THE RELATION OF SIZE TO AGE IN SOME COMMON FRESHWATER FISHES.

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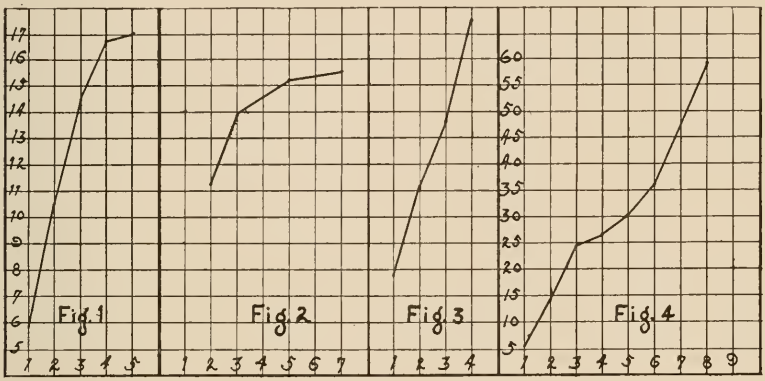
On the scales of most of our common fishes are a series of concentric rings. They may be readily seen under a low power microscope. These rings form alternate dark and light bands due to being closer together in some regions than in others. The dark bands represent periods of slow growth and the light bands periods of rapid growth. Since growth is dependent upon food, the dark bands are undoubtedly formed during winter when feeding is partially suspended. Thus by counting the "winter check" bands we can determine the age of the fish.



Figs. 1-4. Graphs showing rate of growth. The abscissa is the age in years, the ordinate the average length in centimeters. 1, *Lepomis pallidus* (Mitch.), Winona Lake; 2, *L. pallidus*, Shoe Lake; 3, *Perca flavescens* (Mitch.), Winona Lake; 4, *Micropterus salmoides* (Lacépède).

During the summer of 1923, at the Indiana University Biological Station, Winona Lake, Indiana, an attempt was made to determine the relation existing between age and size of some of the common fishes.[1] Data were collected on three species: bluegill, *Lepomis pallidus* (Mitchill); yellow perch, *Perca flavescens* (Mitchill); and large-mouthed black bass, *Micropterus salmoides* (Lacépède).

All the specimens were secured from Eagle (Winona) Lake with the exception of one lot of bluegills from Shoe Lake and a few black bass from other lakes. All of these lakes are located in Kosciusko County, Indiana. Scales were secured from different parts of the body and placed in paper envelopes on which were written all the data secured on each individual, viz., date, species, weight, and length to base of caudal fin. Subsequently the scales were examined under a low power microscope and the age of the fish determined; after which the following tables (Tables I to IV) were compiled and graphs (figs. 1 to 4) constructed.

[1] This work was taken up at the suggestion of Dr. Will Scott to whom I am indebted for advice and direction.

"Proc. Ind. Acad. Sci., vol. 33, 1923 (1924)."

TABLES I to IV.

Data showing relation of size to age of three common freshwater fishes.

TABLE I.—*Lepomis pallidus* (Mitchill), Winona Lake

AGE IN YEARS	Number of Specimens Measured		Length in Cms. to Base of Caudal Fin		Number of Specimens Weighed		Weight in Grams	
	Actual Number	Percent of Total	Average Length	Percent Increase	Actual Number	Percent of Total	Average Weight	Percent Increase
1	16	29.1	5.94	.....	14	48.2	4.14	.....
2	29	52.7	10.5	76.7	13	44.8	41.61	905.0
3	7	12.7	14.43	37.4	.....	.....	.....	.....
4	2	3.6	16.75	16.0	1	3.5	115.	.....
5	1	1.8	17.	1.5	1	3.5	170.	32.3

TABLE II.—*Lepomis pallidus* (Mitchill), Shoe Lake

AGE IN YEARS	Number of Specimens Measured		Length in Cms. to Base of Caudal Fin	
	Actual Number	Percent of Total	Average Length	Percent Increase
1	.....	.....	.....	.....
2	30	76.9	11.28	.....
3	7	17.9	13.96	23.7
4	.....	.....	.....	.....
5	1	2.6	15.25	.....
6	.....	.....	.....	.....
7	1	2.6	15.5	.....

TABLE III.—*Perca flavescens* (Mitchill), Winona Lake

AGE IN YEARS	Number of Specimens Measured		Length in Cms. to Base of Caudal Fin		Number of Specimens Weighed		Weight in Grams	
	Actual Number	Percent of Total	Average Length	Percent Increase	Actual Number	Percent of Total	Average Weight	Percent Increase
1	25	32.9	7.87	.....	23	40.4	7.14	.....
2	31	40.8	11.14	41.5	23	40.4	18.67	119.4
3	19	25.	13.67	22.7	10	17.5	38.8	108.
4	1	1.3	17.5	28.	1	1.7	100.	157.

TABLE IV.—*Micropterus salmoides* (Lacépède)

AGE IN YEARS	Number of Specimens Measured		Length in Cms. to Base of Caudal Fin		Number of Specimens Weighed		Weight in Grams	
	Actual Number	Percent of Total	Average Length	Percent Increase	Actual Number	Percent of Total	Average Weight	Percent Increase
1	3	13.8	5.5	.....	.....	.....	.....	.....
2	1	4.5	14.	154.5	.....	.....	.....	.....
3	3	13.8	24.3	73.5	1	11.1	175.	.....
4	9	40.9	26.88	10.6	4	44.4	418.7	139.2
5	4	18.1	30.12	12.0	3	33.3	566.6	35.0
6	1	4.5	36.5	14.5	.....	.....	.....	.....
7	.....	.....	.....	.....	.....	.....	.....	.....
8	1	4.5	59.	.....	1	11.1	1,644.2	.....

These specimens were taken during a period of ten weeks in June, July and August. All species studied spawn in late spring or early summer[2]. Their ages at time of collection therefore would be a little more than whole years. The fraction is so small that it was thought advisable to consider the age as whole years.

Table I indicates that the bluegills of Eagle (Winona) Lake increase in length about 77 per cent between the ages of one and two years, about 37 per cent the next year and 16 per cent the next. The increase in weight during the second year is over 900 per cent. The bluegills of Shoe Lake (Table II) however, increase but 24 per cent in length between the ages of two and three years. The small number of specimens may be the cause of this discrepancy or there may be a constant difference in rates of growth in the two lakes. This point needs further investigation with larger numbers of specimens.

Yellow perch (Table III) showed a length increase of 41.5 per cent, 22.7 per cent, and 28 per cent respectively for the years from one to four, and an increase in weight of 119.4 per cent, 108 per cent and 157 per cent respectively for the same period. Pearse and Achtenberg[3] "believe that yellow perch become sexually mature in Lake Mendota (Wisconsin) at the end of two years' growth." Hence if they are to be given a chance to breed one season no perch less than 14 or 15 centimeters (measured to base of caudal fin) should be taken.

The numbers of black bass are too few to arrive at any satisfactory conclusions but the data are given in table IV and figure 4.

It is interesting to note, as a comparative study, the rate of growth of yellow perch in Lake Erie[4]. The two, three, and four year old perch average respectively 3.3, 3.1, and 1.2 centimeters longer than those of corresponding ages in Eagle (Winona) Lake.

This question of rates of growth is very closely linked up to other problems of fresh-water biology. It has a connection with population and food conditions of the lakes. If a species grows more rapidly in one lake than in others it indicates that the food complex is more favorable there. This may mean that the food is more abundant or that competition is less severe. A systematic investigation of rates of growth of the fishes of inland waters will no doubt reveal some very interesting facts on the fertility of our various lakes. From an economic viewpoint it will mean a better knowledge of the possibilities of our lake resources.

[2] Forbes, S. A., and Richardson, R. E. The fishes of Illinois. Nat. Hist. Surv. Ill., Vol. III, 1908.

[3] Pearse, A. S., and Achtenberg, Henrietta. Habits of yellow perch in Wisconsin lakes. Bul. U. S. Bur. Fish, Vol. XXXVI, 1917-18, pp. 297-366.

[4] Harkness, W. J. K. The rate of growth of the yellow perch (*Perca flavescens*) in Lake Erie. Uni. Toronto Studies, No. 20, 1922, pp. 89-95.