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INVESTIGATIONS ON LITTLE LONG LAKE, BUCKHORN RANCH (OSCEOLA COUNTY) DURING 1940

by

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Investigational activities on Little Long Lake during 1940 consisted of the intensive creel census and one collecting trip made during July by Messrs. Shetter and Goellner. This report will present the data collected and discuss the findings for the year on this private lake. As stated in earlier reports, Mr. Paul Travis, owner of Buckhorn Ranch, offered this lake to the Institute as an outdoor laboratory for experiments to improve the fishing.

Results of the Intensive Creel Census, 1940

Records of all the fishing were obtained by Mr. Irwin Coller, resident caretaker, from anglers using the lake. Anglers were requested by Coller and by poster to weigh their fish by species, which was done by a majority of them. Enough weights were obtained to give a fairly accurate estimate of the per acre yield of the lake. Numbers and weights of fish were filled out on the regular creel census blanks by the anglers themselves.

During the period June 25 to September 17, a total of 72 fishermen used Little Long Lake, and only ten of them (14 per cent) caught no fish. The total time spent in angling was 231.00Ø hours, during which time 233 legal bluegills, 126 legal largemouth black bass, 50 perch and one bullhead were removed from the lake. The catch per hour for the season was 1.77 fish. The average time spent fishing, per angler, was 3.21 hours. The average number of fish caught per angler was 5.68, and the average total weight of these fish was 3.0 pounds. The quality of the fishing varied from one part of the season to the next, as is shown in the tabular summary in Table 1. The quality of the fishing, as measured by the catch per hour, increased regularly as the season progressed, and was best during the last month of the summer (August 16 to September 17). The highest catch per hour came during the period August 16-31, when 2.31 fish per hour of angling were taken.

At this date, general creel census figures for the 1940 season in Hatchery District 7 are not available. However, in 1939, the catch per hour on non-trout waters in Hatchery District 7 was 1.4 fish. The catch per hour on Little Long Lake in 1940 exceeded this by almost 0.4 fish per hour.

A comparison of the creel census results of 1940 with those of the 1937 and 1938 seasons is of interest. (Unfortunately no records were kept for the season of 1939.) Angling pressure was increased to 6.7 man-hours per acre per season during 1940, as compared with a pressure of 2.6 man-hours per acre per season in 1937 and 1938. During 1940 perch entered the catch in fair numbers (50 fish) for the first time. Almost twice as many largemouth black bass (126) were taken as had been previously recorded in any season (65 in 1937). The bluegill catch seems to be falling off at a more or less gradual rate. With the increased number of fishermen there was also an increase in the number of unsuccessful anglers (from 0.0 per cent in 1937 to 14 per cent in 1940).

The average total length and average weight of the fish taken during 1940 was as follows: bluegills, 7.76 inches and 5.6 ounces; largemouth black bass, 12.18 inches and 15 ounces; yellow perch, 8.34 inches and 5.6 ounces (see Table 2). The bluegills averaged about one-half inch smaller than those caught in 1938, but about one-quarter inch larger than those captured in 1937. The average size of the largemouth black bass was the same in 1940 as in 1937 (12.2 inches), which was almost one-quarter inch larger than in 1938. The largest fish taken was a largemouth bass. According to the creel cards, two largemouth bass caught on August 17, 1940, averaged 17 inches in length and their combined weight was 9 pounds, 5 ounces. For the first time in the three-year period, an adequate sample of the perch was removed. They averaged 8.3 inches in length.

The yield per acre of lake surface to the angler was 11.85 fish weighing 6.27 pounds. This total was made up of 6.75 bluegills per acre, weighing 2.34 pounds; 3.65 largemouth black bass, weighing 3.42 pounds; and 1.45 yellow perch, weighing 0.51 pounds (Table 3). In addition to these fish just listed, two bullheads, 11 bluegills (2 legal, 9 sub-legal) and 10 perch (9 legal, 1 sub-legal) were taken in gill nets. The total weight of these fish was 6.5 pounds. The total poundage of fish known to have been removed from the lake by all methods in 1940 is therefore 222.75 pounds or 6.45 pounds per acre.

Netting Investigations, Age and Food Study

On July 16, 1940, K. E. Goellner and David S. Shetter drove to Buckhorn Ranch where the next two days were spent in gill-netting, seining and angling, in order to obtain a series of specimens for weights and lengths, scale samples, and stomachs for food-habit analysis. The entire shore line was cruised by boat in an attempt to observe the presence of any crawfish, golden shiners or

smallmouth black bass. These species have been stocked in the past as an experiment (see Reports No. 564, 565). Approximately one-fourth mile of shore line was minutely examined with carbide spotlights between 9:30 p.m. and 12 midnight to see if crawfish were present (these are more readily observed after dark as the adults emerge from their burrows and other hiding places at this time).

No crawfish were taken either in the gill nets or in the seine. A claw fragment, unidentifiable because of probable regeneration, was found in a lily-pad bed. One living crawfish was observed by the aid of the carbide light. This specimen was half-buried in the bottom debris in about 2½ feet of water. It successfully evaded our efforts to capture it. The only specimen taken was a "form II" male Cambarus immunis about 2½ inches long, which was found dead in the shallow water on the north beach. This was the species planted in 1939. The specimen had not been dead more than 12 hours. It was large enough to be sexually mature, but was not in breeding condition ("form I").

Mr. Coller, the resident farmer, reported that he had observed three crawfish under the boat as it lay on the north beach early in the spring. He also stated that there had been a few in the fish stomachs taken during the first few days of the bass season (late June).

Four gill-net sets were made, two nets fishing each night,- a total of 48 hours. Nets were set at about 7 p.m. each evening and were inspected at approximately 7 a.m. the next morning. The following fish were taken:

Set # 1 - (Picked up at 7 a.m., July 17, 1940; time fished, 12 hours).
Depth - 3 to 15 ft.
Location - Perpendicular to shore out from old log dock halfway down east shore.
Net mesh - Experimental - 1½ to 4 inches (stretched).
Length - 125 feet.
Fish taken - 7 yellow perch (6½ to 12½ inches, total length)
2 bluegills (5 to 6-1/4 inches, total length)

Set # 2 - (Picked up July 17, 1940, at 7:15 a.m.; time fished, 12 hours).

Depth - 5 to 20 feet.
Location - Directly across lake (west) from Set # 1, and running from point diagonally northwest toward fence line on west shore.
Net mesh - 2½ inches (stretched).
Length - 150 feet.
Fish taken - 2 yellow perch (5-3/4, 6 inches, total length)
1 bluegill (4 inches, total length)
One other small bluegill had been eaten by turtles.

Set # 3 - (Picked up July 18, 1940, at 7:00 a.m.; time fished, 12 hours).

Depth - 5 to 12 feet.
Location - From swimming platform straight south.
Net mesh and length - Same as Set # 1.
Fish taken - 2 bluegills (4-1/4, 9-3/4 inches, total length).

Set # 4 - (Picked up at 7:15 a.m., July 18, 1940; time fished, 12 hours).

Depth - 4 to 8 feet.
Location - Weedy cove directly in front of residence.
Net mesh and length - See Set # 2.
Fish taken - 1 yellow perch (6 inches, total length)
6 bluegills (4- 4-3/4 inches, total length)
2 bullheads (9, 10 inches, total length)

Less than two dozen fish were taken in the 48 hours of gill netting. No bass were caught (either largemouth or smallmouth) nor were any golden shiners captured. The fine-meshed gill net was set in the weedy cove particularly with the hope of taking golden shiners, but failed to capture any of this species. It was not unusual that bass were not taken in the gill nets, as these species are difficult to capture in such gear.

The entire seinable area of the sandy beaches at each end of the lake was thoroughly seined with a 20 x 4 foot common-sense seine on July 17, 1940. No smallmouth bass young were taken, nor were any golden shiners captured. However, there is good evidence that the blunt-nosed minnow (Hyborhynchus notatus) is becoming established in the lake, as several fish of this species were captured by seining on the sandy beaches at both ends of the lake. Also, two spawning adults of the blunt-nosed minnow were found at the swimming beach, guarding a small patch

of eggs on the underside of a boulder. Numerous other blunt-nosed minnows were observed. This species, according to Mr. W. F. Carbine, was mixed in with the 1939 planting of golden shiners. The blunt-nosed minnow is a desirable forage fish and should serve as a food item for all the game fish present in Little Long Lake if it becomes established there.

A few young bluegills and largemouth bass were taken by seining. These two species were observed to be quite abundant in the lily-pads and in other weed beds around the entire shore line where a seine could not be operated successfully.

During the two and a half days Mr. Goellner and the senior author were guests of Buckhorn Ranch, we spent about 15 hours in angling and took 33 legal fish (17 bluegills, 12 largemouth bass, 3 yellow perch and one bullhead). These fish, and also those taken in the gill-netting operations, were measured, weighed and scale-sampled, and the stomachs were removed for food study. We found crawfish and dragonfly larvae to be very efficient bait for the bluegills, while the best artificial bait for the bass was a red-and-white underwater plug with a small forward propellor.

The average total length and average weight of the various species of fish at several ages are presented in Table 4. The indicated ages signify the number of winters of life already completed; thus the fish taken in July, 1940, are all one summer older than the ages given. The data demonstrate that most of the bluegills reach legal size (6 inches, 152 mm.) during or before their fifth summer of life (age group IV). Largemouth bass apparently reach legal size (10 inches, 254 mm.) during their fourth summer of life (age group III). Some yellow perch reach legal size (6 inches, 152 mm.) during their third summer of life (age group II), and apparently all perch in their fourth summer of life have passed the legal limit of six inches. The oldest fish found in the respective species

sampled during 1940 were three bluegills in age group VIII, one largemouth bass in age group VI and three yellow perch in age group VIII.

The rate of growth of the game fish collected during 1940 has been compared with similar data obtained in 1936 and 1937. The various samples were aged, and the average total lengths of the several age groups have been determined. These average lengths have been plotted for the two different periods (1936-1937 and 1940).

The bluegills (Graph 1) now appear to be growing at a somewhat faster rate than in 1936-1937. It will be noted from the graph that in the 1936-1937 collections, bluegills were less than average size for bluegills of equal age from all parts of the state, until they reached their fifth or sixth year. The 1940 collections, with the exception of the fish in age group III, averaged larger than fish of equal age from other parts of Michigan, and were, on the average, from 1/2 to 3/4 of an inch larger than the 1936-1937 collections of the age group IV and age group V fish. The 1940 bluegills of age group III averaged about 3/4 inch less than the age-group III fish of 1936 and 1937. The state averages have been furnished by Mr. W. C. Beckman in Institute for Fisheries Research Report No. 649, and are made up from 4,184 bluegills from all sections of Michigan, collected during 1939 and 1940.

Although state averages for the largemouth black bass are not available, it is of interest to compare the growth curve (Graph 2) from the 1936-1937 sample with that obtained from the 1940 largemouth black bass. Judged on the basis of a small sample, growth of the bass at present is just as good as, if not slightly better than, it was during 1936-1937. The average size of the 1940 fish in age group II was about one inch greater, of age group III only 3/8 inch less, of age group IV one inch greater, of age group V only 3/8 inch less, and of age

group VI 1-7/8 inches less than the fish from the same age groups in the 1936-1937 sample.

The samples of perch were comparatively limited in number both in 1936-37 and 1940. On the basis of the data available, the rate of growth of the perch was somewhat less during 1939 (4 specimens from this year included) and 1940 than during 1936-1937. Of the 1940 sample, only the age group II and the age group VII fish averaged as large as or larger than the 1936-1937 samples. Of the 1940 sample, fish from age group III averaged 1-3/4 inches less, fish from age group IV averaged 2-1/4 inches less, and fish from age group VIII averaged 5/8 of an inch less than fish of comparable ages in the 1936-1937 sample.

Although the 1939-1940 sample of perch indicates that growth has apparently slowed somewhat in comparison with the previous sample, the Little Long Lake perch still compare favorably with perch of other localities, as will be presently pointed out.

The average total length of the fish in the various age groups in the 1940 collections compares favorably with that given by Hile (1931) for the fishes of Indiana lakes, which lie 200 miles south of Little Long Lake, and where the growing season is known to extend over a greater period of the year.

The 1940 sample of bluegills from Little Long Lake grew more slowly than did those from Indiana lakes, but there was less difference in the average sizes of the older age groups (Table 5). Largemouth bass from Little Long Lake appear to be from one to two inches shorter than Indiana largemouth bass for the age groups above III. The Little Long Lake perch, however, are just as large as the Indiana perch up to their third year, and the older age groups (VII and VIII) from Little Long Lake were larger than Lake Erie perch (Table 5)

for which figures are given.

The "coefficient of condition" of the fish (that is, a figure with the symbol "K" expressing whether or not a fish is fat or skinny for its length*) in Little Long Lake also may be regarded as average or in some instances above average. According to Hile (1931), the average "K" for Lake Wawasee largemouth bass was 2.18. In Little Long Lake, K for the same species varied from 2.108 to 2.197.

With the exception of age group III, K's for the Little Long Lake bluegills exceeded average K's for Indiana bluegills. Among the perch, with the exception of age group IV, K's for the Little Long Lake perch also exceeded average K's for Indiana perch (Table 5).

The study of the stomach contents from the fish collected in July, 1940, was done by Burton Hunt under the direction of Dr. J. W. Moffett. Fish remains were checked by Dr. Karl Lagler of the University of Michigan Department of Zoology. We were not able to collect large enough series of perch or largemouth bass stomachs while at Little Long Lake for the findings to have any great significance. This difficulty was partly aggravated because collection of most of the perch by gill-net allows digestion to take place if they are enmeshed early in a "set", and partly by the habit of largemouth bass of emptying their stomachs on becoming hooked. Six bass and five perch stomachs were empty on examination.

A total of 11 largemouth bass stomachs were examined. Of the total volume of the stomach contents of all fish, approximately 23 per cent was unidentifiable debris of organic origin, while 74 per cent was made up of fish of the following species: one bluegill, four ~~xxxxx~~ Iowa darters, and one yellow perch. Two fish were

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*K is the coefficient of condition and is determined by the following formula, $K = \frac{10^5 W}{L^3}$, where W = weight in grams; L = standard length of fish in mm.

not identifiable, and one mud puppy was also found in the stomach of one of the bass. The only other organisms found in the eleven stomachs were two Chironomus larvae (midges) and two dragonflies (Table 6). These together made up the remaining 3 per cent of total volume of food.

Among the perch, three stomachs from age group II contained mostly snails and small clams, chiefly of the genera Amnicola and Pisidium. Three fish of age group III had fed entirely on aquatic forms of insects (mayflies, aquatic beetles, caddisflies and midges). Fish remains (species undetermined) were found in the only stomach from age group IV. The food of the perch will be found listed in Table 7.

The most interesting series of stomachs was obtained from the bluegills (Table 8). In general, their diet was quite varied, but certain organisms were eaten more often by all age groups. The bluegills of age group III (4-6 inches long) showed an apparent preference for small snails and clams of the genera Heliosoma, Amnicola and Pisidium. The next three items most often taken were water fleas (Entomostracans), midge larvae (Diptera) and the immature and adult forms of beetles, stoneflies and mayflies. In age group IV, the food items were eaten most often in the following order: water fleas, dragonflies, snails and clams, and midges. Water fleas and midge larvae were the nutritional items chosen almost to the exclusion of everything else in the bluegills from age group V. Bluegills in age group VIII, the oldest fish, also preferred water fleas, followed by midges, true flies, and snails and clams. Considering all age groups together and judging by the percentage of the total volume, the order of occurrence of organisms in the stomachs was as follows: first, water fleas; second, snails and clams; third, dragonflies; fourth, midge larvae and pupae. Approximately 38 per cent of the stomach contents consisted

of unidentifiable organic debris.

Of the two bullheads examined, the stomach of one was empty, and the other had a small volume of fish fragments remaining (bluegill of approximately $2\frac{1}{2}$ inches).

Other Observations

The brush shelters installed early in 1937 appear to be holding together and numerous small bluegills and small largemouth bass have been observed in their vicinities on several occasions. The spawning boxes installed for the use of the bass were observed to have been used in the 1940 spawning season, but whether by bass or bluegills could not be determined. Adult bluegills, however, were seen over one of the boxes on the east shore. Adequate spawning grounds for bluegills are apparently present on the west shore between the north bay and the fence line.

Examination of the devices placed in the lake for minnow spawning (flat slabs nailed together in the middle with the arms radiating out from the center) failed to indicate any use of the devices by the few blunt-nosed minnows known to be present. Many of the devices are at present misplaced, and are in water that is too deep, but this may have been caused by a rising water level. Some of these minnow slabs should be moved to the sand beaches and anchored in water depths of 6 inches to 18 inches.

Management Suggestions for 1941

1. Detailed recording of the anglers' catches should be continued, and it should be diplomatically suggested to the guest anglers that their fish be weighed by species. Purchase or providing of a hanging balance with a scoop

is recommended*.

2. Perch fishing should be encouraged. This species of fish is not yet fully utilized by the anglers of Little Long Lake. The same is also true of the bluegills. A moderate amount of winter fishing for these species might be permitted.

3. As no smallmouth black bass were taken during 1940, either by netting or angling, apparently the plantings of this species have not been successful. No further plantings of game or forage fish are suggested until it is definitely shown whether or not the blunt-nosed minnow mentioned in this report will succeed in adapting itself to conditions in Little Long Lake. Although we found no evidence of reproduction among the introduced crawfish, another summer should elapse before any further plantings of this organism are made, in order that positive evidence of any reproduction may be observed.

4. Transfer of the minnow spawning slabs to proper depths and locations as mentioned under "Other observations" should be done as soon after the ice leaves as is practical. A map showing the location of brush shelters, spawning boxes and minnow spawning slabs was supposed to have been made by George Travis at the time these were installed, and would be useful in locating the slabs for transfer.

Literature Cited

Hile, Ralph. 1931. The rate of growth of fishes of Indiana. Investigations of Indiana Lakes, No. 2. Div. of Fish and Game, Dept. of Cons., State of Indiana, pp. 8-55.

INSTITUTE FOR FISHERIES RESEARCH
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*An excellent and inexpensive scale for weighing fish is to be found in the 1940-41 Fall-Winter catalog of Sears and Roebuck on page 909, and the cost is $2.45. The catalog number is 11F07189; this scale weighs up to 40 pounds by ounces and is equipped with a large pan; shipping weight 5 pounds.

Table 1

Intensive Creel Census
Little Long Lake, 1940

With comparative figures from 1937 and 1938

Period, 1940	Total anglers	% taking no. fish	Hours fished	Legal fish caught*				Catch per hour	Catch per acre	
				Blue-gills	L.M. bass	Perch	Total		Lbs.	Number of fish
June 25-30	9	55	22.00	4	5	..	9	0.41	0.16	0.26
July 1-15	10	50	27.50	16	5	13	34	1.24	0.43	0.99
July 16-31	13	..	38.75	18	33	2	53	1.37	0.97	1.54
Aug. 1-15	16	..	60.75	92	29	5	126	2.07	1.68	3.65
Aug. 16-31	13	..	45.50	43	38	24	105	2.31	1.88	3.04
Sept. 1-17	11	..	36.50	60	16	6	82	2.25	1.14	2.37
Totals or averages, 1940	72	14	231.00	233	126	50	409	1.77	6.26	11.85
Totals or averages, 1938	39	5	90.50	296	41	1	338	3.73	Not known	9.8
Totals or averages, 1937	35	..	88.50	331	65	13	409	4.63	Not known	11.85

*One bullhead was also taken by angling.

Table 2

Average size and total weight of fish taken by anglers,
Little Long Lake, 1940

With comparative figures from 1937 and 1938

(Lengths are given in inches, weights in pounds)

Time period	Bluegill			Largemouth bass			Yellow perch		
	No.	Average length	Total weight	No.	Average length	Total weight	No.	Average length	Total weight
June 25-30	4	8.8	1.69	5	12.0	3.88	..	..	..
July 1-15	16	10✓7.5	5.63	5	13.0	2✓4.69	13	11✓8.0	4.56
July 16-31	18	8.1	6.00	33	11.6	32✓27.12	2	8.8	0.44
Aug. 1-15	92	74✓7.4	74✓30.60	29	11.9	25✓25.75	5	4✓8.0	1.75
Aug. 16-31	43	39✓8.3	23✓15.50	38	12.5	26✓41.44	24	22✓8.4	4✓7.88
Sept. 1-17	60	45✓7.8	50✓21.50	16	12.9	15.00	6	8.8	2.88
Totals or averages, 1940:	233	190✓7.8	166✓80.92	126	12.2	106✓117.88	50	45✓8.31	17✓17.51
Totals or ave., 1938:	296	8.2	..	41	12.0	..	1	12.0	..
Totals or ave., 1937:	331	7.5	..	65	12.2	..	13	9.5	..

✓- indicates the number of specimens on which averages were based. To obtain total weight, average weight was determined from those actually weighed, and the number of unweighed specimens multiplied by this number and added to the total known weight.

Table 3

Yield Per Acre in Terms of Number of Legal Fish

and Pounds of Legal Fish Taken by Anglers,

Little Long Lake, 1940

Species	Number taken	Total weight	Catch per acre of	
			Legal fish	Pounds of legal fish
Bluegill	233	80.92	6.75	2.34
Largemouth bass	126	117.88	3.65	3.42
Yellow perch	50	17.51	1.45	0.51
Total	409	216.31	11.85	6.27

Table 4

Average Size and Weight of the Various Age Groups
of Bluegills, Largemouth Black Bass and Yellow Perch from
Little Long Lake, July 16-18, 1940

(Lengths are given in millimeters, weights in grams.
154 mm. = 6 inches, 454 grams = 1 pound.)

Number of specimens	Age group	Average standard length	Av. total length	Av. wt.	Av. "K"*	Range in total length	Distribution of sexes	Legal fish in age group
				BLUEGILL				
14	III	97	122	30	3.018	101-158	4♂, 4♀, 6 immature	1
6	IV	147	184	125	3.715	154-212	5 ♂, 1 ♀	6
4	V	162	204	159	3.685	185-243	1 ♂, 3 ♀	4
3	VIII	201	252	312	3.840	245-256	1 ♂, 2 ♀	3
				LARGEMOUTH BLACK BASS				
1	II	175	213	113	2.108	213	1 ♀	0
4	III	206	253	187	2.158	240-268	2 ♂, 2 ♀	2
5	IV	248	300	331	2.177	289-320	1 ♂, 4 ♀	5
1	V	257	318	373	2.197	318	1 ♀	1
1	VI	270	327	416	2.113	327	1 ♂	1
				YELLOW PERCH**				
5	II	130	156	38	1.686	145-154	5 ♀	3
3	III	165	194	80	1.672	163-225	1 ♂, 2 ♀	3
1	IV	146	177	55	1.767	177	1 ♀	1
4	VII	258	301	364	2.085	293-321	2 ♂, 2 ♀	4
3	VIII	248	294	308	2.022	285-309	2 ♂, 1 ♀	3

* "K" is the coefficient of condition and indicates the relationship between the length of the fish and its weight.

** Data from four fish taken in 1939 and twelve fish in 1940 have been combined.

Table 5

Comparison of Average Standard Length and Average Coefficient of Condition between Little Long Lake Game Fish (1940) and Indiana Fish as Given by Hile (1931)

Species	AGE GROUP								
	0	I	II	III	IV	V	VI	VII	VIII
Standard length (millimeters)									
Little Long Lake bluegills	..	..	...	97	147	162	...	...	201
Indiana bluegills	..	66	114	159	170	183	185	191	...
L. Long Lake largemouth bass	..	..	175	206	248	257	270	...	...
Indiana largemouth bass	35	95	150	241	263	312	...	360	384
Little Long Lake perch	..	..	130	165	146	...	...	258	248
Indiana perch	43	87	129	167	206	220	230	...	...
Lake Erie perch	44	..	144	168	187	217	234	244	...
Coefficient of condition (K)									
Little Long Lake bluegills	..	..	...	3.018	3.715	3.685	...	...	3.840
Indiana bluegills	..	..	3.06	3.25	3.14	3.28	3.31	3.14	...
Little Long Lake perch	..	..	1.686	1.672	1.767	...	...	2.085	2.022
Indiana perch	1.34	1.51	1.63	1.60	1.83	1.70	...	...	...

Table 6

Results of Stomach Analysis of Twelve Largemouth Black Bass,
Little Long Lake
Fish taken July 16-18, 1940

Organism	Age group II 1 stomach			Age group III 4 stomachs(2 empty)			Age group IV 5 stomachs (3 empty)			Age group VI 1 stomach			Totals 12 stomachs		
	No. of individuals	Vol., c.c.	% of total vol.	No. of individuals	Vol., c.c.	% of total vol.	No. of individuals	Vol., c.c.	% of total vol.	No. of individuals	Vol., c.c.	% of total vol.	No. of individuals	Vol., c.c.	% of total volume
Worms	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Snails and clams	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Entomostracans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Crawfish	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mayflies	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dragonflies	..	..	..	..	..	..	2	0.30	20	..	..	..	2	0.30	3.2
Stoneflies	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bugs	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Beetles	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Caddisflies	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
True flies	2	trace	..	..	..	..	..	..	..	..	..	..	2	trace	trace
Spiders	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Grasshoppers	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Homoptera	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Butterflies	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bees	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fish	*1	0.90	60	2	0.70	79	..	..	..	..	..	..	3	1.60	73.7
Bluegills	..	..	..	1	3.70		..	..	..	..	..	..	1	3.70	
Perch	..	..	..	1	0.60		..	..	..	..	..	..	1	0.60	
Iowa darters	..	..	..	..	..	..	4	1.10	73	..	..	..	4	1.10	
Algae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Inorganic debris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Organic debris	..	0.60	40	..	1.30	21	..	0.10	7	..	0.20	100	..	2.20	23.1
Grand total	3	1.50	100	4	6.30	100	6	1.50	100	..	0.20	100	13	9.50	100.0

One stomach from the only V group fish was entirely empty.

* Remains of a young mud-puppy (Necturus maculosus). Two individuals in age group III were not identifiable.

Table 7

Results of Stomach Analysis of Twelve Yellow Perch, Little Long Lake

Fish taken July 16-18, 1940

Organism	Age group II 3 stomachs			Age group III 3 stomachs			Age group IV 1 stomach			Totals 12 stomachs		
	No. of individuals	Vol., c.c.	% of total vol.	No. of individuals	Vol., c.c.	% of total vol.	No. of individuals	Vol., c.c.	% of total vol.	No. of individuals	Vol., c.c.	% of total vol.
Worms	..	..	..	..	..	..	..	..	..	..	..	..
Snails and clams	29	0.30	50	..	..	..	..	..	..	29	0.30	38.9
Water fleas	..	..	..	..	..	..	..	..	..	..	..	..
Crawfish	..	..	..	..	..	..	..	..	..	..	..	..
Mayflies	..	..	..	1	0.01	6	..	..	..	1	0.01	1.3
Dragonflies	1	0.20	33	..	..	..	..	..	..	1	0.20	26.0
Stoneflies	..	..	..	..	..	..	..	..	..	..	..	..
Bugs	..	..	..	..	..	..	..	..	..	..	..	..
Beetles	..	..	..	1	0.05	43	..	..	..	1	0.05	6.5
Caddisflies	..	..	..	1	0.04	33	..	..	..	1	0.04	5.2
True flies	..	..	..	2	0.01	12	..	..	..	2	0.01	1.3
Spiders	..	..	..	..	..	..	..	..	..	..	..	..
Grasshoppers	..	..	..	..	..	..	..	..	..	..	..	..
Leaf hoppers	..	..	..	..	..	..	..	..	..	..	..	..
Butterflies	..	..	..	..	..	..	..	..	..	..	..	..
Bees	..	..	..	..	..	..	..	..	..	..	..	..
Fish*	1	0.10	17	..	..	..	1	0.05	100	2	0.15	19.5
Algae	..	..	..	..	..	..	..	..	..	..	..	..
Inorganic debris	..	..	..	..	..	..	..	..	..	..	..	..
Organic debris	..	..	..	..	0.01	6	..	..	..	..	0.01	1.3
Grand total	31	0.60	100	5	0.12	100	1	0.05	100	37	0.77	100.0

Four stomachs from age group VII fish and one from the only age group VIII fish were empty.

*Identification to species of fish eaten was not possible.

Table 8

Results of Stomach Analysis of Bluegills, Little Long Lake

Fish taken July 16-18, 1940

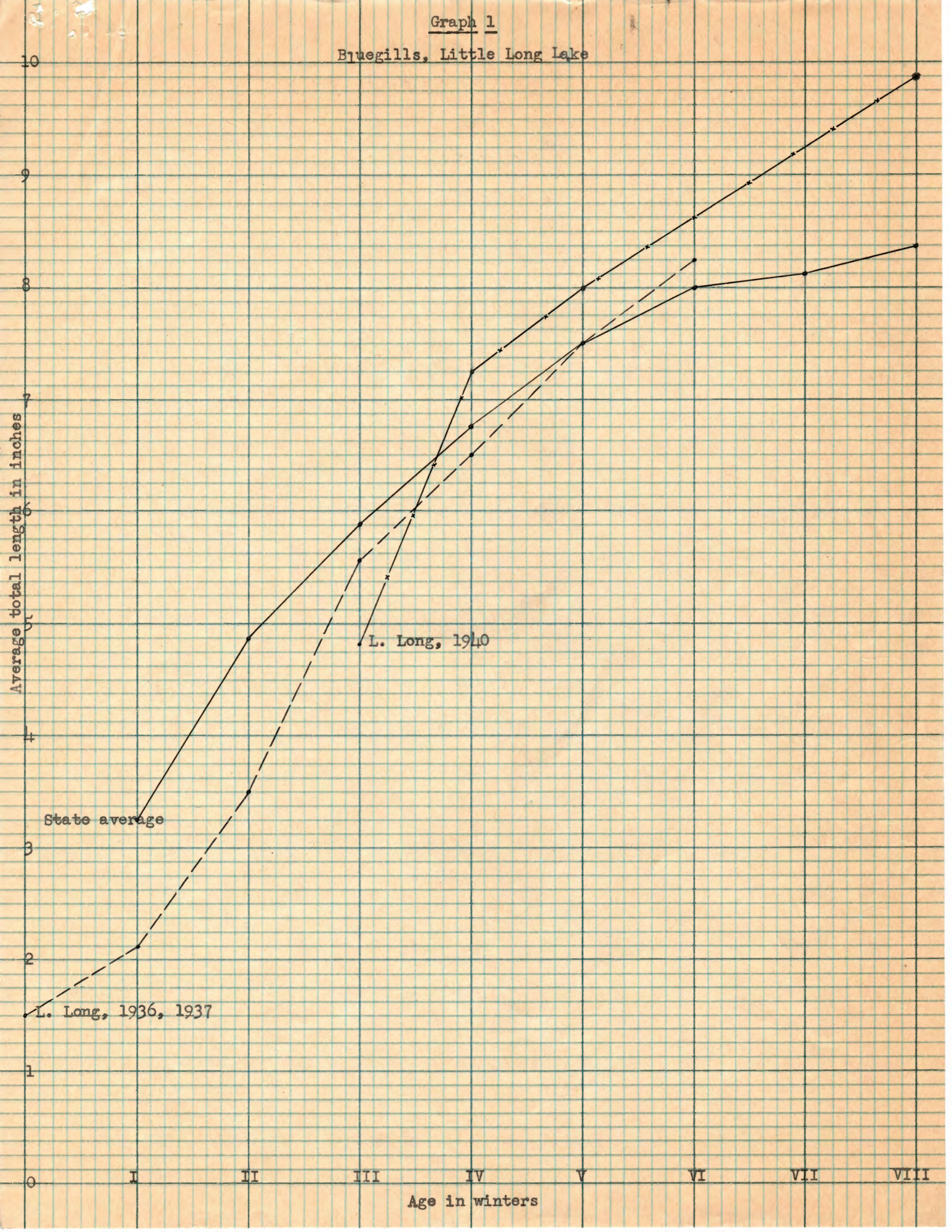
Organism	Age group III 14 stomachs			Age group IV 6 stomachs			Age group V 4 stomachs(1 empty)			Age group VIII 2 stomachs*			Totals 27 stomachs		
	No. of indi-viduals	Vol., c.c.	% of total vol.	No. of indi-viduals	Vol., c.c.	% of total vol.	No. of indi-viduals	Vol., c.c.	% of total vol.	No. of indi-viduals	Vol., c.c.	% of total vol.	No. of indi-viduals	Vol., c.c.	% of total vol.
Worms	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Snails, clams	171	0.87	40	8	0.30	7	..	..	..	4	0.05	3	183	1.22	11.8
Water fleas	607	0.21	10	3,700+	1.25	27	4,000+	1.30	72	2,000+	0.90	49	10,307+	3.69	35.7
Crawfish	2	trace	trace	1	trace	trace	..	..	..	..	..	..	3	trace	trace
Mayflies	2	0.05	2	4	trace	trace	1	trace	trace	..	..	..	7	0.05	0.5
Dragonflies	1	trace	trace	2	0.73	16	..	..	..	..	..	..	3	0.73	7.0
Stoneflies	1	0.05	2	..	..	..	..	..	..	..	..	..	1	0.05	0.5
Bugs	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Beetles	6	0.05	2	..	..	..	3	trace	trace	..	..	..	9	0.05	0.5
Caddisflies	..	..	..	2	0.10	2	..	..	..	..	..	..	2	0.10	1.0
True flies	78	0.15	7	66	0.15	3	27	0.20	11	35	0.05	3	206	0.55	5.3
Spiders	1	trace	trace	..	..	..	1	trace	trace	..	..	..	2	trace	trace
Grasshoppers	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Leaf hoppers	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Butterflies	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bees	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fish**	1	trace	trace	..	..	..	..	..	..	..	..	..	1	trace	trace
Algae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Inorganic debris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Organic debris	..	0.77	35	..	2.00	44	..	0.30	16	..	0.83	45	..	3.90	37.7
Grand total	870	2.18+	100	3,783+	4.53	100	4,032+	1.80+	100	2,039+	1.83	100	10,724+	10.34	100.0

*The stomach from one fish of the age group VIII was not used as the fish was found dead.

**Identification of species of fish eaten was not possible.

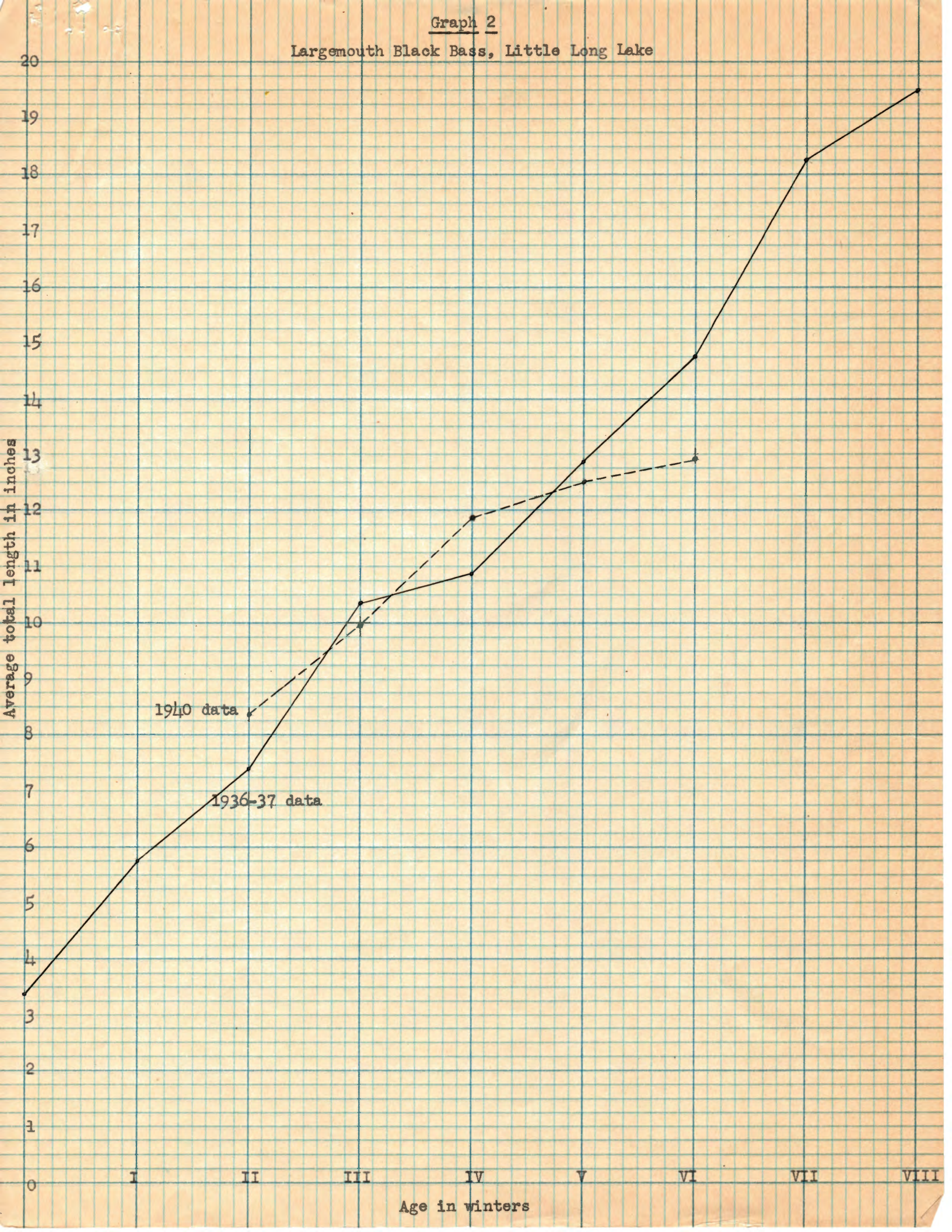
Graph 1

Bluegills, Little Long Lake



Graph 2

Largemouth Black Bass, Little Long Lake



Graph 3

Yellow Perch, Little Long Lake