The Struggle for Dominance

By Ken Undercoffer

There is a popular misconception that brown trout now dominate many of our coldwater streams because they are able to live under degraded conditions intolerable to brook trout. In fact, there is probably not a square-foot of water inhabited by brown trout in Pennsylvania, today, that could not hold native brook trout, were the brown trout not there. Just as our European ancestors took over and dominated the land previously inhabited by native American peoples, European brown trout have taken over and dominated many of the cold water streams once occupied by native brook trout. How did the brown trout accomplished this?

History

Until the late 1800s the brook trout was the only salmonid living in the coldwater streams of Pennsylvania. According to old-time angling literature, freestone brookies once averaged about 9 inches in length and 12- to 14-inch fish were common. Brookies up to 20 inches in length and approaching 4 pounds in weight were taken in larger freestones. In limestone streams, it is said that brook trout averaged about 2 pounds. In the 100 years since their introduction, brown trout have replaced brook trout in most of our limestone streams. Even many larger and more fertile freestone streams are dominated by browns. It is not well understood how brown trout are able to replace brook trout in streams; both evolved in similar environments and have nearly identical physiological requirements. The lethal upper temperature limits are similar: 79.5℉ for brown and 78.0℉ for brook trout. But there are some slight differences in the behavior and biology of the two species which apparently lead to this phenomenon.

Resistance to Angling Pressure

Every skilled trout angler knows that brown trout are very selective feeders and for this reason are much more difficult to catch than brookies. Brown trout evolved in the fertile limestone streams of Europe where food was plentiful. The best strategy was to lay low until a heavy hatch, spinner fall or rainstorm brought an abundance of food and then feed heavily until gorged. This minimized exposure to predators and still allowed rapid growth. This strategy is not as successful in infertile freestone waters, however. In such places food is scarce and nothing edible can be allowed to slip by. These are the kind of places where most brook trout evolved, and that is why they are such "eager eaters." A study by Dr. Edwin Cooper showed that brook trout are three times more likely to be taken by anglers than browns, in a stream where they were living together in similar numbers. This difference in vulnerability to angling pressure can make a big difference in the age structure and therefore size of the two species in a given water. In his studies, Dr. Cooper found that although both brook and brown trout were growing at the same rate, most brookies never got much bigger than the minimum legal size limit of seven inches and few ever exceeded ten inches. This was because the brookies were being taken from the stream almost as fast as they became "keepers." On the other hand, many brown trout in this stream grew larger than ten inches, sometimes reaching sixteen inches. On very rare occasions a brookie of sixteen inches was taken by a fortunate ¾ and apparently very skilled ¾ angler proving that they were capable of reaching sizes similar to the browns. >From the results of this study, Dr Cooper conclude that angling pressure is an important factor in determining which species is able to dominate a stream.

The protagonists: On the left, a beautiful 8.5-inch freestone brookie and on the right, a handsome 10.5-inch freestone brown. A brown trout of this size would have no trouble in excluding a brookie like the one on the left from its territory. Ken Undercoffer photos.

Territoriality

Another factor influencing survival is the intolerance of one trout for another in its living space. Trout living in streams are very territorial. They occupy and hold positions in the stream according to size in what is called a dominance hierarchy. The bigger the fish, the better the position it is able to take and hold. It will hold that position until its biological requirements are no longer being met. When this occurs it must find a more suitable spot in order to continue to grow. Only when a larger fish leaves its chosen position can a smaller fish move up the ladder of dominance. Trout move up the ladder of dominance as they grow, occupying increasingly better stream positions. Those that cannot find a position where they can continue to grow, soon die. This is how nature sorts them out. Only the fastest growing, strongest and most aggressive trout survive to spawn future generations.

Sexual Maturity

An important factor influencing growth rate and ultimate size of trout is the age at which they reach sexual maturity. Spawning requires a lot of energy and growth rate slows once trout start reproducing. Most brook trout reach sexual maturity by the age of two at a length of 5 to 7 inches. On average, brown trout mature about a year later than brook trout. This reduces their reproduction rate but, because of their ability to avoid capture, enough browns survive to maturity to maintain their numbers in many streams. By delaying maturity another year, brown trout gain a size advantage over brookies after the age of two and this seems to be very critical. This size advantage, although slight, enables them to displace smaller brook trout from the more favorable stream positions. Gaining more favorable stream positions allows them to maintain a higher growth rate than brookies which are now forced to occupy the more inferior positions. As the brown trout population increases in both average size and numbers, brook trout are forced ever downward in the struggle for dominance. Sometimes, as in most of our limestoners, to the point of total exclusion from the stream.

The Effects

Because of their ability to breed at an early age and small size, brook trout can, in many cases, maintain reproducing populations in streams inhabited by brown trout. But in streams were brown trout are present in significant numbers, brook trout are limited in average and ultimate size because they are forced to live in inferior positions by the larger browns. The genetics of our brook trout population have almost certainly been shifted toward early-maturing, short-lived, smaller fish in order to more effectively fill the niches left by brown trout. Brook trout are only able to dominate small, infertile streams and headwaters where growth is severely limited by the environment. In such streams brook trout may completely dominate or, as sometimes occurs, will be present in large numbers along with a very few, but much larger, piscivorous brown trout which derive most of their nourishment by feeding on small brook trout.

The struggle for survival in a stream is one of life and death for each and every trout. In streams cohabited by brook and brown trout, the struggle is quite literally for survival of the species. Brook trout lost this struggle in our fertile limestone streams a long time ago. In most of our larger and more fertile freestones brook trout have been able to hang on and to varying degrees have been able to coexist with brown trout. But without better protection the brookies' continued presence in big freestones will always be in jeopardy. Brook trout still dominate most headwaters and tributaries of the major freestone streams of Pennsylvania. Unfortunately, these waters are too acidic, too cold and too infertile to grow trout, either brook or brown, much larger than about 10 inches.