidenskabelig og mathematisk **7:** 349–266.

MACKO, J. K., AND M. ŠPAKULOVÁ. 2002. A description of *Cinclotaenia georgievi* n. sp. (Cestoda: Dilepididae), a tapeworm from the dipper *Cinclus cinclus* (L.) (Passeriformes: Cinclidae). Systematic Parasitology **52:** 75–80.

———, ———, AND A. MACKOVÁ. 2003. Tapeworms of the dipper *Cinclus cinclus aquaticus* Bechstein (Passeriformes: Cinclidae) in the Slovak Republic and a key to cestode species specific to dippers. Helminthologia **40:** 59–62.

MACY, R. W. 1973. *Cinclotaenia filamentosa* gen. et sp. n. (Cestoda: Dilepididae) from the dipper in Oregon. Proceedings of the Helminthological Society of Washington **40:** 201–204.

OSHMARIN, P. G. 1968. Helminth fauna of dippers in view of the question about the formation of the helminth fauna of animals. Parazity Zhivotnykh i Rasteniy **4:** 122–128. [In Russian.]

SIBLEY, C. G., AND B. L. MONROE JR. 1990. Distribution and taxonomy of birds of the world. Yale University Press, New Haven, Connecticut, 1,111 p.

ŠPAKULOVÁ, M., J. K. MACKO, AND A. MACKOVÁ. 2002. The description of *Cinclotaenia paradehiscens* n. sp. and its comparison with *Cinclotaenia dehiscens* (Krabbe, 1879) (Cestoda: Dilepididae), tapeworms of the dipper *Cinclus cinclus* (L.) (Passeriformes: Cinclidae). Helminthologia **39:** 227–231.

SPASSKAYA, L. P., AND A. A. SPASSKII. 1977. Cestodes of birds in the USSR. Dilepididae of terrestrial birds. Izdatel'stvo Nauka, Moscow, Russia, 300 p. [in Russian.]