OBSERVATIONS ON THE INFESTATION OF A FRESH WATER FISH POPULATION BY A MARINE COPEPOD (Ergasilus lizae Kroyer 1863)

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ABSTRACT

Lake Shelby, an 829-acre natural lake, located in Baldwin County at Gulf Shores, Alabama was treated with emulsifiable rotenone in October, 1956 to eliminate an undesirable fish population. The lake was restocked with the bluegill sunfish, *Lepomis macrochirus;* the redear sunfish, *Lepomis microlophus;* and the largemouth bass, *Micropterus salmoides.* Subsequent population examinations following restocking revealed in 1958 that a copepod was infesting the gills of the fish. Collection of specimens and identification revealed the copepod to be *Ergasilus lizae* Krøyer previously reported only from marine hosts. A description and history of Lake Shelby is given. The taxonomy and morphology and observations on the life cycle of *Ergasilus lizae* are also presented.

INTRODUCTION

This report is based upon collections of largemouth bass, *Micropterus salmoides;* bluegill sunfish. *Lepomis macrochirus,* and the redear sunfish, *Lepomis microlophus,* taken from Lake Shelby, an 829-acre natural lake at Gulf Shores, Alabama and collections of the striped mullet, *Mugil cephalus,* from inland canals from Pompano Beach to Hollandale, Florida.

Ergasilus lizae was described by Krøyer (1863) from the gills of the white mullet, *Mugil curema,* captured near New Orleans, Louisiana. The mullet specimens were sent to the Royal Museum in Copenhagen where the parasite examination was made. *Ergasilus lizae* was not reported again until Bere (1936) found it on the gills of the striped mullet, the white mullet, the broad killifish, *Floridichthys carpio,* the long-nosed killifish, *Fundulus similis,* and the southern common killifish, *Fundulus heteroclitus.* Causey (1955) reported *Ergasilus lizae* from the spot, *Leiostomus xanthurus,* and the spade-fish, *Chaetodipterus faber.* Since this report involves, in part, unreported freshwater hosts from a single drainage, Lake Shelby, a description and history of the Lake is given.

DESCRIPTION AND HISTORY OF LAKE SHELBY

Lake Shelby consists of three lakes known as Big Lake (571 acres), Middle Lake (216 acres), and Little Lake (42 acres). Little and Middle Lakes are connected with a deep channel and are actually one lake. Middle Lake is separated from Big Lake by a heavy growth of marsh weeds.

Until approximately 30 years ago the three bodies of water were fresh water lakes. At that time a channel was dredged from the lower end of Big Lake to Little Lagoon which in turn flowed directly into the Gulf of Mexico. The purpose of this channel was to permit small craft to enter Big Lake during severe weather conditions when the waters of the Gulf and Little Lagoon would become rough and dangerous. However, not only did this channel permit the passage of small craft to and from Big Lake, but an easy access was provided for brackish and salt water species of fish which entered with tidal fluctuations. Consequently, when studies were undertaken in 1955 to determine what management techniques could be employed to improve the fishing in these lakes the complicating factors arising as a result of the channel were immediately evident. Salinity tests conducted in July, 1955 revealed that the salt

content of Big Lake was too high for a satisfactory population of fresh water fishes to exist. The salt content of Big Lake varied from 5 ppt. at the upper end to 15 ppt. at the lower end near the channel. Little and Middle Lakes were considered to be fresh water lakes as salinity values were very low varying from 0.07 to 0.14 ppt.

Since the brackish condition of Big Lake was due to the entrance of salt water from Little Lagoon a structure was designed and installed which would allow fresh water to leave the lake but prevented salt water from entering during tidal movements. The structure consists of a battery of 12 culvert pipes, each 48 inches in diameter, with flap gates at the outlet. This unidirectional flow structure was completed in the fall of 1955 and salinity tests made in the next 12-month period revealed that the salt content of Big Lake had been reduced to the point that a desirable fresh water fish population could be sustained (Alabama Department of Conservation Annual Report, 1955-1956).

Fish population studies conducted in July, 1955 indicated that the populations in all lakes were undesirable. Consequently, as the salinity values approached satisfactory levels in Big Lake in 1956, the three lakes and the adjoining marsh areas were treated with 5% emulsifiable rotenone. The lakes received a concentration of 1.4 ppm and the marsh areas 2.2 ppm (Alabama Department of Conservation Annual Report, 1956-1957).

Sample areas in all lakes were treated with 2.5 ppm emulsifiable rotenone six days after the initial treatment but no fish were recovered. Therefore, 1,000,000 bluegills and redears were stocked during the winter of 1956 and 120,000 largemouth bass in the spring of 1957. Seining checks conducted during the summer of 1957 revealed that the fish population in Big Lake was expanding and that the fish were growing at a rapid rate. However, a few small striped mullet and a small number of brackish water minnows were found to be present in Big Lake but it was not thought that these fish would materially affect the game fish populations. Seining checks in Little and Middle Lakes revealed populations of the warmouth, *Chaenobryttus gulosus*, to be present and apparently were suppressing the development of the bluegill and redear sunfish populations in those lakes.

Seining checks of all lakes were continued and in the spring of 1958 the presence of a copepod on the gills of some of the fish in Big Lake was observed. Collections of the copepods were made and specimens were sent to Dr. David Causey, University of Arkansas, who identified the copepod as *Ergasilus lizae* Krøyer.

MORPHOLOGY AND TAXONOMY OF *ERGASILUS LIZAE*

Detailed morphological studies of this group of parasites are limited and the original descriptions of most species cannot be applied too literally. Wilson (1911) presented a translation of the original description but did not examine additional specimens. There is also a lack of agreement among specialists as to which species are valid and what characteristics are pertinent. However, species identification is usually based upon minute anatomical details which necessitate the dissection of mouth parts and legs. In this study, the five thoracic legs of ten specimens from bluegill hosts and ten from the striped mullet collected in Florida were removed and mounted for microscopic study. There was no significant variation between these two groups of specimens. The arrangement of spines and setae on the five thoracic legs, compared with Bere (1936), is tabulated below.

Thoracic legs	*Present Study*	*Bere (1936)*
First exopod	I-0, I-1, II-5	I-0, I-1, II-4
endopod	0-1, 0-1, II-4	0-1, 0-1, II-4
Second exopod	I-0, 0-1, 0-6	0-0, 0-1, 0-5
endopod	0-1, 0-2, I-4	0-1, 0-2, I-4
Third exopod	I-0, 0-1, 0-6	0-0, 0-1, 0-6
endopod	0-1, 0-2, I-4	0-0, 0-2, I-4
Fourth exopod	I-0, 0-5, absent	0-0, 0-5, absent
endopod	0-1, 0-2, I-3	0-1, 0-2, I-3
Fifth	Single segment with 3 setae	Single segment with 2 setae

This material agrees in general with that of the above author but differs in a number of details. She does not describe the armature of each leg in detail but furnished drawings of each. The tabular material is taken from Bere, 1936 (Plate 2, p. 615). She describes the first endopod in some detail and states that it differs from that of the other rami in that the first two segments have a long non-plumose setae at their inner distal corner and that the setae of the other rami are of the plumose type. In our specimens all of the setae are plumose and those of the first rami do not differ from the others.

OBSERVATIONS ON PARASITE ABUNDANCE AND LIFE HISTORY

The principal method of obtaining fish for examination was by seining. Some specimens were obtained by fishing and some were obtained from fishermen.

In arriving at the number of copepods per fish each gill arch was removed and the copepods counted on each side of each gill arch. No index or number of fish to be examined was established. At each visit fish were collected and data obtained as long as time permitted. Consequently, indications of seasonal variations in the abundance of the parasite were revealed from varying numbers of fishes and should be considered with that understanding.

Ovisac observations were made as parasite counts were obtained. The percentages of copepods with ovisacs expressed in Table I were derived either from actual counts or calculated from sub-samples where large numbers of parasites were encountered.

Variations In Parasite Numbers.—The periodic observations made from April, 1958 to March, 1961 indicate that the bluegill is more susceptible to the copepod parasite than the other species of fish collected and examined from Big Lake (Table I). Unfortunately, no studies have been undertaken to date to determine the degree of host specificity, if any, that exists of that host specificity can explain the indicated susceptibility of the bluegill. But, more susceptible or not, the variations in infestations of the bluegills reveal a seasonal cycle for the parasites. There are increases from low figures in the March and April samples to an unknown high some time during the summer as indicated by the May and June samples and a decline as the winter season approaches as indicated by the September sample (Table I).

TABLE I

SUMMARY OF OBSERVATIONS MADE AT LAKE SHELBY, GULF SHORES, ALABAMA FOLLOWING THE INFESTATION OF A FRESH WATER FISH POPULATION BY THE PARASITIC MARINE COPEPOD, *Ergasilus lizae*

Dates of Observation	*Species of Fish Examined*	*Total Number of Fish Examined*	*Average No. of Copepods Per Fish*	*Percentage of Copepods with Ovisacs*
		Big Lake		
4/16/58	Bluegill	12	302	50
5/16/58	(Bluegill	9	591	73
	(Largemouth Bass	3	1	66
	(Striped Mullet	10	0	0
9/ 4/58	(Bluegill	7	700	67
	(Redear Sunfish	1	62	..
4/ 2/59	(Bluegill	12	146	76
	(Largemouth Bass	1	159	..
6/30/59	(Bluegill	9	954	73
	(Largemouth Bass	12	112	..
	(Redear Sunfish	4	196	16
	(Warmouth Bass	1	0	0
3/15/61	(Bluegill	11	62	25
	(Largemouth Bass	2	7	57
	(Warmouth Bass	4	1	0
	(Striped Mullet	1	0	0
		Little Lake		
4/ 2/59	Bluegill	14	1	..
3/15/61	Bluegill	10	23	26

Observations in Middle and Little Lakes in 1958 indicated no parasite infestation on bluegills. However, samples in Little Lake in 1959 revealed that the parasite was present there and 1961 samples indicated an increase in the parasite population (Table I).

The available literature regarding *Ergasilus lizae* has not shown this copepod to be economically important. However, it has been indicated by the observations of this study that *Ergasilus lizae* could present serious management problems where ecological manipulations in brackish water areas are undertaken. The sport fish population development in Lake Shelby following renovation was no doubt adversely affected by the epizootic of *Ergasilus lizae*. The number of copepods counted per fish during this study varied from 0 to 1,792. At this level of infestation, the gills of a 6-inch bluegill exhibited proliferated areas on all gill arches. Observations on largemouth bass fingerlings revealed infestations of similar severity. Based on these observations it is logical to assume that the gross effect upon the bluegill, redear sunfish, and largemouth bass population in Lake Shelby was not confined to the adult fish. The irritation, infections, and general occlusion of the gills resulting from the attachment of this parasitic copepod in all likelihood was more damaging to the fry and fingerling forms and quite possibly caused mortalities of extensive nature.

Ovisac and Egg Development.—Although no observations were made during the winter months sufficient information was obtained to indicate the water temperature at which egg development and nauplii release occurred.

During the observations made in April, 1958 it was noted that all eggs were considered to be "green". The surface water temperature at that time was 60° F. Observations made during April, 1959 revealed that nauplii were being released from some ovisacs and that eggs were in various stages of development. The surface water temperature on this occasion was 65° F. Therefore, it appears that egg formation takes place at temperatures of 60° F. and lower. Egg development and the release of nauplii occurs between 60° F. and 65° F. At this temperature range a considerable part of the year was favorable for the propagation of the copepod population in the Lake Shelby area.

SUMMARY AND CONCLUSIONS

Ergasilus lizae, a parasitic copepod previously reported only from marine fishes, is reported for the first time from fresh-water fishes and reached epidemic proportions on the bluegill, largemouth bass, and redear sunfish in a fresh-water habitat.

A seasonal variation in abundance of the parasite was indicated from samples taken at different seasons of the year.

Morphological studies of parasite specimens collected in this study were compared with previous descriptions and minor variations were observed.

Observations made during this study indicated that ovisac and egg formation occurred from 60° F. and lower while egg development and nauplii release occurred between 60° and 65° F.

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