Basics of Stream Ecology

Text adapted from: http://chamisa.freeshell.org/ecology.htm

The watershed

The area that a stream drains is called its **drainage basin**, **catchment area, or watershed**. Water flows downhill unless it evaporates, freezes, or is taken up by plants. So when it falls as rain, melts from snow or ice, or bubbles up from beneath the earth, it will either flow one direction or another. If you were to stand by a stream at the bottom of a valley, you might look up and see hills all around you. All the land you see that slopes downward toward your river is part of the river's drainage basin. Some drainage basins are so unbelievably huge that you can't even see where their downhill flows begin.

What the stream carries

When water rolls down the slopes of a watershed, it carries things with it. It dissolves chemicals and carries them. It carries particles of dirt. If it is meltwater from a glacier, it will carry **glacial flour**, which is sediment that the glacier has made by grinding the rock beneath it very finely, making the water look almost milky. And it carries organic matter: tiny bits of leaves, bacteria, and a lot of other things too small to see. As it flows, it grows to rivulets, and carries larger bits of matter. By the time the water gets all the way down to the river, it is full of whatever was on (and in) the land around it. The river can carry sticks, leaves, logs, brush, and even sand, pebbles, rocks, and boulders. There are other ways that things can end up in a river. Winds can blow in sediment (particles of dirt) and bits of organic matter. A lot of living things like insects depend on flowing water to carry out their life cycles. Birds leave urine, droppings, and feathers. Other animals visit the river and often leave their waste in it. Many animals die in the river, adding their organic materials to the water. Natural events can occur that alter the river's ecology. Mudslides, heavy rainfall, and fires can make drastic changes. These events (though they seem extreme from our human point of view), are a very large and slow, but nevertheless integral, part of the river's ecosystem.

Even gases get involved

Rivers are closely tied with the atmosphere. Gases from the air, like oxygen, carbon dioxide, and nitrogen dissolve into the water. The colder the water is, or the more it churns as it flows downhill, the more gases there will be in it. Rain scrubs molecules and other particles out of the air, and when the air is polluted by coal-burning power plants and automobile exhaust, the rain becomes acidic, and falls as **acid rain**.

The riparian corridor

The narrow area alongside a stream that has its own special vegetation is called the **riparian corridor** or **zone**. What plants you will find in a riparian corridor depend on where the river is: the continent, the climate, stream hydrology, geology, alkalinity of the soil, and many other factors. Riparian zones contribute nutrients, shade, organic materials for small organisms to eat, soil stability, and habitat. They also contribute food for fish in the form of bugs dropping from branches. (See Water and Aquatic Ecosystems resource document “Buffer Zones” (On the Living Edge) for more information about riparian zones).

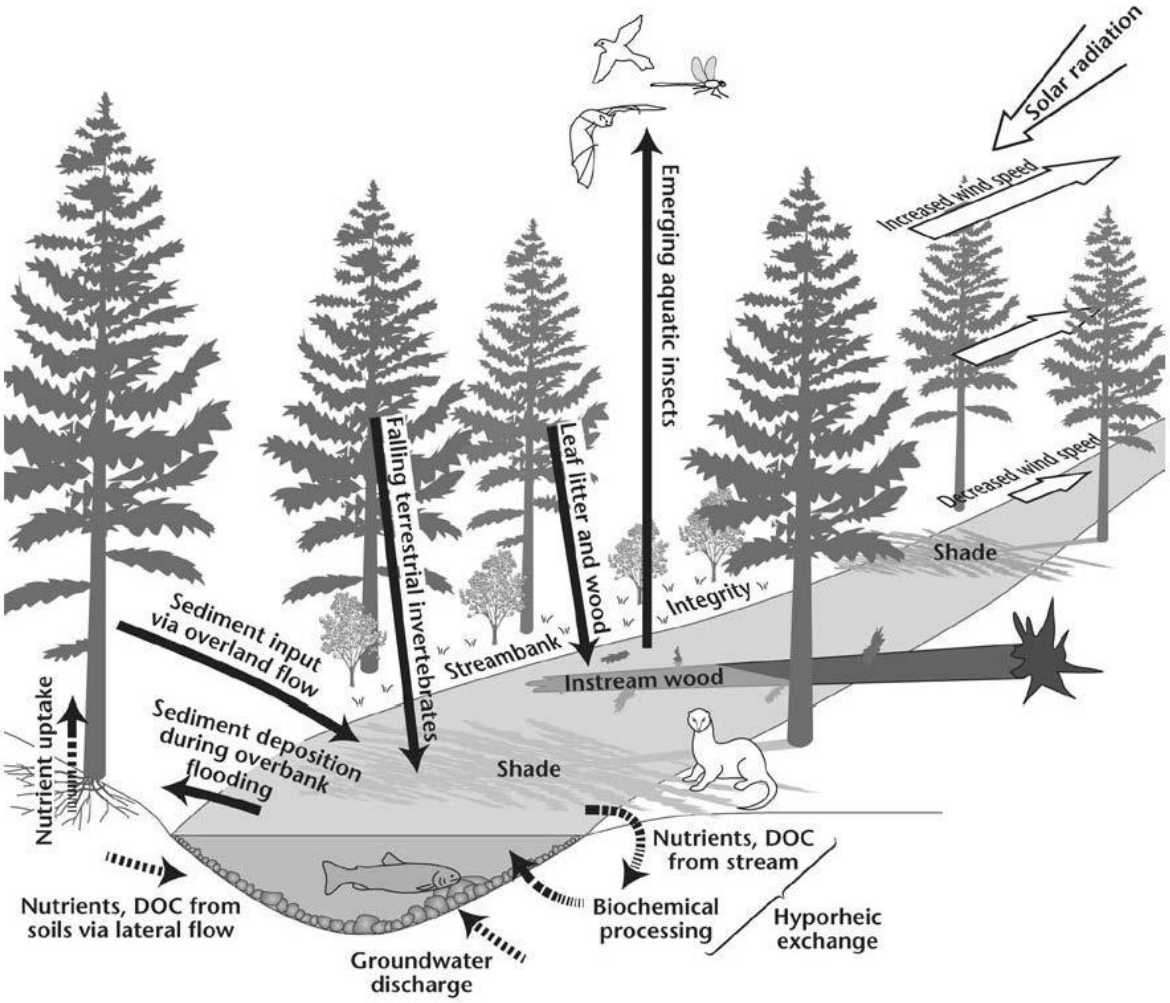

FIGURE 1. A STREAM REACH SHOWING MANY OF THE ELEMENTS AND PROCESS THAT LINK STREAMS AND RIPARIAN AREAS **(*E. LEINBERGER, UNIVERSITY OF BRITISH COLUMBIA*)**
RESOURCE: RICHARDSON, J. S., & MOORE, R. (2010). COMPENDIUM OF FOREST HYDROLOGY - STREAM AND RIPARIAN ECOLOGY (P. 443). RETRIEVED FROM HTTPS://WWW.FOR.GOV.BC.CA/HFD/PUBS/DOCS/LMH/LMH66/LMH66_CH13.PDF

Life

Every stream also carries life-forms and the habitats in which they live. Plants, diatoms, fungi, larvae, crustaceans, mollusks, worms, fishes, mammals, and many other life-forms live in and utilize streams. Diversity is key to the survival of a stream's life-forms. **Genetic diversity** must be present within each species. **Species** and **biological diversity** must be present as well. None of these types of diversity can be created or fostered by humans. They are the products of millions of years of evolution by trial-and-error. Once they are lost, they cannot be re-fashioned by scientists. Finally, **habitat diversity** is essential. Each stream contains many different habitats and microhabitats. A single species may require several different habitats to carry out its life functions, and each habitat is inhabited by its own species that cannot live elsewhere. **Keystone species** are those species whose functions are so intertwined with the lives of other animals in a system that their disappearance will cause the system to become imbalanced or even collapse. The beaver is a perfect example of a keystone species. It dams rivers, creating ponds and wetlands that support an entire system of stream organisms. When beavers are removed from a stream, many of those stream organisms are displaced or die.

Floods

Floods are natural events which influence stream ecology. Animal and plant communities in rivers have spent millions of years adapting to the conditions around them, and floods have simply become a part of a larger cycle of river ecology for them. Riparian corridors depend almost exclusively upon their streams' flooding cycles for their existence. Many fishes wait until the first sign that the annual spring flood has begun to start **breeding**. Many insect larvae wait for flooding to begin to **lay eggs**, **hatch**, or **metamorphose**. Flooding provides a bonanza in new **food sources** for stream denizens. Floods flush insects, bugs, and worms that used to be on land into the stream, which become dinner for fishes. Flooding results in increased **nutrients** for the river. The more nutrients present in a river (up to a point), the more invertebrates will be able to live in it--and invertebrates form the base of the **food web**. Nutrients (like nitrogen and phosphorus) are washed out of soil and animal feces. Nutrients added to the shallow, warmer waters of the floodplain lead to extra growth of **plankton**. Floods also wash dead brush and trees into the stream, providing **habitat** for countless animals.

Human impacts on streams

Dams

People dam rivers in order to store water for drinking, washing, farming, watering lawns, swimming pools, agriculture, and countless other uses. They also dam them to control floods downstream, and in order to make electricity. Damming rivers changes their ecology forever. Each stream has its own biological community, all members interacting with each other in a complex fashion, all depending on each other for their survival. Dams change those communities by changing flows, temperatures, and water clarity. Many fish species migrate up rivers in order to reproduce; if they can't get all the way up a river, or if their offspring can't get all the way back down, reproduction fails. Soon, there are fewer and fewer of them, and ultimately they will disappear forever. Of course, many dams have fish ladders--but fish ladders are not always successful. And on the trip back down to the sea, many juvenile fish die in the turbines of the dam or after falling the long distance from the reservoir to the river below the dam. It isn't the fall that hurts them; rather, they get "the bends," like any diver, from high concentrations of nitrogen gas in the turbulent waters below the outfall.

Channelizing streams

When a stream is prone to flooding, or to meandering out of control and across property lines or roads, we often **channelize** it. We may dry up whole sections of stream in order to bulldoze it into a tidy, straight line of water. We may try to protect ourselves from its unruly behavior by lining the stream's banks with concrete or riprap. This kind of channelization leads to loss of both stream and riparian habitat. It also increases the destructive potential of the river. A channelized stream becomes poor in nutrients and habitat. Without periodic flooding, its riparian zone is starved of water and nutrients. Stream inhabitants depend on the riparian zone for food, shade, and debris. Channelization creates artificial river banks without variation, while stream inhabitants depend on natural variations such as backwaters, riffles, embayments, and large woody debris for shade or warmth, cover, protection, and food.

Ironically, the more you try to channelize a river, the more out of control it becomes. Erosion, a minor irritant before, threatens property, buildings, and roads. Flooding becomes more catastrophic when streams are channelized. Water gathers energy as it flows downhill. When a stream meanders, it creates banks. The water then 1) pushes against the banks, and 2) swirls in eddies. In both cases, the energy of the flowing water is decreased. When a stream is channelized, however, there is nothing to prevent it from gathering more and more destructive

energy as it flows downhill. Secondly, a healthy **floodplain** acts as a sponge, soaking up floodwaters, while channelized rivers simply forward the extra water downstream until it overwhelms dams, dikes, or walls. Finally, when rivers are channelized, people are encouraged to live on floodplains, risking lives and property in the event of a catastrophic flood. The inevitable response to catastrophic flooding is, unfortunately, to increase channelization, which leads to even more catastrophic flooding.

Development

We also change our rivers by changing the land around them. If we pave land or remove vegetation from it, rainwater runs directly off of it instead of soaking into the earth. This **urban runoff** carries pollutants like car oil and pesticides instead of nutrients. When we change the vegetation around a stream, we change its chemistry. For instance, a developer may cut down all the trees around a stream in order to place a big neighborhood of houses next to it. This has many effects, among them that no more leaves will fall into the stream, taking out the very base of the stream's food web. Tree branches will no longer shade the stream and it will become too warm for the fish that belong there, and choked with algae. In addition, without overhanging branches, bugs will no longer fall from them to feed fish. The trees themselves were critical to that stream because they were providing nutrients to it, as well as shade for the growth of other important streamside vegetation. And finally, without the roots of vegetation to anchor streamside soil, the soil will become eroded away by the stream--forcing homeowners to channelize the stream.

Logging

As wooded areas become popular places to live, logging increases in order to build more homes. Logging in itself is not always such a harmful thing to streams: it is the logging roads that must be built for the logging trucks that do the lion's share of the damage. Silt from these dirt roads washes down the hillsides with the rain and enters the river, choking the substrate by filling in the spaces between gravels and cobbles of the streambed. This eliminates an important habitat of many of the aquatic insects that fish eat. Without habitat, the insects disappear. It also hinders the maturation of fish eggs. Salmonid (salmon and trout family) eggs spend their early lives buried in streambed gravels, sheltered from the river's current and hidden from predators. They live off their yolks until they are large enough to fend for themselves, before emerging into the water column. While they are still in the gravel, water must flow rapidly over them to bring them fresh, dissolved oxygen and to carry their wastes away. When silt from development fills in the spaces between the rocks, the fish can no longer grow there.

In some rivers, especially those that run through clay soils, silt from logging, farming, or development can cloud up the river (**high turbidity**), blocking light. When light is blocked from a river, a whole different set of plants and animals grows and the original community is lost.