This Lake Alive!

An Interdisciplinary Handbook for Teaching and Learning about the Lake Champlain Basin

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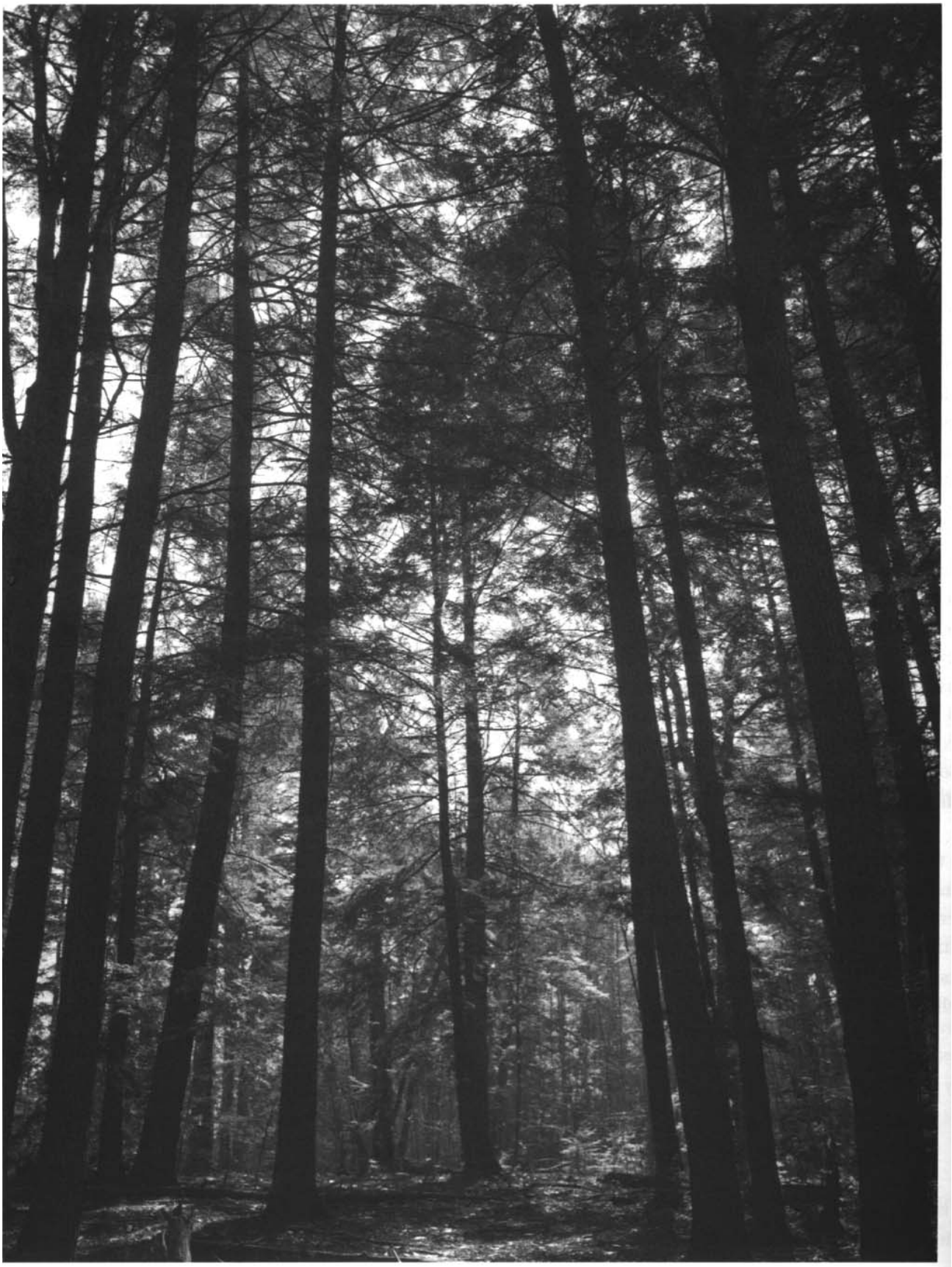

Gluskabi and the Game Animals

as told by Joseph Bruchac

Long ago Gluskabi decided he would do some hunting. He took his bow and arrows and went into the woods.

But all the animals said to each other, "Ah-hah, here comes Gluskabi. He is hunting us. Let us hide from him." So they hid and Gluskabi could not find them. He was not pleased. He went home to the little lodge near the big water where he lived with Grandmother Woodchuck.

"Grandmother," he said. "Make a game bag for me."

So Grandmother Woodchuck took caribou hair and made him a game bag. She wove it together tight and strong and it was a fine game bag. But when she gave it to Gluskabi, he looked at it and then threw it down.

"This is not good enough," he said.

So then Grandmother Woodchuck took deer hair. She wove a larger and finer game bag and gave it to him. But Gluskabi looked at it and threw it down.

"This is not good enough, Grandmother," he said.

Now Grandmother Woodchuck took moose hair and wove him a very fine game bag indeed. It was large and strong and she took porcupine quills, which she flattened with her teeth and she wove a design into the game bag to make it more attractive. But Gluskabi looked at this game bag, too, and then threw it down.

"Grandmother," he said, "this is not good enough."

"Eh, Gluskabi," said Grandmother Woodchuck, "how can I please you? What kind of game bag do you want?"

Then Gluskabi smiled. "Ah, Grandmother," he said, "make one out of woodchuck hair."

So Grandmother Woodchuck pulled all of the hair from her belly. To this day you will see that all woodchucks still have no hair there. Then she wove it into a game bag. Now this game bag was magical. No matter how much you put into it, there would be room for more. And Gluskabi took this game bag and smiled.

"Oleohneh, Grandmother," he said. "I thank you."

Now Gluskabi went back into the woods and walked until he came to a large clearing. Then he called out as loudly as he could, "All you animals, listen to me. A terrible thing is going to happen. The sun is going to go out. The world is going to end and everything is going to be destroyed."

When the animals heard that, they became frightened. They came to the clearing where Gluskabi stood with his magic game bag.

"Gluskabi," they said, "What can we do? The world is going to be destroyed. How can we survive?"

Gluskabi smiled. "My friends," he said, "just climb into my game bag. Then you will be safe in there when the world is destroyed."

So all of the animals went into the game bag. The rabbits and the squirrels went in and the game bag stretched to hold them. The raccoons and the foxes went in and the game bag stretched larger still. The deer went in and the caribou went in. The bears went in and the moose went in and the game bag stretched to hold them all. Soon all of the animals in the world were in Gluskabi's game bag. Then Gluskabi tied the top of the game bag, laughed, slung it over his shoulder and went home.

"Grandmother," he said. "Now we no longer have to go out and walk around looking for food. Whenever we want anything to eat we can just reach into my game bag."

Grandmother Woodchuck opened Gluskabi's game bag and looked inside. There were all the animals in the world.

"Oh Gluskabi," she said, "why must you always do things this way? You cannot keep all the game animals in a bag. They will sicken and die. There will be none left for our children and our children's children. It is also right that it should be difficult to hunt them. Then you will grow stronger trying to find them. And the animals will also grow stronger and wiser trying to avoid being caught. Then things will be in the right balance."

"Kaamoji, Grandmother," said Gluskabi. "That is so." So he picked up his game bag and went back to the clearing. He opened it up.

"All you animals," he called, "you can come out now. Everything is all right. The world was destroyed, but I put it back together again."

Then all of the animals came out of the magic game bag. They went back into the woods and they are still there today because Gluskabi heard what his Grandmother Woodchuck had to say.

And so the story goes.

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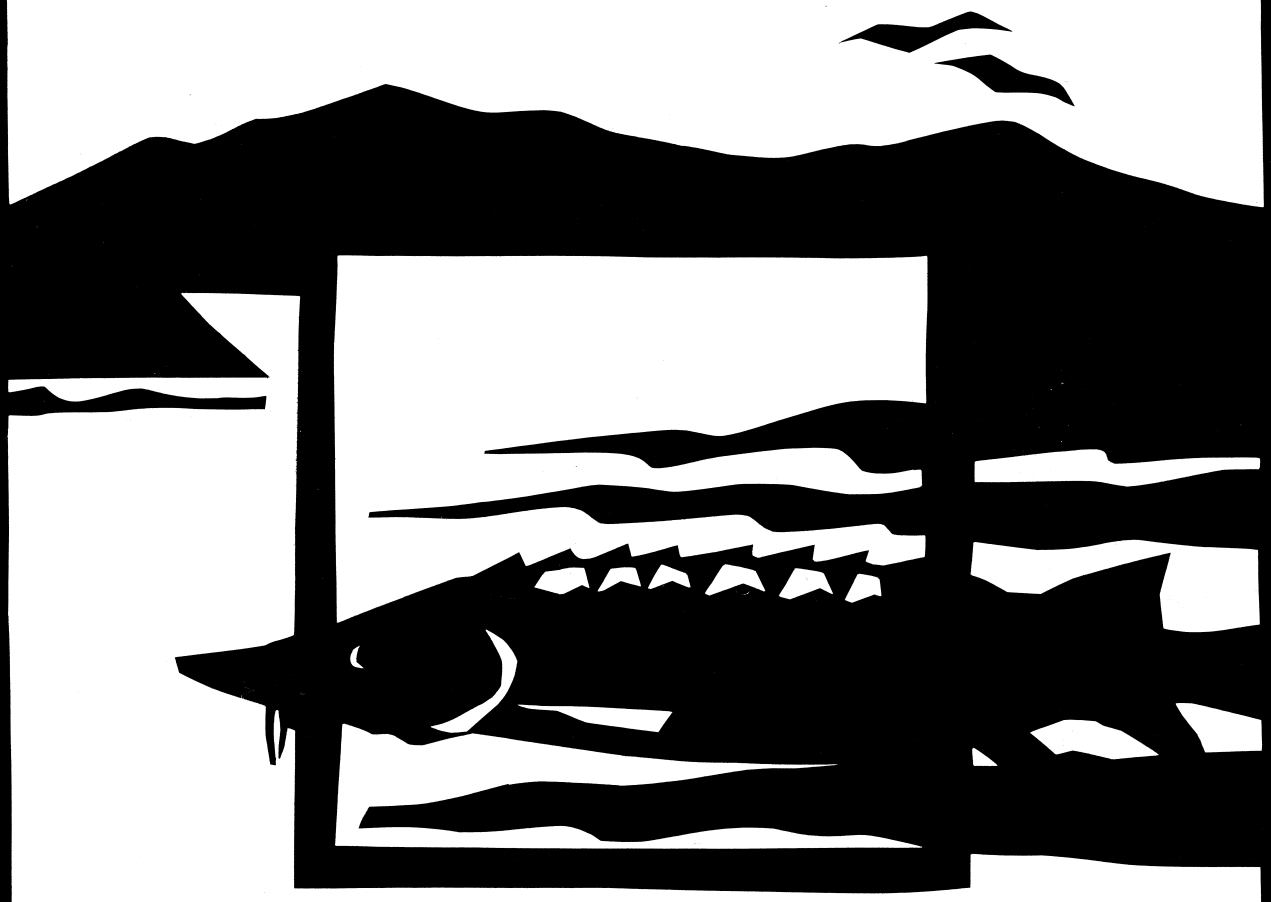


The Living Treasures of the Lake Champlain Basin

The Great Journey

by Colin Brady, Grade 5, School Street School, Milton, Vermont

One day in 1993, a fish named Colin had a huge fight with his parents and decided to run away.

"I'm going to run away," yelled Colin to his parents.

So Colin gathered up his supplies like: scales, extra fins and food. He went to his best friend's house to see Brian, a small little perch.

"Will you come on a journey with me?" asked Colin.

"Sure," answered Brian.

They left the next morning. They traveled about a mile north and then met their first kind of trouble of being alone, a mean gang of northern pikes. That doesn't really sound like such a big problem but when their leader's name is Butch and another guy's name is Spike, you would be pretty scared.

Brian screamed, "We're in their territory, we're dead now!"

"How do you know?" yelled Colin.

"Because that sign back there said Northern Pike Territory!"

But you couldn't count these guys down yet. Colin wasn't fish of the year for nothing. He had a plan. The plan was to swim for their lives! So they started swimming as fast as they could.

"Swim faster, you slowpoke!" yelled Brian.

"I'm trying," yelled Colin.

They swam a few more feet and then Brian said "YES! We're out of their territory!"

"How do you know?" asked Colin.

"Because there was a sign back there that said you're out of their territory," answered Brian.

That night, after their adventure, they spent the night in the sunken ship, the *Phoenix*. In the middle of the night, a skull fell on Brian's fin. He woke up instantly and screamed, "AAAAA!"

Colin woke up after Brian's scream and asked what was the matter.

"There's a skull!" yelled Brian.

"Oh" said Colin and went back to sleep.

Two seconds later Colin screamed, "A skull!" and they swam off and spent the night in an old beer can.

The next day, they were swimming along when they met some northern pikes. Instantly they swam away. By then they were in the Champlain Canal. They had been resting a little when Brian noticed a little minnow floating around. He went up and grabbed it.

The fisherman yanked up and caught Brian. But the fisherman said, "aw, too small," and he threw Brian back in.

Those two got out of there pretty fast. They swam into the St. Lawrence Seaway and then swam for days and days into the Atlantic Ocean. They found partners and mated. They each have eight kids and are about to go on their great journey back to Lake Champlain.

EPILOGUE: This will probably go on and on forever. With that I will leave you. Have a safe trip back, young fish.

Introduction

The Living Treasures of the Lake Champlain Basin was not in the original plans for THIS LAKE ALIVE! It became a need as we worked on the ecology chapter. We felt that what we wanted to say about the natural world needed its own space, although much of the contents in *Living Treasures* are intertwined with key concepts of the ecology chapter and the chapters should be regarded as "cousins."

I began with a short essay by William Countrymen and Judy Elson and I wrote what you see here. It soon took on a life of its own as it became important to include all living things, as well as how humans have interacted with the natural world. Even so, it falls short of exploring all aspects of the basin as an ecosystem, as it does not fully deal with interactions among nonliving things, such as soils and climate. The *Geology*, *Ecology* and *Geography* chapters can be used to expand the meaning of this chapter.

William Countrymen's article, "Plant, Fish and Wildlife Communities in the Champlain Basin," appears in a publication of the Lake Champlain Committee: ESSAYS ON LAKE CHAMPLAIN.

Mostly, we wanted this chapter as part of this book because of the profound lessons the natural world can teach us about living on earth. Children are already linked to this world; our only job as teachers is to make sure that this link stays intact as they go through school.

Many people contributed to this chapter. Don Jarrett, Laura Eaton, Mark Scott and Nick Staats reviewed this chapter; Steve Faccio and Madeleine Little read parts. Deb Parrella wrote the section on plants. Mary Watzin, Lou Borie and Mark Labar contributed short pieces.

Judy Elson and I had many conversations about whether the piece on exotics belonged in *Living Treasures* or *Ecology* . We didn't disagree; we just couldn't decide. So we decided to let it sit in this chapter, but place it separately so you can use it however you choose! It's an important part of both chapters. Exotics, by telling their own tale, tell the larger tale as well. Also, like any topic that deals with the management of natural resources, it has a lot of timely information. For example, at the moment, everyone is alarmed about zebra mussels and there is, at present, no plan to protect the shipwrecks in Lake Champlain from these invaders. What zebra mussels will do to the native mussel population is a huge concern.

The monitoring and management of nuisance species is constantly being revised. This is important to share with students, but it also means that this piece will be outdated sooner than others. If I had written it without information about management plans, it would not be very useful. New information is readily available from Departments of Fish and Wildlife in your area. I hope you agree that it was still helpful to write the piece this way.

The Living Treasures of the Lake Champlain Basin

The Lake Champlain Basin is an ecosystem. An ecosystem is a combination of interactions over time among living and nonliving things. Ecosystem is really a term that represents an idea more than a place or set of things. An ecosystem includes living organisms, nonliving components, and a source of energy. Defining the Lake Champlain Basin as an ecosystem helps us to understand the relationships between all the living things in the basin and how they affect each other.

The basin is home to a variety of creatures, all of whom reside in a web of interdependence. This essay will explore some of the ways that the natural world of the basin operates. It will also look at some of the ways that humans have had an impact on the fragile balance among creatures and relate the story of some of the interesting inhabitants of this region as we slip into the twenty-first century. If you ever feel lonely, you won't after you find out how many winged, furred, leafed and scaled creatures share this world with you.

"We can draw an imaginary line around a section of the larger world and decide to treat its elements separately from the rest—and call it an ecosystem. When we describe how the organisms in the system behave: how they interact, grow, adapt; what they eat; how long they live; what happens to them when they die; what they require to stay healthy or to reproduce, we are dealing with the way in which the whole system operates—we are thinking SYSTEMATICALLY. We are finding connections."

AQUATIC WILD

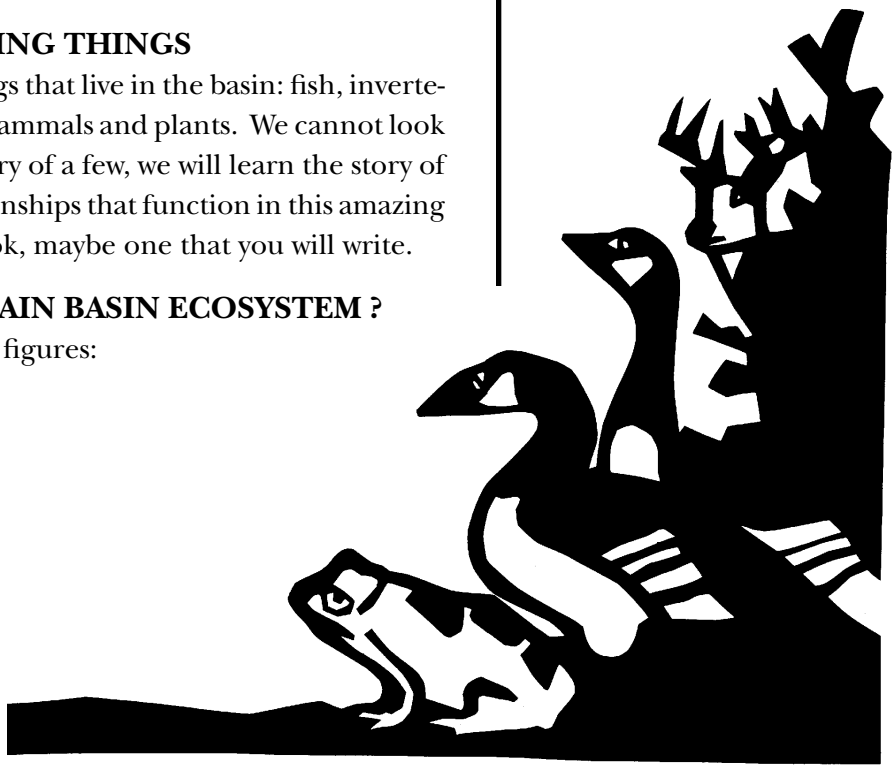
THE BASIN *is* HOME *to* MANY LIVING THINGS

There are six major groups of living things that live in the basin: fish, invertebrates, amphibians and reptiles, birds, mammals and plants. We cannot look at all the creatures, but by telling the story of a few, we will learn the story of many. Nor can we review all of the relationships that function in this amazing ecosystem—that would take a whole book, maybe one that you will write.

WHAT LIVES *in the* LAKE CHAMPLAIN BASIN ECOSYSTEM ?

Just to give you an idea, check out these figures:

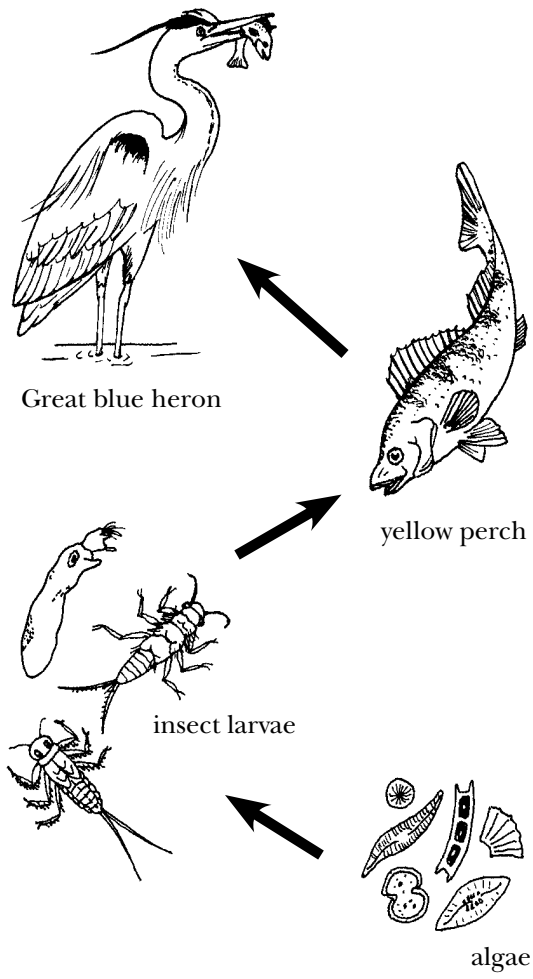
- fish - 81 species identified
- birds - 318 species breed or live
- mammals - 56 species
- reptiles - 20 species identified
- amphibians - 21 species identified
- countless invertebrates
- vascular plants - over 1,900 identified



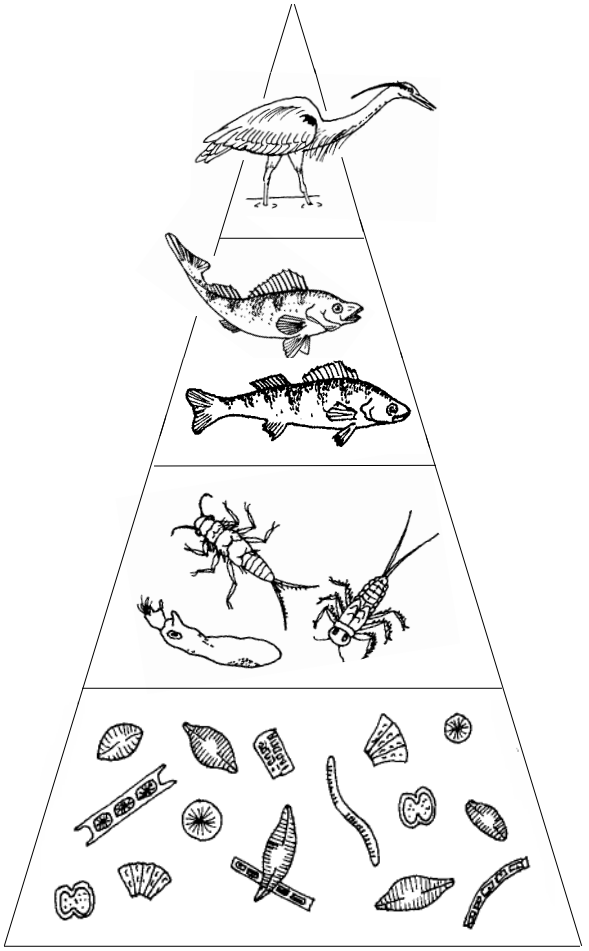
The Lake Champlain Special Designation Act "envisions that all aspects of human and ecological life within the basin be maintained in harmony with one another."

All of these living things interact in numerous complex relationships. The major relationship between living things is the process of transferring energy from one species to another via a simple food chain or a more complex food web. These species depend on one another because many of them eat one another. Plants are considered the producers. Animals and plants that eat other plants or animals are called consumers. The graphics below display a simple food chain, a food pyramid and a more complex food web. At each feeding stage or trophic level, energy is transferred to the consumer. Approximately 2 to 40% of the energy at one level of a food pyramid gets passed on to the consumer at the next level. Therefore, the animal at the top of the food chain has progressively less available energy.

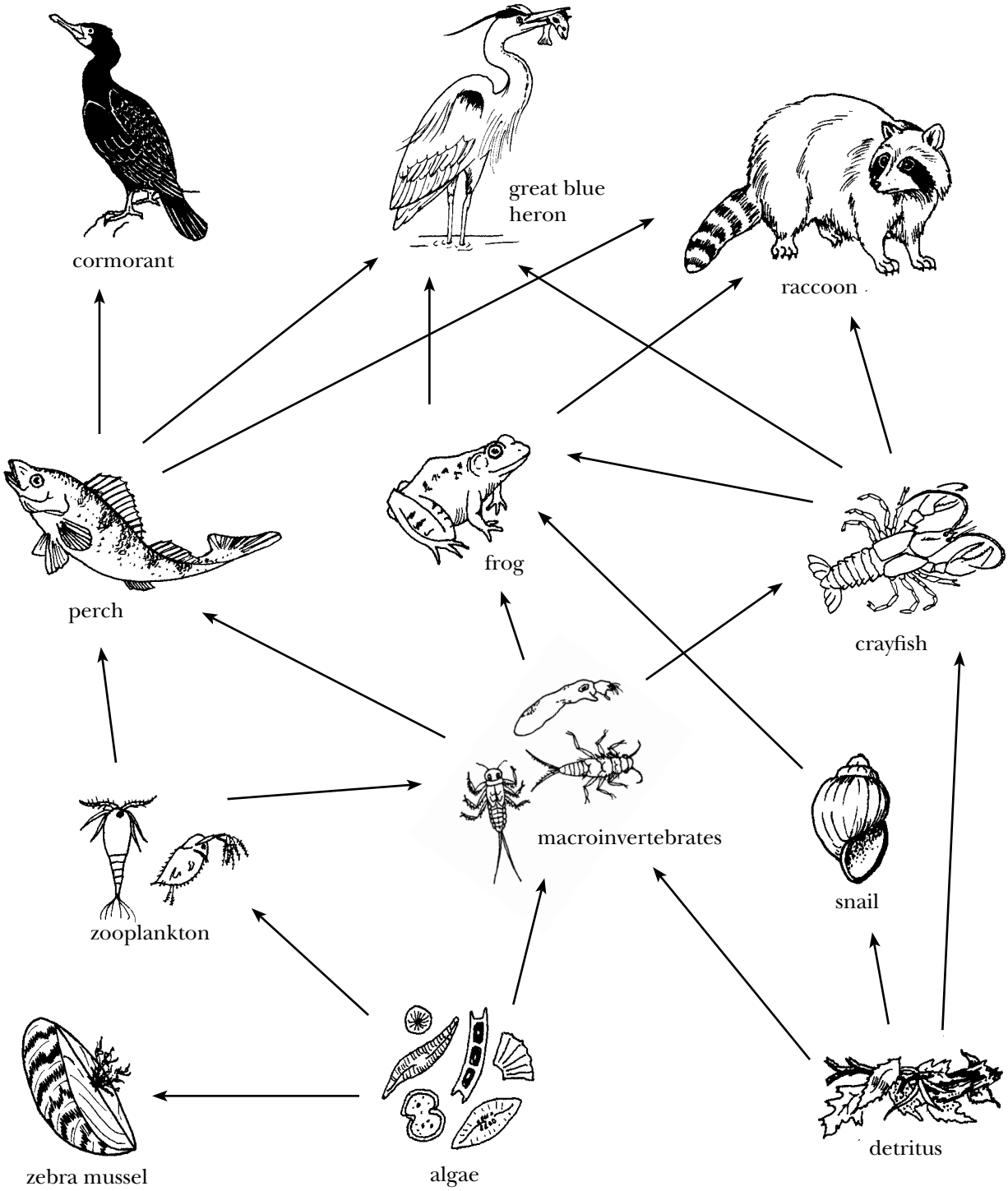
Food Chain



Food Pyramid



Food Web

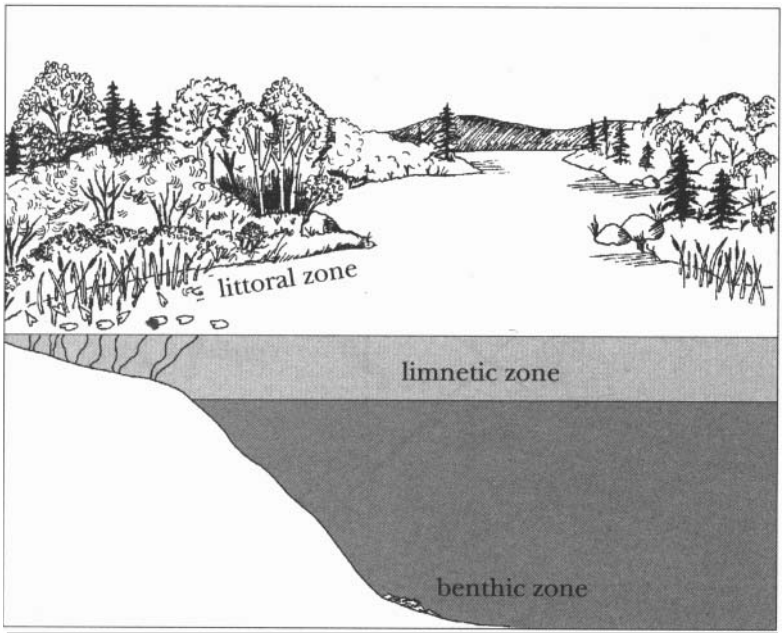

cormorant
great blue heron
raccoon
perch
frog
crayfish
macroinvertebrates
zooplankton
snail
zebra mussel
algae
detritus

Biologists classify habitats in very specific terms. What we might call woods in the mountains might actually be a sub-alpine heath/ krummholz community.

THE BASIN CONTAINS MANY HABITATS

Habitats are places where plants and animals live, where they feed, find shelter and reproduce. Some habitats are relatively small, like a nesting and feeding area of a largemouth bass, which may encompass only one-half of an acre; some are quite large, such as that of an osprey, which may fly miles in search of food. Some habitats vary according to the season, and animals may change their habitats for many reasons, some of them natural, and some not.

Habitats are defined by their different physical features. In the Lake Champlain Basin you will find many distinct habitats: woods, rivers and streams, open meadows, wetlands and lake waters. All land and water is classified according to the type of habitat it provides. Each of these habitats is divided into zones. Let's just look at the different parts of the lake.



The lake itself, home to many aquatic creatures, contains a variety of habitats. By definition, a lake is a body of water that is deep enough to have layers. The layers that exist in a lake as deep as Lake Champlain are called littoral, limnetic and benthic. These zones have different characteristics that determine what variety of fish and other aquatic creatures live there. Some fish like the layer where the water is cold and deep; others like warm, shallow water. Some creatures can tolerate water with low amounts of oxygen and others cannot.

While aquatic animals such as fish live in the lake, other animals such as otter, muskrat or red-winged blackbird depend directly on the lake but don't live in it. Some other animals live nearby. Wildlife species such as snow geese, great blue herons, double-breasted cormorants, ring-billed gulls and common terns depend on the islands in the lake and wetlands around it for feeding, breeding, wintering and migration habitat. Other animals live on the land surrounding the lake and in the wooded forests in the mountains. They depend on the tributaries in the lake's watershed. Even though a moose's habitat is the forest, for example, it depends on wetlands for many meals. Many creatures travel from one place to another and live in many kinds of habitat.

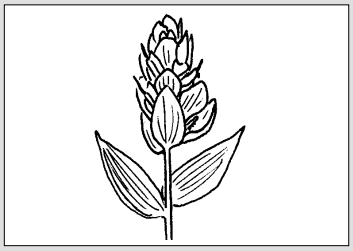
The basin is located on the Atlantic Flyway for migratory birds. During the fall, there have been an estimated 20,000 to 40,000 ducks and geese passing through.

It is natural for migrating birds to change habitats according to the seasons. But sometimes habitats become unsuitable for some species. If wetlands are filled, or too many trees that grow near water are cut down, birds that prefer a rotting tree overlooking a wetland full of food will nest somewhere else. If land is overdeveloped and soil erodes and turns a gravelly river bottom into a murky and silty river bottom, the fish that usually spawn there will not return. If many habitats are destroyed over time, a population of a species will decline or disappear.

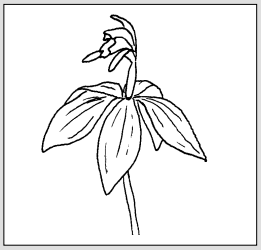
Wetlands are an especially important habitat in the Lake Champlain ecosystem. Wetlands are defined as areas that have a certain amount of moisture and thus provide a unique environment for specific plants and animals. They are spawning and nesting areas, resting places and safe hideaways as well as a nutrient-rich feeding ground for many animals. They benefit the entire basin as they also perform critical cleansing and purifying duties.

Where have all the species gone? Habitat destruction, pollution and hunting are the major reasons why species are disappearing. Humans are the main cause for species becoming **rare, threatened, endangered, extinct and extirpated.** Some species have very specific needs in order to survive. For example, the black sedge is a plant that only grows on certain mountains in Vermont. A species that is "picky" about its food or habitat limits its ability to survive in a changing world.

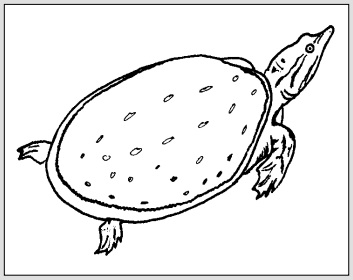
• A **rare** species has a small population due to natural reasons or human impact. The pale painted cup is designated as rare because it has a specific habitat located in Smuggler's Notch in Vermont.



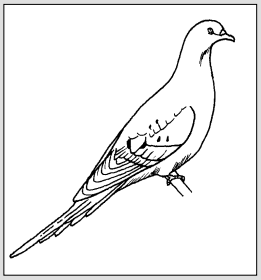
• **Endangered** animals and plants are in immediate danger of becoming extinct or extirpated if they are not protected. The small whorled pogonia is endangered in the Lake Champlain Basin and also is listed as a federal endangered species.



• **Threatened** species are those with declining populations, and they may become endangered if they are not protected. The spiny softshell turtle is a threatened species that lives in the shallow, sandy areas in Lake Champlain.



• **Extinct** means forever. If all the animals of a certain species die, they are extinct—gone forever. The passenger pigeon is an example of an extinct species. The last passenger pigeon died in a zoo in 1914. You will never be able to see a living passenger pigeon.



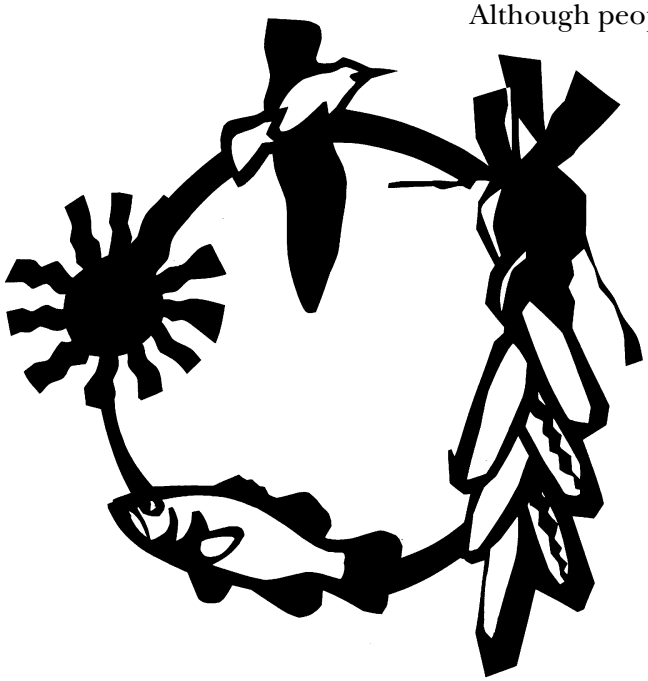
• When a species disappears from a specific area, but is not extinct in the world, it is said to have been **extirpated**. An example of a species in the Lake Champlain Basin that has been extirpated is the wolf. Wolves are not extinct throughout the world, but they no longer live in the basin.

ABENAKI *and* IROQUOIS *were* STEWARDS *of this* LAND

The Abenaki and the Iroquois were the first people who lived, fished and hunted in the Champlain Basin. Their survival depended on knowing the land and the rhythms and habits of the plants and animals that lived here. In order to safeguard the supply of food, the people had to protect the bounty of the earth. Through the centuries, people saw themselves as part of a community of living creatures, not the dominant force. The first lake dwellers believed that humans were stewards of the land and waters.

In the late summer, when women gathered plants to use for medicine, they left a family of a plant behind and scattered seeds from the mature flower so that new plants would grow. The food they ate depended on what was available during each season. They would often make seasonal camps so that a whole village could live near a food supply. In the spring, they lived near the rapids of the rivers and caught fish; in the winter, they moved to the mountains where the larger game lived.

There was a plan for what parts of the land were hunted. The native people rotated areas where they hunted, choosing a new quarter each season. This gave the plants and animals a chance to replenish. Hunters also tended to seek out the slower and older members of a herd, leaving the younger animals to mature.



Although people hunted and fished to sustain themselves, they paid respect to the animals that provided life-giving sustenance. For example, when one killed beaver, muskrat or waterfowl, one did not just throw away the bones. To show respect, the bones were returned to the water, with a request that the species be continued. Wasting food was considered an offense to the animals. If the animals felt they were not respected, they would not continue to give themselves to the people.

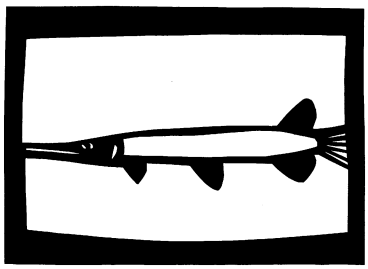
Although agriculture was not central to the survival of native people, it was practiced and followed similar principles of conservation. The soil was fertilized and crops were rotated so that the soil could replenish itself. Crops were used to supplement fishing and hunting and the harvest was stored for the lean months of winter.

THE EUROPEANS COME *to the* CHAMPLAIN BASIN

When the Europeans came to this land in the 1600s, most of them did not recognize the system of stewardship that had been in place for thousands of years. They thought of the land as an uninhabited wilderness, using the Old English "wild deer ness," which meant "lonely empty, undeveloped and untouched."

Samuel de Champlain was the first European to visit the Lake Champlain Basin. He came in 1609 with a group of Algonquins to make war against the Iroquois. He also recorded the natural resources of the region. The Algonquins brought Champlain a strange-looking fish, the long-nose gar. Champlain wrote:

> *"The largest of them, as these tribes have told me, are from eight to ten feet long. I have seen some five feet long which were as big as my thigh, and had a head as large as my two fists, with a snout two feet and a half long, and a double row of very sharp, dangerous teeth....When the birds come and light on its snout, mistaking it for a stump of wood, the fish is so cunning, that shutting its half-open mouth, it pulls them by their feet under the water. The natives gave me the head of one of them, a thing they prize highly, saying that when they have a headache, they bleed themselves with the teeth of this fish at the spot where the pain is and it eases them at once...."*



Another person who wrote early recordings of the area's resources was a Swedish scientist named Peter Kalm, who, in 1749, was sent here to gather seeds and plants. Kalm traveled from one end of the lake to the other. He was especially interested in the laurels: mountain laurel, sheep laurel, and pale laurel. He sent specimens of these species to Linnaeus, who, in honor of Kalm, named that genus of plants after Kalm. The genus is called Kalmia.

Kalm's journal contains many interesting observations of the natural wealth of the region:

> *"Bears are plentiful hereabouts, and they kept a young one about three months old at the fort. He had exactly the same shape and qualities as our common bears in Europe, except the ears, which seemed to be longer in proportion, and the hairs were stiffer; his color was deep brown, almost black. He played and wrestled every day with one of the dogs. A vast number of bear skins are annually exported to France from Canada.*
>
> *The Indians prepare an oil from bear's fat, with which in summer they daub their faces, hands, and all naked parts of their body, to secure them from the*

Linnaeus was a Swedish naturalist for whom Kalm was working. Linnaeus developed our modern system of binomial nomenclature where each species has a two-part name. The first name identifies the group (or genus) that similar species belong to. The second name is the specific species name. Think of it like your own family: you may all share a common last name but you are given specific first names. Linnaeus grouped all Laurel plants in the genus ***Kalmia****, so sheep laurel is known as* ***Kalmia angustifolia.*** ***Angustifolia*** *is the species name.*

bite of gnats. With this oil they likewise frequently smear the body, when they are excessively cold, tired with labor, hurt, and in other cases. They believe it softens the skin, and makes the body pliant, and promotes longevity."

EUROPEANS BRING CHANGES *to* LAND *and* WILDLIFE

Europeans induced native people to trap vast quantities of mammals to sell in Europe to make fashionable European clothing. Beaver, bear, marten, fisher, lynx and others were hunted in huge quantities. Caribou, deer, elk and wolverine were also hunted.

In addition to the huge impact Europeans had on the animal population, many other things changed. Native people who had lived in harmony with the creatures of the forest and woods were enticed to hunt year-round and go further from home. Time-honored practices were sacrificed as the fur trade brought more pressure on native society. Who owned the land that provided the fur- bearing animals became important. Relationships between family groups changed when it began to seem as if there wasn't enough to go around.

The very heavy, unregulated, year-round trapping, by both native peoples and whites, was only part of the change that was happening. New lifestyles and a different kind of relationship with nature affected the land in various ways.

The settlers who followed the fur trade were farmers and brought with them their own outlook on land. They practiced an age-old custom of planting the same crop in a field year after year, regardless of the slope, without fertilization. These practices had exhausted the soils in southern New England; farmers came north looking for new soil and kept the same practices. Farmers were self-sufficient and used wood to build everything. Trees were burned to clear thousands of acres for agriculture.

Burned trees yielded potash, one of the area's first export crops. It was used as fertilizer and a raw material for soap. It was also one ingredient for gunpowder.

The logging industry and sheep farming also accounted for much of the habitat loss, seriously depleting the land. By the 1850s, 75% of Vermont's land was open. It had been cleared for timber, pastures or crop lands. This destruction of habitat caused a significant decline in the populations of many species.

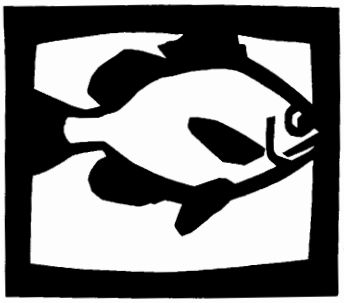
The dominant rule of the land became private ownership. There were still small enclaves where Native Americans preserved their way of life. Along the Missisquoi, for example, a community survived and maintained fishing and hunting practices that they have maintained until today. These native people came into increasing conflict with the existing government, but have fought to preserve practices that they believe protect the land and the winged and furred creatures that reside here.

For over a hundred years, no notable white voices spoke against this destruction of land and habitat. George Perkins Marsh, who wrote MAN AND NATURE in 1864, was one of the first exceptions. One of the first environmentalists, Marsh spoke in favor of land conservation and species preservation. Another person who spoke out was Rowland Robinson, an author and naturalist who criticized the deforestation and loss of wildlife.

The presence and the practices of the Europeans brought many changes to the Lake Champlain Basin in a short period of time. The following section will look at some of the species that survive and thrive in the region today.

WILDLIFE *of the* LAKE CHAMPLAIN BASIN

Animals are divided into two large groups, vertebrates and invertebrates. Vertebrates get their shape from an endoskeleton also known as the backbone. You have a backbone and so do all other mammals, birds, fish, amphibians and reptiles. Invertebrates do not have backbones. Invertebrates such as earthworms, snails and insects use other bodily adaptations to create their body structures: segmented bodies, a hard outside shell or mucous skin. You are part of a very diverse group of creatures that live on this planet. Let's explore some of the local vertebrates and invertebrates of the Lake Champlain Basin.



FISH

All fish are cold-blooded animals that spend their whole lives living in water. Most fish have fins to help them move through the water. Fish are separated into two large groups: those with a skeleton made of cartilage (like your nose) and those with skeletons made of bone.

The scientific name for cold blooded is ectothermic. Ectothermic animals cannot regulate body temperature. Their body temperature is determined by the temperature of their surroundings.

There are over 81 species of fish that have been identified in Lake Champlain, which provides one of the largest assortments of freshwater fish of any lake in the world. Some of the many fish in Lake Champlain are the lake sturgeon, bowfin, freshwater drum, mooneye, northern pike, walleye, largemouth bass, smallmouth bass, rock bass, bluegill and muskellunge.

Fish have scales that cover their body and help protect them. Some fish, however, do not have scales; they have a leathery outer skin instead. Scales help us age a fish. As a fish's scales grow in size, the number of rings per scale indicate the age of the fish. This is similar to counting the rings on a tree.

Fishing is an important part of our region's economy. Anglers are mostly interested in 20 species of the lake's fish. The lake has excellent warm-water fisheries for largemouth bass, smallmouth bass, walleye, northern pike, chain pickerel, brown bullhead, channel catfish and yellow perch. Cold-water fisheries are home to lake trout, landlocked Atlantic salmon, rainbow trout, brown trout and rainbow smelt.

In 1988, $31.7 MILLION was spent on fishing in Lake Champlain.

Lake Champlain has the only New England population of mooneye, an unusual freshwater fish. The mooneye inhabits the waters off Port Henry, south to Whitehall, New York, and is usually not seen elsewhere. This fish belongs to a special group called the bony tongues (osteoglossomorpha). As you might guess from the name, the mooneye has large pointed teeth on its tongue! It also has large eyes and a short snout.

The bowfin is a primitive, hard-headed fish that can live in water with little oxygen. It can actually absorb atmospheric oxygen by coming to the water surface and using its swim bladder as a lung. Bowfin spawn in shallow, weedy areas of the lake. The males clear away vegetation to build a nest about three feet in diameter. After the eggs are hatched, the young attach to the vegetation around the nest. The young fish form a school around the male who guards them for several weeks. They begin by feeding on plankton and small insects, then switch to fish. Adult bowfin feed on aquatic vertebrates and occasionally will eat a shrew or a duckling.

The freshwater drum is a fish that can grow to a tremendous size. The drum is also called the sheepshead because it resembles the face of a sheep. It has two funny-looking bones in its ears, called otoliths, which can be carved out of its skull. Known as "lucky bones," they are considered good luck; keep one in your pocket if you ever find it. From the size of the lucky bones in some Native American graves, we now assume that the sheepshead can reach a weight of 75 pounds or more. The freshwater drum makes a strange grunting noise that can be heard from shore.

All bony fish have otoliths, but the ones in sheepshead are unusually large. A bony fish has three otoliths in each side of the head, one large and two small. Each set of three bones is encased in a liquid-filled pouch that helps the fish maintain its balance.

Historically, salmon and lake trout were abundant in Lake Champlain. Both fish were an important food source. By the late 1800s, however, they were nearly, if not completely, eliminated from Lake Champlain. Native communities who still practiced ways of preserving fish populations had the only "regulations" on fishing practices. Otherwise, there were no laws about when or how many fish could be harvested. The biggest problem was that dams built to power the growing industries blocked the migratory routes of the salmon on their spawning runs. The dams also allowed easy harvest. Great numbers of fish would gather near the dam and people would harvest them, further speeding their disappearance. The sea lamprey also contributed to the problems of the lake's fisheries.

Heavy logging in Lake Champlain's watershed also hurt the salmon and trout. Logging caused erosion and silt to enter the rivers. This suffocated the incubating salmon eggs. The loss of the tall trees, which had provided shade, also caused the sun to warm the water in the streams so that the temperature became too high for the young salmon.

The Lake Champlain Restoration Program, which began in 1973, has restored landlocked Atlantic salmon and lake trout to Lake Champlain. The sea lamprey was an obstacle in the success of this program because it threatened the survival of the fish. In February of 1996, a 23-pound lake trout was caught in Button Bay. This was the first salmonid over 20 pounds caught in Lake Champlain since the restoration program began.

Fish and Wildlife biologists Dan Plosilla from New York and Jon Anderson from Vermont both discovered this fact about the same time. They set one-meter-square trays covered with burlap into the water, and after leaving them for a time, found eggs on the trays. The eggs were then put into a refrigerator where they hatched into smelt, thus solving the mystery.

A female carp can lay as many as two million eggs. Carp mature rapidly. They muddy the waters and uproot the vegetation that wetland birds such as ducks depend on.

Many people think fish tastes better when the water temperature gets colder during the winter months. One reason is that the fish are hosts to fewer microorganisms.

No one can even imagine how many smelt there are in the lake, but they certainly number in the millions. They provide the food base of many other fish species, such as lake trout and salmon. For many years their breeding spots in Lake Champlain were unknown, and there was no evidence that they were breeding in the tributaries. Scientists only found out recently that smelt can breed in fairly deep water, about 40 to 90 feet down.

The common carp is the largest minnow in the lake. It was introduced to the United States from Europe in the late 1800s because people thought it was a good eating fish and adaptable to different habitats. Now it is considered a pest. Carp reproduce plentifully.

Yellow perch is considered to be an important food fish. It can be caught easily at any time and is most popular in the winter as the cold seems to improve its taste. It is also an important feed fish for other, larger fish in the lake and used as an indicator for the health of other fish populations. Perch populate shallow areas near the side of the lake.

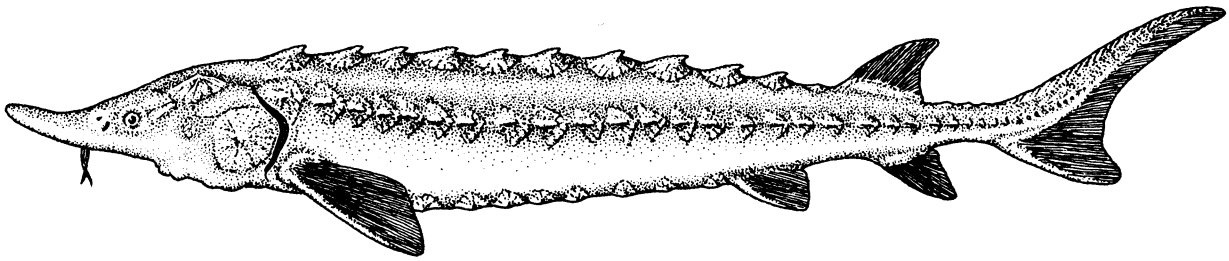
The eastern sand darter is one of the lake's smallest fish. It matures to three inches long. It lives in the sandy river bottoms of Lake Champlain's tributaries but is threatened because its habitat is changing. Soil erosion has covered river bottoms with silt. The fish will disappear when there is no habitat for them. The eastern sand darter is one of the five fish listed as threatened or endangered in the state of Vermont.

THE IMPORTANCE *of* KNOWING *about* FISH

Fishing has continued to be an important part of the culture of our region. Although we sometimes think of fishing as just a relaxing sport, there are many important issues to look at when studying the lake's fisheries.

- Fish can be an indicator of water quality and the status of a habitat.
- Species that are introduced, even if they are a welcome guest like the rainbow or brown trout, may alter the aquatic ecosystem.
- The traditional practices of Native Americans are in conflict with existing fish and wildlife laws. The Abenaki have held fish-ins to spotlight their claim to aboriginal rights.
- Mercury levels in fish have become a concern and scientists monitor levels of chemical contaminants in fish flesh. Dietary guidelines have been issued by the Vermont and New York Departments of Health for moderate fish consumption.

THE LAKE STURGEON: Giants of Lake Champlain



Over the years, people who don't believe in Champ have claimed that the creature must have been a sturgeon, not a sea monster. One can understand the confusion when you consider that sturgeon can be over six feet long and weigh over two hundred pounds. Some sturgeon live for 150 years! It is the largest freshwater fish in New England.

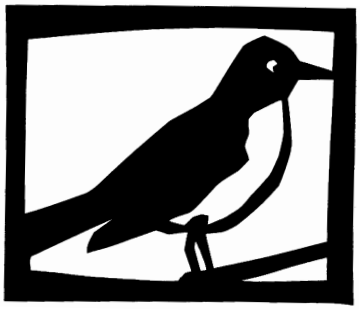
Sturgeon like to live where there is a clean sandy bottom. They eat clams, snails, crayfish and insects. Young sturgeon have teeth but adult sturgeon do not. Adults find their food with sensory barbels or whiskers and suck up their meal like a vacuum.

Sturgeon populations have declined over the years due to overfishing. Their meat and roe, which was used to make caviar, was in demand. Even their skin was once used to make leather. Also, dams built on rivers stopped sturgeon from swimming upstream to lay their eggs. Some areas where the sturgeon could have laid their eggs were buried because of soil erosion.

The lake sturgeon breeds in the tributary streams of Lake Champlain. Sturgeon are not able to reproduce until they are about 20 years old and then only spawn every 3 to 4 years. This makes their survival even more precarious. Although once nearly extirpated, a few still survive.

Although this species is in peril, it also has proven itself over time. Sturgeon inhabited the earth before dinosaurs. Those that do survive have a long and active life. One sturgeon was tagged in 1942 in the St. Lawrence River, recaptured in 1944 in Lake St. Clair and recaptured 28 years later in Lake Michigan.

Currently, Fish and Wildlife officials are considering ways to restore sturgeon populations, such as placing spawning habitat below stream barriers and researching methods of cultivating sturgeon in hatcheries. The University of Vermont did a study in 1994 to see if it would be possible to restore sturgeon to Lake Champlain. The Lake Sturgeon is threatened in New York and endangered in Vermont. Their status in Lake Champlain is described as rare.



BIRDS

Birds live on land, in trees and on water, but most birds fly. Some birds, such as penguins, do not fly. All birds have four general characteristics. They have wings, feathers, beaks and scaly legs. Birds also lay hard-shelled eggs. Bird bones are hollow, which makes birds lightweight. The main difference among the 8,500 species of birds in the world is their beaks.

It is difficult to estimate accurately how many species of birds there are in the Champlain Basin. Some breed in the region, some are blown in by storms, and others migrate through the area. The total number of species that has ever been observed is 318.

The loon, or great northern diver, is a magnificent bird with bright red eyes and a glossy black head. The Abenaki called the loon "The Spirit of Northern Waters." The French called it "The Diver with the Necklace." Since its legs are situated very far back on its body, the loon finds it awkward or impossible to walk on land. Hence, it spends most of its time in the water, diving with great ease. It catches meals of fish, insects, crayfish and special aquatic plants. The loon's water takeoffs are characterized by a lot of wing flapping—it needs a long "runway" to become airborne. Loons are currently not nesting on Lake Champlain but use the lake as a resting spot during their migrations. Non-nesting singles may stay for an extended time.

Loons do nest on smaller lakes in the basin. A canoeist, fisherman, boater or other intruder such as an otter or raccoon who ventures too close or stays too long will cause the parents to abandon the nest. Repeated boating or canoeing close to nesting areas guarantees abandonment. Since loons are endangered in this area, the protection of a single nest can affect the future of this species.

Many people think the wood duck is the most beautiful of all the waterfowl. Its Latin name, *Aix sponsa*, means "water bird in bridal dress." It almost became extinct in the late 1800s when people cut down large amounts of forests, which is an important habitat for the wood duck. The wood duck especially likes to nest in the cavities of dead or dying trees. After the young chicks hatch they are moved to the marshes to feed and mature. The Migratory Bird Treaty of 1918 set up protection of the species and its recovery is seen as one of the success stories of modern waterfowl management.

It is no longer against the law to hunt wood ducks, as their numbers have reached a healthy population. Wood ducks are omnivores. They eat vegetation and invertebrates, fish and amphibians. They provide a link in the food chain between herbaceous plants and invertebrates and higher predators such as raccoon, foxes, great horned owl and mink.

Osprey are the only birds of prey in North America that feed almost entirely on live fish. They are acrobats of the skies, plunging to the water to catch fish with their feet. The claws of an osprey have special serrations to hold the slippery catch. Imagine the energy it takes for an osprey to become airborne from the water carrying its prey! Osprey populations were decimated in the 1960s because of the use of the pesticide DDT. The pesticide entered the food

chain and was eventually consumed by birds of prey. This caused the birds' eggshells to be thinner than normal and the chicks could not survive.

The peregrine falcon was extirpated east of the Mississippi River in the 1940s. Efforts to reintroduce the species have generally been successful. Vermont and New York have some breeding birds. Birds are hatched in captivity and placed on ledges. Their natural nesting sites are cliffs. This falcon is one of the fastest of birds; it can fly at speeds close to two hundred miles per hour.

Herons are many people's favorite birds. It is a wonderful thing to witness the patience of a heron as he awaits his dinner, standing on one leg in a marsh until the moment is right. Herons love to eat small fish and frogs, which fit down their gullets whole. Herons use their very sharp beaks to stab their prey.

Herons winter in the southern United States and South America and travel to Lake Champlain to spend the summer raising their young in wetlands or any wet, quiet place.

There is a special rookery on one of the Lake Champlain Islands where a colony of black-crowned night herons live. Black-crowned night herons are small with short necks and legs. This species is dark on the back and the top of the head and snowy-white beneath, which makes them easy to identify. They hunt at night and sleep during the day.

Bald eagles do not nest in the basin but do use the lake during spring and fall migrations. They will even stay the winter if the water on the lake stays open. Bald eagles eat fish, live or dead and other carrion. They always live near water and need undisturbed shoreline and large trees, such as those that grow in old forests, to nest in and perch on. Like the osprey, bald eagles were harmed by DDT but also are making a comeback.

The Lake Champlain Basin is home to many songbirds. Many songbirds migrate south during the winter to find food. Due to habitat destruction in both their winter and summer homes, many songbird populations are declining. Organizations such as the Vermont Institute of Natural Science in Woodstock, Vermont, study songbird populations and habitats to keep a pulse on the health of songbird populations.

DDT was banned in the United States in the 1970s but is still used in South America where the birds migrate for the winter. DDT is still manufactured in other parts of the world, some in factories owned by American companies.

Osprey, also called fish hawks, used to breed along Lake Champlain. For many years there were no reliable records of any breeding in the area. As a result of a Vermont Fish and Wildlife osprey restoration effort, however, there are now over 10 nesting sites in the basin, near but not on the lake.

Of the 318 species of birds in the basin, 13 species are on state or federal lists of endangered or threatened species.

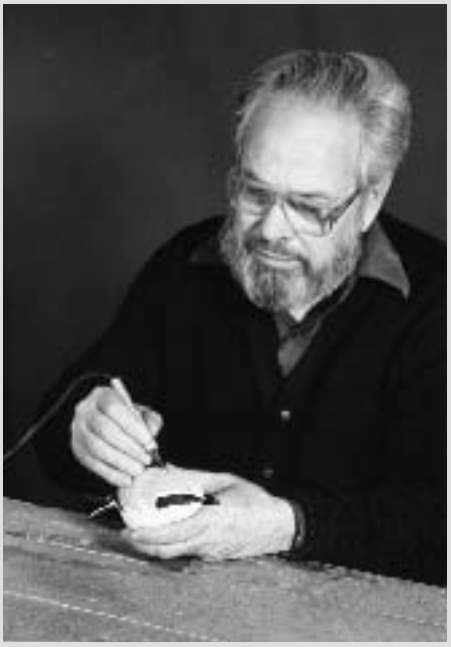
THE IMPORTANCE *of* KNOWING *about* BIRDS

Although we sometimes think of birds as just a lovely addition to the natural world, there are many important issues to look at when studying the birds that live in the basin.

- Birds have a particular role in an ecosystem and perform many specific tasks, such as carrying seeds and facilitating pollination. Raptors are important for controlling rodents and many birds eat insects.
- Birds have particular habitat needs and are sensitive to development.
- Birds are long-distance travelers and link issues concerning the health of the basin to the health of the planet.
- Birds depend on the basin for breeding grounds and stopovers on migration routes.
- There are many federal and state programs to protect and restore birds' habitat and nesting sites.

Bob Spear: Bird Lover

by Lou Borie



One day, when Bob Spear was eighteen, he captured a stray parakeet that had flown into the woodshed of the family farm in Colchester. The bird became a family pet, and it also became the model for Bob's first bird carving, whittled from a piece of white pine with a jackknife by the light of a kerosene lamp. That was more than fifty years ago and Bob Spear has been carving birds ever since. More than two hundred and fifty of his bird carvings can be seen at the Birds of Vermont Museum in Huntington.

The parakeet carving opened up the world of living things to Bob, who had been encouraged by his mother to explore the world of nature. Bob began to carve other species of birds, sometimes working late into the night in his shop. *"I used to get the chores done and eat, and then I'd go out and work until 11 or 12 o'clock and sleep out there on a cot,"* Spear remembers.

Many years later, when he was director of the Green Mountain Audubon Nature Center in Huntington, Bob used his carving skills to develop a set of bird carvings he could take to schools to illustrate his talks on Vermont's birds.

Bob discovered that students could focus on the bird carvings better than on live birds. It was hard for students to concentrate when he led them on walks through the nature center.

> *"When you take a group of school kids out on a field trip, the birds fly overhead or you hear them sing—occasionally you get a glimpse of them nearby. Kids don't really get a good look at them. The carvings are great for teaching because you can form the birds any way you want, and you can create a scene that would be almost impossible to see in the wild. The kids really get interested in the carvings."*

In 1970, someone donated a collection of bird nests to the nature center. Bob thought of creating displays with the nests and a pair of carved birds to go with them. He started to think about a complete collection of wood carvings of Vermont's birds. Now, more than twenty years later, the Birds of Vermont Collection is a reality.

To make a bird carving, Spear starts with a block of native Vermont basswood, a relatively soft wood with a fine, straight grain. He uses photographs in books and mounted specimens as guides. He roughs out the bird's shape with carving knives and chisels. He then uses a power carving tool with ruby-tipped

bits to contour the bird and to outline individual feathers. When the body of the bird is finished and painted, Bob fashions legs and feet out of solid wire and plumber's solder and inserts glass eyes.

For the display, Spear starts with a real nest, which he collects after it is abandoned by a pair of birds in the fall. Songbirds don't use the same nest twice, and Spear has both federal and state permits to salvage bird nests. If a bird nests in a tree cavity, the way woodpeckers do, Spear tries to find a section of a tree with an abandoned nesting cavity in it.

Eggs for the nest are made from sections of hardwood dowels, shaped to exact dimensions and painted. Spear makes remarkably lifelike leaves and flowers using thin-gauge aluminum, the kind used for pie pans, then scribes them with veins and other tiny details.

When Spear's artistry is complete, each display is mounted on a pedestal and enclosed in a Plexiglas case. Walking through the rows of display cases, you see the birds as if they had been frozen in time, captured at one instant of their lives in the wild. A screech owl, wings and talons extended, comes to rest on a tree limb with a just-captured beetle in its mouth. A cliff swallow wheels in towards its mud nest that is tucked up under the eaves of a house. A bluejay lands with outspread wings while its mate sits secretively by the nest.

Bob has been captivated by the endless variety of the natural world his whole life. He's carved hundreds of birds since the parakeets he crafted as a teenager, but he never tires of his task.

At times, he still works late into the night, sitting at his carving bench, applying the techniques which make his carvings so unique. Most would consider Bob Spear's collection a lifetime achievement, but for Spear the carvings are simply the culmination of his many years spent studying the natural world and encouraging others to appreciate its wonders.

Used with permission.

AMPHIBIANS

Amphibians are cold-blooded animals that are adapted to live part of their life in water and part of their life on land. In order to live their lives like this, most amphibians go through metamorphosis—a process whereby their bodies change. For example, a frog starts its life as a tadpole with only a head and a tail. As the tadpole grows to be an adult, its body changes. First the back legs grow, then the front legs grow, then the body forms and the head becomes large and more defined. Most amphibians have moist, smooth skin and lay their eggs in the water. The eggs in the water are surrounded by a jelly-like substance that helps to nourish the young amphibians as well as protect them. Amphibians are split into two groups, those with tails (salamanders) and those without tails (frogs and toads).

In the summer of 1996, frogs with missing, deformed or extra limbs were found on the shores of Lake Champlain. One resident of St. Albans, whose children found numerous deformed frogs, claimed that "probably 40% were mutated in some way or another." Scientists had not determined the reasons for the deformities.

The mud puppy is an aquatic salamander with a "collar" of odd-looking clusters of external gills. It is a creature that keeps some of its larval characteristics, such as its gills, its whole life. Because it has both gills and lungs, it is often used in comparative anatomy courses to show the transition from gills to lungs. Up to a foot in length, it is mostly nocturnal and likes to feed on aquatic insects, crustaceans and small fish. Not entirely true to its name, it lives in clear or muddy water, but spends much of its time along the muddy bottom of streams and wetlands.

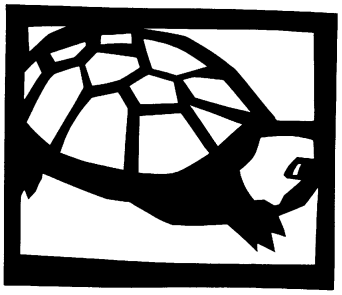
Vermont and New York are both working on statewide atlases of reptiles and amphibians, which should be completed in 1999.

The red spotted newt is a small salamander about three to four inches long. Its tail has a fin with a fleshy keel on the top and bottom. Newts are green with little spots like speckled trout. Red efts, the terrestrial stage of the red-spotted newt, are juveniles that sometimes live on land two to seven years before returning to water to transform to adults. You might think that their bright orange color would mark them as easy prey, but Mother Nature was looking out for the red eft. Their orange skin is toxic and discourages predators.

The tiny striped chorus frog is only one inch long. It sings "preep" in its breeding ponds in June and is very rare in Vermont.

A bullfrog has a familiar call that you can hear near water. It is the largest frog in North America and is sometimes hunted for its tasty legs. Male bullfrogs have an eardrum that is bigger than its eye; females have an eardrum that is the same size as the eye. Tadpoles overwinter for one or two years and won't reproduce until up to five years. Bullfrogs spend the winter buried in the bottom of a pond or wetland.

Bullfrogs tend to eat anything that moves and that they can swallow. When humans have introduced them to new territory, bullfrogs have been known to reduce or extirpate local populations of semi-aquatic amphibians and reptiles such as other frog species, garter snakes and small turtles.



REPTILES

Reptiles are cold-blooded animals with thick, dry, scaly skin. This skin helps to protect the reptiles. Reptiles can live in water or on land and they have lungs for breathing. Most reptiles lay tough leathery eggs usually on land. When young reptiles hatch from their eggs, they resemble their adult parents. There are four types of reptiles: lizards, snakes, turtles, and alligators and crocodiles.

The northern water snake can often be seen swimming in or near the water's edge of ponds, streams and lakes. These snakes are often confused with the venomous water moccasin and are often killed by fearful humans. If you are ever fortunate enough to observe one of these beautiful and graceful creatures, take a minute to sit back and observe its behavior. The water snake may be seeking its favorite prey of tadpoles, small fish or salamanders; it may be seeking refuge from a predator such as a heron, raccoon or fox, or it may be seeking a safe location to leave the water and bask in the sun along the shore. Water snakes are one of the reptiles that have live young. A female water snake will give birth to 12 to 60 baby snakes. The mother snake does not care for the babies, and they eventually slither away to fend for themselves.

The American toad is slow-moving and easy to catch. Toads have two large glands behind the eyes that secrete a bad-tasting milky fluid, so even though they are slow, they are not that appealing to predators. American toads breed in the early spring and females lay thousands of eggs.

On North Hero Island, scientists are trying to keep people from disturbing nests in June when map turtles come to lay their eggs.

The map turtle is named because its green shell is etched with lines like a map. It is a Great Lakes species that occurs only in Lake Champlain and nowhere else in New England. It lives in shallow rivers and lake shores and likes to hibernate in muddy river bottoms. You might see a map turtle sunning itself on a log. The map turtle nests on sandy beaches and since there are so few quiet sandy beaches in the springtime, scientists are concerned about the survival of this species.

A stinkpot is a very small turtle. Its carapace, or top shell, is only three-and-a-half to five-and-a-half inches in length. It is dark brown, high-domed, and sometimes covered with algae. Young stinkpots do stink; they have two glands that emit a smelly, yellowish liquid. They eat plants and animals and sometimes carrion. If the carcass is large, a stinkpot will hold onto it with its

front feet and tear off large pieces of meat that make its little throat bulge as it swallows its meal.

Perhaps the most interesting turtle we have in the lake is the eastern spiny softshell. Its "shell" is leathery in texture and it has a long, snake-like head with a snout on it. These turtles like shallow, sandy areas in lakes and prefer to lay their eggs on sandbars. They cannot tolerate any kind of pollution. They like to eat tadpoles, frogs and sometimes plants. The eastern spiny softshell turtle is threatened. It is what is called a distinct species in Lake Champlain: its small population is isolated in this region and is found nowhere else nearby. Lake Champlain is the furthest east this species is found.

Biologists believe that the Lake Champlain Basin is an "ecotone" between New York and Vermont habitats. The basin contains many species that are common to New York but not found in New England and species that are common in Vermont but not found in New York and points further west. There are some living creatures that are found only in the Champlain Basin.

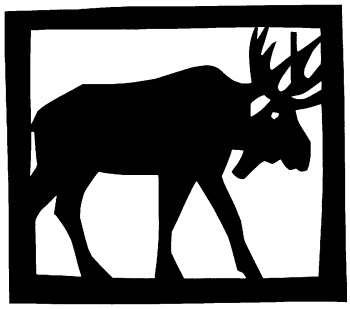
THE IMPORTANCE *of* KNOWING *about* REPTILES *and* AMPHIBIANS

Athough you may think they are slimy, scaly and potentially dangerous, reptiles and amphibians have many characteristics that help people understand the diversity of life on earth.

• Amphibians, because of their permeable skin cover and dependence on both land and water, are vulnerable to pollution and other changes in the environment.

• Reptiles (like some snakes) are thought to be harmful, but usually are not.

• Both groups play critical roles in transferring energy along the food chain. They are effective predators of a wide range of animals (and plants) from invertebrates to fish to small mammals, and in turn, are preyed upon by many other animals.



MAMMALS

Mammals are warm-blooded with fur or hair on their bodies. All mammals feed milk to their young. Mammals can be grouped according to what they eat.

- Carnivores eat meat.
- Omnivores eat meat and plant material.
- Herbivores eat only plant material.

Mammals also can be separated into three groups based on how their young are born:

Monotremes: *Young hatch from eggs. (The duck-billed platypus is a monotreme but not a resident of the basin!)*
Marsupials: *Young are born live in an immature stage. The young crawl into the mother's pouch on the front of her abdomen and live there and drink her milk until they are fully developed. The only North American marsupial is the opossum.*
Placentals: *Young stay inside their mother's body until they are fully developed and then they are born. Most mammals, including yourselves, are placentals.*

For many different reasons, mammals are vulnerable to human predation. They are sought after for food, furs and killed as sport. In addition, mammals suffer from loss of habitat. Some animals such as cougars and wolves were extirpated because they threatened people. Today, these two species are no longer found in the basin. The range of habitat that they depended on is gone.

Big cats such as the catamount, need a large territory in which to roam and that expanse of land is no longer present in the basin.

The last catamount, or mountain lion, was shot in the region in 1881 near Barnard, Vermont. It can be seen at the Vermont Historical Society Museum in Montpelier. Recent reported sightings of the catamount in the Adirondacks and Vermont may signify a return of the catamount to the region. In December of 1994, Vermont Fish and Wildlife officials confirmed that scat found in Craftsbury, Vermont, was from a catamount.

The last wolf in Vermont was killed in 1900.

An animal that survived longer in this region was the timber wolf, always an enemy of sheep and cattle farmers. Samuel Williams, a Vermont historian, wrote in 1794:

> *"One of the most common and noxious of all animals is the WOLF....His eyes generally appear sparkling; and there is a wildness, and a fierceness, in his looks....This animal is extremely fierce, sanguinary, and carnivorous. When a number of them assemble, it is not for peace, but for war and destruction. The animal at which they...aim, is the sheep....They attack the deer, foxes and*

rabbits, and are enemies to all other animals; and their attacks are generally attended by the most horrid howlings...There is nothing valuable in these animals but their skins."

The wolf was bountied in 1779 and from then until 1820, wolf hunts were a popular sport. These hunting raids and continued land development destroyed the territory of the wolf. By 1900, the wolf was gone from the region.

The wolf and the cougar were the top of the food chain, and now both are extirpated from the region. The disappearance of these animals is used to justify the hunting of deer. As the deer's natural predators are gone, people must serve as predators.

Beginning in the 1940s, the coyote has taken some of the place of the wolf in the food chain.

Historically, white-tailed deer were abundant and an important food supply for Native Americans. The arrival of the white settlers and loggers soon changed that. The deer were hunted year-round, supplying commercial meat markets; their forest habitat dwindled and no laws protected them. The first laws to protect them were issued to the New Hampshire grants in 1741, but early efforts did not succeed in restoring the deer population. By 1800, deer were nearly extinct in the east. It became illegal to hunt deer in Vermont.

Deer were imported to Vermont from New York in the 1870s. Things improved. Wolves and catamounts, the natural predators of the deer, were being hunted and were less of a threat. Also, forest habitats in the 1860s and 1870s were making a comeback so the region became more hospitable to deer. An open season on deer was reestablished at the turn of the century. By the 1960s, populations were large. Hunting is the major wildlife management tool used today to keep the deer population in balance with the natural habitat.

The beaver was the most sought after mammal by the first Europeans, and was hunted primarily for its fur. The beaver is the largest North American rodent. Fur-trading companies hired Native Americans to supply them with beaver and other skins. The beaver population was close to extinction from the Atlantic to the Mississippi River by the middle of the nineteenth century.

The story of the restoration of the beaver population is similar to that of the deer. Biologists sought protective laws and brought in beavers from out of state. Now, if you're a farmer in the basin who has lost your fields to beaver ponds you may wish these out-of-staters would return to where they came from!

The story of the fisher and the porcupine is interesting. The fisher, or fisher cat, is neither a cat, nor is fish its favorite food. It is omnivorous and eats fruits, berries and a variety of animals, including porcupines. The fisher is actually a weasel. Fishers and porcupines were abundant in the region but the fisher had a prized pelt that sold for a large sum of money in the seventeenth century. By the mid-1800s, they were extirpated from the region. Then, there started to be an overabundance of porcupines. Porcupines were a big problem to loggers because they gnawed through trees and destroyed good timber. The fisher, a good hunter, was a predator of the porcupine, being strong and agile enough to knock the porcupine from the tree and attack its soft underbelly without getting quilled. Biologists decided to bring back fishers and in 1959 began a program that restored fishers to the region. Now the fishers are established and loggers no longer have problems with porcupines. Surely the porcupines don't think this was a good solution!

Insectivores are a group of insect-eating mammals that includes the mole and the shrew. They don't hibernate in winter and have to work hard to find their food. Because they have high metabolisms, they have to eat almost constantly or they will starve to death. In winter, they live under the snow.

The starnosed mole works underground in the moist soil of river bottoms and near lakes. It goes deeper in the winter than in the summer as it moves down below the frost line in search of prey. It uses its fleshy, tentacle-like nose to sense the movement of earthworms and grubs, then digs furiously with its spade-like front paws to reach them.

A smaller relative, the short-tailed shrew, scours higher up either in the humus and leaf litter of the soil or in the low vegetation. Even though it is small, it is a fearless hunter, day and night. Weighing about as much as a toothbrush, it will attack mice and other prey twice its size. It also eats earthworms, insects, land snails and other terrestrial animals.

The moose used to be present in large numbers in the Champlain Basin. It became scarce in the 1800s. Now moose can be seen in their natural habitat,

roaming in the thickets around remote ponds or lakes, browsing on waterside plants or wading to uproot aquatic weeds.

Sometimes a moose causes quite a commotion when it wanders into populated areas. Although it may just be lost or in search of a mate, it may be suffering from "moose sickness." This disease is caused by a parasitic worm that bores into the brain tissue of the moose and causes it to be disoriented and clumsy. The worm gets into the moose's body from a snail that hosts the worm. The moose might eat the snail while munching on aquatic plants, where the snail may be living. The worm leaves the snail and works its way into the moose's central nervous system and then into the brain.

The Indiana bat is one of the few mammals we have that is on the federal endangered species list. It has been found in Brandon, Vermont, and several south-central areas. The bats prefer limestone caves for hibernation.

The brown bat, a resident of the basin, can consume as many as 600 mosquitos in an hour. Some people are scared of bats, but lately, more people are aware of how helpful bats can be. People are even putting up bat houses nearby so the bats can eat bugs. Scientists also are protecting caves where bats live by placing gates over the entrances to keep people out.

Rabies Alert!

All mammals can get rabies. Bats are tolerant to the virus so they live to pass it on. Raccoons and skunks are also relatively tolerant to the virus and often live in human-occupied environments. You should never go near any animal that is acting oddly or appears unafraid of you.

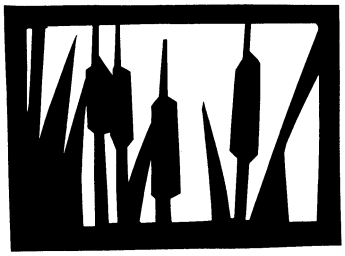
If a person is bitten by any wild animal, the animal should be captured, destroyed and tested for rabies. Whether the animal is captured or not, the wound should be cleaned immediately and a doctor contacted.

In general, it's a much better idea to watch wildlife than to touch it—as it may pose a risk to you or to the wild animal.

THE IMPORTANCE *of* KNOWING *about* MAMMALS

Although we may only see the mammals that have gotten used to living around humans, such as squirrels, chipmunks and even deer, there are many important issues to look at when studying all of the mammals of the basin.

- Our ancestors living tens of thousands of years ago depended on mammals for their survival. They hunted mammals for their food, clothing and weapons. Today, we continue to depend on mammals in many ways by eating their meat, making clothes from their hides, drinking their milk, and using them in scientific research.
- Some mammals are highly visible and "part of the scenery." Other mammals, like the shrew, are rarely visible and remain hidden to the human eye.
- The hunting of mammals—deer, moose, bear—is an ancient tradition of native people in the basin. Their age-old traditions are in conflict with current fish and game laws.
- There are numerous other issues surrounding the practice and regulation of hunting.



PLANTS

Flowering plants are in the kingdom Plantae. They are characterized by having cells containing chloroplasts and rigid cell walls. The chloroplasts are filled with the green pigment chlorophyll, which allows plants to convert sunlight energy into food. The Lake Champlain Basin, with its diverse bedrock geology and long growing season, supports a variety of natural communities and rich flora.

One of the common plants growing along the wooded bluffs of Lake Champlain is northern white cedar. Cedar is a long-lived evergreen tree with aromatic scale-like leaves and tiny cones. To the Native Americans it was canoe wood. They discovered that cedar logs pounded on one end split easily along the growth rings. These strips were then fashioned into ribs and frames of canoes. Additionally the wood is lightweight and resistant to rot, perfect for water travel.

Growing beneath cedar on lakeshore bluffs are two rare plants that are protected in Vermont. Golden corydalis is related to bleeding hearts and dutchman's breeches. It has yellow, spurred flowers and finely cut leaves. Ram's head lady slipper is a small delicate orchid that is also state-protected. The inch-long purple flower has a lip petal that points downwards and early botanists compared its unusual shape to a ram's head.

In big river corridors and along the lake, you are sure to see cottonwood. This tree's large sticky buds leaf out into triangular leaves with large fuzzy catkins. But it is probably best recognized in spring when its seed pods burst, sending forth a mass of white cottony seeds floating everywhere.

Shagbark hickory is another characteristic tree of the basin. It is easily recognized by its smoke-grey bark, which warps and peels away from the main trunk in strips one foot or more long and 6 to 8 inches wide. These loose curling strips make the tree look shaggy in profile or silhouette. Its nuts were collected in the past and its wood prized for its high fuel value. Today its green wood is unmatched for the flavor it imparts to meats smoked over its coals.

The herb layer of floodplain forests is often composed of ostrich fern, known as the fiddlehead fern. This wild edible is commonly collected and sold in grocery stores as a gourmet spring delicacy.

Many people are familiar with jack-in-the-pulpit but few have seen its close relative, the rare green dragon, which can also be found growing in these wet woods. The green dragon is threatened in the State of Vermont. The green dragon has a compound leaf composed of 5 to 15 leaflets. The so-called flower is actually composed of a spathe, or leaf covering. A spathe is made up of modified leaves that encircle the actual flowers. The floral structures are borne at the base of a fleshy spadix, or floralspike. In a green dragon this spadix is prolonged into a long, pointed tail that extends well beyond the enclosing spathe. This is quite unlike little jack who remains inside his pulpit.

In springtime, carpets of white trillium are a familiar sight in the Champlain Basin. As the name implies, the flower has its parts in threes—three leaves, three sepals and three petals. These showy flowers in the lily family put on quite a display turning from white to pink as they age.

trillium, the sign of spring

Growing on the dunes and sandy beaches of Lake Champlain are three Vermont state-listed plants that are most commonly found along the Atlantic seacoast. Beach pea has typical pea foliage, lovely purple pink flowers and arrowhead-shaped stipules. Beach heather is low-growing with fuzzy grey-green foliage and star-shaped yellow flowers. Champlain beach grass forms cones and is one of the few grasses well adapted to shifting sands. It is excellent at stabilizing the dunes where it grows. These plants are post-glacial relics from the time when Lake Champlain was part of a great inland sea.

The beach pea is a threatened plant. Beach and heather and Champlain beach grass are endangered in the state of Vermont.

Everyone is probably familiar with cattails, which grow in marshes throughout the Champlain Basin. The brown sausage you see is the female flowering structure composed of thousands of brown hairs connected to seeds, which are still attached to the central stalk. Protruding above this sausage is a bare spike, which originally held the male flowers. They die back after they shed their yellow pollen, which pollinates the lower female flowers. Cattails are well-adapted to life in the water. Their leaves and stalk are filled with special open cells that transport oxygen down to the saturated roots. Cattails and other wetland plants provide many vital ecological functions. They recharge groundwater, provide flood protection, and filter water. Cattails are able to take up excess nutrients and pollutants in water. Through complex metabolic processes, nutrients and pollutants are transformed into less harmful substances and/or incorporated into tissues of the plants. Tests have shown that water leaving a cattail marsh is remarkably cleaner than that entering it. Cattails are also an important food source.

THE IMPORTANCE *of* KNOWING *about* PLANTS

The Lake Champlain Basin is fortunate to have both a variety and an abundance of plant species. Even where humans have tried to stop plant growth, such as by paving an area of land for a parking lot, often the plant prevails. The pavement gets a small crack where a seed can lodge—add water, sunlight, a few nutrients and up pops a plant!

• Plants are considered the producers in the food chain. This means that they can produce their own food. This happens through a process called photosynthesis. Basically, the plant combines carbon dioxide with water and sunlight to produce oxygen and carbohydrates (food).

• Plants are used by humans as a source of food, clothing, shelter, and medicine. The Native Americans taught the settlers in the basin about the medicinal properties of some of the native plants. Witch hazel, a common shrub within the basin, was and still is used today as an astringent (a medicine that stops bleeding). The Native Americans showed the settlers how to turn the leaves, bark and twigs of the witch hazel into usable remedies.

• Plants help to keep the earth from falling apart! The roots of plants hold the soil together and stop the soil from eroding into our streams and rivers. When lots of soil gets into the water it causes trouble for the aquatic species. It clogs the gills of fish, for example. Shoreline restoration is a popular project in the basin: people plant species such as willow trees along eroding riverbanks. As the willows take root and grow, the soil is held into place, decreasing the amount of soil eroding into the river.

"The first rule of intelligent tinkering is to save all the species."

Aldo Leopold
A SAND COUNTY ALMANAC

INVERTEBRATES

The Lake Champlain Basin is home to many invertebrates. These invertebrates have a very important job in the basin. They are an important food source to other larger invertebrates and vertebrates.

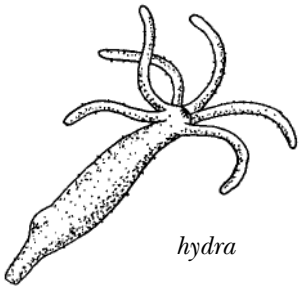
There are eight major groups of invertebrates in the world: sponges, hollow-bodied animals, flatworms, roundworms, segmented worms, mollusks, spiny-skinned animals and arthropods. Invertebrates are the largest group of animals on the earth.

Due to the fact that invertebrates are so small, many of them are very sensitive to changes in their environment. Scientists can use invertebrates as indicators of environmental health. Invertebrates can be found on land and in the water throughout the basin. Let's take a closer look at the small critters who share our ponds, lakes and streams.

Sponges are the simplest kind of invertebrate. They live in water and do not have heads, mouths or other separate body parts. Their bodies are like sacks. The cells of a sponge take on various body jobs like breathing and eating. The next time you are wading in a body of water in the Lake Champlain Basin, look closely at the rocks. If you are lucky, you may see areas of green and brown slippery or bumpy "stuff" attached to the rocks. This material can be removed easily from the rocks, but please be careful not to disturb its habitat. You have found a freshwater sponge! Some larger invertebrates live in and feed on the sponges.

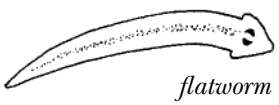
sponge

Hollow-bodied animals, such as jellyfish and sea anemones, have a hollow center lined with digestive cells, tentacles dangling from the hollow body and a mouth. Most of these animals live in the ocean or freshwater. The green hydra, a close relative to the jellyfish, is an example of a hollow-bodied animal that can be found in the Lake Champlain Basin. It can grow to be four inches tall and has six or more dangling tentacles that catch tasty morsels such as water fleas as they float by in a clump of zooplankton.



hydra

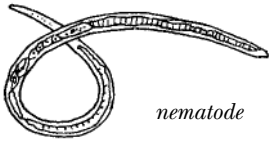
Flatworms live in fresh or salt water or in plants or animals. Flatworms have one body opening where food and waste enter and leave the body. Many flatworms are parasites; they feed on the cells of another plant or animal. The tapeworm, for example, is a human parasite. A parasitic relationship



flatworm

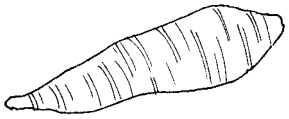
means that one species benefits while the other is harmed or sometimes killed. A human tapeworm lives in the intestines of humans and can grow to be ten feet long! This can cause a human to become very sick. Underneath a flatworm's body are many hair-like structures, called cilia, that help the flatworm to glide along surfaces such as rocks. Can they see where they are going? Flatworms have two eyespots located in the head region that are sensitive to light. So if you were about to step on a rock that had a flatworm on it, the flatworm might detect a decrease in light produced by the shadow of your foot. Watch where you step!

Roundworms or nematodes are similar to the tapeworm except they have two body openings. Many roundworms are also parasites and are more commonly found living in the soil or in plants or animals. Nematodes are the smallest of all the worms. You will need to look closely to see them with the naked eye! Good luck.



nematode

Segmented worms are more complex than the tapeworms or roundworms. They have a digestive system with two openings as well as a nervous system with a small brain. Their bodies are made up of small ring-like segments. An earthworm is a segmented worm. Although we may be more familiar with the terrestrial earthworm, it has an aquatic counterpart that also likes to eat soil. Another common segmented worm is the leech. Depending on the species, leeches can range in size from 3 to 18 inches. Believe it or not, leeches can fly, with a little help from some feathered friends. A leech uses its well-developed sucking mouth to attach to the legs of certain waterfowl species. When the bird decides to move to another pond or lake, the leech gets a bird's-eye view of the world below and a new home!

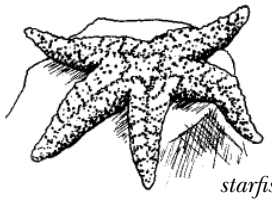


leech

Mollusks also have two body openings but they also may have small eyes, a shell or a foot. There are three major groups of mollusks: the one-footed mollusks such as a garden snail, the scallop, which is a mollusk with two shells hinged together like a clam or mussel, and the octopus, which has tentacles instead of a single foot. Mollusks are found in freshwater, saltwater and on land. The zebra mussel, first found in Lake Champlain in 1993, is an example of a mollusk that is not a native of the Lake Champlain Basin.

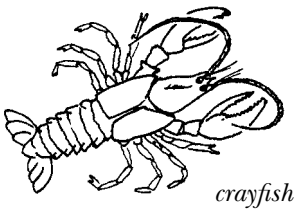
freshwater mussel

Spiny-skinned animals have hard outside coverings, such as seen with the starfish or sea urchin. Spiny-skinned animals are only found in the ocean. They once lived in the Champlain Sea. Fossils of these animals can be found in the Lake Champlain Basin.



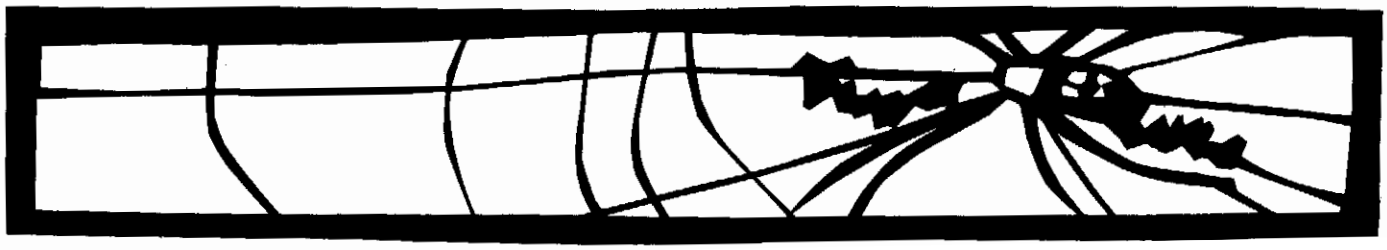
starfish

Arthropods are known as the joint-legged animals. This group is made up of insects, spiders, centipedes and millipedes, and hard-covered crustaceans such as lobster, shrimp and crayfish. Arthropods can live in water, on land or in the air. They have segmented bodies and often jointed legs. Arthropods have a hard outside covering called an exoskeleton that gives them structure and protection. A favorite insect to all who love to explore water environments is the caddis fly. The caddis fly is an insect that spends its youth in the water in a larval stage and then goes through metamorphosis, changing into an adult with wings and emerging from the water to fly and mate. The larval stage of the caddis fly is great fun to find. In a stream, look for moving sticks or small rock tubes. Caddis fly larvae spin silk around their bodies and then stick pond material to these silk cases and live inside the case for protection from predators. The caddis fly is one of nature's true sculptors.



crayfish

caddis fly



THE IMPORTANCE *of* KNOWING *about* INVERTEBRATES

Invertebrates, because they tend to be small, may not be noticed by many basin residents. However, these creatures are very important in the natural world.

• The soil beneath our feet is full of invertebrates. Earthworms may be considered the star of the soil show! They help to keep the soil healthy by wiggling around and putting air into the soil and by decomposing organic matter through their digestion process. They are nature's plows and fertilizers! Some farmers in the basin use worms as an indication of healthy soil—the more earthworms the better the soil.

• By studying aquatic macroinvertebrates (invertebrates you can see with an unaided eye), we can determine the quality of the water. A stonefly nymph can only live in healthy water while a leech can live in both healthy and polluted water. By surveying the macroinvertebrate populations in a local body of water, you can help your community learn more about the water quality.

• Invertebrates sit at the base of the food chain—they provide a strong and healthy foundation for all other animals to stay alive. You may think that mosquitoes are a pain in the neck as they buzz in your ear or bite you, leaving a welt on your skin, but mosquitoes are important food for many other animals, like the brown bat.

Champ's Chat with Mary Watzin

midge larva

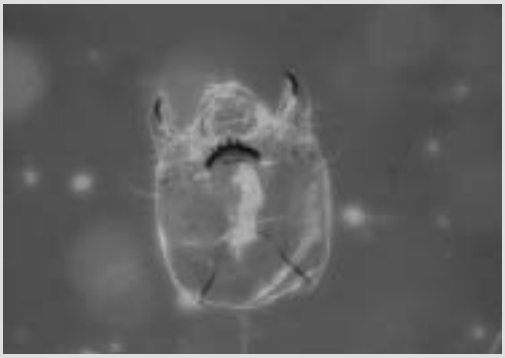
Champ: What are midges?
Mary Watzin: Midges are small insects. As larvae, they live in the mud at the bottom of the lake. They look like little worms and they are a favorite food of some fishes like yellow perch. When a midge larva is a couple of months old, it pupates, metamorphoses and emerges from the water as a flying adult. The adults look very much like mosquitoes, but they don't bite. The adults only live a few days; they mate, the females deposit the eggs in the water and then they die.

Champ: Why did you start to study them?
Mary Watzin: I started to study midges because I wanted to know how important the larvae were in the diet of yellow perch. It turns out, they are a pretty important prey item for these fish when the fish are 2 to 5 years old and feeding on the bottom of Lake Champlain. Midges are also eaten by other fish and by insects, frogs and birds.

I also study midges because they are a good test species to see if there are toxic substances, or poisons, in the mud in polluted parts of the lake. In lakes, toxic substances tend to accumulate in the bottom sediments so those organisms that live there, like midges, are often most vulnerable to the pollution. Studying midges can help us decide where we need to focus our pollution-prevention activities before the problem gets so bad that the entire ecosystem is in jeopardy. I study the teeth of midges. Midge teeth get deformed when the insects are exposed to some contaminants. We can sometimes use deformed teeth as an early warning of a pollution problem.

Champ: How do you study midges?
Mary Watzin: I study midge larvae in the laboratory and out in Lake Champlain. To see if midge larvae were being eaten by yellow perch, we collected perch and looked at their gut contents. We found lots of midge larvae in perch guts. We also sampled the sediment in places where yellow perch like to feed, like the weedy areas along the shores of the lake, to see how many midges were available as fish food.

The midges we use in pollution studies we grow in the lab. We have little midge aquaria where we grow large numbers of larvae. We bring mud from areas where we think pollution may be a problem into the laboratory, and let the midges live in this mud. After several days, we look to see how well they are doing.



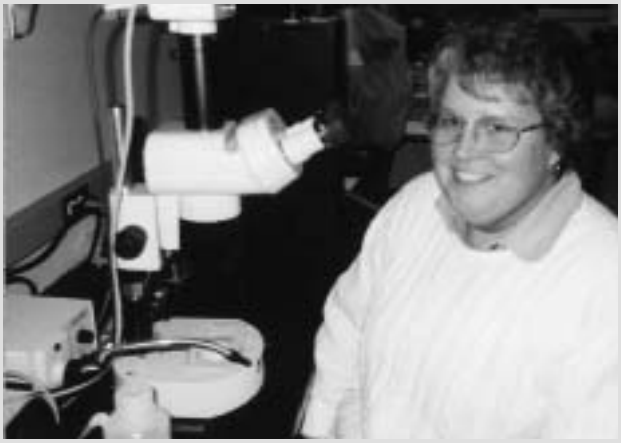
midge head larva

Midge larvae are pretty tiny creatures. You could lay about 10 of them on a penny. To look at the teeth of midges, we must mount the midges on a slide and look at them under the microscope so we can see their head capsules. It's pretty amazing to see how these little creatures look when the microscope makes them 50 or 100 times bigger than they are in the natural world. They have antennae, and mouth parts with teeth, and segments, and little clusters of setae (spines) on their tails. You can't see any of this with the naked eye.

Champ: Why are midges important?
Mary Watzin: Midge larvae are very important in the food web of Lake Champlain. They are eaten by a variety of fishes, and help to break down dead plant material in the sediment. Adult midges are eaten by other insects and by frogs and birds.

Midges are also important because they can help us understand where contaminants might be a problem in Lake Champlain and other lakes.

Champ: What is important for scientists to think about when doing this kind of research?
Mary Watzin: There are a lot of reasons that ecosystems change. Some change is natural, but some change is the result of human activities. Scientists studying pollution have to be very careful to design their experiments so they can distinguish one environmental problem from another. It sometimes seems harsh to expose organisms to materials we think may be toxic just to verify that a poison is there, but unfortunately, sometimes that's the only way to do it. We can't see chemicals in the environment. Once we know what the problems are, we can begin to look at ways to clean them up.



"Being an environmental scientist is a little like being a detective. I apply scientific methods to read the clues about how nature works. I apply the information I gather to help solve pressing environmental problems, like pollution, and to work for better management of our aquatic resources."

Mary Watzin

GOOD NEWS!

This essay has told some of the stories of creatures of the basin. Many of these stories tell of the harm that humankind has done by overhunting, habitat destruction or planned eradication. Yet there is a lot of good news when one looks at the relationship between people and creatures. Here is some of the GOOD NEWS! On the next page you can read about one of the basin's success stories: "The Common Tern Returns."

Humans share the earth with so many wonderful and unique plants and animals. Every day these creatures struggle to survive in an ever-changing world. Those in the Lake Champlain Basin are no exception. The Lake Champlain Basin was designated by the federal government as a Biosphere Reserve in 1989. This decision confirms that we live in a very unique environment. Due to the fact that species in the basin and everywhere do not speak our language, it is up to all of us to act and protect this precious place.

The Common Tern Returns

by Mark LaBar

For at least 100 years, the common tern has returned to nest on the same small, rocky islands on Lake Champlain. This graceful, robin-sized waterbird is white and gray with a black cap, pointed red bill and forked tail. It eats small fish that it catches by diving into the water from the air above.

The common terns nest in dense groups, called colonies, which enable them to team up for defense against predators. These colonies can range in size from several pairs to thousands of pairs. The largest colony of common terns on Lake Champlain is on Popasquash Island, near St. Albans, where 100 pairs nested in 1993.

In 1988, only 50 pairs of common terns nested on Lake Champlain. Their numbers were so low that the common tern was put on the Vermont Endangered Species list. People began to wonder what was causing the decline in the number of adult terns and soon realized that if something wasn't done, the common tern might become extinct on Lake Champlain.

In 1987, biologists from the Vermont Institute of Natural Sciences and the Vermont Department of Fish and Wildlife began studying the common tern on the lake to find out what was happening to the terns and what could be done to protect them. After doing their studies, biologists realized that very few chicks were surviving. Without young terns to replace the older terns, the population was getting smaller and smaller.

Biologists found three reasons why the chicks were not surviving. First, many chicks were being eaten by predators, primarily great horned owls and black-crowned night herons. Second, ring-billed gulls were forcing terns off their traditional nesting areas. And third, humans were disturbing the terns by landing their boats on the terns' nesting islands.

After pinpointing these problems, biologists explored different solutions to help the terns. The biologists started by putting floating signs around the islands, stating that the terns were endangered and asking people not to disturb them. Next, the biologists built wooden and rock shelters for the chicks so that they could hide from hungry predators. And finally, ring-billed gulls were prevented from nesting in the traditional tern nesting areas.

All this work paid off. Since 1989 the number of surviving chicks has increased dramatically and the number of breeding adults has doubled. Although things are looking better for the common tern on Lake Champlain, predation continues to be a problem. Still, biologists are hopeful that the populations will continue to increase and that the common tern will remain part of Lake Champlain's bird community.

Credit: *"Casin the Basin," newsletter of the Lake Champlain Basin Program. Used with permission.*

EXOTICS AFFECT *the* ECOSYSTEM *of the* BASIN

In the natural scheme of things, species exist in a balance. Each organism in the food chain has a particular role or "niche" and together the links in the chain form a closed circle. Of course, all kinds of things upset this balance. A disaster, like an early blizzard or hard winter, may kill off or weaken a species. Humans may destroy a habitat or overhunt a species. Or humans may, without realizing the impact, bring a new species to an area, which can cause havoc to the existing order of things.

The "existing" food web is the one that is in a region naturally. The species that were there originally are called indigenous or native. When a species is introduced to an area from somewhere else it is called nonindigenous, non-native or exotic. Exotics are generally considered harmful. Species that intrude on an area and cause trouble are called invaders or "nuisance" species. Nuisance species upset the natural balance in the existing ecosystem.

Every new species introduced has an impact, but sometimes the damage is minimal. Some exotics have been introduced to an area with no serious consequences to the existing ecosystem. Brown trout were not originally in Lake Champlain but have been stocked by Fish and Wildlife biologists. Although they do have an impact on the food chain of the fishery, they are generally considered welcome guests!

Some of the most common non-native nuisance species that we see are Eurasian milfoil, water chestnut, purple loosestrife, flowering rush, common reed, and sea lamprey. White perch, European rudd, and gizzard shad are recent non-native fish introductions that also could become nuisances. Great watercress, slender-leaved naiad, yellow floating heart and curly pondweed are plant species that may become a nuisance.

At the time this book is being written, zebra mussels are an exotic that is causing great concern. The zebra mussel was discovered in Lake Champlain in 1993 and has quickly established itself in many parts of the lake. Scientists are designing management plans to protect native mussels and important water intake pipes from zebra mussel infestations.

The management of nuisance species that have not yet done significant damage is a tricky one for scientists. It is hard to predict how a new species will impact a food chain and the variety of habitats within the lake's ecosystem. Scientists have to develop plans for every non-native species; it's complicated!

The European water chestnut is a nuisance plant. The plant produces one seed that has a hard shell. The shell has four points so that however a seed sits, one point sticks up. The four points also have spines, each containing small, curved teeth. If you have ever stepped on a water chestnut shell at the beach, you know all about those little teeth!

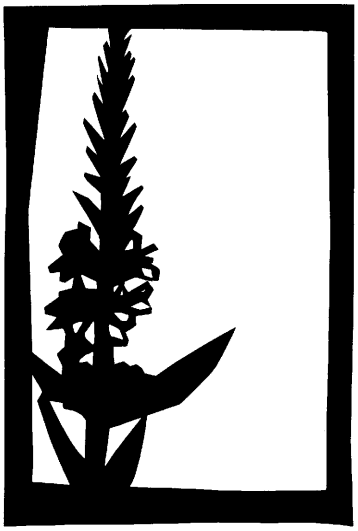
The water chestnut, like other nuisance aquatic plants, is easily spread by boat trailers. Infested areas are now posted with notices requesting people to pick the weeds off their gear to avoid extending the noxious plant to uninfested waters.

The seed of the water chestnut will sink to the bottom of the lake but sometimes can remain at the bottom of the lake for 12 years before producing a new plant.

In the northern and southern ends of Lake Champlain, Eurasian milfoil has become a serious problem. The long stringy plant gets wound up in the propellers of boats. St. Albans Bay has been infested with the plant for more than 20 years; some years the milfoil has been raked out of the water and loaded onto trucks in order to clear the waters sufficiently for recreation and navigation.

Because the water chestnut and the Eurasian milfoil are the most troublesome nuisance weeds in the lake, the Departments of Environmental Conservation in both Vermont and New York, in conjunction with the U.S. Army Corps of Engineers, conducted a mechanical harvesting program for several years to stop the spread of the water chestnut in the southern part of the lake and to control the Eurasian milfoil in St. Albans Bay. Scientists have discovered an aquatic weevil that eats milfoil and are testing the effectiveness of using the weevil to control the spread of the milfoil.

The mechanical harvesting of Eurasian milfoil was stopped when researchers found that plant fragments would fall to the bottom of the lake and re-root, resulting in new plant growth.



In the southern part of Lake Champlain you are also apt to find floating heart, an attractive plant with a yellow flower. It is even possible to buy it from water plant nurseries, which is probably how it was introduced to the lake.

Purple loosestrife is another European plant that can be found in the basin. It often grows in highway ditches and can now be found across the United States. This plant invades wetlands and displaces native wetland plants. Many people find the weed pretty and it used to be sold in nurseries. The plant has little value to wildlife, however, unlike the native plants it's displacing. Scientists at Cornell University are doing experiments with an insect that eats the roots of this plant.

Sea lamprey are an ocean native, believed to have invaded Lake Champlain, New York's Finger Lakes and the Great Lakes in the 1800s, when canals from the Hudson River were built to link these waters.

The sea lamprey in Lake Champlain is a strange-looking, parasitic fish. It is eel-shaped and has a sucker-like mouth and a rasping tongue. It attaches to fish and bores into the flesh of its hosts. Sea lamprey attacks have been documented on virtually all of Lake Champlain's larger fish species. It prefers smooth-bodied fish like salmon and lake trout, however, because it can penetrate such fine-scaled species more easily than it can fish with heavy, thick scales such as the northern pike. Each sea lamprey will consume 40 pounds of fish blood in its lifetime. Their impacts on the Lake Champlain fisheries are enormous.

Prior to the efforts of Vermont and New York agencies to re-establish landlocked salmon and lake trout in Lake Champlain, the lamprey was not much of a problem. When the salmon and trout were stocked in the lake, however, the lamprey population suddenly increased because more host fish were available.

The lamprey has a curious life cycle. It spawns in tributary streams. What hatches from the egg is a little wiggly thing called an ammocoete. The ammocoete buries itself in the sand and feeds by filtering microscopic organisms out of the water. Eventually the ammocoete metamorphoses, grows eyes, leaves the sand, becomes parasitic and then attaches itself to a host fish. The lamprey control program, which began in 1990, is aimed at reducing the numbers of ammocoetes produced in Lake Champlain tributaries.

The lampricide program is based on a concept called "minimum lethal." Scientists need to determine what is the very minimum toxin they can put in the rivers to kill the ammocoete and not kill other organisms. The impact of the program on macroinvertebrates is not known and rivers are being monitored continually.

Lampricide programs involve placing toxic material in the stream. Although scientific evidence supports the claim that the damage to the river ecology is minimal, some people are concerned that placing toxins in the streams is not an acceptable risk. Other nonchemical methods of controlling lamprey populations include small barrier dams, electrical barriers and adult trapping. In general, however, the lampricide programs have popular support because of the extensive damage that lampreys have inflicted on the Lake Champlain fisheries.

Barrier dams have been placed on Lewis Creek and the Great Chazy River.

THE LATEST EXOTIC: ZEBRA MUSSELS

Zebra mussels were discovered in Lake Champlain in 1993:

On July 24, 1993, 13-year-old Matt Toomey and his sister were fishing off their dock in Benson Bay in Orwell, Vermont. As Matt began to reel in what he thought to be a big fish, he recruited the help of his sister to pull up what turned out to be just an old brick. But attached to the brick was a zebra mussel, the first to be found in Lake Champlain. Matt encouraged his mother to call the Lake Champlain Hotline and report his find.

The next day, the specimen was taken to the Vermont state biology lab for identification. James Kellogg, aquatic biologist with the Vermont Department of Environmental Conservation, positively identified the specimen as a zebra mussel. Since that time, zebra mussels have been found as far north as Rouses Point.

Matt Toomey

Why are people so upset about the possible invasion of zebra mussels? To understand that, let's learn more about them!

Zebra mussels were first identified in North America in 1988 in Lake St. Clair, Michigan, near Detroit, and they have spread quickly through the interconnected waterways of North America to the Mississippi and Ohio river systems. It is believed that the zebra mussels, native to the fresh surface waters of southeastern Europe were unknowingly transported in the ballast waters of transatlantic freighters.

Biological Impacts

The specific impacts of zebra mussels in Lake Champlain are not yet known. However, because zebra mussels are not indigenous and reproduce quickly, it is feared that their population will rapidly grow out of balance with the lake ecosystem.

Zebra mussels filter-feed on phytoplankton and detritus, main elements of the aquatic food chain. If zebra mussels are present in large numbers, they could:

- alter established food chains so that the survival of some species is threatened,
- harm or kill fish and wildlife that consume zebra mussels containing high concentrations of toxic materials,
- starve or suffocate native mussels.

Exotics travel all over the world! A jellyfish, native to the east coast of the United States, found its way to the Black Sea in the ballast water of ships. It is thriving there because it has no natural predators and it is devastating the ecosystem. In 1996, the jellyfish reached an estimated mass of 900 million tons—equal to 10 times the world's annual fish catch!

Zebra mussels are thumbnail-sized freshwater mussels whose D-shaped shells are often striped with alternating light and dark bands—similar to a zebra's. The common zebra mussel is also known by its scientific name: ***Dreissena polymorpha****.*

Economic Impacts

Zebra mussels can quickly foul human-made water systems by attaching to solid, submerged surfaces and rapidly forming dense colonies. They also:

- clog water intake or outflow pipes,
- disrupt sensitive, water-dependent systems
    a) boat motors
    b) municipal water facilities
    c) industrial facilities,
- harm tourism
    a) litter beaches with sharp shells and emit a foul odor
    b) cover and therefore damage historical treasures: shipwrecks, etc.

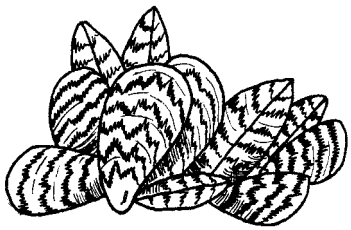
Zebra Mussel Life Cycle

The typical zebra mussel lives 2 to 5 years on average. Despite its seemingly short life, the zebra mussel is able to multiply rapidly. In each seasonal reproductive cycle, a mature female zebra mussel can release 40 thousand to one million eggs while the mature male zebra mussel can release more than two hundred million sperm. Fertilization of the eggs occurs in the water outside of the female zebra mussels. In approximately two days, the fertilized eggs develop into free swimming larvae known as veligers. The veliger stage lasts 2 to 3 weeks. Veligers are active swimmers and they can be dispersed though the water by currents. The older veligers seek and attach to solid surfaces underwater.

Zebra mussels cling to surfaces by using thread-like strands called byssal fibers, which are tipped with a strong, sticky substance. As many as 700,000 mussels have been reported to occupy a square meter area. Once attached, zebra mussels generally remain on the solid surface but they can detach, crawl slowly and move about. It is possible for zebra mussels to be transported by "hitchhiking" on fish, crayfish, waterfowl or on vehicles such as boats, boat trailers, barges or seaplanes. Adult zebra mussels feed by filtering water and removing the available zooplankton, phytoplankton or detritus to use as a food source. A mature, thumbnail-sized zebra mussel is known to filter one liter (approximately one quart) of water each day.

Zebra Mussel Habitat

Zebra Mussel Life Cycle



Filter Feeding
1 zebra mussel filters
1 liter of water/day

up to 700,000 mussels/m^2

Growth

Juveniles
6–18 months

Settling
10,000 /m^3/day
Veligers grow shells;
attach to hard surfaces

Veligers (*Larvae*)
2–3 weeks
up to 500,000 veligers/
m^3 of water

approximately
95% die

Fertilized eggs
2–5 days

Adults
2–5 years

female
releases
40,000–
1,000,000
eggs/year

+

male
releases
200,000,000
sperm/year

What you can do

The more you know about the possible effects of zebra mussels in Lake Champlain, the better prepared you will be to help reduce their spread. You can help by reporting zebra mussels you see at new locations. Pass on what you've learned to others. All of these actions are essential to help prevent the spread of zebra mussels to other inland lakes and rivers as well as within Lake Champlain.

The ideal habitat for zebra mussels is directly related to the filtering mechanism that mussels use to obtain food. Zebra mussels prefer water that contains enough phosphorus to support healthy populations of phytoplankton. Because zebra mussels rely on filtering nutrient-rich water, water intake (or outflow) structures can be ideal habitats for the zebra mussel. Such structures generally provide a steady flow of water, which brings food to the mussels and removes waste. These structures also protect mussels from predators, severe weather and environmental changes.

Taking Action

- Learn to identify the zebra mussel.
- Use the Zebra Mussel WATCH Card available from Lake Champlain Basin Program. It explains how to identify a zebra mussel.
- Attend zebra mussel workshops and ongoing information sessions in Vermont and New York.
- Monitor for the presence or absence of zebra mussels.
- Collect samples of zebra mussels if you find them.
- Preserve the samples in containers filled with rubbing alcohol.
- Record the precise location of the collected sample.
- Contact the Lake Champlain Basin Program immediately at 1-800-468-LCBP.
- Educate others.

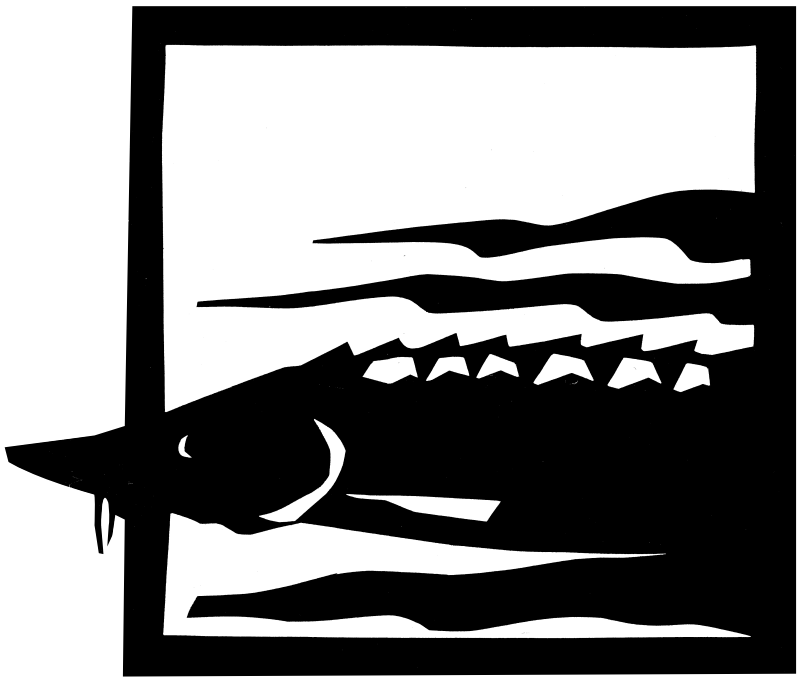
Actions for Boaters and Anglers

Anglers and recreational boaters may accidentally transport zebra mussels from infested Lake Champlain waters into other areas of the lake and to inland lakes and waterways. Mussel larvae, which are invisible to the naked eye, can be carried in boat bilge water, live in wells, bait buckets and engine cooling water systems. Juvenile and adult mussels can also attach to boat hulls, engine drive units and boat trailers.

Credit: *Zebra mussel information from Lake Champlain Basin Program, "Fact Sheet Series," Number 1. Used with permission.*

Help prevent the spread of zebra mussels by taking a few precautionary steps after boating or fishing:

- *Inspect your boat and trailer carefully for mussels and aquatic vegetation. Remove any mussels or vegetation and discard them in the trash.*
- *Drain all water from the boat, including the bilge, live well and engine cooling system.*
- *Dry the boat and trailer in the sun for at least two days or if using your boat sooner, rinse off the boat, trailer, anchor, anchor rope and chain, bumpers, engine, etc. with tap water or at a car wash.*



The Living Treasures of the Lake Champlain Basin

Activities

You will see that there are noticeably fewer activities in this section than in other chapters. There are so many activities for teaching about the natural world in other resources that we felt teachers could easily access these. (See "Key Resources" in this chapter and in *Ecology).*

I recommend reviewing some of these sources so that you can sprinkle some study of living creatures into whatever else you are doing. The world of living things is such a strong learning connection for kids that it will add fuel to any study.

Before I began teaching science, I always marveled at teachers who got their classes outdoors. It seemed like you had to know so much before you went and it took a tremendous amount of planning. Well, it does take a lot of planning but the payback is enormous. I learned that Mother Nature is a very forceful teacher and wonderful teammate. Get outside as often as you can and you will see!

QUESTIONS

- What fish and wildlife live in the Champlain Basin?
- How is their health?
- How do humans impact the lives of fish and wildlife?
- What animals are threatened or endangered?
- What is being done and what more can be done to protect these species?

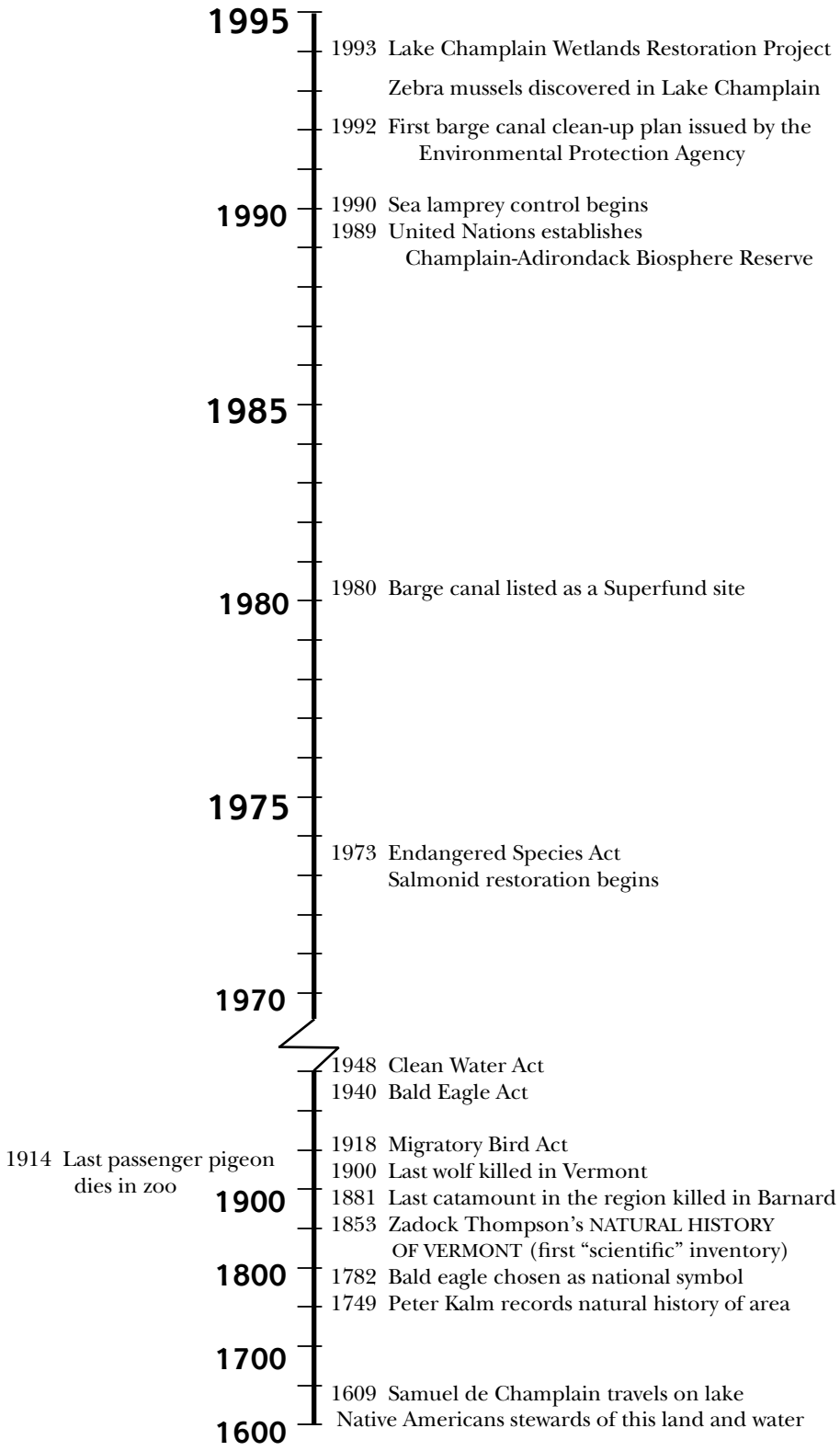
KEY RESOURCES

- Vermont Fish and Wildlife Department
- New York Department of Environmental Conservation
- U. S. Fish and Wildlife Service–Lake Champlain Fish and Wildlife Resources Office—*publications and educational resources*
- Vermont Threatened and Endangered Species Education Guide—*Vermont Fish and Wildlife Department*
- The Nature of Vermont *by Charles Johnson*
- Opportunities for Action—*Lake Champlain Basin Program*
- NatureScope Series—*National Wildlife Federation*
- Project Wild—*Western Regional Environmental Education Council*
- Aquatic Project Wild—*Western Regional Environmental Education Council*
- The Original Vermonters: Native Inhabitants, Past and Present *by William Haviland and Marjory Power*
- Keepers of the Animals *by Michael Caduto and Joseph Bruchac*
- The Stokes Nature Guide Series *by Donald Stokes*

Word Bank

alpine
amphibian
anglers
benthic
bird
carnivore
DDT (*dichloro-diphenyl-trichloro-ethane*)
ecosystem
endangered
environment
extinct
extirpated
fish
food chain
habitat
herbivore
ice fishing
limnetic
littoral
mammal
neotropical
omnivore
organic
pesticide
phytoplankton
population
predator
prey
primary consumer
reptile
secondary consumer
species
threatened
tip-ups
vertebrate
wetland
zooplankton

Natural History of the Lake Champlain Basin



Activity: Food Sources Calendar

TEACHER NOTES *and* INFO

The graphic in this activity, created by Peter Thomas, shows how Native people gather food according to the seasons. This activity allows students to interpret a unique "picture chart." Interpret the chart with your class. Ask them to make true statements about traditional food gathering. For example:

- *"In May people hunted...."*
- *"In March, _____ were not hunted."*

Observe that no animals were hunted year-round. What would be the reasons for that? (*Spawning, nesting, hibernating, mating habits*)

Could such a chart be made for most students today? Some foods are eaten seasonally—but pizza is consumed year-round! What other things do we do seasonally? Discuss what parts of our lives are tied to the seasons. Discuss the technology that was used to obtain food at different times in history.

Understanding seasonal customs, which some Vermonters practice today, sheds light on the controversy between Native Americans' claim of aboriginal fishing rights and fish and wildlife laws that limit harvesting. What are the similarities and differences between the two points of view?

STUDENT ACTIVITY

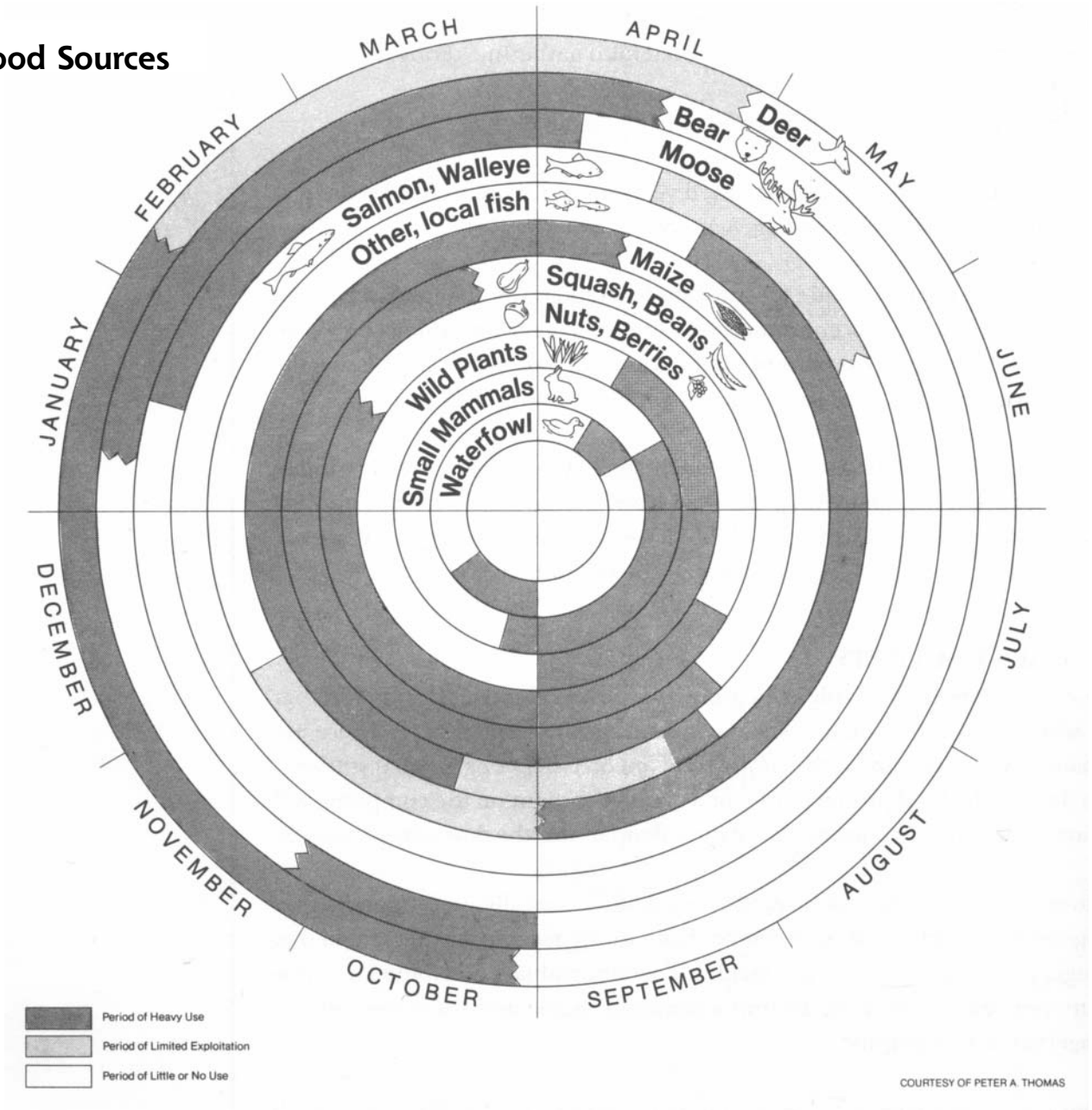
Have students, individually or in groups, design a calendar. Decide whether it will be about one theme, such as sports, or an open choice. There are many ways to organize production. How you do it depends on what you want to do with the final product. You, or a creative student on the computer, will have to provide the bottom part of the calendar with the days of each month.

Ruby Thibault, of School Street School, has successfully used calendars designed by the school as fundraisers. Each of the eleven classes created one page, plus one page from the faculty. Each individual contributed a miniature pen-and-ink drawing around a common theme and these were joined together as one graphic.

You could have partners design one illustration (2 x 12 = 24) and copy all

twelve for a class project. Students could create their own during the year (starting in September with their summer memories), complete them in June, and you could assemble them over the summer (with all the money left over in your classroom activity budget!) and present them in September as a "Welcome back to school" gift! I have never done this, but I like it!

Food Sources



Activity: Food Chain Game

TEACHER NOTES *and* INFO

The Lake Champlain Basin harbors a wealth of interconnecting food chains called food webs. Taking a closer look at food chains helps students understand how we are all connected and how energy travels from one species to another. Students also become more aware of predator and prey relationships. Students can research their own food chain relationships to play the following game or you can utilize the one below as a model. This is an active game that requires a large open space where students can move around and be loud. (There is a lot of laughter and excited screams as predators move in on and eat their prey!)

You will need:
cards for a class of 25 (with string to hang cards around students' necks):

- 2 with a picture of a bass (or some other local carnivorous fish)
- 8 with a picture of a smaller fish such as a minnow
- 15 cards with a picture of a caddis fly larva
- popcorn to serve as phytoplankton
- 25 bags as "stomachs" to collect food

STUDENT ACTIVITY

Designate the playing area or pond and spread the phytoplankton (popcorn) around the pond. All critters should be outside the pond at this time. While handing out the cards, explain the food chain the students represent. The caddis fly eats the phytoplankton, the minnow eats the caddis fly and the bass eats the minnow. Hand out the bags, which represent the stomachs or the place where food will be collected. Explain that the critters will enter the pond, a species at a time, with their bags to collect food.

Caddis flies enter the pond first; they must crawl on their hands and knees to collect the phytoplankton in their bags. After 20 seconds of caddis fly feeding, the minnows enter the pond. Their goal is to tag the caddis flies. The caddis flies must hop on one foot. When a caddis fly is tagged, it hands over its stomach contents to the minnow, crawls out of the pond and sits quietly along the edge to view the food chain in action. All other un-eaten caddis flies can continue to eat the phytoplankton and dodge their predators. Next enter the bass. Bass must walk heel-to-toe while in the pond as they try to tag the minnows. A tagged minnow must give its stomach contents to the bass and hop on out of the pond. Yell "freeze" after a minute of food chain action. Make observations as to who remains alive and who is sitting along the edges of the pond.

After the food chain chasing ends, discuss the following questions with students:

- Why did the game start out with more caddis flies than minnows or bass?
- What did it feel like to be tagged?
- If you wanted to extend the food chain, who would eat the bass?
- How is this game different from the real life of critters in the pond? How is it the same?

Students are great at coming up with variations to this game. Have fun!

Activity: What Can You Do?

TEACHER NOTES and INFO

This book offers many opportunities to discuss with students how their lifestyles affect our natural world. The information here is from the Vermont Threatened and Endangered Species Education Guide. It is a succinct summary of the many possibilities students might consider.

STUDENT ACTIVITY

Brainstorm with your students the negative and positive impacts that humans have on the natural world. Ask them to identify which impacts they might have control over. You may choose to use the handout as a reference for yourself as students create their own "guide" or hand it out and have them share it with others.

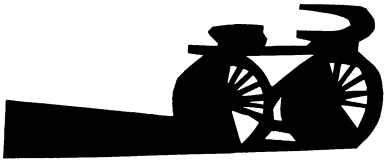
STUDENT HANDOUT - "What Can You Do?"

What Can You Do?

If you are interested in creating more good news, you may want to think about things that you can do to help the natural life of the basin. Here are some ideas from the Vermont Department of Fish and Wildlife. *You* can have an impact and save wild species from extinction.

1. Examine your lifestyle.

Habitat loss is the greatest danger to animals. Practice minimum impact. This means decrease your influence on wild species and their habitats. You can apply this to all parts of your life.



Transportation

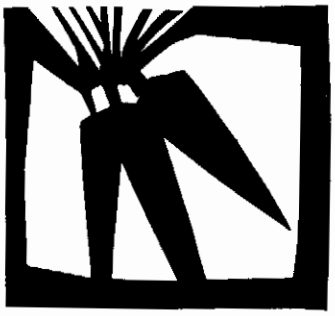
• Walk or bike or use a bus whenever possible.

Energy consumption

• Find out what type or types of energy your family uses for heating, cooking and lighting.

• What impact does each energy source have on wild species? Think of its origins. How is it taken from the earth? How does it get to your home and does it cause pollution?

• Think of ways you can cut back on energy use in your home. Turning off the lights when you leave a room is one way to conserve energy.



Food

• Organically-grown food is more healthful for you and for wildlife. Because chemical pesticides and weed killers are not used in organic foods, chemical residues do not get into your food, the soil, the water or other animals through the food chain.

• Reduce the amount of food waste and garbage you produce by:

- eating everything on your plate,

- avoiding the use of individually packaged foods and plastic bags,

- recycling egg cartons, cereal boxes, glass and plastic bottles, and aluminum cans,

- learning about composting food scraps so that organic wastes can be put back in the soil.

Household Chemicals

• Find out what poisonous and hazardous chemicals you have in your home. These could include chlorine bleach, drain cleaner, cleaning chemicals, car polish, paint and paint thinner, weed killer and pesticides. If a chemical is poisonous to people, it is probably poisonous to wildlife (and vice versa!)

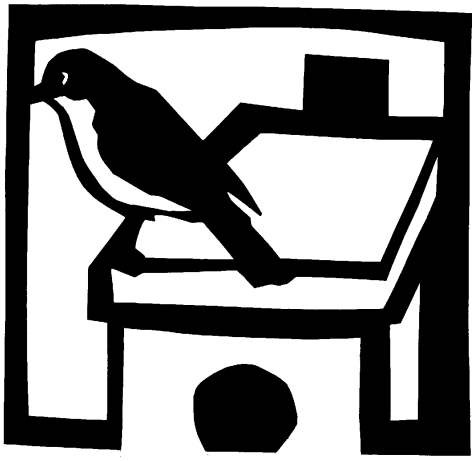
• Don't pour chemicals down the drain. They will eventually pollute rivers and lakes. Find out how to safely dispose of toxic chemicals.
• Learn how you can use fewer hazardous cleaning products in your home and in your school.

Recreation
• Certain sports and recreational activities have high impacts on wildlife. For example, snowmobiling in a deeryard may frighten deer.
• Examine the environmental impact of your favorite pastimes. Consider the noise, pollution, land use and energy use of each activity.

Recycling
• Recycling can benefit wildlife habitat by reducing the need for more landfills, and by reducing the need to take raw materials from the land.
• Recycle these substances: paper, glass, aluminum, copper, steel, plastic, rubber, wood, food and yard waste.

2. Get involved in government.
• Find out who your state and federal legislators are. Write letters to encourage the protection of habitat, to stop pollution and to protect endangered species. Support elected persons who support environmental protection.
• Learn how local, state and/or federal laws are passed. Find out who the people are in your area responsible for the enforcement of these laws.
• Go to town meetings and learn how you can help shape the future of your town. Support issues that will help protect habitat and insure the survival of native species.

3. Do something wild!
• Volunteer for a state or private agency that is directly working with threatened and endangered species.
• Do a report or project about an endangered or threatened species or some aspect of wildlife that interests you. Share it with a school, scout or church group.
• Feed birds during the winter.
• Set up bluebird nest boxes at home or at school.
• Set aside some land for wildlife habitat on your property.



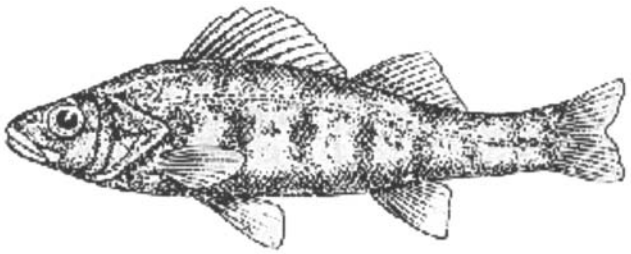
Activity: Lake Champlain Yellow Perch Problem

TEACHER NOTES *and* INFO

Explain the simulation to the class.

STUDENT ACTIVITY

You are a fish biologist working for the Vermont Department of Fish and Wildlife. One of the tools you use to gain information to manage a lake fishery is the creel survey. Creel surveys are designed to obtain estimates of fishing pressure, the amount of fish harvested from a body of water, and other items of interest. A creel survey is done by going out on the lake at predetermined time periods, and counting and talking to anglers. You ask them what they are fishing for, what they have caught, and how long they have been fishing. If they have fish, you might measure them and take a fish scale off each. Fish scales, when studied under a microscope, will show the age of the fish.



While doing a survey in the northern part of Lake Champlain, you hear complaints that the perch fishing has declined. The anglers tell you:

"All I catch are small perch."
"People are overharvesting the perch; they're taking all the big ones."
"We need to put a limit on the numbers of perch you can keep in a day."
"There needs to be a length limit to protect the small perch."

You, the fish biologist, head back to your laboratory to determine what the problem is and how to solve it. After analyzing your angler count and interview data, you find that:

1. The estimated perch harvest is high.
2. Catch rates (the number of fish caught per hour of fishing) are also high here, compared to other areas of the lake.

Nick Staats visits School Street School

After analyzing the perch scales you collected and fish lengths, you find:

3. The perch vary in age from four to eight years old.
4. The size of the perch for each age differs only a little. (In other words, they are growing slowly.) For example, seven-year-old perch are not much bigger than six-year-old perch.

As a scientist, you have learned from other scientific studies that:

1. As fish populations become more abundant, competition for food increases, which tends to cause them to grow slowly.
2. Overharvested fish populations have good or fast growth rates. This is because there are less fish competing for the same food source.
3. When perch populations are overharvested, there will be more younger fish (two-to-four-year-olds). This is because when there are fewer perch, they mature earlier to reproduce more fish.
4. Walleye fish eat perch and the walleye population has declined.
5. Perch feed on minnows, which feed on small water animals that survive on the nutrients in the water. People have been trying very hard to clean up the lake's water by reducing the amount of nutrients entering the lake.

Compare this information with what you have found out about the perch in northern Lake Champlain. What can you determine is going on with that population?

- Are the perch being overharvested?
- Would putting a limit on the number of fish you can catch in a day help solve the "problem"?
- Would a length limit help?
- Do you create a new perch-fishing regulation to satisfy the anglers even when it may or may not help the perch?
- Could the walleye population have an effect on the perch?
- Could the amount of nutrients entering the lake have an effect on the perch?

You realize now that the perch problem is more complicated. It may not be solved in a week, year, or even five years. What you do know is that there are anglers disappointed about the perch fishing and want something done—now. What will you do?

Credit: *Activity from Nick Staats, Fish Biologist, U.S. Fish and Wildlife Service. Used with permission.*

Activity:
Zebra Mussel Information

TEACHER NOTES *and* INFO

There is a wealth of information available on the zebra messel—the current "villain" in the story of Lake Champlain. The Lake Champlain Basin Program has generated a lot of information in recent years. There is also material available from the Great Lakes region. The story of how an exotic affects an ecosystem is a fascinating one to explore with children. The story of the zebra mussel is so current and important that discussion takes on a special significance. Students must understand a great deal about the life cycle of a zebra mussel in order to comprehend the impact it can have. For example, the juvenile—called a veliger—is microscopic and cannot be stopped by conventional screens or barriers.

As the story unravels, students engage in higher level thinking:

- What will happen to the native mussel population?
- What if the native mussels were put in a "zoo" to be protected until we solve the problem?
- What if veligers from the water in the fish hatchery are transported to all the small lakes in Vermont?

STUDENT ACTIVITY

Read the essay section, "The Latest Exotic: Zebra Mussels" (p. 387–390). Complete the worksheet after reading the information.

STUDENT HANDOUT - "Zebra Mussel Worksheet"

Taking It Home

Design with your students a system to share information with family and friends.

The process could be posted as an exponential math problem: If one student tells two people and each person agrees to tell two people how many people will your class have informed? How many could they inform if every person who was told, told another?

Zebra Mussel Worksheet

1. Describe what a zebra mussel looks like.

2. Zebra mussels were first found in 19 ___ in St. Clair, _____ .

3. How did zebra mussels come to North America?

4. The scientific name for zebra mussel is: _____ _____.

5. What are the potential **biological** impacts of the zebra mussel?
- A. alter _____ _____
- B. harm or kill _____ and _____ _____
- C. starve or suffocate _____ _____

6. What are the potential **economic** impacts of the zebra mussel?
- A. clog _____ or _____ pipes
- B. disrupt systems that need water:
  - a. _____
  - b. _____
  - c. _____
- C. harm _____

7. Please draw the life cycle of a zebra mussel—with labels!

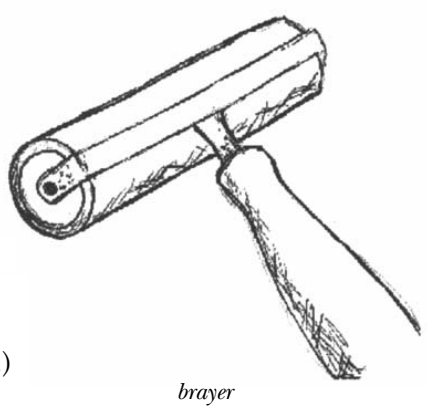
8. Write short meanings for these words:
- A. **indigenous** _____
- B. **plankton** _____
- C. **veliger** _____
- D. **detritus** _____

9. What are three things you can do to protect our lake from zebra mussels?

Answers: 1. *answers will vary,* **2.** 1988, Michigan, **3.** ballast of ships from Europe, **4.** Dreissena polymorpha, **5A.** food chains, **5B.** fish, wildlife, **5C.** native mussels, **6A.** intake, outflow, **6Ba.** boat motors, **6Bb.** municipal water facilities, **6Bc.** industrial facilities, **6C.** tourism, **7.** *answers will vary,* **8A.** native, **8B.** micro-scopic plant growth, **8C.** microscopic young zebra mussels, **8D.** base of food chains, **9.** *answers will vary.*

Rubies Pearls

Activity: Fish Prints



brayer

YOU WILL NEED:

- the total body of a fish that doesn't move; if it is frozen dry it off with a paper towel. Frozen fish are best.
- speedball printing ink
- styrofoam meat trays (washed and disinfected)
- soft sponge brayer (available from an art supply catalog)
- newsprint or thin drawing paper (thin copy paper is good)

STUDENT ACTIVITY

1. Place two tablespoons of printing ink in a styrofoam tray.

2. Roll ink all over the inside of a tray with the soft sponge brayer. This will place a nice thin coat of ink on the sponge roll. When the ink covers the roll with a nice layer, it is *ready*.

3. Take the brayer and roll up, down, and side-to-side, *all over* the fish. When a nice thin layer of ink covers the textured body, you are ready to print.

4. Place newsprint paper over the fish—try to hold still. Rub on top of the paper—gently but firmly.

5. Pull off the paper: You have a great print! You can take two prints before you need to re-ink the fish with the brayer.