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VARIATION IN CONDITION OF ANGLER-CAUGHT BROOK TROUT FROM HUNT CREEK AND PIGEON RIVER, 1954 TROUT SEASON

By

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One of the implied duties of a fish or game biologist is to determine when a harvestable species is in prime condition. Within limits imposed by reproductive needs and economic considerations, he usually will recommend that the species not be harvested until most of them reach or approach prime condition.

Among fishes the coefficient of condition (called condition factor or condition index by some) measures the robustness of a fish. These index figures are useful in comparing the bodily well-being of fish of different sizes, or in comparing a series of fish taken from two different habitats, or the same habitat at different times.

Various combinations of length and weight measurement units result in several indices of condition (see Klak, 1941; Cooper and Benson, 1951). For reasons that have been discussed in detail elsewhere (Hile, 1948), the so-called English index C appears to be the most readily understood, and has been employed in the present study.

C is determined by the formula $C = \frac{W \times 10^5}{L^3}$, where C = coefficient of condition,

W = weight in pounds
L = length in inches.

For example, a 10-inch brook trout whose weight is 0.3 pound is in poorer condition than one whose weight is 0.4 pound. The C value for the first fish is 30; for the second fish, 40.

Cooper and Benson (1951) found a pronounced seasonal variation in condition of wild brook trout for the Pigeon River during 1949 and 1950. Cooper (1953) demonstrated the same phenomenon for wild brook trout of Hunt Creek, Pigeon River, and the North Branch of the Au Sable River through bimonthly and monthly sampling of the 0 and I age-groups. This limitation eliminated much possible bias that might have resulted from sampling fish old enough and large enough to be removed by angling during the course of the investigation. Most of the fish in Cooper's samples were smaller than the minimum legal size of 7 inches, total length. Further studies by Benson (1954) indicated that wild brook trout 6.8-12.9 inches underwent the previously described seasonal variation in condition. Also, he found that condition indices and rate of growth were highest and that the greatest volume of food was found in the stomachs of angler-caught brook trout when the stream temperatures ranged between 55° and 66° F.

Cooper's monthly tabulations of coefficients of condition for sublegal brook trout showed a rapid increase from an early spring low to almost the maximum, usually within the period April 15-May 15, in all three of the streams investigated. The present series of data was tabulated and examined to determine if this seasonal variation in condition also took place among angler-caught brook trout of sites other than the Pigeon River, particularly as regards the rapid increase during the early spring. If this were true for angler-caught fish, then a greater weight of brook trout might be available for angling by delaying the brook trout season opening date until the second Saturday in May.

The 1954 data were collected at the Pigeon River Trout Research Station, located on the middle reaches of the Pigeon River in Otsego County, and at the

Hunt Creek Fisheries Experiment Station, situated on the headwaters of the Hunt Creek drainage in south-central Montmorency County.

Prior to the 1954 trout season, instructions were given to all personnel as to the type of fish which were usable for this study, and for their indication among the records. Only fresh, moist, undamaged specimens were utilized. If the fish was dressed, bleeding, tail broken, or if creel-bent or dehydrated, such a specimen was not used in the tabulations. Lengths were measured on a hardwood ruler inset in a flat board. The zero end of the ruler abutted against a vertical board. The nose of the fish was placed flush with the vertical board, the mouth being kept closed. The tail lobes were slightly compressed to give the greatest possible total length, which was read to the nearest one-tenth inch. Weights were measured on a spring balance calibrated either in hundredths of a pound, or in 2-gram intervals.

Calculation of C values was expedited by the use of tables of reciprocal factors given in Carlander (1950). For those who may wish to convert C values in this study to K values (computed from standard length in millimeters and weight in grams), multiply by the factor 0.02768; to convert C values to R values (computed from total length measurements in inches and weights in grams), divide by the factor 22.038.

The individual C values were tabulated by weeks of the 1954 trout season for three different habitats or localities, and weekly average C indices were obtained. These three localities, and the numbers of specimens in each, were:

Pigeon River stream brook trout --- 1,380

Hunt Creek stream brook trout --- 380

Hunt Creek lake and pond brook trout --- 177

Results

For all sizes of fish combined, the average C values for the various weeks of the 1954 trout season are given in Table 1. The graph (Figure 1) shows the changes that occurred in the weekly average coefficients of condition from April 24 to September 12 in the three different sites. The average C values for all fish for the entire season in each of the three habitats were:

	Mean	Std. Error
Pigeon River stream brook trout.....	34.5±	0.103
Hunt Creek stream brook trout.....	33.3±	0.175
Hunt Creek lake and pond brook trout....	35.1±	0.397

The difference between the average C values for Pigeon River and Hunt Creek stream fish is statistically significant (P = 99.9+ percent). The difference between the average C values for the Hunt Creek stream trout and the Hunt Creek lake and pond trout also is significant (P = 99.9+ percent). The difference between the Pigeon River stream fish and the Hunt Creek lake and pond fish is not highly significant (P = 85.56 percent).

When the curves portrayed in Figure 1 are compared, it can be noted that the Hunt Creek stream fish were consistently lower in average C value than Pigeon River fish until the first week in August. After that time Hunt Creek stream fish were in approximately equal or better condition except for one week.

Lake and pond fish from Hunt Creek were in the poorest condition of any of the three habitats during the first week of the season. They appeared to gain in relative weight during the second week in contrast to the stream fish. The general trend of the curve suggests that they reach peak condition later in the season than the stream fish; also their average weekly C values were generally higher than those for stream fish in the same week. Analysis of the seasonal variation in condition among the lake and pond fish was complicated by lack of specimens in several of the weekly periods (Table 1).

The 1954 data were compared with the series of condition indices tabulated by Cooper from his 1952 monthly and semi-monthly shocking. Cooper's indices (R) were converted to C values by multiplication of R x 22.038. His Pigeon River and Hunt Creek curves are portrayed along with the 1954 data for angler-caught brook trout from both streams (Table 2, Figures 2 and 3).

In both localities, the average C values determined by Cooper mainly for sublegal brook trout were consistently higher than those calculated for angler-caught brook trout in 1954. The general shape and trend of both curves in both localities are similar. The differences may be the result of sampling in different years, or it may be that the smaller brook trout (which are for the most part immature) tend to have higher coefficients of condition than do longer, mature fish. The latter reason is suggested by Cooper and Benson (1951), and the small difference apparently results from a change in slope of the length-weight curve.

To determine if C values of the smaller, angler-caught brook trout differed from C values of larger fish, the 1954 Hunt Creek stream fish tabulations were separated into two size classifications--above and below 8.0 inches--and biweekly average C values were examined by means of the t test (Table 3). In nine of the ten periods the difference in average C values between fish smaller (33.3) and larger (33.5) than 8.0 inches was non-significant (the one period where a difference was found contained only one specimen in one of the groups and the comparison is meaningless). The difference between the combined average C values for fish above and below 8.0 inches was also non-significant (P = 37.44 percent).

The possibility that C varied with age was investigated, using the 1954 Hunt Creek stream fish. Average C values were determined for age-groups I, II and III by monthly periods, and also for the entire season (Table 4). The tabulation reveals no significant differences between age groups in the same

period, where adequate numbers of specimens were available in the age groups compared. Over the entire season there was no significant difference between the average C values calculated for age-groups I (33.6), II (33.4) and III (32.9). P values ranged between 30 and 44 percent in all comparisons.

The results suggest that there was no variation in C values with age or size of fish, at least for the 1954 Hunt Creek angler-caught brook trout. The variation noted in weekly average C values very likely results from seasonal changes in availability of food, water temperature, gonadal changes, and other factors not now definitely established.

The data pertaining to the increase in C values noted for angler-caught fish in the first five weeks of the season were examined in greater detail. Pigeon River fish taken during the third week of the season were found to have significantly higher average C values than those taken during the first week. Hunt Creek stream fish, although showing an increase in average C values during the third week, were not significantly better in condition. Possibly the disparity in numbers in the weekly samples at Hunt Creek influenced the calculations. When Hunt Creek and Pigeon River data are combined, the average C value found for the third week (35.0) is significantly higher than the average C value determined for the first week (32.5). The standard t test yields a P value of 99.9+ percent.

The information concerning fish from lakes and ponds at Hunt Creek is scant between the first and sixth weeks. The increase in average C values from 30.6 during the opening week to 36.5 in the sixth week is significant above the 99 percent level.

The scales from Hunt Creek fish listed in Table 1 were examined in detail, utilizing the samples collected during the first five weeks of the season. Where the scales were not legible, they were discarded. Where we had readable scales from fish on which no C values were calculated (because of dressing or

other damage, but on which lengths were available), such scales were utilized. These two reasons account for differences in numbers of fish in the C samples and numbers of fish in the scale studies in the various weeks.

Regardless of the age of the fish, back-calculations were made from scale measurements utilizing a nomograph to determine the amount of growth between the time of annulus formation and the time of capture in the respective weeks of the trout season. The average growth increment was determined for each weekly period. The results are shown in Table 5. According to our findings, the Hunt Creek stream brook trout grew at least one inch during the month of May, 1954.

It is also possible to predict that if the 1954 season had opened on May 8, and if the 133 fish listed for the first week had not been taken until the third week, their average coefficient of condition would have been 33.1 instead of 32.1. According to the growth increment suggested by the averages in Table 5, instead of averaging 7.6 inches they would have been 8.1 inches (0.5 inch being the difference between average growth increments for the first and third weeks).

If the observed and calculated values are compared, we find:

> Average weight of brook trout taken the first week, whose average size was 7.6 inches, equalled 0.147 pound (by direct observation).
>
> Average weight of brook trout taken the third week, whose average size (8.1 inches) would be 0.5 inch greater than in first week, would equal 0.176 pound (from substitution in formula for C).

The potential gain in poundage of fish harvested, assuming no mortality and assuming that these fish would be caught just as readily during the third week as during the first week, amounts to 19.7 percent over the weight during the first week. If caught later than the third week, the gain would be even greater. As far as individual fishermen are concerned, this gain is of small proportions. Based on the figures just given it amounts to about one-half

ounce per fish. However, when this gain is multiplied by several thousand fish, it represents a large potential harvest which is not utilized under present Michigan angling regulations. This noticeable change in condition, particularly during the early weeks of the present trout season, is only one of several arguments which can be advanced for a later opening date.

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INSTITUTE FOR FISHERIES RESEARCH

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Approved by: G. P. Cooper

Typed by: P. R. Darling

Table 1.--Average weekly C values, brook trout, for Hunt Creek and Pigeon River stream fish, Hunt Creek lake and pond fish, 1954 trout season

Time period, 1954	Pigeon River		Hunt Creek streams		Hunt Creek lakes and ponds	
	Number	Average C	Number	Average C	Number	Average C
4/24-30	69	33.2	133	32.1	49	30.6
5/1-7	68	32.3	18	32.0	8	31.6
5/8-14	55	35.4	10	33.1	...	...
5/15-21	79	34.8	7	34.0	...	...
5/22-28	142	34.1	17	33.2	...	...
5/29-6/4	17	35.0	17	34.3	28	36.5
6/5-11	78	35.3	20	33.2	...	...
6/12-18	49	35.7	23	35.0	2	37.5
6/19-25	72	35.4	12	34.2	13	35.9
6/26-7/2	226	35.4	9	34.3	1	34.7
7/3-7/9	165	35.2	6	34.7	10	38.3
7/10-16	74	34.6	4	34.2	1	35.0
7/17-23	22	35.2	9	32.6	28	39.2
7/24-30	15	35.3	14	34.6	1	40.7
7/31-8/6	26	33.8	5	36.4	2	37.2
8/7-13	25	33.9	15	34.0	6	34.4
8/14-20	38	33.2	7	32.9	3	32.7
8/21-27	36	33.5	24	35.3	3	37.7
8/28-9/3	14	33.0	8	33.1	13	37.4
9/4-9/12	110	33.1	22	34.4	9	37.7
Totals and averages	1,380	34.5	380	33.3	177	35.1
Std. Error	...	0.103	...	0.175	...	0.397

Table 2.--E. L. Cooper's R values and their corresponding C values (R x 22.038)

Collection date[*]	Hunt Creek		Pigeon River	
	R	C	R	C
3/28/51	1.38	30.4	1.31	28.9
4/13/51	1.61	35.5	1.45	32.0
4/26/51	1.61	35.5	1.50	33.1
5/10/51	1.63	35.9	1.74	38.3
5/24/51	1.63	35.9	1.67	36.8
6/7/51	1.66	36.6	1.64	36.1
6/21/51	1.63	35.9	1.62	35.7
7/26/51	1.63	35.9	1.65	36.4
8/23/51	1.68	37.0	1.55	34.2
9/26/51	1.56	34.4	1.47	32.4
10/25/51	1.64	36.1	1.50	33.1
11/29/51	1.47	32.4	1.42	31.3
1/2/52	1.34	29.5	1.32	29.1
2/1/52	1.39	30.6	1.27	28.0
3/11/52	1.41	31.1	1.27	28.0

[*]Collection dates on Pigeon River and Hunt Creek usually were within one day of date given, except for the March, 1952 collections, which were one week apart.

Table 3.--Comparison of average biweekly C values for Hunt Creek stream brook trout larger and smaller than 8.0 inches, 1954 trout season

Time period, 1954	6.5-7.9 inches			8.0 inches and larger		
	Number	Average C	Std. error	Number	Average C	Std. error
Apr. 24-May 7	115	32.2	0.39	36	31.7	0.54
May 8-21	15	33.3	0.45	2	34.7	2.56
May 22-June 4	27	33.3	0.42	7	35.6	1.37
June 5-18	33	33.9	0.51	10	34.9	0.97
June 19-July 2	16	34.2	0.80	5	34.4	1.77
July 3-16	9	34.3	0.73	1	36.0	0.00
July 17-30	20	33.7	0.71	3	34.6	2.44
July 31-Aug.13	16	34.4	0.54	4	35.1	0.25
Aug. 14-27	23	34.8	0.63	8	34.4	0.96
Aug. 28-Sept. 12	27	33.9	0.46	3	36.2	1.86
Totals and averages	301	33.3	0.20	79	33.5	0.39

Table 4.--Comparison of average monthly C values of Hunt Creek stream brook trout of different ages (age-groups I-III), 1954 trout season

Time period, 1954	I			II			III		
	Number	Average C	Std. error	Number	Average C	Std. error	Number	Average C	Std. error
Apr. 24-May 21	5	31.1	0.78	88	32.1	0.36	63	32.6	0.47
May 22-June 18	3	36.7	0.90	44	32.3	0.83	9	34.7	1.26
June 19-July 16	7	33.0	0.71	19	34.0	1.72	...	...	...
July 17-Aug. 13	13	34.9	0.82	27	34.2	0.55	2	32.5	1.99
Aug. 14-Sept.12	17	33.1	0.39	18	33.5	0.57	2	35.7	1.07
Totals and averages	45	33.6	0.37	196	33.4	0.31	76	32.9	0.40

Table 5.--Average total length, average C value, and average calculated growth of Hunt Creek stream brook trout during the first 5 weeks of the 1954 trout season

Time period, 1954	Average total length	Average C	Number	Average calculated growth	Number	Number, no growth
Apr. 24-30	7.6	32.1	133	0.1	126	110
May 1-7	7.6	32.0	18	0.4	10	7
May 8-14	7.4	33.1	10	0.6	11	5
May 15-21	7.5	34.0	7	0.8	10	4
May 22-28	7.6	33.2	17	1.1	13	4

Figure 1.--Weekly average C values, Hunt Creek stream brook trout, Hunt Creek lake and pond brook trout, and Pigeon River stream brook trout, 1954 trout season.

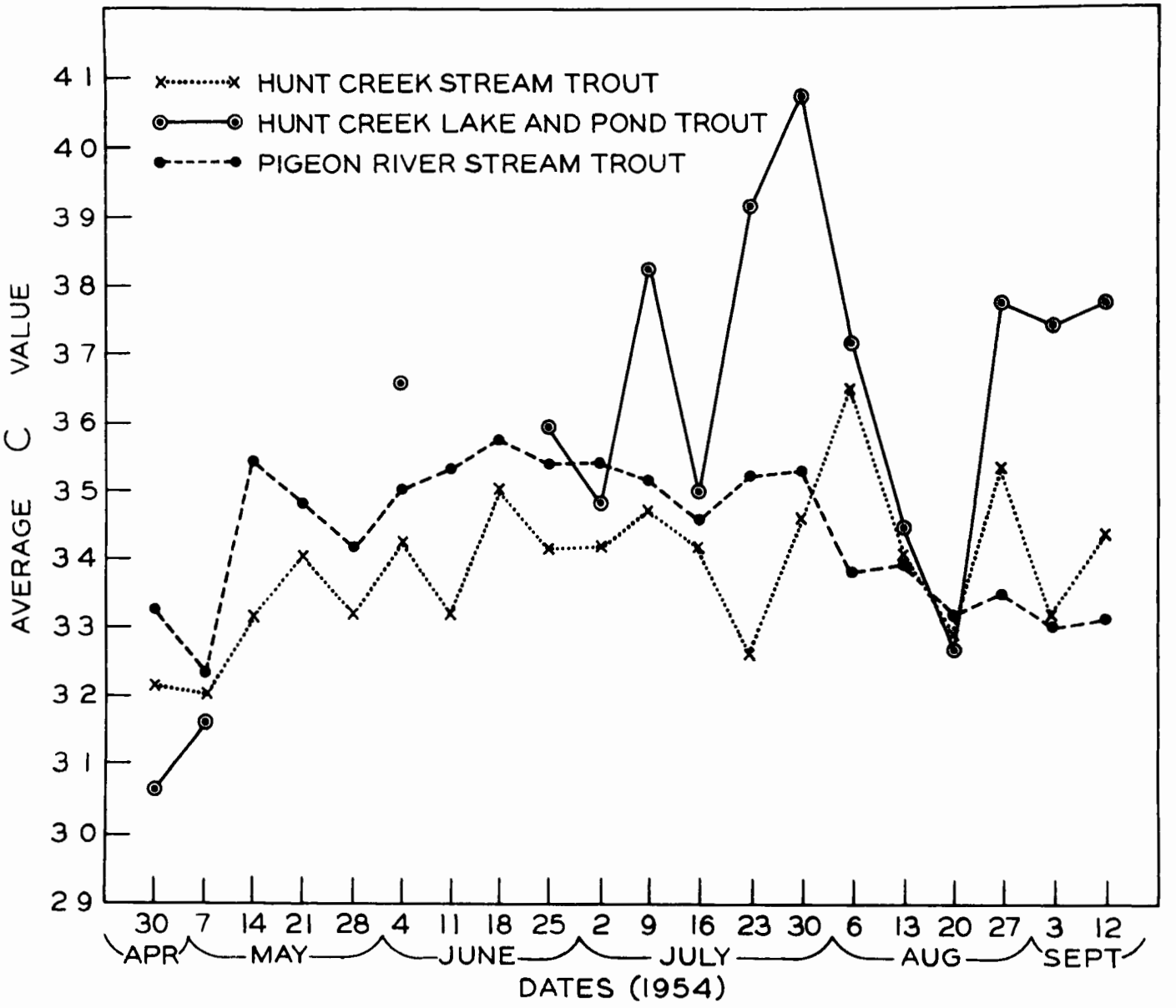
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Figure 2.--Comparison of Cooper's C values for Hunt Creek brook trout with the 1954 Hunt Creek brook trout taken by anglers.

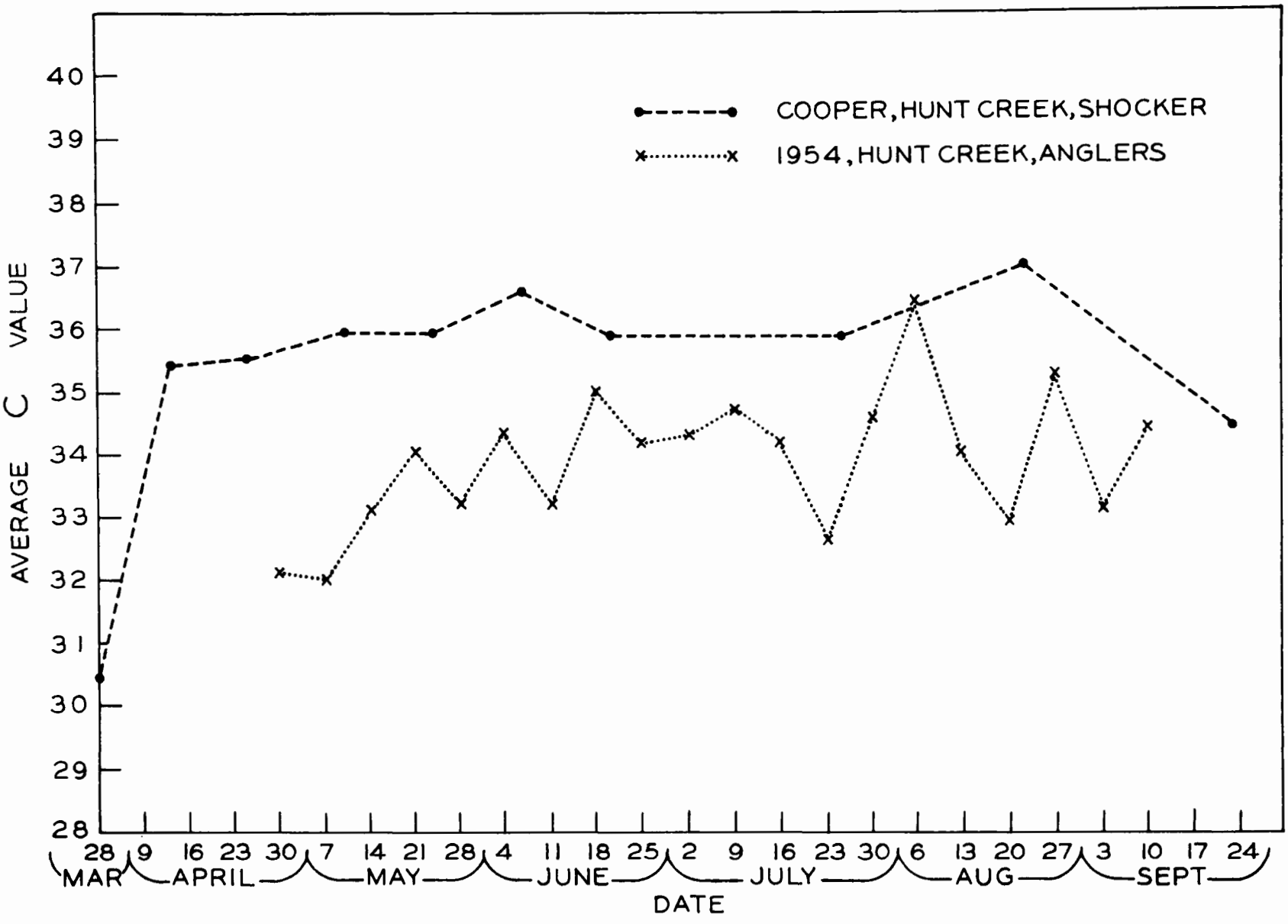
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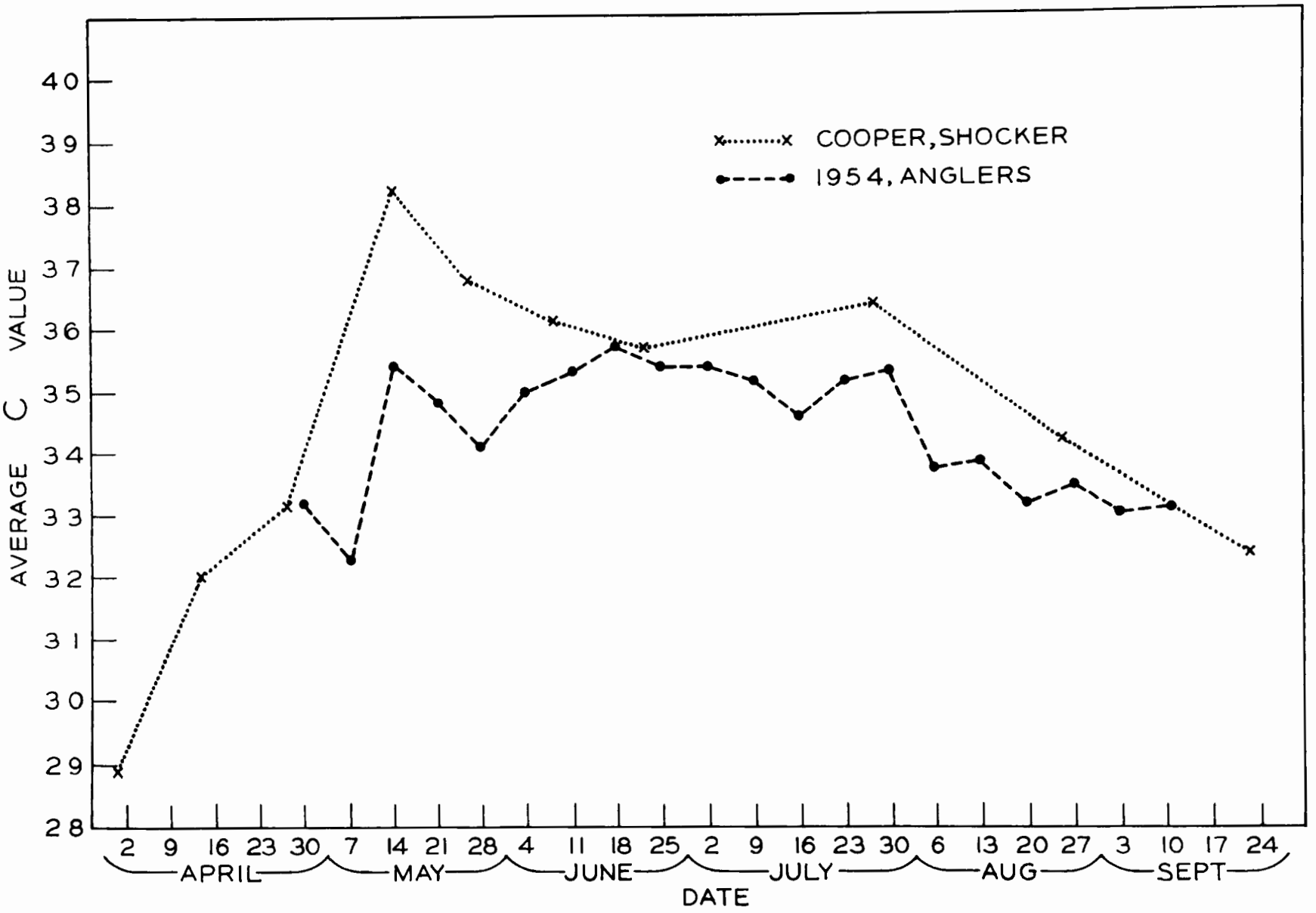
Figure 3.--Comparison of Cooper's C values for Pigeon River brook trout with the 1954 Pigeon River brook trout taken by anglers.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