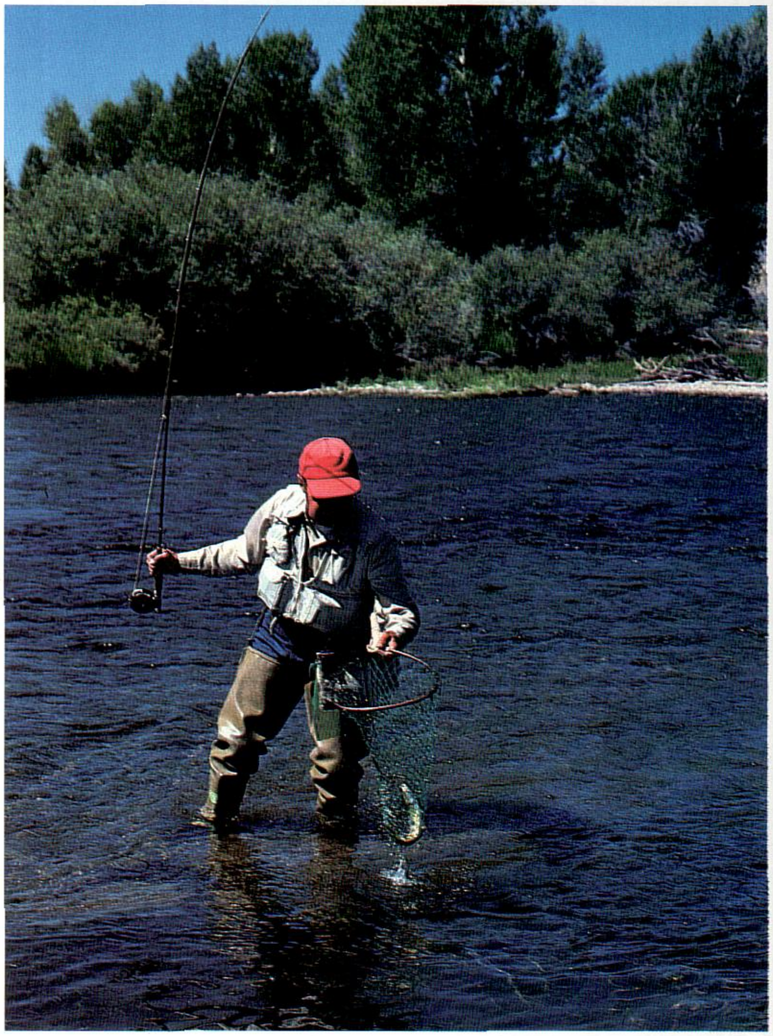
Sport Fishery Habitat Requirements

Habitat Extension Bulletin No. 22



A self-sustaining population of trout requires a variety of aquatic habitats, good water quality, and protection from over-harvest.

Rainbow, cutthroat, brook, and brown trout are the most popular sport fishes in Wyoming, but other species, such as bass, walleye, sunfish, and yellow perch, have their admirers. Gamefish are found in both streams and lakes throughout Wyoming and provide both recreation and food to many anglers. However, their habitats are sensitive to a variety of man's activities, and special measures should be undertaken to protect these habitats.

This bulletin is divided into sections on the various habitat needs of trout, followed by habitat protection and improvement sections, and concludes with a section on other gamefish and a list of references providing more detailed information.

Habitat Extension Services

WYOMING GAME AND FISH DEPARTMENT

Spawning gravel is a critical part of good trout habitat. Eggs must be sheltered in the crannies of the gravel bottom where they develop. The right water temperature and oxygen content are important for the developing trout. Protection from predators, including other trout, is also vital. Silt from heavy erosion or grazing along stream banks can smother good spawning gravel for miles downstream.

Trout

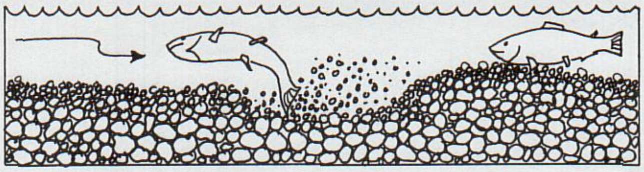
Trout are usually associated with clear, cold streams and lakes, and their habitat needs must be met to maintain a high-quality fishery. Though habitats for adults differ between lakes and streams, the spawning habitats for all trout species are similar.

Spawning

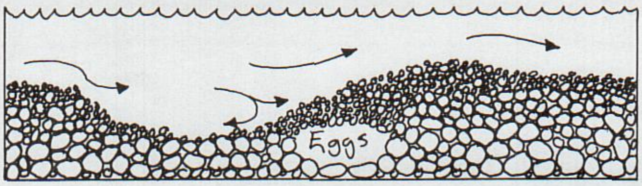
Most species of trout usually spawn in riffles of streams. They will excavate a depression in one-half- to three-inch gravel, deposit and fertilize their eggs, and then bury the eggs beneath more gravel. This excavated area is known as the redd. Trout often run up small tributaries of larger streams because these tributaries contain more areas with suitable gravel. Rainbow and cutthroat trout spawn in the spring or early summer, often after the peak flow has been reached. Brook and brown trout are fall spawners and begin reproductive activity in response to declining water temperatures.

In productive streams, trout may spawn every year, and most fish survive the spawning period, unlike Pacific salmon. However, in very cold streams at high elevations, trout may only obtain enough food to be able to spawn every other year. Individuals of most species begin spawning when they are two or three years old, but very old fish may cease spawning.

To sustain naturally reproducing populations of trout, lakes must have above-ground tributaries or outlets containing suitable spawning gravels. Occasionally, trout can spawn in lakes in areas of groundwater upwelling. Brook trout may require such upwelling even in streams.



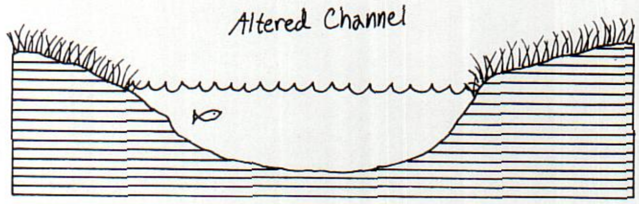
Salmonid cutting a redd (above) and completed redd showing typical location of incubating eggs (below).



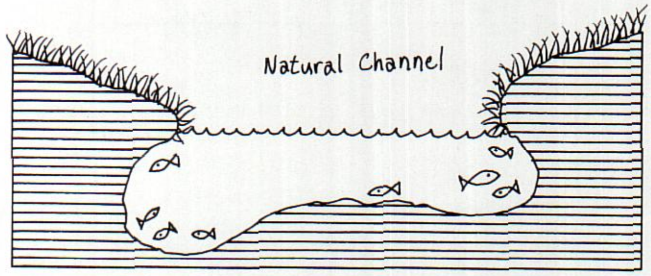
Stream Habitat

Habitat needs of trout are fairly simple: Cover for protection from predators and the current; water temperatures that remain cool enough to minimize stress and prevent death in summer; both land-based and aquatic insects and other invertebrates to provide food; adequate oxygen dissolved in the water to allow trout to "breathe," and instream flows that influence all of these characteristics.

Cover can be undercut banks, overhanging vegetation, turbulent or deep water, submerged logs or vegetation, large rocks, or anything that provides shelter for trout. Shrubs, grasses, and herbs growing along streams, collectively referred to as riparian vegetation, are very important for providing cover. Riparian vegetation stabilizes undercut banks, provides shade and overhanging cover along stream edges, and contributes logs and branches to the stream channel to provide additional cover. Large rocks form pools and submerged pockets that furnish resting and feeding sites.



Undisturbed stream channels hold significantly more trout than altered channels due to increased habitat.

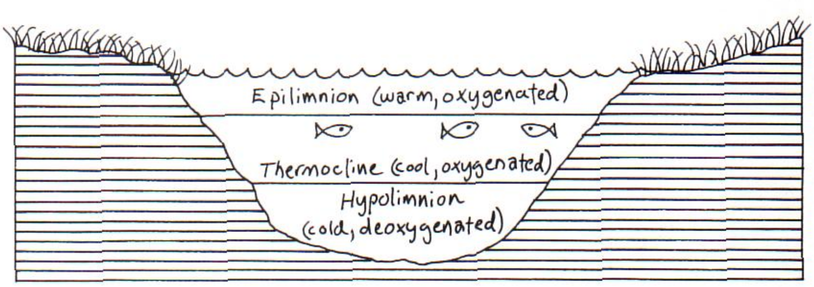


Optimal water temperatures for trout growth are in the mid-fifties to low sixties. Except in streams where flows are sustained by groundwater (which has a fairly constant temperature), temperatures in trout streams may fluctuate from near freezing to over 80 degrees during the year. Sustained exposure to high temperatures can cause trout to die. Short-term exposure to high temperatures reduces growth and increases susceptibility to disease. Alternatively, very low temperatures are accompanied by very little growth. Again, riparian vegetation is important because it regulates stream temperatures. In summer, the shade provided by vegetation moderates increases in temperature. In streams that remain open in winter, riparian vegetation reduces the loss of heat to the atmosphere and decreases the chance of anchor ice formation. If surface ice forms, vegetation can shield the banks from excessive erosion.

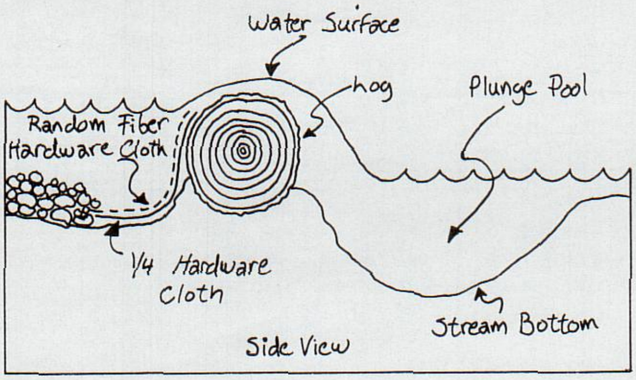
Most animals large enough to be seen, small enough to be eaten, and in or on streams will be consumed by trout. Trout food ranges from insects barely visible to the naked eye to small mammals such as mice. However, the bulk of this food consists of insects and other invertebrates. Aquatic invertebrates spend at least part of their life cycles in the stream. In most trout streams, the stream bottom abounds with immature and adult insects as well as worms, crayfish, and other invertebrates. In riffles, water flow through the gravel and cobble on the stream bottom is relatively high, and this flow delivers oxygen to bottom-dwelling organisms. Therefore, riffles are usually the most important food-producing areas in trout streams. But in fertile streams with very stable flows and temperatures, aquatic plants may support large populations of invertebrates that are available to trout. However, not all food comes from the stream. Terrestrial insects, such as grasshoppers or ants, often form a major portion of the trout diet in late summer. These insects don't spend any part of their life cycles in streams and only become available to trout by chance. Not surprisingly, streams with large amounts of riparian vegetation receive greater numbers of terrestrial insects.

The concentration of dissolved oxygen is directly influenced by water temperature, elevation, and barometric pressure. Trout do best when water contains as much oxygen as possible based on the three variables; this is called 100 percent saturation. Oxygen levels in streams may be substantially below saturation if the water contains large amounts of decomposing vegetation, pollutants, or other organic material.

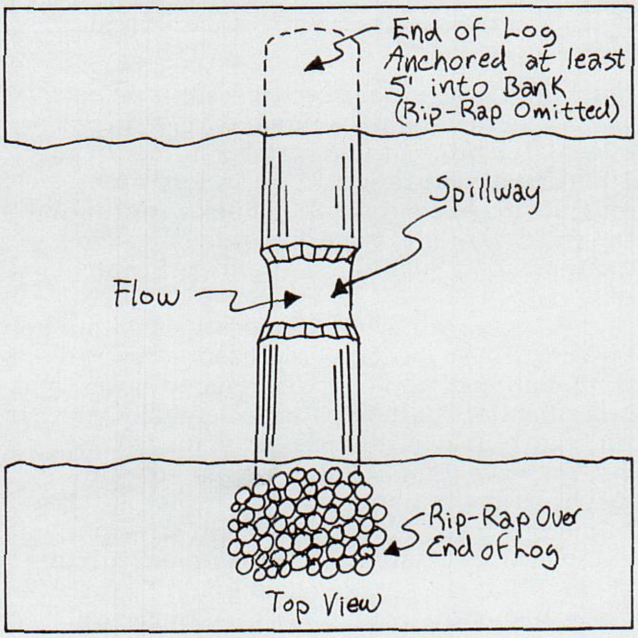
Trout occupy only certain locations within a stream. These locations represent a favorable combination of depth, water velocity, cover, and other habitat characteristics. Generally, more of these favorable locations exist at moderate stream flows than at lower stream flows, thus instream flow is important. For example, the number of favorable locations in a stream in late summer may determine the maximum number of trout that the stream can support. Furthermore, higher instream flows in summer will dampen the changes in water temperature. Optimal instream flows can provide habitats for spawning, incubation of eggs, and rearing of fry, as well as providing balance between the number of riffles, which provide food, and pools, which provide feeding and hiding sites for adults.



The layering of water in a deep lake during warm weather. The thermocline has both the temperature and oxygen concentration preferred by trout.



Construction of a low-profile log dam that reduces upstream water velocity. The small spillway scours the stream bottom creating pools downstream.



Lake Habitat

Trout have the same physiological needs in lakes as they do in streams, but the habitats are far different. Because trout in lakes don't fight a current and because lakes are often more fertile (and thus contain more food), trout in lakes may reach much larger sizes. However, trout face different problems in lakes that can influence their growth and survival.

In summer, the surface waters of lakes begin to warm up. Wind will mix the water and in shallow lakes there will be little difference between water temperatures at the lake surface and bottom. Temperatures in very shallow lakes may exceed those tolerated by trout. But in deeper lakes, the warm surface water will not completely mix with colder, denser water near the bottom. In summer, these deeper lakes are essentially divided in two layers: a warmer, more oxygenated upper layer (the epilimnion); a colder, less oxygenated lower layer (the hypolimnion); and a transitional zone between the two (the thermocline). Trout are limited to areas of favorable temperature and oxygen concentrations, and this favorable layer may become smaller as solar heating increases the temperature of the epilimnion and decomposition decreases the oxygen content of the hypolimnion. In autumn, the upper water layer cools and approaches the temperature of the lower layer. Then a single storm may cause the upper and lower layers to mix, returning oxygen to the deeper water.

Winter poses a different problem. Once ice covers the lake, mixing of the water may stop. Furthermore, aquatic vegetation will no longer release oxygen, but decomposition of dead plants and animals, as well as the breathing of living organisms, will continue to use oxygen. In large lakes, lakes with groundwater or surface inflow, or lakes with very little aquatic vegetation, enough oxygen will remain in the lake to support trout until oxygen becomes more available in the spring when the ice goes out. But in small, shallow lakes with no inflow and abundant aquatic vegetation, trout may die as oxygen concentrations fall below a critical concentration. This phenomenon is called winterkill.

Habitat Protection

It is much easier and cheaper to protect trout habitat in streams and lakes than it is to correct a problem caused by improper land management. To protect trout habitat, one should consider the needs of trout and reduce or avoid any activity that might damage habitat.

Livestock grazing can have a severe impact on trout habitat in streams and lakes. Livestock congregate around water and tend to heavily graze riparian vegetation. They may cause the collapse of undercut banks which results in a loss of cover and an increase in sedimentation. Fine sediment may fill the spaces between gravel particles on the stream bottom and reduce the abundance of aquatic invertebrates. Disturbance of lake shores increases the amount of fine sediment suspended in the water which can reduce the numbers of aquatic invertebrates. This reduced light also diminishes the ability of trout to feed. Organic wastes from livestock can increase the nutrients in lakes, leading to greater production of aquatic vegetation. This increase in fertility is called eutrophication and can result in a greater probability of winterkill.

Fencing watercourses and lake shores solves many of these problems but is extremely expensive. Alternatively, preventing overuse of one area by herding animals to other areas has been successful. Distributing salt blocks well away from water also may help. However, the best solution probably is simply to avoid overstocking a range.

Timber harvesting can harm trout habitat in streams by increasing sedimentation and damaging riparian vegetation. Riparian vegetation, including large trees, helps maintain the stability of stream channels. Eventually, dead timber will fall in the stream and provide cover and buffer the channel from high stream flows. Precautions should be taken to reduce sediment runoff from roads and logging equipment, and fallen timber should be kept out of stream channels. If possible, little or no timber should be harvested from the riparian zone.

Recreation and second homes usually have minor effects on streams and lakes, unless untreated sewage reaches the water. This can reduce dissolved oxygen concentrations in streams and lead to problems with excessive plant growth or algal blooms in lakes. Recall that the latter problem may lead to winterkill.

Habitat Improvement

Most streams and lakes will recover from man-caused damage to habitat, but habitat improvements hasten this process. Many of the improvement techniques simultaneously improve several different aspects of habitat.

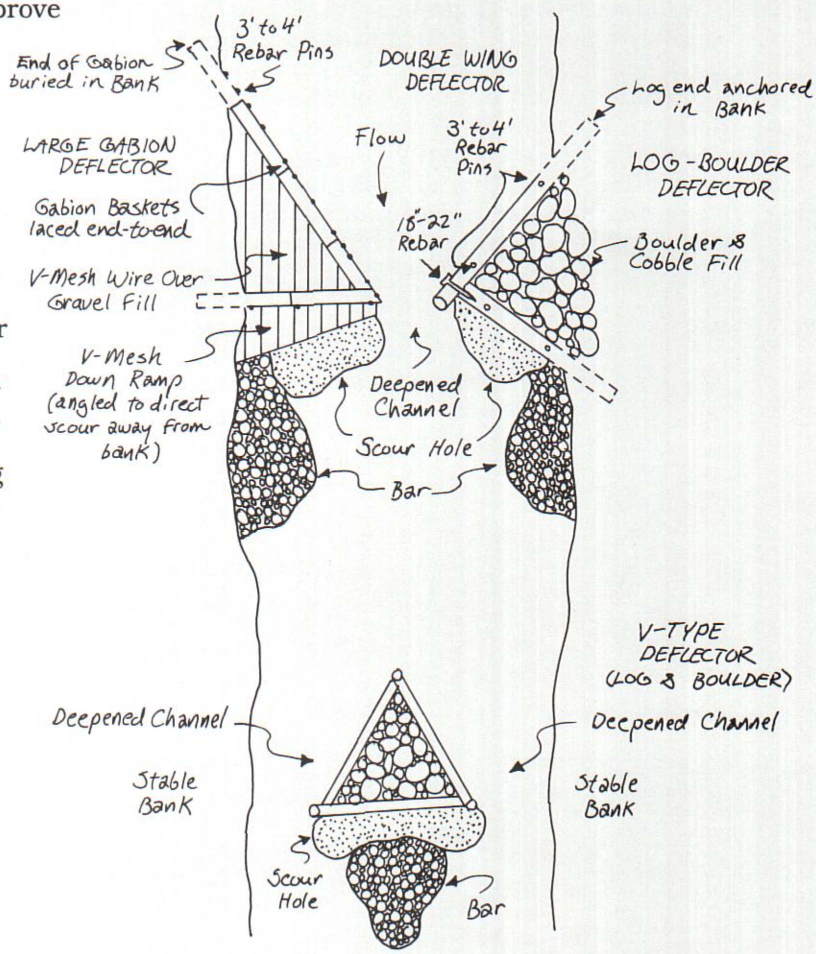
Current deflectors constructed of boulders, wire gabions, or logs narrow the stream channel and increase current velocity. During high flows, the stream bottom is scoured adjacent to the deflector, providing additional pool habitat by deepening the water and creating surface turbulence. To prevent the stream channel from shifting away from the deflector, the opposite bank should be very stable or two deflectors should be placed on opposite sides of the stream. Securely anchoring these structures is somewhat difficult.

Low-profile dams of the same materials decrease upstream water velocity, forming large pools, and the small waterfall downstream scours the stream bottom and creates another pool. Bank treatments, such as tree revetments or riprap, increase the amount of cover and help reduce bank erosion. Again, these structures must be correctly installed to be durable and enhance trout habitat.

There are natural, low-cost techniques for improving stream habitat for trout. If deciduous trees or shrubs are nearby or can be provided, beaver can be introduced. Their dams create excellent pool habitat and enhance the growth of riparian vegetation. However, beaver will remove many standing trees in an area. By planting shrubs, such as willows, a stream owner can accelerate the recovery of riparian vegetation and create the potential for greater bank stability, more cover, less stream heating, and greater availability of terrestrial insects.

Non-trout sport fish

Few other species of gamefish have become widely established in Wyoming. Smallmouth bass and largemouth bass have been introduced in a few areas, but Wyoming is generally too cold for either species to display good growth or survival. Green sunfish, bluegill, pumpkinseed, and white and black crappie have become



Building current deflectors in a stream-bed that increase water velocities. High water flows create scour holes and deeper channels.

established in some waters, but they rarely reach large sizes. However, all of these species can provide fisheries in fertile waters that contain abundant aquatic vegetation and are too warm for trout. Cover, in the form of shoreline vegetation, sunken logs or brush, or large rocks improves habitat quality. In good habitat, the problem becomes one of balancing the numbers of predatory species, such as bass, with forage species, such as sunfish.

Members of the perch family fare somewhat better. Walleye do well in Wyoming but usually only in very large lakes or reservoirs. Yellow perch survive quite well in many ponds and sluggish streams. However, individuals of this species may stunt if they are allowed to overpopulate.

In general, all of these species can tolerate higher water temperatures and lower concentrations of dissolved oxygen than trout. Introducing any of the aforementioned species into waters containing trout is risky. If the habitat is suitable for these other species, they may either out-compete or prey on trout. Alternatively, if their spread cannot be controlled, these species could replace trout in mediocre trout waters.

For More Information

Because the protection and improvement of fish habitat is a complex procedure, this review has been very general. The following references provide detailed information on the habitat needs of trout and on habitat protection and improvement techniques. These materials are available at the University of Wyoming Science Library or from the author(s). Because the science of maintaining and enhancing fish habitat is rapidly evolving, we recommend contacting the Wyoming Game and Fish Department for advice before beginning any project.

Marcus, M., M. K. Young, L. Noel, and B. Mullen. 1988. *Review, survey, and bibliography for research needs on salmonid-habitat relationships in the central Rocky Mountains.* Western Aquatics, Inc., 203 E. Grand, Laramie, Wyoming, 82070.

Nelson, R. W., G. C. Horak, and J. E. Olson. 1978. *Western reservoir and stream habitat improvements handbook.* U. S. Department of the Interior, U. S. Fish and Wildlife Service, Fort Collins, Colorado. FWS/OBS-78/56.

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Wesche, T. A. 1985. *Stream channel modifications and reclamation structures to enhance fish habitat.* Pages 103-164 in J. A. Gore, editor. The restoration of rivers and streams. Butterworth Publishers, Stoneham, Massachusetts.

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This publication is one in a series of habitat extension bulletins produced by the Wyoming Game and Fish Department. Call 1-800-842-1934 for additional information or assistance.