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Temperature Effect on the Distribution of *Gyrodactylus elegans* on Goldfish

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Abstract

A survey of *Gyrodactylus elegans* on goldfish indicated that the temperature had an effect on the number of these parasites on the body but little or no effect on the number found on the gills. As the water became warmer the number of body parasites increased. The pectoral, pelvic and anal fins had more parasites per unit of area than the larger dorsal and caudal fins.

Introduction

A routine examination of goldfish (*Cyprinus* auratus Linnaeus) in our aquaria indicated that the fish were parasitized with a monogenetic trematode, a ciliate, *Trichodina* sp., and a protozoan *Ichthyophthirius* sp. An examination of the armature of the trematode indicated that it was *Gyrodactylus elegans* Nordmann, 1932.

It was noted that more of these trematode parasites occurred on the fish which were in cold water than on those at room temperature. Experiments in Russia, as reported by Byhovskaya-Pavlovskaya[1] and Dogiel, Petrushevski and Polyanski[2] indicated that goldfish in ponds had the highest mortality from gyrodactyliasis during March and April when the water was coldest. Experiments were set up to check this hypothesis using fish approximately 3 inches long and a year old.

Materials and Methods

The fish were placed in two 30 gallon battery jars. One jar was placed in an aquarium and was surrounded by running cold water to maintain a low temperature. The other jar contained a heater to maintain fish at a high temperature.

The experiments were set up using approximately equal numbers of fish from a source maintained at room temperature. Each group of fish placed in the jar was given 3 days to adjust to the new temperatures before necropsies were begun. Each group was kept in the same jar for the duration of the experiment. The shortest period of time that a fish was in a high or low temperature jar was 3 days. The last ones to be sacrificed, of each experiment, were in as long as 8 weeks. Individual fish were used first from one jar and then the other so that the number of fish remaining in each jar was approximately the same.

There was a total of five experiments involving 95 fish. In four of these the two groups of fish were maintained at fairly constant temperatures for the entire experiment. In one experiment, involving nine fish in each of two jars, after the 7th

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day the jar containing fish at low temperature was taken from the cold water aquarium and was equipped with a heater to raise the temperature to 33.5 C. The heater was removed from the other jar, which had been maintained at high temperature, and the jar was placed in the cold water aquarium with a resultant drop in temperature to 16.5 C (Table 1). The fish in these jars were allowed to adjust to the new temperatures for 3 days before they were checked for parasites.

The fish were killed by cutting off the head just posterior to the operculum. The gills were placed in a separate dish and set aside until the parasites on the inner and outer surfaces of the opercula were counted. The parasites from the inside of the operculum were counted with the gills and the parasites from the outside were counted with the body. There was no attempt to separate the parasites of the left gill from those of the right. The fins were examined in the same order for each fish beginning with the left pectoral then the left pelvic, right pectoral, right pelvic, anal, dorsal and caudal. The body was examined last. It was found that better results were obtained if the fish was completely scaled and the individual scales were examined in a petri dish. Scales with attached parasites were removed from the dish as they were counted so there would be no chance of counting them a second time.

Results

This survey, which covered a period from Feb. 23, 1966 to Sept. 23, 1966 indicated that temperature influenced the distribution of *Gyrodactylus elegans* on the body and gills. The number of parasites on the body of the fish in cold water was higher than the number on the gills, whereas the number on the body in warm water was usually less than the number on the gills. The total number of parasites reached a seasonal peak during the months of April and May.

TABLE 1. *Effect of temperature reversal on number of* Gyrodactylus elegans *on goldfish body and gills*

Fish No.	Date	Temp. C.	No. of Body Parasites	No. of Gill Parasites
1	8-16	32.0	15	9
2	8-17	18.0	38	4
3	8-18	31.0	67	31
4	8-19	18.0	36	5
5	8-19	33.0	9	43
6	8-20	18.0	74	7
		TEMPERATURE REVERSED		
7	8-23	33.5	5	10
8	8-23	16.5	29	6
9	8-24	33.5	4	12
10	8-25	14.5	40	46
11	8-26	35.0	10	67
12	9-14	35.0	0	6
13	9-15	39.0	0	4
14	9-17	15.0	218	93
15	9-20	37.0	0	3
16	9-21	16.0	17	4
17	9-22	35.0	1	11
18	9-23	15.5	150	42

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TABLE 2. *Percent of* Gyrodctylus elegans *on body and gills of goldfish at different temperatures.*

Month	Mean Temp. C.	% of Parasites on Body	% of Parasites on Gills	Total No. of Parasites	No. of Fish in Sample
		Low Temperatures			
Feb.	7.0	89	11	36	1
March	8.5	97	3	127	9
April	9.0	90	10	290	13
May	11.0	95	5	701	13
June	12.5	64	36	107	1
July	13.0	97	3	65	2
Aug.	17.0	75	25	57	5
Sept.	15.5	74	26	174	3
		High Temperatures			
Feb.	17.0	25	75	52	1
March	19.5	15	85	67	9
April	—	—	—	—	—
May	22.0	57	43	42	5
June	22.0	37	62	48	18
July	29.0	54	46	37	3
Aug.	33.0	37	63	46	6
Sept.	36.5	0	100	6	6

In Table 2 which shows the results obtained with low and high temperatures, the parasitic distribution at 17.0 C. in February seems to vary from the distribution at 17.0 C. in August. The source fish that were used in these experiments were held in a running water aquarium at room temperature. There is a possibility, since fish were taken from water at a temperature at approximately 7.0 C. in February and placed for the experiment in water at 17.0 C., that there would be a warm water reaction to the change. The August fish went from the holding tank with water at approximately 21.0 C. to water in the jar at 17.0 C. and showed a typical cold water reaction. More needs to be done in this area since the number of fish was so small.

The distribution of parasites on the individual fins depended to some extent on the size of the fin. There was no significant difference between the number of fin parasites on the right or left side. There was, however, a graduation in numbers of parasites per unit of fin area from the pectorals to the caudal (Table 3). This distribution was approximately the same for fishes in both cold and warm water.

There did not seem to be any relationship between the numbers of *Gyrodactylus elegans* and the numbers of *Trichodina* sp. or of *Ichthyophthirius* sp. Eighteen fish had heavy infections of *Ichthyophthirius* sp., and of these ten died, whereas nineteen fish had heavy infections of *Trichodina* sp., and of these five died. Among these five fish, maintained at 10.0 C. to 13.0 C., were four which also had heavy *Ichthyophthirius* sp. infections. Heavy infections were considered as over 200 individuals of *Ichthyophthirius* sp. and 50 *Trichodina* sp.

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TABLE 3. *Distribution of* Gyrodactylus elegans *on the fins of goldfish.*

	No. of Parasites	% of Parasites	Mean Area Sq. Mm.	% of Total Fin. Area	Ratio No. of Parasites/ Mean Area
Pectoral Fins	2954	24	175	16	1.5
Pelvic Fins	2687	22	181	17	1.3
Anal Fin	1090	9	75	7	1.3
Dorsal Fin	2108	17	205	19	0.9
Caudal Fin	3404	28	457	41	0.7

Discussion

During these studies the presence of *Trichodina* sp. and *Ichthyophthirius* sp. proved troublesome. It seemed as if both of these parasites, when present in large numbers, had a much more deleterious effect on the fish than that caused by the gyrodactylids. One fish with 2892 of these monogenetic trematodes appeared unaffected. However, Yin and Sproston[6] found that goldfish were killed by gyrodactyliasis. They indicated that death was probably due to secretion of excess mucus on the gill surface due to irritation by large numbers of these parasites. These authors mentioned the presence of a ciliate parasite, probably *Trichodina* sp., on both the body and the gills. Ikezaki and Hoffman[5] described *Gyrodactylus eucaliae* on the brook stickleback and indicated that it was found in association with *Trichodina* sp. Hoffman and Putz[4] found *Gyrodactylus macrochiri* on bluegills in conjunction with large numbers of *Ichthyophthirius* sp. Their experiments showed also that 12 C. was nearer optimum for *Gyrodactylus macrochiri* than 20 C. More investigation is needed on the effect of various parasites and the possible interaction of different species at varying temperatures.

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