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ANALYZING COMPETITION BETWEEN BROOK TROUT AND BROWN TROUT

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ABSTRACT

We predicted that brown trout should have a negative impact on native brook trout. Contrary to expectation, brook-trout lengths were not significantly lower in streams where the brown trout was present, as compared to where they were present. Brown-trout body lengths were not affected by the presence of brook trout either. Furthermore, brook-trout and brown-trout abundance were not significantly different between two vs. one trout-species streams.

Keywords: Body size, brook trout (Salvelinus fontinalis), *brown trout* (Salmo trutta), *competition, competitive exclusion principle.*

INTRODUCTION

The brook trout, *Salvelinus fontinalis,* is a native fish species of Pennsylvania. The brook trout is a fish of the wilds and prefers the solitary streams and lakes of the north woods. Deforestation, pollution and the introduction of other trout to its native waters have caused the brook trout to disappear in many waters, and thus it is usually only found in remote mountain streams.

The brown trout *Salmo trutta* was introduced into North American brook-trout streams from Europe in 1883 (Caine, 1949). The brown trout prefers larger waters than the brook trout. Brown trout are also more tolerant of adverse environmental conditions than brook trout, including higher water temperatures. The most piscivorous (fish-eating) trout in streams are generally brown trout, and introduction of these fish into streams may be followed by a decline in the abundance of native trout and other fish (Moyle, 1993).

In some situations brown trout are thought to compete unfavorably with the brook trout. The most severe type of competition that occurs in trout streams is among coexisting trout. Interspecific competition is very high where one species is a recent introduction to the stream. For example, brown trout can displace native brook trout from the best holding places in the stream. The brook trout are displaced into less protected areas where food is harder to obtain and where they are more likely to be caught by other anglers or other predators. The result is that brook-trout streams often become brown-trout streams in a few years (Moyle, 1993).

The reason that trout interactions are so severe is that trout are very naturally aggressive, and all trout species seem to use the same basic set of signals in their behavior (Moyle, 1993). Brown trout and brook trout have very similar territory-defending behaviors. If a brown trout exhibits this behavior, the smaller brook trout will normally flee.

The two species also occupy very similar niches and compete for the same resources. In streams where the two species coexist, one species will suffer if there is not a sufficient amount of resources. In a

stream where only one species lives, intraspecific competition is beneficial because it force individuals to "spread out" ecologically and make maximum use of the limited food and space available.

In modern stocking, it is usually recommended that browns not be planted in brook-trout waters (Caine, 1949). Current fish-stocking efforts are placing brown trout into the same waters as native brook trout, which is causing a decline in brook-trout populations and body size. If we continue our stocking efforts in this fashion, our native species may drastically decline or even vanish. By ending stocking of brown trout to native brook-trout waters, the brook-trout populations should rebound.

The purpose of our study was to test whether interspecific competition between brown trout and brook trout affects their abundance and body size by comparing streams where both species occur with those where only one species exists. We predicted that because of the competitive exclusion principle, body lengths of both species will be lowered where the two species coexist because of direct competition for resources. We also predicted that the brook trout will be more abundant in waterways where the brown trout is absent.

FIELD SITES

We took electroshock samples from four streams in Blair County, Pennsylvania. Piney Creek is a small limestone creek that is well shaded and has many pools and riffles. Stocking was ended in 1987, and currently only has populations of wild brown trout (Landis, 1995). We sampled at the T431 Bridge at the lowest end of the creek, just upstream from where it empties into the Frankstown branch of the Juniata River (Fig. 1).

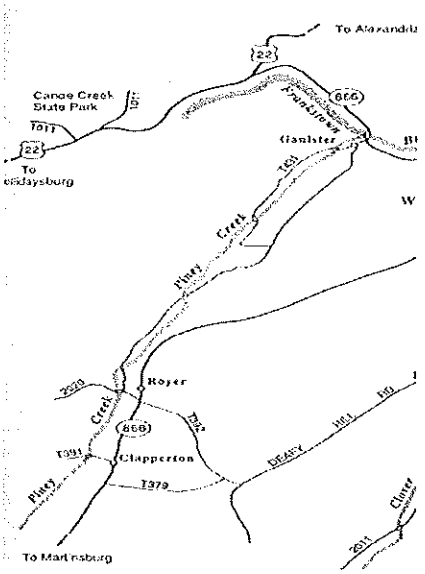

Figure 1. Map showing the geographical location of Piney Creek, Blair County, Pennsylvania

Tipton Run is a remote mountainous stream that is no longer stocked because it has good populations of native brook trout and wild brown trout (Landis, 1995). We sampled about one mile down from the Tipton reservoir and also above the reservoir where Three Springs Run joins in. We also sampled in Three Springs Run, which is an unstocked native brook trout stream. We sampled upstream from where it dumps into Tipton run, and around the route 4023 bridge. The last study stream was Big Fill run, which is a small freestone creek that has populations of native brook, and wild brown trout in its upper waters. We sampled at the Route 350 bridge, and a section downstream about 1 mile. Some environmental characteristics of the study streams are listed in Table1.

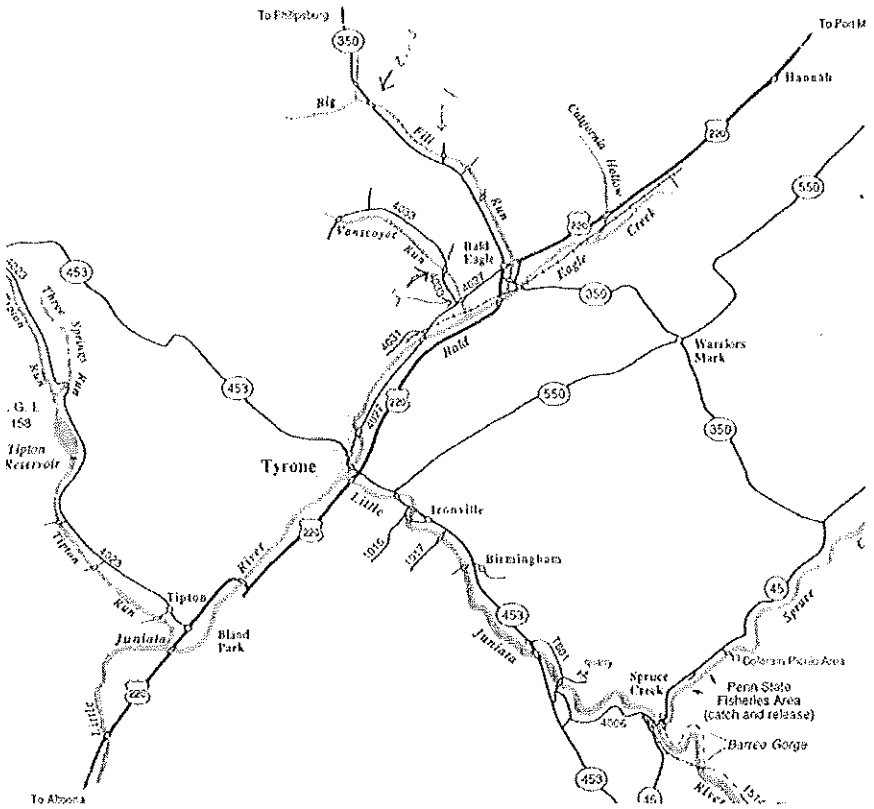

Figure 2. Map showing the geographic locations of Big Fill Run, Three Springs Run, and Tipton Run

Table 1. Some environmental features (means of five samples per stream) of the four study streams.

Stream	Water Temperature (degrees Centigrade)	pH	Dissolved Oxygen (mg/L)	Flow Rate (m/s)
Tipton Run	10.0	5.6	12.2	.35
Three Springs Run	9.5	6.0	12.3	.37
Big Fill	9.0	6.4	11.6	.73
Piney Creek	11.5	7.7	12.8	.74

METHODS AND MATERIALS

We used a gas-powered fish shocker to immobilize the fish, and large dip nets, a seine, and buckets to hold them for counting, identification, and length measurements with a ruler. In each stream we sampled three, ~60-ft stream lengths (as determined by a tape measure), so as to include a wide variety of microhabitats (including both pools and riffles). The stream widths were very similar in each stream so the area shocked for each stream was about the same.

Within each sample area, electro-shocking was done downstream towards a hand-held seine. The seine and dip nets were used to collect immobilized fish. Several fish species were collected and identified, including sculpins and dace. A qualitative assessment of macroinvertebrate abundance was also made at each site. Water pH and dissolved oxygen were measured with a Markson field pH meter and YSI oxygen meter, respectively. Substrate was described by the relative amount of the stream bed that was covered by boulders, cobbles, gravel, sand, and organic material.

RESULTS

Contrary to our prediction, brook and brown trout showed no significant differences in mean body length between streams in which they lived alone and those in which they coexisted (Table 2). No significant differences in trout abundance between two and one trout-species streams were observed either (Table 3).

Table 2. Mean body lengths (± S.D.) of brook and brown trout when they coexisted and when they lived alone. The t-test values indicate no significant differences between two and one trout-species streams (P > 0.05).

	Brook Trout Alone	Brook with Brown Trout	Brown with Brook Trout	Brown Trout Alone
Mean length (inches)	4.42 (± 1.60)	4.04 (± 1.05)	6.71 (± 1.91)	6.44 (± 2.19)
t-test value	.1813		.3726	

Table 3. The number of trout per 60-foot section. The t-test values indicate no significant difference in numbers between two vs. one trout-species streams.

	Brook Alone	Brook together	Brown alone	Brown together
Number of fish per 60 foot section	10	5	15	3
"	10	2	5	1
"	7	5	9	1
"		7		2
t-test value	0.007		0.012	

DISCUSSION

Contrary to our hypothesis, the body lengths of brown and brook trout did not differ significantly between streams where both species lived together versus streams where they lived alone. No differences in trout abundance were observed between two and one-trout species streams, as well. Therefore, our study provides no support for the literature, which suggests that brown trout have a negative impact on brook trout (Caine, 1949; Moyle, 1993). Perhaps interspecific competition is weak between these two ecologically similar species in our study area because in streams where both species coexist there appears to be a relatively high diversity and abundance of macroinvertebrates.

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LITERATURE CITED

Caine, L.S. 1949. North American fresh water sport fish. A.S. Barnes and Company, New York, New York, USA.

Moyle, P.B. 1993 Fish: an enthusiasts guide. University of California Press, Berkeley, California, USA.

Landis, Dwight. 1995. Trout Streams of Pennsylvania: An Angler's Guide. 2nd Edition. Hempstead-Lyndell, Bellefonte, Pennsylvania, USA.