AN ECOLOGICAL STUDY OF THE METAZOAN PARASITES OF THE SALIENTIA OF COMANCHE COUNTY, OKLAHOMA

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INTRODUCTION

Works concerned with the parasites of the Salientia are numerous but relatively few have been published concerning the ecological relations between this group of Amphibia and their parasitic populations. Several papers, however, have dealt with this subject. Fortner (1923) concluded from a study of the parasites of three species of frogs in the Douglas Lake region, that the food of the host was a factor influencing the absence or presence of parasites. It was pointed out that the amount of rainfall, which determines the abundance of insects serving as secondary hosts, has a marked influence on the number of parasites during any one season. Holl (1932) made an ecological study of the parasites of the cricket frog, *Acris gryllus*, along with those of *Triturus viridescens* and several fishes. He demonstrated that the cricket frogs are infected only during the breeding season when they are in the water and that they have no helminth parasites during the remainder of the year. Brandt (1936)[1] made an extensive study of the parasites of six species of North Carolina Salientia. He found the habitually aquatic species to be more often parasitized although their prevalence was noted to be erratic. Little seasonal variation was shown except in bladder flukes, which were found to be most numerous during that season when the hosts were in the water, and in cestodes, which were most numerous just after the breeding season. A definite relation between the size of bullfrogs and the number of parasites infecting them was demonstrated. Little host specificity was indicated and multiple infection was of common occurrence.

Other works which have dealt with the ecological aspects of amphibian parasitism are those of Ward (1909), who reported the greatest incidence of parasites in *Rana pipiens* to be from the time of spawning to hibernation, and Pearse (1932), who found a significant seasonal variation in the parasites of Japanese salamanders.

Although life history studies have thrown some light on the ecological aspects of salientian parasitism, these papers have dealt with this subject only in so far as it was necessary to explain the life cycles. It is noteworthy, therefore, that more research is needed to give a true picture of the part played by environmental factors on parasitic populations. With this in mind, a study has been made of the metazoan parasites of the Salientia of Comanche County, Oklahoma. The materials examined served as the basis for a thesis presented in partial fulfilment for the degree of Master of Science at the University of Oklahoma by the first-named author. The direction of the thesis and the treatment of the data in this paper were done by the other author. The identifications of the hosts were checked by Dr. A. I. Ortenburger and Dr. A. N. Bragg; those of the trematodes by Dr. R. Chester Hughes; those of the nematodes by Dr. E. W. Price and Mr. J. T. Lucker; and those of the Acarina by Dr. H. E. Ewing. Dr. A. O. Weese assisted in the statistical treatment of the data. Appreciation is hereby expressed to each of these gentlemen for their cooperation.

[1] For an extensive review of the literature, see this paper.

THE ECOLOGY OF COMANCHE COUNTY

Comanche County is located in the southwestern part of Oklahoma, a region characterized by a diversity of habitat conditions. The average annual rainfall is thirty inches and during the seasons when salientia are active, there are often droughts of ten to twelve weeks duration. During the summer months the maximum temperature ranges from 80° F to 110° F. The northeastern part of the county is an area of blackjack oak and savannah. This grades into short grass in the south, a mixture of woods and savannah in the northwest, and the partially wooded Wichita Mountains in the west. The area is well drained by permanent streams from the Wichita Mountains. Numerous artificial lakes have been impounded on them and semipermanent artificial farm ponds are located throughout the area.

The streams are bordered by such trees as willow, elm, oak, cottonwood, and walnut. The farm ponds are located in shallow valleys or slight depressions in open fields and vary in age from some that are new, with unstabilized floral and faunal populations, to some as old as fifteen years with well stabilized populations.

MATERIALS AND METHODS

The frogs and toads studied were collected at night and taken to the laboratory and examined within three days. Trematodes and cestodes were fixed in Bouin's fixative and stained either by Lynch's borax-carmine precipitation method or with acetocarmine. Nematodes were killed in hot 70 percent alcohol and preserved in 1 part glycerin to 3 parts 70 percent alcohol. The mites were killed and preserved in 70 percent alcohol.

ECOLOGICAL CLASSIFICATION OF THE HOSTS

The salientians collected were divided into four habitat groups: *Rana catesbeiana* Shaw was classed as aquatic; *R. sphenocephala* (Cope)[2] and *Acris crepitans* Baird, as semiaquatic; *Microhyla olivacea* (Hallowell) and *Pseudacris clarkii* (Baird), as semiterrestrial; and, *Bufo cognatus* Say, *B. compactilis* Wiegmann, *B. insidior* Girard, *B. woodhousii woodhousii* Girard, and *Scaphiopus couchii* Baird, as terrestrial-fossorial.

Although specific determinations of all animals, both hosts and parasites, were made, the hosts have been treated according to habitat classification since it is the environmental factors that are the object of study rather than specific relationships.[3] Likewise, the parasites have been treated according to groups rather than specifically. They fall into the classes: Trematoda, Cestoidea, Nematoda, and Acarina. This seems justified since it has been demonstrated that little host specificity exists among salientian parasites. Also, the life cycles of the parasites within these groups are, in general, similar and would be expected to respond in the same manner to environmental factors. A total of 226 individual hosts were examined. Of the terrestrial-fossorial group, fourteen specimens of *Scaphiopus couchii*, thirty-eight of *Bufo w. woodhousii*, one of *Bufo insidior*, two of *Bufo cognatus*, and twenty-one of *Bufo compactilis* were examined. In the semiterrestrial group, eleven examples of *Microhyla olivacea* and three of *Pseudacris clarkii* were examined. In the semiaquatic group, twenty-three specimens of *Acris crepitans*, and seventy-three of *Rana sphenocephala* were examined. Forty individuals of *Rana catesbeiana* made up the aquatic group.

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[2] According to Bragg (1944, unpublished) all grass frogs in this area probably belong to the species *sphenocephala*.

[3] For a list of species of hosts and species of parasites recovered from them, see Kuntz (1940 and 1941).

PARASITE INFECTIONS

In the 226 hosts, there were 116 trematode infections. These include multiple infections as well as those by one species in more than one host. The species taken were *Diplorchis americana* Rodgers and Kuntz, *Allassostoma parvum* Stunkard, *Diplodiscus temparatus* Stafford, *Gorgodera amplicava* Looss, *Haematoloechus medioplexus* Stafford, *Haematoloechus uniplexus* Harwood, *Glyphthelmins quieta* (Stafford), *Halipegus occidualis* Stafford and immature distomes and amphistomes which could not be identified. Of these, only *Diplorchis americana* and *Halipegus occidualis* were found in only one species of host.

There were sixty-three cestode infections in the 226 hosts examined. They were *Ophiotaenia magna* Hannum, *Nematotaenia dispar* (Göze), *Distoichometra bufonis* Dickey, and immature proteocephalids. Only *Ophiotaenia magna* found in *Rana catesbeiana* was limited to one species of host. One hundred and thirty-nine nematode infections were found. They were *Rhabdias* sp., *Spironura catesbeianae* (Walton), *Pharyngodon* sp., *Oxysomatium* sp., *Oswaldocruzia waltoni* Ingles, *Oswaldocruzia* sp., *Foleyella* sp., *Camallanus* sp., *Spinitectus gracilis* Ward and Magath, and immature Anisakinae and Physalopteridae. Of this group, the Anisakinae, *Spironura catesbeianae*, *Spironura* sp., *Foleyella* sp., and *Spinitectus gracilis* were taken from one species of host, *Rana catesbeiana*. *Camallanus* sp. was found only in *Rana sphenocephala*. *Hannemania penetrans* Ewing was the only mite taken. It showed no tendency toward host specificity.

RESULTS

Table I shows the relationships between the four parasitic groups and the four groups of hosts. When these figures are subjected to statistical analysis, some significant data are seen. Trematode infection increases significantly from the terrestrial-fossorial habit to the aquatic, while cestode infection decreases in the same direction. Mites and nematodes are significantly high in the semiaquatic group. Obviously the collections of semiterrestrial forms were too small to form a basis for comparison.

Taking the data as a whole, it is seen that the aquatic and semiaquatic environments favor trematode parasitism whereas the terrestrial-fossorial habitat has the opposite influence. On the other hand, the terrestrial-fossorial habitat strongly favors cestode infection. The correlation between the nematodes and habitat conditions are less striking, indicating that these as a class are adapted to a greater diversity of host environmental factors. The Acarina are shown to be favored by the moist semiaquatic while they are definitely not adapted to the terrestrial-fossorial environment.

DISCUSSION

One would expect the trematodes to be more numerous in aquatic and semiaquatic species because the life cycle requires aquatic conditions. By this same reason, the scarcity of the group among the terrestrial-fossorial species is explained. The statistically significant abundance of cestodes in terrestrial-fossorial animals indicates that their secondary hosts frequent dry environments. It is suggested that there are obvious reasons for the prevalence of mite infection in the semiaquatic environment and the extreme lack of it in the terrestrial-fossorial and aquatic habitats. In the first place, these air-breathing arthropods could not survive continued submergence and in the second place, if for no other reason, they might have difficulty in penetrating the dry, tough skins of the terrestrial-fossorial species.

TABLE I

	Terrestrial-fossorial hosts		Semi-terrestrial hosts		Semiaquatic hosts		Aquatic hosts	
	Total hosts	No. of infect'ns	Total hosts	No. of infect'ns	Total hosts	No. of infect'ns	Total hosts	No. of infect'ns
Trematoda	76	8	14	3	96	65	40	40
Cestoidea	76	41	14	6	96	13	40	3
Nematoda	76	39	14	8	96	77	40	15
Acarina	76	3	14	5	96	51	40	1

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