DISTRIBUTION OF HELMINTH PARASITES IN TURTLES NATIVE TO SOUTHERN ILLINOIS

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ABSTRACT.—From October, 1965, through October, 1966, 287 turtles representing six genera and seven species were collected from 31 sites in southern Illinois. These turtles were killed and examined for helminth parasites. Two hundred thirty-two (80.8%) of the turtles were infested with parasites. Twelve genera and 22 species of parasites were identified. The distribution of the various parasites was dependent on food| habits and habitat of host in relation to life cycle of the parasite involved. Eight new host records occurred.

From October, 1965, through October, 1966, 287 turtles representing seven species were collected within a 30 mile radius of Carbondale, Illinois. Species studied in this survey were *Chelydra serpentina, Chrysemys picta, Pseudemys scripta, Sternotherus odoratus, Terrapene carolina, Terrapene ornata,* and *Trionyx spinifer.*

The purposes of this investigation were to determine which helminth parasites were present in the turtles, to determine which species of turtles were parasitized, to determine the degree of infestation, and to determine possible factors affecting the distribution of the helminth parasites in the turtles.

Monogenetic and Digenetic Trematodes, Cestoda, Acanthocephala, Nematoda, and Hirudinea have been reported previously from turtles in North America. However, very little concerning the parasites of turtles found in southern Illinois has been published. Cahn (1937) in his monograph on turtles of the state makes brief mention of finding a few parasites in his survey. The most recent work on turtles of Illinois is summarized in Smith (1961), but little mention is made of parasites. Apparently, few parasites have been reported from turtles in southern Illinois; and no distributional study of the parasites in turtles from this area has been made.

MATERIALS AND METHODS

In this survey, 287 turtles were collected from various sites in southern Illinois and were examined for ecto- and endoparasites. The turtles were collected by hand, by electroshocking, with a hook and line, and with traps.

The turtles were killed and examined for parasites as soon as possible after collection. Any parasites found while examining the external surfaces or internal organs were removed and placed in a 0.75% saline solution.

Trematodes, acanthocephalans, nematodes, and leeches were killed and fixed with either AFA or Gilson's solution. The worms were flattened during fixation by placing them between glass slides ,a slide and a coverslip, or two glass plates. The worms were then transferred to 70% alcohol and stored until staining. Leeches were relaxed before fixation by using a magnesium sulfate solution.

The helminths were stained with borax carmine if the fixative was AFA and with carm alum if the fixative was Gilson's solution. Then, the worms were dehydrated in an alcohol series, cleared in xylene, and mounted in permount.

The turtles were identified with keys and descriptions in Smith (1961). The helminth parasites were identified with keys and descriptions in Acholonu (personal communication), Byrd (1939), Cable and Hopp (1954), Fisher (1960), Mackin

(1936), Pennak (1953), Price (1939), Wharton (1940), Yamaguti (1958, 1961), and Yorke and Maplestone (1926). Verification of the identifications was made by Dr. George Garoian and Miss Lee Morin of the Zoology Department, Southern Illinois University.

Results

Twelve genera and 22 species of helminth parasites were identified. The names of the various parasites and their frequency of occurrence within the various hosts are given in Table I and Table II.

No new species of helminths were found in this survey. However, eight new host records occurred; and these are given in Table III.

Discussion

There is a great deal of variation in the parasitism of the different species of turtles. (Table II). Two species showed no parasites, and one species was 100% infested. The lack

Table I
FREQUENCY OF PARASITES IN SEVEN SPECIES OF TURTLES FROM SOUTHERN ILLINOIS

	Hosts							
	Chelydra serpentina	*Chrysemys picta*	*Pseudemys scripta*	*Sternotherus odoratus*	*Terrapene carolina*	*Terrapene ornata*	*Trionyx spinifer*	TOTALS
Number of hosts examined	17	69	125	10	63	2	1	287
	Number of hosts infested							
Trematoda Monogenea								
Neopolystoma orbiculare		6	11					17
Polystomoides coronatum	1	5	38					44
Digenea:								
Heronimus mollis	5	8	2					15
Spirorchis elegans		2	1					3
Spirorchis magnitestis	2							2
Spirorchis sp.		1	2					3
Telorchis corti	4		2		2			8
Acanthocephala:								
Acanthocephalus sp.	1							1
Neoechinorhynchus chrysemydis		4						4

TABLE I
FREQUENCY OF PARASITES (Continued)

	Hosts							
	Chelydra serpentina	*Chrysemys picta*	*Pseudemys scripta*	*Sternotherus odoratus*	*Terrapene carolina*	*Terrapene ornata*	*Trionyx spinifer*	TOTALS
Neoechinorhynchus emyditoides			26					26
Neoechinorhynchus pseudemydis	1	1	113					115
Neoechinorhynchus sp.			5					5
Nematoda:								
Camallanus trispinosus	4	11	87	1	7			110
Immature nematodes					2			2
Immature oxyuroids	1		2		15			18
Oswaldocruzia leidyi					7			7
Oswaldocruzia pipiens					3			3
Spironoura affine			1		6			7
Spironoura chelydrae	1							1
Spironoura longispicula					1			1
Spironoura sp.	3		1		11			15
Spiroxys contorta	3	10	22		11			36
unidentified nematodes	1		6		3			10
Hirudinea:								
Placobdella parasitica	1	6	6					13
Placobdella rugosa		1	1					2

TABLE II

DEGREE OF HELMINTH INFESTATION OF SEVEN SPECIES OF TURTLES FROM SOUTHERN ILLINOIS

Host species	Number examined	Number parasitized	Percentage parasitism	Number of turtles infested				
				Monogenea	Digenea	Acanthocephala	Nematoda	Hirudinea
Chelydra serpentina	17	14	82.4	1	11	2	9	1
Chrysemys picta	69	42	61.8	12	11	1	20	8
Pseudemys scripta	125	125	100.0	45	7	123	99	12
Sternotherus odoratus	20	2	20.0	0	0	0	2	0
Terrapene carolina	63	48	76.2	0	2	0	48	0
Terrapene ornata	2	0	0.0	0	0	0	0	0
Trionyx spinifer	1	0	0.0	0	0	0	0	0
TOTALS	287	232	80.8	68	31	126	196	21

TABLE III

NEW HOST RECORDS

Parasite	New Host
Acanthocephala:	
Acanthocephalus sp.	*Chelydra serpentina*
Neoechinorhynchus pseudemydis	*Chelydra serpentina*
Nematoda:	
Camallanus trispinosus	*Terrapene carolina*
Oswaldocruzia pipiens	*Terrapene carolina*
Spironoura affine	*Pseudemys scripta*
Spiroxys contota	*Terrapene carolina*
Hirudinea:	
Placobdella parasitica	*Pseudemys scripta*
Placobdella rugosa	*Pseudemys scripta*

of parasites in *T. ornata* and *T. spinifer* was due to the small number of hosts examined, since a variety of parasites has been reported previously from these two species (Barker, 1911; Barker and Parsons, 1914; Harwood, 1932; Hill, 1941; Hughes, Baker, and Dawson, 1941; Hughes, Higginbothan, and Clary, 1942, Morgan, 1945; Odlaug, 1956; Price, 1939; Rausch, 1947; and Stunkard, 1926).

The 100% infestation of *P. scripta* is due to several factors. One of these is diet. They eat molluscs, small fish, insects, crustaceans, and vegetation—all of which are important in the life cycles of various parasitic groups.

Secondly, *P. scripta* is more aquatic in habit (Smith, 1961). There is more opportunity for infestation since the larval stages of most parasitic groups are aquatic or require an aquatic intermediate host (Rankin, 1945).

Table II also shows that the percentage of infectation of two other aquatic turtles — *C. serpentina* and *C. picta* — was relatively high. Again diet and aquatic habit are the major factors for this high percentage.

However, the percentage for *S. odoratus,* also an aquatic turtle, was low — only 20%. The cause of this was not determined. It was probably due to the small number of hosts examined.

Rankin (1945) also noted that a larger variety of parasites occurred in the aquatic habitat than in the terrestrial habitat. Thus, an aquatic turtle should be infested with a greater number of species of parasites than a terrestrial turtle. This can be seen by examining Table I. Although there were ten or more species of parasites found in *P. scripta, C. serpentina, C. picta,* and *T. carolina;* in *T. carolina,* a terrestrial animal, all the parasites (with one exception) were nematodes. The parasites of the other turtles included trematodes, nematodes, acanthocephalans, and leeches.

The species of parasites found in aquatic turtles are usually not the same as those found in terrestrial turtles. An examination of the distribution of each parasitic group in Table I will support this statement.

Monogenetic trematodes normally are restricted to aquatic hosts. This is due to a direct life cycle with an aquatic larval stage. Tables I and II show that monogenetic trematodes were restricted to aquatic hosts in this survey.

Three genera of digenetic trematodes were found in this survey. *Spirorchis* and *Heronimus* were genera that were limited to aquatic hosts (Table I). These genera are limited to aquatic hosts because *Spirorchis* cercaria must directly penetrate the final host (Olson, 1967), and *Heronimus* cercaria require a molluscan intermediate host (Crandall, 1960). *Telorchis,* the third genus, was found in both aquatic and terrestrial turtles. (Table I). Apparently, *Telorchis* has little host specificity as it has been found in many aquatic and terrestrial turtles (Hughes, et. al., 1942; Warton, 1940).

Acanthocephala normally are not restricted to aquatic hosts, as they were in this survey. Since the life cycles of *Neoechinorhynchus chrysemydis, N. emyditoides,* and *N. pseudemydis* have not been completed, it is not yet known if these species can utilize a terrestrial host or if they are limited to aquatic hosts.

Nematodes were the parasites most frequently found in this survey. They infested 62% of the turtles examined. Four genera were identified: *Camallanus, Spironoura, Spiroxys,* and *Oswaldocruzia.*

Oswaldocruzia was limited to *T. carolina,* a terrestrial turtle (Table I). The eggs of this parasite are deposited on the ground and swallowed

accidently while the host is feeding (Baer, 1951). Aquatic turtles normally would not be infested. *Spiroxys* was found only in aquatic turtles (Table I). Copepods serve as intermediate hosts (Baer, 1951), so terrestrial turtles should not be infested. *Camallanus* and *Spironoura* were found in both aquatic and terrestrial turtles (Table I). Fish or copepods serve as intermediate hosts for *Camallanus* (Baer, 1951; Cheng, 1964). This life cycle infers aquatic final hosts. The infestation of *T. carolina* suggests either additional intermediate hosts or an aquatic diet for *T. carolina*. *Spironoura* has a direct life cycle in which eggs can be deposited on land or in water (Cheng, 1964). Both aquatic and terrestrial hosts are possible.

In all previous reports of leeches on turtles, (Cahn, 1937; Mathers, 1948; and Pennak, 1953) only aquatic hosts were involved. The same results were found in this survey.

No tapeworms were found in this survey, although they were reported previously from the same hosts by Cahn, 1937; Hughes, Baker, and Dawson, 1941; and Odlaug, 1956. Their absence in this survey was not determined.

No larval stages of helminth parasites were found. Their absence indicates the turtles are not suitable as intermediate hosts for these parasites.

Summary

As a group, turtles in southern Illinois are parasitized rather heavily. Two hundred thirty-two (80.8%) turtles had helminth infestations. Approximately 20.6% were parasitized by Monogenetic trematodes, 10.8% by Digenetic trematodes, 43.5% by Acanthocephala, 62% by Nematoda, and 7.3% by Hirudinea. The helminth fauna of aquatic turtles was havier and more varied than the helminth fauna of terrestrial turtles from the same area. The distribution of the parasites in the turtles examined infers a relationship between food habits and habitat of host and the life cycle of the parasite involved.

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Literature Cited

Baer, J. G. 1951. Ecology of animal parasites. University of Illinois Press, Urbana. 224 pp.

Barker, F. D. 1911. The trematode genus *Opisthorchia*. Arch. Parasitol. 14: 513-561.

Barker, F. D. and Parsons, S. A. 1914. A new aspidobothrid trematode from Lesseur's terrapin. Amer. Micr. Soc., Trans. 33: 261-262.

Byrd, E. E. 1939. Studies on the blood flukes of the family Spirorchiidae, Part II. J. Tenn. Acad. Sci. 14: 116-161.

Cable, R. M. and Hopp, W. B. 1954. Acanthocephalan parasites of the genus *Neoechinorhynchus* in North American turtles with the descriptions of two new species. J. Parasitol. 40: 674-681.

Cahn, A. R. 1937. The turtles of Illinois. Illinois Biol. Monog. 16: 1-218.

Cheng, T. C. 1964. The biology of animal parasites. W. B. Saunders Co., Philadelphia. 727 pp.

Crandall, R. B. 1960. The life history and affinities of the turtle lung fluke, *Heronimus chelydrae* MacCallum 1902. J. Parasitol. 46: 289-307.

Fisher, F. M. 1960. On Acanthocephala of turtles with the description of *Neoechinorhynchus emyditoides*, n.sp. J. Parasitol. 46: 257-266.

Harwood, P. D. 1932. The helminths parasitic in amphibia and reptilia of Houston, Texas, and vicinity. U.S. Nat. Mus., Proc. 81: 1-71.

Hill, W. C. 1941. *Physaloptera terrapenis*, a new nematode from a tortoise. Amer. Micr. Soc., Trans. 60: 59-64.

Hughes, R. C. Baker, J. P., and Dawson, C. B. 1941. The tapeworms of reptiles, Part I. Amer. Midl. Nat. 25: 454-468.

HUGHES, R. C., HIGGINBOTHAN, J. W., and CLARY, J. W. 1942. Trematodes of reptiles, Part II. Okla. Acad. Sci., Proc. 21: 35-43.

MACKIN, J. G. 1927. *Dracunculus globocephalus*, n.sp. from *Chelydra serpentina*. J. Parasitol. 14: 91-94.

MATHERS, C. K. 1948. Leeches of Okoboji region. Iowa Acad. Sci. Proc. 55: 397-425.

MORGAN, B. B. 1945. Nematode genus *Abbreviata*. Amer. Midl. Nat. 34: 485-490.

ODLAUG, T. O. 1956. Helminth parasites reported from vertebrates in Minnesota. The Flicker 28: 138-148.

OLSON, O. W. 1967. Animal parasites: their biology and life cycles, 2nd ed. Burgess Pub. Co., Minneapolis. 431 pp.

PENNAK, R. W. 1953. Freshwater invertebrates of the United States. Ronald Press Co., New York. 769 pp.

PRICE, E. W. 1939. North American monogenetic trematodes IV. The family Polystomatidae (Polystomatoidea). Helm. Soc. Wash. Proc. 6: 80-92.

RANKIN, J. S. 1945. Ecological study of helminth parasites of amphibians and reptiles of west Massachusetts and vicinity. J. Parasitol 31: 142-150.

RAUSCH, R. 1947. Observations on some helminth parasitic in Ohio Turtles. Amer. Midl. Nat. 38: 434-442.

SMITH, P. W. 1961. The amphibians and reptiles of Illinois. Ill. Nat. Hist. Surv. Bull. 28: 1-298.

STUNKARD, H. W. 1926. A new trematode, *Vasotrema amydae*, n.g., n.sp. from the vascular system of the soft-shelled turtle *Amydae*. Anat. Rec. 34: 165.

WHARTON, G. W. 1940. The genera *Telorchis*, *Protenes*, and *Auridistomum* (Trematoda:Reniferidae). J. Parasitol. 26: 497-518.

YAMAGUTI, S. 1958. Systema helminthum, Vol. 1: The digenetic trematodes of vertebrates, Parts I and II. Interscience Publishers, Inc., N.Y. 1575 pp.

———. 1961. Systema helminthum, Vol. 3: The nematodes of vertebrates. Parts I and II. Interscience Publishers, Inc., N.Y. 1261 pp.

YORKE, W. and MAFLESTONE, P. 1926. Nematode parasites of vertebrates. P. Blakiston's Son & Co., Philadelphia. 536 pp.

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