

CHANGES IN ABUNDANCE AND STANDING CROP OF BROOK TROUT CONCURRENT WITH
REDUCTIONS OF RAINBOW TROUT FROM FOUR SYMPATRIC STREAM POPULATIONS
IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK

Stephen Moore
Bromfield Ridley
Department of Biology
Tennessee Technological University
Cookeville, Tennessee 38501

Gary Larson
U.S. Department of the Interior
National Park Service, Southeast Region
Uplands Field Research Laboratory
Great Smoky Mountains National Park
Gatlinburg, Tennessee 37738

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The brook trout is the only salmonid species native to the Great Smoky Mountains National Park. The range of the species has declined about 70% in the park during the last 75 years. Much of this decline is attributed to the encroachment of rainbow trout into the streams. In view of these changes in brook trout range, an investigation was conducted from 1976 to 1978 to determine the feasibility of removing rainbow trout by electrofishing and to determine the response of the brook trout populations to the removal. Four headwater streams were included in the study.

A two-man electrofishing crew was able to substantially reduce the numbers and standing crop of rainbow trout in each stream, but the species was not eradicated. This reduction apparently did contribute to an increase of brook trout as their standing crop and number increased markedly in most study streams.

INTRODUCTION

The brook trout (Salvelinus fontinalis) is the only salmonid species native to the Great Smoky Mountains National Park (GRSM). During the last 75 years this once abundant species has disappeared from about 70% of its original range in the park. Many biotic and abiotic aspects are responsible for the decline, but a main reason has been the encroachment of rainbow trout (Salmo gairdneri) into brook trout streams. Studies by King (1937 and 1938), Lennon (1967), Jones (1975), and A. Kelly (personal communication) have traced the encroachment process. Rainbow trout gained access to the park through stocking from the early 1900's until 1975.

Owing to the dramatic reduction in the range of brook trout, an investigation was initiated in 1976 on four small headwater streams in the park to determine the feasibility of removing the exotic trout species with electro-backpack fish shockers and to determine the resulting effects on the brook trout populations. This paper presents preliminary information concerning changes in abundance and standing crop of brook trout concomitant with the reduction of rainbow trout in these streams. Additional information about the investigation is available in Moore's Ms. (in prep.).

METHODS

Electrofishing was conducted by a two-man crew, using a gasoline driven 110 VAC backpack electrofishing unit. The unit contained a device to change voltage output. The most suitable for capturing fish in the study areas was 650 VAC. Study sections averaged about 2 m to 3 m in width and .1 m to .4 m in depth in summer.

Each stream was sampled in summer from 1976 to 1978, although some portions of the study sections were not sampled during the first two years because of shocker failure (Table 1). Nonetheless, each stream was usually shocked in 300-m sections, three passes being made through each section. On each pass the fish captured were measured (total length) and weighed. Brook trout were returned to the section from which they were captured after the third pass. Rainbow were discarded. Young-of-the-year of both species were identified as individual fish less than ~~25~~²¹ mm in total length. This age class was determined from length frequency data. Other age classes were grouped and identified as age 1+.

In this paper, the term sympatric means that populations of brook trout and rainbow trout are mixed within the study sections. Standing crop is defined here as the total weight per hectare of trout collected in each study area each year.

For the purposes of this paper, only data from 1976 and 1978 will be discussed, except for Silers Creek, for which 1977 and 1978 data will be used. Silers Creek was not completely sampled in 1976.

RESULTS AND DISCUSSION

Changes in Number and Weight

In general, the removal of rainbow decreased the area per fish and increased the weight per m² for brook trout between 1976 and 1978 (Table 1). Only the area per fish in Beetree Creek did not change between the sample years. For rainbow trout, the harvest substantially increased the area per fish and decreased their weight per m² (Table 1).

The contribution of young-of-the-year brook trout and rainbow trout to the abundance and total weight of each species varied between streams during the study (Moore, Ms., in prep.) For brook trout, their numbers decreased in one stream, remained unchanged in another, and increased in two. Rainbow increased in two streams and decreased in two. On a weight basis, brook trout increased in three streams and decreased in one, and rainbow trout decreased in all streams. In fact, no rainbow young were captured in 1978 from Beetree Creek (July) and Sams Creek (June). Although these cases of zero captured were related to the removal efforts,

they were undoubtedly influenced greatly by the size of the young at the time of shocking (Moore, Ms., in prep.). Similar results have been observed by Cooper and Lagler 1956, Libosvársky 1962, and Goodnight and Bjornn 1971.

CHANGES IN STANDING CROP

The standing crop of trout from the four sympatric populations collectively for each year are shown in Figure 1A. Rainbow trout weight per hectare dominated these four areas (78.64%) in 1976 (Fig. 1B). In 1978 brook trout weight per hectare in all areas collectively was more than double that of rainbow trout, increasing to 71.8% of the total standing crop for that year (Fig. 1B). The total standing crop in 1978 was 80.72 kg/ha (Fig. 1A), 30.61% less than in 1976. Nonetheless, the data illustrate a pronounced, progressive, cumulative increase in brook trout standing crop as rainbow trout were removed from the areas each year.

Summarizing changes in composition of total sympatric standing crops within each sampling area, brook trout standing crop in Beetree Creek increased 66% and the rainbow trout standing crop decreased 81%; the brook trout standing crop in Sams Creek increased 134% and the rainbow trout standing crop decreased 81%; in Silers Creek the standing crop of brook trout increased 185% and rainbow standing crop decreased 51%; and the brook trout standing crop of Taywa Creek increased 133% and the standing crop of rainbow trout decreased 77% (Table 1).

CONCLUSIONS

In this study, a two-man crew with one electrofishing unit was not able to eradicate rainbow trout from selected reaches of small headwater streams in the Great Smoky Mountains National Park. The crew substantially reduced the number and standing crop of exotic trout in these streams, however. These reductions apparently did contribute to an increase of brook trout, as their number (except in Beetree Creek) and their weight (per hectare) increased markedly in these areas.

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Table 1 - Numbers and weights of brook trout and rainbow trout from sympatric populations by stream and by year. Numbers are expressed as area (m^2) per fish. Weights are expressed as mg/m^2 .

Stream	Year	Sample Area	Brook Trout		Rainbow Trout	
			Area, m^2 fish	Wt, mg/m^2	Area, m^2 fish	Wt, mg/m^2
Beetree	1976	1791	27	614	28	2078
	1977	1791	25	963	149	375
	1978	1791	27	1021	199	393
Percent change 1976 to 1978			0	+66	+611	-81
Sams	1976	6058	20	1007	54	1629
	1977	6354	18	1306	318	170
	1978	6354	12	2358	289	310
Percent change 1976 to 1978			-40	+134	+435	-81
Silers	1976	1584	26	634	17	2810
	1977	3606	19	964	26	1953
	1978	3606	11	1779	37	955
Percent change 1977 to 1978			-42	+185	+142	-51
Taywa	1976	3045	113	230	13	2630
	1977	2058	1029	37	412	110
	1978	3045	32	537	30	618
Percent change 1976 to 1978			-72	+133	+131	-77

Fig. 1. A - Changes in cumulative standing crop from four rainbow-brook trout sympatric populations after reduction of rainbow trout each year by removal.
B - Cumulative standing crop by species.

