# SMALL STREAM ECOSYSTEM

## TEACHER'S GUIDE

# INTRODUCTION

Put on your old tennis shoes, cutoffs and t-shirts! It's time to get wet again with Rick Hill. Four years ago we waded through the Stream Ecosystem; two years ago we dove into the Big River Ecosystem; this year we'll be wading and splashing in the Small Stream Ecosystem.

Small streams are unique and fascinating. Each major river system may have hundreds of feeder streams, and the animals in each one vary. While one species may be found in only one watershed, other similar species could be found over several states. In this poster, all species selected are widely distributed species. This allows several states to use the poster for educational purposes.

A headwater stream is often envisioned as a trickle from a spring, a stream order 1, with very few aquatic organisms. However, with warm water flowing from the ground, this headwater stream may have many species in the winter. Because we wanted to illustrate the year-around diversity of aquatic creatures, the stream depicted in the poster is a stream order 2 or 3. That means two streams that initiated constant flow (order 1) flowed together forming an order 2 stream or two 2 order streams intersected for an order 3. The stream depicted would be a shallow, narrow stream with the deepest sections not more than two or three feet deep at normal flow. While not quite a "step across" stream, one could probably pick a narrow riffle and cross with only one wet foot. However, because of typically narrow flood plains, streams like this could also turn into raging currents with just a few inches of rain in their watersheds.

Readers familiar with this poster series will note two things. First, the water depicted in this poster is much clearer than previous posters. The illustrated stream would be clear, because it is depicted as a forested ecosystem and shows mainly a rocky bottom. The same size stream in an area of farmland could have water more clouded with silt. The second thing you may notice is the relative size of the depicted animals. These are much closer to natural size, as the picture is of a much smaller aquatic resource.

The entire poster series and teacher guides have been created through funds from the Sport Fish Restoration Program. **The goal is to educate all people on the importance of healthy aquatic systems and their relationship to lifelong aquatic recreation.** Each section of this guide is intended to give you, the teacher or youth leader, knowledge on the given subject followed by activities. For Kentucky teachers, each activity is followed by one KERA Acacemic Expectation to illustrate various expectations that may be accomplished with this guide.

To improve our efforts, please fill out the evaluation on the following page. If you adapt other activities to this poster, please include basic information and we can pass that on to other teachers in the future. Please send all comments to:


Aquatic Education Administrator
KY Dept. Fish and Wildlife Resources
#1 Game Farm Rd.
Frankfort KY 40601
(800) 858-1549
lonnie.nelson@mail.state.ky.us

# *EVALUATION*

Name: ________________________ Grade taught: ____________
School: ________________________ Phone: _____________________
Address: ________________________ e-mail: _______________________________
________________________

**1.** I received my Small Stream Ecosystem poster and teacher's guide from the following source.

______________________________________________________________________________

**2.** On a scale of one to ten, please evaluate the poster in comparison to similar materials you have received.

1 2 3 4 5 6 7 8 9 10

**3.** What did you like most or least about the poster to rate it as you did?

______________________________________________________________________________

**4.** How have you used this poster?

______________________________________________________________________________

**5.** On a scale of one to ten please evaluate the teacher's guide you received in comparison to other similar products?

1 2 3 4 5 6 7 8 9 10

**6.** What did you like most or least about the teacher's guide to rate it as you did?

______________________________________________________________________________

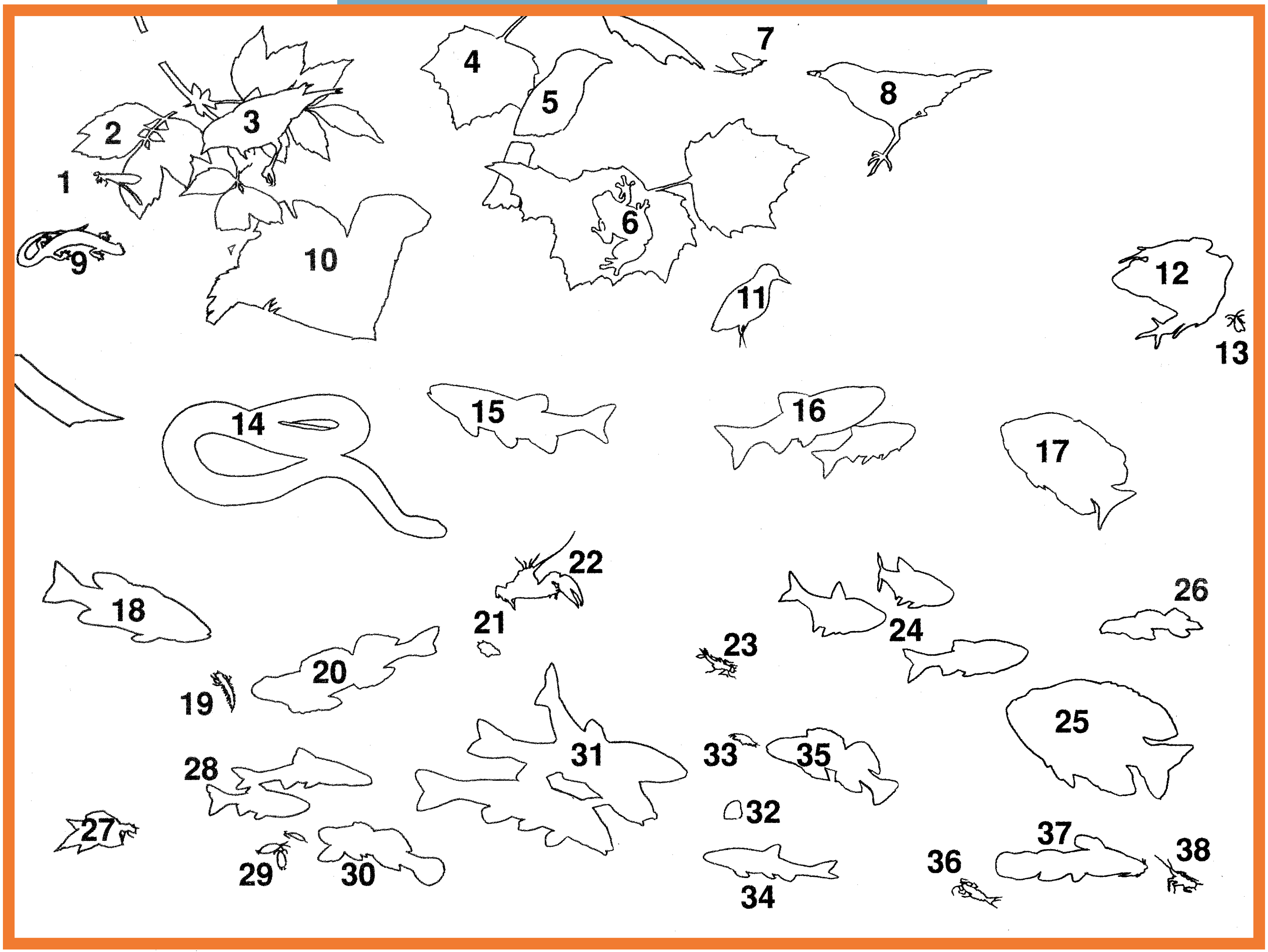
**7.** What other aquatic related materials would you find useful in your class or youth group?

______________________________________________________________________________

ADDITIONAL COMMENTS (*PLEASE INCLUDE HERE ANY ACTIVITIES YOU HAVE DEVELOPED FROM THIS POSTER*):

I REQUEST THE FOLLOWING:
_____ Contact me with Project WILD training opportunities.
_____ Place me on a mailing list for future materials.
_____ Please send _____ copies of Small Stream Ecosystem for teachers at my school.
_____ Please send _____ copies of Stream Ecosystem for teachers at my school.
_____ Please send _____ copies of Big River Ecosystem for teachers at my school.
_____ Other

# Small Stream Ecosystem Legend



# Species List and Scientific Names

| Common Name | Scientific Name |
|---|---|
| 1. **Damselfly** | *Agrion (Calopteryx) maculatum* |
| 2. **Boxelder** | ***Acer negundo*** |
| 3. **Yellow-throated warbler** | ***Dendroica dominica*** |
| 4. **Sycamore** | ***Platanus occidentalis*** |
| 5. **Acadian flycatcher** | ***Empidonax virescens*** |
| 6. **Copes gray treefrog** | ***Hyla chrysoscelis*** |
| 7. **Mayfly** | ***Rhithrogena*** |
| 8. **Louisiana waterthrush** | ***Seiurus motacilla*** |
| 9. **Southern two lined salamander** | ***Eurycea cirrigera*** |
| 10. **Mink** | ***Mustela vison*** |
| 11. **Spotted sandpiper** | ***Acyitis macularia*** |
| 12. **Southern leopard frog** | ***Rana utricularia*** |
| 13. **Alderfly** | ***Sialis*** |
| 14. **Queensnake** | ***Regina septemvittata*** |
| 15. **Creek chub** | ***Semotilus atromaculatus*** |
| 16. **Striped shiner** | ***Luxilus chrysocephalus*** |
| 17. **Longear sunfish** | ***Lepomis megalotis*** |
| 18. **Smallmouth bass (young)** | ***Micropterus dolomieui*** |
| 19. **Alderfly larva** | ***Sialis*** |
| 20. **Greenside darter** | ***Etheostoma blennioides*** |
| 21. **Gilled snail** | ***Goniobasis*** |
| 22. **Crayfish** | ***Cambarus*** |
| 23. **Damselfly larva** | ***Agrion (Calopteryx) maculatum*** |
| 24. **Redfin shiner** | ***Notropis umbratilis*** |
| 25. **Green sunfish** | ***Lepomis cyanellus*** |
| 26. **Johnny darter** | ***Etheostoma nigrum*** |
| 27. **Caddisfly larva** | ***Limnephilus*** |
| 28. **Bluntnose minnow** | ***Pimephales notatus*** |
| 29. **Sowbug** | ***Asellus*** |
| 30. **Fantail darter** | ***Etheostoma flabellare*** |
| 31. **Central stoneroller** | ***Campostoma anomalum*** |
| 32. **Fingernail clam** | ***Sphaerium*** |
| 33. **Scud** | ***Hyalella*** |
| 34. **Silverjaw minnow** | ***Ericymba buccata*** |
| 35. **Rainbow darter** | ***Etheostoma caeruleum*** |
| 36. **Mayfly larva** | ***Rhithrogena*** |
| 37. **Brindled madtom** | **Noturus miurus** |
| 38. **Stonefly larva** | ***Acroneuria*** |

NOTES

# STREAM CENSUS: WHO LIVES HERE?

In any given **watershed**, the plants and animals that are found are dependent on the surrounding land and corresponding land use. One stream may originate from sheer granite with few nutrients added from the rock. Another may have its beginnings from limestone springs with corresponding rich diversity of life. A third stream could be found in or near fertile farmland and receive abundant nutrients from those fields. Finally, in urban areas, streams may receive excess fertilizer from gardens and lawns.

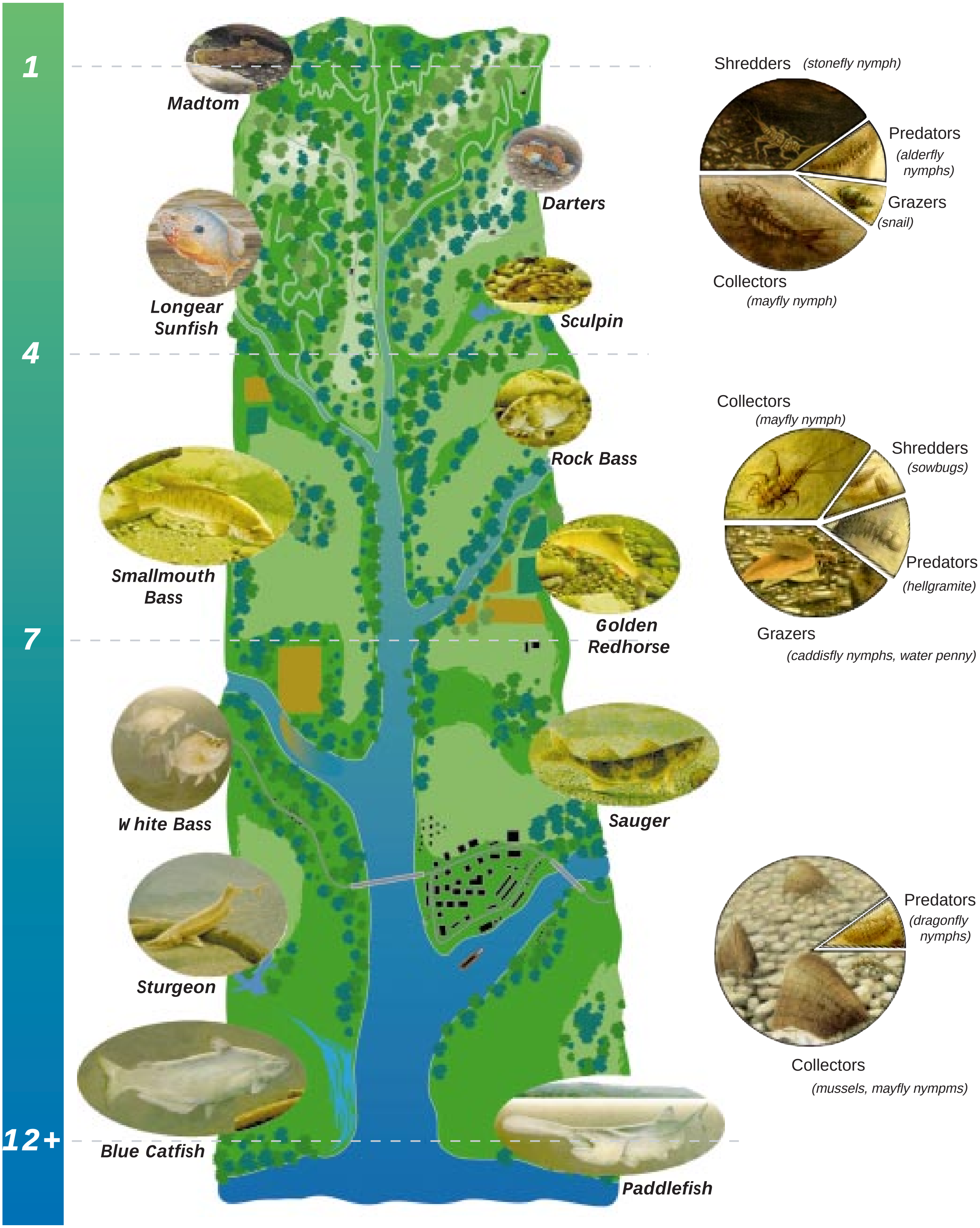
There is a definite connection between water fertility and **biodiversity** in the stream. Mountain streams receive runoff from rock walls that do not lose nutrients to the water. Because plants need nutrients to grow, some mountain streams are very low in numbers of plants and animals or species diversity. The animals that live in these streams are primarily dependent on food that falls into the water from other sources. Therefore, most of the animals in these streams eat on large leaves (coarse particulate matter) or are **predators** on terrestrial insects that fall into the water. There are few **grazers** because few plants grow for them to eat. Some **collectors** (mussels or insects) live in these conditions and eat the fine particulate matter created by those eating the coarse material.

In watersheds with higher fertility, more aquatic plants grow, and the diversity of grazers grows. In streams with overhanging vegetation, there will still be plant and animal matter falling into the water, and animals will be there to eat it. The diversity of collectors will most likely increase as there are more animals munching on more diverse plants. With a higher diversity of plant eaters, the predators in the stream will adapt to the availability of prey, and we would expect greater predator diversity. However, because of the increase of all species, the percentage of predators remains about the same.

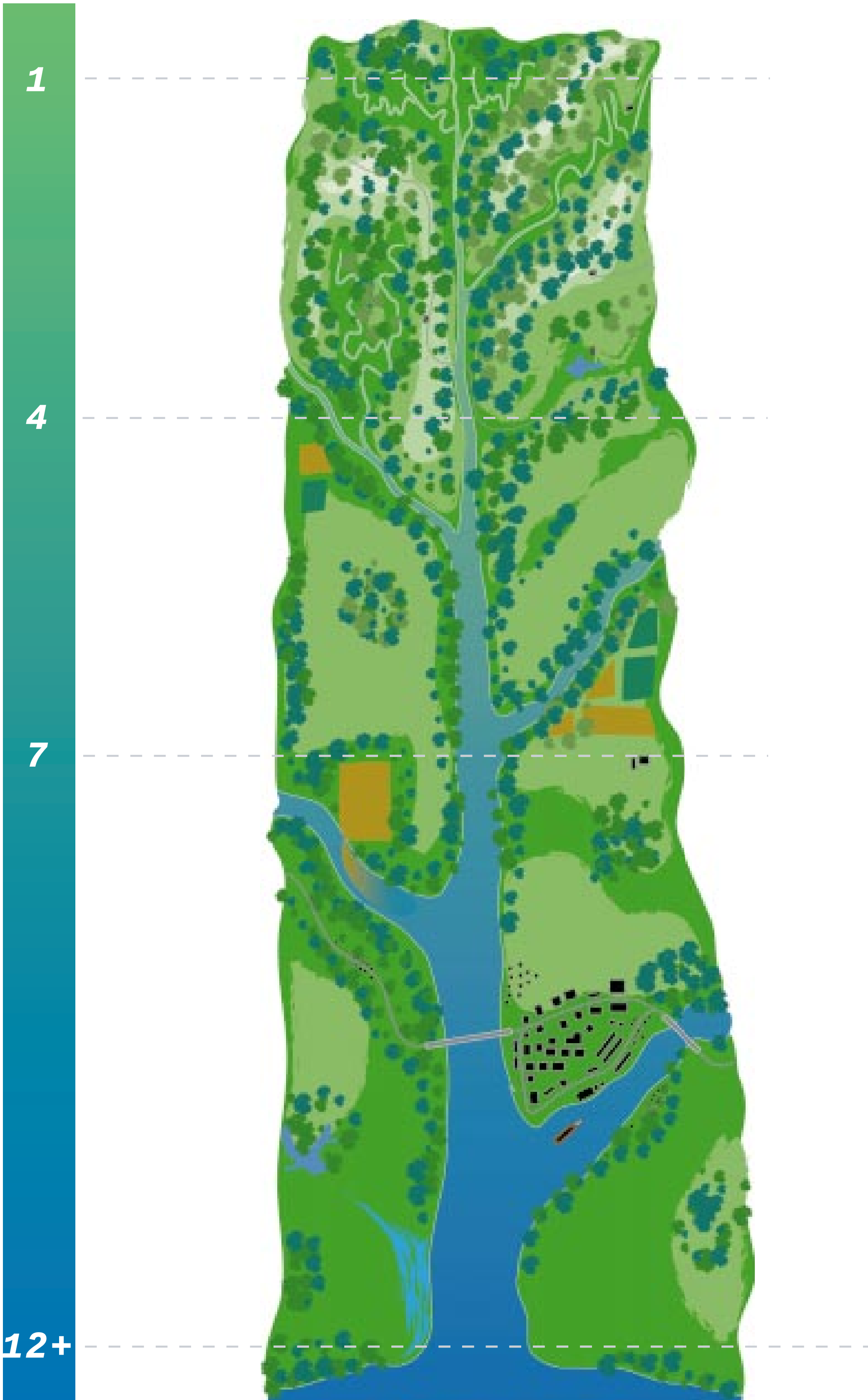
This process continues as the water flows downstream into larger streams and rivers. By the time the water reaches the big river regime, such as the Tennessee, Ohio or Mississippi, the water is highly fertile, but often laden with silt. While algae blooms are common, the sunlight can not penetrate the cloudy water and plants seldom become rooted. Therefore, with lower diversity of plants, there is a lower diversity of grazers. As larger rivers are not covered by riverside vegetation, less plant material falls directly into the water, and the percentage of animals that eat the coarse material decreases. Therefore, the group with the greatest variety or diversity in the big river ecosystem is the collector group.

The following pages illustrate the variation in stream life as ariver grows. The first page shows the whole picture. Next we break down three components: plants, invertebrates and fish, and provide an explanation of the ecologocial processes with an accompanying picture. These pages could be copied in transparencies. The three component pictures will build the whole picture page when overlaid.

# STREAM ORDER



# STREAM ORDER



NOTES

## PLANTS CONTRIBUTION IN THE WATERSHED

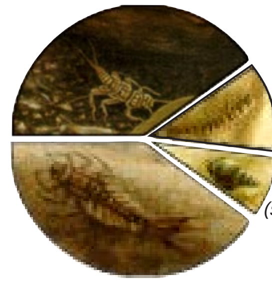
In stream order 1-3 streams, the primary plants that contribute to the ecosystem are those on the banks of the stream. The leaves fall into the water along with the insects that eat these riparian plants. As there is limited fertility, there are few plants of any kind growing within the water.

In stream order 4-6 streams, fertility increases based on the natural processes of decomposition within the stream and some input from human activity in the watershed. Therefore, more plants grow in the water. These include phytoplankton and rooted vegetation. There is still considerable input from plants growing in the riparian zone, especially in forested regions.

In stream order 7-8 streams, creeks or rivers, the fertility continues to increase. As depth of the water increases there will be fewer rooted plants. The phytoplankton will continue to increase in numbers. Contribution from those plants growing on the banks continues to decrease proportionately due to the volume of the stream and human land use in the watershed.

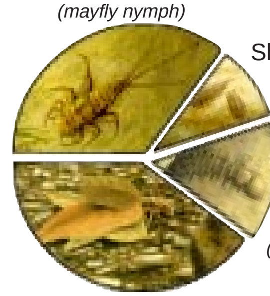
A stream order 9-12 would be considered a river. In these rivers, the depth and constant flow of water will inhibit rooted aquatic vegetation in most cases. The primary producers are therefore phytoplankton. These large rivers have great volumes of water and typically have wide flood plains with intensive human land use. Therefore, there is usually very little input from plants on the banks of the river.

1



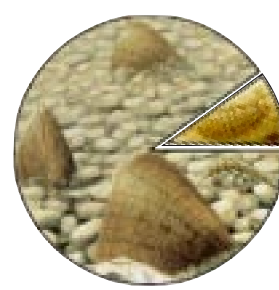
Shredders (stonefly nymph)
Predators (alderfly nymphs)
Grazers (snail)
Collectors (mayfly nymph)


4



Collectors (mayfly nymph)
Shredders (sowbugs)
Predators (hellgramite)
Grazers (caddisfly nymphs, water penny)


7



Predators (dragonfly nymphs)
Collectors (mussels, mayfly nympms)


12+

NOTES

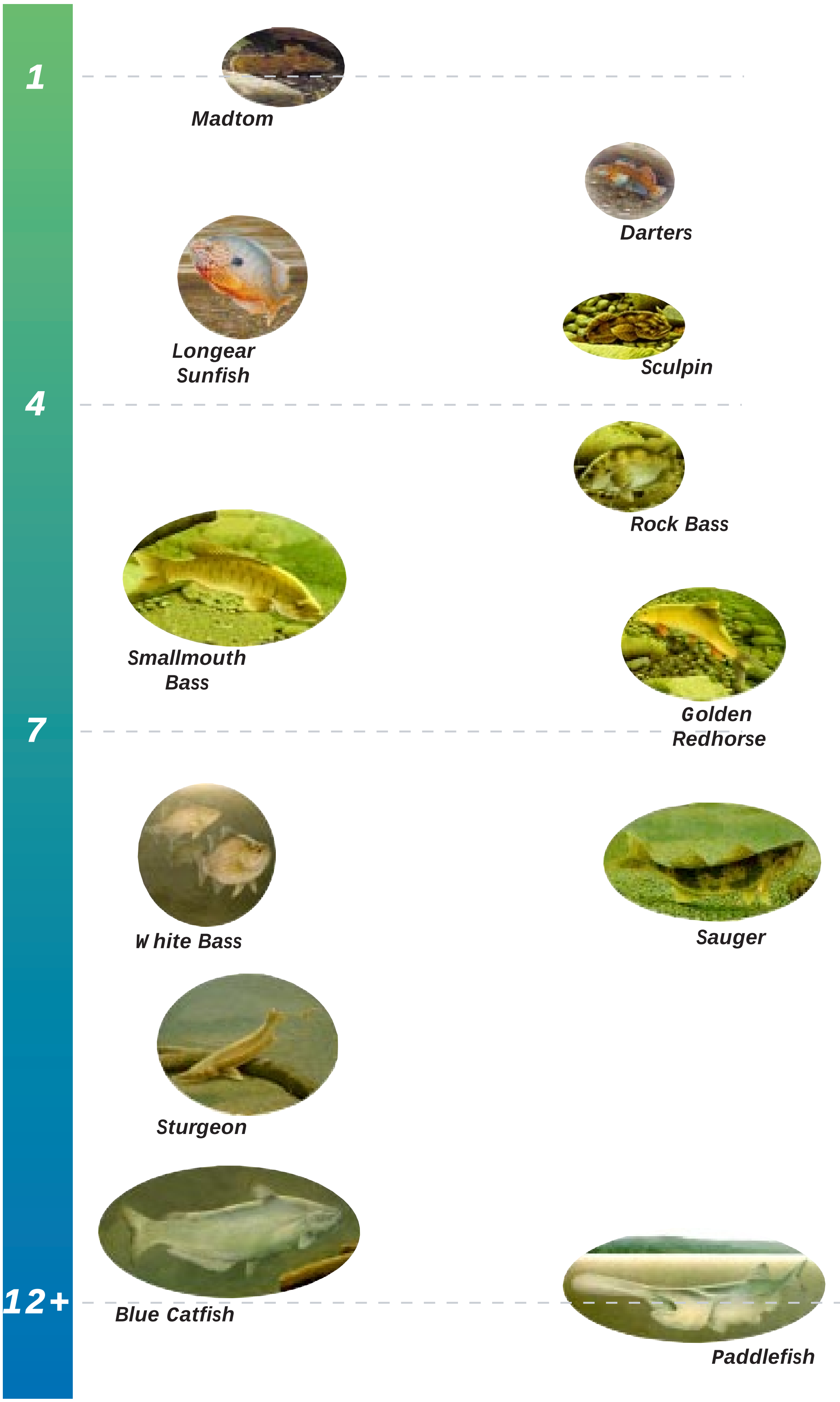
## BIODIVERSITY OF INVERTEBRATES

In stream order 1-3 streams, the invertebrates are adapted to the food that is available. As the primary food is the leaves that fall into the water, the first group of invertebrates that flourishes is shredders. They eat from the leaves and leave particles of dead plant material in the water for collectors, the second group that does well in this stream region. There are a few grazers and a few predators, but the biodiversity is comparably low for all invertebrates

In stream order 4-6 streams, the plants offer a greater variety of food, and the invertebrates adapt. There is a higher percentage of grazers feeding on those plants growing in the water. Again the collectors will have a high variety of dead plant material in the water and they will typically be well represented. The number of shredders will decrease proportionately. The number of predators will increase somewhat, but as biodiverity of all invertebrates has increased, the proportion of predators will remain about the same.

In stream order 7-8 streams, creeks or rivers, the grazers and collectors continue to dominate with slightly more collectors. This is primarily due to the decrease of rooted vegetation. Shredders continue to decrease and predators remain constant in proportion.

A stream order 9-12 would be considered a river. Here collectors are clearly dominant. While there could be a few shredders and grazers, they would be much less evident in a given sample. Predators again would remain reasonably constant in their representative proportion.


1
Madtom
Darters
Longear
Sunfish
Sculpin
4
Rock Bass
Smallmouth
Bass
Golden
Redhorse
7
White Bass
Sauger
Sturgeon
Blue Catfish
12+
Paddlefish

NOTES

## FISH THROUGHOUT THE WATERSHED

Fish are unique in the aquatic system in that they are capable of migrating from one stream order to another, at least temporarily. The fish depiction is a generalization, as fish could be found at different stream levels depending on circumstances.

In stream order 1-3 streams, the fish found would typically be the smaller fish that feed on insects that fall into the stream or the dominant aquatic invertebrates. The largest fish that would eat other fish would be green sunfish or possibly small smallmouth bass. The other fish found are mostly considered predators, but eat the insects as prey. One exception would be the stoneroller which feeds on algae when it grows in the pebbles. These streams may be stocked with trout, and are easily waded with a rare deep hole.

In stream order 4-6 streams, the biodiversity of fish increases dramatically. There is a much wider food source available and fish adapt to it. Many species from smaller streams continue to exist in these stream orders, and many more find a niche for their life style. Predator fish may be much larger (such as muskellenge), while there are now more prey species that are feeding on zooplanton (sunfishes) or collecting the dead material (suckers). Most of these size streams are wadable with occasional deep holes.

In stream order 7-8 streams, creeks or rivers, fish biodiversity is either stable or begins to decline slightly. A few of the fish, such as darters or sunfish, from much smaller streams are still adaptable and can find a niche here. Larger predators, such as flathead catfish, are now common along with smallmouth and/or largemouth bass. As there are more mussels in these waters, those fish that feed on them (drum) are also found. Some of these waterways could be wadable, especially in low water conditions, but they usually have deeper stretches that would be unsafe for waders.

A stream order 9-12 would be considered a river. There is still a high diversity of fish in the larger rivers. There are many fish in all guilds (predators, collectors, or grazers) that are usually found only in the larger rivers. However, many of the smaller fish such as darters, madtoms, and dace are not found in great diversity in these systems. These rivers are usually accessible for anglers from the shore or by boat only.

NOTES

## OTHER RELATIONSHIPS

There are several interesting relationships that are reflected in the Small Stream Ecosystem poster. The stonerollers, shown in the lower center of the poster, move small stones around as they graze for algae or build their nest. In so doing, many invertebrates are dislodged in the swift water. The silverjaw minnow is waiting nearby to eat the insects disturbed by the stonerollers.

The **spawning** behavior of the redfin shiner is somewhat similar to **the parasitic nesting** behavior of cowbirds. Redfin shiners are stimulated to spawn by the **milt** and ovarian secretions of the green sunfish pair. Male redfin shiners establish territories in the free flowing water above the nest. There may be as many as 100 male shiners associated with one green sunfish nest. When a female arrives, she and one dominant male lay and fertilize the eggs above the nest. The fertilized eggs drop into the silt-free nest of the green sunfish, and the male green sunfish guards the nest.

The queen snake shown in the poster is a specialist in that it feeds primarily on crayfish that have just shed their shells (soft craws). This factor makes the queen snake very difficult to keep in captivity.

In the small stream ecosystem, there is a close relationship between the aquatic animals and those who live in the nearby **riparian zone**. This zone is commonly defined as the area where the vegetation receives water from the water table fed by the running water. The vegetation shades the water, and as the water is already cool, the air in the riparian zone is usually a few degrees cooler than the surrounding landscape. Therefore, the riparian zone is a unique “micro habitat” that is not found just a few hundred feet away in the surrounding valley.

## Activities:

Fishy Who’s Who. Project WILD Aquatic, Page 8. The basic activity associates the student with the fish in their watershed, state or region. They then associate those fish with specific habitats and needs. There are several extensions that may be attractive to different aged students. One more suggested extension is to use computers to find information on specific fish or to communicate with professional specialists.

Recommended for grades 4 to 12. **KERA Learner Outcome 2.3: Students identify and describe systems, subsystems, and components and their interactions by completing tasks and/or creating products.**

“Create An Aquatic Food Chain.” Play a game where students represent the different species of fish. After the students have researched the fish that are found in a river in their area, hand out cards for the various fish found there. Each card represents from 5 (predator) to 100 (prey) individuals, so only one needs to survive for species survival. For each species, you would want to have different sizes. Then a small bass would have to eat only small prey species and could be eaten by other predators. The larger predators such as flathead catfish would be able to eat all prey species and most predators except the very large ones (like large muskies). However, they (larger predators) should be limited to one or two fish (prey) per game.

By having several species of fish represented, students will visualize the interdependence of the various fish. Through their research they should know which are schooling fish and which are solitary predators. Therefore, 4 or 5 students would “swim in a school” (minnows or shad) while predators (largemouth bass, muskies or flathead catfish) would “swim” independently.

“The river” can flow down an outside sidewalk or around the perimeter of the classroom. Predators can catch (tag) only one prey specimen at a time, return them to a predetermined site (a tree outside, or a desk inside), then they can continue “feeding”. Depending on the space you have, allow 1 to 3 minutes for each “feeding frenzy”. Repeat the game with different students playing the part of prey or predators. At the end of the exercise, have the students graph the results to illustrate behavioral and survival patterns.

For one extension, students could draw pictures of the fish they represent to tape on their back. Another would be to remove most of the predators from the system to explain how prey species over-populate.

Recommended for grades 4-8. **KERA Learner Outcome 2.4: Students use models and scale to explain or predict the organization, function, and behavior of objects, materials, and living things in their environment.**

## A LITTLE PIECE OF HEAVEN

From this author’s perspective, there is nothing quite as exciting as going to a new stream and discovering the wonders that live there. Each watershed offers its unique life giving ingredients.  The combination of nutrients and minerals in the soil makes that place special, and plants that grow there are specialized to that environment. Therefore, an aquatic ecosystem flowing from that locale exhibits a unique ecological personality.

When two streams meet, it is somewhat like a school at dismissal: there is a mixture of all living ingredients! There is potential for species from each of the parts to find habitat in the resultant stream or to move upstream into the opposite stream. As the stream grows, all aspects change including **gradient** and underwater structure. Because of the variety of niches, different aquatic species may live in the resultant stream that may inhibit those from upstream through **predation** or **competition**. This biological mixture occurs at every juncture of creeks, streams, and rivers all the way through the largest rivers. However, there may also be a chemical or physical change that prevents some species from using the resultant habitat.

NOTES

NOTES

Chemically, two streams in a given landscape would be very similar in a natural world. However, with human land use practices, it is possible for one stream to have a different **pH**, **dissolved oxygen** level, or **nutrient load** from the other. The balance of pH is particularly important as each species has a **window of tolerance**. While we think of acidic conditions killing fish, we must remember that alkaline conditions are equally fatal. Dissolved oxygen (DO) levels can also limit certain species. Generally, oxygen is not a factor in small streams as they are typically aerated with water bubbling over a sequence of riffles. However, in areas where the stream is sluggish and has an abundance of plant growth, DO levels could drop when the plants decompose. Nutrients typically do not inhibit aquatic animal species, but they do determine the plant species diversity that is the basis of the food chain.

There are two primary physical characteristics to consider: temperature and gradient. If a stream is spring fed, the temperature of the water is cool, with the water having been deep underground. In the same landscape, two joining streams would have similar temperatures. However, if one stream receives runoff water from roads or parking lots, it could be considerably warmer than another stream with a forested watershed. Further, if one stream comes from a south-facing slope in the valley and the other originates on the north-facing slope, the water temperature from the two streams could vary due to the angle of sunlight.

**Gradient** is measured in feet of drop per stream distance traveled. With a constant input of water, the gradient determines the flow rate as gravity pulls the water downhill. It is important to remember that streams **meander** or wander back and forth. Therefore, a stream may travel 2 to 3 miles in meanders while covering a "straight line" distance of one mile. This reduces the flow rate and natural erosion of the streambed.

One major human impact that affects stream gradient and water temperature is **channelization**. Streams are usually channelized to get the water away from human development as quickly as possible. By digging a straight channel and removing all vegetation, the water can cover the "straight line" distance more rapidly. Let us take an example of a meandering stream that traveled 2 miles in one lateral mile, the gradient would be doubled if the stream were channelized. With increased gradient and a constant source of water, the flow rate will increase, causing erosion in the streambed and on the channelized banks that have no tree roots to hold the soil. If the source of water is rainfall runoff, there will be periods of high rate of flow with much greater erosion, and between rains, periods with almost no flow. This creates a situation with high variation of water temperature. During high flow rates, the water will be the temperature of the rain, typically cool, and during low flow conditions, sunlight will warm the water, as there is no shade from trees. Plants and animals that are intolerant to change usually disappear from channelized small streams, leaving only those species that are highly adaptable to variable conditions.

# DROUGHT AND FLOOD EFFECTS

NOTES

Drought affects small streams in several ways. First, direct runoff from rainfall is decreased. If the drought lasts several months, the groundwater supply could be greatly reduced and springs may contribute less water or even dry up. Finally, the temperature of the water will increase and flow rate will decrease. All of these effects will give aquatic plants more opportunity to grow. Animals that are intolerant to warm water or low-flow conditions may migrate to better conditions. If there are constant flowing springs or deep holes in the system, a high density of fish would be expected. The deep hole could be a trap for smaller fish, however, as larger predators may be swimming upstream from larger streams to find refuge from the drought conditions.

Floods have varying effects on small streams. Much depends on the watershed and how dense the vegetation is near the stream. If trees are stable in the watershed, the water may get much deeper, but the flow rate and level of siltation should be within acceptable limits for most inhabitants. If vegetation has been removed, the flood event could be very intense with high flow rates, siltation, and disturbance of habitat features such as rocks.

The darter family is well adapted to the high water events with large fins that allow them to maintain position in high flow rates. Other fish would find refuge behind rocks or stable logs until the water recedes. Insect larvae can be dislodged as the water moves smaller rocks and washes the insects downstream. This could mean a slight decrease in food for the fish after the flood event.

# A FINAL NOTE

Fishery biologists have reported that small streams are very valuable during pollution events. Pollutants typically affect the fish by either removing oxygen from the water or blocking oxygen transfer in the gills of the fish. The biologists report finding reasonably large fish crowded into very small feeder streams to escape the polluted section in larger rivers to get oxygenated water. After the event is cleaned up or diluted enough to allow to fish to return, the fish repopulate naturally from the small streams to their former habitat.

## Activities:

"Watershed", Project WILD Aquatic, page 128. After completing the basic activity, teachers may want to discuss some listed extensions: #4. Determine the health status of your watershed. #9 A noted scientist once remarked, "Human activities speed up the flow of water while nature

NOTES

slows it down." Is this true in your community and why?

Recommended for students in grades 4-12. **KERA Learner Outcome 2.19: Students recognize the geographic interaction between people and their surroundings in order to make decisions and take actions that reflect responsibility for the environment.**

"Where Does Water Go Run?", Project WILD Aquatic, page 21. This activity focuses on wildlife and how the runoff water alters habitat. One suggestion is to have the students witness the runoff as soon as possible after a storm event. Have them see where the water is going and how it will affect their individual lives. Will they be able to play in the playground, city park, or ball field? Are there storm drains where it may be unsafe for younger students to play after rain events? Do any students live near the stream that receives the runoff water? Will people in the watershed have flooded basements? Were the effects more intense because the water ran off the pavement and buildings?

Recommended for students in grades 6-12. **KERA Learner Outcome 2.1: Students use appropriate and relevant scientific skills to solve specific problems in real-life situations.**

## GLOSSARY

*** indicates quoted definition from Project WILD**

**Biodiversity**

***Species diversity*** – The number of species found. Normally when more species are present, ecological systems are more stable based on interactions between species.

***Genetic diversity*** – Each species needs variety within its gene pool to provide protection against catastrophic loss due to disease or mutation.

***Ecosystem diversity*** – Within each ecosystem there must be diversity of habitat features to provide the needs for the species present.

***Landscape diversity*** – Wide area diversity as demonstrated by a watershed or mountain range. Each ecosystem within the landscape is dependent upon the health of other aquatic or terrestrial systems. Many species within individual ecosystems often travel to other systems for certain life requirements.

**Channelization** – The act of changing the natural channel of a streambed.

**Collectors** – Animals in the aquatic environment that bring water into their body and strain it to remove food particles.

**Competition** – * "When two or more organisms have the potential for using the same resource. May be inter- or intra- specific." For true competition to exist, the resource must be of limited quantity.

**Dissolved Oxygen** - * "Oxygen dissolved in water." Measured in parts per million. Good dissolved oxygen in a stream would be 7-10ppm. The air we breathe is measured in % or parts per hundred.
**Gradient –** The vertical distance water drops over a given horizontal distance.
**Grazers –** Animals that eat vegetation which is growing in their environment.
**Meander –** The tendency of moving water to flow back and forth across the landscape.
**Milt –** Male fish reproductive material, another name for sperm.
**Nutrient load –** The amount of nutrients dissolved in the water.
**Parasitic Nesting –** The intentional act of placing eggs in the nest of another species to allow that species to raise the young.
**pH –** A measure of the relationship of acid and base in water.
**Predation –** The act of killing another animal for food.
**Predators –** Animals that kill and eat other animals.
**Riparian Zone –** That area next to a river where the plants primarily get water from the ground being soaked by the river.
**Spawning –** The act of reproduction in fish.
**Watershed –** The landmass that drains into a given aquatic system.
**Window of tolerance –** A parameter within which a given species can exist. It could be a measurement of pH > 5.9 to 8,1<, dissolved oxygen >4.5ppm, or temperature <83 degrees, for instance.

SPORT FISH RESTORATION

KENTUCKY DEPT. OF FISH & WILDLIFE RESOURCES

Sportsmen Pay For Conservation