1-2008

Two Cyclocoelids from the Lesser Yellowlegs, Tringa flavipes (Scolopacidae), from the Central Flyway of North America, Including the Description of Haematotrephus selfi n. sp. (Digenea: Cyclocoelidae)

Norman O. Dronen
Texas A&M University

Scott L. Gardner
University of Nebraska

F Agustin Jimenez-Ruiz
Southern Illinois University Carbondale, agustinjz@siu.edu

Published in *Comparative Parasitology*, Vol. 75, No. 1 (2008): 1-11.

Comp. Parasitol.
75(1), 2008, pp. 1–11

Two Cyclocoelids from the Lesser Yellowlegs, *Tringa flavipes* (Scolopacidae), from the Central Flyway of North America, Including the Description of *Haematotrephus selfi* n. sp. (Digenea: Cyclocoelidae)

NORMAN O. DRONEN,[1,3] SCOTT L. GARDNER,[2] AND F. AGUSTÍN JIMÉNEZ[2]

[1] Laboratory of Parasitology, Department of Wildlife and Fisheries Sciences, Texas A&M University, 2258 TAMU, College Station, Texas 77843-2258, U.S.A. (email: n-dronen@tamu.edu) and

[2] H. W. Manter Laboratory of Parasitology, University of Nebraska State Museum, University of Nebraska, Lincoln, Nebraska 68588-0514, U.S.A. (e-mail: slg@unl.edu; fruiz@unlserve.unl.edu)

ABSTRACT: Seven specimens of cyclocoelids (6 specimens representing *Haematotrephus selfi* n. sp. and 1 specimen representing a second unidentified species of *Haematotrephus*) collected by the late Dr. J. Teague Self, former professor, Department of Zoology, University of Oklahoma, Norman, Oklahoma, U.S.A., from the body cavities of 3 lesser yellowlegs, *Tringa flavipes*, (2 birds collected from Roger Mills County, Oklahoma on 23 and 29 August 1963, and 1 collected from Manitoba, Canada on 3 June 1964) and deposited in the Manter Laboratory of Parasitology, University of Nebraska, Lincoln, Nebraska are described. *Haematotrephus selfi* n. sp. can be distinguished from all other species in the genus that lack an oral sucker except *Haematotrephus limnodromi* by having intertesticular uterine loops. It most closely resembles *H. limnodromi* but differs from it by having a smaller body, a smaller pharynx, smaller testes, a shorter cirrus sac, and somewhat smaller eggs. In addition, *H. selfi* n. sp. lacks a uterine seminal receptacle.

KEY WORDS: Canada, Cyclocoelidae, Digenea, Haematotrephinae, *Haematotrephus selfi* n. sp., *Tringa flavipes*, lesser yellowlegs, Manitoba, *Neohaematotrephus*, North America, Oklahoma, Scolopacidae, Trematoda, U.S.A., *Uvitellina*.

All names of birds (common and scientific) used in this paper were taken from the American Ornithologists' Union (1983). The lesser yellowlegs, *Tringa flavipes* Gmelin, (syn. *Totanus flavipes*, *Scolopax flavipes*) (Scolopacidae), is a relatively common wading bird found in marshes, bogs, flooded fields, wet meadows, ponds, lakes, estuaries, and mudflats of North America. It most frequently breeds from western and central Alaska through most of western and central Canada to the upper central United States, but has been reported from eastern coastal North America to as far south as Argentina, South America (American Ornithologists' Union, 1983). As far as we can determine, there have been only 5 reports of species of Cyclocoelidae (Stossich, 1902) from this species of bird in the Western Hemisphere: *Cyclocoelum mutabile* (Zeeder, 1800), reported from Brazil by Fernandes (1976); *Cyclocoelum phasidi* Stunkard, 1929, reported from Brazil by Fernandes (1976); *Haematotrephus nittanyense* (Zeliff, 1946) (Syn. *Corpopyrum nittanyense* Zeliff, 1946), reported from North and South America by Yamaguti (1971); *Haematotrephus halli* (Harrah, 1922) (syn. *Cyclocoelum halli* Harrah, 1922), reported from the U.S.A by Harrah (1922) and Guadeloupe by Euzeby and Graber (1975); and *Selfcoelum brasilianum* (Stossich, 1902) (syn. *Corpopyrum brasilianum* [Stossich, 1902]; *Cyclocoelum brasilianum* Stossich, 1902; *Haematotrephus brasilianum* [Stossich, 1902]), reported from Brazil by Dubois (1959) and Guadeloupe by Euzeby and Graber (1975).

Yamaguti (1971) recognized 3 subfamilies of Cyclocoelidae: Cyclocoelinae, Stossich, 1902; Typhlocoelinae Harrah, 1922; and Promptenovinae, Yamaguti, 1971; and included *Haematotrephus* Stossich, 1902 in Cyclocoelinae. Yamaguti (1971) listed 3 other genera in Cyclocoelinae that are similar to *Haematotrephus* by having a pretesticular ovary, vitelline fields that were not united posteriorly, and a postpharyngeal genital pore: *Corpopyrum* Witenberg, 1923; *Haematoprimum* Witenberg, 1923; and *Wardianum* Witenberg, 1923. Lal (1939), Macko and Feige (1960), and Kanev et al. (2002) considered *Corpopyrum*, *Haematoprimum*, and *Wardianum* to be synonymous with *Haematotrephus*. Yamaguti (1971) also included a fourth similar genus in Cyclocoelinae, *Harrahium* Witenberg, 1926, where the ovary is opposite the anterior testis, as a member of Cyclocoelinae; however, other authors (e.g. Bashkirova *in* Skrjabin, 1950; Feizullaev, 1980; and Kanev et al., 2002) considered this genus to also be a synonym of *Haematotrephus*.

Yamaguti (1971) listed 9 species of *Haematotrephus*: *Haematotrephus lanceolatum* (Wedl, 1858), the type species, described by Wedl (1858) as

[3] Corresponding author.

Monostomum lanceolatum (Wedl, 1858) from the abdominal cavity of *Himantopus rubropterus* from Siberia (*H. rubropterus* is not a valid species of bird. There are 2 species of *Himantopus* Brisson, 1760 worldwide: the black-winged stilt, *Himantopus himantopus* [Linnaeus], and the black-necked stilt, *Himantopus mexicanus* [Müller]; only *H. himantopus* would likely be present in Siberia [Bellrose 1978; Walters 1980; American Ornithologists' Union 1983; Rappole and Blacklock 1994]); *Haematotrephus adelphus* Johnston, 1917 described by Johnston (1917) from the body cavity of the white-headed stilt, *Himantopus leucocephalus* (Linnaeus) (=*Himantopus himantopus*), from South Australia; *Haematotrephus consimile* Nicoll, 1914 described by Nicoll (1914) as *Haematotrephus consimilis* Nicoll, 1914 from the thoracic cavity of the spur-winged plover, *Lobivanellus lobatus* Linnaeus (=*Vanellus spinosus*), from Australia; *Haematotrephus dollfusi* (Tseng, 1930) described as *Cyclocoelum* (*Uvitellina*) *dollfusi* by Tseng (1930) from specimens collected by Dr. Hsien-Wen from the body cavity of the grey-headed lapwing, *Microsarcops cinereus* Blyth (=*Vanellus cinereus*), from China; *Haematotrephus facioi* (Brenes and Arroyo, 1962) described by Brenes and Arroyo (1962) as *Cyclocoelum* (*Haematotrephus*) *facioi* Brenes and Arroyo, 1962 from the air sacs of the northern jacana, *Jacana spinosa spinosa* (Linnaeus), from Costa Rica; *Haematotrephus inflatocoelum* Oshmarin, 1963 described by Oshmarin (1963) from the air sacs of the common ringed plover, *Charadrius hiaticula* Linnaeus, from Russia; *Haematotrephus lobivanelli* Gupta, 1958 described by Gupta (1958) from the air sacs of the red wattled lapwing, *Lobivanellus indicus* Boddaert (=*Vanellus indicus*), from India; *Haematotrephus nittanyense* (Zeliff, 1946) described by Zeliff (1946) from the air sacs of the solitary sandpiper, *Tringa solitaria* Wilson, from the U.S.A.; and *Haematotrephus simile* (Stossich, 1902) (=*Uvitellina simile*) described by Stossich (1902) from the abdominal cavity of *Himantopus atropterus* (Linnaeus) (=*H. himantopus*), from Egypt. Sharma (1986) described *Haematotrephus chengi* Sharma, 1986 from birds in China (based on information in Zoological Record, Vol. 122; however, details on the specific host, the locality where the host was collected, or a description of this species could not be obtained because this article is not available from libraries outside of the Peoples Republic of China. The author could not be contacted). Dronen et al. (2006b) described *Haematotrephus limnodromi* Dronen, Gardner, and Jiménez, 2006 from the air sacs of a long-billed dowitcher, *Limnodromus scolopaceus* (Say), from Roger Mills County, Oklahoma, U.S.A.

Yamaguti (1971) listed 10 species of *Corpopyrum*: *Corpopyrum kossacki* Witenberg, 1923, the type species, described by Witenberg (1923) from the air sacs of the dunlin, *Tringa alpina* Linnaeus (=*Calidris alpina*), from Russia; *Corpopyrum brasilianum* (=*Selfcoelum brasilianum*) described by Stossich (1902) from the abdominal and thoracic cavities of the lesser yellowlegs from Brazil; *Corpopyrum capellae* Yamaguti, 1933 described by Yamaguti (1933) from the air sacs of the common snipe, *Capella gallinago* Linnaeus (=*Gallinago gallinago*), from Formosa; *Corpopyrum gendrei* (Dubois, 1959) described as *Cyclocoelum* (*Haematotrephus*) *gendrei* Dubois, 1959 by Dubois (1959) from the air sacs of the African jacana, *Arctophilornis africana* (Gmelin), from Africa; *Corpopyrum jaenschi* (Johnston and Simpson, 1940) described by Johnston and Simpson (1940) from the air sacs of the hoary-headed grebe, *Podiceps poliocephalus* Jardine and Selby (some authors place this species of bird in *Tachybaptus* Riechenbach), and the black-throated grebe or Australian dabchick, *Podiceps novaehollandiae* Stephens, from Australia; *Corpopyrum longisacculatum* Yamaguti, 1933 described by Yamaguti (1933) from the air sacs of the spotted redshank, *Erythroscelus erythropus* Pallas (=*Tringa erythropus*), from Japan; *Corpopyrum nebularium* Khan, 1935) described by Khan (1935) from the air sacs of the common green shank, *Glottis nebularia* Gunnerus (=*Tringa nebularia*), in India; *Corpopyrum nigropunctatum* (von Linstow, 1883) described by von Linstow (1883) from "Akatza" from Russia (the site within the bird or the specific identity of the bird host were not given); *Corpopyrum phaneropsolus* (Stossich, 1902) originally described by Stossich (1902) from 5 specimens from the Berlin Museum (no. 1139) that were labeled *Distoma* ex *Totano* (=*Totanus*, which has been synonymized with *Tringa*), from Japan; and *Corpopyrum tringae* (Brandes, 1892) described as *Monostomum tringae* Brandes, 1892 by Brandes (1892) from the abdominal cavity of the dunlin, *Tringa variabilis* from the Sinai of Egypt (*T. variabilis* appears to be a synonym for *Calidris alpina* [Linnaeus]. As far as we can determine, this species designation for dunlin has never been recognized at either the species or subspecies levels, and therefore, the actual identity of this host can not be determined.)

Yamaguti (1971) listed only 1 species of *Haematoprimum*, *Haematoprimum fasciatum* (Stossich, 1902), the type species, originally described as

Haemaotrephus fasciatus Stossich, 1902 by Stossich (1902) from specimens from the Eurasian curlew, *Numenius arquatus* Linnaeus (=*Numenius arquata*), from Europe, that had been deposited in the Museum of Florence, Florence, Italy by Dr. C. Parona. Neither the exact locality where the bird was collected nor the location in the host where the specimens were found was given.

Yamaguti (1971) listed 5 species of *Wardianum*: *Wardianum triangulare* (Harrah, 1922), the type species, originally described as *Cyclocoelum triangulare* Harrah, 1922 by Harrah (1922) from the air sacs of the spotted sandpiper, *Tringa maculata* Linnaeus (=*Actitus macularia*), from the U.S.A.; *Wardianum lateriovari* Oshmarin, 1963 described by Oshmarin (1963) from the air sacs of *T. nebularia* from Russia; *Wardianum taxorchis* (Johnston, 1917), originally described as *Cyclocoelum taxorchis* Johnston, 1917 by Johnston (1917) from the body cavity of a godwit, *Limosa novae-hollandiae* (the indentification of this bird could not be confirmed because we were not able to find a listing of this species or any godwit from Australia; the red-necked avocet, *Recurvirostra novaehollandia* Vielillot, is the only godwit-like bird we could find that has been reported from Australia), from Lord Howe Island, Australia; *Wardianum titiri* (Chatterji, 1958) originally described as *Cyclocoelum titiri* Chatterji, 1958 by Chatterji (1958) from the body cavity of the spur-winged plover, *Haplopterus ventralis* (Linnaeus) (=*Vanellus spinosus*), from India; and *Wardianum wilsoni* (Harrah, 1922), originally described as *Cyclocoelum wilsoni* Harrah, 1922 by Harrah (1922) from the intestine (?) of the Wilson's snipe, *Gallinago wilsoni* Ord (=the American snipe, *Gallinago delicate*), from the U.S.A. Gupta and Gupta (1979) described *Wardianum chauhani* Gupta and Gupta, 1979 from the intestine (?) of the common snipe from India.

Yamaguti (1971) listed 1 species of *Harrahium*, the type species, *Harrahium halli* (=*Haematotrephus halli*), originally described as *Cyclocoelum halli* Harrah, 1922 by Harrah (1922) from the air sacs of greater yellowlegs from the U.S.A.

The purpose of this study was to provide additional information concerning members of *Haematotrephus* and the cyclocoelids of North America.

MATERIALS AND METHODS

In conjunction with a study of the endohelminths of wading birds from the Texas Gulf coast, 7 specimens of cyclocoelids from the Harold W. Manter Laboratory of Parasitology (HWML), University of Nebraska, Lincoln, Nebraska, U.S.A. were studied. Five of these specimens had been collected by the late Dr. J. Teague Self, former professor, Department of Zoology, University of Oklahoma, Norman, Oklahoma from the air sacs of 2 lesser yellowlegs obtained during a virus survey of birds from Cheyenne Bottoms, Roger Mills County, Oklahoma (35°42′N, 99°42′W) (HWML 41195-3 specimens, 41280-2 specimens) on 23 and 29 August 1963. Two of these specimens came from a single lesser yellowlegs collected by Dr. Self from Manitoba, Canada (53°49′N, 101°09′W) (HWML 42309 [2 specimens]) on 3 June 1964. Specimens were removed from vials where they had been stored in 70% ethanol, stained in Semichon's carmine and mounted in Canada balsam. Measurements are in micrometers (μm) and are given with the mean followed by the range in parentheses unless otherwise stated. Comparative measurements were taken from the original species descriptions unless otherwise stated. We examined the following specimens stored at HWML; the United States National Parasite Collection (USNPC), Beltsville, Maryland, U.S.A.; the Natural History Museum (NHM), London, England; and the Laboratory of Parasitology collection (ND) at the Texas Cooperative Wildlife Collection, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas, U.S.A.: *Allopyge undulatus* (USNPC 037166.00), *Allopyge* sp. (NHM 1979.3.1.9–10), *Cyclocoelum bivesiculatum* (NHM 1952.12.17.58–67, 1980.6.3.96–98, 1981.2.11.97, 1983.10.10.2), *Cyclocoelum microstomum* (NHM 1952.12.5.161), *Cyclocoelum mutabile* (USNPC 024905.00; NHM 1964.8.25.14–15, 1984.7.7.3, 1984.10.9.18–19, 1988.2.29.4, 1991.7.11.41), *Cyclocoelum obscurum* (USNPC 075304.00, 084775.00; NHM 1965.7.27.9–11, 1979.4.10.132–133, 1980.6.3.136–138, 1982.5.21.146, 1992.6.25.9–11; ND 77a–117a), *Cyclocoelum* (=*Hyptiasmus*) *oculeus* (NHM 1952.12.5.162–163), *Cyclocoelum phasidi* (NHM 1946.12.20.20–23), *Cyclocoelum* (=*Morishitium*) *polonicum* (NHM 1983.9.30.3–37), *Cyclocoelum problematicum* (NHM 1922.10.25.98–99), *Cyclocoelum pseudocotylerus* (NHM 1973.12.11.61–65), *Cyclocoelum vanelli* (NHM 1920.8.26.1–2), *Cyclocoelum* sp. (NHM 1956.9.16.400–401, 1956.11.16.125, 1977.3.28.118–124; HWML 11775, 41216, 42309; ND 71-226-1–6), *Haematotrephus* (=*Cyclocoelum*) *kossacki* (NHM 1975.2.24.117–119), *H.* (=*Cyclocoelum*) *lanceolatum* (USNPC 078879.00; NHM 1991.7.11.50), *H. limnodromi* (HWML 48259–61), *H.* (=*Cyclocoelum*) *tringae* (NHM 1990.1.10.1–7), *H.* (=*Cyclocoelum*) *vanelli* (NHM 1970.8.26.1–2), *Haematotrephus* sp. (NHM 1953.10.8.3–5, 1975.2.24.117–119, 1982.5.20.42–56, 1982.5.21.109–111, 1982.5.21.117, 1986.7.14.11; HWML 43005b, 41280; ND 77-426-7), *Ophthalmophagus bucephali* (HWML 21790, 48164), *Ophthalmophagus* sp. (HWML 1501), *Morishitium* sp. (HWML 43005a, 43009, 42237; ND 77a-117–118), *Neoallopyge americanensis* (USNPC 094819.00, 094820.00), *Neohaematotrophus* sp. (HWML 11775, 30407, 43007), *Selfcoelum limnodromi* (HWML 41212, 48162, 48163), *Szidatitrema yamaguti* (HWML 48329–48331; USNPC 96975), *Wardianum catoptrophori* (HWML 48370), and an unidentified cyclocoelid (NHM 1946.12.20.24–25). Digital photographs of *Neohaematotrephus arayae* (USNPC 93196, 93197) and *Neohaematotrephus fischthali* (USNPC 72781, listed as *Cyclocoelum brasilianum*?) were provided by USNPC.

Haematotrephus selfi n. sp. (Figs. 1–3)

Description

Based on 6 specimens (4 entire mature specimens, 1 young adult specimen, and 1 broken adult specimen). With characteristics of the genus. Body large, tapered anteriorly, 9.5 (6.4–11.9) mm long by 3.9 (3.8–4.0) mm wide at widest point (n = 5). Oral sucker and acetabulum absent. Mouth slightly subterminal; prepharynx short and well developed, 151 (115–210) long by 149 (130–175) wide; esophagus 413 (370–450) long. Ceca simple, uniting near posterior extremity to form cyclocoel. Genital pore immediately postpharyngeal near midline of body, overlapping posterior end of pharynx in some specimens. Testes smooth, spherical to subspherical, diagonal, located in intercecal region in posterior fifth of body. Anterior testis in anterior aspect of posterior fifth of body, 530 (400–650) long by 490 (315–630) wide. Posterior testis located near posterior extremity of body, 525 (460–560) long by 505 (335–650) wide. Cirrus sac 436 (360–530; approximately 5% of body length) long by 130 (90–170) wide. Ovary smooth, oval, slightly pretesticular to directly opposite the anterior testis in some specimens, forming triangle with testes, 365 (265–450) long by 310 (130–400) wide. Posttesticular space 525 (430–710 long; approximately 6% of body length). Typical seminal receptacle absent. Laurer's canal absent. Ootype elliptical, located somewhat dextral and immediately posterior to ovary with anterior fourth overlapping posterior third of ovary, approximately 340 long by 320 wide. Vitelline follicles distributed along ceca from level of cecal bifurcation to near posterior extremity on one side, more extensive on other side reaching anteriorly to level of cirus sac, longer extent not consistently found on left or right side, not confluent posteriorly. Uterus extensive, with extracecal loops common throughout body length, 2 intertesticular loops present; proximal eighth filled with sperm, uterine seminal receptacle ("receptaculum seminis uterinum" of Yamaguti [1933]; "receptacle seminalis uterinum"of Harrah [1922]) absent. Eggs in anterior-most loops of uterus, 145 (125–170) long by 80 (60–90) wide (n = 30). Miracidia oculate. Excretory vesicle v-shaped with excretory canals entering on both sides of stem and at tips of bladder. Excretory pore slightly subterminal on dorsal surface.

Taxonomic summary

Type host: Charadriiformes: Scolopacidae: *Tringa flavipes* (Gmelin, 1789); the lesser yellowlegs.

Type locality: Cheyenne Bottoms, Roger Mills County, Oklahoma, U.S.A. (35°42′N; 99°42′W).

Additional locality: Manitoba, Canada (53°49′N; 101°09′W).

Site of infection: Air sacs of lungs.

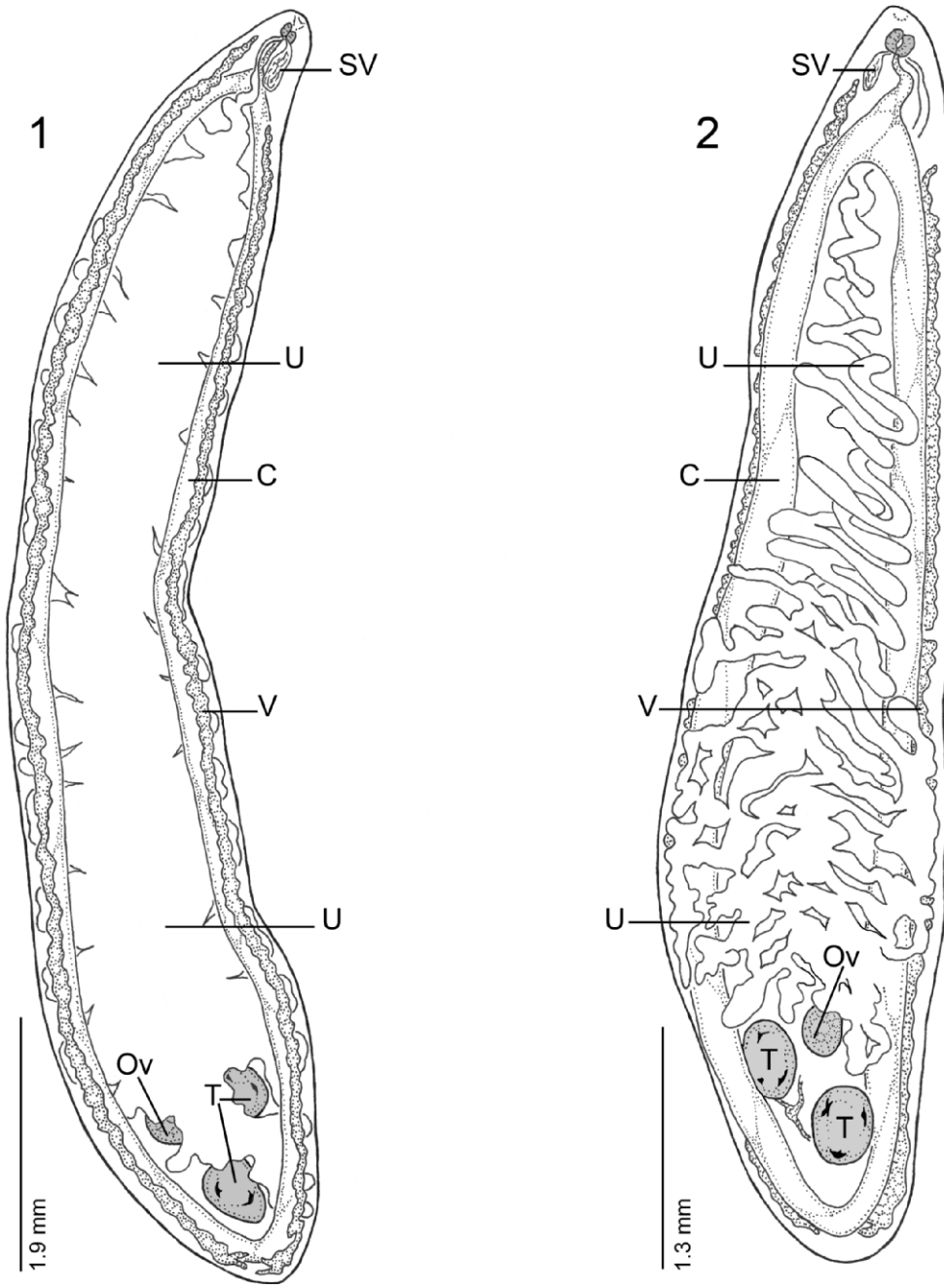
Deposited specimens: Holotype HWML 48493; paratypes (2 specimens) HWML 48494; vouchers (3 specimens) HWML 48495 and 48496.

Etymology: The species is named after the late Dr. J. Teague Self in recognition of his many contributions to our knowledge of the endohelminth parasites of the birds of North America.

Remarks

Haematotrephus selfi n. sp. has an ovary that is opposite to the anterior testis placing it in Haematotrephinae Dollfus, 1948. Kanev et al. (2002) recognized 3 genera of Haematotrephinae: *Haematotrephus*, where the vitelline fields are not united posteriorly and the genital pore is postpharyngeal; *Neohaematotrephus* Kanev, Radev, and Fried, 2002, where the vitelline fields are united posteriorly and the genital pore is prepharyngeal; and *Uvitellina* Witenberg, 1923, where the vitelline fields are united posteriorly and the genital pore is postpharyngeal. The new species has diagonal testes that form a triangle with the ovary, a postpharyngeal genital pore, and vitelline fields that do not unite posteriorly, placing it in *Haematotrephus*.

Kanev et al. (2002) proposed that *Corpopyrum* (10 species), *Haematoprimum* (1 species), *Harrahium* (1 species), and *Wardianum* (6 species) be synonymized with *Haematotrephus* (11 species). Of these 29 species, *C. tringae*, *H. adelphus*, *H. simile*, and *W. titiri* have a postpharyngeal genital pore and vitelline fields that are united posteriorly, and have been assigned to *Uvitellina*. *Corpopyrum brasilianum*, as originally described by Stossich (1902), has an intertesticular ovary that forms a triangle with the testes (Cyclocoelinae), a postpharyngeal genital pore, vitelline fields that are not united posteriorly, testes that are entire, and extracecal uterine loops; it has been assigned to *Selfcoelum* Dronen, et al. (2006b). *Corpopyrum gendrei* has a pretesticular ovary (Haematotrophinae), a prepharyngeal genital pore, and vitelline fields that are united posteriorly, and has been assigned to *Neohaematotrephus* (Zamparo et al., 2003; Dronen et al., 2006b). Zamparo et al. (2003) supported the assignment of *C.* (*Haematotrephus*) *facioi* to *Neohaematotrephus*; however, Dronen et al. (2006b)



Figures 1, 2. *Haematotrephus selfi* n. sp. from the lesser yellowlegs, *Tringa flavipes*. **1.** Ventral view of fully mature adult. **2.** Ventral view of young adult. (Cecum, C; Ovary, Ov; Seminal vesicle, SV; Testis, T; Uterus, U; vitellaria, V.).

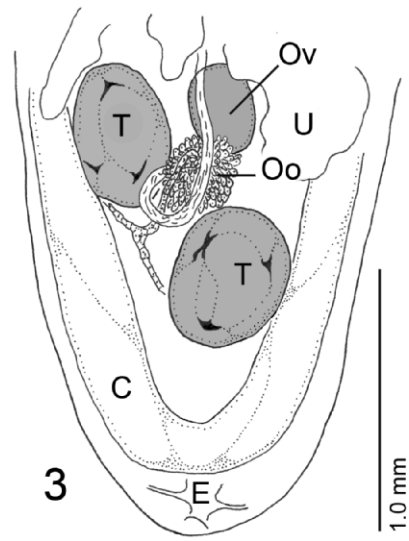
and Dronen (2007) considered *Wardianum*, where the ovary is pretesticular, the vitelline fields are not united posteriorly, the genital pore is postpharyngeal, and the testes are positioned laterally to one another (side by side) to be a valid genus, and based on their interpretation of the vitelline fields and the placement of the genital pore, recommended that *C*. (*Haematotrephus*) *facioi* be placed in *Wardianum*

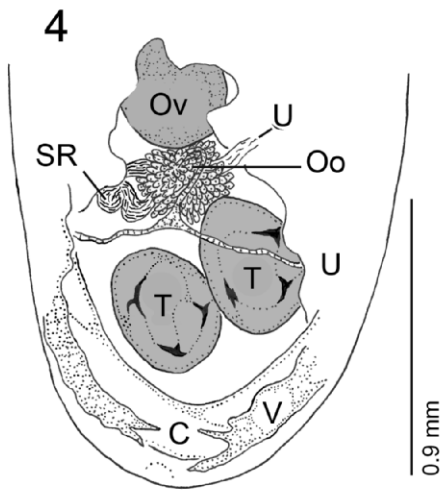
along with *W. chauhani*, *W. lateriovari*, *W. taxorchis*, *W. triangulare*, and *W. wilsoni*. Of the remaining 17 species that Dronen et al. (2006b) included in *Haematotrephus*, there are 11 species that are similar to *Haematotrephus selfi* n. sp. in lacking a rudimentary oral sucker: *Haematotrephus capellae* (Yamaguti, 1933), *H. chengi*, *H. dollfusi*, *Hae. fasciatum* (Stossich, 1902), *H. kossacki* (Witenberg, 1923), *H. lanceolatum*, *H. limnodromi*, *Haematotrephus longisacculatum*, *Haematotrephus nebularium*, *Haematotrephus nigropunctatum* (Linstow, 1883), and *Haematotrephus phaneropsolus* (Stossich, 1902). *Haematotrephus selfi* n. sp. can be distinguished from all of these species except *H. limnodromi* by having intertesticular uterine loops. Of the original 29 species listed above, only *Har. fasciatum* and *H. limnodromi* have intertesticular loops. Unlike *Har. fasciatum*, *H. selfi* n. sp. lacks an oral sucker and has 2 intertesticular uterine loops compared to 1, has smaller testes (averaging 508 in width compared to 894), it has smaller eggs (145 by 80 compared to 161 by 99), and has a postpharyngeal genital pore rather than a prepharyngeal one. The new species most closely resembles *H. limnodromi* in having intertesticular uterine loops, but differs from this species by having a smaller body (9.5 mm compared to 14.6 mm long), a smaller pharynx (149 [130–175] wide compared to 210 [190–220]), smaller testes (anterior testis 530 [400–650] long, 6% by 490 [315–630] wide, 5% compared to 1,100 [870–1,200], 8% by 1,300 [1,020–1,460], 9%; posterior testis 525 [460–560] long, 6% by 505 [335–650] wide, 5% compared to 1,250 [950–1,410], 9% by 1,425 [1,100–1,600], 10%), a shorter cirrus sac (436 [360–530] long compared to 670 [620–750]), somewhat smaller eggs (145 long by 80 wide compared to 155 by 76). *Haematotrephus selfi* n. sp. lacks a uterine seminal receptacle and is from the lesser yellowlegs rather than the long-billed dowitcher. The new species differs from *H. capellae*, *H. longisacculatum*, and *Hae. fasciatum* where the uterus is completely intercecal by having extracecal uterine loops, and it differs from *H. dollfusi* and *H. lanceolatum* by having a uterine loop that extends posterolateral along the posterior testis, but does not invade the posttesticular space. The new species has a smaller pharynx (149 [130–175] wide, 2% of body length) than *H. capellae* (240, 3%), *H. dollfusi* (483, 3–4%), *H. kossacki* (285–524, 5%), *H. longisacculatum* (350, 3%), and *H. nebularium* (200–250, approximately 2%). It has smaller testes (anterior testis 490 [315–630] wide, 5% of body length; posterior testis 505 [335–650] wide, 5% of body length) than *H. capellae* (630, 7%; 750, 8%), *H. dollfusi* (920, 7%; 989, 7%), *H. longisacculatum* (750, 6%; 1,020, 8%), and *H. nebularium* (700–1,000, 7–8%; 710–1,200, 7–9%). It also has a smaller cirrus sac (436 [360–530] long, 5% of body length) than *H. dollfusi* (522, 4%), *H. longisacculatum* (1,030, 8%), and *H. nebularium* (800–1,000, approximately 8%). *Haematotrephus selfi* n. sp. has larger eggs (145 [125–170] long by 80 [60–90] wide) than *H. capellae* (125–131 by 68.8–75), *H. kossacki* (120–130 by 67–72), *H. longisacculatum* (129–135 by 81–90), and *H. nebularium* (87 long), and smaller eggs than *H. dollfusi* (243 by 106), *H. lanceolatum* (216 long), and *H. nigropunctatum* (170 by 80). Comparisons to *H. chengi* were not possible because specimens and the original description were not available from any source we could find outside of the Peoples Republic of China. The author could not be contacted.

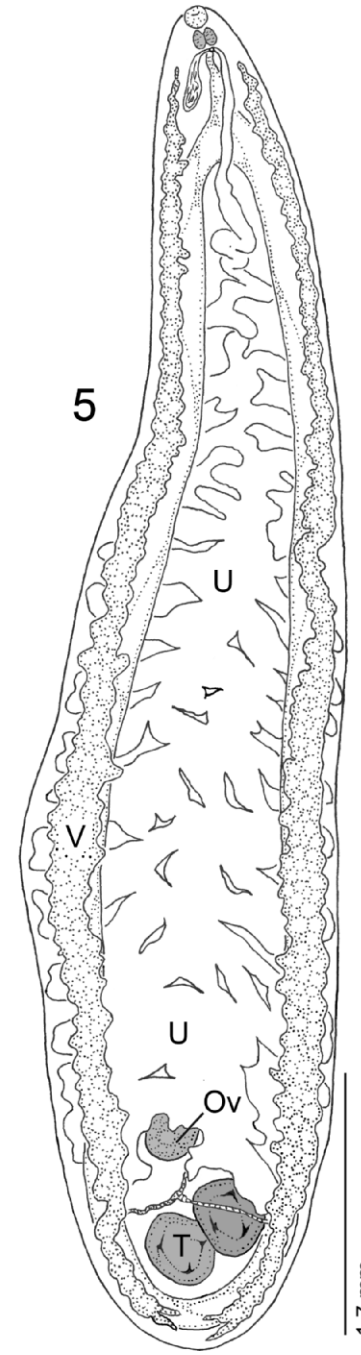
Haematotrephus sp. (unidentified species) (Figs. 4–5)

Description

Based on 1 specimen. Body relatively large, tapered anteriorly, 8.3 mm long by 1.8 mm wide at widest point. Rudimentary oral sucker present, wider than long, 110 long by 190 wide. Acetabulum absent. Mouth slightly subterminal; prepharynx short, 30 long; pharynx well developed, wider than long, 130 long by 140 wide; esophagus approximately 11 times longer than prepharynx, 320 long. Ceca simple, uniting near posterior extremity to form cyclocoel. Genital pore immediately postpharyngeal near midline of body. Testes smooth, spherical to subspherical, diagonal, contiguous, located in intercecal region in the posterior fifth of body. Anterior testis in anterior aspect of posterior fifth of body, contiguous with left cecum, longer than wide, 455 long by 400 wide. Posterior testis located near posterior extremity of body, longer than wide, 440 long by 415 wide. Cirrus sac 340 by 100. Ovary smooth, oval, slightly pretesticular, forming triangle with testes, 305 long by 250 wide. Posttesticular space 380 long; approximately 5% of body length. Typical seminal receptacle absent. Laurer's canal absent. Ootype elliptical, located immediately posterior to ovary with anterior fourth overlapping posterior end of ovary, approximately 240 long by 250 wide. Vitelline follicles distributed along ceca from level of cirrus sac to near posterior extremity, not confluent posteriorly. Uterus extensive, with extracecal loops common throughout posterior half of body, intertesticular loops absent;







Figures 3–5. *Haematotrephus selfi* n. sp. and *Haematotrephus* sp. from the lesser yellowlegs, *Tringa flavipes*. **3.** Composite drawing of genital complex of *H. selfi* n. sp., ventral view. **4.** Composite drawing of genital complex of *Haematotrephus* sp., dorsal view. **5.** Ventral view of fully mature adult of *Haematotrephus* sp. (Cecum, C; Excretory vesicle, E; Oötype, Oo; Ovary, Ov; Testis, T; Uterus, U; Uterine seminal receptacle, SR; Vitellaria, V.).

proximal end filled with sperm, uterine seminal receptacle located immediately sinistral to posterior end of ootype. Eggs in anterior-most loops of uterus, 130 (125–135) long by 55 (50–60) wide ($n = 30$). Miracidia nonoculate. Excretory vesicle simple, v-shaped, anterior extent not visible. Excretory pore slightly subterminal on dorsal surface.

Taxonomic summary

Host: Charadriiformes: Scolopacidae: *Tringa flavipes* (Gmelin, 1789); the lesser yellowlegs.

Locality: Cheyenne Bottoms, Roger Mills County, Oklahoma, U.S.A. (35°42′N; 99°42′W).

Site of infection: Air sacs of lungs.

Deposited specimens: Voucher (1 slide) HWML 48497.

Remarks

The unidenified species of cyclocoelid appears to represent a previously undescribed species of *Haematotrephus*; however, we had only 1 specimen from this bird host, precluding an adequate diagnosis and description. There are only 6 species that are similar to *Haematotrephus* sp. by having an oral sucker present: *H. consimile*; *Har. fasciatum*; *H. inflatocoelum*; *H. jaenschi* (Johnston and Simpson, 1940); *H. lobivanelli*; and *H. nittanyense*). It is difficult to compare our specimen to *H. consimile* because the original description by Nicoll (1914) was minimal. The description included very few measurements, there were no illustrations, there was no indication that specimens were deposited in a museum, and the author compared *H. consimile* to only *U. simile* (considered to be *Haematotrephus simile* by Stossich [1902]). Our specimen is smaller than *H. consimile* (8.3 mm long by 1.8 mm wide compared to 10–12 mm by 2 mm), has smaller eggs (125–135 long by 50–60 wide compared to 200 by 80), and the esophagus (320) is longer than the pharynx compared to being shorter than the pharynx or "almost absent." This species differs from the other 5 species in the genus by having a smaller pharynx (130 long by 140 wide compared to *Har. fasciatum*, 263 wide; *H. inflatocoelum*, 390 by 320; *H. jaenschi*, approximately 420 wide [calculated from figure 6 of Oshmarin, 1963]; *H. lobivanelli*, 300–350 by 350–380; *H. nittanyense* 240 by 220) and by having nonoculate miracidia within its eggs. It is smaller (8.3 mm long by 1.8 wide mm) than *Har. fasciatum* (11–14 mm by 3–4 mm) and *H. nittanyense* (10–11 mm by 2–3 mm), but it is similar in size to *H. inflatocoelum* (6.4–8 mm by 2.7–3.2 mm), *H. jaenschi* (7–9 mm by 2.3–3 mm), and *H. lobivanelli* (8.9–9.3 mm by 1.9–2.4 mm). It has a smaller ovary (305 long by 250 wide) compared to *Har. fasciatum* (434 wide), *H. inflatocoelum* (600 by 400), and *H. jaenschi* (400 wide); smaller testes (anterior testis 455 long by 400 wide; posterior testis 440 by 415) compared to *Har. fasciatum* (894–1,052 wide), *H. jaenschi* (900–1,000 wide), and *H. nittanyense* (530–900 wide); a shorter cirrus sac (340 long) compared to *H. jaenschi* (800–1,000) and *H. nittanyense* (630); and a smaller egg (125–135 long by 50–60 wide) compared to *Har. fasciatum* (161 by 99), *H. inflatocoelum* (165 by 76), and *H. jaenschi* (195 by 94). Also, *Haematotrephus* sp. is similar to *H. nittanyense* by having contiguous testes and lacking intertesticular uterine loops. In these 2 species the uterine loops do not invade the post-testicular space. It differs from *Har. fasciatum* and *H. jaenschi* (described but not figured by Johnston and Simpson, 1940) where the testes are separated by some distance and there are intertesticular uterine loops, and from both *H. inflatocoelum* and *H. lobivanelli* where the uterine loops invade the posttesticular space. Zamparo and Brooks (2006) described *Neohaematotrephus fischthali* Zamparo and Brooks, 2006 from the spotted sandpiper, *Actitis macularia* Linnaeus, 1766 (Scolopacidae), from Venezuela. The placement of this species in *Neohaematotrephus* was based on the presence of a pretesticular ovary, vitelline follicles that are confluent posteriorly, and a genital pore that is prepharyngeal. Our interpretation of the position of the genital pore in *N. fischthali* is that it is postpharyngeal rather than prepharyngeal. If the vitelline follicles are not confluent posteriorly, as is shown in the figure, then this species should be placed in *Haematotrephus*. With the confusion surrounding this species and the described presence of an oral sucker (not figured), we feel it is necessary to compare our specimen of *Haematotrephus* to *N. fischthali*. Our specimen has a smaller body (8.3 mm long compared to 11.5 mm); a smaller pharynx (130 long by 140 wide compared to 240 by 220), smaller testes (anterior testis 455 long by 400 wide compared to 640 by 580; posterior testis 440 by 415 compared to 670 by 540); a shorter cirrus sac (340 long compared to 650) and smaller eggs (130 long by 55 wide compared to 175 by 100–110). *Haematotrephus* sp. also differs from *N. fischthali* by having contiguous testes and by lacking intertesticular uterine loops.

DISCUSSION

The description of *N. fischthali* by Zamparo and Brooks (2006) raises the issue of the difficulty of

dealing with the variability of characteristics seen in most cyclocoelids. Due to the innate variability found in the group, it is impossible to cover the literature in which previous authors have supported different placement of species in genera, genera in subfamilies and subfamilies in the family. A recent series of publications has documented some of these problems. Kanev et al. (2002) recently developed keys that allow for the placement of species into genera and provided diagnostic characteristics for most genera of cyclocoelids; however, there remains a great deal of difficulty in the separation and/or assignment of species within many genera. Dronen and Blend (2007) pointed out, "Most measurements that have been used to describe existing species have large ranges, and most species within a genus are often very similar in overall appearance leaving relatively few characteristics apparent that can be used to show specific differences." These authors also pointed out that cyclocoelids frequently occur in low numbers, descriptions of many species have been from a limited number of specimens (often as few as 1 specimen) from a restricted geographical area, and most species have been reported from relatively few sites within their hosts. This situation has led to a dependence on the geographical location where species have been described, the host from which the species was described, and the site within the host where the species was found to help distinguish species. Our experience with species of cyclocoelids (i.e. *Allopyge* spp.; *Cyclocoelum* spp.; *Haematotrephus limnodromi*; *Neoallopyge americanensis* Dronen and Blend, 2005; *Ophthalmophagus bucephali* Dronen and Blend, 2007; *Selfcoelum limnodromi* Dronen, Gardner and Jiménez, 2006; *Szidatitrema yamagutii* Dronen, Craig and Hammond, 2006; *Wardianum catoptrophori* Dronen, 2007) has shown that at least some species of cyclocoelids can be found in a variety of sites within their hosts (i.e. body cavity, air sacs, nasal cavities), suggesting that caution should be taken when using the site within a host as a diagnostic feature. Dronen et al. (2006a) and Dronen and Blend (2007) pointed out that the position of the genital pore is often difficult to see in cyclocoelids. In species like *Selfcoelum limnodromi* (11 specimens) (Dronen et al., 2006a) and *Szidatitrema yamagutii* (over 90 specimens; 11 specimens and sections used in the species description) (Dronen, Craig, et al., 2006), where there have been large numbers of specimens to examine, the placement of the genital pore can vary from being located near the midlevel of the pharynx to being distinctly postpharyngeal. Historically, most authors have considered species with this range in the placement of the genital pore to have a postpharyngeal genital pore, as opposed to those where the genital pore is distinctly prepharyngeal (i.e. species assigned to *Cyclocoelum* Brandes, 1892 or *Ophthalmophagus* Stossich, 1902). It is also noteworthy that the location of male and female gonads is a much easier characteristic to see than is the location of the genital pore in cyclocoelids (Dronen et al., 2006a); however, the position of the ovary relative to the testes can also be quite variable. For example, the position of the ovary approaches being opposite to the anterior testes in a few specimens of *S. limnodromi*, although in most specimens it is intertesticular. Given the available keys, the question becomes, does this suggest that this species should be placed in Ophthalmophaginae Harrah, 1922 because a few specimens appear to have the ovary opposite to the anterior testis, or should it be placed in Cyclocoelinae because most of the specimens have an intertesticular ovary? Dronen, Craig, et al. (2006) suggested that the variation seen in the position of the ovary in *S. limnodromi* may be related to the amount of curvature of the body at the time of fixation. In straighter specimens the ovary is distinctly intertesticular, while in some specimens that are bent slightly to the left, it is almost adjacent to the anterior testis. In any case, there is little doubt that some innate variability in the placement of the ovary and the genital pore exists in cyclocoelids. It may be that the position of the genital pore relative to the pharynx, or the location of the ovary in relation to the testes, are too variable in some cyclocoelids to be used as diagnostic characteristics, and that our understanding of the phylogeny and placement of species and genera in this group will have to wait until molecular techniques can be employed to help resolve these issues.

Meanwhile, it is our recommendation that determination of the generic or specific status of specimens follow the convention of considering those species where the genital pore is not distinctly prepharyngeal to have a postpharyngeal genital pore.

ACKNOWLEDGMENTS

We are indebted to the late Dr. J. Teague Self, former professor at the University of Oklahoma, Norman, Oklahoma for collection of these materials. A special thanks to the Harold W. Manter Laboratory, University of Nebraska, Lincoln, Nebraska; Mrs. Patricia Pilitt, the United States National Parasite Collection, Beltsville, Maryland; and Eileen Harris, the Natural History Museum, London, England for allowing us to examine specimens of cyclocoels

from their holdings. Mrs. Patricia Pilitt was also kind enough to provide critical digital photographs of cyclcoelids from the collection. This study was funded by a grant from the Schubot Exotic Bird Research Center, the Texas Veterinary Center, Texas A&M University. It was carried out through the Big 12 Faculty Fellowship Program (Texas A&M University and the University of Nebraska), which provided funds for travel between Lincoln, Nebraska and College Station, Texas and for the costs of staying in Lincoln. Release time for this study was provided for Norman Dronen through the Faculty Development Leave Program, Texas A&M University, College Station, Texas.

LITERATURE CITED

American Ornithologists' Union. 1983. Check-list of North American Birds, 6th ed. American Ornithologists' Union, Washington, D.C. 691 pp.

Bashkirova, E. I. 1950. Family Cyclocoelidae Kossack, 1911. Pages 329–493 *in* K. I. Skrjabin, ed. Trematodes of Animals and Man. Vol. 4. Moskva, Leningrad, U.S.S.R.

Bellrose, R. C. 1978. Ducks, Geese and Swans of North America, 2nd ed. Stackpole Books, Harrisburg, Pennsylvania. 540 pp.

Brandes, G. P. H. 1892. Revision der Monostomiden. Centralblatt für Bakteriologie und Parasitenkunde 12: 504–511.

Brenes, R. B., and G. Arroyo. 1962. Helmintos de la República de Costa Rico XX. Algunos tremátodos de aves silvestres. Revista de Biología Tropical 10:205–227.

Chatterji, P. N. 1958. On a new avian trematode of the genus *Cyclocoelum* Brandes, 1892. Journal of Parasitology 44:559–565.

Dronen, N. O. 2007. *Wardianum catoptrophori* n. sp. (Digenea: Cyclocoelidae: Haematotrephinae) from the willet, *Catoptrophorus semipalmatus* (Scolopacidae), from the Galveston, Texas area of the Gulf of Mexico, U.S.A. Comparative Parasitology 74:35–40.

Dronen, N. O., and C. K. Blend. 2007. *Ophthalmophagus bucephali* n. sp. (Digenea: Cyclocoelidae) from the American goldeneye, *Bucephala clangula americana* (Anatidae), from the central flyway of North America and a checklist of goldeneye parasites. Comparative Parasitology 74:48–74.

Dronen, N. O., T. M. Craig, and E. E. Hammond. 2006. *Szidatitrema yamagutii* n. sp. (Digenea: Cyclocoelidae: Ophthalmophaginae) from the bearded barbet, *Lybius dubius* (Capitionidae), and the white-necked myna, *Streptocitta albicollis* (Sturnidae), that died at the Audubon Zoo in New Orleans, Louisiana, U.S.A. Zootaxa 1219:59–68.

Dronen, N. O., S. L. Gardner, and F. A. Jiménez. 2006a. *Selfcoelum limnodromi* n. gen., n. sp. (Digenea: Cyclocoelidae: Cyclocoelinae) from the long-billed dowitcher, *Limnodromus scolopaceus* (Charadriiformes: Scolopacidae) from Oklahoma, U.S.A. Zootaxa 1131:49–58.

Dronen, N. O., S. L. Gardner, and F. A. Jiménez. 2006b. *Haematotrephus limnodromi* n. sp. (Digenea: Cyclocoelidae) from the long-billed dowitcher, *Limnodromus scolopaceus* (Scolopacidae) from the central flyway of North America. Zootaxa 1153:51–61.

Dubois, G. 1959. Revision des Cyclocoelidae Kossack, 1911. Revue Suisse de Zoologie 66:67–147.

Euzeby, J., and M. Graber. 1975. Deuxieme enquete parasitologique en Gaudeloupe. 1. Les trematodes des oiseaux aquatiques. Bulletin de la Societe des Sciences Veterinaires et de Medicine Comparee du Lyon 77: 317–320.

Feizullaev, N. A. 1980. Trematodes of the superfamily Cyclocoeloidea, morphology, biology, phylogeny and systematics. Izd-vo ELM, Baku, Azerbaijan. 209 pp. (In Russian.)

Fernandes, B. 1976. Sobre as especies brasileiras da famalia Cyclocoelidae Kossack, 1911 (Trematoda: Cyclocoelidae). Memorias do Instituto Oswaldo Cruz 74:289–294.

Gupta, P. C., and S. P. Gupta. 1979. Two new avian trematodes (Family Cyclocoelidae Kossack 1911): *Wardianum chauhani* n. sp. and *Morishitium rauschi* n. sp. from Kanpur. Indian Journal of Parasitology 3: 24–27.

Gupta, P. D. 1958. On a new trematode of the genus *Haematotrephus* Stossich, 1902 from the air sac of *Lobivanellus indicus* (Boddaert) in India. Research Bulletin of the Panjab University 144:107–111.

Harrah, E. C. 1922. North American monostomes primarily from freshwater hosts. Illinois Biological Monographs 7:225–324.

Johnston, S. J. 1917. On the trematodes of Australian birds. Proceedings of the Royal Society of New South Wales 50:187–261.

Johnston, T. H., and E. R. Simpson. 1940. The anatomy and life history of the trematode, *Cyclocoelum jaenschi* n. sp. Transactions of the Royal Society of South Australia 63:273–278.

Kanev, I., V. Radev, and B. Fried. 2002. Family Cyclocoelidae Stossich, 1902. Pages 131–145 *in* D. I. Gibson, A. Jones., and R. A. Bray, eds. Keys to the Trematoda. Vol. 1. CABI Publishing and The Natural History Museum, London, U.K.

Khan, M. H. 1935. On eight new species of the genus *Cyclocoelum* Brandes from north India snipes. Proceedings of the Indian Academy of Sciences 4:342–370.

Lal, M. B. 1939. Studies in helminthology. Trematode parasites of birds. Proceedings of the Indian Academy of Sciences 10:111–200.

Macko, J. K., and R. Feige. 1960. Zur revision einiger Cyclocoelidengattungen und arten auf grund der variabilität von *Haematotrephus lanceolatum* (Wedl, 1858). Helminthologia 2:254–265.

Nicoll, W. 1914. The trematode parasites of North Queensland. II. Parasites of birds. Parasitology 7:105–127.

Oshmarin, P. G. 1963. Parasitic Worms of Mammals and Birds in the Primorskii Krai. Moskvo, Izd-vo Akademii Nauk, SSSR. 323 pp. (In Russian.)

Rappole, J. H., and G. W. Blacklock. 1994. Birds of Texas. Texas A&M University Press, College Station, Texas. 280 pp.

Sharma, A. K. 1986. The morphology of a new trematode *Haematotrephus* (*H.*) *chengi* sp. nov. Bio-Science Research Bulletin 2:38–39.

Stossich, M. 1902. II *Monostomum mutabile* Zeder e le sue forme a affini. Bollettino della Societá Adriatic di Scienze, Trieste 21:1–40.

Tseng, S. 1930. Un nouveau monostome de la Chine: *Cyclocoelum* (*Uvitellina*) *dollfusi* n. sp. Annales de Parasitologie Humaine et Comparée 8:254–258.

von Linstow, O. F. B. 1883. Nematoden, trematoden und acanthocephalen, gesammelt von Professor Fedtschenko in Turkestan. Archiv Für Naturgeschite 49: 274–314.

Walters, M. 1980. The Complete Birds of the World. T. F. H. Publications, Inc., Neptune, New Jersey. 367 pp.

Wedl, C. 1858. Anatomische beobachtungen über trematoden. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch Naturwissenschaftliche Classe 26:241–278.

Witenberg, G. G. 1923. The trematodes of the family Cyclocoelidae and a new principle of their systematics. Trudy Gosudarstvennogo Institute Çeksperimental'noæi Veterinarii 1:84–141.

Yamaguti, S. 1933. Studies on the helminth fauna of Japan. Part 1. Trematodes of birds, reptiles and mammals. Japanese Journal of Zoology 5:39–50.

Yamaguti, S. 1971. Synopsis of Digenetic Trematodes of Vertebrates. Vol. 1. Keigaku Publishing Company, Tokyo, Japan. 1,074 pp.

Zamparo, D., and D. R. Brooks. 2006. A new species of *Neohaematotrephus* (Digenea: Echinostomiformes: Cyclocoelidae) in the spotted-sandpiper *Actitis macularia* (Charadriiformes: Scolopacidae) from Venezuela. Journal of Parasitology 92:167–169.

Zamparo, D., D. R. Brooks, D. Causey, and B. Rodriguez. 2003. *Neohaematotrephus arayae* n. sp. (Digenea: Echinostomiformes: Cyclocoelidae) in *Jacana spinosa* (Aves: Charadriiformes: Jacanidae) from the area de Conservación Guanacaste, Costa Rica. Journal of Parasitology 89:829–831.

Zeliff, C. C. 1946. A new species of *Cyclocoelum* (a trematode) from the eastern solitary sandpiper. The Ohio Journal of Science 46:340–342.