

## Warmwater Streams

February 2006

Fish and Wildlife Habitat Management Leaflet

Number 30

### Introduction

Streams and the corridors through which they flow are valued resources across the United States. Streams and stream corridors also support many recreational opportunities including fishing, canoeing, kayaking, swimming, and hiking. Stream corridors have tremendous economic value as agricultural and forest lands and provide some of the most desirable sites for real estate development, highways, and railroads. Less well understood, but equally important, are the ecological values stream corridors provide including water quality protection, water supply, flood pulses, nutrient cycling, and biological diversity. Warmwater streams provide habitat not only for popular game fish such as bass and catfish, but also for non-game fish such as darters and minnows, amphibians, aquatic insects, some reptiles, and many species of mussels, clams, and crayfish.

This leaflet focuses on small warmwater streams. The average water temperature of a warmwater stream during the summer is usually greater than 75 °F. This temperature generally excludes trout and other cold-water species that require cooler temperatures and higher oxygen levels. Readers of this leaflet will become more familiar with the physical, biological, and chemical processes that characterize warmwater stream systems and how these processes influence habitat conditions both within the stream and the adjacent riparian zone. In addition, methods, resources, and funding sources available to landowners wishing to conserve, improve, or restore warmwater stream habitats are identified.

### Warmwater stream systems

A stream corridor consists of a stream, its adjacent riparian zone, and its flood plain. The riparian zone is the portion of the terrestrial landscape from the high water mark towards the uplands, where vegetation may be influenced by elevated soil moisture. The flood plain is the land alongside the stream that is susceptible to flooding. Intact stream corridors are among



NRCS

**Clear Creek in California is an example of a warmwater stream.**

the most diverse, dynamic, and complex habitats and ecosystems in North America. Their riparian zones account for less than 2 percent of the land area of the United States, yet more vertebrates depend on these areas during some part of their life cycle than any other habitat type. Streams and their floodplains have historically served as town sites and have been used for irrigation, transportation, water supply, hydroelectric power, industrial development, and even waste disposal sites. These human activities cause increased surface erosion, excessive sedimentation, water pollution and altered hydrologic conditions, which significantly degrade or eliminate stream and riparian habitats.

A warmwater stream and its riparian zone is an integrated ecosystem, such that the effective functioning of one component affects the health of the others. For example, the seasonal flooding of streams enriches the soil of riparian areas with nutrient-rich alluvium. Alluvium is material (sand, gravel, silt, topsoil) that is deposited in the flood plain of a river or stream during flood events. Alluvium is created as a result of erosion. Alluvium can significantly alter floodplains, as is the case in the Mississippi River Delta, which began forming from alluvium millions of years ago. Alluvium from the Mississippi River has created rich, agricul-



Billy Teels, NRCS

**Riparian buffers protect and improve stream habitat.**

tural land in the lower Mississippi Delta. These deposits, along with increased soil-moisture from flooding, increase plant productivity in riparian zones and floodplains. Likewise, the stream benefits from the riparian plant community—overhanging vegetation provides shade and important cover for fish; tree roots stabilize banks; the input of leaf litter and other organic material feeds microbes and invertebrates that are at the base of the food chain; large wood provides instream cover and habitat complexity for aquatic species; and dense understory vegetation helps filter surface water that runs off the land during storms. Due to the interdependence of warmwater streams and their riparian zones, the degradation of either of these components adversely affects the flora and fauna of the others.

### Warmwater stream fauna

#### **Fish**

There are hundreds of different species of fish found in warmwater streams in the United States. The most complete guide available on freshwater fishes is *The Atlas of North American Freshwater Fishes* (Lee et al. 1980), which documents some 775 species. Table 1 lists some common native warmwater fishes.

To learn which fish species are likely to occur in a particular watershed, contact the local state fish and wildlife agency, or visit <http://www.fishbase.org/search.cfm> to search for the information on the internet. The distribution of fish throughout the United States depends on their particular habitat needs and their ability to colonize a given stream. Barriers to the dispersal of fish can be as large as a mountain range and can be as small as a road culvert or a 10-foot wa-

terfall. While some barriers to migration can easily be identified, others are difficult to detect. For example, a stream may be too steep for a fish to swim up, or a short segment of stream may have such poor water quality that a fish will avoid it.

#### **Factors affecting fish distribution**

The distribution of fish within a stream is affected by physical factors including water temperature, gradient or steepness, substrate, and flow. Temperature variations occur both seasonally and longitudinally (in an upstream and downstream direction), and different fish species tolerate or prefer different temperature ranges. Some species seek different temperatures at different stages of their life cycles. The gradient of the stream channel influences not only fish distribution, but also water velocity, substrate size, and pool formation.

Many natural factors cause variations in the chemical make-up of streams that in turn affect the distribution of fish. Hardness of the water (level of dissolved mineral concentration), dissolved oxygen, pH, salinity, and the concentrations of heavy metals and chlorine all affect the distribution and abundance of fish and other aquatic species.



Billy Teels, NRCS

**The satinfish shiner (*Notropis analostanus*) is one of a number of species of shiner found in warmwater streams across North America.**



Billy Teels, NRCS

**The largemouth bass (*Micropterus salmoides*) prefers clear, quiet waters with lots of vegetation and can be found in warmwater streams in most regions of the United States.**

## Warmwater Streams

**Table 1** Common native warmwater fishes<sup>1</sup>

Common name(s)	Genus	Range in North America
Rock bass, shadow bass, Roanoke bass	<i>Ambloplites</i>	Eastern U.S., Great Lakes Region
Central stoneroller, largescale stoneroller, Mexican stoneroller, bluefin stoneroller	<i>Campostoma</i>	Eastern and central U.S., northern Mexico
Suckers (many different species)	<i>Catostomus</i>	Most of continental U.S. and Canada, northern Mexico
Redside dace, rosyside dace	<i>Clinostomus</i>	Great Lakes Region, eastern U.S.
Banded pygmy sunfish, Okefenokee pygmy sunfish, everglades pygmy sunfish	<i>Elassoma</i>	Southeastern U.S.
Blackbanded sunfish, bluespotted sunfish, banded sunfish	<i>Enneacanthus</i>	Eastern U.S.
Chain pickerel, grass pickerel, redfin pickerel, muskellunge	<i>Esox</i>	Eastern U.S., Mississippi Valley, Great Lakes Region
Smoothbelly darters (many different species)	<i>Etheostoma</i>	Central and eastern U.S.
Topminnows (many different species)	<i>Fundulus</i>	Eastern U.S., Mississippi Valley
Bigeye chub, highback chub, lined chub, rosyface chub, clear chub	<i>Hybopsis</i>	Eastern U.S., Mississippi Valley, Great Lakes Region
Channel catfish, blue catfish	<i>Ictalurus</i>	Central U.S., southern Canada
Redbreast sunfish, green sunfish, orangespotted sunfish, bluegill, dollar sunfish, longear sunfish, redear sunfish, spotted sunfish	<i>Lepomis</i>	Most of continental U.S.
White shiner, crecent shiner, striped shiner, warpaint shiner, common shiner, duskystripe shiner, bleeding shiner, bandfin shiner	<i>Luxilus</i>	Eastern U.S. and Great Lakes Region
Largemouth bass, redeyebass, smallmouth bass, Suwannee bass, spotted bass, Guadalupe bass	<i>Micropterus</i>	Continental U.S.
Striped bass, yellow bass, white bass, white perch	<i>Morone</i>	Most of continental U.S.
Redhorse suckers, redhorses (many different species)	<i>Moxostoma</i>	Central U.S., Mississippi Valley, central Canada
Bull chub, bigmouth chub, river chub, bluehead chub, redbtail chub, hornyhead chub, redspot chub	<i>Nocomis</i>	Eastern U.S., Mississippi Valley, Great Lakes Region
Shiners (many different species), redeye chub, silverjaw minnows, Ozark minnows	<i>Notropis</i>	Most of continental U.S., central Canada
Madtoms (many different species)	<i>Noturus</i>	Eastern U.S., Mississippi Valley, Great Lakes Region
Roughbelly darters (many different species)	<i>Percina</i>	Eastern and central U.S., central Canada
Creek chub, fallfish, Sandhills chub	<i>Semotilus</i>	Eastern and central U.S.

<sup>1</sup>For specific habitat information about these fish, visit [www.fishbase.org/search.cfm](http://www.fishbase.org/search.cfm).

Several biological factors also affect fish distribution, not only longitudinally, but also vertically in the water column, and according to specific habitats within a reach of stream. Biological factors affecting fish distributions include predation, competition, and behavioral differences. For a given species to exist in the presence of one of its predators, it must have access to hiding cover in the form of large bottom substrate, woody material, or overhanging banks and vegetation.

Behavioral differences among fish include choice of substrate for spawning (laying eggs) and feeding behavior. Some fish use sandy stream bottoms to spawn, some spawn on vegetation or in the water column, some require gravel or crevices to build their nests, and others bear live young. Feeding behaviors differ greatly among species and vary according to where in the water column a fish finds food, the time of day it feeds, the type of food eaten, and the size of food items selected. Many species can be found in close proximity due to only slight differences in feeding behavior. For example, it is not uncommon for more than 20 species of fish to occupy a relatively short reach of many southern streams (approximately 100 meters).

Whereas many natural influences affect the distribution of fish and other aquatic organisms, human disturbances are often equally influential. For example, acidic water drainage from mines and roadfills (soil material used in road embankments) has reduced aquatic fauna and caused water quality problems in many streams of the eastern United States. Hydroelectric dams and water supply impoundments can dramatically alter a stream's flow regime and habitat quality and act as physical barriers to fish dispersal, while sewage and industrial wastewater outflows often create chemical barriers. In addition, human intervention has significantly expanded the range of many fish species, both intentionally and unintentionally, to areas where they did not naturally occur. The introduction of non-native species has contributed to the decline and extinction of many native fish that were not able to survive in the face of new competition or predation.

The combined effect of human influences has been a dramatic decline in native freshwater fauna. About one-fourth of native freshwater fish species, three-fourths of native freshwater mussel species, one-fourth of native amphibians, and one-third of native crayfish species are considered to be imperiled or extinct. In 1998, at least 40 percent (by length) of streams of the United States were listed as impaired by the Environmental Protection Agency (EPA). This effect is most pronounced in warmwater streams where the greatest faunal diversity and most extensive disturbances occur.

## Aquatic macroinvertebrates

Aquatic macroinvertebrates including insects, crustaceans, mollusks, and worms are an important part of the aquatic food web, feeding on organic material (algae or leaves) and other organisms, and serving as food for larger animals, such as fish. Aquatic macroinvertebrates can serve as indicators of water quality. Because these aquatic animals differ in their sensitivities to water pollution, their presence or absence is a good indication of the quality of the water in which they are found. Table 2 identifies various macroinvertebrates and their sensitivities to contamination. By examining the macroinvertebrates living in a particular stream reach, the water quality and overall stream health can be inferred.

Freshwater mussels make up a large group of aquatic macroinvertebrates. Nearly 300 species and subspecies of freshwater mussels are present in the United States. The south-central United States has the highest diversity of freshwater mussels in the world. Like many other aquatic macroinvertebrates, freshwater mussels are highly sensitive to habitat disturbances. Of the 297 known native mussel species in the United



Billy Teels, NRCS

**Giant stoneflies (*Pteronarcys californica*, above) and leeches (*Clitellata*, Subclass: *Hirudinea*, below) are aquatic macroinvertebrates found in streams. Giant stoneflies are very sensitive to water contamination, while leeches are tolerant of it.**

States, 72 percent are considered endangered, threatened, or of special concern. Only 70 species are considered to have stable populations, although many of these also have declined in abundance and distribution. Freshwater mussels benefit from intact, well-managed stream reaches. When stream reaches become degraded as a result of human activity, mussel populations suffer.

**Amphibians and reptiles**

Many amphibians (frogs, toads, salamanders, and newts) require access to warmwater streams to complete various stages of their life cycles (breeding), as well as to keep their glandular skin moist. Amphibians are most frequent and abundant in flood plain wetlands and riparian zones during their breeding seasons. Some species of reptile including turtles, lizards, alligators, and snakes also depend on riparian areas adjacent to streams for feeding, basking, and egg-laying. Riparian areas can be critical for reptiles and amphibians by providing avenues for dispersion to new habitats.

**Stream assessment**

Landowners wishing to improve stream habitat should first evaluate the existing conditions. The health of a stream ecosystem depends on the interaction of several physical, chemical, and biological processes that can be relatively easy to evaluate. However, many factors such as streamflow, water quality, and sediment transport are affected by processes occurring upstream or at other places in the watershed and so cannot be adequately addressed by the evaluation of a small reach. On the other hand,

there is much that a landowner can do to protect and/or improve stream and riparian habitat quality on the property. A quick visual assessment will often yield clues about the general health of a stream reach. A simple evaluation of canopy cover in the riparian area, bank stability, water clarity, and other easily recognizable features often suggest actions that can be taken to improve stream and riparian habitat.

The Stream Visual Assessment Protocol (SVAP) developed by the Natural Resources Conservation Service (NRCS) is a simple tool that requires little specialized equipment or experience. Table 3 summarizes some of the components and characteristics of streams evaluated by the SVAP. Using SVAP, the landowner can evaluate and score each stream habitat component separately and then average all the scores together to determine an overall rating of stream condition. If the landowners do not feel that they have the expertise to make this assessment, they can solicit assistance from the local NRCS biologist. Individuals interested in obtaining a copy of the SVAP can visit <http://www.nrcs.usda.gov/technical/ECS/aquatic/svapfnl.pdf>.

**Conserving and restoring instream and riparian habitats**

Once a reach of stream has been assessed, the landowner may focus on actions that can be taken on the property that will benefit the stream and its flora and fauna. Techniques to improve instream cover, such as placing large wood in the stream, are often successful at increasing the diversity and abundance of fish. For long-term maintenance of good aquatic habitat, establishment of riparian vegetation that will naturally fall into the stream may be all that is required. Other approaches to stream corridor restoration are described in the multi-agency Stream Corridor Restoration Handbook available online at [http://www.nrcs.usda.gov/technical/stream\\_restoration/](http://www.nrcs.usda.gov/technical/stream_restoration/).

Larger-scale stream habitat improvements should be planned in partnership with other land users who manage lands adjacent to streams. Before designing and implementing a stream habitat project, consider the known or expected problems within the watershed such as non-point source water pollution land management activities such as logging, farming, or development; and other watershed-related concerns. Non-point source pollution comes from many diffuse sources. It is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into streams and other bodies of water. The pollutants in

**Table 2** Aquatic macroinvertebrate sensitivity to pollution

Very sensitive	Somewhat sensitive	Tolerant
Caddisflies	Damselflies	Aquatic worms
Mayflies	Dragonflies	Black fly larvae
Stoneflies	Crayfish	Midge fly larvae
Riffle beetles	Scuds	Leeches
Water pennies	Sowbugs	Pouch snails
Gilled snails		Other snails
Hellgrammites		
Freshwater mussels		

## Warmwater Streams

non-point source pollution include: excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas; oil, grease, and toxic chemicals from urban runoff and energy production; and sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks.

Any stream habitat management project is most effective when applied within the context of overall watershed conditions and with clear objectives for stream management goals. There are several options that can be used singularly or in combination to improve stream habitat:

- Through watershed planning, establish soil conservation, nutrient management, pesticide management, and other management practices to minimize non-point sources of water pollution.
- Manage excessive surface runoff with grassed waterways.
- Restore or protect riparian and flood plain vegetation and associated wetlands.
- Maintain enough water in the stream to allow fish species to swim upstream and downstream.
- Maintain physical habitat components important to aquatic species such as sediment-free spawning gravel, boulders, large wood, resting pools, overhead cover, and stable banks.
- Eliminate fish migration barriers such as improperly installed stream crossings.
- Provide barriers/screens to exclude fish and other aquatic species from water pumps, diversion ditches, or any area where unintentional entrapment could occur.

**Table 3** SVAP components of stream health

	High score	Above average score	Below average score	Low score
<b>Channel condition</b>	Natural channel; no evidence of erosion	Evidence of past channel alteration	Altered channel	Channel is actively downcutting or widening
<b>Hydrologic alteration</b>	Flooding every 1.5–2 years	Flooding every 3–5 years	Flooding every 6–10 years	No flooding
<b>Riparian zone</b>	Natural vegetation extends >2 active channel widths on each side	Natural vegetation extends 1 active channel width on each side	Natural vegetation extends 1/3 of active channel width on each side	Natural vegetation extends <1/3 the active channel width on each side
<b>Bank stability</b>	Stable	Moderately stable	Moderately unstable	Unstable
<b>Water appearance</b>	Very clear or clear, but tea-colored	Occasionally cloudy	Considerable cloudiness	Very turbid or muddy
<b>Nutrient enrichment</b>	Clear water	Slightly greenish water	Greenish water	Pea green, gray, or brown water
<b>Barriers to fish movement</b>	No barriers	Water withdrawals limit fish movement	Drop structures <1 foot	Drop structures >1 foot
<b>Instream fish cover</b>	>7 cover types available	5-6 cover types available	2-3 cover types available	0-1 cover type available
<b>Pools</b>	Deep and shallow pools abundant	Pools present but not abundant	Pools present but shallow	Pools absent
<b>Riffle embeddedness</b>	Gravel or cobble particles are <20% covered with fine sediment	Gravel or cobble particles are 20-40% covered with fine sediment	Gravel or cobble particles are >40% covered with fine sediment	Riffle is completely covered with fine sediment

- Improve flood plain-to-stream channel connectivity including off-channel habitats by setting back or eliminating berms, levees, and dikes.
- Limit streamside access for recreational use, livestock, and equipment.
- Use irrigation waters as efficiently as possible, maximizing the amount of water left in the stream for aquatic fauna.

### ***Maintain or restore riparian buffers***

By far the most important factor affecting stream conditions and aquatic habitats on a local scale is the presence of an ecologically functional riparian buffer. Vegetated stream buffers serve numerous functions including filtration of sediments, nutrients, and toxins; contribution of woody material to the stream channel; contribution of organic matter that forms the base of the food chain; floodwater storage; bank stabilization and erosion reduction; shading and consequent stabilization of water temperatures; and provision of habitat for terrestrial invertebrates, amphibians, reptiles, birds, and mammals. The benefits of riparian buffers on both aquatic and terrestrial wildlife vary dramatically based on the types of vegetation planted and the width of the area planted. In general, benefits increase with increasing width and complexity, and the wider and more ecologically complex the buffer the more value it will have for wildlife and other aquatic species in the stream.

In naturally forested landscapes, the ideal riparian buffer zone has mature trees spaced sufficiently to allow an understory of grasses, forbs, and shrubs. Trees should be close enough to the stream so that exposed roots supply cover and allow stable undercut banks to develop. This proximity to the channel assures that



*Kathryn Boyer, NRCS*

**Vegetated riparian buffers serve valuable ecological functions.**

some trees will fall into the stream when they die, providing habitat complexity in the channel. Grasses, forbs, and shrubs should have deep root systems, dense top growth, and an ability to recover and grow subsequent to inundation of water and sediments during floods.

Landowners can take an active role in maintaining and restoring riparian buffers by planting native woody species as seedlings or saplings. On the other hand, the landowner may choose to take a passive approach to restoration, and simply allow natural recruitment of woody species along the streambank. If the landowner takes the more active approach, there are a number of factors to consider.

Before beginning, a landowner should examine the surrounding plant community and learn about native plant species and current and projected flooding of the stream. With this information, the landowner is better equipped to restore native vegetation in such a way as to maximize growth based on flooding and/or drought. It is not practical to plant the full complement of vegetation desired in the riparian area. Rather, a landowner should plant dominant species, or those species unlikely to colonize readily, and let the others establish themselves over time. Typically, vegetation at the outside edge of the stream corridor is very different from the vegetation that occurs within the interior of the corridor. The topography, aspect, soil, and hydrology of the corridor provide several naturally diverse layers and types of vegetation. An edge that gradually changes from the stream corridor into the adjacent landscape features will soften environmental gradients, minimize any associated disturbances, encourage species diversity, and buffer nutrient and energy flows.

### ***Leave woody material in place***

Woody material in the form of fallen trees, limbs, and branches plays a major role in both aquatic and terrestrial components of ecosystems and should be maintained within the riparian buffer. Woody material helps trap sediment that may otherwise enter the stream. In addition, woody materials create seedbeds for additional recruitment of woody species, help retain moisture during droughts, and provide an important habitat component for many invertebrates, amphibians, reptiles, birds, and mammals. Along the stream bank, branches and fallen trees can help to stabilize streambanks and provide moist cover for amphibians such as salamanders. Within the stream channel, large wood provides important cover for many fish and other organisms and traps fine sediments. Large logs extending above the water are often used as perch sites for wading birds while reptiles



Billy Teels, NRCS

**Woody material plays a major role in both aquatic and terrestrial ecosystems.**

such as turtles and snakes often use them to bask in the sun.

Allowing fallen tree limbs, branches, and even entire trees to stay in-place can significantly improve both instream and riparian habitat. To maintain the ecological integrity of the stream and riparian area, it is not essential that every piece of woody material be left in place, but rather that the landowner takes into consideration the value of woody material to wildlife rather than hastily clearing the ground to a manicured and unnatural state. Through informed decisions, ecological benefits and personal preferences for aesthetic appearance can be well balanced.

***Construct fishways and replace culverts***

Instream barriers, such as dams, weirs, and road culverts, can reduce the ability of many fish to move freely upstream and downstream to spawning, rearing, and feeding areas. While some barriers are man-made,

others are natural, such as cascades or waterfalls. If possible, man-made fish barriers should be removed or modified to allow fish passage. Replacing culverts to conform to the gradient of the stream and allow free fish passage can be done efficiently by working with conservation partners and state agencies. For example, bottomless arch culverts can replace perched culverts to make fish passage easy. Fishways can be built to allow fish to migrate through or over barriers. Fishways are constructed by creating a series of pools and small steps over or around the barrier, usually with rocks. Fish are able to move up or down the fishway by swimming into a pool, resting, and then swimming up or down the step into the next pool, until they have cleared the barrier. For more information on fish passage techniques, see <http://wdfw.wa.gov/hab/engineer/habeng.htm> or <http://www.stream.fs.fed.us/fishxing/index.html>.

***Manage livestock access***

Livestock using riparian areas and streams for forage or water often trample streambanks and riparian vegetation. Grazing prescriptions that minimize access to these vulnerable areas are an effective way to protect stream corridors. Fences can be built to limit livestock access to riparian areas where damage is extensive. If livestock need access to the stream for water, a fenced chute can be installed to allow access to only a small portion of the stream. Funding for fencing to manage livestock access in streams and riparian areas is available to landowners through the USDA Wetland Reserve, Wildlife Habitat Incentive, and Environmental Quality Incentive Programs, and the U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program (table 4).



Washington Department of Fish and Wildlife

**Bottomless arch culverts (left) can replace perched culverts (right) to make fish passage easy.**

**Warmwater Streams**

**Table 4** Assistance programs

<b>Program</b>	<b>Land eligibility</b>	<b>Type of assistance</b>	<b>Contact</b>
Conservation Reserve Program	Cropland (including field margins), riparian pastureland, highly erodible land	50% cost-share for establishing permanent cover, annual rental payments in return for establishing long-term, resource-conserving covers, additional financial incentives are available for some practices	NRCS or FSA state or local office
Environmental Quality Incentives Program	Cropland, rangeland, grazing land, and other agricultural land in need of treatment	Up to 75% cost-share and incentive payments to implement conservation practices to a maximum term of 10 years	NRCS state or local office
Partners for Fish and Wildlife Program	Most degraded fish and/or wildlife habitat	Up to 100% financial and technical assistance to restore wildlife habitat under minimum 10-year cooperative agreements	U.S. Fish and Wildlife Service local office
Waterways for Wildlife	Private land	Technical and program development assistance to coalesce habitat efforts of corporations and private landowners to meet common watershed level goals	Wildlife Habitat Council
Wetlands Reserve Program	Previously degraded wetland and adjacent upland buffer, with limited amount of natural wetland and existing or restorable riparian areas	75% cost-share for wetland restoration under 10-year contracts and 30-year easements, and 100% cost-share on restoration under permanent easements. Payments for purchase of 30-year or permanent conservation easements	NRCS state or local office
Wildlife at Work	Corporate land	Technical assistance on developing habitat projects into a program that will allow companies to involve employees and the community	Wildlife Habitat Council
Wildlife Habitat Incentives Program	High-priority fish and wildlife habitats	Up to 75% cost-share for conservation practices under 5- to 10-year contracts	NRCS state or local office



Billy Teels, NRCS

**Fences can be built to keep livestock away from streams, protecting streambanks.**

### ***Use pesticides and fertilizers safely***

Fertilizers and pesticides (including herbicides and insecticides) can have serious detrimental effects on stream habitat and water quality. Fertilizers are taken up by algae in stream waters, a process that uses up valuable oxygen and can produce poisonous methane, ammonia, and sulfur gases, which can kill fish and other aquatic animals. Pesticides can be toxic to humans, animals, and plants and they are one of many factors contributing to the decline of fish and other aquatic organisms. Insecticides are used to kill destructive crop and forest insects, but they can also kill beneficial stream insects and fish. Similarly, herbicides used to kill land weeds can also kill oxygen-producing water plants and reduce the food supply for aquatic animals.

Homeowners, farmers, ranchers, and land managers using fertilizers and pesticides can use these chemicals wisely and minimize their effects on warmwater streams.

- Avoid fertilizing near streams or on steep slopes, particularly during rainy weather or when the ground is frozen or covered with ice and snow.
- Apply pesticides only when and where necessary, using those that are short-lived, avoiding applications near streams or drainage ditches, using soil conservation practices to limit runoff, and properly disposing of old or unused pesticides and their containers.
- Read and follow the directions on fertilizer or pesticide labels.
- Consider Integrated Pest Management (IPM) when managing insects and other pests.

IPM is a system of using a variety of methods, including pesticides, to reduce pest populations to acceptable levels. IPM strategies include agricultural control (crop rotation and selected planting dates to avoid pests), host resistance (using plants and livestock that are resistant to pests), mechanical control (uprooting, weed harvesting, cultivation, and use of insect traps), biological control (introducing a pest's natural predators), and chemical control (using pesticides).

### ***Address streambank conditions***

Severely eroding streambanks are often the first sign that a stream and its habitat are in poor condition. Landowners wishing to stop erosion of streambanks should seek technical assistance in evaluating the cause of the severe erosion and methods to minimize further damage that are compatible with conservation of fish and wildlife habitat. Newer approaches to streambank stabilization especially suitable for small streams involve using natural materials such as logs, boulders, live trees, and/or branches to temporarily arrest erosion until riparian vegetation can be re-established. These approaches, referred to as bioengineering, usually employ live cuttings of readily sprouting species that are set deep into the bank.

Streambank restoration has proven most successful in slowing bank erosion when the flow regime is relatively unaltered or controlled to mimic natural conditions. Decisions regarding whether and how to use stabilizing techniques should be based on local site conditions, as well as watershed conditions, such that no standard approach can be outlined in this leaflet. Successful implementation of bioengineering techniques requires professional design, installation, and long-term monitoring. However, in many cases bioengineering is the most effective solution available to re-



Billy Teels, NRCS

**The instability and erosion apparent in this stream are signs of an unhealthy streambank.**



*Federal Interagency Stream Restoration Working Group, 1998*

**Bioengineering employs live cuttings of readily sprouting species that are set deep into the bank to increase streambank stability.**

store streambanks to healthy conditions, so landowners should consider contacting local state agencies for assistance with streambanks that have been severely eroded. In such cases, professional opinions will be invaluable in determining what solutions are likely to be most cost effective, if indeed a feasible option does exist. For additional information and guidelines for implementation, see <http://plant-materials.nrcs.usda.gov/technical/publications/riparian.html>.

### **Assistance programs**

Financial and technical assistance for maintaining and improving warmwater stream habitat is available from an array of government agencies and public and private organizations. Table 4 lists organizations that can provide technical and/or financial assistance to landowners for warmwater stream management and other natural resource projects, and describes their associated conservation incentive programs.

### **Conclusion**

Human activity has had a significant impact on warmwater streams and the fish, aquatic invertebrates, birds, mammals, reptiles, and amphibians that live in and around them. However, warmwater streams can be managed in such a way to protect, improve, or restore stream habitats. A stream assessment, followed by habitat management practices such as maintaining and restoring riparian buffers, managing woody material, reengineering stream crossings, managing livestock access, limiting and properly using fertilizers and pesticides, and addressing streambank conditions can greatly benefit the habitats and biota of warmwater streams. The resultant healthier streams provide many ecological and economic benefits, including recreational opportunities and increased water quality and biodiversity.

## References

### On-line sources

FishBase: A global information system on fishes. 2005. Search FishBase. <http://www.fishbase.org/search.cfm> [Accessed 31 March 2005].

National Biological Service. n.d. Freshwater mussels: a neglected and declining natural resource. <http://biology.usgs.gov/s+t/noframe/f076.htm> [Accessed 10 November 2004].

United States Department of Agriculture. 2002. Integrated taxonomic information system. <http://www.itis.usda.gov/> [Accessed 9 November 2004].

Washington Department of Fish and Wildlife. 2005. Fish passage technical assistance. <http://wdfw.wa.gov/hab/engineer/habeng.htm> [Accessed 31 March 2005].

### Printed sources

Bentrup, G. and J.C. Hoag. 1998. The practical stream-bank bioengineering guide. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID, USA. Available at <http://plant-materials.nrcs.usda.gov/pubs/idpmcpustguid.pdf>.

Federal Interagency Stream Restoration Working Group. 1998. Stream corridor restoration: principles, processes, and practices. Available at [http://www.nrcs.usda.gov/technical/stream\\_restoration/](http://www.nrcs.usda.gov/technical/stream_restoration/).

Firehock, K. and J. Doherty. 1995. A citizen's stream-bank restoration handbook. Isaak Walton League of America, Inc., Gaithersburg, MD, USA.

Flanagan, S.M., K.W. Nielsen, K.W. Robinson, and J.F. Coles. 1999. Water-quality assessment of the New England coastal basins in Maine, Massachusetts, New Hampshire, and Rhode Island: environmental settings and implications for water quality and aquatic biota. U.S. Geological Survey Water-Resources Investigations Report 98-4249.

Glasgow, L.L. and R.E. Noble. 1971. The importance of bottomland hardwoods to wildlife. Proceedings, Symposium on Southeastern Hardwoods. United States Department of Agriculture, Forest Service.

Helfrich, L.A., D.L. Weigmann, P. Hipkins, and E.R. Stinson. 1996. Pesticides and aquatic animals: a guide to reducing impacts on aquatic systems. Virginia Cooperative Extension Publication Number 420-013. Virginia Polytechnic Institute and State University and Virginia State University, VA, USA.

Helfrich, L.A., D.L. Weigmann, and R.J. Neves. 1998. Landowner's guide to managing streams in the eastern United States. Virginia Cooperative Extension Publication Number 420-141. Virginia Polytechnic Institute and State University and Virginia State University, VA, USA.

Kohler, C.C. and W.A. Hubert, editors. 1999. Inland fisheries management in North America, second edition. American Fisheries Society, Bethesda, MD, USA.

Lee, D.S., C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J. R. Stauffer, Jr. 1980. Atlas of North American fresh water fishes. North Carolina State Museum of Natural History, NC, USA.

Moyle, P.B. and J.J. Cech, Jr. 2000. Fishes: an introduction to ichthyology, fourth edition. Prentice Hall, Upper Saddle River, NJ, USA.

Naiman, R.J., H. Decamps, and M. Pollack. 1993. The role of riparian corridors in maintaining regional diversity. *Ecological Applications* 3: 209-211.

Natural Resources Conservation Service Aquatic Assessment Working Group. 1998. Stream visual assessment protocol. National Water and Climate Center Technical Note 99-1. United States Department of Agriculture, Natural Resource Conservation Service. Available at: <http://www.nrcs.usda.gov/technical/ECS/aquatic/svapfnl.pdf>.

Popotnik, G.J. and W.M. Giuliano. 2000. Response of birds to grazing of riparian zones. *Journal of Wildlife Management* 64: 976-982.

Schueler, T.R. and H.K. Holland, ed. 2000. The practice of watershed protection. Center for Watershed Protection, Ellicott City, MD, USA.

Shields, F.D., Jr., S.S. Knight, N. Morin, and J.C. Blank. 2003. Response of fishes and aquatic habitats to sand-bed stream restoration using large woody debris. *Hydrobiologia* 494: 251-257.

Stein, B.A. and S.R. Flack. 1997. 1997 species report card: the state of U.S. plants and animals. The Nature Conservancy, Arlington, VA, USA.

Taylor, C.A., M.L. Warren, J.F. Fitzpatrick, H.H. Hobbs, R.F. Jezerinac, W.L. Pflieger, and H. W. Robison. 1996. Conservation status of crayfishes of the United States and Canada. *Fisheries* 21: 25-38.

Verry, E.S., J. Hornbeck, and C.A. Dolloff, eds. 2000. Riparian management in forests of the eastern continental United States. CRC-Lewis Publishers, FL, USA.

- United States Environmental Protection Agency. 2000. Water quality conditions in the United States: the 1998 national water quality inventory report to congress. Report No. EPA841-R-00-001, Washington, DC, USA.
- United States Department of Agriculture. 2003. Fish assemblages as indicators of the biological condition of streams and watersheds. Technical Note 190-16, Natural Resources Conservation Service, Washington, DC, USA.
- United States Department of Agriculture. 2001. Fish passage. Conservation Practice Standard Number 396. Natural Resources Conservation Service. Available at *ftp://ftp-fc.sc.egov.usda.gov/NHQ/practice-standards/standards/396.pdf*.
- Washington Department of Fish and Wildlife. 2000. Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual.
- Williams, J.D., M.L. Warren Jr., K.S. Cummings, J.L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. *Fisheries* 18: 6-22.
- Williams, J.E., J.E. Johnson, D.A. Hendrickson, S. Contreras-Balderas, J.D. Williams, M. Navarro-Mendoza, D.E. McAllister, and J.E. Deacon. 1989. Fishes of North America endangered, threatened, or of special concern. *Fisheries* 14: 3-20.

**Natural Resources Conservation Service**

*Mailing address:*

P.O. Box 2890  
Washington, DC 20013

*Street address:*

14th and Independence Avenue SW  
Washington, DC 20250

The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment.



[www.nrcs.usda.gov](http://www.nrcs.usda.gov)

**Wildlife Habitat Council**

8737 Colesville Road, Suite 800  
Silver Spring, Maryland 20910  
(301) 588-8994

The mission of the Wildlife Habitat Council is to increase the amount of quality wildlife habitat on corporate, private, and public land. WHC engages corporations, public agencies, and private, non-profit organizations on a voluntary basis as one team for the recovery, development, and preservation of wildlife habitat worldwide.



[www.wildlifehc.org](http://www.wildlifehc.org)

Primary authors: **Bob Batz** and **Raissa Marks**, Wildlife Habitat Council. Drafts reviewed by: **Rob Pauline**, Wildlife Habitat Council; **Kathryn Boyer**, Natural Resources Conservation Service; **Billy Teels**, Natural Resources Conservation Service; **Donald C. Jackson**, Mississippi State University; **C. Andrew Doloff**, Virginia Tech University; **Paul Angermeier**, Virginia Tech University; and **Ed Buckner**, University of Arkansas at Pine Bluff.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.