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Neohaematotrephus arayae n. sp. (Digenea: Echinostomiformes: Cyclocoelidae) in *Jacana spinosa* (Aves: Charadriiformes: Jacanidae) from the Área de Conservación Guanacaste, Costa Rica

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NEOHAEMATOTREPHUS ARAYAE N. SP. (DIGENEA: ECHINOSTOMIFORMES: CYCLOCOELIDAE) IN *JACANA SPINOSA* (AVES: CHARADRIIFORMES: JACANIDAE) FROM THE AREA DE CONSERVACIÓN GUANACASTE, COSTA RICA

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ABSTRACT: Specimens of a species of cyclocoelid digenean inhabiting *Jacana spinosa* from the Area de Conservación Guanacaste, Costa Rica, most closely resemble *Haematotrephus facioi* (Brenes and Arroyo, 1962) Yamaguti, 1971, in the same host from Aranjuez, Puntarenas Province, Costa Rica, in having confluent vitelline follicles posteriorly, diagnostic of *Neohaematotrophus,* and in pharynx length, ovary width, and cirrus sac on the sinistral side. The new species is also highly similar in appearance to *H. gendrei* Dubois, 1959, also inhabiting a jacanid (from West Africa), which has vitelline follicles confluent posteriorly, and extending anteriorly to the intestinal bifurcation and genital pore opening immediately posterior to the anterior margin of the pharynx. Like *H. facioi*, *H. gendrei* has a relatively much shorter and broader cirrus sac than does the new species. Examination of the holotype and paratype of *H. facioi* confirmed that the specimens from Guanacaste differ in having a longer body, a larger ovary and eggs, and smaller testes. They also have the ovary on the sinistral rather than the dextral side of the body, genital pore anterior to the pharynx rather than at or posterior to the level of the posterior margin of the pharynx, longer and thinner cirrus sac, and eggs without eyespotted miracidia. Half the eggs in both specimens of *H. facioi* have well-developed eyespotted miracidia, whereas the typical condition for cyclocoelids is for virtually all eggs to exhibit eyespotted miracidia. Both *H. facioi* and *H. gendrei* are transferred to *Neohaematotrophus,* along with the new species.

The family Cyclocoelidae represents an enigmatic group of digeneans living as adults primarily in the body cavities and air sacs of birds, although there have been reports of their being found in the trachea (Pence and Bush, 1973; Scott et al., 1981), orbits, and nasal cavities (Taft and Heard, 1978). Migration from the intestine to the air sacs is known to involve a body-cavity route (Scott et al., 1982; McLaughlin and Marcogliese, 1983). When miracidia hatch, they already contain redia. Rediae have posterior appendages, and some also have anterior appendages. The miracidium is either ingested or actively seeks the intermediate host, but it is the redia that penetrates aquatic snails, both marine and freshwater (Taft and Heard, 1978). Cercariae are produced within this single redia; no other generation of rediae is produced. Cercariae are tailless and either encyst within the redia (Stunkard, 1934; Johnston and Simpson, 1940; Wooton, 1964; McLaughlin, 1976) or emerge and encyst in the host's tissues (Timon-David, 1955). Infection of the definitive host requires active foraging on the infected snails.

In this report on the activities of an inventory of the eukaryotic parasites of vertebrates living within the Area de Conservación Guanacaste (http://www.acguanacaste.ac.cr) in northwestern Costa Rica (http://brooksweb.zoo.utoronto.ca/index.html), we describe a new species of cyclocoelid digenean inhabiting *Jacana spinosa.*

MATERIALS AND METHODS

Worms were collected alive from recently killed birds, killed and fixed by shaking in hot formalin, then stored in 70% ethanol. Specimens were stained with Mayer's hematoxylin, dehydrated, and mounted in Canada balsam. All measurements are in micrometers unless otherwise stated; mean values are followed by actual values in parentheses. All figures were made by using a drawing tube.

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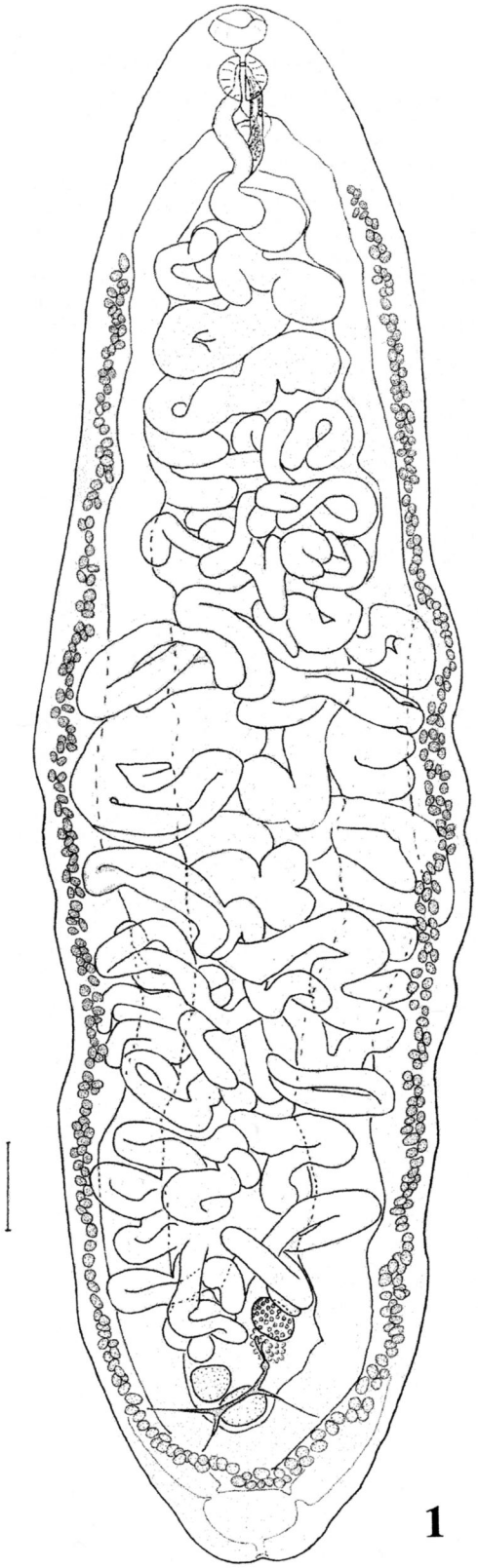
DESCRIPTION

Neohaematotrephus arayae n. sp.
(Figs. 1–3)

Description (based on 3 mature worms): Total body length: 9.2 mm (8.8, 9.60, 9.2 mm). Maximum body width 2.5 mm (2.4, 2.7, 2.5 mm) occurring equatorially. Ventral sucker lacking. Oral sucker subterminal, poorly developed, 268 (253, 281, 270) wide. Pharynx, large, round, very muscular, 253 (266, 247, 247) long by 271 (266, 266, 281) wide. Prepharynx short, 108 (76, 114, 133), outer wall covered by small gland cells. Esophagus typically c shaped, expanded in middle, narrowing at junction with pharynx and with ceca, lined with epithelial cells, 377 (334, 360, 436) long by 105 (82, 87, 146) wide. Ceca forming cyclocoel. Genital pore ventral to anterior margin of pharynx. Testes obliquely situated, oval, sinistral testis 258 (255, 266, 255) long by 228 (255, 220, 209) wide. Dextral testis anterior to sinistral testis and slightly smaller, 222 (190, 228, 247) long by 200 (201, 209, 190) wide. Cirrus sac elongated, weakly muscled, thin walled, 633 (642, 668, 591) long by 77 (77, 92, 62) wide, containing unarmed cirrus, pars prostatica, and internal seminal vesicle. Ovary oval, anterior to testes on sinistral side, 246 (254, 256, 228) long by 224 (255, 209, 209) wide. Mehlis gland posterodorsal to ovary, may partially overlap ovarian margins (2 of 3 specimens). Laurer canal arising dorsally from distal portion of ootype, ending blindly, filled with vitelline material and possibly other waste products of egg production. Uterus passing posteroventral from ootype, initial portion glandular, possibly serving as receptaculum seminis uterinum; loops then ascending anteriad and ventral to ceca; some uterine branches extending extracecally in midbody. Vitellarium follicular, lateral, confluent posteriorly near outer wall of cyclocoel; follicles 74–101 in diameter. Vitelline reservoir posterodorsal to ootype, entering distal portion of ootype near Laurer canal. Metraterm present, thick walled and expanded distally, lined with gland cells. Eggs elliptical, yellow to light brown in color, eggs near metraterm, 147 (133–160) long by 88 (84–99) wide, none possessing miracidia with eyespots. Excretory pore terminal, vesicle expanded posterior to cyclocoel.

Taxonomic summary

Type host: Jacana spinosa (Aves: Charadriiformes: Jacanidae).
Site of infection: Body cavity.
Type locality: Laguna Los Jicaros, Sector Santa Elena (10°52′1″N, 85°38′35″W; 321 m elevation).
Type specimens: Holotype, USNPC no. 93196; paratypes, USNPC no. 93197.
Etymology: The species is named after Sra. Elda Araya, Area de Conservación Guanacaste (ACG) parataxonomist, in recognition of her outstanding efforts with the parasite inventory.



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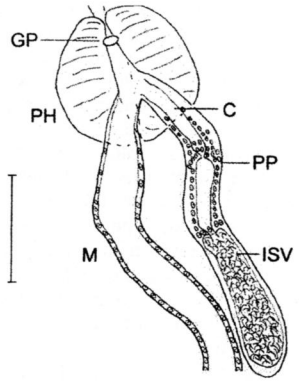

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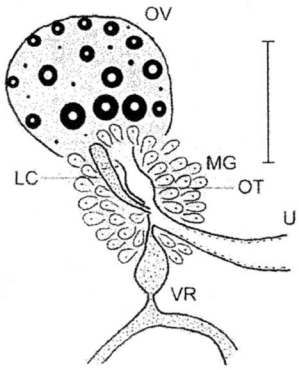

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FIGURES 1–3. *Haematotrephus arayae* n. sp. **1.** Ventral view of holotype. Bar = 500 μm. **2.** Male genitalia: C, cirrus; GP, genital pore; ISV, internal seminal vesicle; M, metraterm; PH, pharynx; PP, pars prostatica. Bar = 200 μm. **3.** Female reproductive system: LC, Laurer canal; MG, Mehlis gland; OT, ootype; OV, ovary; VR, vitelline reservoir; U, uterus. Bar = 200 μm.

Remarks

According to Kanev et al.'s (2002) recent key to the Cyclocoelidae, the new species is a member of the subfamily Haematotrephinae Stossich, 1902, by virtue of having a pretesticular ovary. Furthermore, by virtue of its having confluent vitelline follicles at the posterior end of the body and prepharyngeal genital pores, the new species belongs to *Neohaematotrephus* Kanev et al., 2002.

Among species placed in *Neohaematotrephus* by Kanev et al. (2002), the new species is most similar in appearance to *Cyclocoelum* (*Haematotrephus*) *gendrei* Dubois, 1959 in a jacanid from West Africa (French Guinea) (Dubois, 1959), which has vitelline follicles confluent posteriorly, vitelline follicles extending anteriorly to the intestinal bifurcation, and genital pores opening immediately posterior to the anterior margin of the pharynx. By having confluent vitelline follicles posteriorly, sinistral cirrus sac, and similar pharyngeal length and ovarian width, the new species most closely resembles *C.* (*Haematotrephus*) *facioi* Brenes and Arroyo, 1962, on the basis of 2 specimens in *J. spinosa* from Aranjuez, Puntarenas Province (Brenes and Arroyo, 1962). We examined the holotype and paratype of *C.* (*H.*) *facioi* and confirmed that the new species differs from it in some characters that might be affected by small sample size (2 for *C.* (*H.*) *facioi* vs. 3 for *N. arayae*): longer bodies, larger ovaries and eggs, and smaller testes. However, they also differ in more qualitative traits: *N. arayae* has the ovary on the sinistral rather than the dextral side of the body, genital pores anterior to the pharynx rather than at or posterior to the level of the posterior margin of the pharynx, longer and thinner cirrus sacs, and eggs without eyespotted miracidia. Half the eggs in both specimens of *C.* (*H.*) *facioi* have well-developed eyespotted miracidia, whereas the typical condition for cyclocoelids is for virtually all eggs to exhibit eyespotted miracidia. Like *C.* (*H.*) *gendreii*, *C.* (*H.*) *facioi* has a relatively much shorter and broader cirrus sac than does *N. arayae*.

Using primarily characters associated with the uterine loops, Yamaguti (1971) raised *Haematotrephus* to the generic level and placed *C.* (*H.*) *facioi* within it as *H. facioi* (Brenes and Arroyo, 1962) Yamaguti, 1971. Yamaguti (1971) also transferred *C.* (*H.*) *gendreii* to *Corpopyrum* Wittenberg, 1923 as *C. gendrei* (Dubois, 1959) Yamaguti, 1971. Using the recent key to cyclocoelid genera by Kanev et al. (2002), we place *H. gendrei* in *Neohaematotrephus* as *N. gendrei* (Dubois, 1959) comb. n. and *H. facioi* on account of the difference in the position of the genital pores (prepharyngeal vs. postpharyngeal), in *Uvitellina* as *U. facioi* (Brenes and Arroyo, 1962) comb. n. We hasten to add that we are not completely satisfied that 2 species occurring in the same host species in adjacent provinces of the same country should be placed in different genera in the absence of a phylogenetic analysis of cyclocoelids supporting such a placement.

DISCUSSION

The female reproductive system may be a source of phylogenetically informative characters (Zamparo and Brooks, 2003). Nonetheless, many descriptions of cyclocoelids lack detailed information about the female reproductive system. The most extensive discussion to date was made by Madhavi and Rao (1979), who in a study of *Cyclocoelium elongatum* reported a receptaculum seminis uterinum as well as a blindly ending Laurer canal containing vitelline material (and possibly sperm) arising near the insertion of the vitelline duct in the portion of the ootype proximal to the ovary. This condition of the Laurer canal has evolved at least 1 other time, among members of the Hemiuridae, where it is called the Juel organ (Gibson and Bray, 1979). All 3 specimens of *H. arayae* exhibit the configuration reported by Madhavi and Rao, with 1 exception. The vitelline reservoir and Laurer canal in *H. arayae* and in *H. facioi* enter the ootype distally rather than proximally (see Fig. 3). We note that the blindly ending Laurer canal may be confused with a portion of the vitelline duct because it may be packed with vitelline material.

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