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EFFECTS OF A FLIES-ONLY REGULATION
ON ANGLING AND TROUT POPULATIONS
IN FORD LAKE, OTSEGO COUNTY,
MICHIGAN[↓]

by

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[↓] Contribution from Dingell-Johnson Project No. F-27-R, Michigan.



Introduction

In 1955, Shetter and Allison showed conclusively that mortality of trout released after they were caught with worm-baited hooks was significantly higher than mortality of trout caught with artificial flies and released. Immediately the question arose of whether a regulation which permitted the angler to use only the commonly accepted wet or dry fly as a lure would, subsequently, increase the catch of trout. Seemingly the elimination of the fatal hooking of sublegal trout with worm bait would increase survival in a trout population unless mortality from other sources offset the increased survival resulting from the use of flies. In 1962, Shetter and Alexander evaluated the effects of a flies-only restriction on a wild, brook trout population in 5,000 feet of Hunt Creek, Montmorency County, Michigan. They concluded that the main result of the flies-only regulation was a greater catch per hour for the fewer anglers fishing the restricted water during 1955-59. The sublegal or protected segment of the population did not increase under the regulation.

Since 1955, only the commonly accepted wet or dry fly has been used as bait in Ford Lake, Otsego County, Michigan. The effects of the regulation on angling and on the trout population in the lake were evaluated. Ford is one of the seven experimental lakes at the Pigeon River Trout Research Station. Hemlock, another of the lakes, was used as a control. In Hemlock Lake, anglers could use any bait except

minnows. In both lakes a daily creel limit of 5 trout, at least 7 inches long, was in force. The fishing season extended from the last Saturday in April through the second Sunday in September.

Ford Lake is 10.2 acres in area, and has a maximum depth of 29 feet; Hemlock Lake is 5.9 acres, and has a maximum depth of 59 feet. Geologists describe the lakes as limestone sinks, i. e., they were formed through the solution of underlying limestone by ground water, accompanied by a settling of the surface layer of sand and gravel, producing a cone-shaped pothole. For a more complete physical and chemical description of each lake, see Eschmeyer (1938) and Tanner (1960).

Although the fish populations in both lakes were poisoned in the early 1950's, the mudminnow (Umbra limi) is present in Ford Lake and the bluntnose minnow (Pimephales notatus) in Hemlock Lake. The mudminnow survived the poisoning but the bluntnose minnow was introduced into Hemlock Lake after the poisoning, probably by an angler fishing illegally with minnows.

Trout spawning is unsuccessful in these lakes, and the fishery is maintained by annual fall plantings of fingerling brook trout (Salvelinus fontinalis). A nearly complete record of the harvest is obtained by a permit-type creel census which has been in operation at the station since 1949. All anglers are required to report their catch at the end of each trip to each lake.

Plantings and harvest

The initial planting rate was about 500 brook trout (age-group 0, average length about 4 inches) per acre. Each autumn, Ford Lake received 5,850 and Hemlock, 3,000 fingerling brook trout. In 1957, however, the planting rate was reduced to 100 fingerlings per acre; Ford Lake received 1,170, and Hemlock Lake, 600 trout each autumn. In 1956, with an improvement in the hatchery diet, the brook trout averaged more than 4 inches by autumn, and since then 5- to 6-inch trout (average total length about 5.5 inches) have been selected for planting each year.

In addition to the fingerling plants, legal-size trout were planted in Ford Lake in 1952-55, and in Hemlock Lake in 1952-53. The plantings and the subsequent harvests, in number and weight, for Ford and Hemlock lakes are given in Tables 1 and 2.

With the increase in 1956 of size of trout planted and a decrease in 1957 of number planted per acre, there has been an approximate doubling of the percentage of a year class caught both in numbers (Figure 1) and pounds (Figure 2). However, in both lakes the actual number and weight harvested from a year class is generally less now than under the previous planting program. In Hemlock Lake, the total number caught in recent years is about one half as great as in the early years prior to changes in planting program; weight is about three quarters as great (Table 2). In Ford Lake, the catch from the fingerling plants in the

early years was extremely variable, undoubtedly as a result of the competition and predation from the plantings of legal-size trout, but it was usually larger than in recent years (Table 1).

Concurrent with the change in the planting program, there has been an increase in the average total length of trout in the catch from Ford Lake (Table 3) and Hemlock Lake (Table 4).

The flies-only regulation was imposed on Ford Lake in 1955. The 1954 year class which was planted after the close of the fishing season in the autumn of 1954, was the first to be subjected to the new regulation. If there was to be an increase in survival of sublegal trout and a corresponding increase in the catch, the change should have first appeared in the returns from the 1954 year class which was harvested in 1955-59. However, the percentage of year class caught, both in number and weight, did not increase until 1958-60 when the 1957 year class was harvested (Figures 1 and 2). A similar increase in percentage of harvest, occurred in the 1957 year class in Hemlock Lake. The increase in percentage of harvest in both lakes must be attributed to the reduction in planting rate and larger size of trout planted rather than the flies-only regulation.

Population and mortality estimates

The methods used to determine number of trout in Ford and Hemlock lakes each spring and fall and to estimate mortality rates were described in detail by Latta (1963). Samples of fish to be used in the

"mark-and-recapture" estimates of population size were taken by angling, by shocking with direct current at night with underwater lights, and by creel census. Mortality rates were calculated by methods described by Ricker (1958); and the same symbols have been used. Catches and population estimates for each spring and fall, 1960-62, are given for Ford Lake in Table 5, and for Hemlock Lake in Table 6. The corresponding mortality estimates for each winter and summer are given in Tables 7 and 8. The instantaneous and conditional mortality rates presented here plus those in Latta (1963) provide estimates from 1956 through 1962.

One would expect the natural mortality rate of the sublegal trout (during the first summer in the lake) to be less under a flies-only regulation than under an any-bait regulation unless there were some other source of mortality. A comparison of instantaneous natural mortality rates, q , for the first summer of life in Ford Lake with corresponding rates for the first summer of life in Hemlock Lake, for 1957-62, is shown in Figure 3. A "t" test indicated there was no significant difference between the natural mortality rates, q , in the two lakes.

Fishing pressure and angling quality

The number and percentage of successful fishing trips, hours fished in total and per acre, and average number of brook trout caught per hour per trip for each year, 1953-62, for Ford and Hemlock lakes

are given in Tables 9 and 10, respectively. Means for these data and for similar data from the four other experimental lakes under the same planting program as Ford and Hemlock lakes for the years 1955-62 are given in Table 11.

Fishing pressure, measured in number of hours of fishing per acre each year, was plotted for Ford and Hemlock lakes in Figure 4. Since 1955, the beginning of the flies-only regulation, the fishing pressure on Ford Lake has been rather constant. Fishing pressure on Hemlock Lake has varied more, but it has been higher than on Ford Lake. Hemlock Lake has had a mean of 147.6 hours per acre of fishing pressure as compared with the mean of 48.5 hours per acre for Ford Lake for the years 1955-62 (Table 11). Of the six experimental lakes where fingerling brook trout are planted annually, mean fishing pressure per acre was lowest on Ford Lake, the only lake under the flies-only regulation. (In the other lakes any bait except minnows could be used.) In 1953 and 1954, before the flies-only regulation, total fishing pressure on Ford Lake was almost twice as high (mean--935 hours) as after (mean--494 hours) the regulation was imposed (Table 9).

Angling quality, as measured by the average number of trout caught per hour per trip, was plotted for the two lakes in Figure 5. Since 1955, the catch per hour per trip has varied considerably in both lakes but it has been higher in Ford than in Hemlock in 6 of 8 years. The mean for Ford Lake was 0.69 trout while for Hemlock Lake it was

0.43 trout for the years 1955-62 (Table 11). Of the six experimental lakes, the mean of 0.69 trout on Ford Lake was the highest.

With the imposition of the flies-only regulation on Ford Lake, the fishing pressure has been approximately halved and it has remained lower than on any of the experimental lakes. As a consequence of the lower fishing pressure, the fishing quality (or number of fish caught per hour per trip) has been consistently higher than on the other lakes.

Since 1958 in Hemlock Lake, and 1959 in Ford Lake, the quality of the fishing has decreased (Figure 5). This can be attributed to the reduction in 1957 of the planting rate from 500 to 100 trout per acre.

Discussion

Although the use of artificial flies as a lure reduces mortality from hooking, apparently in Ford Lake mortality from other sources was great enough to offset the survival gained by using only flies. There was no indication of increased survival either in percentage of return from a year class or in a comparison of natural mortality rates for the first summer in the lake (the time when the brook trout are of sublegal size and growing into the catch). The quality of the fishing was higher on Ford Lake than on the control lake (and the other experimental lakes in the area), but this was a result of the lower fishing pressure. The better fishing on Ford Lake did not attract fishermen from the other lakes.

The difference in fishing pressure (hours per acre) between Ford and Hemlock lakes was considerable (48.5 as compared to 147.6 hours). Undoubtedly, an increase in fishing pressure on Ford Lake would result in an increased catch, a reduction in number of trout caught per hour per trip, a lesser density of trout in the lake and, probably, an increase in survival of the remaining trout. What effect the flies-only regulation would have under an increased fishing pressure is unknown.

Acknowledgments

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INSTITUTE FOR FISHERIES RESEARCH

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Report approved by G. P. Cooper

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Table 1.--Number, weight (pounds) and average length (inches) of brook trout planted in Ford Lake and the subsequent harvest in numbers and weight (pounds), 1953-62

Date stocked (Year and month)	Number and weight (pounds) planted	Average length (inches) planted	Number and weight (pounds) caught										Total	Percentage return by number and weight
			1953	1954	1955	1956	1957	1958	1959	1960	1961	1962		
1952	2,650	4.0	263	211	6	...	...	...	...	...	...	...	480	18.1
October	106		42.0	41.9	3.0								86.9	82.0
	265	8.1	141	1	...	...	...	...	...	...	...	...	142	53.6
	60		29.1	0.3									29.4	49.0
1953	5,850	3.5	...	240	234	22	...	...	...	...	...	...	496	8.5
September	133			38.9	61.6	9.7							110.2	82.9
August	650	8.1	203	155	3	12	...	...	...	...	...	...	373	57.4
	143		35.0	28.4	1.0	2.4							66.8	46.7
1954	5,850	4.2	...	...	6	167	2	1	1	...	...	...	177	3.0
November	176				0.9	34.7	0.4	0.5	2.4				38.9	22.1
April	600	7.0	...	364	19	4	...	...	...	...	...	...	387	64.5
	85			61.9	5.6	1.1							68.6	80.7
1955	5,850	4.3	...	...	...	54	186	20	3	...	...	...	263	4.5
October	172					8.2	40.3	8.2	1.7				58.4	34.0
May	300	6.7	...	...	41	51	...	...	...	...	...	...	92	30.7
	38				5.9	11.0							16.9	44.5
1956	5,850	5.7	...	...	...	...	14	261	292	36	...	...	603	10.3
October	380						1.5	37.0	63.0	10.8			112.3	29.6
1957	1,170	5.6	...	...	...	...	...	7	252	23	...	...	282	24.1
November	72							0.9	48.0	6.4			55.3	76.8
1958	1,170	5.6	...	...	...	...	...	...	6	257	6	...	269	23.0
November	74								0.9	51.3	1.9		54.1	73.1
1959	1,170	5.5	...	...	...	...	...	...	...	101	157	9	267	22.8
November	63									18.8	54.7	5.0	78.5	124.6
1960	1,170	5.5	...	...	...	...	...	...	...	...	152	124	276	23.6
November	67										26.9	42.1	69.0	103.0
1961	1,170	5.5	...	...	...	...	...	...	...	...	...	75	75	6.4
November	65											13.8	13.8	21.2
Total														
Number			607	986↓	327↓	310	202	289	554	417	315	208		
Weight (pounds)			106.1	173.9	83.7	67.1	42.2	46.6	116.0	87.3	83.5	60.9		

↓ For 1954, 15 trout weighing a total of 2.5 pounds and, for 1955, 18 trout weighing 5.7 pounds, were added to the totals. They could not be assigned to a year class because of errors in recording and/or marking.

Table 2.--Number, weight (pounds) and average length (inches) of brook trout planted in Hemlock Lake and the subsequent harvest in numbers and weight (pounds), 1953-62

Date stocked (Year and month)	Number and weight (pounds) planted	Average length (inches) planted	Number and weight (pounds) caught										Total	Percentage return by number and weight
			1953	1954	1955	1956	1957	1958	1959	1960	1961	1962		
1952	1,475	4.0	...	1	...	...	...	...	...	...	...	...	1	0.1
October	61			0.1									0.1	0.2
	148	8.1	...	...	...	...	...	...	...	...	...	...	...	...
	32													
1953	3,000	3.5	...	427	49	1	...	...	...	...	...	...	477	15.9
September	67			83.3	21.6	1.2							106.1	158.4
	450	8.1	...	6	...	...	...	...	...	...	...	...	6	1.3
	66			2.4									2.4	3.6
1954	3,000	4.2	...	...	213	453	4	...	...	...	...	...	670	22.3
November	87				29.9	75.4	1.0						106.3	122.2
1955	3,000	4.3	...	...	...	282	274	6	...	...	...	...	562	18.7
October	91					42.5	49.2	1.4					93.1	102.3
1956	3,000	5.7	...	...	...	...	322	319	5	...	...	...	646	21.5
October	190						46.9	74.7	2.9				124.5	65.5
1957	600	5.6	...	...	...	...	...	244	40	3	...	...	287	47.8
November	38							56.0	20.8	3.0			79.8	210.0
1958	600	5.6	...	...	...	...	...	...	254	83	2	...	339	56.5
November	38								51.1	36.6	2.4		90.1	237.1
1959	600	5.3	...	...	...	...	...	...	...	149	143	5	297	49.5
November	35									27.3	58.8	4.4	90.5	258.6
1960	600	5.5	...	...	...	...	...	...	...	...	105	86	191	31.8
November	35										19.6	40.8	60.4	172.6
1961	600	5.5	...	...	...	...	...	...	...	...	...	176	176	29.3
November	33											32.4	32.4	98.2
	Total													
	Number		...	435↓	263↓	736	600	569	299	235	250	267		
	Weight (pounds)			86.1	51.8	119.1	97.1	132.1	74.8	66.9	80.8	77.6		

↓ For 1954, 1 trout weighing 0.3 pound and, for 1955, 1 trout weighing 0.3 pound were added to the totals. They could not be assigned to a year class because of errors in recording and/or marking.

Table 5.--Catches, and spring and fall population estimates of brook trout in Ford Lake, 1960-62

[The 95-percent confidence limits for population estimates are given in parentheses]

Year class	Population estimates and catches, by years [↓]						
	1960		1961			1962	
	N ₂	N ₁ ²	C	N ₂	N ₁	C	N ₂
1958	13	2 ³	6	...	...	...	...
1959	342 (272-451)	209 (155-319)	157	19	1 ³	9	4
1960	....	640 (522-893)	152	276 (234-349)	256 (170-585)	124	28 (22-56)
1961	...	...	...	...	854 (681-1,119)	75	483 (418-595)
Totals	360	851	315	295	1,111	208	515

[↓]N₁ = April population estimate, C = catch, N₂ = October population estimate.

²Fifty to 100 trout were removed illegally during the winter. Probably most of trout taken were from the 1959 year class.

³Minimum estimate; number of fish handled. N₁ assumed to be 6 in 1961, and 13 in 1962.

Table 6. --Catches, and spring and fall population estimates of brook trout in Hemlock Lake, 1960-62

[The 95-percent confidence limits for population estimates are given in parentheses]

Year class	Population estimates and catches, by years ¹						
	1960	1961			1962		
	N ₂	N ₁	C	N ₂	N ₁	C	N ₂
1958	2 ²	2	2	...	...	...	...
1959	183 (146-251)	176 (144-234)	143	5	1 ²	5	...
1960	...	512 (397-682)	105	140 (118-180)	126 (89-218)	86	20
1961	...	...	...	...	453 (391-553)	176	238 (174-402)
Totals	185	690	250	145	580	267	253

¹N₁ = April population estimate, C = catch, N₂ = October population estimate.

²Minimum estimate; number of fish handled. N₁ assumed to be 5 in 1962.

Table 7. --Instantaneous and conditional mortality rates for brook trout
in Ford Lake, 1960-62

Year class	Mortality rate symbol	Year and season				
		1960	1961		1962	
			Winter	Summer	Winter	Summer
1958	i	1.10		∞		
	p	0.00		∞		
	q	1.10		0.00		
	a	0.67		1.00		
	m	0.00		1.00		
	n	0.67		0.00		
1959	i	0.49	2.40		0.38	1.18
	p	0.00	1.98		0.00	1.18
	q	0.49	0.42		0.38	0.00
	a	0.39	0.91		0.32	0.69
	m	0.00	0.36		0.00	0.69
	n	0.39	0.34		0.32	0.00
1960	i	0.60	0.84		0.07	2.22
	p	0.00	0.35		0.00	1.21
	q	0.60	0.49		0.07	1.01
	a	0.45	0.57		0.07	0.89
	m	0.00	0.30		0.00	0.70
	n	0.45	0.39		0.07	0.64
1961	i				0.31	0.57
	p				0.00	0.12
	q				0.31	0.45
	a				0.27	0.43
	m				0.00	0.11
	n				0.27	0.36

Table 8. --Instantaneous and conditional mortality rates for brook trout
in Hemlock Lake, 1960-62

Year class	Mortality rate symbol	Year and season				
		1960	1961		1962	
			Winter	Summer	Winter	Summer
1958	i		0.00	∞		
	p		0.00	∞		
	q		0.00	0.00		
	a		0.00	1.00		
	m		0.00	1.00		
	n		0.00	0.00		
1959	i		0.04	3.58	0.00	∞
	p		0.00	2.99	0.00	∞
	q		0.04	0.59	0.00	0.00
	a		0.04	0.97	0.00	1.00
	m		0.00	0.95	0.00	1.00
	n		0.04	0.44	0.00	0.00
1960	i		0.16	1.30	0.11	1.84
	p		0.00	0.37	0.00	1.49
	q		0.16	0.93	0.11	0.35
	a		0.15	0.73	0.10	0.84
	m		0.00	0.31	0.00	0.78
	n		0.15	0.61	0.10	0.29
1961	i				0.28	0.65
	p				0.00	0.53
	q				0.28	0.12
	a				0.24	0.48
	m				0.00	0.41
	n				0.24	0.11

Table 9. --Number and percentage of successful fishing trips, hours fished in total and per acre, and average number of brook trout caught per hour per trip for Ford Lake, 1953-62

Year	Fishing trips		Hours fished		Average number of fish caught per hour per trip
	Number	Percentage successful	Total	Per acre	
1953	266	68.5	694.5	68.1	1.09
1954	435	62.6	1,176.0	115.3	0.94
1955	214	50.5	494.0	48.4	0.82
1956	243	43.6	576.0	56.5	0.54
1957	175	40.0	417.5	40.9	0.43
1958	163	51.5	360.0	35.3	0.83
1959	232	61.6	510.5	50.0	1.15
1960	204	60.3	503.0	49.3	0.82
1961	224	56.2	592.5	58.1	0.54
1962	193	39.4	500.5	49.1	0.37

Table 10. --Number and percentage of successful fishing trips, hours fished in total and per acre, and average number of brook trout caught per hour per trip for Hemlock Lake, 1953-62

Year	Fishing trips		Hours fished		Average number of fish caught per hour per trip
	Number	Percentage successful	Total	Per acre	
1953	22	...	32.0	5.4	...
1954	265	51.3	846.5	145.5	0.49
1955	255	32.6	773.0	131.0	0.30
1956	336	64.0	974.5	165.2	0.75
1957	383	46.5	992.5	168.2	0.61
1958	339	50.1	995.0	168.6	0.66
1959	256	41.8	745.5	126.4	0.37
1960	219	37.4	670.5	113.6	0.29
1961	291	33.7	930.0	157.6	0.21
1962	251	42.2	887.0	150.3	0.26

Table 11.--Means for fishing trips, hours fished and average number of brook trout caught per hour per trip for six experimental lakes, 1955-62

Lake	Fishing trips		Hours fished		Average number of fish caught per hour per trip
	Number	Percentage successful	Total	Per acre	
Ford	207	50.4	494.2	48.5	0.69
Hemlock	291	43.5	371.0	147.6	0.43
North Twin	311	41.2	349.6	130.8	0.43
South Twin	292	29.6	331.9	174.8	0.30
West Lost	334	37.4	906.9	245.1	0.35
Lost	210	38.0	524.9	150.0	0.43

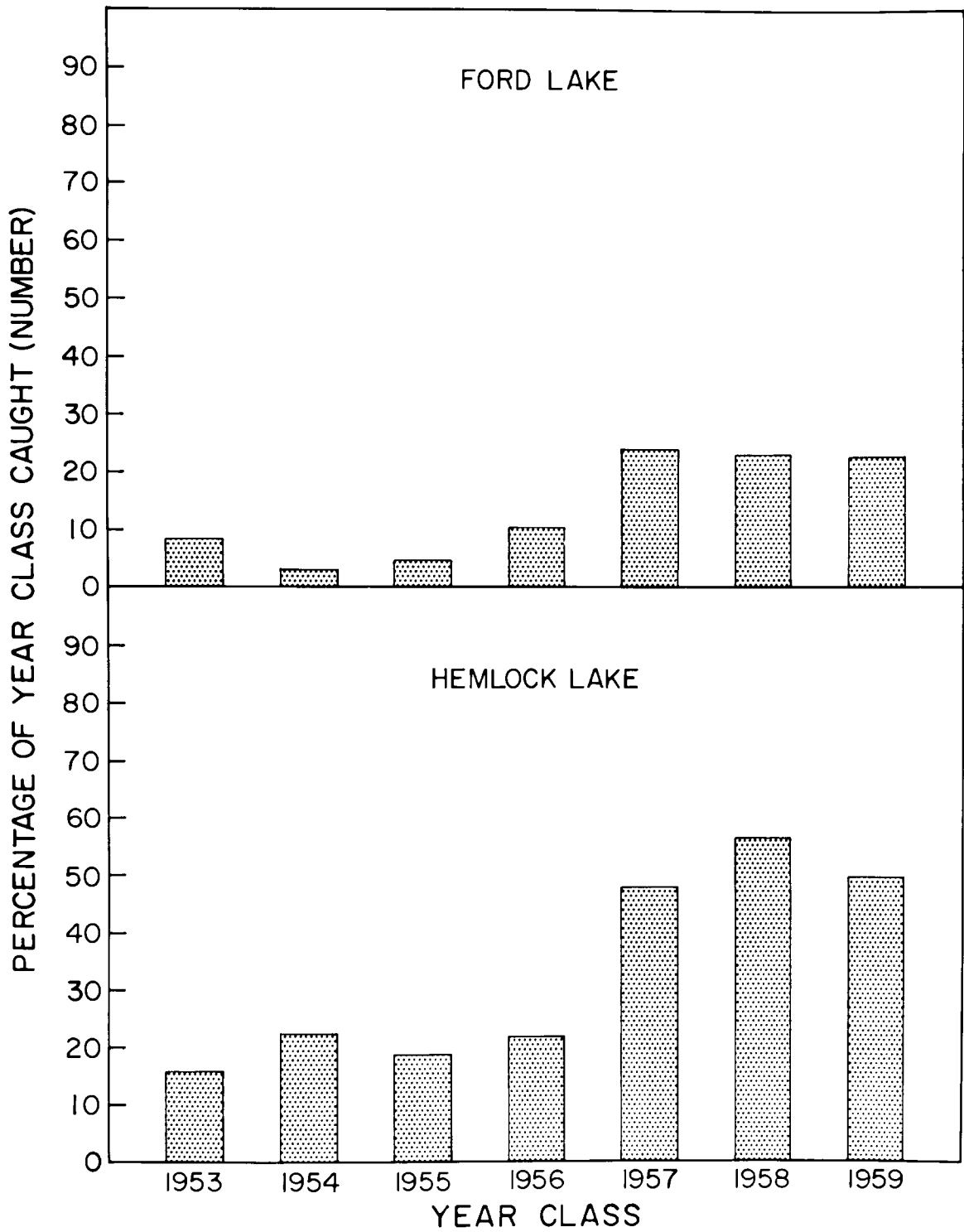


Figure 1. --Percentage (number) of brook trout, from each year class, 1953-59, caught in Ford and Hemlock lakes.

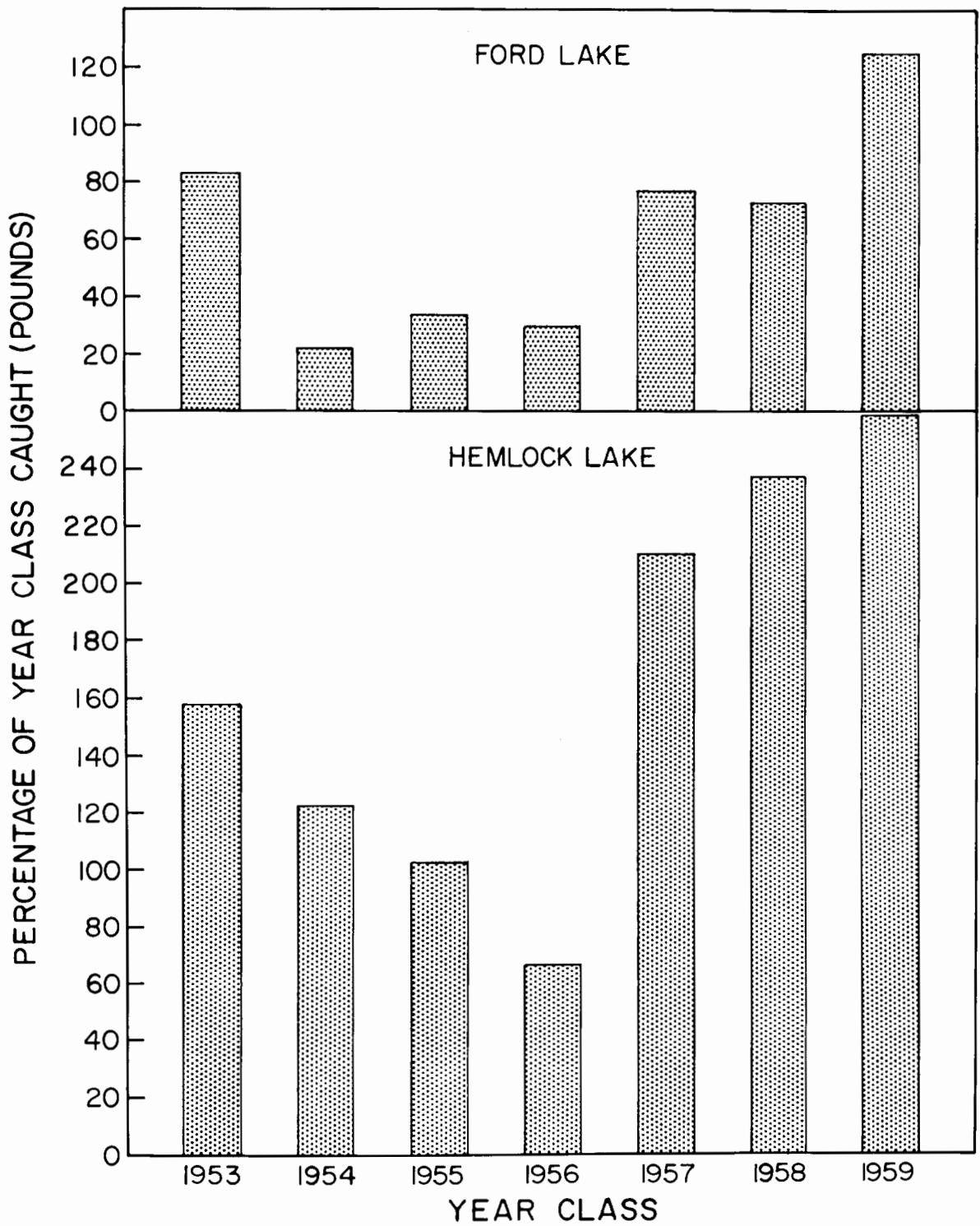


Figure 2. --Percentage (pounds) of brook trout, from each year class, 1953-59, caught in Ford and Hemlock lakes.

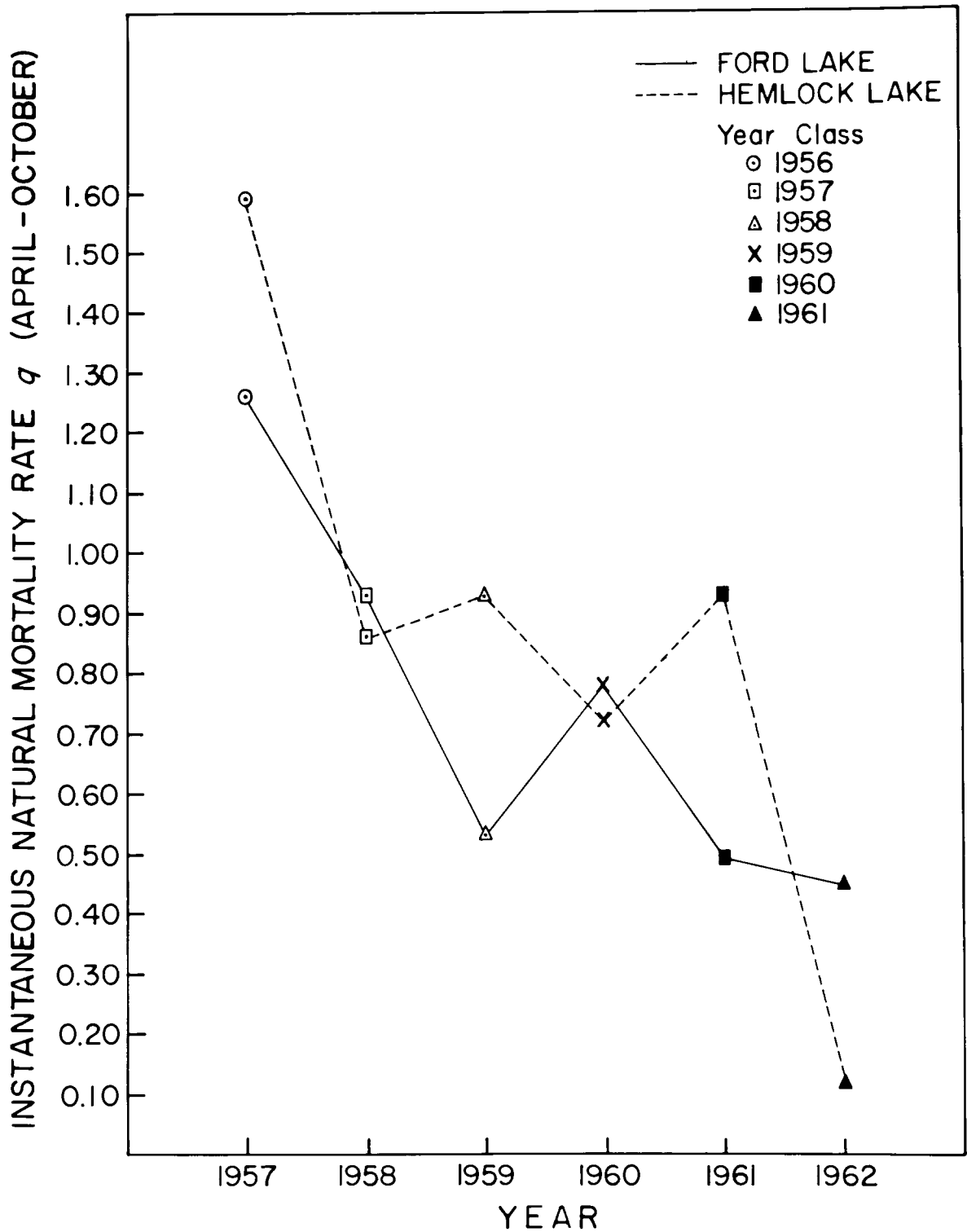


Figure 3. --Instantaneous natural mortality rates, q , for brook trout during their first summer in Ford and Hemlock lakes, 1957-62.

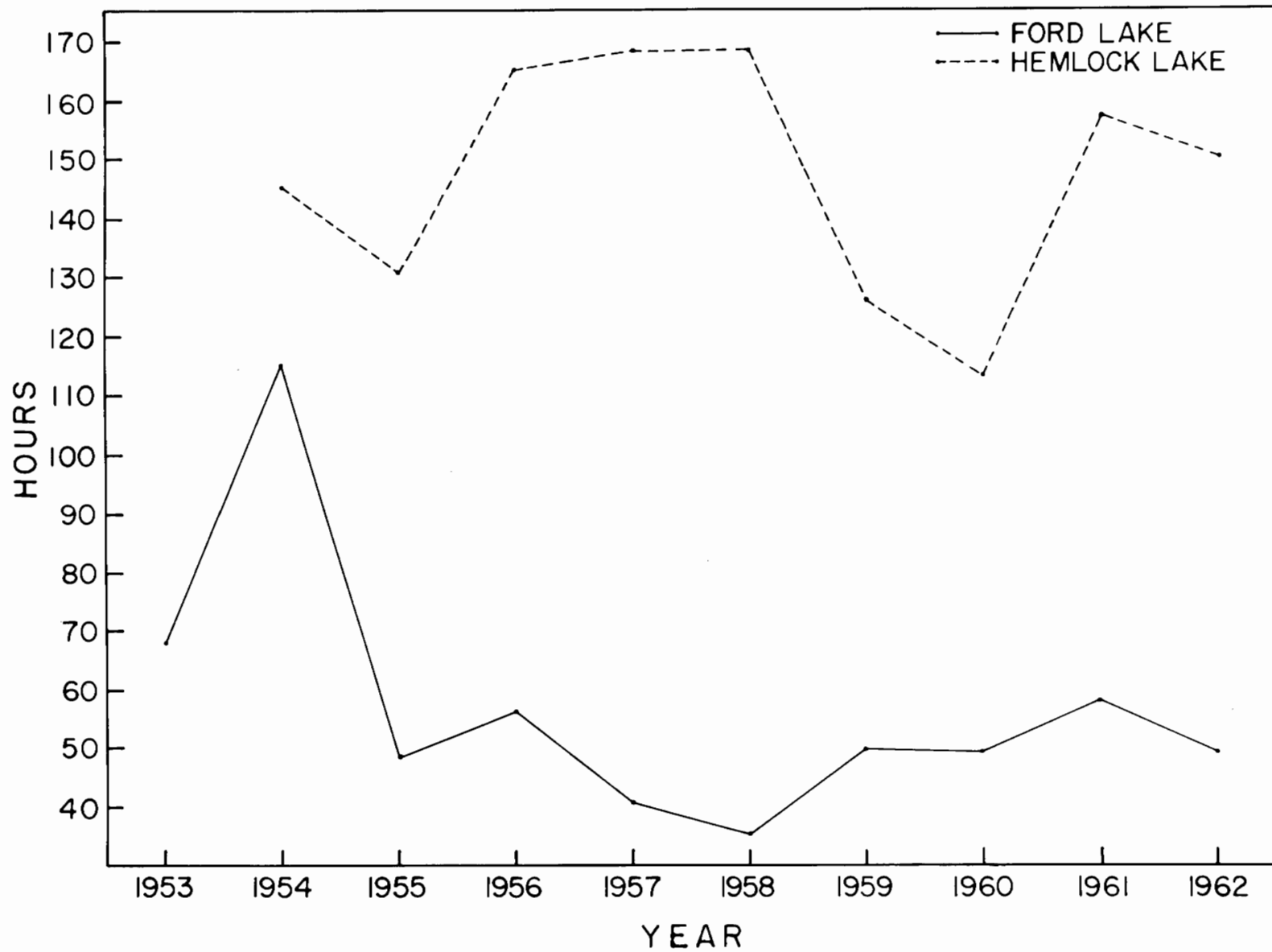


Figure 4. --Hours of fishing per acre each year, 1953-62, on Ford and Hemlock lakes.

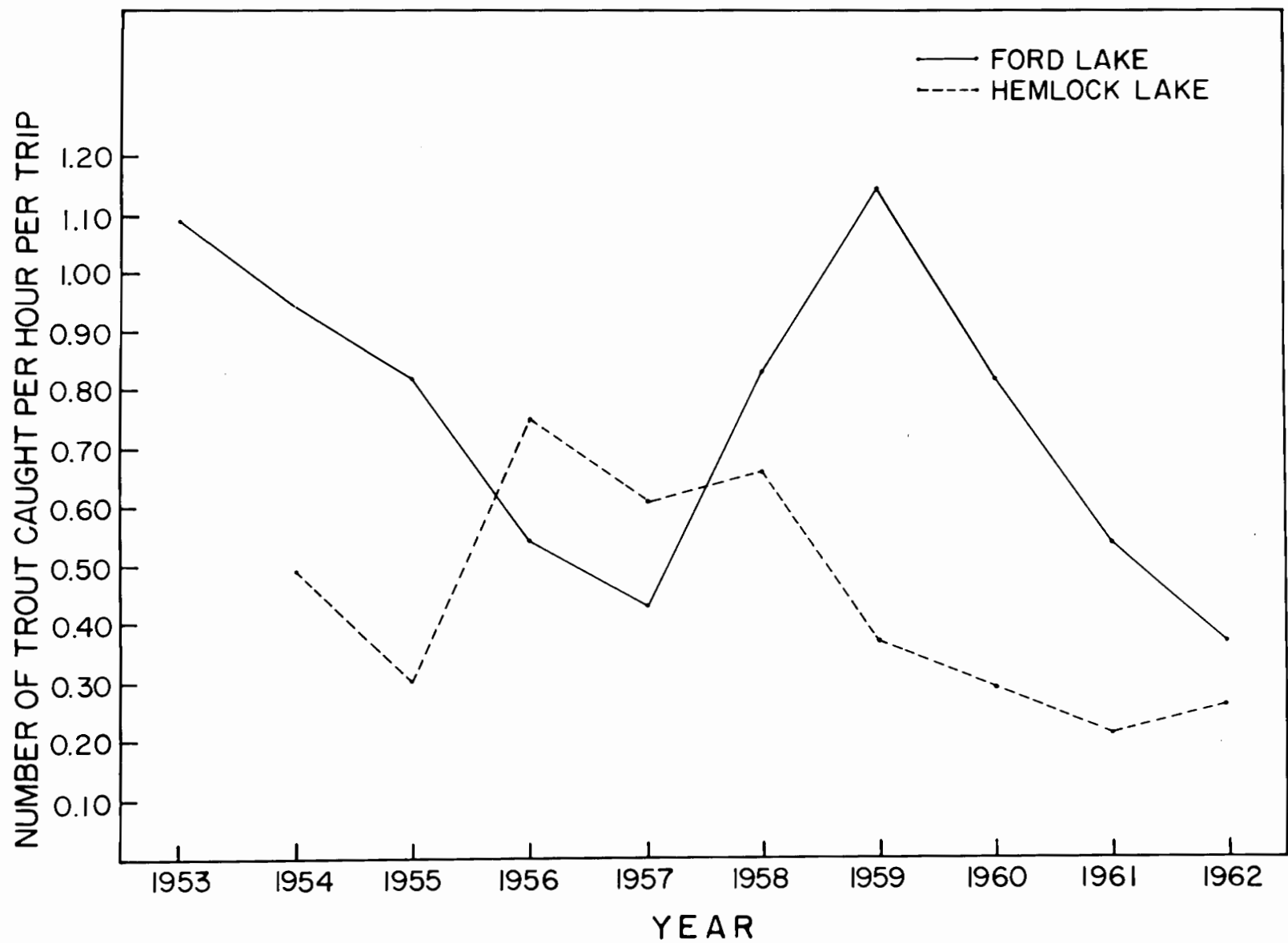


Figure 5.--Average number of trout caught per hour per trip each year, 1953-62, on Ford and Hemlock lakes.