A leading fly-fishing conservationist experiments with an important concept in wild-trout management

A Man-Made Spawning Area

CHARLES K. FOX

Stalls for spawning trout, built by the author in the Letort behind his home. The lighter areas are recently constructed (by trout) redds, and the trout are slightly visible in this photo as dark bars next to the redd in the center. Photo by Charles A. Fox (the author's son).

SOW THAT YE MAY REAP. This principle is basic to most conservation practices, but in fisheries management I have found that it has a very specific application. In the early 1960's I began, with the help of friends, to plant gravel in the streambed of Letort Spring Creek in Pennsylvania. Our intention was to create new spawning areas in order to help produce an annual crop of trout, and thereby to improve the fishing for native trout.

If natural trout fishing is to exist in any stream, there are four basic elements that must be present in that stream: homes (holding lies for the fish), an adequate food supply, a brood-fish population and suitable spawning areas. When these four elements are in evidence and in balance, the rewards for the angler may be great. And the quality of the fishing will not deteriorate if, in conjunction with these four assets, fish killing is reduced to a point at which the stream retains an ample supply of brood fish that will produce a satisfactory crop of juveniles.

The Letort runs by my home, and I have fished and studied the stream for many years. Its waters possess an abundant food supply; there are homes galore in the water weeds and under the undercut banks and overhanging grasses; and thanks to stringent killing regulations, there is a good head of brood fish. However, the Letort is marred by a lack of productive spawning beds. Because it is a stream with little vertical drop in a well-populated agricultural valley, over the decades it has suffered from siltation and from carrying the runoff of fertilized soils. As a result, dense beds of *Elodea* (an aquatic weed) have grown up where there was once clean gravel. Although this eliminated productive spawning redds, as clean gravel is the most important element of any productive spawning area, the weed growth has greatly increased the food supply and the number of homes. The gain is greater than the loss, because man can more readily create spawning areas than he can new food supplies or the enormous number of holding lies that the *Elodea* creates. In my judgment, the Letort is a much finer trout stream today than it probably was when the Indians were the only human visitors to its banks. But it does have that one weakness: insufficient gravel.

By placing gravel beds in some areas of the Letort, we attempted to achieve a better balance between natural reproduction and the carrying capacity of the river. Our efforts involved considerable trial and error, with subsequent alterations in design. We learned that the size and shape of the gravel used, and the flow and depth of the water into which it was placed were the factors contributing most to the success or failure of our project.

For brook and brown trout the spawning ritual begins in late autumn in the Letort. When a hen chooses a spot for her nest, she is attended by several cock fish which, although they spend considerable time fighting among themselves, do not assist in the strenuous act of preparing the gravel bottom to receive the hen's eggs. The hen faces upstream, turns on her side and undulates violently for a brief period of time. Her action cleans the gravel of silt and causes a small embankment in the gravel, leaving a drepression into which her eggs will be laid. This is an extremely tiring process for the hen, and it is punctuated by periods of rest. Current speed, determined by the depth of the gravel, is crucial to the nest making as well as to the processes that follow.

In due course the hen deposits eggs in the depression, against the embankment. A male rushes to fertilize the eggs with a cloud of ejected milt. A sperm will live for only about 45 seconds, and within that time it must locate an egg and bore through the egg's shell in order to fertilize it.

Resuming her sideways contortions, the hen creates another depression above the fertilized eggs, thus moving protective gravel over them. At all times the flow of the current through the gravel is providing necessary aeration to the eggs, sperm and fertilized eggs.

One hen may continue the mating ritual over a period of four or five days, covering an area of gravel several feet in length. When she has expelled the last of her eggs, she leaves, although the cocks remain to seek a new nesting hen.

THE LETORT IS SITUATED in a limestone area with numerous quarries, so crushed rock is readily available and inexpensive; our first experiments in creating gravel beds were with crushed limestone. When some was placed in a controlled area between a strong spring and a holding pond, the result was quite negative. The hens tried to form nests in this gravel, but the sharp points of the limestone cut their tails, and the flat sides of the gravel prevented the hens from propelling it into place by their undulations.

The second experiment was with half-inch, screened, river gravel in a feeder stream of the Letort. We learned several things from this attempt. Brook trout preferred shallow water, even to the degree that it barely covered their backs, whereas brown trout chose depths of 12 inches to 30 inches. Results were reasonably good, although we noticed there was room for refinement. It was apparent that many eggs were left exposed, only to be gobbled up later by small, loitering male trout. We concluded that coarser gravel might hold and shelter the eggs better, and also provide an easier escape for the alevins, or newly hatched trout, when they emerged in the spring.

Charlie and young helpers transporting gravel for deposit in the man-made redds on the Letort. Photo by Kris Lee.

The brown trout worked the gravel harder than the brook trout, making deeper troughs over a longer area

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and covering the eggs more thoroughly. It was evident, too, that while the flat-sided crushed limestone of the initial experiment could not be moved by the hens, the rounded river gravel would roll and bank properly.

At this point in our on-going project a streak of good fortune developed. A road was constructed near the main river that made it possible to drive a truck to the stream's edge, and the man-made redd operation was shifted to the main Letort.

Also by this time we had learned that the larger hens not only laid a greater number of eggs than the first-time spawners, but they made larger nests and covered the eggs in a more thorough manner. Therefore, it seemed logical to focus our efforts on improving conditions for the big ones. In light of our previous observation, we shifted from one-half inch river gravel to three-quarter-inch in the belief that not only could larger, stronger fish move this as readily as the smaller hens had worked the lighter stones, but also the crevices in the larger gravel would better house the eggs and provide an easier escape for the alevins.

The first gravel beds we put in were wide and deep. Depth of gravel not only built up a good base over any mud, but it also quickened the flow. One large hen would dominate the area, the smaller ones being afraid to come in. As soon as one big hen completed her job and left, another would usually take over at or close by the same spot.

AS I WATCHED THIS, two things bothered me. First, there appeared to be a waste of time and gravel, because only one hen at a time could use the bed. Second, it seemed logical that after a limited area was used by a number of strong hens, some eggs were eventually buried so deeply in the gravel that, even if they were undamaged and did hatch, the young ones would never be able to work their way to freedom.

My solution was to divide the beds with submerged walls to create more nests and simultaneous spawning. The work was done in August and September, prior to the arrival of the first spawners. The divisions made the wide gravel bed look like five stalls.

It worked like a charm. So long as the hens did not see each other, all was well. We had so much success with the dividers that over the years we have expanded the spawning area greatly. The total number of nests has grown from a scant half-dozen in 1965 to about 30 today, and we even have some limited room left for continued expansion.

Since the hens move gravel downstream, it is best to freshen up the front of the old nests each year with a new layer of gravel. Because we had the most success with coarser gravel, our current refinements focus on the introduction of even larger stones. Our most recent supplies have been of one-inch gravel. So far, from the standpoint of nest making, the larger gravel has been a great success. Time will tell about the hatch of eggs, but it could very well double.

Over the years more than 100 tons of river gravel have been planted in the area and many tons of large chunks of limestone. It has developed into something more than a spawning section—due to a greater surface area of stone, or better aerated water, or the two in combination, three different hatches of mayflies have staged substantial comebacks.

The day after Christmas, 1974, I watched the largest trout I ever saw inspect the area, then pick her site. She appeared to be over 30 inches in length and 10 pounds in weight.

THE NATURE OF THE SPAWNING AREA has exacting standards, but the quality of the nursery is just as important. We may be sure the fish will spawn, but we cannot be sure the eggs will hatch. Silt on the streambed and heavy silt in suspension rots eggs—not only those of trout, but those of aquatic insects as well. Clean water over clean gravel insures that the eggs will hatch. But as soon as the alevins have escaped, the immediate consideration becomes a suitable environment for the fry. Feeding locations are needed in shallow, flowing water adjacent to cover. Here the fry will live and grow to the fingerling stage before they move into deeper quarters.

In the natural habitat, the babies consume microscopic zooplankton in quantity. Once the trout are large enough, this diet is supplemented by *Diptera*, midges that appear in great quantity when they are most needed by the trout—spring and fall. Even the larger stream-bred fish will continue to eat some of both of these forms of minutiae. A failing of hatchery fish is that once stocked, they will not as a group turn on minutiae, because they are accustomed to partaking of coarser foods. In a controlled area where there was little food other than zooplankton, I have seen newly stocked trout starve to death while stream-bred fish grew.

FISHERIES MANAGERS HAVE ONE tremendous advantage over those in the sister field of game management, and that is that a fish can be used more than once, but when game succumbs, that is the end.

The necessary approach for successful fisheries management is regulated fishing, and regulated fishing goes hand in hand with stream improvement. Together they produce a superior type of angling. Under fishing pressure, trout become more sophisticated. The result is a challenge to the angler in which the order of the day becomes the best of imitations attached to fine leaders, precisely delivered. This is quality fishing.

In our effort to assist nature via the stocking of fingerlings, we unavoidably plant some diseased fish, which creates an unnecessary hazard for the native population. Where there are periodic stockings, the supply of planted fish rapidly fades under fishing pressure and from natural causes; and studies have revealed that where there is heavy stocking, native populations may dwindle.

These factors emphasize the importance to the angler of stream-bred fish. Man, with stream improvement and restricted killing, can help this cause immeasurably. The goal, which is attainable through sincere effort and intelligent observation, is to provide quality angling week after week, month after month, and year after year.

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