

*The beauty of Aquascape's
natural ecosystem
is irresistible.*



understanding pond ecology

tales from the FIELD

Not too long ago, our tech department got a call from a good old boy named Bob who, after consulting the internet (no, he didn't call us first), poured chlorine pool shock into his pond. Then he said, "I just don't understand why all my fish up and died."

Not a Surprise!

When you're in the business for any length of time, calls like this one just don't surprise you. We get 'em all too often. Anyway, after asking Bob if he'd read the *Pond Owner's Manual* that came with his pond, he replied, "I don't never read no directions on nothin'." We then informed him that adding chlorine to his pond is "a sure fire way to kill darn near anything in his pond, including his fish."

Then we explained that he's not just dealing with a watering hole with fish in it, but that he needed to understand that in reality, he's dealing with an entire ecological system – a circle of life

kind of thing, where every element (like his fish, for instance) is dependent upon all the others in order for it to function properly. "And Bob, when you mess with Mother Nature, you're begging for trouble," we told him.

It Ain't Rocket Science

So, before you get into the pond business, it's critically important that you have a basic understanding of ecology. No, you don't have to speak Latin, or sound like a professor. But it ain't rocket science, folks. It's ecology. Just peruse the remainder of this chapter, and you'll have all the knowledge you'll ever need.

Ellen Beaulieu
NAWGS President



What Is an Ecosystem Anyway?

In biological terms, a community can be defined as plants and animals interacting with one another in the sharing of available resources and restraints in a defined area.

An ecosystem encompasses all the parts of this environment, including the living (biotic) plants and animals, and the non-living (abiotic) components, such as water, air, and the sun's energy.

Ponds are ecosystems, in that they play host to a total interrelationship of all organisms in the environment—birds, fish, frogs, plants, and many microscopic organisms. Thus, ponds not only create a natural ecosystem in their defined environment, but they also fit into the community or life cycle of not just one homeowner's back yard, but of the entire ecological region.

Ponds Are a Piece of the Ecological Puzzle

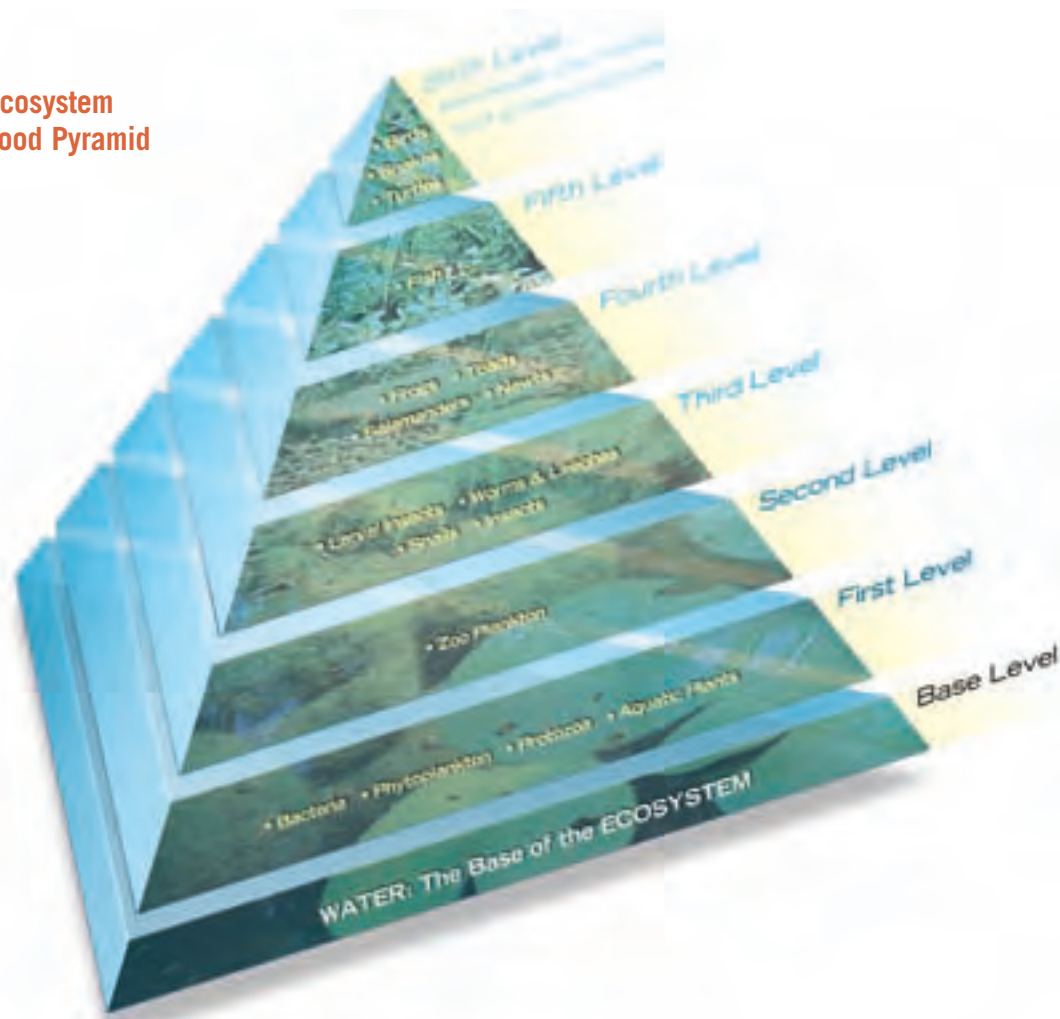
An ecological region is made up of thousands of elements, water being the most basic of these. Each pond is a piece of this puzzle. As wild habitats are depleted due to commercial development and other factors, these pieces are eliminated. This is why it is so important to restore and preserve as many

of these as possible. A backyard pond restores one of these pieces back to an ecosystem. So don't just see a pond as an independent, unrelated element. See it instead, as part of the "big picture," the regional environment.

A regional ecosystem or pond ecosystem can be likened to a triangle. In a regional ecosystem, ponds, streams, and lakes (water) are the base of the triangle.

In the pond ecosystem, the water is the base of the triangle. Everything found above the base is completely dependent, either directly or indirectly, on water. Since water is at the base of all this diverse life, let's take a quick look at the properties of this very important substance and at some of the major contributors to water chemistry.

Ecosystem Food Pyramid





Water Quality

A Mini Lesson on pH

pH stands for potential of hydrogen. The pH scale represents the relation of hydrogen ions to hydroxyl ions. Higher hydrogen content equals more acidic water, and as hydroxyl ions outnumber hydrogen ions, the water becomes more basic.

pH is measured on a numbered scale of 1 to 14. A pH of 7 is neutral. This means that the hydrogen and hydroxyl ions are in complete balance. Numbers above this are called basic, or mistakenly alkaline, and hard. Numbers below seven are termed acidic.

Typical ponds have a pH range of 6 to 11, which is slightly acidic to strongly basic. For instance, 8.2 would be a very acceptable pH level (see scale above). A pH of 4 is strong enough to

dissolve nails, so, needless to say, this is not good for aquatic life.

There are many things that influence the pH values in water. Probably the most influential are existing dissolved minerals and metals found in the water. These elements are buffers, typically expressed as alkalinity and hardness.

Alkalinity

The higher the alkalinity levels, the more the water becomes “stuck” at a higher pH. Alkalinity is made up of the total of all buffering elements in the water typically expressed in ppm (parts per million).

Hardness

Hardness is similar but more specific. It refers to the amount of dissolved calcium and magnesium or CaCO_3 in the water. Water is termed ‘hard’ when



TIP from TEAM AQUASCAPE

Having explained some aspects of water chemistry, it's now time for a word of wisdom for the pond builder. Leave the test kit alone! It is not called water ‘chemistry’ for nothin’. It truly is chemistry. Most people who begin tinkering with test kits do more damage to their water than they do good. That's because it's very difficult to influence and manage water quality in an outdoor pond using chemicals. Resist the temptation to become a slave to the test kit. Relax. Don't worry. Be happy.

levels are around 300ppm or more. The higher the hardness and alkalinity values are, the lower the chances that you will have fluctuations in your pH.

Hard Water Table

	Hardness PPM CaCO_3
Soft	0 - 79
Slightly Hard	80 - 149
Hard	150 - 299
Very Hard	300 +



TIP from TEAM AQUASCAPE

The pH levels in a pond involve many variables. This makes it very difficult, and potentially dangerous, to use chemicals to change the pond's pH levels. If you have hard water, chances are that even large quantities of chemicals won't immediately change the pH. Then suddenly it may drop drastically, causing your whole system to crash.

Nutrients, Macro & Micro

Other contributors to water quality are macro and micronutrients...the stuff you can't see that makes life function. There are 17 elements that are required for life, including three macronutrients and 14 micronutrients. Macronutrients are what are found in commercial fertilizer mixes. When you see a fertilizer that says 20-10-20, these numbers refer to the percent volume of nitrogen (N), phosphorous (P), and potassium (K). These are the nutrients required in the largest quantities for proper plant growth.

Macronutrients

Nitrogen

In a pond, ammonia and nitrate are forms in which nitrogen is available in water. High levels of ammonia and nitrate are very toxic to most fish. Because of this, and the fact that algae is fueled by nitrogen, it's best if these levels are undetectable or very low.

Phosphorous

Phosphate is the nutrient available form of phosphorous. Again, in a pond situation it is best to have low or non-existent levels of phosphate. Although phosphate is not a problem for fish, it does cause prolific and unchecked algae growth (see chapter 18 for more information on controlling algae growth).



Potassium

The final macronutrient is potassium. It's rare to find high levels of potassium in a pond ecosystem. And even if you did, it wouldn't be a problem, as it is key for plant and fish metabolism.

Micronutrients

The other category of nutrients is micronutrients. There are the 14 micronutrients required for life, and each is required in different ratios for different members of our pond-based ecosystem. They each have very specialized important functions on the cellular level for all forms of life. These include: boron (B), carbon (C), calcium

(Ca), chlorine (Cl), copper (Cu), iron (Fe), hydrogen (H), magnesium (Mg), manganese (Mn), molybdenum (Mo), nickel (Ni), oxygen (O), sodium (Na), sulfur (S), and zinc (Zn).

Tea Colored Water

One by-product of having a small amount of organic matter decomposing at the bottom of a pond, is water discoloration. This is often referred to as tea colored water. The proper name is dissolved organic carbons, or more commonly known as DOCs. These DOCs make up tannins, which are natural pigments or stains.

A cup of tea has its color because of DOCs. Water that is strongly stained with DOCs tends to be slightly acidic. This stain in the water is not a bad thing in and of itself. What could be a problem however, is a possible overload of the organic matter that causes the staining. Activated carbon has the unique ability to pull these stains from the water. *(For more information on activated carbon see chapter 18.)*

Another problem caused by excess organic matter is the depletion of oxygen. The process of leaves decomposing on the bottom of the pond can quickly consume valuable oxygen. This can be a potentially dangerous situation for the fish, especially if the pump, which provides additional oxygen, shuts off. This can be avoided by using a skimmer in the pond.



A healthy ecosystem sparkles when you add activated carbon to absorb colorants from the water.



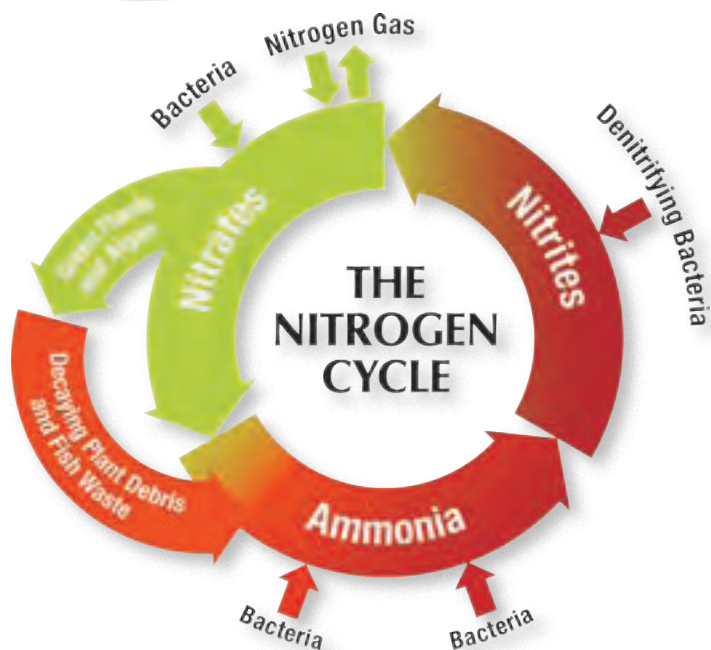
The First Level of the Ecosystem

Now that we've discussed a little about the base of the ecosystem, we can take a look at the next level – the first level consumers/converters. This is the biological level that makes life on earth possible. By consumers, we mean organisms that consume waste and its chemical elements, and energy from the sun, and convert these into energy, mass and life.



Bacteria

Bacteria is very important in the function of an ecosystem, and there are countless types of bacteria, something for every function. Bacteria prefer to be anchored to a substance like rocks or gravel, and are found in largest quantities in the midst of decomposing leaves.



TIP from TEAM AQUASCAPE

Putting rocks and gravel in a pond significantly reduces the amount of muck buildup in the bottom of the pond. This is because rocks and gravel provide many places for bacteria to call "home," much more than bare liner. More bacteria means more capacity to break down fish waste and plant debris, which leads to better water quality.

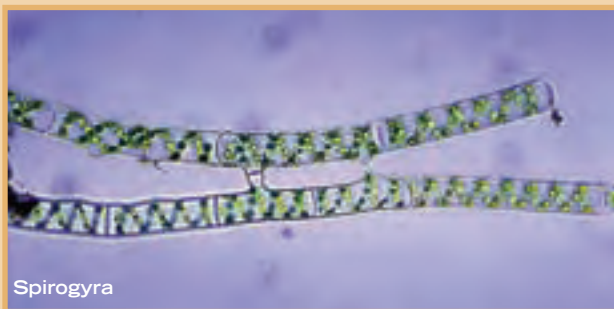


Types of
Phytoplanktons:

Closterium



Anabaena



Spirogyra

Plankton

Next, we have phytoplankton (algae), diatoms, and protozoa. Phyto-plankton are sun dependent free-floating organisms. This is a fancy way of saying free-floating algae, or “green-pea soup” water. There are dozens and dozens of varieties of these phytoplankton: closterium, and anabaena to name a few. It’s never difficult to find many kinds of algae in all parts of the pond.



Diatoms

Another category of algae are diatoms. These tiny, free-floating plants tend to give the water a tan to light brown hue if they are present in large numbers (which is rare in a pond). These

little things show off some of the most geometrically complex shapes in all of nature. Diatoms are what we make dynamite with and are where a high percentage of fossil fuels come from. A couple of common species of diatoms found in ponds are Asterionella and Navicula.

Protozoa

Also on this level we have the protozoa. The most familiar of these tiny single-celled animals are Amoeba and Paramecium. They can be found free floating in the water, and they absorb nutrients via osmosis through their cell walls.



Aquatic Plants

The final, and by far, the most visible member of the consumer/converter category are the aquatic plants. There are literally thousands of kinds from all over the world, including submerged, floating, emergent, and marginal plants. Some can be submerged 20 or more feet, while others just like their feet wet. (See chapter 3 on aquatic plants for more information.)



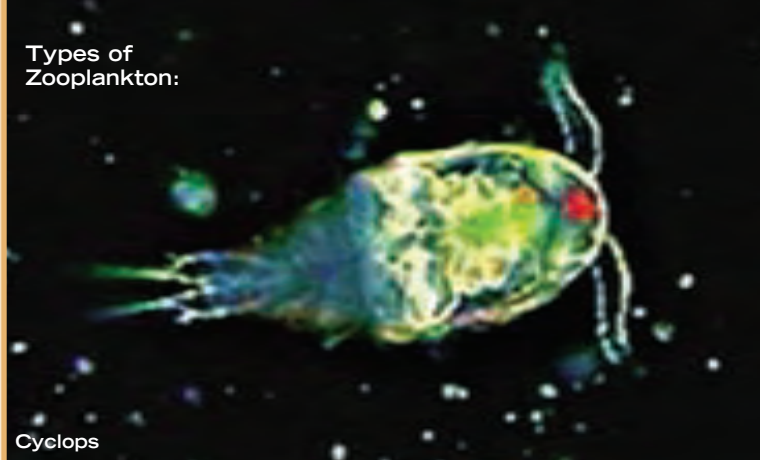
Water Hyacinth



Lotus



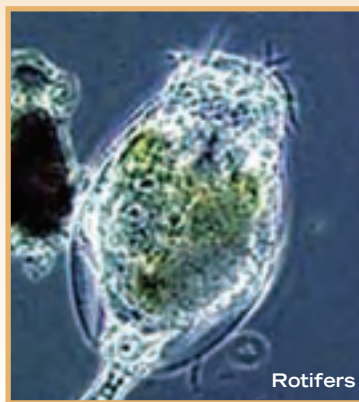
White Iris

Types of
Zooplankton:

Cyclops



Daphnia



Rotifers

Second Level of the Ecosystem

Next, we have the second level of the food chain, zooplankton. These little animals are consumers. Most species of zooplankton are filter feeders. They can be found drifting through the water, sifting out food particles. They primarily eat algae, but they also consume protozoa and other smaller zooplankton. Some common species of zooplankton include daphnia, cyclops, and rotifers. Zooplankton are technically part of the next category (invertebrates), but because of their size, they are lower on the food chain.

Third Level of the Ecosystem

Aquatic invertebrates make up the third level of the food chain. These are part of the Arthropod family, which includes all insects. It's the largest group of animals on earth. Larval insects are very common in a backyard pond. If you keep your eyes peeled, you will definitely find some type of larvae/nymph in your pond. The primary places to look would be on the bottom of the pond, in some decomposing leaves or near the surface around the edges of the pond.



Larval Insects

Larval insects consume rotting organic matter, bacteria, diatoms, and zooplankton. Some of the common larval/nymph insects are, black fly larvae, caddis fly larvae, mosquito larvae, dragonfly nymph, damselfly nymph, and mayfly nymph.



Black Fly Larvae



Mosquito Larvae



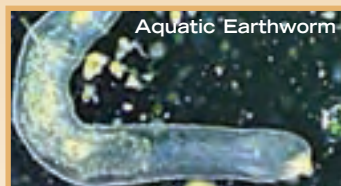
Caddis Fly Larvae



Rat Tailed Maggot



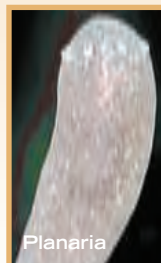
Tubifex Worms



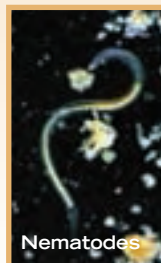
Aquatic Earthworm



Horse Hair Worm



Planaria



Nematodes



Leeches

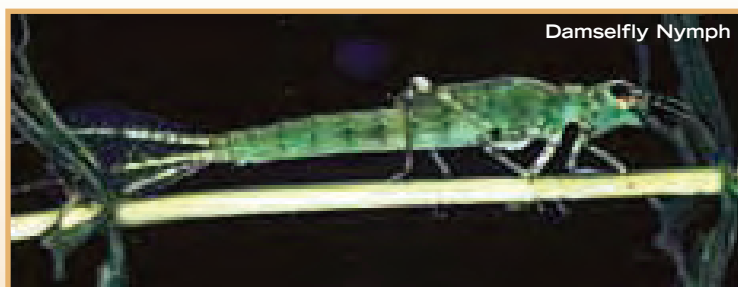
Worms & Leeches

Many people are grossed out by these little critters, but none of them can hurt anyone. About two thirds eat other little animals, muck, detritus, and plants, while the other third just eat muck and

detritus. The place to find these guys is right in their food, at the bottom of the pond.

Some of the common kinds of worms you may find in a pond include rat-tailed maggots, nematodes, tubifex worms, aquatic earthworm, horsehair worms, planaria, and bloodsucking leeches.

Yes, leeches are part of this level of the ecosystem. They are not as scary as people think. Some ponds may go through a period where they have leeches. A pond may have them for a couple of years and then they will disappear. They are fairly slow to attach themselves to their dinner (you), so don't fear. Usually you can pick 'em off before they suck your blood. If you get a leech on your body, just salt it and it'll release.



Damselfly Nymph



Mayfly Nymph



Dragonfly Nymph

Dragons in the Air

Of all the insect nymphs you may possibly find in your pond, dragonflies may be the most common, and eventually the most beautiful. Dragonflies mate in the air, and the females deposit their eggs in the pond in many various places, such as plant stems or in a moist nook along the pond's edge. The eggs hatch and the small nymphs emerge, eating just about anything—worms, other insect's nymphs, or even small fish. Then, after at least three months they will crawl out of the water onto a stem, rock, or a log, just above the water's surface, and go through the transformation into adulthood, which is called imago.



Photo by Scott Hughes



Snails

Snails primarily feed off of detritus, little dead animals, diatoms, and algae. It's common to find them under water, sucking and scouring the rocks and gravel. They don't harm anything, though sometimes they can reproduce at prolific levels. Don't ever use chemicals

to control snails. If there are too many, just do a spring clean out (to decrease their food supply), and let them naturally balance themselves out. Some of the common types of snail you'll find in ponds include hairy wheel snails, little pond snails, orb snails, wrinkle snails, and the giant pond snail.

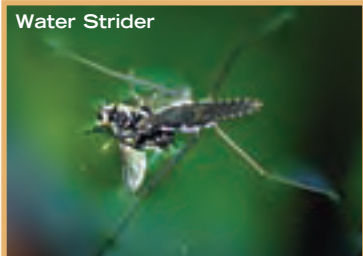
Insects

The next, and final, category on this level of the food chain is insects in their mature form. These can pri-

marily be found on the surface of the water and around the pond. Some of the common insects you'll see in and around your pond are water striders, whirligig beetle, water boatman, giant water bug, damselflies, dragonflies, diving beetle, mayflies, water scorpions, mosquitoes, and pill bugs. There are thousands more, but these are the most common. The majority of these insects prey on other insects, larvae, and even small fry.

Insect Types:

Water Strider



Whirligig Beetle



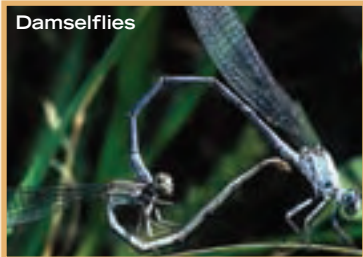
Water Boatman



Giant Water Beetle



Damselflies



Dragonflies



Diving Beetle



Mayflies



Mosquitoes



Pill Bugs



Water Scorpions



Frog Types:

Leopard Frog



Green Frog

Bullfrog



Pickerel Frog



Fourth Level of the Ecosystem

Frogs

Amphibians make up the fourth level in the pond food chain, and include hundreds of species. Frogs are probably the most renowned members of this group. They breed in the spring through early summer, which is when they constantly croak. They lay their eggs, which hatch into tadpoles. Frogs will eat just about anything they can get their mouths around—insects, worms, small animals, small fish, even tadpoles or other frogs. They can often be found during the day sunning themselves on a rock or lily pad, soaking up the sun's rays. The most common types of frogs seen in ponds are leopard frogs, green frogs, bullfrogs, and pickerel frogs.

Toads

A toad might surprise you when you move a rock or skimmer lid. And no, you will not get warts from touching them. Toads have a

diet similar to frogs, although they're not quite as daring when it comes to the size of their prey. While they don't live in water, you can usually find them hiding under something in a moist area. Common toads include the American toad, Fowler's toad, and the Eastern spadefoot toad.



Salamanders & Newts

Salamanders and newts are very hard to find in backyard ponds. Even in regions where they are found, only about one in ten ponds will have them. If you have them, you should feel lucky. They feed on worms, insects, and larvae. You can find them in moist spots full of organic matter. If you're lucky, you can see them in their juvenile form in the pond. The most common newts and salamanders you may see in your pond are the red spotted newt, spotted salamander, tiger salamander, mud salamander, red-backed salamanders, two-lined salamanders, and the dusky salamander.

Salamander & Newt Types:

Red Spotted Newt



Spotted Salamander



Tiger Salamander



Mud Salamander



Hey! Hey! See me! Take my picture, I'm here, see me!



Fifth Level of the Ecosystem

Fish

On the fifth level of the pond food chain we find fish. In a natural pond you may find bass, blue gill, sunfish, the common carp, or any number of other kinds of fish. In the backyard pond the most common fish include koi, goldfish, and orfe. Each have their own diet preferences, but generally most are omnivorous, meaning they'll eat just about anything. They eat worms, nymphs, larvae, other fish, algae, detritus, tadpoles, and ... pretty much anything they can cram into their mouths. *(For more detailed information on fish, see chapter 4.)*

Sixth Level of the Ecosystem

This sixth level of the food chain is the connection to the surrounding environment. This is where the backyard pond begins to contribute to the "big picture," the regional environment.

Birds

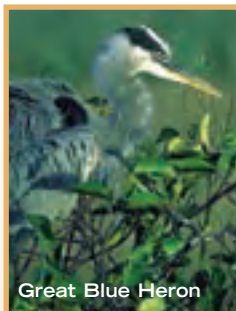
The main top-end predator of the pond and its inhabitants are birds. Their diet consists of various aquatic life. Most birds love fish, aquatic plants, crustaceans, and any other tasty morsels they can fit between their beaks.

The primary hunter in most ponds is the great blue heron. These birds love ornamental pond fish because they're easy targets to catch. Other birds that prey upon pond inhabitants include hawks, osprey, egret, green heron, kingfisher, and an occasional eagle. For the most part, geese, swan, and all types of ducks prefer a diet of aquatic vegetation but will consume some smaller pond animals. A

bird of prey is usually an unwanted visitor to the backyard pond because of the expensive ornamental fish they may eat. If you can, try to co-exist with them as much as possible. *(See the section in chapter 4 under "predator control" if you need help controlling these guests.)*



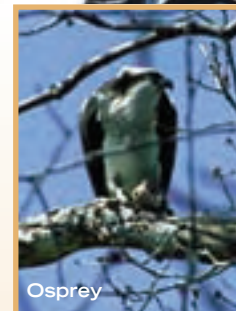
Bird Types:



Great Blue Heron



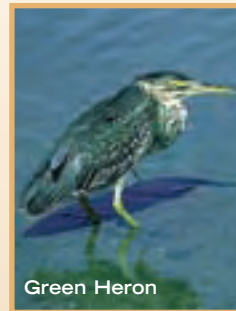
Red Tailed Hawk



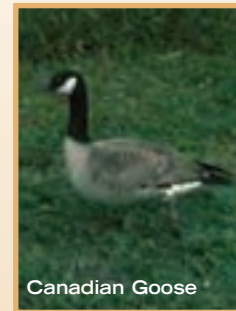
Osprey



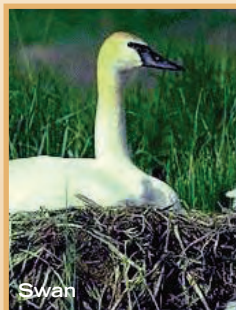
Bald Eagle



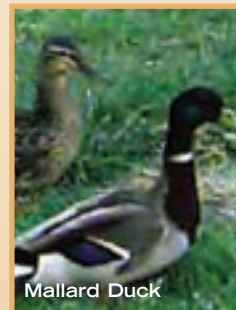
Green Heron



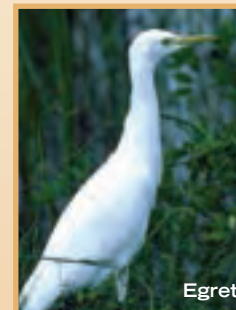
Canadian Goose



Swan



Mallard Duck



Egret

Types of Snakes:

Garter Snake



Water Snake

Reptiles

Next in this category are reptiles, snakes, and turtles. These guys are very misunderstood, and therefore feared by most people. These animals eat almost anything in the pond ecosystem, while nothing in that system eats them.

Snakes

Snakes eat fish and frogs rather frequently. The good thing about snakes is that they also eat pesky rodents commonly found around the yard. Most ponds will not have snakes. If you do, don't freak out. Just be cautious when you open the skimmer box or tinker around the pond so as not to provoke them. Some of the common kinds of snakes you'll find around ponds are garter snakes, blacksnakes, and common water snakes.

Turtles

Turtles are a more welcome addition to a pond. Large turtles can eat fish, and they do in natural lakes and ponds. Typically in backyard ponds, turtles don't eat fish. They'd rather munch on fish food and all sorts of vegetation. They actually make very tame and wonderful pets. Some common turtles are musk turtles, mud turtles, painted turtles, pond sliders, and spiny softshell turtles.

Other Animals

Other animals that spend time near the pond and depend on the pond ecosystem for some part of their food or water source include raccoons, deer, and birds. Naturally, animals are dependent on water.

**Turtle Types:**

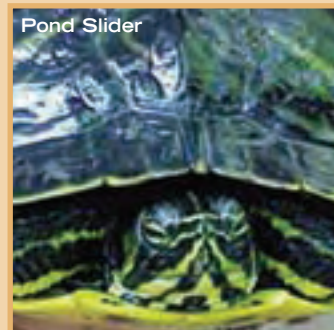
Musk Turtle



Mud Turtle



Painted Turtle



Pond Slider



A pond shortly after construction.

How Does Pond Building Affect the Ecosystem?

We should remember that our backyard water features are not only enjoyable for us, but also necessary for the well being and functioning of our environment. As we understand how ponds work and what plants and animals live in them, we learn to appreciate nature instead of being scared of it. So relax, nothing in your pond will hurt you!

Do you want your pond to be more diverse? Given time and some proper plant selection in and around the pond, you can create a very diverse ecosystem in your yard. Just remember to keep it simple and, with patience, your pond will mature over the years into a beautiful part of nature.

One pond in one backyard may not seem very important, but when you have a thousand similar backyard ecosystems functioning simultaneously, there's truly a positive impact

being made on the environment. Large amounts of habitat are restored for frogs, toads, newts, and salamanders, all of whose numbers have been declining sharply for many years now. Birds have also been driven from many of their natural wetland habitats, which they need so desperately to survive. So at a grassroots level, as the pond industry grows, there are additional habitats and diversity being added to our stressed suburban environments.



The same pond after adding landscape decoration.