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Title

Age, growth, production and infection with Trisacnophorus nodulosus  
of the yellow perch, Perca flavescens (Mitchill) of Manitoba

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## INTRODUCTION

The yellow perch, Perca flavescens (Mitchill) is a common freshwater fish in southeastern Canada and the northeastern United States. Its fine quality appeals to the angler and it usually commands a good price on the market when fished commercially. The commercial production of yellow perch in Manitoba is limited by the animal's northward distribution and by the fact that they are not fished intensively and form only an incidental portion of the catch. The total Manitoba production in 1950-51 was 436,600 pounds with the northern Manitoba lakes contributing only 100 pounds. The small production from the northern lakes is due, in part, to the almost exclusive use of larger mesh nets for the capture of whitefish, Coregonus clupeaformis, and yellow walleye, Stizostedion v. vitreum, thus excluding the perch from the fishing except those accidentally caught by their mouth parts. An opportunity to further study the perch in Manitoba was afforded at Heming Lake where investigations of fish parasites of the genus Triacnophorus have been in progress since 1945.

## MATERIALS AND METHODS

The investigation of the age and growth of Heming Lake yellow perch has been based on the examination and measurement of the scales of 330 fish taken by gill-nets (mesh sizes  $1\frac{1}{2}$ -inches to 5-inches) and by the use of 5% emulsifiable rotenone broadcast

on inshore shallow waters. These fish were collected from May to September during the summers of 1950, 1951, and 1952. All fish were weighed and measured when fresh. The fork lengths were recorded to the nearest millimeter and weights to the nearest half ounce.

The scales were examined by the author with the aid of a compound microscope and, where necessary, checked on a micro-projection machine at a magnification of X30. Ages were designated by arabic numerals corresponding to the number of annuli on the scales. Thus yellow perch with one annulus (in the second year of life) are shown as 1+.

#### ACKNOWLEDGEMENTS

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#### AVAILABILITY OF YELLOW PERCH AT HEMING LAKE

During the first three summer investigations at Heming Lake an average of 11 perch per year were caught. No data are available on the number or yardage of nets fished during this period. Since 1950, an accurate check of the number of nets set has been

kept and some indication of the availability is given in Table I. The majority of yellow perch were caught in the  $1\frac{1}{2}$ " mesh gill-nets and the availability for this net was .12 and .32 fish per net set for the years 1951, 1952, respectively. Yellow perch were taken very rarely by angling, also indicating low availability. With the increased intensity of fishing since 1950 and no substantial increase in the catch, it must be assumed that the yellow perch population is small. Observations made while poisoning along the shore showed the yellow perch to be co-dominant with the spottail shiner, Notropis hudsonius and present in very large numbers. Since large yellow perch are rarely caught while there appears to be an abundance of little yellow perch it is assumed then that a fairly high mortality rate exists for the yellow perch of Heming Lake.

#### GROWTH

No weights were recorded for the yellow perch taken in 1950 and 1951 as the fish were quite small and it was not possible to weigh the fish with any degree of accuracy using a spring balance. Both length and weight were recorded for the 1952 sample. The average lengths at each age for each of the three years are shown in Table II. Sexes have been combined in all instances. The differences in average lengths between the various years may have resulted from differences in the date of capture. Growth

curves of length and weight obtained by combining the data for 1950, 1951, and 1952 are shown in Figure I.

The average fork lengths of yellow perch from various Canadian and American lakes are shown in Table III. The average lengths of yellow perch from Heming and Wapun Lakes (which are connected) are approximately the same for the ages considered and are also comparable with Costello Lake, Ontario and Jesse Lake, Nova Scotia yellow perch. The yellow perch in Lake Manitoba, a large shallow lake, do not grow as fast as Lake Erie yellow perch but grow considerably faster than Heming Lake yellow perch for all ages.

#### INFECTION OF YELLOW PERCH WITH *TRIAENOPHORUS NODULOSUS*

##### Life history

The cestode, *Triaenophorus nodulosus* occurs as an adult in the intestine of the pike, *Esox lucius*. In early spring the adult tapeworm matures, deposits its eggs and dies. The eggs hatch into coracidia and if ingested by plankters they then develop into procercoids. If the infected plankter is eaten by a yellow perch (one of several second intermediate hosts), the procercoid passes through the gut wall into the body cavity and penetrates the liver. A cyst forms and the procercoid is transformed to a plerocercoid. When an infected yellow perch is eaten by a pike the cycle is completed. In Europe, *T. nodulosus* is reported as

an adult from 22 species of fish and 30 species of fish are known to serve as second intermediate hosts. At Heming Lake the adult has been found only in the pike and the sculpin, Cottus cognatus, the burbot, Lota maculosa, and the yellow perch serve as second intermediate hosts.

#### Observations on the cyst and plerocercoid

The plerocercoid is enclosed in a cyst; the cyst is opaquely white in colour, varying in shape from perfectly spherical to pear-shaped and ranges from 2.5-13.5 mm. in length and from 1.5-3 mm. in width (see fig. 2). The cyst is apparently composed of connective tissue formed by the host and stimulated by the presence of a foreign substance in the liver tissue. The plerocercoid within the cyst is surrounded by a mucuous-like substance, supposedly composed of broken-down host tissue and its own excretory products. The plerocercoids were thread-like and white in color, with a scolex at the one end and identical with that of the adult worm. The strobila did not possess any sex organs. Plerocercoids removed from yellow perch livers August 19, 1952 averaged 47.0 mm. in length with a range of 32 to 75 mm.

Usually only one worm was found in a cyst, however, as many as four plerocercoids were observed in one cyst. The greatest number of cysts per infected liver recorded was five. In many of the small yellow perch examined the size of the cyst in proportion

to the size of the liver was so great that as little as 10 per cent of the liver was present. One yellow perch of the year examined did not have any evidence of liver tissue being present. Whether the liver had been destroyed by infection with T. nodulosus or whether it was simply anomaly cannot be stated. It seems likely that the presence of these cysts in the livers of young yellow perch must have a deleterious effect on the animal's health. When a lake is heavily infected T. nodulosus plays a large role in the mortality rate of the yellow perch population.

#### Rate of infection

In 1950, 98 yellow perch were examined for T. nodulosus and 50 per cent were infested. In 1951, 44 per cent of 177 yellow perch examined contained cysts of T. nodulosus. In 1952 only 12 per cent were infected. The difference in rate of infection is directly attributable to the size of perch examined as the majority of fish examined in 1950 and 1951 were under 90 millimeters in length, whereas in 1952 no fish in this size group were measured. In 1950, and 1951, most of the fish were captured by poisoning while in 1952 the majority were taken in gill-nets. The relationship between the length of yellow perch and infection with T. nodulosus is shown in Table IV. Heaviest infection occurs in the smallest fish. This is, no doubt, a reflection of change of feeding habit with increasing size as the small yellow perch tend

to congregate in the very shallow waters where the chances of assimilating infected plankters would be greater. The larger fish are found at varying depths and probably do not feed to any great extent on plankton.

#### RELATIONSHIP OF AGE OF YELLOW PERCH TO FREQUENCY OF CYSTS

The relationship of the age of yellow perch to cyst frequency is shown in Tables V, VI, VII, VIII and Fig. 3. Although the greatest percentage of infection occurs in fish in their first, second and third years of life the older fish are not entirely free of infection. The percentage of infection drops appreciably after the third year of life. It is obvious, however, that the young fish have a more critical position in the life-history of the tapeworm because of their high infection rate and because of their numerical strength, would have more chances to be consumed by the pike than the remaining older, less heavily infected yellow perch.

#### AFFECT OF T. NODULOSUS ON GROWTH

The perfect parasite is one that is in complete harmony with its host and causes it no disturbance. As mentioned previously, several species of fish serve as second intermediate hosts for T. nodulosus and it is probable that many of these are incidental

hosts, and as such their growth rates might be affected by the presence of foreign substances located in or on important visceral organs and tissues. An attempt was made to ascertain the effect of cysts of T. nodulosus on yellow perch by comparing the fork length of infected and non-infected fish. The results are shown in Tables IX and X. Unfortunately the number of fish employed is not too great and consequently not too much reliability can be placed on the results. In some instances the heaviest infected fish are longer than the non-infected fish, in others the growth rate is slower. The results indicate T. nodulosus does not seriously affect the growth rate of Heming Lake yellow perch.

#### TRIAENOPHORUS NODULOSUS FROM OTHER CANADIAN WATERS

Yellow perch from 10 lakes and rivers of Manitoba and Ontario were examined for T. nodulosus, Table XI. Lake Muskeg in northwestern Ontario contained infected yellow perch and one yellow perch from Lake Nipissing had a pit in its liver which was taken to represent a former cyst which had shrivelled after fixing in formalin. For many of the lakes the scarcity of fish in the sample may have masked the actual abundance of infected yellow perch, the size of the majority of the fish examined, however fell within the range of heaviest infection as found in Heming Lake, Manitoba. From the data available it appears that T. nodulosus is not prevalent in the yellow perch of the more southern lakes and rivers.

## SUMMARY

1. The age and growth of 330 yellow perch, Perca flavescens, was determined.
2. A description is given of the cyst and plerocercoid of Trisenophorus nodulosus in yellow perch.
3. The infection of yellow perch with T. nodulosus is greatest in fish up to three years of age.
4. There is no apparent effect on growth of yellow perch infected with T. nodulosus.
5. Examination of yellow perch from many localities indicated little infection with T. nodulosus in southern waters.

## LITERATURE CITED

- Carlander, K. D. Handbook of Freshwater Fishery Biology,  
Dubuque, Iowa, 1950.

Table I. Availability of yellow perch at Heming Lake during 1950, 1951, 1952.

Year	No. of net sets	No. of yellow perch captured	No. of yellow perch captured/net set
1950	81	20	.24
1951	277	29	.10
1952	459	80	.17

Table II. Average fork length (mm.) of yellow perch at each age for the years 1950, 1951, 1952.

Age	Year		
	1950	1951	1952
0	51.3	44.7	-
1	67.0	71.5	-
2	84.2	91.3	139.7
3	125	102.5	136.7
4	143.2	149.6	140.1
5	173.0	140.0	136.8
6	216.7	185.7	221.6
7	253.5	209.5	234.0
8	228.6	239.1	265.5
9	279.4	-	302.6
10	-	-	292.1
11	-	-	304.8

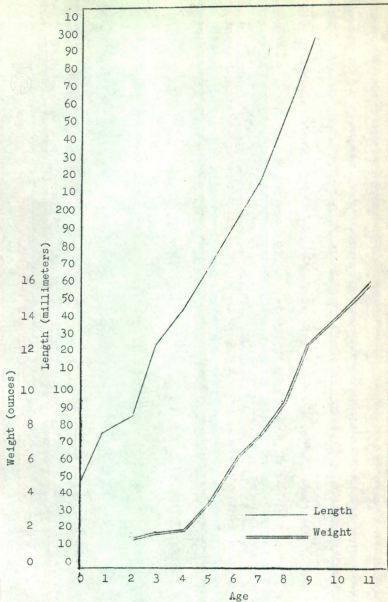


Fig. 1. Growth curves of Heming Lake yellow perch. Data for 1950, 1951, and 1952.

Table III. A comparison of the average fork lengths (inches) of yellow perch from various localities.

	Age										
	0	1	2	3	4	5	6	7	8	9	10
Lake Erie (Ontario)*	2.0	-	6.6	7.7	8.5	9.9	10.8	11.0	-	-	-
Lake Manitoba (Manitoba)*	-	-	5.0	6.3	7.9	8.8	10.0	10.8	-	-	-
Muskellunge Lake (Indiana)*	-	5.1	6.2	7.3	6.9	-	-	-	-	-	-
Heming Lake (Manitoba)	1.9	2.8	3.4	4.9	5.6	6.7	8.4	9.1	10.2	11.9	-
Wapun Lake (Manitoba)	1.3	2.6	3.3	4.6	5.1	-	-	-	-	-	-
Costello Lake (Ontario)*	-	2.8	3.5	4.5	-	-	-	-	-	-	-
Jesse Lake (Nova Scotia)*	1.4	3.1	3.6	4.3	-	-	-	-	-	-	-

\* Data compiled from Carlander 1950.

Table IV. Relationship of infection with Triaenophorus nodulosus to fork length of yellow perch in Heming Lake in 1950 and 1952.

Length in mm.	Number of fish infected		Number of fish Non-infected	
	1950	1952	1950	1952
50-69	28	-	18	-
70-89	16	-	11	-
90-109	3	-	1	-
110-129	-	6	3	4
130-149	1	5	8	21
150-169	-	-	2	10
170-189	2	-	5	5
190-209	-	-	-	8
210-229	-	-	-	6
230-249	-	-	-	7
250-269	-	-	-	6
230-289	-	-	-	5
290-309	-	-	-	6
309-	-	-	-	1

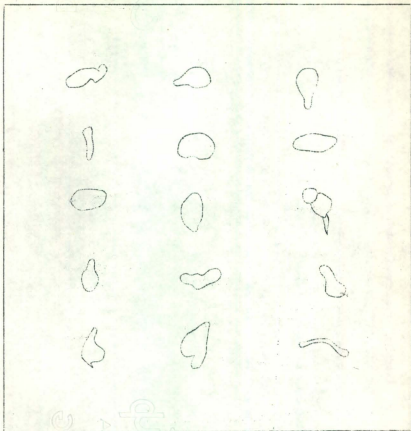


Fig. 2. Sketches of variety of cysts found in yellow perch livers. Cysts varying from the spherical shape usually contained more than 1 plerocercoid.

Table V. Relationship of age of yellow perch and number of cysts of T. nodulosus at Heming Lake during 1950.

Number of cysts	Age					
	0	1	2	3	4	5
0	9	1	1	0	12	-
1	7	16	11	-	1	-
2	4	4	2	-	-	-
3	-	2	-	-	1	-
4	-	-	-	-	-	-

Table VI. Relationship of age of yellow perch and number of cysts of T. nodulosus at Heming Lake during 1951.

Number of cysts	Age								
	0	1	2	3	4	5	6	7	8
0	8	49	2	3	-	-	-	-	-
1	4	34	3	4	1	1	1	1	1
2	1	7	1	1	-	1	-	-	-
3	2	2	1	-	-	1	-	-	-
4	1	-	-	-	-	-	-	-	-
5	1	-	1	-	-	-	-	-	-

Table VII. Relationship of age of yellow perch and number of cysts of T. nodulosus at Heming Lake during 1952.

Number of cysts	Age											
	0	1	2	3	4	5	6	7	8	9	10	11
0	-	-	-	13	19	10	10	10	11	3	1	1
1	-	-	-	2	9	-	-	-	-	-	-	-
2	-	-	-	-	1	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-

Table VIII. Relationship of age of yellow perch and number of cysts of T. nodulosus from a sample of yellow perch obtained by poisoning at Wapun Lake, Manitoba, August 8, 1951.

Number of cysts	Age				
	0	1	2	3	4
0	3	4	3	0	0
1	10	5	-	-	-
2	1	3	1	-	-
3	-	-	-	-	-

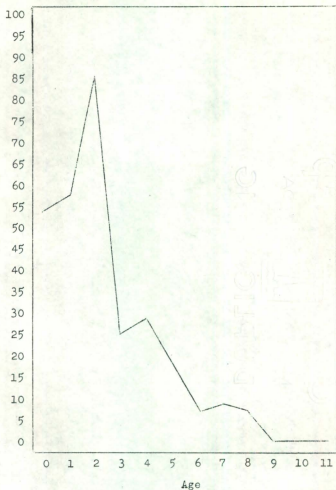


Fig. 3. Percentage of yellow perch infected with *T. nodulosus* at each age. Data for 1950, 1951 and 1952 combined.

Table IX. Average fork lengths (millimeters) of yellow perch at various ages and with varying degrees of infection in 1950.

Number of cysts	Age					
	0	1	2	3	4	5
0	52.3	77	80	-	-	-
1	49.5	63.2	83.2	-	-	-
2	51.7	64.7	90	-	-	-
3	-	67.5	-	-	-	-

Table X. Average fork length (millimeters) of yellow perch at various ages and with varying degrees of infection in 1951.

Number of cysts	Age			
	0	1	2	3
0	43.8	71.1	-	-
1	48	72.1	-	-
2	45	67.7	-	-
3	-	61.5	-	-

Table XI. Place and year of capture, range in fork length and infection with Trisolenophorus nodulosus of yellow perch from several Canadian localities.

Locality	Year of capture	Number examined	Range in length (mm.)	Number infected
Lake Opeongo	1940	13	37 - 50	0
Lake Erie	1946	25	33 - 36	0
Lake Attawapiskat	1939	3	41 - 49	0
Lake Winnipeg	1947	15	50 - 65	0
	1951	120	123 - 208	0
Lake Nipissing	1934	10	42 - 50	1
Lake Nipigon	1921	5	41 - 66	0
Lake Ontario	1948	9	69 - 107	0
Spanish River (Ontario)	1951	10	63 - 72	0
Beverage Creek (Ontario)	1937	5	61 - 64	0
Lake Muskeg (Ontario)	1950	44	127 - 184	3
Home Lake (Manitoba)	1951	21	35 - 60	9
Wapun Lake (Manitoba)	1951	35	40 - 65	19

Table XI. Size and sex of several years in each year class.  
 Inclusive of 1930-1931 and 1932-1933.  
 from several different locations.

Locality	Year of capture	Number of males	Number of females	Number of immatures
Lake Ontario	1934	13	27	0
Lake Erie	1934	27	35	0
Lake St. Clair	1939	13	17	0
Lake Winnebago	1937	13	20	0
	1938	100	133	0
Lake Michigan	1937	11	22	1
Lake Superior	1937	7	11	0
Lake Ontario	1940	9	12	0
Genesee River (Ontario)	1931	10	13	0
Lovely Creek (Ont.)	1931	11	14	0
Lake Superior (Ont.)	1937	14	18	1
Lake Erie (Ontario)	1931	11	15	0
Wagon Lake (Ontario)	1937	17	20	19