# THE WORK AND BEHAVIOR OF RIVERS: PART 2

The "Web of Life" model has three flip panels in the river channel (to represent what life is on or in the bottom, in the middle, and on the surface of the river), and three flip panels on the floodplain and upland area along the river (representing grass, bush, and tree riparian environments). General text is attached to the right streambank. What follows is the pictures and text for each of the flip panels in the channel and on the embankment.

### *General Text on the Right Streambank*

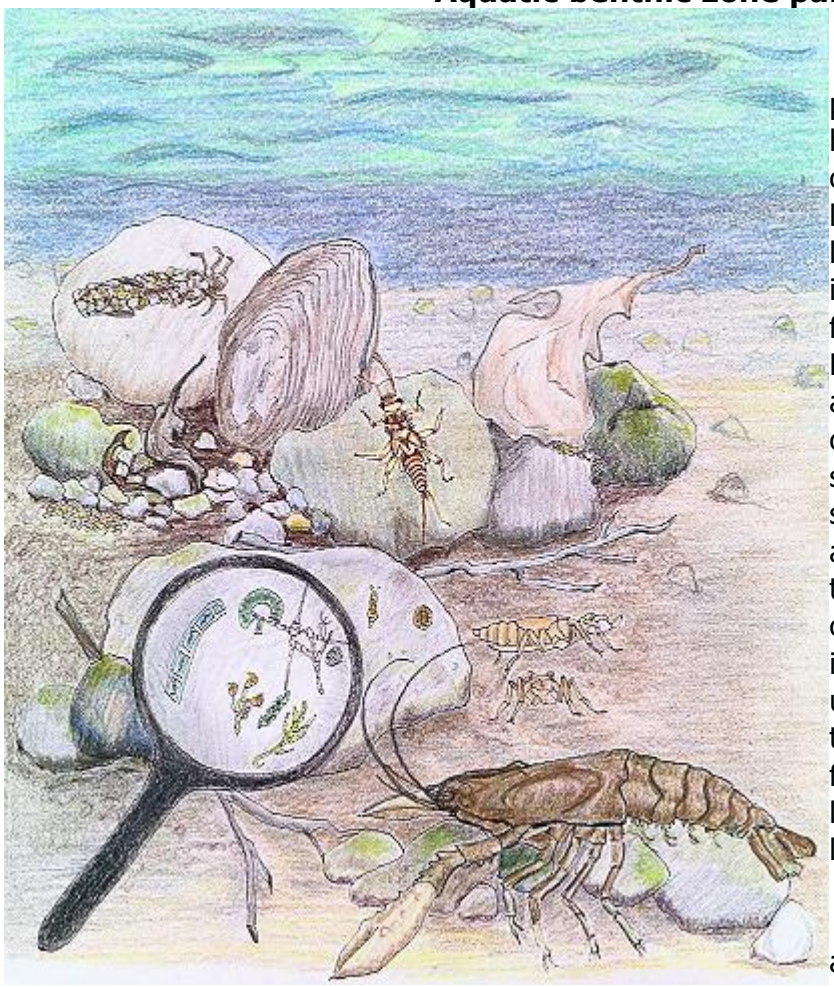
Wildlife depends more on river channels and their adjacent lands than any other type of habitat. Rivers are transportation corridors for migratory birds and fish, and home to many unique species of plants and animals. As the river adjusts for maximum efficiency, the animal and plant communities adjust creating another dynamic equilibrium of life for each type of community.

River habitats can be grouped into benthic, aquatic, and terrestrial zones. In the benthic zone, plants and animals live in, under, or close to the streambed. These species are usually attached to or buried in the substrate. The aquatic zone is that of flowing water with the animals who live in it, such as fish, insects, reptiles, amphibians, and some mammals. The adjacent upland vegetated area is the terrestrial zone visited by animals, many of whom are dependent upon the river water for food or reproduction.

River ecosystems vary along the length of a channel as it grows from a small rivulet to a large river. Forest detritus is the initial basis of the stream's organic load and food

chain. Any activity that alters the detritus sources in headwater streams will affect the downstream ecosystems.

**Aquatic benthic zone panel:**



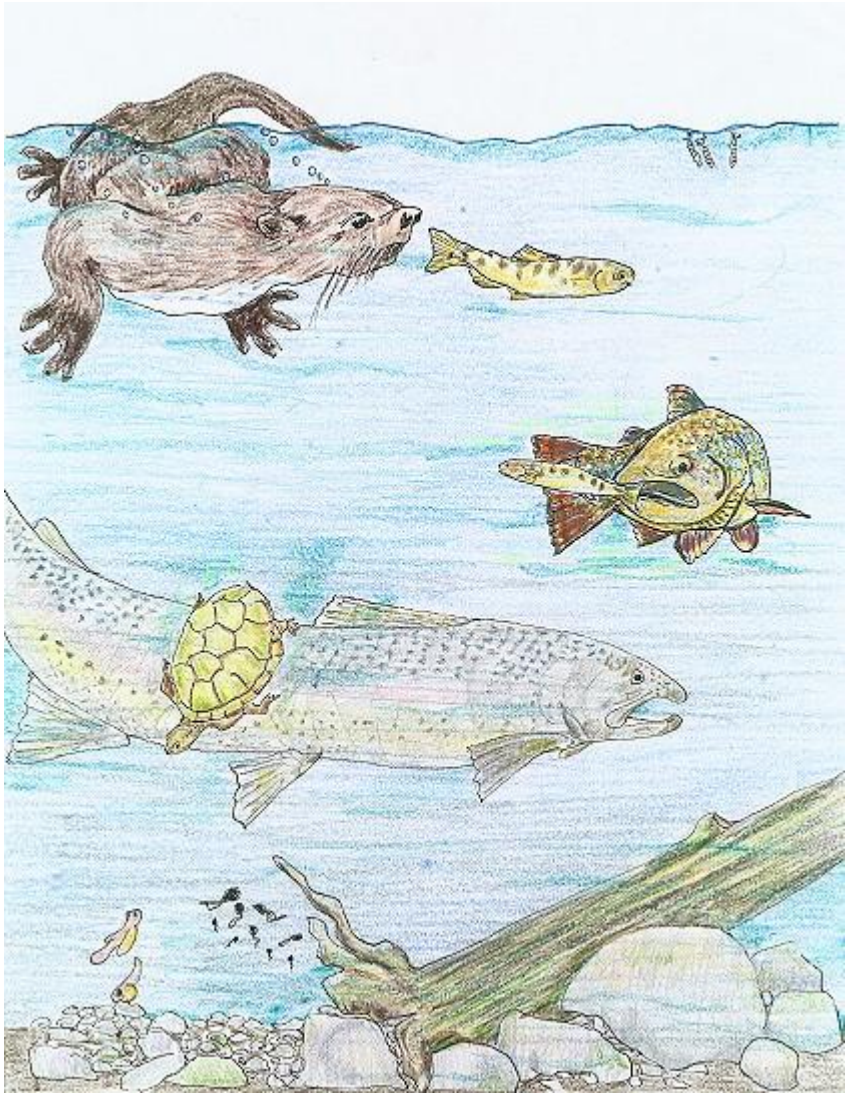
Stones, gravel, and the pockets between them, are homes for important river life. In crannies where the flow is slow, leaf debris and twigs collect. Leaf litter is broken down by abrasion in the stream and is colonized by feeding microorganisms. Periphyton is the name given to algae and other microorganisms on the bottom rocks that make surfaces exposed to water feel slimy. Diatoms are single celled algae about 1/1000th of an inch thick. They float in water and cover leaves, stems, and aquatic insects. All life in the water ultimately depends for food upon these microorganisms (algae, fungi, and microscopic animals like vorticella) that enrich the leaf litter with nitrogen.

Caddis flies look like moths and are known for their larvae covered with tiny sticks and stones cemented together with larvae saliva. Caddis and stonefly larvae east the nitrogen rich litter and prey on each other. Dragonflies and damselflies spend most of their lives in the water as nymphs and are voracious insect eaters. These macro-invertebrates, seen with the naked eye, are indicators of good water quality and are the food for crustaceans and many young fish.

Crayfish tear water insects and small fish into bite size pieces with their pincers. They burrow into banks and hide under stones of lime-enriched rivers. Mussels feed on algae, diatoms, and plankton. Freshwater mussels are one of the most endangered groups of animals in North America, and in Lake Champlain they are being smothered by alien zebra mussels. Mussel larvae are parasitic, attaching themselves to fish gills until they drop off in a few days and transform into miniature mussels. Since the mussel larvae are so small and can't battle the current, they need their "ride" on fish for distribution

throughout the river.

**Aquatic mid-stream panel:**



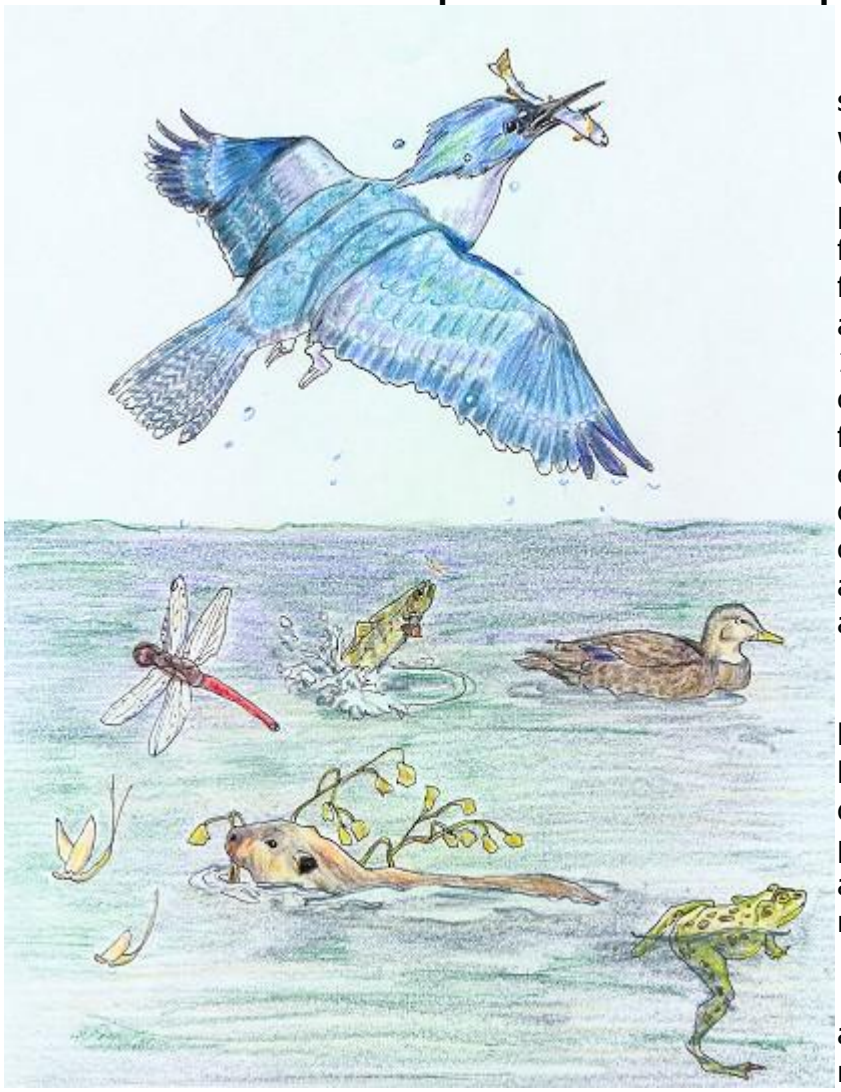
Otters live on the borders of streams and eat mostly fish, frogs, crayfish, salamanders and turtles, but also are known to eat birds and invertebrates. They appear to slide for sport down river embankments and line their dens in the banks, or in old beaver lodges, with vegetation.

Small fish, like the brown trout pictured, eat primarily aquatic insects. Good water quality, cool temperatures (below 70o F.), and plenty of vegetative cover are also necessary. Brook trout and Atlantic salmon, our favorite game fish, need the same habitat and consume aquatic insects and small fish. Adults require clean gravel for spawning. A half-pound trout or salmon female will bury about 500 eggs in a gravel nest in the fall. When eggs hatch into alevin in the spring they look something like tadpoles because their yolk sacs still balloon from their undersides. Once the sac nutrients have been consumed, the alevin become fry and feed on small insect larvae.

In April, the frog and toad amphibians emerge from winter burrows and move toward water where the current is not swift to lay their eggs in curving tubes of jelly. These eggs develop into tadpoles. Most of our river turtles hibernate in woodland holes and must have unpolluted water where they frequently mate and where the newly hatched turtles are miniature likenesses of their parents. Turtle diet is varied, from snails,

spiders, and worms, to tadpoles, young plants and aquatic insects.

**Aquatic surface of water panel:**



The belted kingfisher uses streambanks for nest sites and, with two focal centers in each eye (one to scan the sky for predators, and the other to look for food), dives into the water for fish and crayfish. It burrows a hole in the bank sometimes for 15 feet and the small end chamber, lined with regurgitated fish bones, is a nest for its 5-8 eggs. The beautiful wood duck, on the other hand, nests in tree cavities not far from the river and eats aquatic plants, insects, and even acorns.

Lodges made of branches or burrows in streambanks are home for the beaver that is decidedly a vegetarian, particularly eating the bark of alder, aspen, willow, birch and maple.

Although most of their lives are in a nymph stage when they reside in the water, adult winged mayflies –who live but a day or a few hours—don't eat at all. Instead they begin to mate, dancing through the late afternoon air over a river, hundreds moving together. Some of the males will manage to mate with a few females who lay their eggs on the water then die on its surface. Mayfly are the most important food of young fish in the river. Dragonflies or "devil's darning needles" make bee-line flights skimming the water surface after midges and mosquitoes which they capture while flying.

**Terrestrial floodplain grassy area panel:**

The only hawk to dive into water is the osprey which has a diet of fish and builds stick nests in dead trees. Building similar nests, the heron fishes by standing motionless in streams for long time periods. Needing water nearby to wash food, racoons also require trees for protection and hollow trees to raise their young. Our white-tailed deer use forested and brush edges of rivers for most of their browsing, shelter and nesting needs, but also enjoy fields and abandoned pasture land for grazing. Salamanders, who can regrow a lost tail or leg, need water to deposit their egg masses into during the spring. Eggs hatch into larval salamanders with gills. These spend a good part of their life in water eating small aquatic invertebrates, while the adult salamanders require logs and decayed stumps or other vegetative material for shelter, coolness, and the grubs and worms they eat.

The cinnamon fern is common in wetlands and river floodplains; its leaves are eaten by deer and turkey. Sedges also grow in wet areas and are consumed by a wide variety of wildlife including ducks, insects, and birds. Their tufted growth allows animals hiding places and provides ducks with nesting area. Burreeds also occur along moist edges of streams and its seeds are eaten by ducks and birds, while muskrats enjoy the whole plant.

Damselflies are daintier and lighter than dragonflies. As nymphs they take a long time to mature and, along with dragonfly nymphs, are the dominant insect carnivores on the river bottom, lunging at their prey. Females have a special egg depositor that lets them place eggs into leaves and stems of water plants. Sometimes the damselfly will go

underwater to deposit eggs. A scientist observed one damselfly under water for 25 minutes. It wound its wings around its abdomen, enclosing air, then walked down a plant stem and explored the stream bottom for several feet. Grasshoppers, with their long jumping legs bent so their knees are higher than their backs, are important in the diet of birds and other insect-eating animals. A grasshopper near water will often eat hairworms which continue to grow within the grasshopper's body. If the grasshopper frequents the water edge again, the full grown hairworm will burrow is way out to mate and lay eggs in the water.

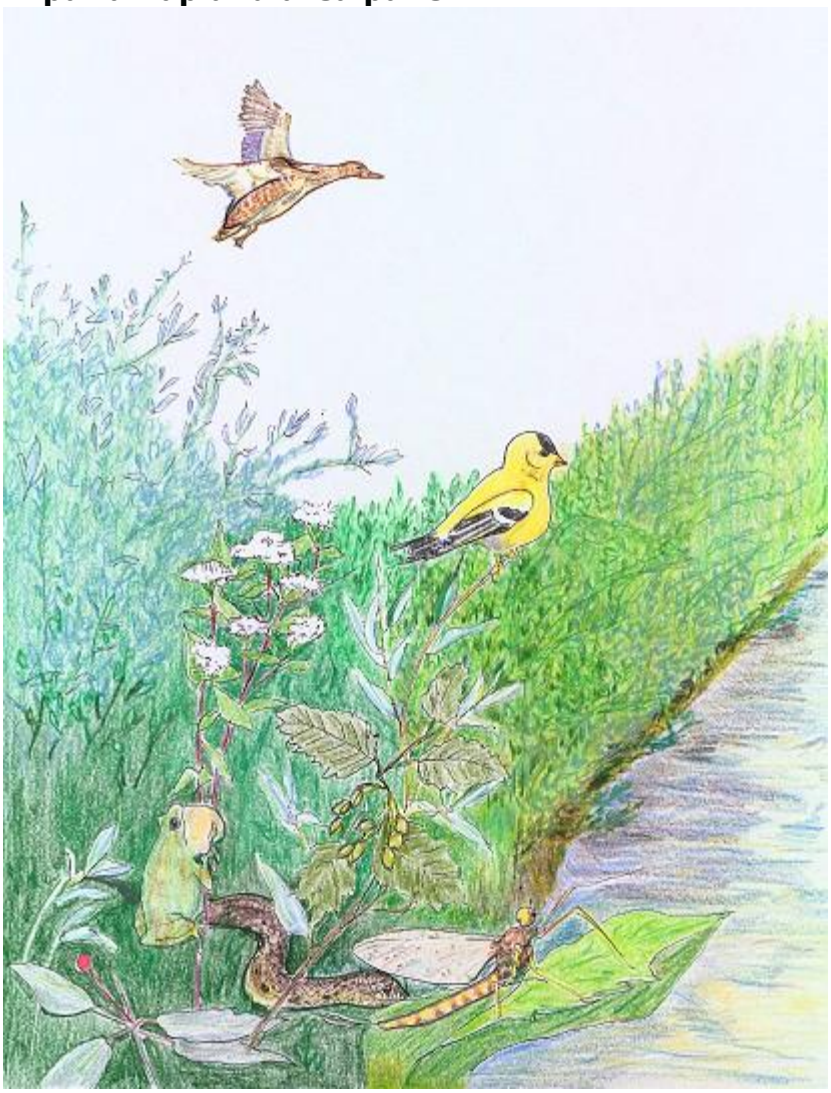
**Terrestrial riparian shrub area panel:**

Ducks, frogs and insects scurry back and forth between water and shrubs that supply food, nesting, and sheltering habitat. Frogs will stay close to water, however, during the whole year. In the winter they hibernate by burrowing into the mud under water. Adults eat spiders, insects, and small invertebrates, while the tadpoles are usually vegetarian.

Shrubs most often colonizing our streams are the willows, red osier dogwood and alder bushes whose roots form a thick entangled mass helping them to combat the dislodging forces of swift currents while, simultaneously, providing excellent protection from streambank erosion. The pale green leaves and light red August berry of the Mountain Holly are frequently found along streambanks at slightly higher elevations.

Goldfinches and other small finches frequent these shrubs for seed, while the dense growth patterns makes very effective cover and hiding places for birds and small mammals. Rabbits, deer and moose browse on willows, alders, and dogwood.

**Forested riparian upland area panel:**



When trees overhang the stream, tree litter falls directly into the water. Litter includes leaves, branches, bud scales, flowers, fruits, and the droppings (frass) of leaf-living animals. Bud scales fall in spring and frass is a constant source in summer. Many upland streams receive most of their energy from organic matter washed into the stream, largely as leaf litter.

Bears vary their fish diet taken from streams with fruit and carrion found in the shrub and treed riparian zone. Pheasants roost on the ground and in trees, and prefer brushy areas where they find plenty of insects, berries and seeds. Mice also prefer the edge of woods. Here, they add to their seed and fruit diet with the beatles, caterpillars and roots found along the edge. When frightened, the white footed mouse can vibrate its front legs to make a drumming sound.

The twigs and foliage of white cedar and hemlock trees are important browsing material for deer who frequently "yard" near a river during the winter. Hemlocks provide excellent cover as well as food for both birds and mammals. Another tree specie that grows on river margins is the Black Ash, producing more food for birds and mammals with its catkins and winged seeds.