Missouri Streams Fact Sheet

STREAM HABITAT

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When most people think of *habitat*, they usually picture places where fish or wildlife live, like a hollow log or a fox den. This is only a part of habitat. Stream habitat includes the physical and chemical conditions of their ecosystems. There are many habitat conditions that all play a large role in determining the numbers, sizes and species of fish and aquatic invertebrates that live in a stream.

What factors affect stream habitat?

A stream reflects conditions in the watershed. Climate, topography, geology and vegetation in a watershed control streamflow and the size and shape of stream channels. Geology determines the extent of ground water storage, type of soils, material available for erosion and transport and the basic chemical makeup of the water. In the same way, the surrounding riparian corridor of a stream directly and indirectly affects the stream habitat.

Streamside vegetation helps determine a stream's species diversity and biological productivity. This vegetation provides woody debris which serves as cover for fish to hide from predators or to stalk their prey. The woody debris also creates scour holes that increase depth and velocity variety in a channel. Leaves from riparian trees and other organic materials are important in a stream's food web (Figure 1). Riparian plants can also reduce flood peaks, enhance base flows, slow erosive energy of floodwaters, filter sediments and nutrients, effect water temperature and dissolved oxygen levels and help stabilize stream banks, all of which affect habitat.

Stream Habitat Affects Aquatic Communities

There are five categories of habitat factors that affect stream fish and aquatic communities; s*treamflow, water quality, food sources, physical habitat* and *biotic interactions*. The complex mixture of these factors and characteristics determines what fish and aquatic invertebrates can be found in a stream reach. If any of these factors are changed, stream communities will be

Figure 1

affected. Also remember that characteristics of the watershed and riparian zone affect these five habitat factors. So, to effectively protect and improve stream habitat, the extremely complicated relationships between aquatic and terrestrial environments and stream life must be considered.

Streamflow

Streamflow is influenced by precipitation, evapotranspiration, groundwater storage, shape and size of the watershed, dams, water withdrawals, vegetation and land use within the watershed. Streamflow directly affects aquatic communities by influencing water quality, food sources, biotic interactions and creation and the availability of physical habitat.

Stream life needs water!

The fact that stream life needs water to live may seem obvious, but how much water is needed and when it is needed are not so easy to understand. Any watershed practice that changes base streamflows affects stream habitat. Reduction in base streamflow usually harms stream communities by changing water quality, reducing available food and wetted habitats.

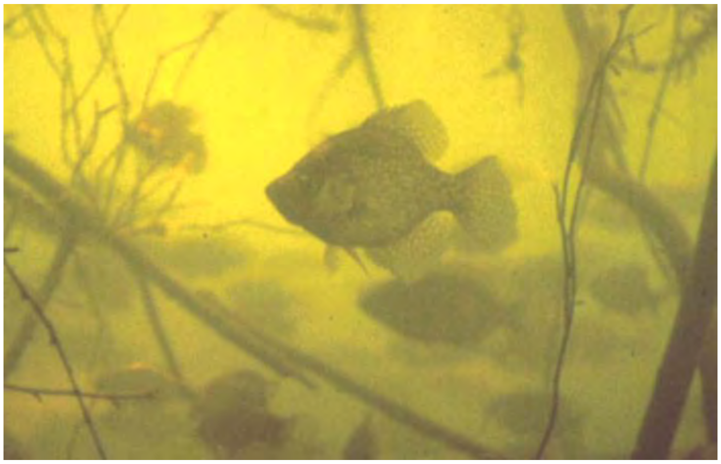

Figure 2

Stream life is well adapted to the seasonal cycle of flooding and low flows, or droughts. For example, springtime rises in flow trigger spawning for many fish species (Figure 2).

Flowing water creates habitat.

Streamflow also shapes the stream channel (Figure 3). Natural erosion and sediment transport continually create habitat and keep the stream in balance. A stream channel in balance with watershed conditions is considered stable but not unchanging. The continual adjustments of a stable stream to seasonal and yearly variations in climate and vegetation are what make streams dynamic and productive aquatic systems. For example, gradual erosion creates stream habitat by causing scour holes, exposing tree roots and causing some riparian trees to fall in the stream. Changes in stream flow can have a tremendous impact on stream riparian habitat conditions.

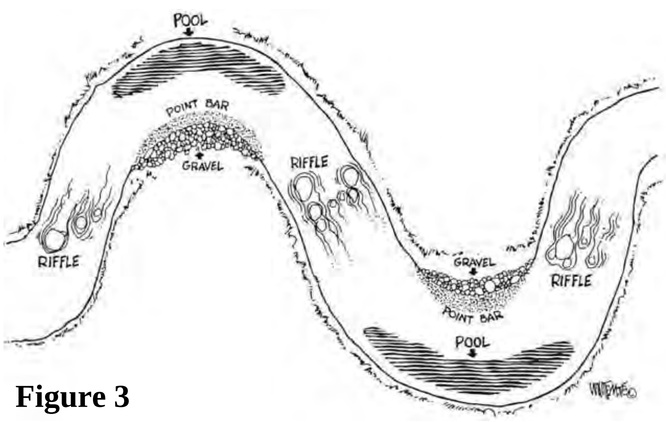

Figure 3

Water Quality

Good water quality helps produce healthy stream communities. Poor water quality can cause health, growth or survival problems for stream life. Levels of turbidity, pH, dissolved oxygen, temperature, alkalinity, pollutants and other water quality elements directly affect the health of individual organisms and aquatic populations. For instance, this stonefly nymph (Figure 4) is more sensitive to pollution than many other macroinvertebrates living on the streambottom. Water quality can influence stream fish and macroinvertebrates through effects on food production, too. Water quality affects survival, reproduction and growth of algae, aquatic plants and microorganisms, which are important elements of a stream's food web. Water quality varies between streams and within a stream on a daily and seasonal basis. For example, dissolved oxygen concentrations are often higher during the day than at night due to photosynthesis of sunlight by algae and aquatic plants.

Figure 4

Activities such as timber clearing, channelization and dam construction that affect physical stream habitat also can degrade water quality. For example, high turbidity, which reduces water clarity, can affect survival of fish eggs and young fish. Another example is when lack of shade due to clearing of riparian trees produces high summer water temperatures in shallow pools. Temperatures that are too high can stress fish and may cause fish kills by lowering dissolved oxygen levels.

Food Sources

The food web of a healthy stream is driven by sunlight, or solar energy. Aquatic and terrestrial plants convert solar energy into organic matter through the process of primary production known as photosynthesis. The energy, or food, in the organic matter is then processed through the food web. Another aspect of stream habitat is the need for dependable food sources and photosynthesis provides just that.

Most streams rely heavily on the input of leaves, twigs and other food materials produced on land. This is particularly true for headwater streams where overhanging trees reduce the sunlight available for primary production, or photosynthesis, in the stream. Changes in riparian vegetation or flow regime can affect input of food into a stream. If flooding doesn't occur due to unnatural obstructions like levees, or if the riparian corridor is cleared, there is no way for nutrients to be put back into the stream.

Streams also depend on sources of food produced in the stream water. Algae and small plants growing on rocks and other substrates account for most of this primary production. Other primary producers in streams include large aquatic plants and phytoplankton, which are microscopic plants in the water column.

Unfortunately, sewage and fertilizers in runoff can also be sources of food for a stream. Aquatic communities can be drastically changed in streams where the food web is driven by sewage or fertilizers, rather than by sunlight. Species like stoneflies, caddisflies and mayflies (Figure 5) that cannot tolerate the conditions disappear. Pollution-tolerant species like leeches and aquatic worms become more abundant and algal blooms can change physical habitat conditions and cause large fluctuations in dissolved oxygen levels.

Figure 5

Physical Habitat

When most people think of habitat, they probably envision physical habitat like cover. Physical habitat in a *stream reach* varies throughout the year. Seasonal changes in streamflow, sediment deposition, aquatic vegetation and riparian vegetation affect the physical conditions within the channel. However, aquatic and terrestrial life is adapted to this seasonal variability and relocates or weathers the elements.

Following are descriptions of the key factors that affect the quality and diversity of physical habitat of a stream reach.

Gradient

Gradient is one of the most important variables affecting physical habitat in a stream because the steepness of a stream affects so many parts of a stream. Any changes in stream gradient caused by man-made structures or alterations will change stream power, current velocities, water depths, sediment and woody debris transport and habitat types, all of which affect aquatic life.

Sinuosity

Meandering streams provide a greater diversity in habitat types than less *sinuous* or straightened streams. A bend in a meandering stream usually has a pool on the outside of the bend, a gravel or sand bar on the inside and riffles or runs at each end, each providing a different form of physical habitat. By providing many habitat types in a small area, a meandering stream can support many different species of fish and other aquatic life. Straight streams, especially channelized ones, provide fewer habitat types and less variety of life.

Water velocity

Many stream fishes and aquatic insects are adapted to either fast or slow currents. Streams that provide a variety of velocities usually support a more diverse aquatic community. Current velocity influences water quality and adds more diverse habitat types.

Substrate

Substrate includes all natural materials on the stream bottom like clay, silt, sand, gravel, boulders (Figure 6), bedrock, logs and roots. Substrate provides habitat for many important food organisms including algae, plants, insects, crayfishes, snails, mussels and small fish. Many of these organisms have specific requirements for habitat in the substrate. As with many of the other factors, streams with many different substrate types can support a larger variety of aquatic organisms.

Figure 6

Cover

Any place or situation that provides aquatic animals with a place to rest, hide, congregate or feed is considered cover. In streams where streamflow, food and water quality are adequate, the amount of cover can directly affect numbers of fish and invertebrates. Cover includes water depth, substrate, boulders, logs, stumps and *rootwads* (Figure 7), *undercut banks*, aquatic plants and *riparian* vegetation:

Depth- Large fish spend most of their time in deep pools and occasionally move to shallow areas to feed. Small fish often use shallow habitats to feed or to avoid larger, predatory fish.

Substrate- Areas between or behind medium-size substrates such as gravel, rubble, cobble and woody materials can serve as resting or hiding places for invertebrates and small fish.

Boulders, **Logs**, **Stumps** and **Rootwads**- These provide shelter from predators, hiding spots for predators that ambush their prey and protection from swift currents. These large structures can also produce deep-water cover by scouring holes in the stream bed.

Undercut Banks- These provide resting areas and shelter from predators. Bass, catfish, sunfish and trout commonly use undercut banks.

Figure 7

Aquatic Plants– Beds of *submersed* and *emergent* aquatic vegetation are important and productive stream habitats. Aquatic vegetation provides cover for prey species and ambush spots for predatory fish and birds. Some fish species spawn in aquatic vegetation. Many young fish hide and search for food in vegetated habitats, which are very productive areas for macroinvertebrates. Water willow in Ozark streams also can add stability to channels by protecting the edges of point bars (Figure 8).

Riparian Vegetation– This vegetation out of the stream can protect fish from swift currents during floods. Stream bank plants and trees can also provide cover by shading the stream and by hanging over or into the stream. Small, naturally formed log jams can provide important stream habitat features. Logs and other woody materials can provide excellent cover for fish and feeding sites for *macroinvertebrates*.

Figure 8

Habitat Type

The physical habitat needed by aquatic life is not the same for all species. In fact, many species are adapted to specific habitat types. Habitat that a species needs can vary with gender, season, time of day and activity. Due to the differences in habitat needs, a diversity of habitat allows for a more diverse and healthy stream community. For example, the variety of habitats provided by riffles, runs and pools provide habitat for many aquatic species.

Riffles

Riffles are shallow, swift, highly productive areas that provide habitats for a variety of aquatic organisms and help add oxygen to the water through aeration (Figure 9). Aeration occurs when air is drawn into the water when water trickles and runs over rocks or debris in the stream. Riffles serve as a dependable habitat for many macroinvertebrates. Many fish species spawn and feed in these areas also.

Figure 9

Generally, riffles are the shallowest, steepest, and often the swiftest and most turbulent habitats of a stream. Substrate in riffles is usually bedrock or the larger size material found in a given stream. In gravel-bed streams, riffle substrate includes gravels, cobbles, boulders and bedrock.

Runs and Glides

Runs and *glides* (Figure 9) are more difficult to define but, in general, are deeper and slower than riffles and shallower and swifter than pools.

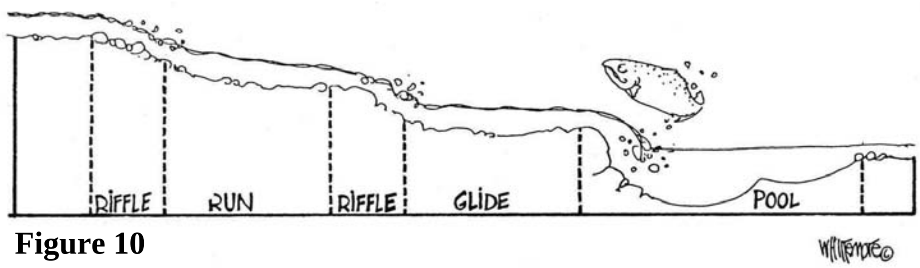

Figure 10

Runs are shallow to somewhat deep stream habitats with swift to moderate velocities and minor surface turbulence. A run often forms a short reach between two riffles or provides a transition from a riffle to the upper end of a pool or glide.

Glides are wide habitats with even flow and low to moderate velocities and little or no surface turbulence. Substrates are usually sand, gravel or cobble. Glides often form a transition from a pool to the upper end of a riffle.

Pools

Pools are typically the deeper reaches of a stream. At low flows, pools have low to moderate velocities and little surface turbulence, except around obstructions. Substrate in pools is usually sand or gravel, with larger substrates scattered or in clumps. Submerged vegetation, like coontail, and emergent vegetation like water willow, usually is most abundant along the edges of pools.

Habitat changes from a river's headwaters to the mouth.

The diversity and type of aquatic community is supported by a stream depends on its size and location in the watershed. As a stream flows from its headwaters to its mouth, a continuum of changes in all of its factors occur. Larger streams within a drainage basin generally have more diverse aquatic communities because of higher and more stable base streamflows, more habitat volume and more habitat types (Figure 11). Larger streams also influence the aquatic communities of their tributaries. A small stream flowing into a large stream usually has a more diverse community than a similar small stream that flows into another small stream.

Photo courtesy of Vicki Richmond

Figure 11

A stream changes in size, shape and channel pattern as it flows from its headwaters to its mouth. These changes in physical conditions produce changes in aquatic and riparian communities. Note the difference in Missouri River habitat from its unchannelized reachs near Gavin's Point (Figure 11) and its channelized downstream reach in our state near Jefferson City (Figure 12).

Photo courtesy of Missouri Department of Natural Resources **Figure 12**

The downstream trends of a stream are generally classified into three longitudinal zones: *headwater*, *middle reach* and *lower reach*. Although there are distinct differences between these zones, wide variations in characteristics can occur. The headwater is typically the upper reaches of a stream that have V-shaped channel with steep slopes and few, small tributaries. The channel widths are generally narrow and often shaded by riparian vegetation which contributes to the cooler, consistent water temperatures. Organic material from outside the stream, or *allochthonous* material, provides most of the food for the lower organisms such as fungi, bacteria and macroinvertebrates. Species diversity is generally low due to the little input of nutrients and narrow temperature ranges.

The midreach is defined by moderate slopes with wider channels that are U-shaped and have more aquatic plants than the headwater zone. Floodplains have developed and bank cutting replaces downward cutting, which contributes significantly to the sediment load. Increased nutrient loading, more habitat types, more persistent habitats and warmer but more variable water temperatures contribute to increased species diversity in the midreach zone.

Figure 13

Finally, the *lower reach* is found at the downstream end of the river system and is characterized by wider channels, slower water and less dramatic changes in temperature, gentle gradient, stable streamflow, fine sediments and relatively stable temperatures. The valleys are wide, have deep soil deposits and show the history of channel changes such as oxbow lakes, meander scars and swamps. Figure 13 shows an aerial view of the Missouri River from 1972. The land shows meander scars 40 years after channelization. Increased depth and turbidity here can inhibit aquatic plant growth and influence the habitats of aquatic biota. Overall species diversity is generally lower than in the midreach zone.

Humans and Aquatic Habitat

Human activities have drastically changed the habitat features of many Missouri streams over the last 200 years. Land use, development and stream channel modifications have produced many unstable streams with excessive sedimentation, poor water quality and altered aquatic communities. Human uses of land and water have also changed the water tables and flow characteristics of our stream systems.

Streams continuously adjust their individual physical conditions to surrounding watershed conditions. In turn, almost any change in a watershed directly or indirectly affects stream habitat. Increased runoff, forest fires, clearing of land, urbanization, channelization and changes in agricultural practices can alter stream habitat characteristics like depth, water quality, streambed materials and flow.

Human activities in a watershed can affect all of the key factors of habitat for the worse. By protecting riparian corridors and by using best management practices, we can attempt to minimize the damage caused to stream habitat by watershed alterations. Ultimately, by protecting stream habitat, we not only protect aquatic organisms, but we also protect our most valuable resource: water.