Wildlife Ecology

NATIONAL ENVIROTHON OBJECTIVES:

- Identify common wildlife species and wildlife signs.
- Identify basic wildlife survival needs.
- Describe specific adaptations of wildlife to their environment and their role in the ecosystem.
- Describe predator/prey relationships and identify examples.
- Describe food chains and food webs and cite examples.
- Describe factors that limit or enhance population growth.
- Evaluate a given habitat and its suitability for a designated species when given a description of its habitat needs.
- Describe ways a habitat can be improved for specific species through knowledge of its specific requirements.
- Discuss the concept of carrying capacity and limiting factors.
- Discuss various ways the public and wildlife managers can help in the protection, conservation, management, and enhancement of wildlife populations.
- Describe the potential impact of the introduction of non-native species.
- Describe major factors affecting threatened and endangered species and methods used to improve the populations of these species.

BUT WHAT DO WILDLIFE ECOLOGISTS DO?

Every organism on our planet functions in a system. The activities of one organism will in turn effect the life of another organism. Wildlife Ecology is a component of the science which studies the relationships of earth's living things to one another in their surroundings. These scientists examine and monitor terrestrial inhabitant-habitat interactions, to better understand how our natural world functions systemically and to create management strategies to deal with problems which might arise during those interactions. Wildlife Ecologists specifically study topics such as animal behavior, predator-prey relations, animal populations and migrations, rare and endangered species, ecosystem rehabilitation, and human impact assessment.

As our society continues to urbanize and expand into areas which were previously wildlands, the need for intensive assessment of human impacts on wildlife are required. As human populations grow, these assessments will aid us in conserving our wildlife and predicting the effects which human activity will have on wildlife ecology. Wildlife Ecologists also spend much of their time investigating and monitoring in the outdoors and must have a love for nature. They must retain the physical stamina that is needed to enjoy long hours trekking about outside. Wildlife Ecologists also spend time in the lab and behind a computer analyzing their field data.

To become a Wildlife Ecologist, one must first attend a four year bachelor's degree program at an accredited university. Wildlife Ecologists generally study and graduate with degrees in ecology, environmental science or biology. Postgraduate study is often required for research positions. A recent graduate might work for the government in the U.S. Department of Fish and Wildlife or the US Environmental Protection Agency. Many Wildlife Ecologists find work at universities as professors or researchers, or in secondary schools teaching science. Often Wildlife Ecologists will work for Non-Profit Organizations which strive to preserve our nation's and our world's wildlife.

Basic Areas of Knowledge
Participants should be able to describe basic wildlife survival needs. They should also be able to identify species and their corresponding characteristics as well as the habitats which are found in the metropolitan area. They should be able to evaluate a given habitat or ecosystem and assess what species would thrive within it, or what improvements could be made to facilitate colonization. Students must also be familiar with some of the major problems affecting local wildlife including non-native species, pollution and urban sprawl. They should have some knowledge about the site itself, history and current issues in conservation and recovery.

Species of the New York Metropolitan Area
The New York Metropolitan Area has approximately 330 bird species, 30 mammalian species, 32 reptilian and amphibian species and over 200 fish species.

Avian and other Terrestrial Species

Peregrine falcons (*Falco peregrinus*)
Peregrine falcons are raptors or birds of prey, which were originally adapted to life on craggy mountain habitats, but can now be seen occupying bridges and buildings across New York. In the 1960's the peregrine falcon population was decimated by DDT. DDT, a nationally used pesticide, weakened the fragile shells of peregrine eggs, causing a severe decline in offspring survival. By 1972, a national ban was placed on DDT but unfortunately, by that time, no peregrine falcons were left on the East Coast. Peregrine falcons were subsequently added to the list of endangered species and conservationists launched a huge effort to reintroduce the falcons into the wild. In the 1970's and 1980's, 150 peregrines were bred and hand raised in captivity, then released throughout New York.

Thanks to an increase in peregrine falcon population, the U.S. Fish and Wildlife Service was removed the species from the Federal list of threatened and endangered species on August 25, 1999. The species will be monitored for several years to ensure that it no longer needs the protection of the Endangered Species Act and if necessary, the species can be re-listed in the future. Today, peregrine falcons nest in 11 sites across the 5 boroughs, such as the Manhattan Tower of the Brooklyn Bridge, the Met Life Building on East 45th Street and the George Washington Bridge.

Peregrine falcons are generally 1.5 ft tall with narrow, tapered grayish blue wings. These birds are adapted for speed and can exceed 60 miles per hour during level flight. They have sharp, curved beaks and yellow, razor talons, perfect for preying on pigeons which are very dense in the urban area. In the wilderness one bird may occupy a 5-10 mile radius nesting in high cliff areas, but in the urban environment multiple birds may occupy an area of one mile.

Red-tailed Hawks (*Buteo jamaicensis*)
Red-tailed hawks are raptors, with sharp curved beaks and long, curved, sharp talons. They are stocky birds with broad wings, a white underbelly, yellow legs and feet and rust or cinnamon colored tails. The female is usually 25% larger than the male, a characteristic known as *sexual dimorphism*. These birds are generally monogamous.

The red-tailed hawk can be as tall as 2 ft, making it the largest raptor in the metropolitan area. These birds feast primarily upon small rodents. Their extraordinary eyesight allows them to easily spot the small mammals from above— a red-tailed hawk's eyesight is 8x stronger than a humans. Red-tailed hawks can often be seen perching on power lines and have been very successful at colonizing urban and suburban areas.

Local Red-tails; Pale Male and Lola
Pale Male and Lola are two famous hawk residents of New York City. Pale Male took up residence in Manhattan in the early 1990s and was the first red-tailed hawk to move to the city, nesting on the expensive 927 Fifth Avenue penthouse directly across from Central Park.

Pale Male is approximately thirteen years old and is known to have sired twenty-six chicks with four mates. He is named for his unusual pale white

coloring. Red-tailed hawks are monogamous birds and Pale Male is no exception. He has only had four mates throughout his lifetime and his most recent is Lola.

For over a decade, the residents of 927 Fifth Avenue objected to the presence of Pale Male's residence on their building but could not get rid of his nest due to the Migration Bird Law. However, in December 2004 the nest was removed from the Park Avenue condominium. The nest was empty for the winter and the United States Fish and Wildlife Service ruled that removing an empty nest would not violate the Migration Bird Law. After the nest's destruction, New Yorkers quickly came out in protest. The out pouring of support was overwhelming and protests were held outside of the building daily demanding that the hawks be allowed to return. The NYC Audubon, with help from Mary Tyler Moore (one of 927 Fifth Avenue's residents), lead the effort to restore the hawks' nest. Finally, in late December 2004, workers installed a new home for the hawks; a stainless steel, spiked basket (which will help catch all the blood of their food and subsequent excrement which the building residents complained of) that weighs 300 pounds and rests atop an ornate window ledge.

In February 2005, the hawks did build a nest on 927 Fifth Avenue and in March Lola laid eggs. Unfortunately, the eggs did not hatch, but failures like these have happened in the past. In 1993 and 1994, Pale Male and his former mate Chocolate laid eggs that did not hatch at the same site. As of January 2006, Pale Male has been spotted almost every day at the nest site, constructing a new nest for the upcoming season. To receive daily updates on his progress, visit www.palemale.com.

After the Pale Male controversy, a team of public and private partners started the New York City Raptor Fund. The fund supports habitat improvements, bird rehabilitation and education. It will work to support and protect Pale Male as well as other raptors and migratory birds of New York City. The NYC Audubon Society also continues it work to protect and conserve local bird populations with its two volunteer oriented programs, Project Safe Flight and the Harbor Herons Project.

Barn Owl (*Tyto alba*)
The barn owl is a local predator which can locate and capture its prey in the dark using its well-developed sense of hearing (though its excellent eyesight also helps). The barn owl has a white, heart-shaped monkey-like face. It is mostly white with feathers of buff or light golden brown. The eyes of the owl rest in a fixed, forward-looking position and cannot move side to side. To see behind or to the side, an owl must rotate its whole head.

The barn owl can grow up to twenty inches high. It preys on small mammals and can be distinguished by its rasping hiss, very unlike the "hoot" call of other owls. These birds will nest almost anywhere and were originally recruited by the city to attack the rodent population. The owls still prey on the rats of New York, though the birds have made no lasting dent in the enormous rodent population.

Harbor Herons
Eight species of wading birds nest in the New York/New Jersey Harbor area, including Great Egrets, Snowy Egrets, Glossy Ibises and Green Backed Herons. Together, this group of birds are known as the harbor herons.

These birds construct platter-sized nests on island rookeries throughout the Harbor area, such as Shooter's Island off Staten Island, North and South Brother Island, Pralls Island, the Isle of Meadows, Hoffman Island and Swinburne Island. The islands are covered by mostly deciduous forests and tidal wetlands. Both males and females sit on nests and fly out for food, seeking prey in the salt marshes and wetlands of the region. The herons primarily feed on killifish and fiddler crabs.

The herons can be identified by their long S-curved necks, stilt-like legs excellent for wading and large wings spanning up to 4.5 ft long.

Ospreys (*Pandion haliaetus*)
The osprey is a large raptor, which can measure up to 25 inches in height, with a wingspan reaching out to 6 ft. The osprey's back is covered in brown feathers, while the underbody and the head is covered in white feathers. The predominantly white head is crowned by dark brown feathers with a dark brown streak on either side. Males and females are similar in appearance, though the female is slightly larger.

Ospreys use sharp talons to catch fish and will often entirely submerge themselves into the water during hunting. They usually construct large nests atop dead trees, but forest fragmentation has destroyed much of their natural habitat around the local area. Conservationists have constructed nesting platforms in areas such as Jamaica Bay and ospreys will often nest there or other similar human-constructed structures.

DDT caused the thinning of osprey eggshells in the 1960's, initiating a massive decline in the population. Since New York's 1972 DDT ban, the osprey population has been consistently on the rise.

Pigeons (*Columba livia*) or **Rock Doves**
Pigeons are a non-native bird species which arrived from Europe around the 1600's. Originally, the New York pigeon was a domesticated animal raised for food. Today, they crowd the streets, feeding on handouts such as bread and birdseed, and nest on building ledges and underneath bridges.

New Yorkers once raised pigeons for sport, maintaining coops with hundreds of trained racing birds. Some still do, though the hobby is not as popular as in the past. These domesticated racing birds have been recorded in flight at speeds of 80 miles per hour. Street pigeons have also been recorded at high speeds, reaching 45 miles per hour. These high speeds make pigeons one of the fastest birds in the wild.

Pigeon chicks reach adult size after one week. The adults have bluish-gray feathers, two dark wing bands and an iridescent sheen around their plump necks.

These birds have been blamed for ruining architecture with their excretion, since their acidic droppings eat through limestone, corroded steel and discolor brass. The peregrine falcon population keeps a constant check on the pigeon population, consuming at least 200 street pigeons per week.

Squirrels (*Sciurus carolinensis*)
Squirrels abound in the wooded areas of New York City, clustering in parks like Washington Square, Union Square and Central Park. They must maintain a proximity to trees where they live and rest. Squirrels construct leaf nests in tree limb crooks and will generally have between three to four babies. City squirrels survive on acorns and other local seeds, plus whatever handouts they can get from people or even trashcans.

In their natural forest habitat, squirrels have a one acre territory which they vehemently defend against other squirrel intruders. In the New York urban habitat, 20 squirrels will peacefully share one acre of space. Forest squirrels are only active in the early morning and evening hours to avoid predators, but urban squirrels have adapted to life in the daylight hours, a time when they are most likely to receive handouts from passer-bys.

Often, one will see black squirrels running about or climbing trees in the City's parks. The black squirrel is a rare color variation of the gray squirrel and is not considered to be a different species. In New York, squirrels can be black-furred, albino or varying degrees of gray. The black and gray varieties have been found in wild populations in the New York-New Jersey area since 1665. They will play and mate with each other, producing litters of both black and gray. Black squirrels are more common in northern areas, especially Canada.

Rats (*Rattus norvegicus*) **–The Norway Rat**

In New York City, there is one rat per every person, meaning that with a population of 8 million people, there is a population of at least 8 million rats.

Rats are a hardy and adaptable species. They are omnivorous (will consume both plant and animal matter) scavengers. They have a short lifespan of one to two years, and adults usually weigh about a 1 lb and are 12 inches long. Rats have very sharp incisors and strong jaws which are capable of applying 20,000 lbs of pressure per square inch. These incisors enable rats to chew through lead pipes, concrete and even brick. Rats can squeeze their bodies through holes as small as a nickel and can also swim, tread water and jump up to a height of 3 feet.

Rats are colonial and live in groups of 20-150 members. They inhabit places which are private and generally inaccessible to most other species. They dig tunnels a foot underground, often in abandoned lots, buildings or subway tunnels. Rats are famous for living in the sewers, places which provide privacy, abundant water and easy access to the surface. Rats breed fast, usually producing five litters of seven to eleven pups per year. A single rat can produce 150 babies during its lifespan.

Rats are actually a non-native species and first arrived in North America during the American Revolution. They traveled over the Atlantic on the boats of troops, then escaped to the shore and colonized North America.

Rats have adapted to the constant human threat which tries to extinguish their populations. They are *neophobic*, meaning that they fear anything new and will not eat food found in unfamiliar spots making them very hard to trap.

Aquatic Species

Blue Crab (*Callinectes sapidus)*

The blue crab is olive and white in color, with bright blue claws and ten legs. The front legs are two claws or pinchers used for hunting and defense, the middle six legs are paired and are used for walking along the ocean or estuary floor (sideways) and the back two paddle-shaped legs are used for swimming.

Blue crabs can be found in the New York/New Jersey Harbor estuary. They are omnivorous creatures, feeding on other crustaceans, bivalves and fish as well as plants and other detritus. Juvenile blue crabs are also prey for species like the stripped bass.

Striped Bass (*Roccus saxatilis*)

The striped bass is dark olive with a silver stomach and has seven to eight horizontal strips along its side. These fish can grow to an enormous size and the largest ever recorded was 125lbs and over 6ft long. However, the average stripped bass is generally between 30lbs and 40lbs. Striped bass feed on smaller fish, often mummichog or flounder.

The striped bass can be found in the Hudson River, and historically helped to support a huge commercial fishing industry along the river before the benthos was contaminated by PCB's and other toxins, which are ingested and stored within the fish's fatty tissue.

Sturgeon

There are two species of sturgeon that live in the Hudson River, the **Atlantic Sturgeon** (*Acipenser oxyrinchus)* and the **Shortnosed Sturgeon** (*Acipenser brevirostrum).* Atlantic sturgeon are *anadromous*, meaning they only use the fresh water portions of the Hudson to spawn and to live as juveniles. They spend the rest of their lives in the ocean. Shortnosed sturgeon (which are classified as an endangered species) live out their entire lifespan within the Hudson River Estuary.

Sturgeons are very large fish and grow very slowly. The Atlantic sturgeon is the largest fish of the Hudson river estuary and can grow to a length of 14 feet and a weight of 800 pounds. Shortnose sturgeon grow to a maximum of 3.5 feet and a weight of 20-25 pounds.

Sturgeon usually live between 50 and 60 years. Four barbs protrude from the area around their mouth and are critical in detecting the small fish and invertebrates upon which they feed. Sturgeon have very thick lips and suck their food up from the bottom in a vacuum-like manner. Five rows of cartilage plates line their backs. Sturgeon are a very old species, and have remained virtually unchanged since the Jurassic period.

The shortnose sturgeon is currently listed as a U.S. endangered species and their numbers continue to decrease internationally as they are hunted for their roe (eggs). Caviar is sturgeon roe and is considered a delicacy worldwide. The shortnose sturgeon, one of New York's two sturgeon species, is an endangered. Shortnose sturgeon are bottom feeders which eat insect larvae, snails, shrimp, crayfish and plants. These fish do not spawn every year and their population has been in decline since the early 1900's. In addition to overfishing; dredging, pollution and dams nearly drove the species to extinction. Dams, in particular, were a big problem because they blocked the fish from traveling upstream to their specialized spawning grounds. It is very difficult for sturgeon populations to rebound after decimation from excessive hunting and pollution because they grow so slowly and take many years to reach sexual maturity.

Bivalves

Bivalves, also known as shellfish, are mollusks which have two shells (valves) joined by strong muscles. The shells close tightly when exposed to air or danger thus protecting the animal inside. In the water the shells will open, allowing the animals to take in water and extract oxygen for respiration and phytoplankton and detritus for food. The bivalve species found in the Hudson River estuary include the Blue mussel (*Mytilus edulis*), American oyster (*Crassostrea virginica*), Soft-shelled clam (*Mya arenaria*), Pearly mussel (family Unionidae) and Zebra Mussel (*Dreissena polymorpha*).

In 1626 when the Dutch arrived, the Native Americans survived primarily on the flourishing bivalve population in the Hudson and New York/New Jersey Harbor. This population became one of New York's largest exports and claims to fame. Unfortunately, the river was used as a sewer and garbage dump, thus polluting shellfish beds around the city. This pollution caused an outbreak of Typhoid fever in 1916, and the shellfish industry eventually collapsed due to the contaminated oysters and their die-off. Hudson River oyster communities have recently been making a comeback and clams still thrive in the Hudson and continue to filter the river's water.

Horseshoe crabs (*Limulus polyphemus*)

Horseshoe crabs have often been referred to as "living fossils" because they have existed, unchanged since the Paleozoic era.

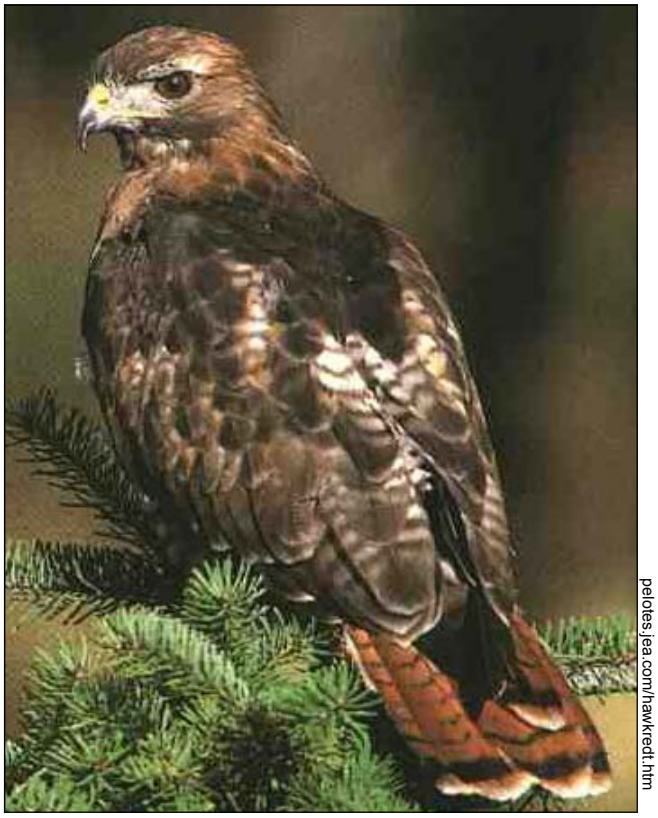
These animals have brown armor plated shells, spiky tails and spindly little legs. They live on the coastal shelf, ranging from the shallow low-tide line to a depth of 75ft. They scavenge through the bottom sediment searching for burrowing mollusks to eat.

Images: New York City Wildlife

Peregrine Falcon

http://www.pgc.state.pa.us

Red-tailed Hawk



pelotes.jea.com/hawkredt.htm

Pale Male with Prey

www.palemale.com

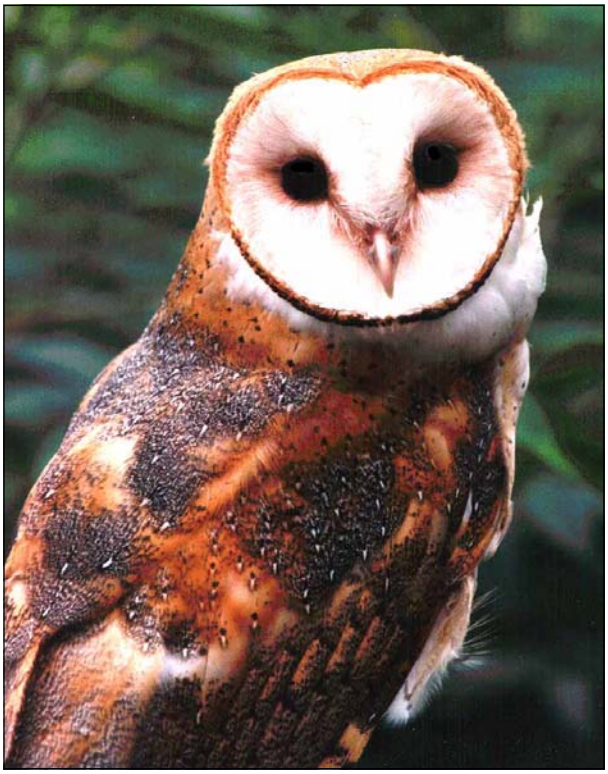
Pale Male working on his nest at 927 Fifth Avenue, 1/29/2006

www.palemale.com

Egret

©Refuge Reporter

Barn Owl



www.hawkcreek.org

Osprey fledglings at JFK

NYC Street Pigeons

www.stevegarufi.com/ny.htm

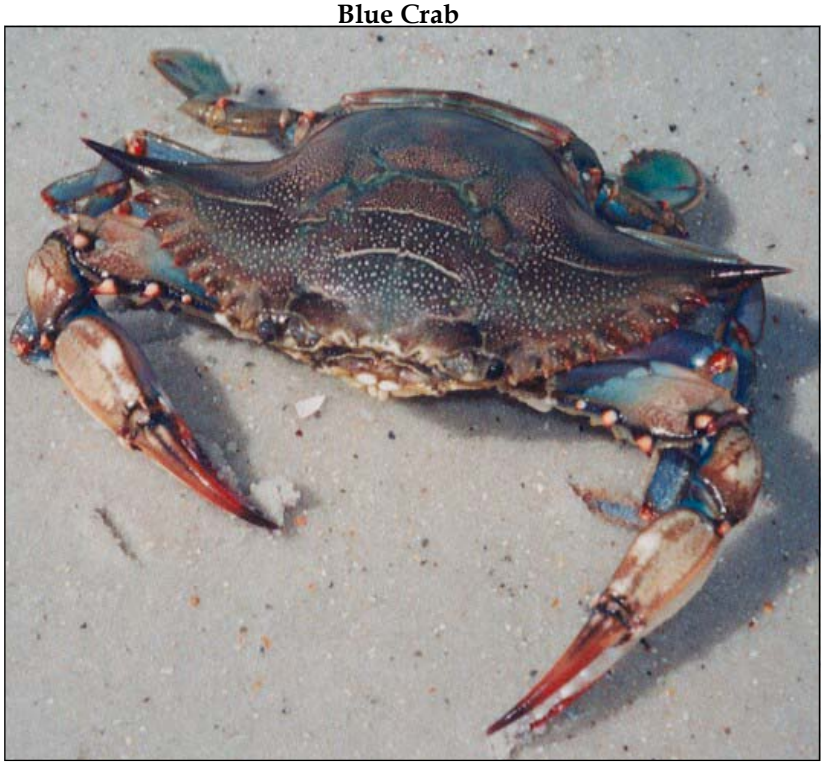
Squirrel in Maple Tree

http://www.netaxs.com/~mhmyers/squ.tn.html

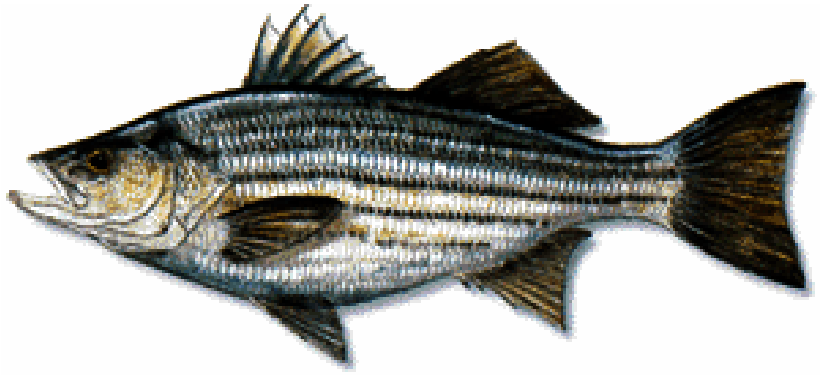
The Norway Rat

http://www.nps.gov

Blue Crab



Striped Bass



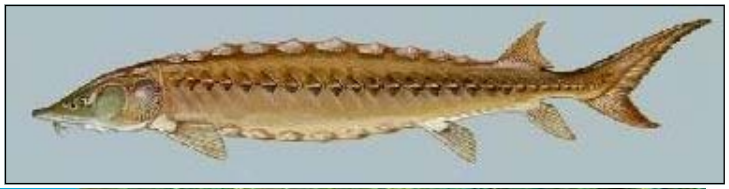
Striped Bass

http://soundwaters.org/new-creatures.html

Oysters

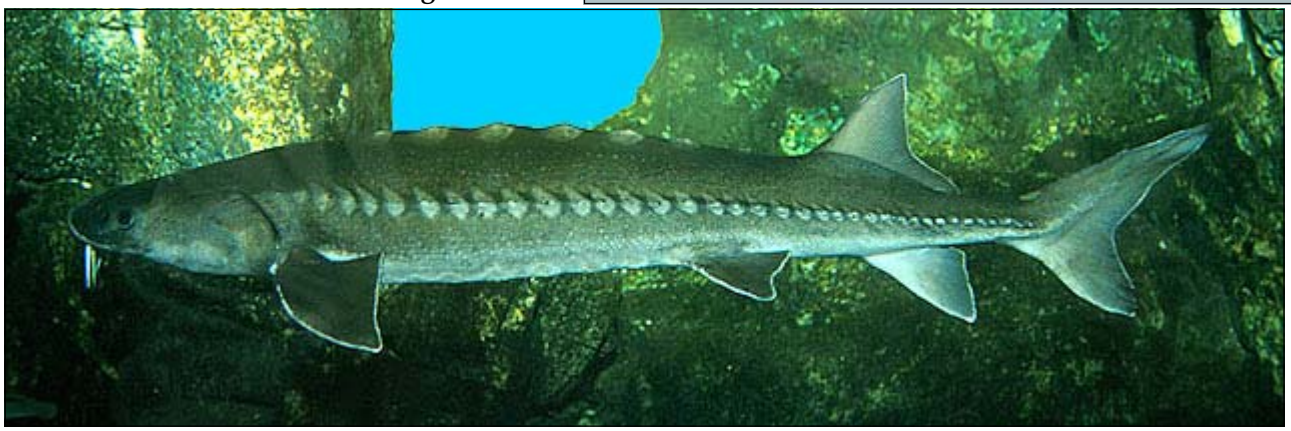
http://www.nature.com/news/2001

http://www.magazine.noaa.gov/stories/mag165.htm



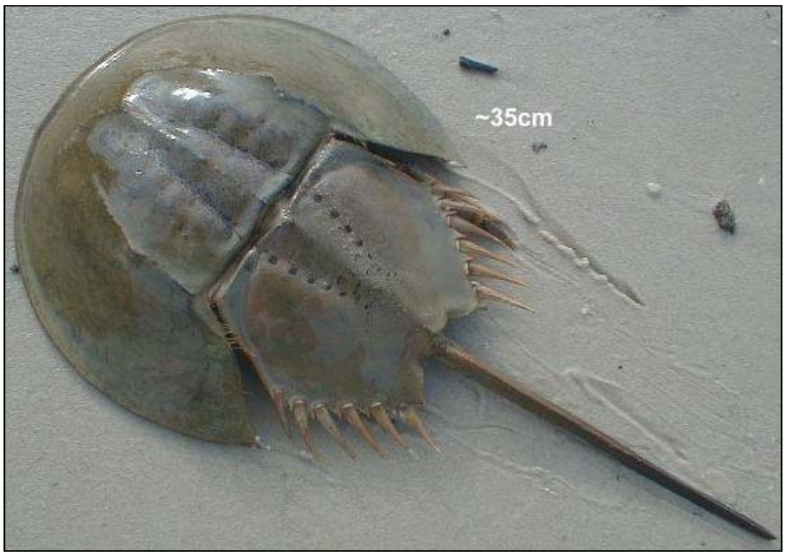
www.canadianbiodiversity.mcgill.ca

Shortnosed Sturgeon



http://www.krisweb.com

Horseshoe Crab



http://www.fishesnpets.net

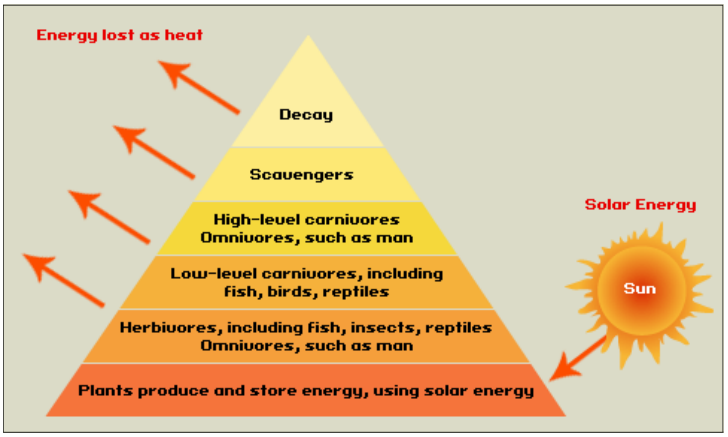
Ecosystems support many different populations, and between these populations many different types of feeding strategies can be observed. The energy flow of consumption between organisms is known as a *food chain*. The foundation of all food chains are *autotrophs*. Autotrophs also known as *producers* are plants which harvest sunlight to produce energy for survival. *Primary consumers* are herbivores (plant eaters) which feed on producers. *Secondary consumers* are carnivores (meat eaters) which feed on herbivores. *Tertiary consumers* are carnivores which feed on secondary consumer carnivores. Omnivores (like humans) are organisms which feed on both plants and animals, and can function either as predators or prey.

www.ftexploring.com

A Simple Food Chain

A *food web* is an interconnection of food chains. Organisms consume many different sources of food, and are feed upon by many different predators. In turn these predators may also be feed upon by many tertiary consumers. Even tertiary consumers are consumed; upon death decomposers (bacteria of decay) break down organic tissue and return organic material and nutrients to the soil. This interaction creates a web of various relationships between predators and prey.

As trophic levels progress, the amount of energy stored in organisms decreases; this energy was originally captured by the photosynthesizing processes of autotrophs. This is known as the *Pyramid of Energy*. The energy is returned to the environment as heat loss. For example, the amount of energy stored in the body of a chicken is far less than the energy stored in the insect it consumed. The energy in the insect is also far less than in the plants (autotrophs) upon which it feed. So, humans (tertiary consumers), who generally rest near the top of the food chain, store far less energy within their bodies than the trophic levels below them.



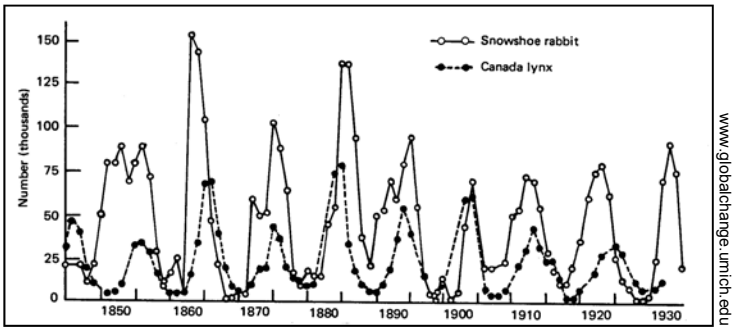
www.bbc.co.uk

The Pyramid of Energy

Predator/Prey Relationships

Organisms need food to survive and sometimes one species is food for another. Predators are organisms which hunt and eat other animals. The hunted animals are known as prey. An example of a predator/prey relationship can be seen in a forested ecosystem with populations of both deer and wolves.

Deer are primary consumers or herbivores and feed upon the grasses and bushes of the forest. The wolves are secondary consumers or carnivores and feed upon the deer. The deer are the prey and the wolves are the predators. The relationship between the two is cyclical. When the population of deer is low, perhaps due to sickness or a decreased food source, the wolf population will also decrease due to the shortage of deer, their prey. As the wolf population plummets, the deer population will rise substantially due to the lack of predation. As the population of deer rises, the wolf



www.globalchange.umich.edu

Predator-prey population cycle (for the lynx and the snowshoe hare)

population will rise again as their food source increases. Once the wolf population has increased, the deer population will again decrease as predation again becomes heavy. The cycle repeats itself again and again or eventually reaches an equilibrium.

If two types of prey exist for a predator, the predator will choose its prey depending on the abundance of each population. When prey A is rare, the predator will eat prey B, and vice versa. This keeps the two different prey populations in opposite cycles of rising and falling populations, while the predator population remains stable.

A *keystone predator* is a predator which helps to maintain a high species diversity in a specific ecosystem by keeping the populations of very strong competitors in check. This predator preys on certain species which would otherwise out compete all the other species for space and food.

Symbiosis is another type of predator/prey relationship in which two species live in close association for long periods. These associations are called symbiotic (*living together*). In symbiosis, at least one member of the pair benefits from the relationship. The other member may be injured or harmed by the relationship, which is known a *parasitism*; the other organism may remain relatively unaffected, which is known as *ommensalism*; or the other organism may also benefit, which is known as *mutualism*.

Animal Adaptations

Prey defenses often serve as strong motivators for natural selection. Prey which can be easily captured and consumed by predators are quickly eliminated from the population while prey that exhibit effective adaptations which are heritable allowing them to survive and reproduce, will eventually dominate the population.

Animal *adaptations* are features that increase the likelihood of the survival and the reproduction of an organism in a particular environment.

Animals will often migrate, or leave a certain ecosystem when it is no longer able to support their needs. Birds are seasonal migrators, traveling south to escape the cold weather each winter. It is much harder for a mammal to migrate a designated distance, since a mammal requires ten times more energy during migration than avian species do. Caribou are one of the main exceptions. Other mammals which must last out the cold winter have developed adaptations to help them survive. Many will *hibernate*, a state in which animals reduce their metabolic activity by lowering their heart rate, body temperature and respiration. This reduced metabolic activity decreases the use of the animal's energy supply long enough to make it through the winter. A hibernating animal must awaken periodically and re-warm, often every few days. During extremely cold winters mortality can occur during hibernation. Examples of hibernating animals include bats, bears and woodchucks.

To last the winter, birds and mammals have also developed structural features, such as feathers and fur which act like insulators, trapping heat against the body.

Insects have also adapted to survival during cold winters and some spend the season as larvae or some adults may simply die off leaving just their eggs behind to weather the winter and hatch during the spring. Other species of insects spend the winter in snug colonies, keeping each other warm. Some insects even produce glycerol in their blood which acts like anti-freeze.

Other structural animal adaptations include features such as teeth. Carnivorous animals have sharp teeth ideal for hunting prey and cutting through meat. Herbivores have rounded flat teeth ideal for chewing and munching on grasses and other plants. Omnivores have rounded flat molars and front teeth as well as sharp canines for both eating plants and animals. Many animals also have an array of scales and spines lining their body for protection.

Often an animal's color is an adaptation. *Camouflage*, which is an arrangement of certain

colors or color patterns, allows an animal to blend into its surroundings, providing protection from predators or even added stealth in hunting.

Mimicry is similar to camouflage and occurs when an animal takes on the coloration, behavior or even sounds of another animal. This mimicry confuses potential predators, often allowing the animal to appear poisonous or dangerous.

Many animals have adapted their body chemistry for defense. Often insects or amphibians are extremely poisonous to predators while skunks have developed a special spray which wards of dangerous intruders with its stink.

Behavioral adaptations are learned or instinctive actions which help an animal to survive. Animals will live in groups or colonies to find protection in numbers, and will often attempt to fool predators through behaviors like playing dead, running in a zigzag or freezing all movement.
and the ecosystem's carrying capacity decreases.

Animal and Plant Rhythms

One way that animals and plants distinguish themselves and compete with other species to establish a place in an ecosystem, also known as a *niche*, is by displaying varying daily and seasonal rhythms. For instance, different foods are available at different times of the day, and different species are adapted to higher or lower daytime temperatures. Also some species have better nighttime vision, or can survive the winter with smaller amounts of food.

Daily and seasonal rhythms are advanced examples of how an entire species has adapted to survive together and share resources with a community. Usually, food and shelter are primary *limiting factors* (factors whose absence exerts influence upon a population and may be responsible for no growth, limited growth (decline)). Many animals' rhythms are thus governed by their bodies' abilities to find food or shelter.
Hibernation is an example of an adaptation which is a seasonal rhythm. Hibernal species survive the winter without having to scavenge for limited food.

Black bears are a hibernal species living in New York State. They are omnivorous, typically consuming flowers, nuts, seeds, stalks and the roots of about 80 different species of plants. Their population ranges from 5000-6000 individuals counted in the state and they travel all over upstate counties. Black bears prepare for hibernation beginning in the summer when they eat lots of sugar-rich foods, such as berries, in order to put on weight which will help them stay warm during the winter.

Other animals that hibernate in New York are raccoons, skunks, woodchucks, box turtles, snakes and bats. The body temperature of some of these smaller animals can drop below 40 degrees Fahrenheit, and they usually wake every few days to warm themselves up, in order not to freeze.

Other seasonal rhythms can be understood by examining the typical annual cycle in the life of a local tree species. The sugar maple, like most trees, has five major yearly life cycle steps, which are mainly based around reproduction. In the winter, like the bear, most trees exhibit some form of hibernation. They lose their leaves in order to prepare for a decreased availability of nutrients in the soil. Thus, tree branches are bare during the winter time.

The next step in a tree's life cycle is budding, or preparation for flower and leaf growth, which occurs in the late winter and early spring. This period is referred to as the *prevernal* period, as *vernal* refers to spring. During the spring, flowers bloom on many trees and plants, allowing for seed dispersal and plant reproduction.

Many plants develop fruit during the summer. During the *aestival* time of year, or summertime, green (non-ripe) fruit is seen on many plants. The *serotinal* time of year, late summer to early fall, brings ripe fruit to many trees in the New York area. The apple tree is an example of a tree which

produces fruit at this time of the year. During the fall and into the winter, trees and plants prepare for decreased activity and the cold.

Since the ecosystems of New York are so diverse and dense, many animals can be active during different times of the day. Many smaller rodents and mammals are *nocturnal*, meaning that they are mainly active at night. These animals, such as the bobcat, wait to do their hunting and traveling at night. Nocturnal animals evolved in response to an increase in food availability at night, and to avoid the heat of the day. Nocturnal animals have adapted their senses which enable them to see, hear, and feel more sensitively at night. The salamander, which is close to endangered in New York, is also nocturnal.

The short-eared owl is a local *crepuscular* species of owl, which means that they are active during the dawn and at dusk. This is unusual for northeastern owl species, as most are nocturnal. Short-eared owls feed mainly on small mammals and other small birds. Other crepuscular animals include the rabbits, deer and some rattlesnakes.

Limiting Factors

Limiting factors, are factors, such as food, which dictate increases or decreases in a population's size. For example, a certain habitat may be able to house and water 30 members of a population but there may be only enough food to support 10 members, thus preventing the population from increasing beyond that number. Other limiting factors include water, shelter, predation, disease, natural disasters (fires or floods) and human interference (the impact of highways, interstates or suburban communities).

Limiting factors also relate to the concept of *carrying capacity*. Carrying capacity defines the number of organisms that can live in a given area, utilizing the local resources without damaging or destroying them. Carrying capacity usually results in the stabilization of a given population due to the limited amount of resources which can support it. Sometimes populations will increase exponentially, exceeding the carrying capacity of their local environment and thus exhausting local resources. If an increasing population consumes all the food in a local area (such as deer consuming local vegetation), then once the primary food source has been extinguished, food becomes a limiting factor and the population decrease due to starvation.

Toxins in the Environment

Toxins such as DDT or PCB's, which are present in the Hudson river estuary, first settle to the benthos and then bind to river sediment. These toxins are *lipophilic*, meaning they bind to fats in the bodies of organisms and are not released (metabolized or excreted) back into the environment. Small fish and other bottom feeders consume the sediment as they feed and then larger fish consume them, creating a buildup of toxins in their fatty tissue. *Bioaccumulation* is the higher concentration of a particular toxic chemical in the cells or tissue of an organism, than in the surrounding environment. Bioaccumulation leads to *biomagnification*.

Biomagnification is the process by which bioaccumulation becomes more harmful at increasing trophic levels. Concentrations of lipophilic substances increase in the bodies of organisms as they pass up through the trophic levels.

Three toxins, which have had devastating effects on the wildlife of the Hudson river estuary and its nearby wetlands are PCB's, Mercury and DDT.

New York City has long been the center of industrial manufacturing and trade. During the development of the environmental movement in the 1960's and 1970's, attention was brought to the pollution of the Hudson River caused by companies upstream, which discharged their waste into nearby waterways.

The dumping of this chemical waste into the City's waterways affected communities and wildlife all the way down to the Bight. The General Electric plant, located near Troy on the Hudson River, was dumping polychlorinated biphenyls (PCBs) throughout the 1940's, 50's, and 60's. PCBs were

considered a miracle chemical because they would not burn and were widely used in electrical equipment installed in wooden factories and school buildings where fire was a constant threat. It was later discovered that PCBs are carcinogenic toxins which biopersist within the environment. The dumping of these wastes was made illegal in 1972, but these chemicals have remained in the river ecosystem and have proven toxic to many organisms.

Mercury, another local contaminant, is released into the atmosphere through the burning of fossil fuels such as coal and is generally deposited into waterways or on the land near its original source. Studies done on fish in the Hudson, and many reservoirs upstate, have indicated a toxic level of mercury in these waterbodies.

Fish advisories from the NYC Department of Health in conjunction with the Department of Environmental Protection have been issued to prevent people from eating too many contaminated fish from these waterways. These organizations recommend that citizens should eat no more than one meal (one-half pound) per week of fish from the state's freshwaters, the Hudson River estuary, Upper Bay of New York Harbor north of the Verrazano Narrows Bridge, Arthur Kill, Kill Van Kull, Newark Bay, East River to Throgs Neck Bridge and Harlem River. In addition, pregnant women and children should not consume any fish from certain other waters throughout the state. Mercury and PCBs account for the majority of contaminants which prevent fish consumption from these waters. To see the full advisory report for 2005-2006, visit http://www.health.state.ny.us/nysdoh/fish/fish.pdf.

Before its ban in 1972, DDT (dichlorodiphenyl trichloroethane) was one of the most notorious culprits in the case of local bird death. DDT biomagnified through the food change, decimating populations of peregrine falcons and american bald eagles. These species consumed DDT contaminated fish and bioaccumulated the toxin within their own fatty tissue. DDT caused the bird's eggshells to become dangerously thin, resulting results in a high birth mortality rate.

These toxins were discovered as harmful only after their effect on animals was observed. In this way, many species act as *indicator species,* or species which indicate to humans that a chemical may be toxic. Studies have shown that mink, a species of mammal which consumes fish from the Hudson, are especially sensitive to PCBs. PCBs build up in their brain and fatty tissue, resulting in the death and deformity of many mink in the Hudson River estuary.

Amphibians, such as frogs, are also useful indicators of toxicity. In general, amphibian populations are on the decline in the area and throughout the state. Pesticides and insecticides are often cause deformities (such as a third leg) and population declines in amphibians.

Invasive species

Invasive species, also known as non-native, exotic or non-indigenous species are plant or animal species which do not naturally occur in an ecosystem but have been introduced either purposefully or accidentally. Ecosystems naturally develop balance over time, with plants and animals adapting their behaviors to local conditions and to one another for the sake of survival. Non-native species may upset this delicate balance. These species are not always harmful, but most can do serious damage. An introduced species may easily out compete other local species in the same niche due to its lack of specialized predators. This population explosion can destroy the natural ecosystem. Such situations can be especially tragic in isolated ecosystems, such as islands, where an introduced species can out compete and destroy a local species that is unique only to that ecosystem. Non-native species can thus reduce biodiversity. They can also decrease the food supply for native organisms, bring disease to many plants or even people and often disrupt the functioning of local economies by destroying local production.

Invasive Species in New York

A majority of the invasive species in New York are aquatic and most are described in the Aquatics

Section.

The mute swan (*Cygnus olor)* is native to Europe and Asia; it was transported to North American in the late 19th century. Mute swans are very large birds measuring 56-62 inches in length with "S" shaped necks, white plumage and orange bills with black knobs. They mainly live in estuarine habitats such as marsh lands. The population of mute swans has increased dramatically in recent years. They over-graze marsh grasses limiting the habitat of crabs, fish and other wetland dependent species.

The Common carp or Eurasian carp (*Cyprinus carpio)* is also an invasive species native to Asia. The carp spread throughout Europe and was first introduced to the United States in 1831. The carp is an adaptable fish that can tolerate different environments and pollution. In Europe the carp is considered a good food source and a prized sport fish. In some parts of the United States it is gaining popularity as a game fish but is still generally considered an undesirable species. Other species of carp, such as bighead and silver carp were brought to the United states in the 1970's. Today, they are prevalent in U.S. waters and often limit food sources for other native fish species.

Threatened and Endangered species

In 1973, the *Endangered Species Act* was established to protect the nation's decreasing biodiversity. The act defines an endangered species as, "any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta." The act defines a threatened species as, "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

Endangered and threatened species are affected by many factors. Most species are experiencing habitat loss due to the increasing range of the human population. The expanding human population destroys local habitat as urban sprawl continues to spread from the cities, clearing land for agriculture, homes and malls. This spread places enormous stress on natural resources such as groundwater and creates an enormous new demand for energy.

Illegal hunting or *poaching* often threatens species which are already listed with the ESA. Also pesticides, industrial waste and all forms of air, land and water pollution place both vulnerable and healthy species in danger. Finally, the introduction of non-native species or diseases can put severe pressure on already small populations of ESA species.

Recovery is the process, sponsored by the U.S. Fish and Wildlife Service, which works to reverse the decline of endangered or threatened species by restoring their original healthy populations as well as their ecosystems. Recovery plans outline the dangers which face species, and create an action plan to recover the species through federal, state and local cooperative action.

Local examples of recovered species include the peregrine falcon and the shortnosed sturgeon (which is currently still listed, though its population is on the rise).

Mute Swan

Eurasian Carp

Sources and Additional Resources

Landry, Sarah B., *Peterson First Guides, Urban Wildlife,* Houghton Mifflin Company.

This book will be used as a field guide so memorizing the information is not necessary.

Garber, Steven D., *The Urban Naturalist*, Dover Publications, Mineola, New York,1987.

A good working knowledge of the book will be helpful.

Yahner, Richard H., *Eastern Deciduous Forest: Ecology and Wildlife Conservation,* University of Minnesota Press, Minneapolis, 1995.

Focus on pages 85 - 177.

Mittelbach, Margaret; Crewdson, Michael. *Wild New York: A Guide to the Wildlife, Wild Places and Natural Phenomena of New York City*, Three Rivers Press, New York, 1997.

This book is helpful in introducing local species.

The U.S. Fish and Wildlife Service, *Endangered Species Program,* (http://endangered.fws.gov/) .

University of Michigan, *Global Change Program, (*http://www.globalchange.umich.edu/)

1. Select *Global Change 1* (http://www.globalchange.umich.edu/globalchange1/)
2. Select *Lectures*
3. Scroll Down
4. Choose lectures:
    - Ecological Communities: Networks of Interacting Species
    - Competition and Resource Scarcity
    - Trophic Links: Predation and Parasitism

The Ecological Society of America, (www.esa.org),

1. Select *ESA Publications* on the left side of the page.
2. Select *Fact Sheets*, located within the paragraph.
3. Choose from:
    - Ecosystem Services
    - Biodiversity
    - Invasion

www.enature.com: an on-line field guide that uses your zip code to create an area-specific field guide for birds, butterflies, mammals, reptiles & amphibians, trees and wildflowers.

Endangered Species List:
http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/etsclist.html

Game Wildlife Page:
http://www.dec.state.ny.us/website/dfwmr/wildlife/wildgame/index.html

The Nature Conservancy "Last Great Places"; Berkshire-Taconic Landscape
http://www.lastgreatplaces.org/berkshire/diversity/art6619.html

Northwestern University biochemistry website
http://www.biochem.northwestern.edu/

The NY Department of Environmental Conservation, Herring of New York page:
http://www.dec.state.ny.us/website/dfwmr/fish/fishspecs/herrtext.html#americanshad

Patuxent Wildlife Research Center of the US Geologic Survey
http://www.pwrc.usgs.gov/bioeco/mink.htm

Rome Field Station studies:
http://www.dec.state.ny.us/website/dfwmr/habitat/hoa1b2e.htm#BIOASSAYS\

The San Francisco Bay-Delta Consortium
www.baydeltaconsortium.org