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A STUDY OF A POPULATION OF LONGNOSE DACE
(Rhinichthys c. cataractae)

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For many years the biologist has known that the fundamental study of life histories was a foremost necessity for better knowledge of the inter-relationships within aquatic communities and for sounder management of our fisheries. Only through the investigation of the life habits of a fish can proper recognition be given that species. Because of their greater economic importance the larger species of fish have warranted most attention from the field of biology in the past and consequently it has only been recently that the smaller, neglected species have been studied more carefully.

One of the latter species is the longnose dace. (*Rhinichthys cataractae*), a minnow generally preferring swift current in shallower portions of cool, rubble-bottomed streams. Although found throughout Minnesota, it is more abundant in small streams in the northern and eastern portion of the state. Its occurrence in trout streams has stimulated an additional interest from the standpoint of establishing the relationship between the dace and the trout.

This paper intends to state the results of a study of a large population of this species and it entailed the assessment of age and rate of growth, study of food habits, and observations of other features concerning this minnow.

MATERIALS AND METHODS

For this study 728 specimens of longnose dace were used. Of these, 614 came from one site on Thompson Creek, a tributary of the Root River in southeastern Minnesota, and for comparative purposes, 53 dace from a site on the North Branch of the Whitewater River and 61 dace from a similar site on the Middle Branch of the same river.

To ascertain the age and growth rate of these minnows, scales were removed from their bodies and mounted in a gelatin medium on a glass slide for observation under high magnification. Irregularities in the circuli appear on the scale at intervals and can be interpreted as annuli or year-marks. The number of annuli and the measurement of their diameters along with the diameter of the scale were recorded for the computation of growth rate. Empirical total fish lengths in millimeters were recorded on each mounted set of scales.

Methods used in the food study are mentioned in a later section of this paper.

GROWTH RATE

Since the growth of the scale is employed as an index of the

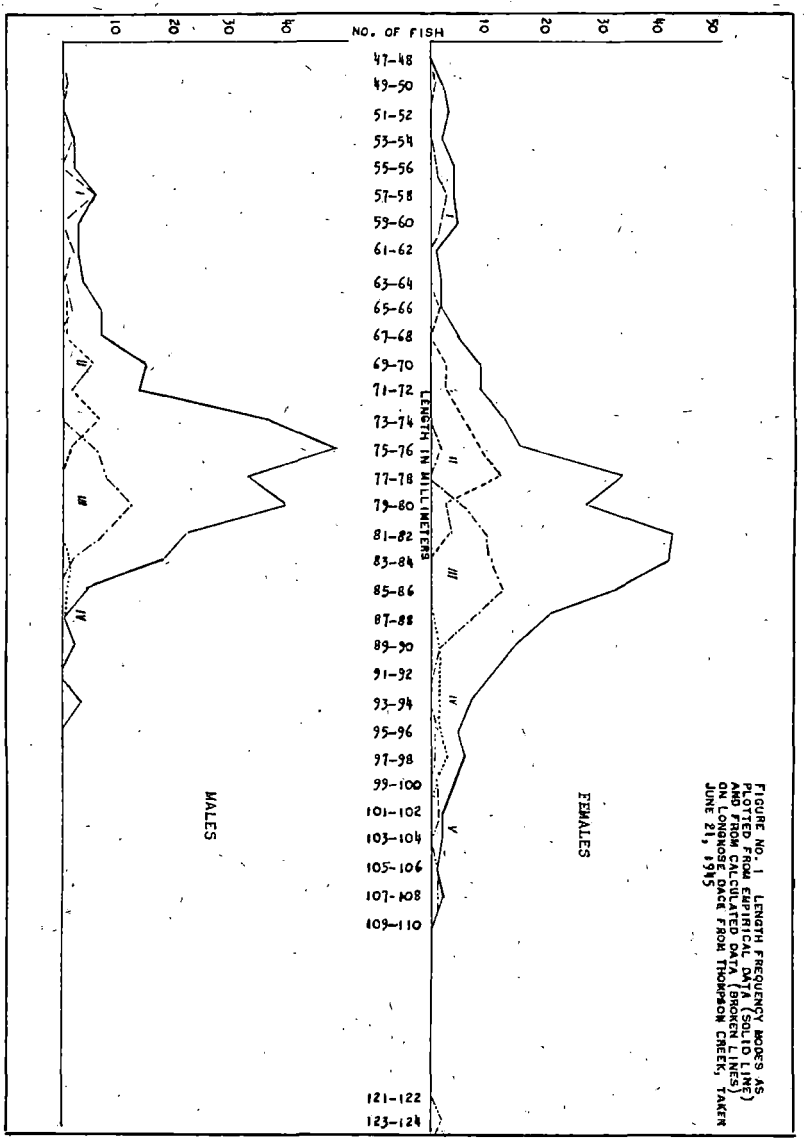

FIGURE NO. 1 LENGTH FREQUENCY MODES AS PLOTTED FROM EMPIRICAL DATA (SOLID LINES) AND FROM CALCULATED DATA (BROKEN LINES) ON LONGNOSE DACE FROM THOMPSON CREEK, TAKER JUNE 21, 1945

growth of the fish by the scale method, an accurate ratio or relationship between the growth of each must be established. For this purpose, four or five scales were removed from identical locations on 86 fish. The diameters of these scales when plotted on a graph possessed a straight line relationship with empirical lengths of the fish from which they were taken. It could therefore be assumed that for all practical purposes the scale grew in the same proportion as the body of the fish did in length. Since this proportion existed it was fairly simple to calculate fish length using scale measurements for any year during the fish's life.

To ascertain the validity of the scale method with this species various methods suitable for this purpose were selected and used. The following methods did prove the scale method valid for the longnose dace.

1. The empirical or actual fish lengths corresponded with calculated fish lengths for almost all age classes.
2. The empirical length-frequency modes for each sex (as seen in Fig. No. 1) coincide with the calculated length-frequency modes.
3. The significance of the low standard deviation of calculated lengths proved the scale reading to be fairly consistent.
4. The calculated growth of dace from Thompson Creek resembled that growth calculated for two foreign populations of dace from the Whitewater River.

TABLE NO. 1.

AVERAGE CALCULATED TOTAL LENGTHS IN MILLIMETERS FOR LONGNOSE DACE TAKEN AT THREE LOCALITIES IN SOUTHEASTERN MINNESOTA, MALES AND FEMALES COMBINED.

Place	Number Examined	Average Calculated Total Length 1	2	3	4	5
Thompson Creek	204	47	61	74	85	99
North Branch Whitewater R.	53	51	64	76	90	98
Middle Branch Whitewater R.	61	48	60	73	81	99

CALCULATED RATE OF GROWTH

Figure No. 2 depicts the growth of each sex graphically and it shows the longnose dace to be fastest growing in its first year and relatively slow growing in later years. In fact, 48 to 58 percent of all growth is attained in the first year. A noticeable difference in growth rate between male and female dace occurs after the second year of life or after maturity is reached. Females exceeded the males in growth by 14 per cent after that time.

In this stream the largest longnose dace were females which reached an age of 5 years and a total length of 124 millimeters or approximately 5 inches. Several females had completed 5 years of life but no males were found over 4 years of age and the latter

never exceeded 96 millimeters total length. This age lies within the range of maximum ages found for other species of minnows where 3 to 5 years were found to be the maximum.

TABLE NO. II.

AVERAGE CALCULATED TOTAL LENGTHS IN MILLIMETERS FOR EACH YEAR OF LIFE OF 135 FEMALE AND 79 MALE LONGNOSE DACE FROM THOMPSON CREEK, HOUSTON COUNTY, TAKEN JUNE 21, 1945.

Age	Sex	Average Length at Capture	Year Class	Number Examined	Average Total Length at Each Annulus 1	2	3	4	5
I	Female	58	1944	9	50				
	Male	61		13	51				
II	Female	76	1943	41	47	64			
	Male	74		19	47	62			
III	Female	84	1942	54	45	61	74		
	Male	81		37	49	63	73		
IV	Female	94	1941	13	44	61	76	86	
	Male	92		10	44	60	73	83	
V	Female	107	1940	8	43	59	76	89	99
	Male			0					
		Grand Average	(female)		46	61	75	88	99
			(male)		48	62	73	83	

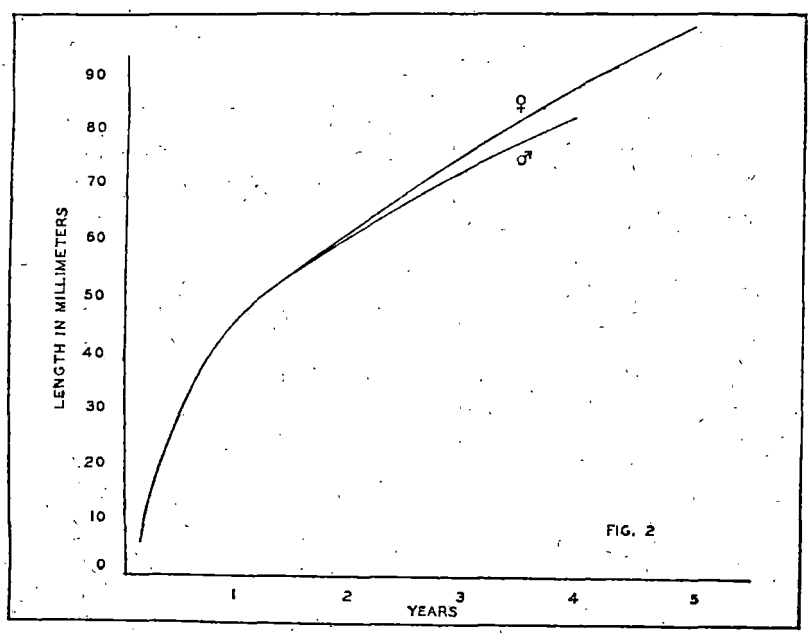

Fig. 2. Calculated growth rate curve for male and female longnose dace from Thompson Creek taken June 21, 1949.

FOOD HABITS

The food study was carried out on 196 longnose dace from the Thompson Creek population. After opening the entire gut the contents were spread out in a petri dish where they were identified and counted. Insect items were grouped by their respective Orders except for members of the Order Diptera which were separated to Families. Annelid worms were grouped under that Phyllum.

Measurement of food volumes was facilitated by measuring displacement of water by known numbers of the major kinds of food items. The ratio was then applied to the numbers recorded originally and percent by volume could be calculated.

The average number and percent (by volume) composition of each food type is listed separately for each age class, males and females combined, in Table No. III. From this tabulation the change in food habits with change in age is quite apparent. Whereas, chironomid larvae averaged 67 percent of the food contents in one-year-old dace, this food item averaged less than one percent by volume in the five-year-olds. On the other hand, simulid larvae were found more prevalent in the older dace. This larvae formed about 2 percent of the one-year-olds' diet but about 61 percent of the food of five-year-old dace. Ephemerid nymphs constituted a larger

TABLE III.

FOOD CONTENTS OF 196 INTESTINAL TRACTS OF LONGNOSE DACE OF THOMPSON CREEK TAKEN JUNE 21, 1945, ARRANGED ACCORDING TO AGE.

Average Number and Percent Volume (estimated of food items)

Age	No. of Int. Tracts with Food	Empty		Chironomidae Larvae	Chironomidae Pupae	Simulidae Larvae	Simulidae Pupae	Ephemeridae Nymphs	Other Insects	Annelid Worms	Algae	Debris
I	21	6	No.	23.2	0.0	0.4	0.0	1.8	0.14	0.00	0.00	—
			%	67		2		26	1			5
II	64	2	No.	49.6	0.5	4.1	0.0	5.7	0.02	0.01	0.00	—
			%	55	1	9		32	*	*		3
III	82	2	No.	58.7	0.5	3.3	0.0	7.7	0.02	0.07	0.05	—
			%	53	1	6		35	*	1	1	3
IV	14	0	No.	72.5	0.4	35.5	0.7	6.3	0.00	0.07	0.17	—
			%	38	*	37	1	17		1	3	3
V	5	0	No.	8.0	0.0	119.2	0.0	16.0	0.20	0.20	0.00	—
			%	*		61		21	*	3		15
	Average number			41.0	0.5	32.5	0.1	7.5	0.10	0.10	0.04	—
	Average per cent			42.6	0.4	23.0	0.2	26.2	0.20	1.00	0.80	5.8

* — less than one per cent

"Other insects" include Dragonfly nymphs *(Odonata)*, Caddis-fly larvae *(Trichoptera)*, and *Coleoptera*.

"Annelid worms" include aquatic oligochaetes and leeches *(Hirodinea)*.

"Algae" include *Cladophora* and *Microspora*.

part of the diet of the two and three-year-olds than the other age classes.

Considering all ages of dace, chironomid larvae provided the bulk of the food for dace (43 percent). Simulid larvae constituted a fair proportion (23 percent) and ephemerid nymphs formed most of the remainder of the diet in their common occurrence (26 percent).

The food of these dace, as summarized above, consists almost entirely of insects which undergo their immature stages in that portion of the stream which is the preferred habitat of this species. In this shallow portion of the stream the dace can utilize the excellent food production usually associated with the rubble type of bottom. It seems very likely that young and possibly adult trout compete with longnose dace for some food because in many instances both frequent similar parts of the stream in the course of their activities and many of the food items of trout, known through former studies, were found in the dace stomachs examined in this work. On the other hand, this minnow is probably a source of food for the trout whose diet consists partly of small fishes such as this species, as noted by Adams and Hankinson (1928).

The longnose dace like many other stream fishes has been accused of eating many trout eggs and, in this respect, may be detrimental to trout reproduction in the streams where the dace occurs. Trout eggs were not present in Thompson Creek at the time of collection, June 21, since trout are fall-spawners and thus the lack of eggs in the digestive tracts studied would have no bearing on this assumption. However, in defense of this minnow and others accused of being trout egg-predators, Greeley (1932) points out the fact that most eggs eaten by egg-predators are those accidentally dislodged or swept away from the redd in the act of spawning or in future nest-building activities of late spawners. Such eggs will not hatch and, quoting Needham (1938), "their presence in stomachs of other fish is an insufficient basis for condemning them as spawn destroyers."

From the small numbers of one-year-old longnose dace taken over the riffles of a stream, it is the writer's belief that such young and immature fish seek the quieter portions of the stream in which to spend the early part of their life. Traver (1929) observed this separation of young and adults in his study of the life history of the blacknose dace.

SUMMARY

1. By use of the scale method it was possible to determine the age and rate of growth of the longnose dace. The growth rates revealed the females grew 14 per cent faster than males and lived to be five years of age. Maturity is attained by both sexes after two years of

life, or in its third summer, when the minnow is approximately 75 millimeters total length.

2. This species was found to be almost entirely insectivorous at the time of the collection. Chironomids, ephemerids, and simulids, in their immature stages, comprised most of the food and their proportion in the diet varied according to the age of the fish.

In conclusion, it is hoped that this study has shed some light on several important life history phases of the longnose dace, which will aid an evaluation of the part played by this minnow in the synecology of trout streams.

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APPLICATION OF THERMISTORS TO TEMPERATURE MEASUREMENTS IN EXPERIMENTAL INVESTIGATIONS*

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The thermistor was introduced into our laboratory because we hoped it would permit temperature measurements of living tissues in situ during exposure to microwave diathermy. So far as we know, there is no satisfactory method for measuring such temperatures in the presence of high-frequency alternating currents. Although we failed to achieve the desired goal, the thermistor has proved a very convenient element for temperature measurements in experimental animals. The first equipment which we constructed followed the description given by Drummeter and Fastie.[1] Later models have been modified somewhat according to the particular application. We have been using the thermistor for almost four years, and during this time its usefulness has gradually increased. A report of the applications which we are making may be of general interest to all who measure temperatures in the physiologic laboratory.

The word "thermistor" connotes the phrase "thermally sensitive resistor." Thermistors are made of solid semiconducting materials

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