ASPECTS OF THE OCCURRENCE OF ASPIDOBOTHRID PARASITES (TREMATODA: ASPIDOBOTHREA) IN OKLAHOMA NAIADS (PELECYPODA: UNIONIDAE)

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Extensiveness and intensity of infection by *Aspidogaster conchicola* von Baer, 1826, and *Cotylaspis insignis* Leidy, 1857, are reported in a study of 557 naiads comprising 12 genera and 18 species of Unionidae from 5 localities in Oklahoma. Two new host records are reported for *A. conchicola*, and seven for *C. insignis*. New extremes of intensity in a single individual by *A. conchicola* are reported for *Anodonta grandis* (169), *Potamilus purpuratus* (1545), *Leptodea fragilis* (62), *Lampsilis radiata* (38), and *Lampsilis ovata* (413). New extremes of intensity of infection by *C. insignis* are reported in *A. grandis* (83), *Lasmigona complanata* (25), *Quadrula quadrula* (29), *P. purpuratus* (54), *P. alata* (30), and *L. ovata*. (47). Unprecedented extent of infection by *A. conchicola* are reported for *A. grandis* (67/88) and *P. purpuratus* (67/108).

The aspidobothrid trematodes which parasitize mollusks, fishes and turtles are characterized primarily by a large adhesive disk (aspis) which encompasses a major portion of the body's ventral surface. The best known members of the group are *Aspidogaster conchicola* van Baer, 1826, and *Cotylaspis insignis*, Leidy, 1857, both of which occur principally as endosymbionts in a variety of naiad species throughout the United States (1-5). Several authors have reported on the distribution of these parasites and on selected aspects of the host-parasite relationship (1-5). Little data are available on the intensity of infection of these two species in naiads and on the biological and physical parameters which affect their population dynamics either individually or in sympatry (1). This paper reports on the extent and intensity of occurrence of *A. conchicola* and *C. insignis* in Unionids representing 12 genera and 18 species collected from 5 localities in Oklahoma.

MATERIALS AND METHODS

Five hundred fifty-seven freshwater naiads representing 18 species of 12 genera were collected from eight sites which constituted both lotic and lentic environments within five localities in Oklahoma. Site locations are as follows:

1. Spavinaw Creek, 0.4 km south of Spavinaw, Mayes County, downstream from Spavinaw Dam 500 meters to bridge carrying State Highway 20 and 82.

2. Spavinaw Creek, 0.4 km south of Spavinaw, Mayes County, downstream 500 meters west of bridge carrying State Highways 20 and 82.

3. Medicine Creek, 0.4 km south of Medicine Park, Comanche County, downstream 0-100 meters from a dam diverting water to the State Fish House and Hatchery.

4. Blue River, 0.4 km north of Armstrong, Bryan County, downstream from the Durant Dam 100-600 meters.

5. Fort Gibson Reservoir, 5 km northeast of Wagoner, Wagoner County, at the mouth of Whitehorn Cove.

6. Fort Gibson Reservoir, 5 km northeast of Wagoner, Wagoner County, at the upper reaches of Whitehorn Cove.

7. Tenkiller Ferry Reservoir, 6 km north of Gore, Sequoyah County, on State Highway 100 at Pine Cove. Naiads were collected in 5 m of water by diving.

8. Tenkiller Ferry Reservoir, 6 km north of Gore, Sequoyah County, on State Highway 100 at the upper reaches of Pine Cove at low water.

Naiad identification was made during autopsy utilizing the University of Oklahoma Biological Station reference collec-

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tion prepared by B. D. Valentine, a shell key by Valentine and Stansbery (6), and a taxonomic key by Eddy and Hodson (7) which required the use of internal as well as external characteristics.

A. conchicola is found primarily in the pericardial cavity, although it is commonly encountered in the renal cavity, particularly when the intensity of occurrence is high (1). *C. insignis*, most of the time, occurs at the juncture of the internal lamella and the visceral mass (1). Occasionally it may be found in the branchial tubes, on either the external or internal lamellae (3), in the pericardium (1), and on the foot (8). Because of this variability of location, the autopsy consisted of 12 distinct steps, with each step carried out in the same sequence for every naiad examined. First, the adductor muscles were severed and the left valve opened. After opening the pericardial cavity, the visible parasites were removed and the cavity was rinsed with a jet of water under slight pressure. The rinsings were examined later for parasites. The renal cavity was opened, scraped, and rinsed. Following this, the left mantle was lifted and its junction with the external lamella examined and rinsed.

TABLE 1. *Extent and intensity of A. conchicola and C. insignis infections in Unionidae in lotic sites*

	1		2		3		4	
	A	C	A	C	A	C	A	C
Anodonta grandis	3/7 0-5	3/7 0-20	3/3 1-9	3/3 8-83	37/46 3-169	0/46 —	— —	— —
Lasmigona complanata[a] [b]	— —	— —	— —	— —	— —	— —	0/2 —	0/2 —
Tritigonia verrucosa[b]	— —	— —	— —	— —	1/1 10	0/1 —	1/21 0-3	10/21 0-5
Fusconaia flava[b]	— —	— —	— —	— —	— —	— —	3/13 0-3	2/13 0-3
Quadrula quadrula	— —	— —	— —	— —	2/3 0-21	0/3 —	11/14 0-29	0/14 —
Quadrula pustulosa	— —	— —	— —	— —	— —	— —	28/36 0-8	0/36 —
Amblema plicata	— —	— —	— —	— —	— —	— —	38/50 0-21	0/50 —
Obliquaria reflexa	— —	— —	— —	— —	— —	— —	9/26 0-2	0/26 —
Potamilus purpuratus	3/3 5-14	2/3 0-28	1/1 11	1/1 9	5/5 400-1545	0/5 —	24/26 0-52	6/26 0-1
Leptodea fragilis[b]	— —	— —	— —	— —	— —	— —	26/31 0-62	7/31 0-3
Truncilla truncata[b]	— 1	— —	— —	— —	— —	— —	7/11 0-2	1/11 0-1
Truncilla donaciformis	— —	— —	— —	— —	— —	— —	9/12 0-26	0/12 —
Lampsilis anodontoides	0/1 —	0/1 —	— —	— —	— —	— —	12/15 0-16	5/15 0-2
Lampsilis radiata[a] [b]	1/2 19	1/2 3	1/4 1	2/4 0-47	— —	— —	2/17 0-38	0/17 —
Lampsilis ovata	4/16 0-24	10/16 0-18	0/1 —	1/1 11	1/1 413	0/1 —	2/14 0-6	2/14 0-1
Mean Extent (%)	40	53	56	78	82	—	60	12
Mean Intensity	3.62	3.79	3.33	23.0	108.6	—	4.37	.20

[a] New host record, *A. conchicola*
[b] New host record, *C. insignis*

TABLE 2. *Extent and intensity of A. conchicola and C. insignis infections in Unionidae in lentic sites*

	5		6		7		8	
	A	C	A	C	A	C	A	C
Anodonta grandis	8/10 0-10	10/10 2-26	6/10 0-10	9/10 0-16	1/1 52	1/1 33	5/17 0-14	5/17 0-41
Anodonta imbicilis	— —	— —	— —	— —	— —	— —	1/5 0-2	1/5 0-2
Lasmigona complanata	0/2 —	1/2 1	3/10 0-11	2/10 0-25	— —	— —	— —	— —
Quadrula quadrula	— —	— —	0/2 —	0/2 —	— —	— —	0/6 —	0/6 —
Quadrula pustulosa	— —	— —	1/1 6	0/1 —	— —	— —	— —	— —
Amblema plicata	— —	— —	— —	— —	— —	— —	0/1 —	0/1 —
Obliquaria reflexa	— —	— —	— —	— —	— —	— —	0/2 —	0/2 —
Potamilus purpuratus	3/5 0-24	5/5 4-54	1/3 6	1/3 15	— —	— —	22/65 0-65	3/65 0-3
Potamilus alatus[a]	— —	— —	10/15 0-18	13/15 0-30	1/5 2	1/5 2	0/3 —	0/3 —
Leptodea fragilis	— —	— —	— —	— —	1/8 2	6/8 0-5	— —	— —
Truncilla truncata	— —	— —	— —	— —	— —	— —	0/4 —	0/4 —
Mean Extent (%)	65	94	51	61	21	57	27	9
Mean Intensity	4.95	11.94	2.95	7.49	4.0	3.78	3.0	1.16

[a] New host record, *C. insignis*

A similar search was made of the internal lamella, visceral mass, foot, right lamellae, labial palps, and mantle. The number of parasites recovered from each individual was tabulated.

RESULTS

Tables 1 and 2 summarize the number of clams of each species examined, the number of each naiad harboring one or more parasites, and the range of intensity of infection. Fifty-six percent of the naiads examined in this study were inhabited by *A. conchicola* and twenty percent by *C. insignis*.

Two new host records for *A. conchicola*, *Lasmigona complanata* and *Lampsilis radiata* were recorded in this study. Seven new host records, *L. complanata*, *Tritigonia verrucosa*, *Fusconaia flava*, *Leptodea fragilis*, *Truncilla truncata*, *Potamilus alata*, and *L. radiata* were discovered for *C. insignis*.

New extremes of intensity in a single individual by *A. conchicola* are shown for *A. grandis* (169), *P. purpuratus* (1545), *L. fragilis* (62), *L. radiata* (38) and *L. ovata* (413). Previously unreported extremes of intensity in a single individual by *C. insignis* are *A. grandis* (83), *L. complanata* (25), *Q. quadrula* (29), *P. purpuratus* (54), *P. alata* (30), and *L. ovata* (47). Extremes of extent of infection in a single genus not previously reported were *A. grandis* (67/88) and *P. purpuratus* (67/108).

Nine species of Oklahoma naiads were host to *A. conchicola* more than fifty percent of the time, *A. grandis* (76%), *Q. quadrula* (52%), *Q. pustulosa* (78%), *P. purpuratus* (62%), *L. fragilis* (69%), *T. donaciformis* (75%), *T. truncata* (53%), and *A. plicata* (75%). Only one naiad species, *P. alatus* (61%), was inhabited by *C. insignis* more than fifty percent of the time, although *T. verrucosa* and *L. ovata* approximate this figure by showing an extent of 45% and 41% respectively.

The mean intensity of all naiads examined is 16.85 *A. conchicola* per individual. The mean intensity of *C. insignis* was 6.42 per individual. In lotic environments the mean intensity per individual was 29.9 *A. conchicola* and 6.97 *C. insignis*. In lentic environments the mean parasite load was 3.73 *A. conchicola* and 6.09 *C. insignis* per naiad examined.

DISCUSSION

A note by Fulhage in 1954 (8) constitutes the only literature on the occurrence of *A. conchicola* and *C. insignis* in the state of Oklahoma. We undertook our study for the following reasons: (a) to gather well-documented data on new host records; (b) to provide quantitative information on the extent and intensity of the occurrence of these forms in naiads of Oklahoma; and, (c) to attempt to relate these observations to definable biological and physical parameters in such a way that hypotheses could be developed concerning the regulation of population dynamics.

Thin-shelled forms are parasitized by *A. conchicola* 73% of the time, and thick-shelled forms are infected 67% of the time. This is not a significant difference. By way of contrast, the thin-shelled forms are infected with *C. insignis* 34% of the time and thick-shelled forms 8%. Thin-shelled forms appear more likely than the thick-shelled to harbor the less parasitic symbiont.

The mean intensity of infection with *A. conchicola* is three times that of *C. insignis*. In lotic environments, it rises to five times the intensity, but drops to half the intensity of *C. insignis* in lentic environments.

More collections need to be made from each site to determine whether extent and intensity remain constant from year to year. Data on the size and age characteristics of the host organism may reveal significant correlations such as those reported by Flook and Ubelaker (9) in their survey of unionid parasites in the Garza-Little Elm Reservior in Texas. Reliable preimpoundment data followed by subsequent collections may reveal significant trends in the population dynamics of these two aspidobothrid forms in response to habitat changes in depth, current action, BOD, and substrate.

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