

ADDITIONAL TREMATODES OF MAMMALS IN LOUISIANA WITH A COMPILATION OF ALL TREMATODES REPORTED FROM WILD AND DOMESTIC MAMMALS IN THE STATE

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ABSTRACT

The following trematodes were collected from hunter-trapped mammals in the Atchafalaya basin of Louisiana during the winters of 1981 and 1982: *Alaria alarioides* (Dubois, 1937) Dubois, 1970 from mink, *Mustela vison* Schreber, and river otter, *Lutra canadensis* (Schreber); *Alaria marcianae* (La Rue, 1917) Walton, 1949 from raccoon, *Procyon lotor* (Linn.) and bobcat, *Lynx rufus* (Schreber); *Alaria mustelae* Bosma, 1931 from raccoon and mink; *Amphimerus speciosus* (Stiles and Hassal, 1896) Barker, 1911 from raccoon and the domestic cat, *Felis domesticus* Linn.; *Baschkirovitrema incrassatum* (Dies., 1850) Skrjabin, 1944 from mink and river otter; *Brachylaima virginiana* Dickerson, 1930 from opossum, *Didelphis virginiana* Kerr; *Carneophallus basodactylophallus* Bridgman, 1969 from raccoon; *Cryptocotyle concava* (Creplin, 1825) Luhe, 1899 from mink; *Fibricola cratera* (Barker and Noll, 1915) Dubois, 1932 from mink, opossum, and raccoon; *F. lucida* (La Rue and Bosma, 1927) Dubois and Rausch, 1950 from mink and opossum; *Gyrosoma singulare* Byrd, Bogitsh, and Maples, 1961 from raccoon and mink; *Hasstilesia texensis* Chandler, 1929 from muskrat, *Ondatra zibethica* (Linn.); *Heterobilharzia americana* Price, 1929 from mink, raccoon, and bobcat; *Isthmiophora melis* (Schrunk, 1788) Luhe, 1909 from raccoon and mink; *Linstowiella szidati* (Anderson, 1944) Anderson and Cable, 1950 from opossum and raccoon; *Maritreminoides nettae* (Gower, 1938) Rankin, 1939 from raccoon and mink; *Microphallus opacus* (Ward, 1894) Ward, 1901 from raccoon and mink; *Paragonimus kellicotti* Ward, 1908 from opossum; *Pharyngostomoides procyonis* Harkema, 1942 from raccoon; *Quinqueserialis quinqueserialis* (Barker and Laughlin, 1911) Harwood, 1939 from muskrat; *Rhopalias macracanthus* Chandler, 1932 from opossum; and *Sella-cotyle vitellosa* Sogandares-Bernal, 1961 from mink.

Alaria alarioides, *A. marcianae*, *Amphimerus speciosus*, *Cryptocotyle concava*, *Isthmiophora melis*, *Microphallus opacus*, *Paragonimus kellicotti*, and *Quinqueserialis quinqueserialis* have not been previously reported from Louisiana mammals. Diagnoses are presented for the species representing state records along with pertinent notes on the biology of each. New host records include *Heterobilharzia americana*, *Cryptocotyle concava*, and *Maritreminoides nettae* from mink; *Alaria marcianae*, *Amphimerus speciosus*, and *Linstowiella szidati* from raccoon; and *Hasstilesia texensis* from muskrat. A compilation of trematodes previously reported from Louisiana mammals is presented.

INTRODUCTION

Recently, we reported some trematodes collected from mammals in south Louisiana (Shoop and Corkum, 1981a). Since that time we have continued our examination of hunter-trapped mammals from the Atchafalaya basin of Louisiana during the winters of 1981 and 1982. The following mammals were examined for trematodes: 42 minks, *Mustela vison* Schreber; 37 raccoons, *Procyon lotor* (Linn.); seven river otters, *Lutra canadensis* (Schreber); five muskrats, *Ondatra zibethica* (Linn.); three bobcats, *Lynx rufus* (Schreber); four domestic cats, *Felis domesticus* Linn.; two opossums, *Didelphis virginiana* Kerr; and three red foxes, *Vulpes fulva* (Desmarest). The red foxes were found uninfected with trematodes.

Trematodes were fixed in steaming 10%

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formalin and stained in Semichon's acetocarmine. All measurements are in micrometers unless otherwise stated; means are followed by the ranges in parentheses. Line drawings were prepared with the aid of a microprojector. Representative specimens of the species for which diagnoses are given were deposited in the Manter Laboratory, University of Nebraska State Museum, Lincoln, Nebraska.

Table I lists the trematodes recovered from the eight species of mammals. Lumsden and Zischke (1961) reported and diagnosed *Fibricola cratera*, *F. lucida*, *Hasstilesia texensis*, *Brachylaima virginiana*, and *Rhopalias macracanthus* from Louisiana mammals. Our specimens agree in all respects with Lumsden and Zischke's (1961) diagnoses. Our specimens of *Hasstilesia texensis* from the muskrat represent a new host record. Shoop and Corkum (1981a) reported and diagnosed *Alaria mustelae*, *Baschkirovitrema incrassatum*, *Gyrosoma singulare*, *Maritreminoides nettae*, and *Pharyngostomoides procyonis* from Louisiana mammals. In that report we noted *M. nettae* in raccoons; it is herein reported from the mink as well (new host record). In a more recent note, we (Shoop and Corkum, 1982) commented further on the status of *G. singulare* in this state. *Heterobilharzia americana* has been reported from Louisiana mammals by Malek et al. (1961) and Kaplan (1964). Our collections of *H. americana* from mink represent a new host record. *Carneophallus basodactylophallus* was originally described by Bridgman (1969) from raccoon in Louisiana as was *Sellacotyle vitellosa* from mink by Sogandares-Bernal (1961). Lumsden and Winkler (1962) reported *Linstowiella szidati* from opossum. We have found it in opossum as well as in raccoon. In addition to these trematodes, we identified eight other species that have not been previously reported from Louisiana mammals and that are of importance from epidemiological or zoogeographical standpoints. Table II compiles all trematodes reported heretofore from mammals in the state of Louisiana.

Family DIPLOSTOMIDAE Poirier, 1886
Alaria alarioides (Dubois, 1937)
 Dubois, 1970
 (Figure 1)

Synonyms: *Diplostomum alarioides* Dubois, 1937; *Enhydrodiplostomum alarioides* (Dubois, 1937) Dubois, 1944.

Hosts: *Mustela vison* Schreber and *Lutra canadensis* (Schreber).

Location: Small intestine.

Locality: Belle River, Assumption Parish, Louisiana.

Deposition: Univ. Nebraska State Mus., Manter Lab. Coll. No. 21367.

Diagnosis (based on ten mature specimens): Body elongate, distinctly bisegmented, 1650 (1400-1800) long by 540 (450-650) at the widest point. Forebody spathulate, 777 (640-940) long by 540 (450-650) wide; pseudosuckers present as depressions on either side of the oral sucker, never observed evaginated. Hindbody claviform, 907 (760-1050) long by 430 (400-480) wide, containing reproductive organs. Forebody tegument covered with small spines; hindbody smooth. Oral sucker terminal, 92 (80-100) long by 106 (90-120) wide; acetabulum weak, spherical, 75 (60-80) long by 76 (60-90) wide, often covered by the tribocytic organ; tribocytic organ broadly elliptical when evaginated, 348 (240-400) long by 280 (240-330) wide, with a longitudinal cleft.

Prepharynx and esophagus extremely short or absent; pharynx usually in contact with oral sucker, 77 (70-90) long by 65 (50-80) wide; paired ceca extend to the posterior end of body. Testes tandem, not equal; anterior testis asymmetrical, laterally disposed on either side of midline, 215 (200-250) long by 317 (290-350) wide; posterior testis symmetrical, dumbbell-shaped, much wider than anterior testis, 218 (190-250) long by 394 (350-410) wide, with a ventro-median groove to allow passage of ceca, uterus, and vitellaria; ejaculatory duct opens into the genital atrium; genital atrium opens posterior, subterminally on the dorsal surface. Ovary spherical, located in hindbody just in front of

TABLE 1. Trematodes recovered from hunter-trapped mammals in Louisiana during the winters of 1981 and 1982.

Trematode	Hosts	No. Examined	No. Infected	%	Location
<i>Alaria alarioides</i> (Dubois, 1937)	otter	7	2	29	Sm. Int.
Dubois, 1970	mink	42	24	57	"
<i>A. marcianae</i> (La Rue, 1917)	raccoon	37	2	5	"
Walton, 1949	bobcat	3	2	67	"
<i>A. mustelae</i> Bosma, 1931	raccoon	37	1	3	"
	mink	42	1	2	"
<i>Amphimerus speciosus</i> (Stiles and Hassal, 1896) Barker, 1911	raccoon	37	1	3	Liver
	domestic cat	4	1	25	"
<i>Baschkirovitrema incrassatum</i> (Dies., 1850) Skrjabin, 1944	otter	7	2	29	Sm. Int.
	mink	42	21	50	"
<i>Brachylaima virginiana</i> Dickerson, 1930	opossum	2	1	50	"
<i>Carneophallus basodactylophallus</i> Bridgman, 1969	raccoon	37	2	5	"
<i>Cryptocotyle concava</i> (Creplin, 1825) Luhe, 1899	mink	42	22	52	"
<i>Fibricola cratera</i> (Barker and Noll, 1915) Dubois, 1932	mink	42	4	10	"
	raccoon	37	12	32	"
	opossum	2	2	100	"
<i>F. lucida</i> (La Rue, and Bosma, 1927) Dubois and Rausch, 1950	mink	42	26	62	"
	opossum	2	2	100	"
<i>Gyrosoma singulare</i> Byrd, Bogitsh, and Maples, 1961	raccoon	37	7	19	"
	mink	42	2	5	"
<i>Hasstilesia texensis</i> Chandler, 1929	muskrat	5	1	20	Cecum
<i>Heterobilharzia americana</i> Price, 1929	raccoon	37	20	54	Mes. Ven.
	mink	42	2	5	"
	bobcat	3	1	33	"
<i>Isthmiophora melis</i> (Schrunk, 1788) Luhe, 1909	raccoon	37	6	16	Sm. Int.
	mink	42	2	5	"
<i>Linstowiella szidati</i> (Anderson, 1944) Anderson and Cable, 1950	raccoon	37	1	3	"
	opossum	2	1	50	"
<i>Maritreminoides nettae</i> (Gower, 1938) Rankin, 1939	mink	42	3	7	"
	raccoon	37	6	16	"
<i>Microphallus opacus</i> (Ward, 1894) Ward, 1901	raccoon	37	5	14	"
	mink	42	4	10	"
<i>Paragonimus kellicotti</i> Ward, 1908	opossum	2	1	50	Lungs
<i>Pharyngostomoides procyonis</i> Harkema, 1942	raccoon	37	31	84	Sm. Int.
<i>Quinqueserialis quinqueserialis</i> (Barker and Laughlin, 1911) Harwood, 1939	muskrat	5	2	40	Cecum
<i>Rhopalias macracanthus</i> Chandler, 1932	opossum	2	1	50	Sm. Int.
<i>Sellacotyle vitellosa</i> Sogandares-Bernal, 1961	mink	42	2	5	"

the anterior testis, 103 (90-120) long by 114 (110-120) wide; uterus courses anteriorly into the forebody and turns immediately posteriorly where it opens in the genital atrium; vitellaria penetrate the forebody and extend in two bands through the ventro-medial grooves of the testes to the level of the genital atrium; vitelline reservoir median, intertesticular. Eggs large, operculate, 101 (90-110) long by 55 (50-60) wide. Excretory system not observed.

Discussion: Dubois (1937) originally described *Diplostomum alarioides* from a Brazilian otter. He (Dubois, 1944) subsequently purged the genus *Diplostomum* of all mammalian parasites, retaining it for avian parasites, and erected the new genus *Enhydrodiplostomum* for *D. alarioides* and a second otter parasite, *D. fosteri*. Chandler and Rausch (1946) assigned two additional species, *Alaria clathrata* and *A. pseudoclathrata*, both also parasites of the otter, to the genus *Enhydrodiplostomum*. In a later revision, Dubois (1970) agreed that these four species are closely related, but reassigned them to the genus *Alaria* where additional mustelid parasites are found.

Sawyer's (1961) collection of *A. alarioides* from river otter in Georgia was the first report from North America. Since then, Miller and Harkema (1964, 1968) reported *A. alarioides* from both mink and river otter in North Carolina, and Fleming et al. (1977) reported it from river otter in Alabama. *A. alarioides* is also a common parasite of mink and river otter in Louisiana. Measurements of *A. alarioides* from the two hosts compare favorably with the descriptions of Dubois (1937, 1970).

Alaria marcianae (La Rue, 1917)

Walton, 1949

(Figure 2)

Synonyms: *Cercaria marcianae* La Rue, 1917; *Agamodistomum marcianae* (La Rue, 1917) Cort, 1918; *Alaria americana* Hall and Wigdor, 1918; *Alaria canis* La Rue and Fallis, 1934; *Alaria minnesotae* Chandler, 1954.

Hosts: *Lynx rufus* (Schreber) and *Procyon lotor* (Linn.).

Location: Small intestine.

Locality: Pierre Part, Assumption Parish, Louisiana.

Deposition: Univ. Nebraska State Mus., Manter Lab. Coll. No. 21368.

Diagnosis (based on ten mature specimens): Body elongate, distinctly bi-segmented, 1375 (1000-1600) long by 478 (350-600) at the widest point. Forebody spathulate with lateral margins folded ventrally where they meet at the midline, the entire forebody serving as an organ of attachment, 883 (650-1050) long by 478 (350-600) wide; ear-like appendages present on either side of the oral sucker, rarely observed invaginated to form pseudo-suckers. Hindbody conical, 535 (400-650) long by 363 (280-500) wide, containing reproductive organs. Forebody tegument covered with small spines, hindbody tegument smooth. Oral sucker terminal 90 (60-105) long by 73 (60-81) wide; acetabulum weak, spherical, 74 (60-95) long by 75 (60-95) wide, rarely covered by the tribocytic organ; tribocytic organ elongate when evaginated, 453 (310-550) long by 200 (155-225) wide, with a longitudinal cleft. Prepharynx present, 5 (4-6) long; pharynx pyriform, 102 (75-215) long by 64 (55-85) wide; esophagus 6 (4-10) long; paired ceca extend to the posterior end of the body. Testes tandem, not equal; anterior testis asymmetrical, typically wedge-shaped, laterally disposed on either side of the midline, 160 (128-215) long by 225 (175-300) wide; posterior testis symmetrical, dumbbell-shaped much wider than anterior testis, 210 (165-276) long by 340 (275-425) wide, with a ventro-medial groove to allow passage of ceca and uterus; muscular ejaculatory pouch lies posterior to the testes and empties into the genital atrium; genital atrium located in the posterior end of the body, opening on the dorso-subterminal side. Ovary reniform, located in front of the anterior testis on either side of midline, 72 (60-99) long by 167 (100-180) wide; Mehlis' gland opposite

the ovary; uterus courses briefly into the forebody and turns immediately posteriad where it empties into the genital atrium; vitellaria located only in the forebody, from just in front of the acetabulum to the forebody-hindbody juncture; vitelline reservoir prominent, located in the hindbody at the level of the anterior testis. Eggs few, large, operculate, 122 (110-128) long by 65 (60-75) wide. Excretory pore terminal, remainder of excretory system not observed.

Discussion: Apparently, adult *Alaria marcianae* have not previously been reported from Louisiana. A single specimen of *A. americana* (= *A. marcianae*) from a dog from Baton Rouge was deposited by G. Dikmans (USNM Helm. Coll. No. 25159). We examined that specimen and identify it as *A. marcianae*, being similar to our material from the bobcat.

In a previous report, the epidemiology of *A. marcianae* mesocercariae was studied in Louisiana and evidence was presented that this species was responsible for an autochthonous human infection (Shoop and Corkum, 1981b). In experimental infections only juvenile raccoons served as definitive hosts for *A. marcianae*. Adult raccoons proved to be refractory to the development of the mesocercarial stage, which remained undifferentiated in the subcutaneous fat. These findings were corroborated in the present study because no adult raccoons were found infected. Two yearlings, however, harbored several adult *A. marcianae* in their duodena. This is the first report of raccoon naturally infected with this species. Though these worms from the yearlings exhibited no morphological anomalies, they were smaller than specimens from the bobcat.

The known definitive hosts for *A. marcianae* in Louisiana now include the domestic dog, bobcat, and juvenile raccoons. In experimental laboratory infections we have found that the domestic cat is a suitable definitive host and that it, as well as feral cats, may play a significant role in the maintenance of *A. marcianae* in Louisiana.

Family OPISTHORCHIIDAE

Braun, 1901

Amphimerus speciosus

(Stiles and Hassal, 1896) Barker, 1911

(Figure 3)

Synonyms: *Amphimerus caudalitestis* Caballero, Grocott, and Zerecero, 1953; *A. guayaquilensis* (Rodriguez, Gomez, and Montalvan, 1948) Caballero, Grocott, and Zerecero, 1953; *A. interruptus* (Braun, 1901) Barker, 1911; *A. minimus* Thatcher, 1970; *A. neotropicalis* Caballero, Montero-Gei, and Caballero, 1963; *A. parciotatus* Franco, 1967; *A. pricei* (Foster, 1939) Yamaguti, 1958; *A. pseudofelineus* (Ward, 1901) Barker, 1911.

Hosts: *Felis domesticus* Linn. and *Procyon lotor* (Linn.).

Location: Liver and bile ducts.

Locality: Ramah, Iberville Parish, Louisiana.

Deposition: Univ. Nebraska State Mus., Manter Lab. Coll. No. 21369.

Diagnosis (based on ten mature specimens): Body elongate, sharply tapered anterior to the acetabulum, 10.25 (8.0-12.25) mm long by 2010 (1150-2400) at the widest point. Tegument beset with small, stout spines. Oral sucker 268 (240-300) long by 313 (270-340) wide; acetabulum 200 (150-240) long by 218 (170-250) wide. Prepharynx absent; pharynx 183 (160-200) long by 173 (150-190) wide; esophagus 170 (120-200) long; paired ceca extend to the posterior end of body. Testes tandem, in posterior 1/3 of body, transversely elongate, slightly lobed; anterior testis 498 (410-600) long by 925 (550-1150) wide; posterior testis 573 (450-720) long by 925 (550-1150) wide; seminal vesicle elongate, coiled, opens into the genital atrium which is immediately preacetabular. Ovary oval to reniform, may be slightly lobed, 325 (240-450) long by 470 (370-610) wide; seminal receptacle large, lying immediately postovarian, 525 (200-700) long by 473 (320-600) wide; Laurer's canal present, opening on dorsal surface; Mehlis' gland preovarian, sinistral to midline; uterus forming transverse, intercecal coils between the ovary and ace-

tabulum; vitellaria lateral, extracecal, consisting of two pairs of disjunct bundles on each side, each pair separate at level of the ovary; four vitelline ducts fuse mesially at the level of the ovary to form a vitelline reservoir. Eggs small, 28 (25-32) long by 12 (11-14) wide. Excretory pore terminal or slightly subterminal; excretory vesicle sigmoid, coursing anteriorly between the testes and bifurcating immediately posterior to the seminal receptacle.

Discussion: Reports of species of *Amphimerus* from North American mammals have almost exclusively been *A. pseudofelineus* and this name has become well entrenched in veterinary literature. However, Nasir and Diaz (1972) synonymized the following species with *A. speciosus*: *A. caudalitestis*; *A. guayaquilensis*; *A. interruptus*; *A. minimus*; *A. neotropicalis*; *A. parciotatus*; *A. pricei*; and *A. pseudofelineus*.

Lumsden and Zischke (1963) reported *Amphimerus interruptus* from a yellow-crowned night heron, *Nyctanassa violacea*. Their measurements fall within the ranges we recorded and the specimen figured is remarkably similar to ours, indicating that they are the same species. Lumsden and Zischke also noted similarities between their specimens and the description of *A. speciosus*. These observations corroborate, in part, Nasir and Diaz's (1972) synonymies and further indicate the ability of these organisms to live in both avian and mammalian hosts.

A. speciosus has been reported in cats and dogs from several states in the United States (Rothenbacher and Lindquist, 1963). Chronic morbidity associated with infection includes liver and biliary cirrhosis and pancreatitis. Also, Thatcher (1970) commented on the unassessed possibility of human infection with this species. *A. speciosus* was collected from the liver and bile ducts of one of four domestic cats and two of 37 raccoons in Louisiana. The raccoon apparently is a new host record for this species.

Family HETEROPHYIDAE
(Leiper, 1909) Odhner, 1914

Cryptocotyle concava (Creplin, 1825)
Luhe, 1899
(Figure 4)

Synonyms: *Distoma concava* Creplin, 1825; *Tocotrema concava* Looss, 1899; *Cryptocotyle echinata* Linstow, 1878.

Hosts: *Mustela vison* Schreber.

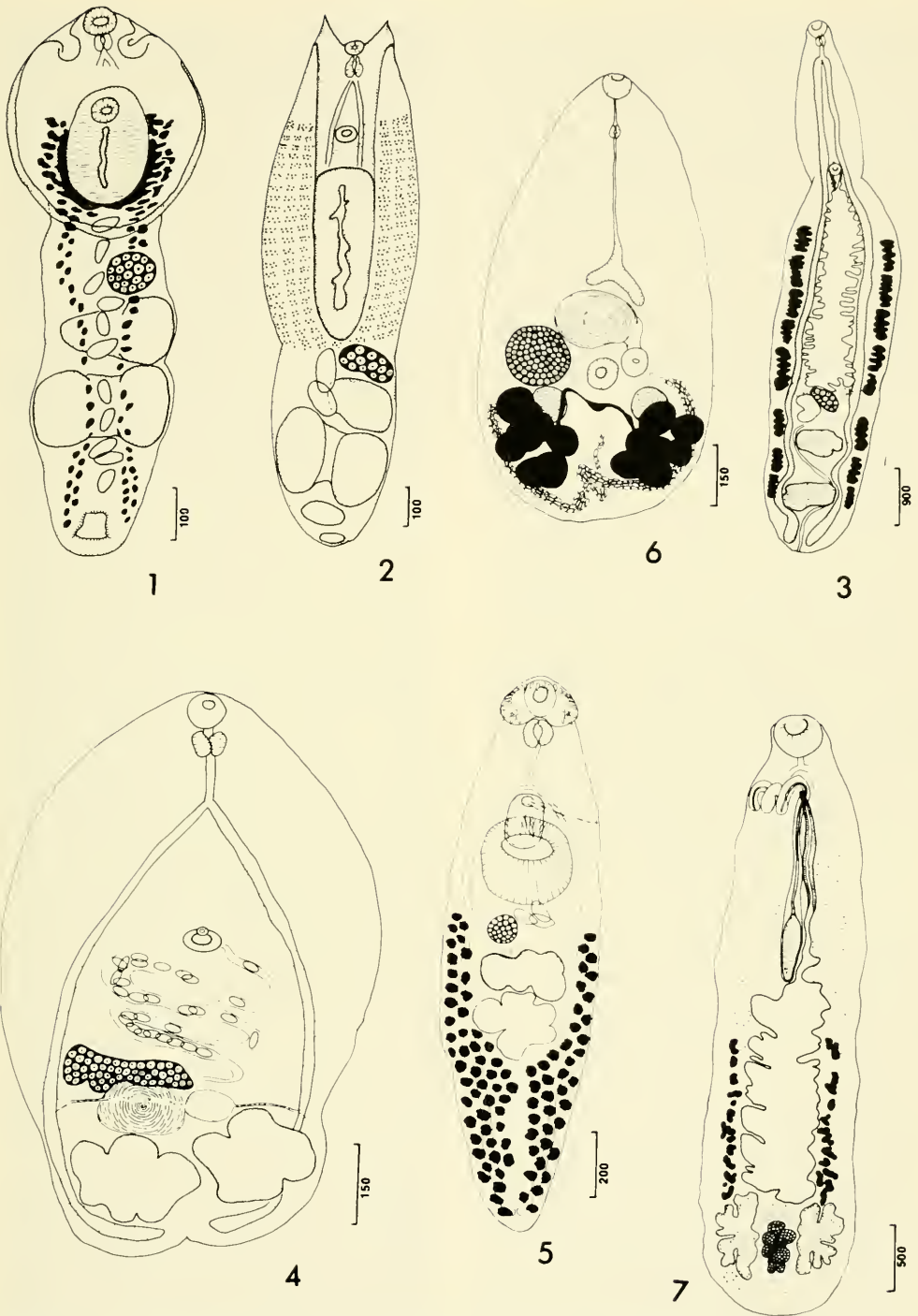
Location: Small intestine.

Locality: Belle River, Assumption Parish, Louisiana.

Deposition: Univ. Nebraska State Mus., Manter Lab. Coll. No. 21370.

Diagnosis (based on ten mature specimens): Body foliate, 904 (780-1050) long by 612 (560-680) wide. Tegument beset with small spines. Oral sucker terminal, 47 (35-55) long by 54 (40-65) wide; acetabulum 41 (35-50) in diameter, found within the genital atrium and comprising a part of the acetabulogenital apparatus; acetabulogenital apparatus 67 (60-75) long by 91 (70-125) wide, located medially and equatorially. Prepharynx 10 (5-15) long; pharynx 49 (40-55) long by 48 (45-60) wide; esophagus 76 (65-100) long; paired ceca extend to the posterior end of body where they turn medially just posterior to the testes. Testes opposite, distinctly lobate, 152 (125-175) long by 233 (210-250) wide, located in posterior end of body; seminal vesicle courses from testes to the acetabulogenital apparatus; cirrus pouch absent. Ovary wedge-shaped, lobate, 93 (70-115) long by 138 (100-175) wide, located dextral to the midline, between the ovary and right testis; uterus makes 3-4 intercecal loops before opening into the acetabulogenital complex; vitellaria mostly lateral, commence behind the level of the cecal bifurcation and extend to the posterior end of body where they meet at the midline; vitelline reservoir is located medially, at the level of the seminal vesicle. Eggs small, operculate, 36 (33-40) long by 15 (13-20) wide.

Discussion: Wootton (1957) first reported *Cryptocotyle concava* from North America and elucidated the life cycle. It included an operculate snail, *Amnicola longiqua*, in which rediae gave rise to pleurolophocercous cercariae; these penetrated and



Figures 1-7. 1. *Alaria alarioides* from mink and river otter. 2. *Alaria marcianae* from bobcat and raccoon. 3. *Amphimerus speciosus* from raccoon and the domestic cat. 4. *Cryptocotyle concava* from mink. 5. *Isthmiophora melis* from raccoon and mink. 6. *Microphallus opacus* from raccoon and mink. 7. *Quinqueserialis quinqueserialis* from muskrat. Scales in micrometers.

encysted in three-spined sticklebacks, *Gasterosteus aculeatus*. When infected fish were fed to both chicks and ducklings adult worms were recovered. Hoffman (1957) found metacercariae of *C. concava* in suckers, *Catostomus commersoni*, and also obtained adults from experimentally infected chicks.

The only other report of *C. concava* from North America was that of Burrows and Lillis (1965) who collected specimens from a dog in New Jersey. We compared our specimens with theirs (USNM Helm. Coll. No. 60902) and find no differences between them.

Our report is the first record of *C. concava* from mink. Its occurrence in them is not surprising due to the prevalence of fish in their diet and the lack of definitive host specificity common in heterophyids. Quite possibly, Louisiana veterinarians may encounter eggs of this trematode in routine stool examination of pets. In addition, the possibility of human infection can not be overlooked because *Cryptocotyle* eggs have already been reported from humans elsewhere (Babbot et al., 1961).

Family ECHINOSTOMATIDAE

(Looss, 1902) Poche, 1926

Isthmiophora melis (Schrunk, 1788)

Luhe, 1909

(Figure 5)

Synonyms: *Fasciola putori* Gmelin, 1790; *Fasciola trigonocephala* Rud., 1802; *Euparyphium melis* (Schrunk, 1788) Railliet, 1919; *Echinocirrus melis* (Schrunk, 1788) Mendheim, 1943. Mendheim, 1943.

Hosts: *Procyon lotor* (Linn.) and *Mustela vison* Schreber.

Location: Small intestine.

Locality: Belle River, Assumption Parish, Louisiana.

Deposition: Univ. Nebraska State Mus., Manter Lab. Coll. No. 21371.

Diagnosis (based on ten mature specimens): Body lanceolate, 2450 (2000-3500) long by 650 (520-700) wide. Anterior tegument densely covered with spines until the posterior level of the acetabulum,

where they diminish in number towards the posterior end of the body. Head collar reniform, bearing 27 spines; each side with 4 corner spines, 59 (57-61) long by 13 (12-14) wide; six marginals on each side, 46 (43-48) long by 11 (9-13) wide; and a double, uninterrupted row of dorsal spines composed of four oral and three aboral spines, 40 (36-44) long by 11 (8-12) wide. Acetabulum large relative to the oral sucker, 380 (350-410) long by 385 (350-430) wide. Prepharynx not discernible; pharynx 130 (110-160) long by 115 (110-140) wide; esophagus 173 (110-210) long; ceca bifurcate immediately anterior to the cirrus sac and extend to the posterior end of the body. Testes tandem, irregular in shape, from strongly indented to completely lobed, posterior testis always more indented or lobate than the anterior testis, both testes wider than long; anterior testis 242 (200-310) long by 348 (310-370) wide; posterior testis 285 (220-410) long by 341 (320-360) wide; cirrus sac ovate, extending from middle of the acetabulum to just posterior to the cecal bifurcation, 265 (220-300) long by 168 (130-200) wide; seminal vesicle distinct; cirrus long, coiled when withdrawn, beset with minute spines. Ovary spherical, dextral to midline, 111 (90-130) long by 114 (90-130) wide, located between the acetabulum and anterior testis; Mehlis' gland broadly oval to reniform, lying immediately in front of the anterior testis; seminal receptacle absent; uterus short, with 3-5 intercecal coils; vitellaria extend from the level of the ovary to the posterior end of body; vitelline reservoir well developed, at the anterior half of the anterior testis. Eggs large, operculate, 97 (95-100) long by 53 (50-60) wide. Excretory pore dorsal and subterminal.

Discussion: Dawes (1946) and Skrjabin and Bashkirova (1956) transferred all the species of *Isthmiophora* to the genus *Euparyphium*, however, Yamaguti (1971) retained the former based on: (1) body shape (lanceolate in *Isthmiophora* whereas *Euparyphium* is subcylindrical); and (2) shape of testes (irregular with lateral indentations in *Isthmiophora* whereas in

Euparyphium they are longitudinally elongated). Based upon a comparative study of several hundred specimens from Louisiana mink and raccoons, our specimens agree with the generic diagnosis of *Isthmiophora* as presented by Yamaguti.

This is the first report of *Isthmiophora melis* from the raccoon and, to our knowledge, the only report of this species from North America. We have found this species in the small intestine of six of 37 raccoons and two of 42 minks. The only other echinostomes found in raccoon are *Euparyphium beaveri* reported by Harkema and Miller (1964) and Bufundo et al. (1980) and *Echinostoma revolutum* which was regarded as an aberrant condition (Larson and Scharf, 1975). Because *Euparyphium beaveri* is also found in minks we compared the type material deposited by Beaver (1941) to our specimens. We find they are very similar in head collar spination and body anatomy, but that they differ strikingly in two respects: (1) the range in size of our specimens (2000-3500) is not concordant with the ranges provided by Beaver (3860-10500) and the averages are markedly dissimilar (2450 for our material to 6100 for that of Beaver's); and (2) the testes in our specimens are broader than long with either deep marginal indentations or completely lobate, whereas that of *Euparyphium* is longitudinally oval with only slight evidence of indentations in the larger specimens. We conclude that our material is distinct from *Euparyphium beaveri*.

Lumsden and Zischke (1961) rediagnosed *Euparyphium beaveri* from Louisiana minks. A close inspection of their diagnosis indicates they probably were not dealing with *E. beaveri* but with the closely related *Baschkirovitrema incrassatum*. At the time of their diagnosis *B. incrassatum* had not been reported from North America. It is now known to be a common inhabitant of mustelids from the Gulf and Atlantic coasts (Sawyer, 1961; Miller and Harkema, 1964; Fleming et al., 1977; Shoop and Corkum, 1981a). At the time we diagnosed *B. incrassatum* from a river

otter in Louisiana we had only specimens from a single otter. We now, however, have a large series of *B. incrassatum* from both river otter and mink and they include the ranges of both our previous material and that given by Lumsden and Zischke (1961). We, therefore, regard *Euparyphium beaveri* of Lumsden and Zischke, 1961 conspecific with *Baschkirovitrema incrassatum*.

Family MICROPHALLIDAE

Travassos, 1920

Microphallus opacus (Ward, 1894)

Ward, 1901

(Figure 6)

Synonyms: *Microphallus ovatus* Osborn, 1919.

Hosts: *Procyon lotor* (Linn.) and *Mustela vison* Schreber.

Location: Small intestine.

Locality: Belle River, Assumption Parish, Louisiana.

Deposition: Univ. Nebraska State Mus., Manter Lab. Coll. No. 21372.

Diagnosis (based on ten mature specimens): Body oval to pyriform, 1233 (1160-1300) long by 664 (620-700) wide. Tegument spined throughout. Oral sucker subterminal, 67 (60-70) long by 80 (75-90) wide; acetabulum 86 (80-90) long by 91 (90-100) wide. Prepharynx 60 (35-85) long; pharynx weak, 36 (35-40) long by 29 (25-30) wide; esophagus 340 (275-400) long; ceca short, rarely extending beyond the seminal vesicle, occasionally with a single sac. Testes two, opposite, 190 (150-230) long by 135 (75-190) wide, very often the testes are not discernible in gravid specimens; seminal vesicle saccular, preacetabular, opening into the genital atrium; genital atrium lies sinistral to the acetabulum, 62 (55-75) long by 74 (65-80) wide. Ovary spherical to oval in shape, dextral to midline, 150 (110-175) long by 160 (130-205) wide; oviduct sinistral to ovary, courses posteriad to the Mehlis' gland; Mehlis' gland prominent, on the midline of the body between the two bundles of vitellaria; uterus makes several loops in posterior half of body and opens

into the genital atrium; vitellaria in two symmetrical clusters of spherical follicles, located in the posterior $\frac{1}{3}$ of body; vitelline ducts fuse in the middle of the body at the level of the Mehlis' gland to form a vitelline reservoir. Eggs small, numerous, 25 (25-26) long by 13 (12-14) wide. Excretory vesicle V-shaped, extending to the anterior level of the vitellaria; a single collecting duct arises from each side of the vesicle and courses anteriorly to the level of the pharynx.

Discussion: Though *Microphallus opacus* is generally regarded as a fish parasite (Yamaguti, 1971) it has been experimentally established in various reptilian species as well as opossum and raccoon by Rausch (1947) and in white mice by Sogandares-Bernal (1965a). Rausch (1946) also reported it from a naturally infected raccoon from Ohio and provided a brief diagnosis. Our material from raccoon and mink agrees well with that description.

Sogandares-Bernal (1965a) surveyed the crayfish parasites in Louisiana and found *Cambarellus puer* and *Procambarus clarkii* naturally infected with the metacercariae of *Microphallus opacus*. He noted that snails of the genus *Amnicola*, "probably *integra*", released several different types of microphallid cercariae at his study site (Rosedale, Louisiana), one of which he believed to be *M. opacus*. The definitive host at that time was unknown. The life-cycle of *M. opacus* in Louisiana can be postulated using Sogandares-Bernal's report and that of the present work to include the following; an amnicolid snail as first intermediate host; several crayfish species as second intermediate hosts; and the raccoon and mink as definitive hosts. At present, the extent to which *M. opacus* uses fishes as definitive hosts in Louisiana is unassessed as it has yet to be reported from fishes in this state.

Family PARAGONIMIDAE
Dollfus, 1939

Paragonimus kellicotti Ward, 1908

Hosts: *Didelphis virginiana* Kerr.

Location: Lungs.

Locality: Baton Rouge, East Baton Rouge

Parish, Louisiana.

Deposition: Univ. Nebraska State Mus., Manter Lab. Coll. No. 21394.

Discussion: We have recovered three mature *Paragonimus kellicotti* from the lungs of a single opossum. We have not figured or diagnosed *P. kellicotti* owing to the paucity of specimens in our possession and to the fact that our specimens are similar to those described by Byrd et al. (1942) which came from the lungs of a Tennessee opossum.

Paragonimus kellicotti metacercariae were reported from crayfish in Louisiana by Ameel (1934) and La Rue and Ameel (1937). Sogandares-Bernal (1965b) reported natural infections of the snail, *Pomatiopsis lapidaria*, with *Paragonimus kellicotti*. Since those accounts, *P. kellicotti* is commonly acknowledged to be present in Louisiana although neither the adult nor the definitive host have been reported from this state.

That the infected opossum was trapped in residential Baton Rouge is epidemiologically significant. The location was an upper middle class neighborhood which borders on the flood plain of the Mississippi River. The area of the flood plain is heavily treed, with numerous bayous, and low lying grounds which are nearly always water laden. This scenario is a classical nidus capable of maintaining all of the hosts essential to the life-cycle of *P. kellicotti* and has the potential of including man into the life-cycle owing to his close proximity and crustacean cuisine.

Family NOTOCOTYLIDAE
Luhe, 1909

Quinqueserialis quinqueserialis
(Barker and Laughlin, 1911)

Harwood, 1939

(Figure 7)

Synonyms: *Notocotylus quinqueserialis* Barker and Laughlin, 1911; *Quinqueserialis hassali* (McIntosh and McIntosh, 1934) Harwood, 1939; *Notocotylus urbanensis* of Harrah, 1922.

Hosts: *Ondatra zibethica* (Linn.).

Location: Cecum.

Locality: Belle River, Assumption Parish,

TABLE II. Compilation of all trematodes reported from Louisiana mammals with pertinent references.

Trematode	Hosts	References
<i>Alaria alarandi</i> (Dubois, 1937) Dubois, 1937	mink, otter	(present study)
<i>E. maculosa</i> (La Rue, 1927) Waller, 1949	raccoon, opossum (larval) raccoon, bobcat, dog	Shoop and Corkum, 1981b (present study)
<i>A. mustelae</i> Bosma, 1931	skunk raccoon raccoon, mink cat, raccoon	Babero, 1960 Shoop and Corkum, 1981a (present study)
<i>Amphimerus speciosus</i> (Stiles and Hassal, 1896) Barker, 1911		(present study)
<i>Allasogonoporus marginalis</i> Oliver, 1938	free-tail bat	Martin, 1976
<i>Apophallus venustus</i> (Ransom, 1920) Cameron, 1936	raccoon	Shoop and Corkum, 1981a
<i>Baschkirovitrema incrassatum</i> (Dies, 1850) Skrjabin, 1944	otter otter, mink	Shoop and Corkum, 1981a (present study)
<i>Brachylaema virginiana</i> Dickerson, 1930	opossum skunk mink opossum opossum	Dikmans, 1931 Babero, 1960 Lumsden and Zischke, 1961 Shoop and Corkum, 1981a (present study)
<i>Carneophallus basodactylophallus</i> Bridgman, 1969	raccoon raccoon	Bridgman, 1969 (present study)
<i>C. choanophallus</i> Bridgman, 1969	raccoon, black rat	Bridgman, 1969
<i>Conspicuum icteridorum</i> Denton and Byrd, 1951	free-tail bat	Martin, 1976
<i>Cryptocotyle concava</i> (Creplin, 1825) Luhe, 1899	mink	(present study)
<i>Dicrocoelium rileyi</i> Macy, 1931	free-tail bat free-tail bat	Byrd and Macy, 1942 Martin, 1976
<i>Echinocasmus schwartzi</i> Price, 1931	muskrat muskrat	Byrd and Reiher, 1942 Penn, 1942
<i>Echinostomum</i> sp.	opossum	Dikmans, 1931
<i>Echinostoma revolutum</i> (Frolich, 1802) Looss, 1899	nutria	Babero and Lee, 1961
<i>Euparyphum beaveri</i> Yamaguti, 1958	mink	Lumsden and Zischke, 1961*
<i>Eurytrema procyonis</i> Burrows and Lillis, 1960	red wolf X coyote	Custer and Pence, 1981
<i>Fasciola hepatica</i> Linn., 1758	cattle, sheep	Bennett, 1938
<i>Fascioloides magna</i> (Bassi, 1875) Ward, 1917	cattle	Dikmans, 1945
<i>Fibricola cratera</i> (Barker and Noll, 1915) Dubois, 1932	mink, raccoon mink, raccoon, opossum mink, raccoon, opossum	Lumsden and Zischke, 1961 Shoop and Corkum, 1981a (present study)
<i>F. lucida</i> (La Rue and Bosma, 1927) Dubois and Rausch, 1950	opossum opossum, mink raccoon, gray fox mink, opossum	Dikmans, 1931 Lumsden and Zischke, 1961 Shoop and Corkum, 1981a (present study)
<i>Gyrosoma singulare</i> Byrd, Bogitsch, and Maples, 1961	raccoon raccoon, mink raccoon, mink	Shoop and Corkum, 1981a Shoop and Corkum, 1982 (present study)
<i>Hasstlesia texensis</i> Chandler, 1929	swamp rabbit swamp rabbit muskrat	Lumsden and Zischke, 1961 Shoop and Corkum, 1981a (present study)
<i>Heterobilharzia americana</i> Price, 1929	dog, raccoon, nutria nutria opossum opossum, raccoon red wolves, coyotes bobcat, mink, raccoon raccoon, mink	Malek et al., 1961 Babero and Lee, 1961 Kaplan, 1964 Shoop and Corkum, 1981a Custer and Pence, 1981a (present study) (present study)
<i>Isthmophora melis</i> (Schrank, 1788) Luhe, 1909		(present study)
<i>Limnaria szidati</i> (Anderson, 1944) Anderson and Cable, 1950	opossum opossum, raccoon	Lumsden and Winkler, 1962 (present study)
<i>Maritremaoides neitae</i> (Gower, 1938) Rankin, 1939	raccoon raccoon, mink	Shoop and Corkum, 1981a (present study)
<i>Microphallus opacus</i> (Ward, 1894) Ward, 1901	raccoon, mink	(present study)
<i>Nudacotyle novicia</i> Barker, 1916	muskrat	Penn, 1942
<i>Ochoerentrema labda</i> Caballero, 1943	free-tail bat	Martin, 1976
<i>Paragonimus kellicotti</i> Ward, 1908	opossum	(present study)
<i>Parametorchis complexus</i> (Stiles and Haisal, 1894) Skrjabin, 1913	raccoon	Shoop and Corkum, 1981a
<i>Paramonostomum pseudolaeatum</i> Price, 1931	muskrat	Penn, 1942
<i>Paramphistomum microbothroides</i> Price and McIntosh, 1944	cattle cattle, sheep	Bennett and Jenkins, 1936 Bennett, 1938
<i>Phagocula angrensis</i> (Travassos, 1916) Yamaguti, 1971	muskrat raccoon	Byrd and Rober, 1942 Sogandares-Bernal and Bridgman, 1960
<i>Pharyngostomoides procyonis</i> Harkema, 1942	raccoon raccoon	Shoop and Corkum, 1981a (present study)
<i>Plagiorchis vesperilionis</i> (Muller, 1784) Braun, 1900	free-tail bat	Martin, 1976
<i>Prosthodendrium swansoni</i> Macy, 1936	free-tail bat	Byrd and Macy, 1942
<i>Psilostomum</i> sp.†	skunk nutria (larval)	Babero, 1960 Babero and Lee, 1961 (present study)
<i>Quinqueserialis quinqueserialis</i> (Barker and Laughlin, 1911) Harwood, 1939	muskrat	
<i>Rhopalus macracanthus</i> Chandler, 1932	opossum opossum, mink opossum opossum	Dikmans, 1931 Lumsden and Zischke, 1961 Shoop and Corkum, 1981a (present study)
<i>Ribeiroia ondatrae</i> (Price, 1931) Price, 1942†	skunk	Babero, 1972
<i>Sellacotyle vitellosa</i> Sogandares-Bernal, 1961	mink mink	Sogandares-Bernal, 1961 (present study)
<i>Sicthorchis subtriquetrus</i> (Rud., 1814) Looss, 1902	beaver	Bennett and Humes, 1939
<i>Uratrema scabridum</i> Braun, 1900	free-tail bat	Martin, 1976
<i>Zonorchis komarecki</i> (McIntosh, 1939) Travassos, 1944	rice rat	Lumsden and Zischke, 1961

*We regard *E. melis* of Lumsden and Zischke, 1961 as a synonym of *Baschkirovitrema incrassatum*. Refer to our discussion of *Isthmophora melis* in this paper.

†In a recent paper (Shoop and Corkum, 1982) we have stated our reasons for regarding *Psilostomum* sp. and *Ribeiroia ondatrae* as junior synonyms of *Gyrosoma singulare*.

Louisiana.

Deposition: Univ. Nebraska State Mus., Manter Lab. Coll. No. 21373.

Diagnosis (based on ten mature specimens): Body elongate, oval, slightly attenuated anteriorly, 3850 (3420-4150) long by 1050 (960-1300) at the greatest width. Tegument aspinous. Ventral surface with five longitudinal rows of spherical glands. Oral sucker subterminal, 335 (320-350) in diameter; acetabulum absent. Pharynx absent; esophagus short, paired ceca extend to posterior end of body. Testes opposite, highly branched, in posterior end of body, 513 (405-610) long by 305 (260-390) wide; external seminal vesicle tubular, coursing antieriad to the base of the cirrus sac; cirrus sac elongate, claviform, 1277 (1050-1500) long by 145 (125-170) at the greatest width; cirrus often extruded and much coiled, densely beset with spines; genital pore median, near intestinal bifurcation. Ovary deeply lobed, intertesticular, 334 (300-390) long by 210 (150-250) wide; Mehlis' gland immediately anterior to ovary; uterus comprised of transverse loops which may extend beyond the ceca; metraterm distinct, 775 (700-900) long; vitellaria pretesticular, in two, extra-cecal bands. Eggs oval, 17 (16-18) long by 8 (7-9) wide, without polar filaments. Excretory system not observed.

Discussion: Penn (1942) examined 1,780 muskrats from coastal Louisiana and recovered the trematodes *Nudacotyle novicia*, *Echinochasmus schwartzi*, and *Paramonostomum pseudalveatum*. Byrd and Reiber (1942) examined three muskrats from the New Orleans area and reported *E. schwartzi* and *Phagicola nana* (= *P. angrense*). Because of their declining numbers, we were unable to obtain a large series of muskrats from trappers, but we were successful in obtaining five carcasses. Two of the muskrat harbored hundreds of *Quinqueserialis quinqueserialis* in their ceca. Although this species is considered a ubiquitous parasite of muskrats in North America, this is the first report of it from Louisiana. Our measurements agree well with those provided by Kinsella (1971) in

his study of intraspecific variation of *Q. quinqueserialis*. The life-cycle has been elucidated by Herber (1942) and includes the freshwater snail, *Gyraulis parvus*, from which monostome cercariae are released and encyst on vegetation. The muskrat becomes infected while grazing on vegetation containing the cysts.

Incidentally, one muskrat was infected with thousands of *Hasstilesia texensis* in the cecum (new host record). We have found *H. texensis* in all of the swamp rabbits, *Sylvilagus aquaticus*, that we have examined in Louisiana. As all of the specimens from the muskrat were gravid and showed neither stunting nor any anomalies, we presume that the muskrat may serve occasionally as a normal, definitive host for this species.

SUMMARY

The following trematodes were collected from hunter-trapped mammals in the Atchafalaya basin of Louisiana during the winters of 1981 and 1982: *Alaria alarioides* (Dubois, 1937) Dubois, 1970; *Alaria marcianae* (La Rue, 1917) Walton, 1949; *Alaria mustelae* Bosma, 1931; *Amphimerus speciosus* (Stiles and Hassal, 1896) Barker, 1911; *Baschkirovitrema incrasatum* (Dies, 1850) Skrjabin, 1944; *Brachylaima virginiana* Dickerson, 1930; *Carneophallus basodactylophallus* Bridgman, 1969; *Cryptocotyle concava* (Creplin, 1825) Luhe, 1899; *Fibricola cratera* (Barker and Noll, 1915) Dubois, 1932; *Fibricola lucida* (La Rue and Bosma, 1927) Dubois and Rausch, 1950; *Gyrosoma singulare* Byrd, Bogitsh, and Maples, 1961; *Hasstilesia texensis* Chandler, 1929; *Heterobilharzia americana* Price, 1929; *Isthmiophora melis* (Schrunk, 1788) Luhe, 1909; *Linstowiella szidati* (Anderson, 1944) Anderson and Cable, 1950; *Martremminoides nettae* (Gower, 1938) Rankin, 1939; *Microphallus opacus* (Ward, 1894) Ward, 1901; *Paragonimus kellicotti* Ward, 1908; *Pharyngostomoides procyonis* Harkema, 1942; *Quinqueserialis quinqueserialis* (Barker and Laughlin, 1911) Harwood, 1939; *Phopalias macracanthus*

(Chandler, 1932; and *Sellacotyle vitellosa* Sogandares-Bernal, 1961.

Adult trematodes reported from Louisiana for the first time are: *Alaria alarioides*, *A. marciana*, *Amphimerus speciosus*, *Cryptocotyle concava*, *Isthmiophora melis*, *Mircophallus opacus*, *Paragonimus kellicotti*, and *Quinqueserialis quinqueserialis*.

New host records include *Heterobilharzia americana*, *Cryptocotyle concava*, and *Maritreminoides nettae* from mink; *Alaria marciana*, *Amphimerus speciosus*, and *Linstowiella szidati* from raccoon; and *Hasstilesia texensis* from muskrat.

Natural infections of adult *Alaria marciana* were found only in juvenile raccoons. This substantiates previous experimental work which demonstrated that adult raccoon are unsuitable for the maturation of this trematode. The larvae, however, are able to employ the adult raccoon as a paratenic host where they remain undifferentiated in the subcutaneous fat.

Amphimerus speciosus is a well known pathogen of dogs and cats in North America, being herein reported from a domestic cat and a raccoon. Synonymization of the better known *A. pseudofelineus* with *A. speciosus* is corroborated by our observations.

Whether *Isthmiophora* is distinct from *Euparyphium* has been debated by several authors. We place our specimens in the genus *Isthmiophora* on the basis of body shape and testicular morphology. We compared our specimens to those of *Euparyphium beaveri* and conclude they are distinct. This is the first report of *I. melis* from a raccoon and, to our knowledge, the only report of this species from North America. We consider *Euparyphium beaveri* of Lumsden and Zischke, 1961 to be a synonym of *Baschkirovitrema incrasatum*.

Microphallus opacus is a common parasite in the mink and raccoon in Louisiana. Sogandares-Bernal (1965a) stated that the aquatic snail, *Amnicola*, probably served as first intermediate host and that several species of crayfish served as second inter-

mediate hosts. Therefore, a hypothetical life-cycle of *M. opacus* from Louisiana can be proposed: the first intermediate host is the aquatic snail, *Amnicola*; several crayfishes serve as second intermediate; and the raccoon and mink are definitive hosts. Fishes have yet to be reported with *M. opacus* from Louisiana.

The first and second intermediate hosts, as well as the larval stages, of *Paragonimus kellicotti* have been previously reported from Louisiana. However, this is the first report from this state of the adult fluke in a naturally infected definitive host, the opossum. The locality of the infection is noteworthy in that it was found in an upper middle class Baton Rouge residential area.

LITERATURE CITED

- AMEEL, D.J. 1934. *Paragonimus*, its life history and distribution in North America and its taxonomy (Trematoda: Troglotremitidae). Am. J. Hyg. 19: 279-317.
- BABBOT, F.L., W.W. FRYE, and J.E. GORDON. 1961. Intestinal parasites of man in Arctic Greenland. Am. J. Trop. Med. Hyg. 10: 185-190.
- BABERO, B.B. 1960. A survey of parasitism in skunks (*Mephitis mephitis*) in Louisiana, with observations on pathology due to helminthiasis. J. Parasitol. 46: 26-27.
- . 1972. A record of progenesis in Trematoda. Proc. Helm. Soc. Wash. 39: 128-131.
- , and J. LEE. 1961. Studies on the helminths of nutria, *Myocastor coypus* (Molina), in Louisiana with checklist of other worm parasites from this host. J. Parasitol. 47: 378-390.
- BAFUNDO, K.W., W.E. WILHELM, and M.L. KENNEDY. 1980. Geographic variation in helminth parasites from the digestive tract of Tennessee raccoons, *Procyon lotor*. J. Parasitol. 66: 134-139.
- BEAVER, P.C. 1941. Studies on the life history of *Euparyphium melis* (Trematoda: Echinostomidae). J. Parasitol. 27: 35-44.
- BENNETT, H.J. 1938. A partial check list of the trematodes of Louisiana vertebrates. Proc. La. Acad. Sci. 4: 178-181.
- , and A.G. HUMES. 1939. Studies on the pre-cercarial development of *Stichorchis subtriquetrus* (Trematoda: Paramphistomidae). J. Parasitol. 25: 223-231.
- , and L.L. JENKINS. 1936. The longe-

- vity of the miracidium of *Cotylophoron cotylophorum*. Proc. La. Acad. Sci. 8: 5-13.
- BRIDGMAN, J.F. 1969. Life cycles of *Carneophallus choanophallus* n. sp. and *C. basodactylophallus* n. sp. (Trematoda: Microphallidae). Tulane Stud. Zool. & Bot. 15: 81-105.
- BURROWS, R.B., and W.G. LILLIS. 1965. Trematodes of New Jersey dogs and cats. J. Parasitol. 51: 570-574.
- BYRD, E.E., and R.W. MACY. 1942. Mammalian trematodes. III. Certain species from bats. J. Tenn. Acad. Sci. 17: 149-156.
- _____, and R.J. REIBER. 1942. Mammalian trematodes. II. Three flukes from small mammals. J. Tenn. Acad. Sci. 17: 143-156.
- _____, _____, and M.V. PARKER. 1942. The anatomy of a lung fluke from the opossum (*Didelphis virginiana* Kerr). J. Tenn. Acad. Sci. 17: 116-129.
- CHANDLER, A.C., and R. RAUSCH. 1946. A study of strigeids from Michigan mammals, with comments on the classification of mammalian strigeids. Trans. Am. Microsc. Soc. 65: 328-337.
- CUSTER, J.W., and D.B. PENCE. 1981. Ecological analysis of helminth populations of wild canids from the Gulf Coastal prairies of Texas and Louisiana. J. Parasitol. 67: 289-307.
- DAWES, B. 1946. The Trematoda with special reference to British and other European forms. Cambridge Univ. Press, 664 p.
- DIKMANS, G. 1931. A new nematode worm, *Vianaia bursobscura*, from the opossum with a note on the other parasites of the opossum. Proc. U.S. Natl. Mus. 79: 1-4.
- _____. 1945. Check-list of the internal and external animal parasites of domestic animals in North America. Am. J. Vet. Res. 6: 211-241.
- DUBOIS, G. 1937. Sur quelques Strigéidé. Rev. Suisse Zool. 44: 391-396.
- _____. 1944. A propos de la spécificité parasitaire des Strigeida. Bull. Soc. Neuch. Sci. Nat. 69: 5-103.
- _____. 1970. Statut des Alariinae Hall et Wigdor, 1918 (Trematoda: Diplostomatidae) et revision de quelques alariens. Bull. Soc. Neuch. Nat. 10: 259-727.
- FLEMING, W.J., C.F. DIXON, and J.W. LOVETT. 1977. Helminth parasites of river otters (*Lutra canadensis*) from southeastern Alabama. Proc. Helminthol. Soc. Wash. 44: 131-135.
- HARKEMA, R. and G.C. MILLER. 1964. Helminth parasites of the raccoon, *Procyon lotor* in the southeastern United States. J. Parasitol. 50: 60-66.
- HERBER, E.C. 1942. The life history studies on two trematodes of the subfamily Notocotylinae. J. Parasitol. 28: 179-196.
- HOFFMAN, G.L. 1957. Studies on the life cycle of *Cryptocotyle concavum* from the common sucker and experimentally in the chick. Proc. North Dakota Acad. Sci. 11: 55-56.
- KAPLAN, E.H. 1964. *Heterobilharzia americana* Price, 1929, in the opossum from Louisiana. J. Parasitol. 50: 797.
- KINSELLA, J.M. 1971. Growth, development, and intraspecific variation of *Quinqueserialis quinqueserialis* (Trematoda: Notocotylidae) in rodent hosts. J. Parasitol. 57: 62-70.
- LARSON, O.R., and W.C. SCHARF. 1975. New helminth records from Minnesota mammals. Proc. Helminthol. Soc. Wash. 42: 174-175.
- LA RUE, G.R., and D.J. AMEEL. 1937. The distribution of *Paragonimus*. J. Parasitol. 23: 382-388.
- LUMSDEN, R.D., and C.A. WINKLER. 1962. The opossum, *Didelphis virginiana* (Kerr), a host for the cyathocotylid trematode *Linstowiella szidati* (Anderson, 1944) in Louisiana. J. Parasitol. 48: 503.
- _____, and J.A. ZISCHKE. 1961. Seven trematodes from small mammals in Louisiana. Tulane Stud. Zool. & Bot. 9: 87-98.
- _____, and _____. 1963. Studies on the trematodes of Louisiana birds. Z. Parasitenk. 22: 316-366.
- MALEK, E.A., L.R. ASH, H.F. LEE, and M.D. LITTLE. 1961. *Heterobilharzia* infection in the dog and other mammals in Louisiana. J. Parasitol. 47: 619-623.
- MARTIN, D.R. 1976. New host and distribution records of helminth parasites of the Mexican free-tail bat, *Tadarida brasiliensis*, from Texas and Louisiana. Proc. Helminthol. Soc. Wash. 43: 85-86.
- MILLER, G.C., and R. HARKEMA. 1964. Studies on helminths of North Carolina vertebrates. V. Parasites of the mink, *Mustela vison* Schreber. J. Parasitol. 50: 717-720.
- _____, and _____. 1968. Helminths of some wild mammals in the southeastern United States. Proc. Helminthol. Soc. Wash. 35: 118-125.
- NASIR, P., and M.T. DIAZ. 1972. Avian flukes from Venezuela. Rivista di Parassitologia 33: 245-276.
- PENN, G.H. 1942. Parasitological survey of Louisiana muskrats. J. Parasitol. 28: 348-349.
- RAUSCH, R. 1946. The raccoon, a new host for *Microphallus* sp., with additional notes on *M. ovatus* from turtles. J. Parasitol. 32: 208-209.
- _____. 1947. Some observations on the host relationships of *Microphallus opacus* (Ward, 1894) (Trematoda: Microphallidae). Trans. Am. Microsc. Soc. 66: 59-63.

- ROTHENBACHER, H., and W.D. LINDQUIST. 1963. Liver cirrhosis and pancreatitis in a cat infected with *Amphimerus pseudofelineus*. J. Am. Vet. Med. Assoc. 143: 1099-1102.
- SAYWER, T.K. 1961. The american otter, *Lutra canadensis vaga*, as a host for two species of trematodes previously unreported from North America. Proc. Helminthol. Soc. Wash. 28: 175-176.
- SHOOP W.L., and K.C. CORKUM. 1981a. Some trematodes of mammals in Louisiana. Tulane Stud. Zool. & Bot. 22: 109-121.
- _____, and _____. 1981b. Epidemiology of *Alaria marcianae* mesocercariae in Louisiana. J. Parasitol. 67: 928-931.
- _____, and _____. 1982. Progenesis reconsidered in *Ribeiroia ondatrae* (Price, 1931) nec Babero, 1972, a junior synonym of *Gyrosoma singulare*. J. Parasitol. 68:424.
- SKRJABIN, K.L., and E.I. BASHKIROVA. 1956. Echinostomatidae Dietz, 1909. In SKRJABIN, K.I., Trematodes of Animals and Man. 12: 53-932.
- SOGANDARES-BERNAL, F. 1961. *Sellacotyle vittellosa*, a new troglotrematid trematode from the mink in Louisiana. J. Parasitol. 47: 911-912.
- _____. 1965a. Parasites from Louisiana crayfishes. Tulane Stud. Zool. & Bot. 12: 79-85.
- _____. 1965b. Studies on American paragonimiasis. I. Age immunity of the snail host. J. Parasitol. 51: 958-960.
- _____, and J.F. BRIDGMAN. 1960. Three *Ascocotyle* complex trematodes (Heterophyidae) encysted in fishes from Louisiana, including the description of a new genus. Tulane Stud. Zool. & Bot. 8: 31-39.
- THATCHER, V.E. 1970. The genus *Amphimerus* Barker, 1911 (Trematoda: Opisthorchiidae) in Colombia with the description of a new species. Proc. Helminthol. Soc. Wash. 37: 207-211.
- WOOTTON, D.M. 1957. The life history of *Cryptocotyle concavum* (Creplin, 1825) Fiscoeder, 1903 (Trematoda: Heterophyidae). J. Parasitol. 43: 271-279.
- YAMAGUTI, S. 1971. Synopsis of digenetic trematodes of vertebrates. Vol. I. Keigaku Publ. Co., Ltd., Tokyo, 1,100 pp.

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