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CHANGES IN THE TREMATODE FAUNA OF CLAMS IN THE LITTLE BRAZOS RIVER, TEXAS

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ABSTRACT: Before the 1950-56 drought, six (possibly seven) species of trematodes were found in the Little Brazos River clams. Seven years after the drought the clams were found to contain two species of flukes found previously and one species not previously found. The range of *Aspidogaster conchicola* von Baer, 1826, and *Cotylaspis insignis* Leidy, 1857, is extended to include Texas.

The Little Brazos River is a small, shallow tributary of the Brazos River. Before the drought of 1950-56, nine species of clams were found in the river, some in great numbers. Sporadic collections of Little Brazos mollusks have been made by students for various research projects since 1935, and trematodes representing six, and possibly seven, species in five families have been found in clams. Five previously named species were identified, and an additional genus was represented by either one or two unnamed species.

During the drought the river ceased to flow; many isolated pools were formed and later became stagnant. In the summer and autumn of 1956 a fairly intensive search failed to reveal any living clams. The Little Brazos River rose and overflowed its banks in the spring of 1957 and has since continued to flow. Several species of clams now live in the river but not in their former abundance. A study was undertaken from February to May 1964, to determine the effect of the drought on the trematode fauna in the clams.

MATERIALS AND METHODS

One hundred and ninety-seven clams of nine species were collected before the drought, while 90 clams of seven species were collected 7 years after the drought ended. In both instances the clams were collected by hand or scoops from approximately a mile and a half of the Little Brazos River in Brazos County, Texas. Since the river became dry in many places during the drought, clams were collected from several different pools of the river to increase the probability of obtaining a representative sample.

The viscera, foot, and mantle of the clams were examined under a dissecting microscope for larval and adult trematodes. Cysts of metacercariae were broken with needles or by gently applying pressure

on a cover slip. The larval flukes were pipette onto a slide and stained by adding a small amount of neutral red.

RESULTS

Table I shows a comparison of predrought and postdrought findings.

Aspidocotylea

Family Aspidogastridae: In 1935 and 1939 a total of 10 *Cotylaspis insignis* Leidy, 1857 were collected from five of 34 specimens of *Lampsilis tampicoensis berlandieri* only. Before the drought this clam was one of the principal unionids inhabiting the Little Brazos but it is now very rare. Of the three that were collected in 1964 only one contained this fluke. The "best host" in 1964 was *Anodonta corpulenta* (= *A. stewartiana*) which yielded 27 *C. insignis* from 11 specimens. Sixty-two *C. insignis* and three *Aspidogaster conchicola* were found in one specimen. Three other clam species were found to harbor *C. insignis* in 1964. Previously, *C. insignis* has been reported from Illinois, Iowa, and Pennsylvania (Kelly, 1899); New York (Osborn, 1903); Michigan (Stunkard, 1917); and Florida, Alabama, Georgia, and Tennessee (Hendrix and Short, 1965).

Aspidogaster conchicola (von Baer, 1827) was not found prior to the drought but was one of the more common flukes in the Little Brazos clams in 1964, being found in 12 of 40 *Amblema perplicata*, two of 18 *Q. forshyei*, three of 11 *Q. houstonensis*, and nine of 11 *Anodonta corpulenta*.

Previously, *A. conchicola* has been reported in the United States from Pennsylvania (Leidy, 1857; Kelly, 1899); Iowa (Kelly, 1899); Illinois (Kelly, 1899; Williams, 1942; Van Cleave and Williams, 1943); and Florida and Alabama (Hendrix and Short, 1965).

TABLE I. Number of clams examined before and after drought, Texas, before and after drought

Host species examined

Before drought
Lampsilis anodontoides
L. tampicoensis berlandieri
Quadrula forshyei
Quadrula houstonensis
Leptodea fragilis
Tritigonia verrucosa
Proptera purpurata
Amblema perplicata
Musculium ferrissi

After drought
Lampsilis anodontoides
L. tampicoensis berlandieri
Q. forshyei
Q. houstonensis
Arcidens confragosa
Amblema perplicata
Anodonta corpulenta

* Percent infection found
** Cercariae found in specimens
5/15—The numerator indicates the number of specimens examined
— Indicates no parasites

Digenea

Family Allocreadae: The Allocreadiidae were first reported in the Little Brazos by P. J. P. (1924), with adult catfish (*Ictalurus punctatus*) encysted in the mollusks, Unionidae. Before the drought metacercariae were found in 81 of 81 *Amblema perplicata* clams, numbers of *Lampsilis tampicoensis berlandieri*, *Quadrula forshyei*, *Tritigonia verrucosa*, *Leptodea fragilis*. The "best host" clam, *Amblema perplicata*, 12,366 encysted specimens, 24 of which were found in acid solutions were found in *P. ictaluri* cysts.

In 1964 three specimens of *P. ictaluri* were found in an extent of approximately a mile

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TABLE 1. Number of clams examined, number and percentage infected with trematodes, in Little Brazos River, Texas, before and after the 7-year drought, 1950-56.

| Host species examined → | No. of clams examined | <i>Cotylaeopsis insignis</i> | <i>Aspidogaster canchicola</i> | <i>Polylekithum ictaluri</i> | <i>Homalometron armatum</i> | <i>Microcreadium parvum</i> | <i>Alleglossidium corti</i> ? | <i>Phyllodistomum</i> sp. |
|------------------------------------|-----------------------|------------------------------|--------------------------------|------------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|
| before drought | | | | | | | | |
| <i>Lampsilis anodontoides</i> | 18 | - | - | 11/61 | 15/93 | 90%* | - | - |
| <i>L. tampicoensis berlandieri</i> | 34 | 5/15 | - | 12/35 | 23/68 | - | - | 11 |
| <i>Quadrula forsheyi</i> | 10 | - | - | 6/30 | 3/30 | - | - | - |
| <i>Quadrula houstonensis</i> | 10 | - | - | 7/70 | 1/10 | - | - | - |
| <i>Leptodea fragilis</i> | 3 | - | - | 3/100 | - | - | - | - |
| <i>Tritigonia verrucosa</i> | 2 | - | - | 1/50 | 2/100 | - | - | - |
| <i>Proptera purpurata</i> | 4 | - | - | 1/25 | - | - | - | - |
| <i>Amblema perplicata</i> | 81 | - | - | 81/100 | 1/12 | - | - | 2** |
| <i>Musculium ferrissi</i> | 32 | - | - | 1/32 | 11/34 | 24/75 | ? | - |
| After drought | | | | | | | | |
| <i>Lampsilis anodontoides</i> | 5 | 2/40 | - | 2/40 | - | - | - | - |
| <i>L. tampicoensis berlandieri</i> | 3 | - | - | - | - | - | - | - |
| <i>Q. forsheyi</i> | 18 | 2/11 | 2/11 | 6/33 | - | - | - | - |
| <i>Q. houstonensis</i> | 11 | 1/0.9 | 3/27 | 1/0.9 | - | - | - | - |
| <i>Arcidens confragosus</i> | 1 | - | - | - | - | - | - | - |
| <i>Amblema perplicata</i> | 40 | - | 12/30 | 3/7.5 | - | - | - | - |
| <i>Anodonta corpulenta</i> | 11 | 11/100 | 9/80 | 1/0.9 | - | - | - | - |

* Percent infection found by Brown.

** Cercariae found in sporocysts.

5/15--The numerator indicates number of clams infected; the denominator percentage of clams infected.

- Indicates no parasites found.

Digenea

Family Allocreadiidae: Before the drought the Allocreadiidae were represented in the Little Brazos by *Polylekithum ictaluri* (Pearse, 1924), with adults in the intestine of channel catfish (*Ictalurus punctatus*). Metacercariae are encysted in the mantle or foot of bivalve mollusks, Unionidae (Hopkins, 1934). Before the drought metacercariae of *P. ictaluri* were found in 81 of 81 *Amblema perplicata*, and in smaller numbers of *Lampsilis anodontoides*, *L. tampicoensis berlandieri*, *Proptera purpurata*, *Quadrula forsheyi*, *Q. houstonensis*, *Tritigonia verrucosa*, *Leptodea fragilis*, and *Musculium ferrissi*. The "best host," the little washboard clam, *Amblema perplicata*, yielded a total of 12,366 encysted metacercariae from 81 host specimens, 24 of which also contained a total of 121 pearls. Very small pearls dissolved in acid solutions were found to be formed around *P. ictaluri* cysts.

In 1964 three of the above hosts (*P. purpurata*, *T. verrucosa*, and *L. fragilis*) were not found in an extensive search centered approximately a mile below the predrought collecting

point. No *M. ferrissi* were examined in 1964. Not only had some of the pelecypods become rare or nonexistent, but the number of clams infected with *P. ictaluri* had greatly decreased. In 1964 this fluke was found encysted in only three of 40 *Amblema perplicata*, and only sparsely in *Anodonta corpulenta*, *Quadrula forsheyi*, *Q. houstonensis*, and *Lampsilis anodontoides*.

Family Lepocreadiidae: This marine family is represented in freshwater by *Homalometron armatum* (MacCallum, 1895) and *Microcreadium parvum* Simer, 1929. These flukes are intestinal parasites of the freshwater drum, *Aplodinotus grunniens*, and utilize clams and snails as second intermediate hosts. The larval stages were described by Hopkins (1937). Prior to the drought, metacercariae of *H. armatum* were found in the sphaeriid *Musculium ferrissi* and in six unionids: *Amblema perplicata*, *Lampsilis anodontoides*, *L. tampicoensis berlandieri*, *Quadrula forsheyi*, *Q. houstonensis*, and *Tritigonia verrucosa*. The "best host" for *H. armatum* was *L. anodontoides*, the sandshell, with 467 metacercariae in the

15 infected clams, while *L. tampicoensis berlandieri* was second best with 178 cysts in 23 hosts. No metacercariae of *H. armatum* were found in the 90 clams examined in 1964.

Microcreadium parvum, before the drought, was found by Hopkins encysted in 24 of 32 *Musculium ferrissi*, and Brown (1940) found that about 90% of *Lampsilis anodontooides* from the Little Brazos River were heavily infected. Brown's records are not available. *M. ferrissi* was very rare in 1964 and none was collected. The five *L. anodontooides* examined contained no metacercariae of *M. parvum*.

Family Gorgoderidae: This family is represented by possibly two species of *Phyllodistomum* in Little Brazos clams. The adults of these flukes have been found in the urinary bladders of the black bullhead, *Ictalurus melas*, and the freshwater drum, *Aplodinotus grunniens*. Before the drought, cercariae of this genus were found twice in sporocysts in *Amblyma perplicata*, and a "spiny-headed" metacercaria similar to *Metacercaria quadraspinis* Coil, 1954, was represented by 60 to 70 individuals encysted in 11 *Lampsilis tampicoensis berlandieri*. Metacercariae of this type were not found in any of the clams examined after the drought.

Family Plagiorchiidae: This family was represented before the drought by metacercariae apparently belonging to *Alloglossidium corti* (Lamont, 1921), abundant in *Musculium ferrissi*. Adults of *A. corti* were taken from the digestive tracts of small catfishes, *Ictalurus punctatus*, *I. melas*, and *Schilbeodes* sp., in the Little Brazos. According to Crawford (1937) the second intermediate hosts of *A. corti* are aquatic insect larvae. *M. ferrissi* were not collected in the recent survey.

DISCUSSION

Several species of clams were found in the Little Brazos River in 1964 but not in their predrought abundance, and the species composition in 1964 was different from that existing before the drought. Preceding the drought, the small "fingernail" clam, *Musculium ferrissi*, was the most abundant clam found in the Little Brazos, but it has now almost vanished from the river. Only two fingernail clams were seen in 1964 and these fell out of an old clamshell back into the river before they could

be collected. *Lampsilis anodontooides* and *tampicoensis berlandieri* were two of the principal clams inhabiting the Little Brazos before the drought but they were rare in 1964.

Specimens of *Leptodea fragilis*, *Tritogon verrucosa*, and *Proptera purpurata* were collected before the drought but were not found in 1964, and two clams, *Arcidens confragosus* and *Anodonta corpulenta*, were collected in the recent study but not previous to the drought. A few large fish kills have been noted since the end of the drought, apparently as a result of cotton insecticides washing into the river. This did not result in the permanent disappearance of clams or fish since several fish (*Cambusia*, *Ictalurus*, and *Micropterus*) were noted and seven species of clams were collected in 1964. If cotton insecticides had depopulated the stream, fish could easily reinvade it since the area sampled is approximately 2 miles above the point where the Little Brazos flows into the Brazos River. The effects of agricultural insecticides on clam cercariae are generally unknown.

Before the drought six, and possibly seven species of trematodes (*Cotylaspis insignis*, *Polylekithum ictaluri*, *Homalometron armatum*, *Microcreadium parvum*, two possible species of *Phyllodistomum*, and *Alloglossidium corti*) were found in the Little Brazos clams. Seven years after the drought the clams were found to contain *C. insignis*, *P. ictaluri*, and one fluke not previously found, *Aspidogaster conchicola*. Prior to the drought *P. ictaluri* was found in all bivalved mollusks and *H. armatum* in snail unionids. In 1964 *P. ictaluri* was the only digenetic fluke found, and the number of clams infected by it was considerably less. The change in the trematode fauna of Little Brazos clams is probably attributable to the effect of the drought upon both fish and clams.

ACKNOWLEDGMENT

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 Kelly, H. M. 15 parasites of the Lab. Nat. Hist.

RESEARCH NOTE

In vitro Cons mansonii un

In the course host-parasite relationship and the white on the 141st day of part of the work of the mice. For worthwhile to study of the fluke re-infection, in the aging of the parasite.

One milliliter Biological Co.) flask of approximately after at carefully dissected

TABLE I. *Gluc schistosoma ma*

| Days after infection |
|----------------------|
| 40 |
| 59 |
| 74 |
| 96 |
| 111 |
| 141 |
| 198 |
| 220 |

Each data point represents

- and *L. pterus* before it. *Trigonostreus* were collected from *Trigostreus* collected in the area. They have been apparently introduced into permanent several *Trigonostreus* is were les had sily re-pproximate the r. The clams or seven. *Trigonostreus*, *Trigonostreus*, *Trigonostreus* were years ago collected not *Trigonostreus* and in six only clams. The Brazos set of
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RESEARCH NOTE . . .

In vitro Consumption of Oxygen and Glucose by *Schistosoma mansoni* under Aerobic Conditions at Different Ages

In the course of other investigations in the host-parasite relationship between *S. mansoni* and the white mouse, it was noted that after the 141st day of infection spontaneous death of part of the worm burden occurred in 45% of the mice. For this reason it was thought worthwhile to study the in vitro metabolism of the fluke recovered at various times after infection, in the hope that signs suggesting aging of the parasite would be detected.

One milliliter of Formula 199 (Grand Island Biological Co.) was introduced into a Warburg flask of approximately 5.0-ml capacity. Immediately after autopsy the paired flukes were carefully dissected from the portal system,

washed free of blood and debris, and added to the flasks in groups of 6 to 10. Experiments were performed in the presence of air.

Oxygen consumption was determined by manometric readings, glucose consumption was determined by the ferrocyanide method on an initial and a final sample of the medium. The figures in Table I are the averages for the first 3 hr of the experiments. At the end of this period motility of the parasites was normal and two-thirds of the flukes remained paired. It is uncertain whether the striking decrease in both parameters after the 111th day should be interpreted as a sign of senility. It has been found that *S. mansoni* does not live in vitro on carbohydrate alone, but that amino acids, mainly the basic ones, are likewise necessary (1963, *Ann. N. Y. Acad. Sci.* **113**: 272-288). The importance for nutrition of the globin moiety split off from hemoglobin has not as yet been elucidated (1959, *Brit. J. Pharmac.* **14**: 68-73).

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TABLE I. *Glucose and oxygen consumption of Schistosoma mansoni, under aerobic conditions.*¹

| Days after infection | Oxygen consumption (mm ³ /pair/hr) | Glucose consumption (μg/pair/hr) |
|----------------------|---|----------------------------------|
| 40 | 0.23 | 0.0 |
| 59 | 0.29 | 1.5 |
| 74 | 0.53 | 2.9 |
| 96 | 0.64 | 9.1 |
| 111 | 0.65 | 10.4 |
| 141 | 0.64 | 8.4 |
| 198 | 0.34 | 7.6 |
| 220 | 0.33 | 4.1 |

¹Each data point represents the average of three experiments.