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THE EFFECTS OF A FLIES-ONLY RESTRICTION ON ANGLING AND FALL TROUT POPULATIONS, HUNT CREEK, MONTMORENCY COUNTY, MICHIGAN

By

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During the past decade there has been much interest in special regulations for trout streams (higher minimum size limits, lower daily creel limits, limitation on lures, etc.). Such special angling rules have been applied on test streams to see if they would improve angling quality. On certain test streams in Michigan, special regulations were invoked, with relatively little prior knowledge of angling quality or status of the trout population; for an evaluation of the effects of the regulations on fishing and on the trout populations in these streams, it is necessary to simultaneously study "control" sections of stream where the regulations have not been changed. Furthermore, on some streams, two or more special regulations have been applied at the same time, making it difficult to ascertain which regulation might be responsible for any subsequent change in angling quality or in the trout population. The present study on Hunt Creek involves a

situation where prior data were available, and only one special regulation was involved.

Hooking experiments conducted on several Michigan trout streams during the period 1951-1953 compared the mortality of trout hooked and released with artificial fly and worm-baited hooks. From these data it was hypothesized that elimination of worm-hooking of sublegal trout in Hunt Creek might increase the total catch of legal brook trout by a substantial amount (Shetter and Allison, 1955). The present study deals with the effects of a flies-only regulation on angling and on the trout population in a portion of Hunt Creek, located in the south-central part of Montmorency County, Michigan.

The experimental area and its operation

The Hunt Creek Trout Research Station has been operated by the Michigan Department of Conservation since 1939. Beginning with the 1949 trout season, by Conservation Commission order, angling has been under a free daily permit. Neither the number of fishermen nor their choice of waters to fish has been restricted. The stream (Fig. 1) is divided into ecologically different sections (Z, A, B, C, D) for recording angling pressure and catch. Data on the morphometry of the various sections are given in Table 1. The physical and ecological features of the experimental sections of Hunt Creek were described by Shetter (1950).

Figure 1. --Map of the Hunt Creek Trout Research Station experimental stream sections, Montmorency County, Michigan.

MICHIGAN DEPARTMENT OF CONSERVATION
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HUNT CREEK FISHERIES EXPERIMENTAL AREA

MONTMORENCY COUNTY

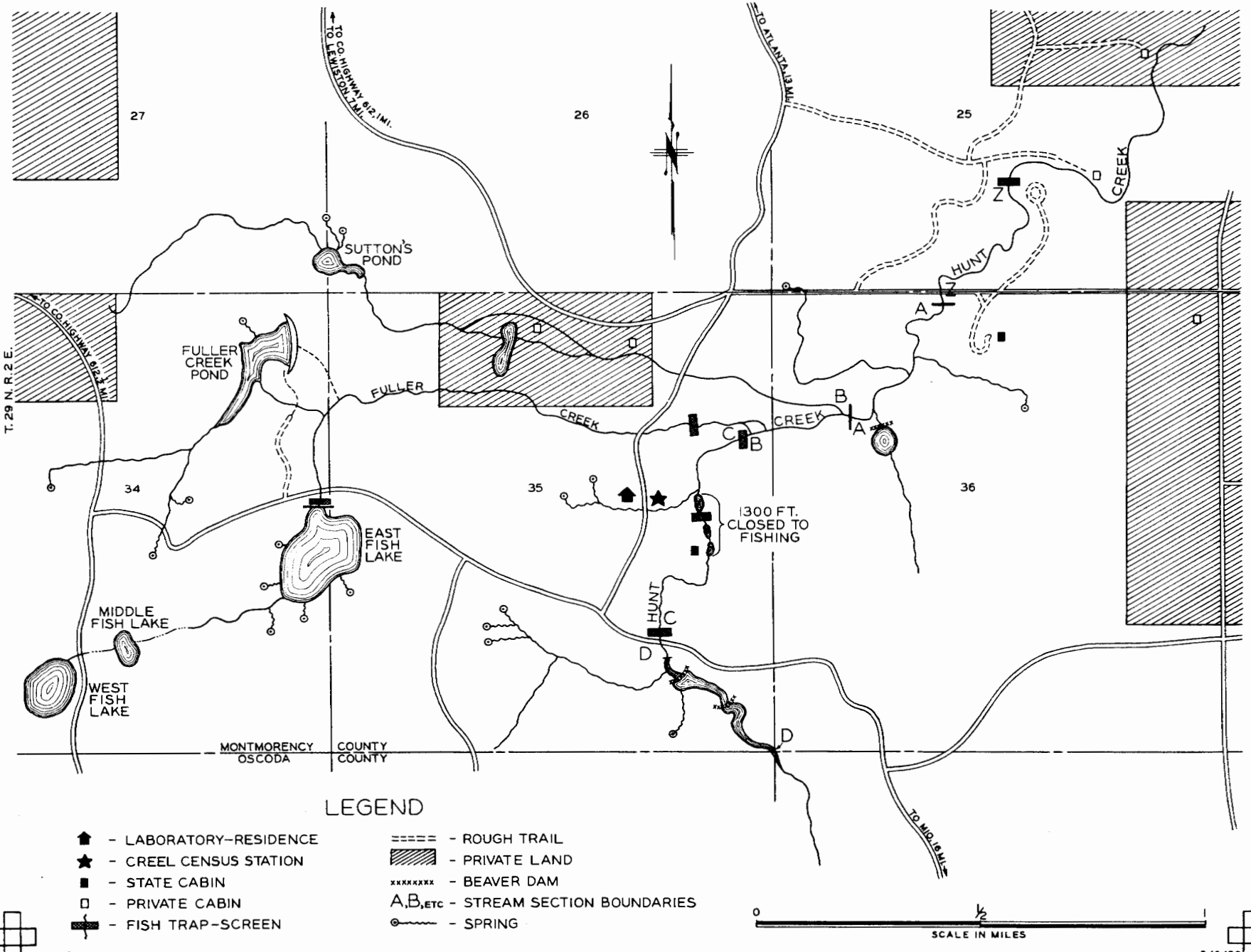

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Figure 1

HUNT CREEK FISHERIES EXPERIMENTAL AREA

OBJECTIVE -- The Hunt Creek Fisheries Experiment Station was established in 1939 as a year-round testing ground and outdoor research laboratory where trained biologists might study brook trout and the effects of angling on a typical brook trout stream. The Hunt Creek drainage was chosen because of availability of state-owned stream frontage and also because of the variety of brook trout habitats present in the area.

State ownership has made possible various experimental restrictions and management procedures not otherwise feasible.

The purpose of the investigations is to find out by observation or by controlled experiments what methods of stream management will increase the quality of the brook trout angling and also preserve the species for the enjoyment of future anglers.

THE ANGLERS' PART IN OUR RESEARCH -- The best measure of an experimental procedure in trout stream management is how it affects the anglers' catch. Therefore, registration of anglers and collection of creel census records constitute an important part of the work each year. Such records provide a measure of the effects of changes in size and creel limits, and, in connection with marking experiments and year-round population estimates, reveal origin and movements of trout within the system. Creel census records compared with population estimates correspond to sales records compared with production schedules in industry.

RESEARCH HERE DURING THE LAST TEN YEARS -- has indicated that:

(1) Natural reproduction is more than adequate in Hunt Creek;
(2) Fall plantings of hatchery-reared brook trout fingerlings contribute less than 3% to the anglers' catches in subsequent years;
(3) Stream improvement, properly carried out, can improve the quality of angling.
(4) Tributary streams are not an important source of adult fish for main stream angling;
(5) In the proper type of lake good brook trout fishing can be created by the elimination of rough fish populations.

Some of the other accomplishments of the station include detailed food studies of the brook trout by Dr. J. W. Leonard, who also identified new species of trout stream insects not previously described; an exhaustive study of the use of brook trout scales in age and growth studies of Michigan brook trout by Dr. E. L. Cooper; and the development by the past and present staff of the electric shocker as a substitute for seines in trout population investigations.

CURRENT INVESTIGATIONS -- include further study of brook trout movements in the main stream through the use of the recently-installed upper and lower screens, detailed year-round population studies on the brook trout population between these traps, trout lake and beaver pond population studies by means of netting, marking and recovery, and investigations of the effect of beaver dams on the fishing in dammed portions of trout streams.

REGULATIONS -- Except for about 1,300 feet of stream in Section C of Hunt Creek, all the waters on the map on the reverse of this sheet are open to angling. The posted waters, marked by Departmental signs, are open to angling under the following restrictions set by the Conservation Commission:

(1) Each angler must first obtain at the checking station a daily free-use permit before fishing.
(2) Each angler must report the results of his fishing at the checking station on conclusion of his angling.
(3) Special regulations are to be observed in certain waters and such waters will be posted with appropriate signs. Otherwise the usual regulations for other waters of the state are in effect on the Hunt Creek Area.

SUMMARY, ANGLING STATISTICS, EXPERIMENTAL SECTIONS, HUNT CREEK, 1939-1949

	YEAR										
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949
TOTAL ANGLER-DAYS.....	438	505	1,015	800	311	340	375	753	607	504	593
TOTAL HOURS FISHED.....	780	901	1,546	1,267	540	640	637	1,206	872	869	1,415
LEGAL BROOK TROUT TAKEN.	492	406	722	543	378	364	315	439	187	492	698
TOTAL POUNDS REMOVED....	67	60	116	83	59	53	52	68	26	78	115
CATCH PER HOUR.....	0.63	0.45	0.47	0.43	0.70	0.57	0.49	0.36	0.21	0.57	0.49
AVERAGE TOTAL LENGTH....	7.5	7.6	7.7	7.6	7.5	7.7	7.9	7.7	7.6	7.7	7.8

SUMMARY, ANGLING STATISTICS, EAST FISH LAKE, 1939-1949

	YEAR										
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949
TOTAL ANGLER-DAYS.....	63	111	155	159	121	311	436	430	344	287	283
TOTAL HOURS FISHED.....	126	308	386	289	200	651	928	935	711	853	1,024
LEGAL BROOK TROUT TAKEN.	51	172	242	367	69	108	169	93	89	117	91
TOTAL POUNDS REMOVED....	--	28	47	97	26	79	131	69	54	55	70
CATCH PER HOUR.....	0.41	0.56	0.63	1.26	0.29	0.17	0.18	0.10	0.13	0.14	0.09
AVERAGE TOTAL LENGTH....	--	8.0	8.5	9.0	9.3	11.2	11.9	11.5	11.1	10.4	11.6

Table 1. --Morphometry of experimental stream sections of the Hunt Creek Trout Research Station

Stream section	Length (feet)	Average width (feet)	Area (acres)
Z	2,397	20.3	1.12
A	2,577	24.3	1.44
B	1,605	17.5	0.64
C	2,700	11.8	0.71
D	2,896	50.0	3.11

Sections Z and A (hereafter referred to as ZA) are in open meadow country with little tree cover; ZA is 4,974 feet long and its area is 2.56 acres. Sections B and C (hereafter referred to as BC) have considerable cover of second-growth trees and shrubs; BC is 4,305 feet long and the area is 1.35 acres.

All anglers on the posted waters of Hunt Creek apply for a permit at the centrally located office. On conclusion of their fishing, they report back to a clerk, who is on duty daily throughout the trout season from 5 or 6 A. M. until the last angler departs in the evening. This operation provides a complete record of angling and catch.

Fish moving upstream and downstream are captured and recorded, in traps at bulkheads at the downstream end of Section Z and at the boundary between Sections C and D (Fig. 1). Since 1949, annual fall population estimates have been made on trout in the entire stream between the two bulkheads (for methods, see Shetter, 1957).

Acknowledgments

The authors wish to acknowledge the aid received from numerous former and present staff members of the Hunt Creek Trout Research Station in collecting creel census and weir records, and in conducting the population studies. The editorial assistance of Gerald P. Cooper and Paul H. Eschmeyer is acknowledged. The figures were drafted by Paul M. Earl.

Experimental plan

The question to be answered is "Will a flies-only regulation result in a higher catch of legal trout, more fishing, and/or an increase in the trout population?" One would presume that the elimination of hooking mortality of sublegal trout which is caused by worm fishing should result in a larger population of sublegal trout and an increase in the anglers' catch of fish of legal size. To test this, a flies-only restriction (by Commission order) was put into effect on Section 2A of Hunt Creek during 1955 to 1959. The minimum size limit remained at 7 inches and the daily creel limit at 10 fish, identical to the size and creel limits in the remainder of Hunt Creek and in other Michigan trout streams.[1] Thus only one regulation (type of lure) was changed in Section 2A. Angling rules were left unchanged in the adjacent upstream experimental section (BC) to serve as an experimental control.

Angling results and annual population data (Tables 8 and 9) have been compiled for 2A and BC for the 6 years (1949-1954) prior to the flies-only order and for the 5 years (1955-1959) while the order was in effect. The two experimental periods are hereafter designated simply as "before" and "after." Annual statistics for the 6-year and 5-year periods were compared by the "Student" t test, and for most fishery values the "before" and "after" means of the annual ratios of 2A to BC

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[1] In 1952, the creel limit on Michigan trout streams was reduced from 15 to 10 trout per day.

were tested statistically. By testing the ΣA/BC ratio means, BC is a "control" for factors other than lure that might cause changes in angling or trout populations.

Possible factors which might cause misinterpretation of creel records and population data

Before presenting angling and population records, we recognize that there are four factors which might complicate the interpretation of the data, which are: changes in rate of growth between the two time periods; significant movement of fish in one direction between the control and experimental sections, either before or after the establishment of the fly regulation; significant movement of fish out of both the experimental and control water before or after the change in regulation; and the presence of hatchery brook trout and rainbow trout during 8 of the 11 years under consideration.

The growth rate of trout was investigated to see if this factor might account for the increases in anglers' catch and fall population. Table 2 summarizes, for brook trout in the 0, I, and II age groups, the average total length in inches and the ΣA/BC ratio of length for each fall of 1949-1959, and the means and standard errors for the before and after periods. The trout were collected for scale sampling by electric shocker, during fall population studies after the close of the fishing season, usually in September.

Table 2. --Average total length in inches, and ΣA/BC ratio, for brook trout, age groups 0, I, and II, in the experimental sections of Hunt Creek, each fall, 1949-1959

Year	Age group 0			Age group I			Age group II		
	ΣA	BC	ΣA/BC	ΣA	BC	ΣA/BC	ΣA	BC	ΣA/BC
1949	3.33	3.04	1.10	5.16	4.90	1.05	6.78	6.80	1.00
1950	3.41	2.99	1.14	5.28	5.02	1.05	6.72	7.05	0.95
1951	3.26	3.02	1.08	5.20	5.06	1.03	6.76	6.96	0.97
1952	3.27	2.97	1.10	5.09	5.04	1.01	6.89	6.87	1.00
1953	3.27	3.14	1.04	4.89	4.87	1.00	6.75	6.63	1.02
1954	3.27	3.02	1.08	5.01	5.00	1.00	6.64	6.73	0.99
Mean	3.30	3.03	1.09	5.11	4.98	1.02	6.76	6.84	0.99
Std. error	0.02	0.05	0.01	0.06	0.03	0.01	0.03	0.06	0.01
1955	3.41	3.16	1.08	5.21	5.17	1.01	6.92	6.83	1.01
1956	3.13	2.99	1.05	5.32	5.26	1.01	7.26	6.85	1.06
1957	3.13	3.13	1.00	4.99	5.15	0.97	6.98	6.82	1.02
1958	3.37	3.04	1.11	5.16	5.10	1.01	6.75	6.83	0.99
1959	3.48	3.11	1.12	5.47	5.19	1.05	7.30	7.17	1.02
Mean	3.30	3.09	1.07	5.23	5.17	1.01	7.04**	6.90	1.02
Std. error	0.07	0.04	0.02	0.08	0.03	0.01	0.07	0.07	0.01

** Indicates difference between the 1949-1954 mean and the 1955-1959 mean significant beyond the 1 percent level.

Within BC, no change in average length of the various age groups was found. There was no change in average total length of 0's or I's in ZA, but there was a significant increase in average size of age-group II in ZA. It seems probable that this increase in size of age-II trout in ZA was due to a decrease in rate of exploitation, rather than to an increase in rate of growth; in other words, fewer of the larger trout of age-group II in ZA were removed by anglers (thus more were left in the fall) with the decreased fishing pressure in ZA during 1955-1959, as will be shown later.

A summary of trout movement between ZA and BC is presented in Table 3. Of 480 legal-size trout tagged in ZA during 1945-1953, 93.6 percent of the recoveries were taken by angling and/or shocker in ZA and 5.2 percent were from BC. Of 2,102 trout fin-clipped in ZA during the fall of 1956, 84.6 percent of the recoveries were from ZA and 9.7 percent from BC. Of 1,543 fingerling brook trout fin-clipped in ZA during the fall of 1956, recoveries one year later, during a population study, were 93.3 percent from ZA and 6.7 percent from BC. Likewise, of the trout marked and liberated in BC, most recoveries were from BC and few were from ZA (Table 3). From these studies of marked fish, it is concluded that there was relatively little movement of trout between ZA and BC during the 1949-1959 period, and furthermore the exchange between the two sections was approximately equal.

Even though there was little movement of trout between ZA and BC, there was a significant amount of migration into, and out of ZA at the lower end of Section Z (through the Section Z bulkhead), and there was

Table 3. --Marking and recovery of native brook trout in Hunt Creek experimental waters, 1945-1959

Sections	Year of marking	Trout		Total recoveries	Recovery percentage, by section		
		Length (inches)	Number marked		ZA	BC	Other
ZA	1945-53	7.0+	480	251	93.6	5.2	1.2
BC	1945-53	7.0+	381	205	8.8	83.9	7.3
ZA	1956	1.9-9.9	2,102	227	84.6	9.7	5.7
BC	1956	1.9-9.9	2,088	217	7.8	76.5	15.7
ZA	1958	1.9-3.9	1,543	637[1]	93.3	6.7	...
BC	1958	1.9-3.9	1,476	576[1]	8.9	91.1	...

[1] Estimated survivors, fall population study, 1959.

migration into, and out of BC at the upper end of Section C (through the Section D bulkhead). The extent of this migration is taken into account, in the present appraisal of the effects of the flies-only regulation.

At both the Z and D bulkheads (Fig. 1) downstream migrants were captured in traps of a type described by Wolf (1951). Also, at the Z bulkhead, migrants in both directions were caught in another type of trap, described by Whalls, Proshek and Shetter (1955). At the D bulkhead, upstream migrants were taken in a conventional V-notch vertical-screen trap. These devices function efficiently except during the relatively short periods of subzero weather when anchor ice will form and cause over-topping of screens. The numbers of live, wild, sublegal and legal brook trout passing up or down through the Z and D bulkhead traps, and the period means and standard errors, are shown in Table 4 for each year from September 21, 1949 to September 28, 1958.

The average number per year of sublegal trout that moved downstream through the Z bulkhead, before and after the regulation change, did not show a significant change (Table 4). Downstream movement of legal-size trout from ZA increased from an average of 64 to 106 per year, a statistically significant increase consistent with the build-up in the fall trout populations of trout in ZA. At the Section D bulkhead, downstream migration of both sublegal and legal trout into BC was about the same during the before and after periods.

At the Z bulkhead, upstream movement of sublegal trout (into ZA) increased about 25 percent after the change in regulation; but with large

Table 4. --Numbers of live wild brook trout moving through Z and D bulkhead fish traps, segregated by direction of movement and size of fish, for the period September 21, 1949-September 28, 1958

Time period[1]	Location of traps, direction of movement, and length classes of brook trout (in inches)							
	Z Bulkhead				D Bulkhead			
	Upstream		Downstream		Upstream		Downstream	
	0-6.9	7.0+	0-6.9	7.0+	0-6.9	7.0+	0-6.9	7.0+
9/21/49-9/17/50	67	18	652	26	171	21	179	71
9/18/50-9/23/51	79	13	1,114	70	257	13	595	16
9/24/51-9/14/52	28	12	1,077	69	333	24	928	63
9/15/52-9/21/53	48	25	1,636	59	227	27	475	51
9/22/53-9/13/54	308	157	1,480	95	196	17	853	22
Mean	106	45	1,192	64	237	20	606	45
Standard error	51	28	172	11	28	2	135	11
9/14/54-9/18/55	344	186	1,808	125	305	22	945	28
9/19/55-9/9/56	126	135	978	96	324	38	638	56
9/10/56-9/22/57	38	84	1,307	123	502	24	549	36
9/23/57-9/28/58	11	21	1,950	79	649	17	416	40
Mean	130	107	1,511	106*	445*	25	637	40
Standard error	76	35	225	11	81	5	199	6
9yr tot mean	1049 116.55	651 72.33	12,002 1333.55	742 82.44	2964 329.33	203 22.55	5578 619.77	383 42.55

[1] From September 1949 to September 1958, fish taken in traps were passed over the barriers in the direction of their movement; after September 1958, such fish were liberated into the section of stream from which they had entered the trap.

* Indicates differences between the mean values for 1950-1954 and 1955-1958 significant at the 5 percent level.

annual variations, the difference is not statistically significant. Upstream movement of legal trout at Z increased by 138 percent, but the difference is not statistically significant because of annual variations. Upstream movement of sub-legal trout at the D bulkhead (out of BC) increased about 88 percent; but upstream movement of legal trout remained about the same (Table 4).

It is assumed that the net gain or loss of trout moving through the Z bulkhead would have an effect mostly on the population in ZA (rather than BC), and that movement through the D bulkhead would affect mostly the population in BC. This assumption is based on the evidence, cited above, of little movement between ZA and BC. The data in Table 4 provide an opportunity to calculate net gains or losses, resulting from migration, of legal and sublegal trout in ZA and BC for the years 1950-1958. The implied assumption, that all of the trout which moved into or out of ZA and BC during a given year would still be present at the end of the year (when the fall population estimate was made), is not tenable. Alexander (unpublished) has found that annual mortality ranged from 50 to 80 percent among different age groups of brook trout in Hunt Creek. Thus the net gains or losses used here are presumably maximal figures.

In Table 5 we compute figures on "net production" of legal-size brook trout by summing the annual anglers' catch, the fall population of legal-size fish, and the net gain or loss of fish at the Z and D bulkheads, for the periods 1950-1954 and 1955-1959. A full year's data on migration was not available for 1949; trout moving after September 28, 1958 were returned to the stream in the direction of origin, so there was no gain or loss resulting from migration during 1959 (Table 5). The

Table 5. --"Net production" of legal-size brook trout, Sections ZA and BC, Hunt Creek, for the years 1950-1954 and 1955-1959

Year	Section ZA				Section BC				ZA/BC ratio
	Catch	Fall population	Loss or gain at Z weir	Net production	Catch	Fall population	Loss or gain at D weir	Net production	
1950	259	158	+8	425	69	70	-50	89	4.78
1951	196	112	+57	365	128	57	-3	182	2.01
1952	353	119	+57	529	162	49	-39	172	3.08
1953	309	77	+34	420	109	35	-24	120	3.50
1954	293	87	-62	318	134	36	-5	165	1.93
Mean				411				146	3.06
Std. error				35				18	0.53
1955	357	193	-61	489	199	74	-6	267	1.83
1956	371	267	-39	599	296	59	-22	333	1.80
1957	282	135	+39	456	200	66	-12	254	1.80
1958	192	149	+58	399	226	74	-23	277	1.44
1959	241	540	0	781	225	130	0	355	2.20
Mean				545				297**	1.81*
Std. error				64				20	0.12

* Indicates differences between mean values for 1950-1954 and 1955-1958 significant at the 5 percent level.

** Indicates differences between mean values for 1950-1954 and 1955-1958 significant at the 1 percent level.

method used here of computing "net production" is admittedly rather crude in terms of vital statistics. An obvious source of error is the assumption that all trout which, during the course of a year, migrated into a section would live during the balance of the year. However, the same assumption is implied when the anglers' catch for the year is added to the fall population. In spite of these problems, we believe that the figures on "net production" are reliable in indicating major differences in trout production.

Average annual net production increased in both ZA and BC. The increase in ZA was not statistically significant because of annual variations, but the increase was statistically significant in BC. The decrease in ZA/BC ratio was statistically significant, reflecting the relatively greater increase in BC than in ZA (Table 5). In other words, BC improved more than ZA in trout production after 1954. These same statistical comparisons, when made on production figures that are "uncorrected" for migration, lead to identical conclusions (see below, and Table 9).

Figures on "net production" of sublegal brook trout (obtained by summing the fall population estimates and the gains or losses through the bulkhead weirs) are given in Table 6. There was a slight decrease in net production of sublegal trout in ZA, and a moderate increase in BC during 1955-1959 as compared to 1950-1954, but the differences were not statistically significant. Nor was there found a statistically significant difference between the average ZA/BC ratios for the two time periods. We arrive at the same conclusions (see below, and Table 9) when we analyze the fall population data for sublegal trout, uncorrected for migration.

Table 6. --"Net production" of sublegal brook trout, Sections ZA and BC, Hunt Creek, for the years 1950-1954 and 1955-1959

Year	ZA			BC			ZA/BC ratio
	Fall population	Migrants at Z weir	Corrected population	Fall population	Migrants at D weir	Corrected population	
1950	3,676	+585	4,261	2,582	-8	2,574	1.66
1951	3,150	+1,035	4,185	3,055	-338	2,717	1.54
1952	3,602	+1,049	4,651	3,235	-595	2,640	1.76
1953	4,598	+1,588	6,186	2,462	-248	2,214	2.79
1954	4,784	+1,172	5,956	3,735	-657	3,078	1.94
Mean			5,048			2,645	1.94
Std. error			427			138	0.22
1955	3,839	+1,464	5,303	2,785	-640	2,145	2.47
1956	3,307	+852	4,159	3,215	-314	2,901	1.43
1957	4,542	+1,269	5,793	3,889	-47	3,842	1.51
1958	4,264	+1,939	6,203	3,645	+233	3,878	1.60
1959	3,513	0	3,513	3,003		3,003	1.17
Mean			4,994			3,154	1.64
Std. error			504			324	0.22

Some hatchery-reared brook and rainbow trout (marked for identification) were planted in Hunt Creek during 1949-1955, but they were equally divided between ZA and BC. Also, natural reproduction of planted rainbow trout produced a few fish in the creel. The creel returns on wild brook trout and on hatchery trout are given separately in Table 7. For all trout (i. e., wild and hatchery combined), creel returns in ZA did not increase with the inception of the fly order, whereas creel returns increased significantly in BC (both actual catch and ZA/BC ratio). Since, as will be shown later, the results for the analysis of the catch of wild fish only were exactly the same, it is concluded that the presence of hatchery trout did not interfere with the appraisal of the effects of the flies-only regulation.

In the above, we have reviewed the four factors which could have produced complications in the interpretation of creel census and fall population data, namely: changes in rate of growth, movement of trout between ZA and BC, movement of trout into or out of ZA and BC at the Z and D bulkheads, and presence of hatchery trout. We conclude that growth rate and movement of trout between sections were not significant factors, and that appropriate recognition of migrations at the Z and D bulkheads and of the presence of hatchery trout does not alter the conclusions. In the following pages we consider angler returns and fall population data for wild brook trout only.

Table 7.--An analysis of the total catch of legal trout (wild brook trout, plus hatchery-reared brook trout, plus hatchery-reared rainbow trout and their progeny) for Sections 2A and BC, Hunt Creek, 1949-1959

Year	Trout catch-2A			Trout catch-BC			2A/BC ratio
	Wild	Hatchery	Total	Wild	Hatchery	Total	
1949	259	...	259	102	...	102	2.54
1950	259	...	259	69	...	69	3.75
1951	196	11	207	128	14	142	1.46
1952	353	...	353	162	...	162	2.18
1953	309	241	550	109	131	240	2.29
1954	293	277	570	134	145	279	2.04
Mean			366			166	2.38
Std. error			64			32	0.32
1955	357	135	492	199	118	317	1.55
1956	371	75	446	296	26	322	1.39
1957	282	12	294	200	22	222	1.32
1958	192	10	202	226	7	233	0.87
1959	241	1	242	225	5	230	1.05
Mean			335			265*	1.24**
Std. error			57			22	0.12

* Indicates differences between mean values for 1950-1954 and 1955-1958 significant at the 5 percent level.

** Indicates differences between mean values for 1950-1954 and 1955-1958 significant at the 1 percent level.

Creel returns and fall populations of wild brook trout

Angling statistics are given in Table 8 and Figures 2 and 3; population statistics are given in Table 9 and Figure 4.

After the flies-only order went into effect, angling trips and hours declined in ZA, and increased significantly in BC. Obviously, many anglers chose to change their fishing sites rather than lures.

Figures on angling quality (i. e., trout per hour) in Table 8 were derived by dividing the total number of legal trout creeled by the total number of hours of angling for the year. Angling quality in ZA increased significantly in the after versus before period; but it also increased slightly in BC, with the result that the increase in the ZA/BC ratio, although substantial, was not significant at the 95 percent confidence level. The increase in quality in ZA was enough so that a reduced number of fishermen caught a slightly larger number of trout per year.

Whereas the number and weight of trout creeled in ZA was approximately equal during the "before" and "after" periods, the number and weight of trout creeled in BC increased significantly during the "after" period (1955-1959). The increased catch in BC can be attributed to a combination of greater fishing pressure and a larger population of legal-size trout.

Information on sublegal trout caught and returned to the water is available for only two years prior to, and for five years after, the establishment of the flies-only restriction (Table 8). Analysis of

Table 8. --An analysis[1] of creel census statistics for wild brook trout in experimental sections of Hunt Creek, 1949-1959

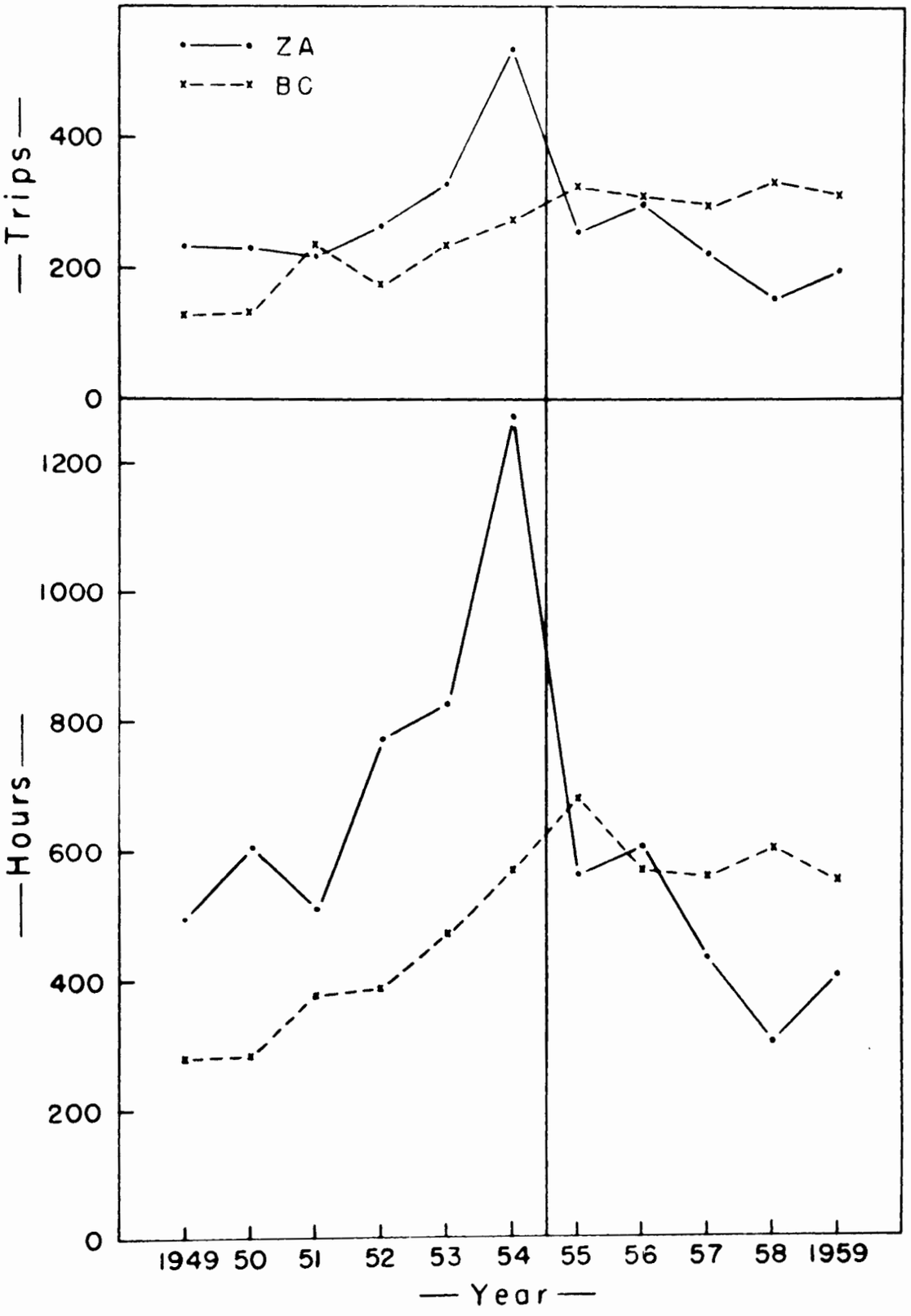
[A "flies-only" regulation was in effect on Section 2A during 1955-1959]

Year	Angling trips			Angling hours			Catch, trout per hour		
	2A	BC	2A/BC	2A	BC	2A/BC	2A	BC	2A/BC
1949	229	124	1.85	495	278	1.78	0.52	0.37	1.41
1950	226	125	1.81	605	285	2.12	0.42	0.24	1.75
1951	216	232	0.93	510	378	1.35	0.38	0.34	1.12
1952	261	174	1.50	775	387	2.00	0.46	0.42	1.10
1953	326	238	1.37	827	477	1.73	0.37	0.23	1.61
1954	535	277	1.93	1,276	572	2.23	0.23	0.23	1.00
Mean	299	195	1.56	748	396	1.97	0.40	0.30	1.33
Std. error	50	26	0.16	119	46	0.13	0.04	0.03	0.13
1955	254	320	0.79	562	689	0.82	0.64	0.29	2.21
1956	293	305	0.96	602	569	1.06	0.62	0.52	1.19
1957	220	298	0.74	436	560	0.78	0.65	0.36	1.81
1958	154	331	0.47	300	604	0.50	0.64	0.37	1.73
1959	193	310	0.62	405	558	0.73	0.60	0.40	1.50
Mean	223	313**	0.72**	461	596**	0.78**	0.63**	0.39	1.69
Std. error	24	6	0.08	55	25	0.09	0.01	0.04	0.17

Year	Legal-size trout in creel						Sublegal trout per trip		
	Number			Weight in pounds					
	2A	BC	2A/BC	2A	BC	2A/BC	2A	BC	2A/BC
1949	259	102	**2.54**	38.8	16.0	2.43	...	...	...
1950	259	69	3.75	35.1	10.4	3.38	...	...	...
1951	196	128	1.53	28.9	21.7	1.33	...	...	...
1952	353	162	2.18	53.6	24.5	2.19	...	...	...
1953	309	109	2.83	45.1	17.3	2.61	6.9	5.6	1.23
1954	293	134	2.19	43.5	20.7	2.10	5.9	5.2	1.13
Mean	278	117	2.49	40.8	18.4	2.34	6.4	5.4	1.18
Std. error	22	13	0.30	3.5	2.0	0.26	0.5	0.2	0.05
1955	357	199	1.79	53.3	32.2	1.66	8.3	6.2	1.34
1956	371	296	1.25	62.1	47.8	1.30	4.4	5.5	0.80
1957	282	200	1.41	49.0	33.0	1.48	5.4	4.4	1.23
1958	192	226	0.85	27.9	34.3	0.81	9.2	6.2	1.48
1959	241	225	1.07	34.6	35.9	0.96	9.7	6.9	1.41
Mean	289	229**	1.28**	45.4	36.6**	1.24**	7.4	5.8	1.25
Std. error	34	17	0.16	6.2	2.9	0.16	1.1	0.4	0.12

[1] The means for years before and after the flies-only regulation went into effect are compared by the t test. Where a difference is statistically significant, the mean for 1955-59 is marked by one (95% confidence level) or two (99%) asterisks.

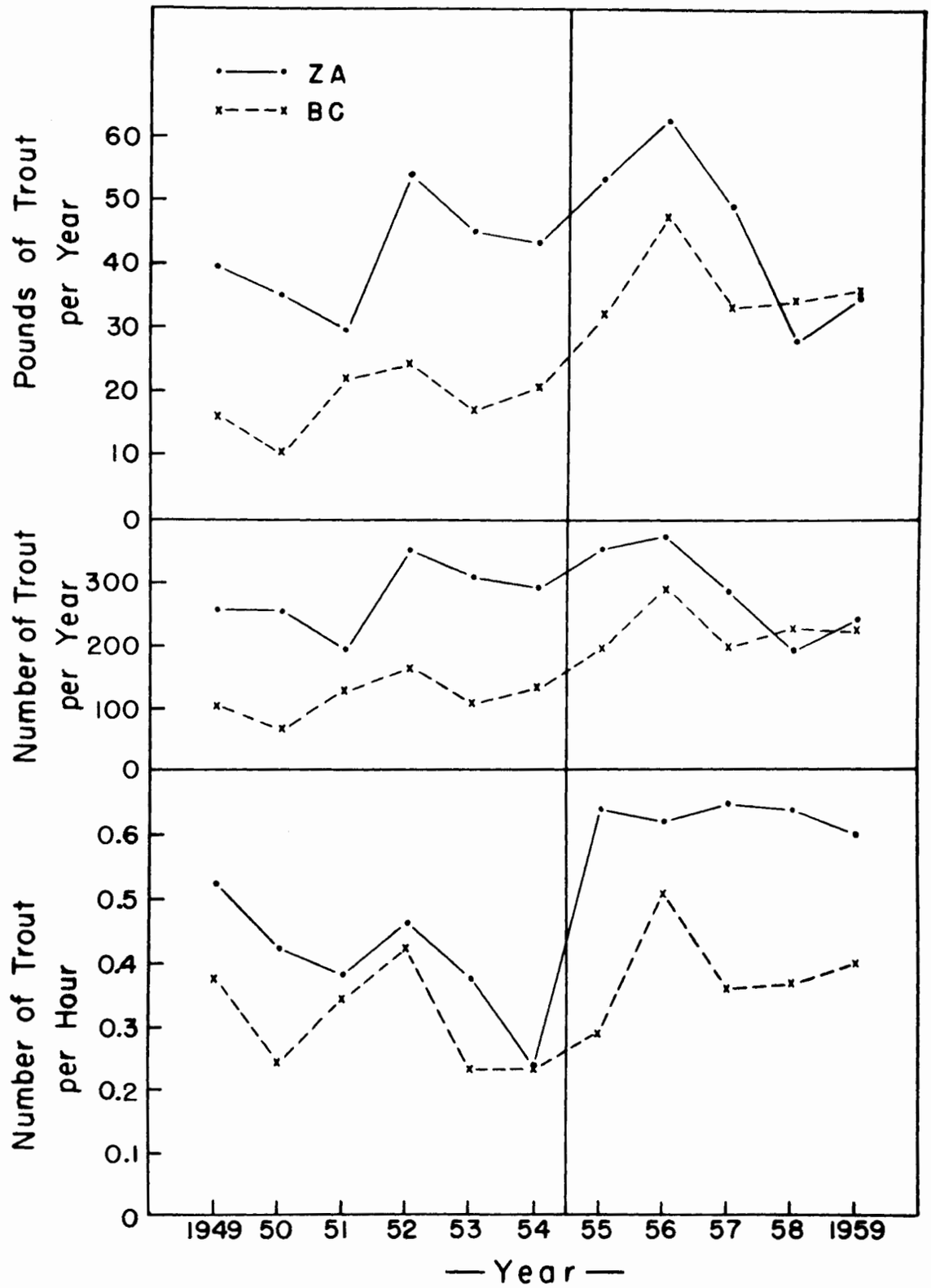
Figure 2. --Number of angling trips and hours on Sections 2A and BC of Hunt Creek, 1949-1959.



Total angling hours and fishing trips, Sections ZA and BC, by year, 1949-1959

Figure 2

Figure 3. --Pounds and numbers of legal brook trout creeled, and catch per hour, Sections 2A and BC, Hunt Creek, 1949-1959.



Angler catch of trout per hour, and per year, Sections ZA and BC, 1949-1959

Figure 3

these limited data suggests that the number of sublegal trout released did not change significantly.

The comparisons involving fall populations and accountable production (fall population of legal trout plus total creeled that season) are given in Table 9 and Figure 4.

Numbers of legal trout remaining in the stream in the fall, at the end of each fishing season, increased by over 100 percent in ZA and by somewhat less than 100 percent in BC. However, because of greater variability, the increase in ZA was not statistically significant (at the 95% level), whereas the increase in BC was statistically significant. There was an actual increase in the mean of ZA/BC ratios, but, with the large annual variability, it was not statistically significant. Some relative increase in the fall population in ZA would be expected, because anglers in BC harvested relatively more legal trout during 1955-1959.

Populations of sublegal trout in the fall were relatively constant in both ZA and BC, and no significant differences could be demonstrated between the mean ZA/BC ratios for the two time periods (Table 9).

The accountable production increased by 40 percent in ZA and by 90 percent in BC during the study. The increase within BC was statistically significant at the 99 percent level, but the increase in ZA was not statistically significant. The ZA/BC ratio test indicated that BC improved significantly more than ZA, and this was due primarily to the great increase in catch from BC during 1955-1959.

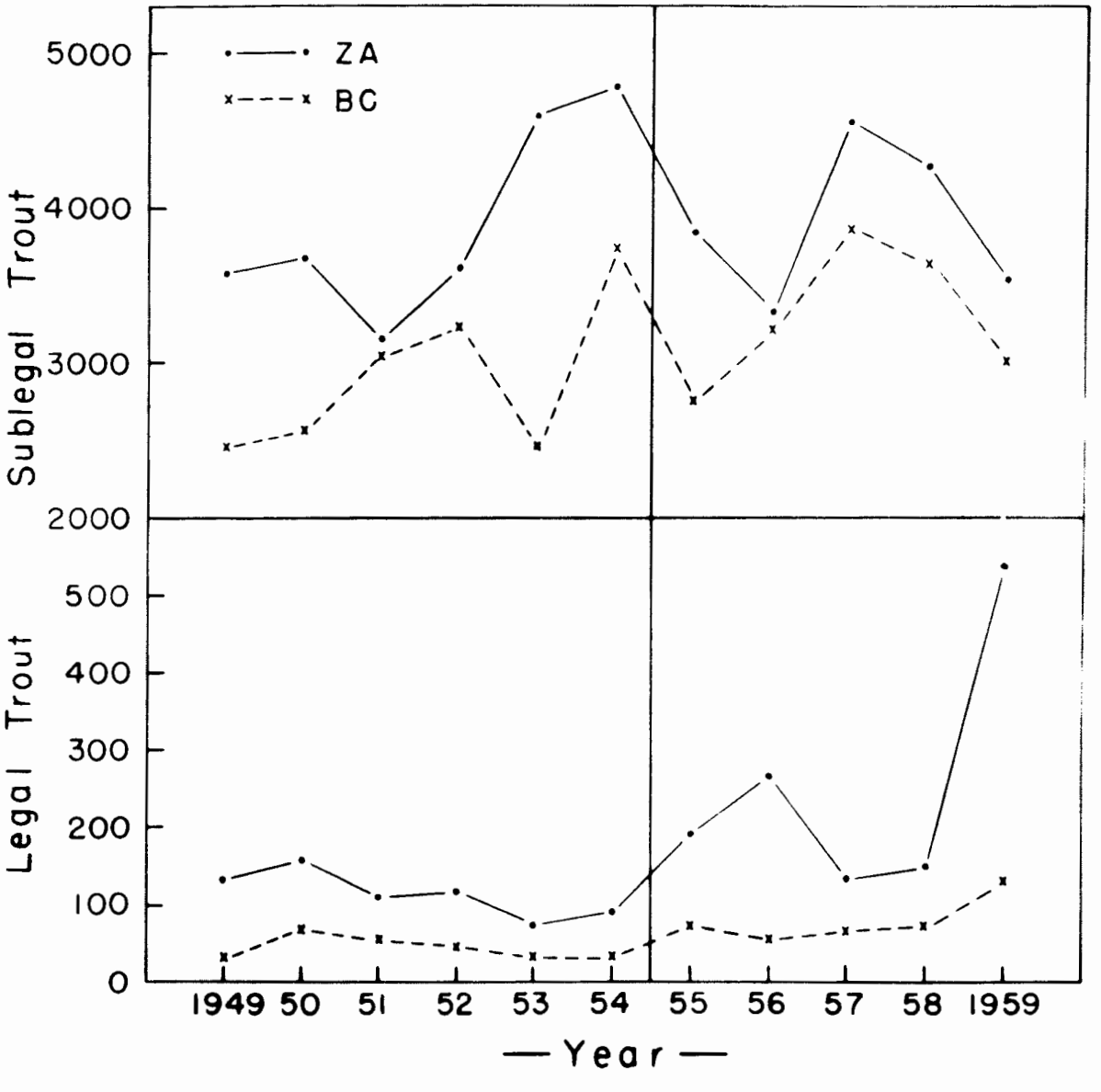
The increased numbers of wild legal brook trout caught in BC, and the larger fall populations of legal brook trout (in both ZA and BC)

Table 9. --An analysis[1] of fall population data, and "production" (fall population plus anglers' catch) for wild brook trout in experimental sections of Hunt Creek, 1949-1959

Year	Fall population						Legal-size trout in anglers' creel plus fall population		
	Legal-size			Sublegal size					
	ZA	BC	ZA/BC	ZA	BC	ZA/BC	ZA	BC	ZA/BC
1949	136	34	4.00	3,569	2,477	1.44	395	136	2.90
1950	158	70	2.26	3,676	2,582	1.42	412	139	2.96
1951	112	57	1.96	3,150	3,055	1.03	308	185	1.66
1952	119	49	2.43	3,602	3,235	1.11	472	211	2.24
1953	77	35	2.20	4,598	2,462	1.87	386	144	2.68
1954	87	36	2.42	4,784	3,735	1.28	380	170	2.24
Mean	115	47	2.54	3,897	2,924	1.36	392	164	2.45
Std. error	12	6	0.30	263	208	0.12	22	12	0.20
1955	193	74	2.61	3,839	2,785	1.38	550	273	2.01
1956	267	59	4.53	3,307	3,215	1.03	638	354	1.80
1957	135	66	2.05	4,542	3,889	1.17	417	266	1.57
1958	149	74	2.01	4,264	3,645	1.17	541	301	1.13
1959	540	130	4.15	3,513	3,003	1.17	781	355	2.20
Mean	257	81*	3.07	3,893	3,307	1.18	545	310**	1.74*
Std. error	74	13	0.53	229	203	0.06	78	19	0.19

[1] The means for years before and after the flies-only regulation went into effect are compared by the t test. Where a difference is statistically significant, the mean for 1955-59 is marked by one (95% confidence level) or two (99%) asterisks.

Figure 4. --Fall populations of sublegal and legal brook trout in Sections 2A and BC of Hunt Creek, 1949-1959.



Fall populations of sublegal and legal-size trout, Sections ZA and BC, 1949-1959

Figure 4

during 1955-1959 cannot be attributed to changes in the rate of growth, movement, or the presence of hatchery-reared trout; the increases noted apparently were the result of increased survival of fish in age-group II (third growing season) and older age groups. The biological reasons for this increased survival are not presently demonstrable; however, the fact that the increases occurred simultaneously in ZA and BC rules out the flies-only regulation as the primary factor contributing to the increases. Also, the fact that no changes of any consequence were noted in the populations of sublegal trout in ZA and BC for the before and after periods indicates that the flies-only order was of little or no consequence in increasing survival of small brook trout in Hunt Creek.

Summary

1. The flies-only regulation reduced angling pressure in ZA during the 1955-1959 period. The decrease was both actual (38 percent) and relative to BC; in the latter test (ZA/BC ratio) it was statistically significant.

2. The anglers' catch increased very slightly in ZA, but considerably in BC, and the relatively greater catch in BC was statistically significant.

3. Average angling quality (measured by simple catch per hour) improved considerably in the fly water, and also slightly in the any-lure water, during the period of the fly regulation.

4. The pounds of wild brook trout creeled increased significantly in the any-lure water but not in the flies-only water.

5. There was little difference in numbers of sublegal brook trout returned to the water by anglers on the fly water and any-lure water.

6. The fall populations of legal brook trout increased in both waters during 1955-1959, but the increase was statistically significant only for the any-lure water.

7. The fall population of sublegal brook trout did not increase as a result of the fly order.

8. Total accountable production (anglers' catch plus fall population of legal brook trout) increased proportionately more in the any-lure water.

9. Analysis of weir records and marking studies provided evidence that movement between sections or out of the test sections did not complicate the appraisal of the effects of the flies-only order.

10. The presence of several hundred hatchery-reared fish did not complicate the appraisal of the effects of the flies-only order.

11. Rates of growth were studied for age-groups 0, I and II in ZA and BC during the "before" and "after" periods; changes in catch and fall population could not be attributed to changes in rate of growth.

12. Increases in anglers' catch and fall population in ZA and BC during 1955-1959 are attributed to increased survival of age-group-II and older fish, the biological reasons for which are unknown at present. The fact that the increases occurred simultaneously in both types of water rules out the fly regulation as the primary cause for the increase.

Literature cited

Shetter, David S.

1950. Results from plantings of marked fingerling brook trout (Salvelinus f. fontinalis Mitchill) in Hunt Creek, Montmorency County, Michigan. Trans. Am. Fish. Soc. 79: 77-93.

1957. Trout stream population study techniques employed in Michigan, p. 64-71. In Symposium on evaluation of fish populations in warm-water streams, Iowa Coop. Fish. Res. Unit, Iowa State College. Mimeo.

Shetter, David S., and Leonard N. Allison

1955. Comparison of mortality between fly-hooked and worm-hooked trout in Michigan streams. Mich. Dept. Cons., Inst. Fish. Res. Misc. Publ. 9: 44 p.

Whalls, Marvin J., Karl E. Proshek and David S. Shetter

1955. A new two-way fish trap for streams. The Progr. Fish-Cult. 17(3): 103-110.

Wolf, Philip

1951. A trap for the capture of fish and other organisms moving downstream. Trans. Am. Fish. Soc. 80: 41-45.

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