The Salmon Times

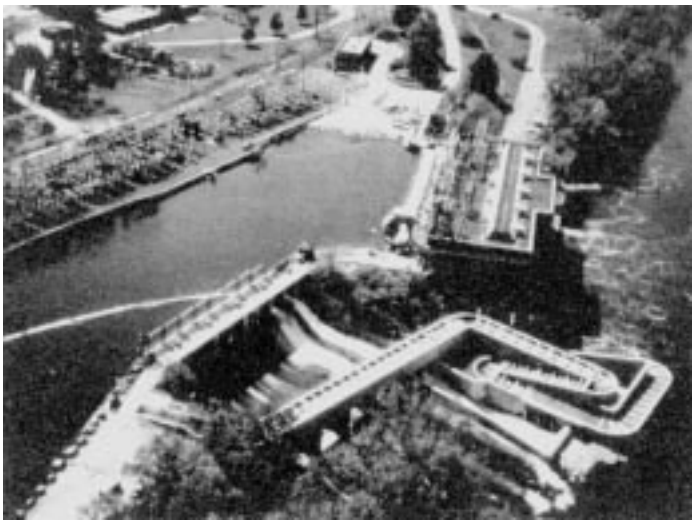
April *Number 7*

One Step at a Time

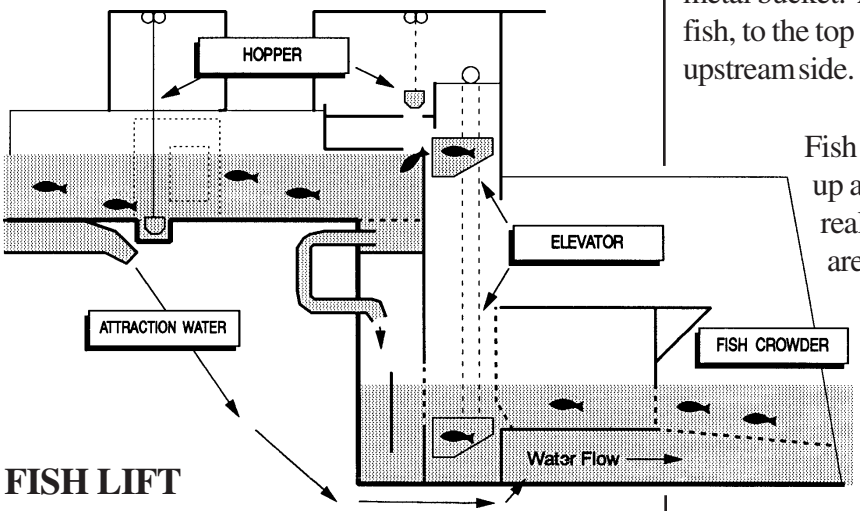
The arrival of spring and warming stream temperatures should remind you that soon wild adult Atlantic salmon will be returning from the sea to New England's rivers on their annual spawning migration. But how will some of these fish make it all the way upriver to their native streams when, in many cases, dams stand in their way? Well, thanks to fishery biologists, working with talented engineers, there are now ways for salmon and dams to peacefully coexist in rivers. Their inventions: fish ladders and fish lifts.

Actually, fish ladders are not really all that new an invention. You've already learned that back in the 1800's there were a number of salmon restoration programs in New England, ranging from Maine to the Connecticut River. One very important element of those efforts was the construction of fish ladders.

The fish ladders of a century ago are, in many ways, similar to the ladders of today. Really, a ladder is a series of pools arranged like a staircase. Attracted to the entrance of a ladder by fast flowing water, fish gradually leap from one pool to the next until they reach the top of the dam. Since each jump requires a fair amount of energy, there is usually a resting place below each pool where fish can "catch their breath" before attempting the next jump. For fish that don't leap, like smallmouth bass, there is generally an opening at the base of each step that allows the fish to simply swim from one step or pool to the next.



Instead of fish ladders, some dams have fish lifts or elevators. You can probably guess how they work. Fish enter a canal at the base of a dam, once again attracted by fast flowing water. Once in the canal, a gate swings shut, trapping the fish. Underneath the fish in the canal is a big metal bucket. A crane lifts the bucket, hopefully full of fish, to the top of the dam and releases them on the upstream side.

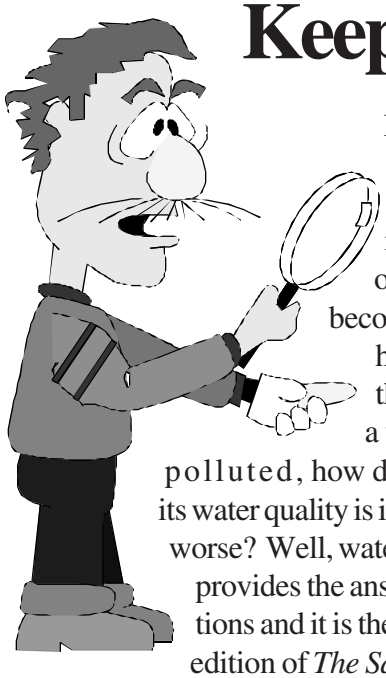


FISH LIFT

Fish ladders can be used by fish migrating both up and downstream. Downstream bypasses, really just big pipes full of fast flowing water, are the principal way that fish migrating down river get over dams.

Fish ladders can be fun and interesting places to visit, especially in the spring when anadromous fish are migrating upriver. Some even have viewing windows.

Keeping an Eye on Water Quality



Last month you learned about some of the ways our rivers, lakes, and other water bodies become polluted. But how do we know if they are polluted? If a water body is polluted, how do we know whether its water quality is improving or getting worse? Well, water quality monitoring provides the answers to both questions and it is the subject of this edition of *The Salmon Times*.

Water has different characteristics that can be examined or tested. The results of such tests can be helpful in painting a picture of water quality and the health of a water body. Results of tests conducted on water from healthy and unhealthy water bodies can be quite different.

Water quality monitoring begins the first time a water body is surveyed, or tested, and continues as surveys are repeated at the same site (or series of sites), on a regular basis. The initial survey, really a series of tests, results in a set of baseline data. Data from further surveys are compared to the baseline data in order to determine whether water quality is staying the same, getting worse, or improving.

Now you know what water quality monitoring is and why it's done. But how is it done? A water quality survey is really a series of tests. Most begin by collecting a sample of water at the survey site. You can examine a variety of physical, chemical, and biological characteristics of water. Each characteristic provides important information. Let's take a look at a few of them and see why they are important:

Simple Observation: Much can be learned about water simply by using your senses. Does the water have an unusual color? Is there a peculiar smell coming from a water body? Simple observations can provide clues as to whether or not a more in-depth investigation of the water quality is needed.

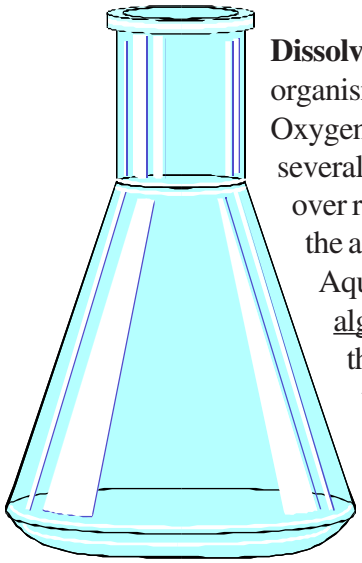
Temperature: Aquatic organisms are sensitive to water temperature. Atlantic salmon prefer colder water than largemouth bass, for example. Trees and other vegetation that grow along a stream provide shade, reducing the warming effects of the sun. Removal of the vegetation can increase water temperature and influence which organisms can live there. As water gets warmer, it holds less oxygen.

Stream Flow: Salmon parr prefer riffles. An angler is likely to catch a catfish in a slower section of the river. Different organisms prefer different stream flows. Each species, whether plant or animal, adapts to certain conditions. Human activities, such as building dams and altering stream channels, can change stream flows and influence which organisms can survive in a certain stretch of river.

Turbidity: Suspended sediment or other particles create murky or turbid water. The sun's rays may not be able to penetrate turbid water and will therefore interfere with

photosynthesis of aquatic plants. Decreased photosynthesis means less dissolved oxygen. Eventually the sediment will settle to the bottom, perhaps altering important habitat.

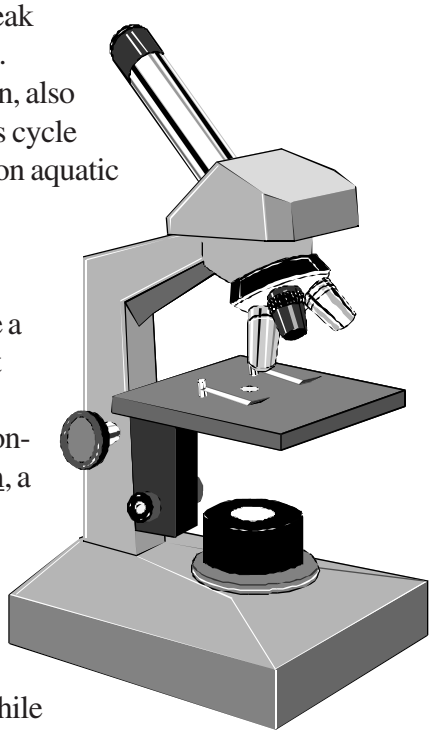
pH: The easiest to spell, but perhaps not the easiest to understand, pH refers to how acidic or alkaline a water body is. pH is measured on a scale from 0 to 14, where 0 is the most acidic and 14 is the most alkaline. pH greatly influences which organisms live in a water body. Atlantic salmon require a minimum pH of 5. Carp and catfish can survive at much lower pH levels. Acid rain is a common cause of low pH levels in water bodies. Other forms of pollution can also affect pH levels in water.



Dissolved Oxygen: Aquatic organisms need oxygen to live. Oxygen is dissolved in water in several ways. As water cascades over rocks in rapids, oxygen in the air mixes with the water. Aquatic plants, including algae, contribute oxygen to the water through photosynthesis. Factors that decrease the amount of dissolved oxygen in a water body greatly influence which organisms can live there.

Nutrients: Nutrients are substances that are essential for plant growth. Two of the more important nutrients generally found in water bodies are phosphorous and nitrogen. Problems occur when there is an excessive amount of either present. Human sources of nutrients include agriculture (fertilizer and manure), stream bank erosion (sediment), and faulty septic systems.

An explosion of plant growth, including algae, can occur with high levels of nutrients in a water body. While plants do produce oxygen through photosynthesis, they also consume it through respiration - just like people. Because photosynthesis only takes place during daylight hours, and plants continue to "breath" oxygen at night, they can actually consume more oxygen than they produce. This can dramatically lower dissolved oxygen levels. Also, when these plants die, large numbers of bacteria appear to break down the plant tissue. These bacteria, in turn, also deplete oxygen. This cycle can be very harmful on aquatic wildlife populations.



Indicator Bacteria: Coliform bacteria are a group of bacteria that are found naturally throughout the environment. Fecal coliform, a specific type of coliform bacteria, exist in the intestines of warm-blooded animals, including people. While coliform bacteria themselves are not generally harmful to people, their presence can indicate the presence of other pathogens, such as disease-causing bacteria and viruses. So monitoring for coliform bacteria is an important element of water quality monitoring.

Fish Condition: The general health of fish can indicate water quality problems. The weight of the fish is compared to its length. Generally, the heavier the fish at a given length, the healthier it is.

The Water Police

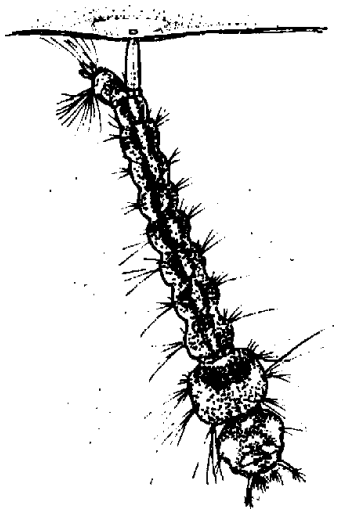
How do you know that the water coming out of your kitchen faucet is safe to drink? Ever wonder who monitors our rivers, lakes, estuaries, and oceans on a continuing basis to make sure they stay safe for us and wildlife?

The Clean Water Act of 1972 sought to make all water bodies in the United States "fishable and swimmable." State agencies, working with the U.S. Environmental Protection Agency, play the primary role in establishing water quality standards and enforcing water quality-related regulations.

Little Critters Delivering Big Messages

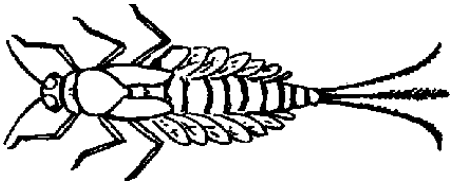
So now you know a little about how to monitor water quality. But not everyone is interested in all that "chemistry stuff!" How about learning a really fun way to determine whether a stream or pond has clean water?

When your parents go to buy a new house, they generally want to know a little about the neighborhood before spending all that money. That only makes sense. One of the best ways to tell whether or not the neighborhood is a good or safe place to live is to talk to people who already live there. You may not be able to talk to the "residents" of a water body, but who (or what species) you find there can tell you a lot about the quality of their aquatic "neighborhood."



Mosquito larva can tolerate a certain amount of water pollution.

When you think of the animals that live in streams or ponds, you probably think of fish, turtles, and frogs. But as you will remember from our discussion of aquatic ecosystems, there are plants and smaller "critters" in water bodies that provide food for these larger animals. It is these tiny animals, which we will call invertebrates, that can reveal a lot of information about water quality. Invertebrates are animals that lack backbones. Aquatic insects, crayfish, and freshwater mussels are common invertebrates found in ponds and streams. Because most of these species can be seen with the naked eye, they are called macroinvertebrates.

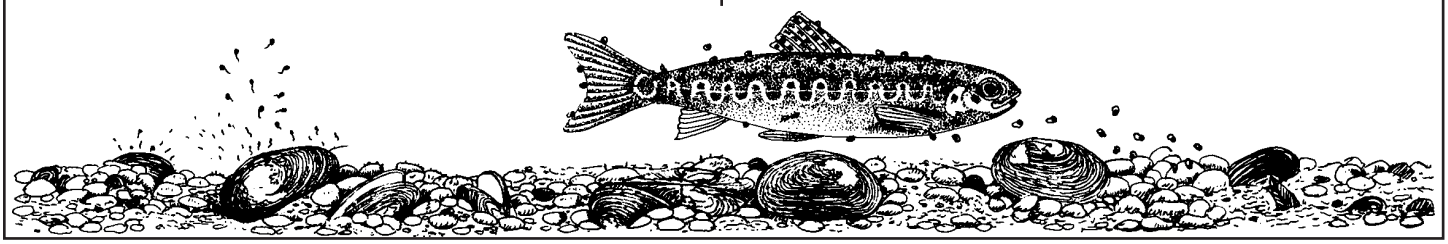


Mayfly nymphs are intolerant species, meaning they are generally found only in very clean streams.

Different macroinvertebrate species can tolerate different levels of water quality. Mayfly nymphs require very clean water. Mosquito larva, on the other hand, can exist in quite dirty water, though they are also found in clean water. If you do a macroinvertebrate survey of a stream and find many species that are intolerant to pollution, then the chances are the water is clean. On the other hand, if you find mostly species that do well in polluted water, and no intolerant species, the stream may be polluted.

You probably remember from a previous edition of *The Salmon Times* that one sure sign of a healthy aquatic ecosystem is the variety or diversity of plant and animal life that lives there. Generally, the greater the diversity, the healthier the habitat. Because macroinvertebrates can indicate the health of an aquatic ecosystem, we call them biological indicators or bioindicators. Bioindicators are a very important part of water quality monitoring.

So how do you go about collecting macroinvertebrates from a stream? Kick seining is a good technique for collecting the little critters. It involves stepping into the water, facing downstream, and kicking the stream bottom with your feet. This dislodges the macroinvertebrates, which then are carried by the current downstream and (hopefully) into your net. Kick seining should only be done in safe water conditions and always with an adult present.

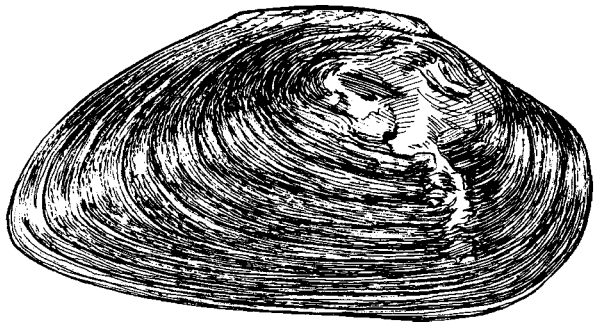


Freshwater Mussels:

A Real Shell Game

When you hear the word mussel, you probably think of ocean tide pools. Well, there are freshwater mussels too. Another type of macroinvertebrate, freshwater mussels live on the bottom of many water bodies right here in New England. Did you know that? Did you also know that many species of freshwater mussels are disappearing because of water pollution?

Freshwater mussels are important bioindicators of water quality because of their rather special life cycle. All freshwater mussels feed by pumping water through their bodies and filtering out tiny food particles. Mussels filter-feed by sitting on the bottom of a water body and letting the current bring food to them.



The dwarf wedge mussel is presently on the U.S. Endangered Species List

Some mussel species are in trouble. Because mussels filter-feed, move around very little (and can't escape a threat), and are choosy about their habitat, they can be extremely sensitive to human impacts on a water body. Young and old mussels can be sensitive to changes in water chemistry and water temperatures.

Getting Into the Act

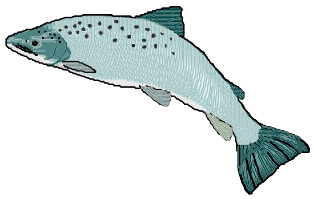
Water quality monitoring is turning out to be quite a popular activity - for adults and kids. And why not? Water is a pretty important part of our lives. What better way is there to learn about water than by getting your hands wet?! It's not like everyone is competing to get a piece of the water quality monitoring action. There are plenty of lakes, streams, ponds, rivers, estuaries, and oceans to go around! As long as "citizen monitors" collect and analyze water samples accurately, the resulting data can be very helpful - even to scientists.

Students from schools in Massachusetts and New Hampshire have been monitoring the water quality of the Merrimack River for several years. Every October students and their teachers tramp down to their school's survey site for a day of sampling and analysis. The data are later entered into a computer bulletin board and shared with other schools involved in the program. What results is an interesting collective picture of Merrimack River water quality.

Water quality monitoring can be a lot of fun. Is your school involved in water quality monitoring? If not, perhaps your class could adopt a stream or pond near the school.

photo by Paul Dest, courtesy of New Hampshire Fish and Game Department

THE PUZZLER



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