Georgia Envirothon Wildlife Study Guide

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Wildlife Curriculum Guidelines

1. Know the meaning of "habitat", and be able to name the habitat requirements for wildlife and the factors that affect habitat suitability. Understand how this knowledge helps us to better protect both the land and the wildlife species that depend on it. Understand common wildlife management practices and methods that are being used to manage and improve wildlife habitat and the wildlife management impact of limiting factors on common wildlife species.
2. Know and understand basic ecological concepts and terminology such as ecosystem, community and population. Be able to explain how communities interact with their non-living surroundings to form ecosystems.
3. Understand wildlife population dynamics such as birth, mortality, age-structure, sex ratio, and mating systems.
4. Recognize that all living things must be well-adapted to their native environment in order to survive. Be able to identify, describe and explain the advantages of specific anatomical, physiological and/or behavioral adaptations of wildlife to their environment.
5. Know the meaning and importance of the 3 levels of biodiversity: genetics, species and ecosystem, and understand the implications of biodiversity loss at each level.
6. Understand the difference between biological and cultural carrying capacity, and be able to identify social and ecological considerations where human use of land conflicts with wildlife habitat needs.
7. Understand the role of federal and state Fish and Wildlife Agencies in the management, conservation, protection, and enhancement of fish and wildlife and their habitats.
8. Understand Georgia's mandatory hunter education program
9. Understand how non-native(exotic), invasive species threaten our environment by impacting wildlife habitat and the biodiversity of many native wildlife species.
10. Learn about the complexities of decision-making in making land use decisions that affect wildlife, and understand that wildlife resources are under constant pressure caused by human population growth, environmental degradation, and habitat reduction.
11. Know that Wildlife species are subject to diseases resulting from exposure to microbes, parasites, toxins, and other biological and physical agents.
12. Understand the role of the Endangered Species Act in helping to conserve endangered and threatened species. Know the organizations and agencies responsible for listing and protecting endangered species on global, federal, and state levels. Understand the characteristics, terminology and factors that affect threatened and endangered wildlife species. Identify the characteristics that many extinct and endangered species possess
13. Have a basic understanding of state and federal laws pertaining to wildlife.

Skills to Know- Wildlife

1. Identify tracks, pelts, and skulls for all mammals listed on the specimen study list without the use of a key
2. Identify all wildlife by live specimens, mounts and photos as well as know habitat, and food for all wildlife listed on the specimen study list without the use of a key
3. Identify plants/trees on the specimen study list and know their wildlife value (without a key)
4. Identify birds from the specimen study list by their calls
5. Be able to age/sex whitetail deer, northern bobwhite, wild turkey, wood duck, and mourning dove
6. Calculate energy/biomass relationships given the number of trophic levels and using the 10% rule
7. Construct up to a 4 level food web with supplied organisms
8. Identify common wildlife registry types from photos, illustrations, or samples
9. How to cast a spinning rod or casting rod

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For the Envirothon wildlife competition, you should learn preferred habitat, food, and how to identify the following wildlife from mounts, photos, and live animals as well as skins, skulls, and tracks for mammals. For plants, learn their wildlife value and how to identify them. There is a wealth of information about the plants on the Internet. Learn the calls for the listed birds. There are many CDs available, internet sites (http://www.enature.com and www.birds.cornell.edu for example). A particularly good app for phones is iBird or iBird pro. For game animals marked with an asterisk (*), age and sex criteria should be studied.

SPECIMEN STUDY LIST

Fish
Channel catfish
Brown bullhead
White Crappie
Black Crappie
Bluegill
Redbreast Sunfish
Redear Sunfish
Largemouth bass
White Bass
Striped Bass
Hybrid Bass
Rainbow Trout
Brown Trout
Brook Trout
Walleye

Big Game Animals
White-tailed Deer *
Black Bear
Wild Turkey *

Small Game Animals
Alligator
Gray squirrel
Cottontail Rabbit
Bobcat
Red fox
Gray fox
Raccoon
Opossum
Fox squirrel

Other Mammals
Beaver
Coyote
Groundhog
River Otter
Mink
Spotted skunk
Armadillo

Nongame Birds
Northern mockingbird
Brown thrasher
Eastern bluebird
Song Sparrow
Blue Jay
Carolina wren
Tufted Titmouse
Carolina Chickadee
Northern Cardinal
Red-tailed Hawk
Red Shouldered Hawk
Screech owl
Barred Owl
Great Horned Owl
Pileated woodpecker
Peregrine Falcon
Great Blue Heron

Game Birds
Northern Bobwhite *
Canada Goose
Wood Duck *
Mallard
Pintail
Mourning Dove *
Woodcock

Exotics
Feral Hog
European Starling
Common carp
House Sparrow
Kudzu
Chinese Privet
Japanese Honeysuckle
Nutria
Flathead catfish
Autumn Olive

Plants
Ragweed
Beggarweed
Partridge Pea
Greenbrier
Pokeweed
American Beautyberry
Muscadine
Strawberry Bush
Blackberry
Clover
Lespedeza spp.

Trees
Flowering Dogwood
Crabapple
Persimmon
White Oak
Southern Red Oak
Northern Red Oak

Reptiles
American Alligator
Black Rat Snake
Red Rat Snake (Corn snake)
Eastern Box turtle
Common Snapping Turtle
Eastern Fence lizard
Green Anole
Eastern King Snake
Eastern Garter Snake
Copperhead
Timber rattlesnake

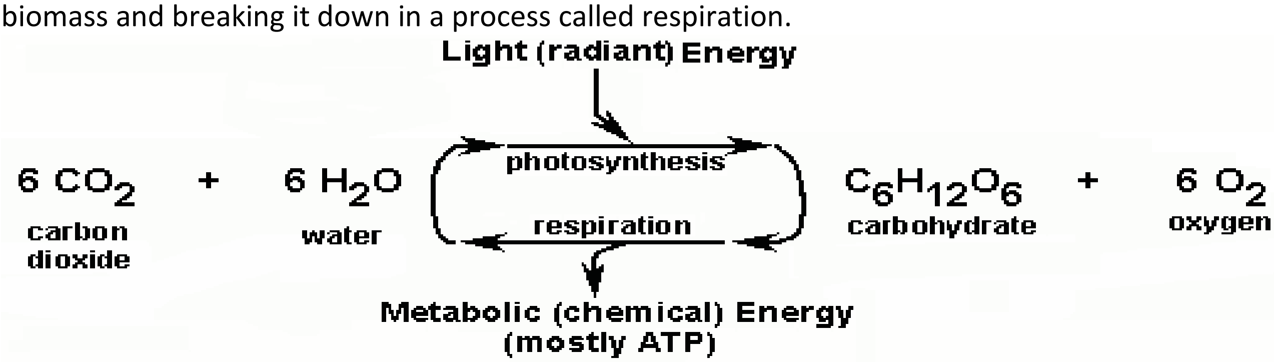
Amphibians
Bullfrog
Green tree frog
American Toad
Spotted Salamander
Marbled Salamander

To study and understand wildlife, one has to look at the environment that supports wildlife. All living things on earth are linked to the non-living and living parts of the environment that provide for their needs. All things are connected. Ecology is the study of where we live. In fact, the word ecology means the study of one's house. The biotic portion of the environment is the living portion and includes all of the organisms present. The abiotic portion includes the non-living parts of the environment which often equate, for our purposes, to limiting factors. Abiotic parts of the environment include sunlight, temperature, water, and soil. Thus ecology is the study of the relationships among organisms and between the organisms and their non-living environment. Organisms must have food, water, shelter and space in a suitable arrangement to survive. These are the components of habitat.

To be considered living, an organism must have at least one cell. Much of the phytoplankton (small floating plants and algae) of our freshwater streams, ponds and lakes, and of our oceans are single-celled algae. They make up the lion's share of the base of the food chain in many aquatic environments. Bacteria (one-celled organisms), are very important as decomposers. They break down dead organisms and waste and return nutrients to the soil for use again by other organisms.

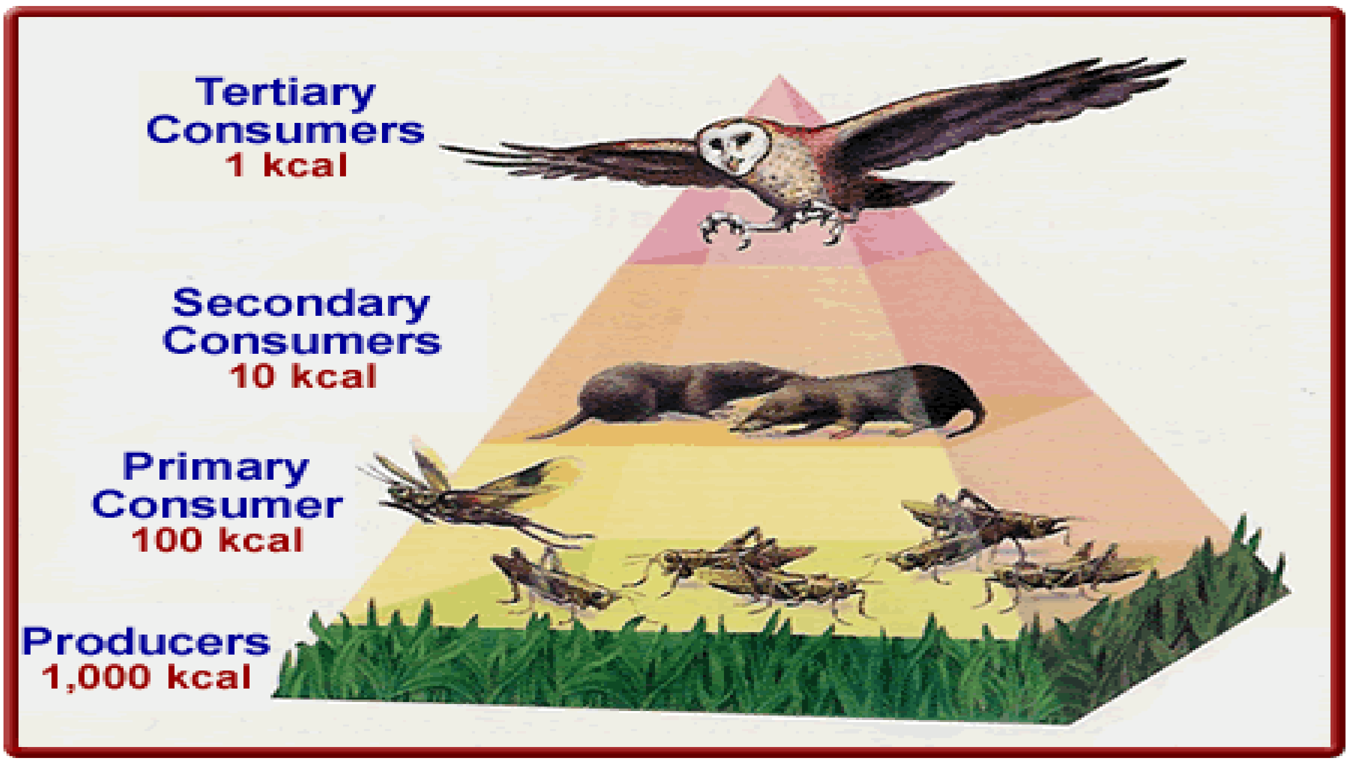
Abiotic (limiting) factors determine what can and cannot live in an environment and the number of each species that an environment can support (carrying capacity). The six commonly recognized "most important" elements for sustaining life are: C (carbon), H (hydrogen), O (oxygen), N (nitrogen), P (phosphorus), and S (sulfur). Any one of these which fails to meet a minimum level needed to maintain existence can set the carrying capacity (serve as the main limiting factor). Georgia Envirothon participants should be able to define each of the following levels and describe how it relates to the level immediately above it. An ecosystem not only includes the interactions between the living organisms, but also the interactions between the organisms and the non-living (abiotic) environment. All of the ecosystems on earth make up the ecosphere, also called the biosphere. The ecosphere is all areas of the earth where life can exist, from the atmosphere, to the depths of the oceans, and into the soil or ground.

Energy In Ecosystems Energy is the ability to do work. Every organism requires energy as it engages in biological work, which includes the processes of life –growing, moving, maintaining the body, repairing damaged tissues, getting food, and reproducing. It is the energy from sunlight that directly or indirectly provides the energy for all life. The sun's energy also powers most of the hydrologic cycle, weather, and atmospheric circulation. Plants and some other organisms can make their own food and get energy from that food (photosynthesis), but the animals that eat the plants do not get all of the energy the plants got from their food. Some of the energy is lost to heat and other forms of energy when the plant does work – (eg. grows, reproduces, or heals. Some organisms get their energy from consuming plant or animal biomass and breaking it down in a process called respiration.



When the plants, animals and other organisms break down sugar for energy by respiration, they use oxygen and give off carbon dioxide. In this way the two gases, carbon dioxide and oxygen, are constantly circulated in what is call the oxygen –carbon dioxide cycle. Plants get the oxygen they need from the soil through their roots. This oxygen is taken into the soil from the atmosphere as organisms tunnel into the soil making air spaces and from the natural soil pore spaces. Decomposers break down dead organic matter and release stored carbon dioxide from the remains of plants and animals.

The Flow of Energy Through Ecosystems The movement of energy in a one-way direction through an ecosystem is called energy flow. All energy in an ecosystem begins with the energy from sunlight. Some of the energy is stored by plants in sugars made by photosynthesis. The energy is passed on to herbivores and ultimately to carnivores through a process called a food chain, which is a simple model of what eats what and the flow of energy from one organism to the next. Organisms that consume plant eating organisms do not get all of the energy originally received from the producer level. As a general rule of movement up the food chain, ***each trophic level gets only about 10% of the energy that was received by the trophic level below it.*** This relationship of the flow of energy through the food chain is known as the energy pyramid, and it helps explain why an ecosystem can only support a certain number of animals at each level of the food chain. Each level of the energy pyramid represents a trophic level (feeding level). The energy pyramid clearly shows that fewer and fewer organisms can be supported as you move up the food chain to the top predators.

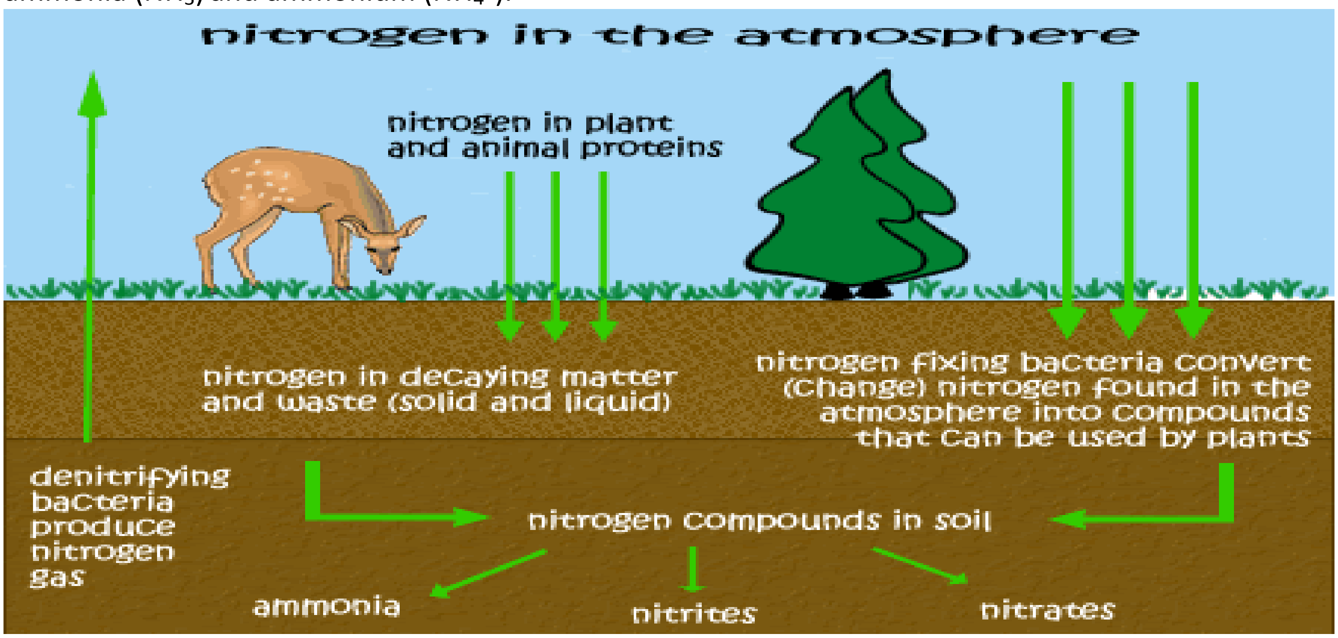


The 90% loss of energy can be explained by a combination of factors which include: use for metabolism and movement, reproduction, wastes, heat loss to the environment, and the fact that a significant amount of any trophic level is simply not consumed by the level above it.

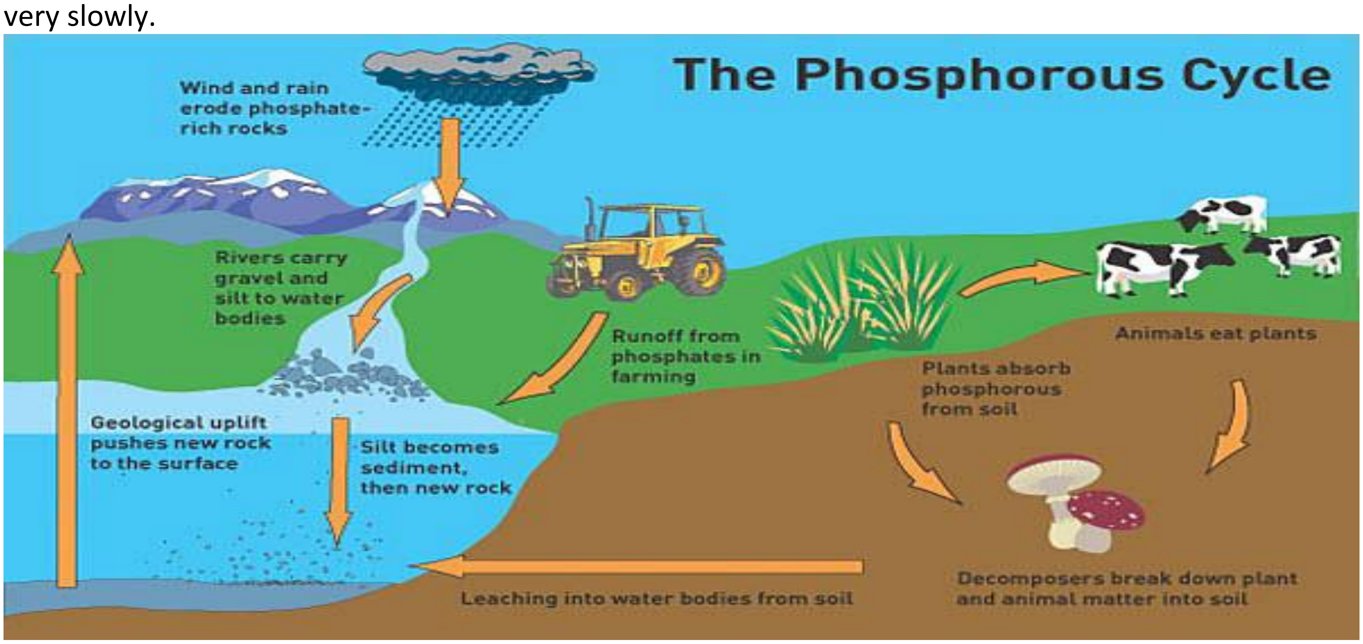
The Earth - A Closed System Earth receives a continuous supply of energy from the sun and releases heat energy back to space. So, in terms of energy, earth is an open system. Energy comes in, and energy goes out. This is not true of everything else on earth. Earth is a closed system for matter. All of the essential mineral nutrients, water, and gases needed for life that are here on earth today were present at the beginning. Earth gets only minute amounts of new matter from space. All matter on earth must be recycled. These gases, minerals, and water have been recycled numerous times and must continue to cycle for life to survive.

Biogeochemical Cycles
Please see the **Hydrologic (water) cycle** as depicted in the Aquatic Ecology section of the Georgia Envirothon Resource Materials. Water is the essential fluid of life. The bodies of all organisms are made up largely of water. Organisms need a continuous supply of fresh water to survive.

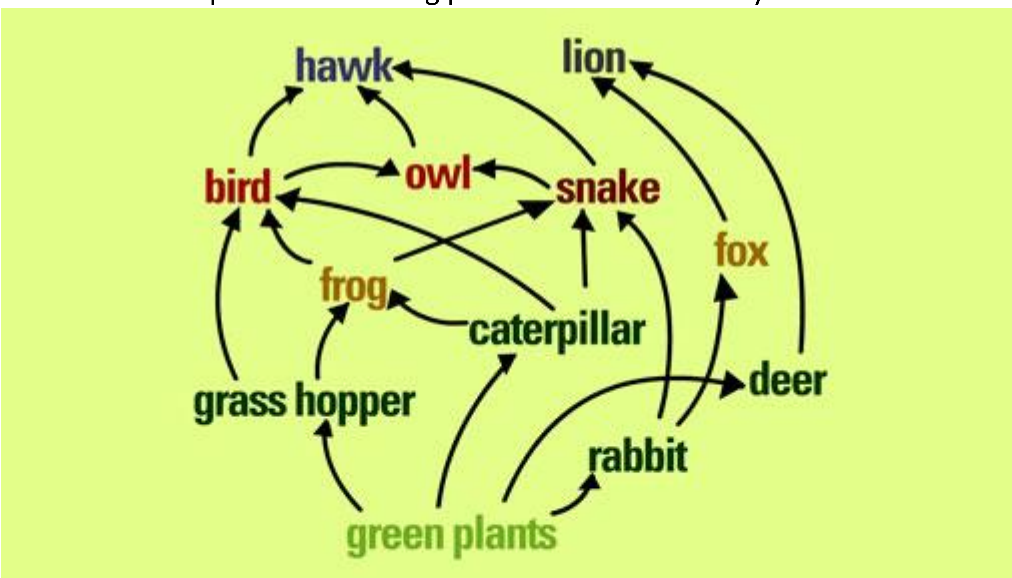
The Nitrogen Cycle Nitrogen is essential for good plant growth. Nitrogen makes up 78% of our atmosphere, but plants, animals and most organisms cannot use nitrogen from the atmosphere. Plants get the nitrogen they need from the soil. Nitrogen enters the soil naturally in several ways. Its atmospheric form, N_2, simply is unusable (won't work) for most organisms. There are organisms found on the roots of certain types of plants called legumes (peas, red clover, and soybeans are examples). Blue-green bacteria are important nitrogen fixing bacteria in aquatic environments. Lightning can also break N_2 into more usable forms which are then deposited on the land.The primary usable forms of nitrogen are ammonia (NH_3) and ammonium (NH_4^+).



The Phosphorus Cycle Phosphorus usually does not enter the atmosphere as it cycles and normally cycles very slowly.



Food Chains and Food Webs –In any ecosystem, the energy flows through a series of organisms –from a producer to a herbivore and then to a carnivore or several carnivores and finally to a decomposer. This energy flow from one organism to the next is called a food chain. A food chain shows who eats whom from one organism to the next. These simple food chains, of one animal always eating one type of plant or animal rarely exist in ecosystems. What really happens is that animals eat a variety of plants or animals that are available in the ecosystem. A diagram that shows this more realistic view of what is eaten is called a food web. A food web shows the complex interactions among food chains of an ecosystem and is a more realistic picture of feeding patterns within an ecosystem.



Relationships and Adaptations The predator-prey relationship has led to all types of adaptations – predators finding better ways to catch prey and prey species finding ways not to be eaten or to escape predators. The eyes of many birds have adapted to help them be successful predators. The osprey can see fish from high above. It then folds its wings and makes a high-speed dive to ambush its prey. Fish are shaded with darker colors on their top side to make them harder to see from above and light colors underneath so as not to be seen from below. This is known as counter shading. Many plants have developed toxins or poisons to keep from being eaten(milkweed). In turn, animal species have developed immunity to the poisons and some use the poisons for their own protection (the monarch butterfly). Another species of butterfly, the viceroy takes advantage of the monarch's defenses by using mimicry. The viceroy looks very much like the monarch butterfly, which predators have learned tastes bad and thus avoid. By mimicry, the viceroy, takes advantage of this to keep predators away from itself. Predators often use a similar strategy to increase their chances of catching prey. The goldenrod spider uses camouflage. This spider is the same color as the yellow and white flowers in which it hides to ambush its prey.

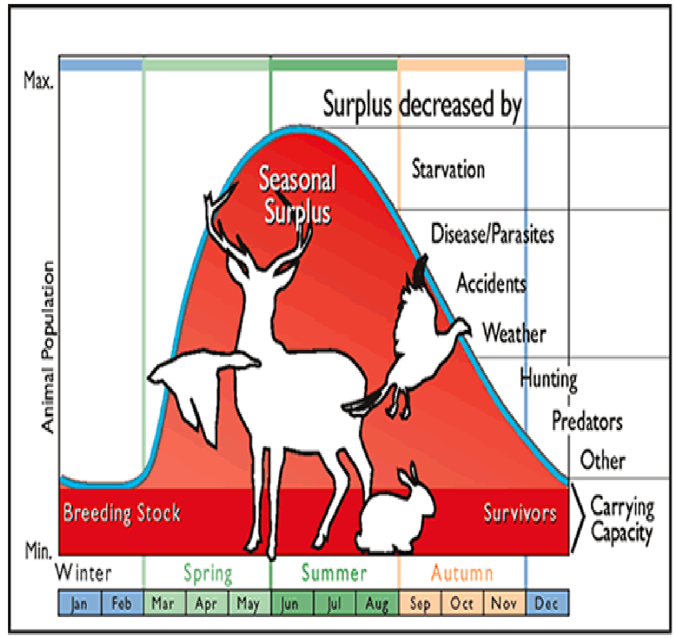
Symbiosis –Living Together Symbiosis exists when an organism lives in, on, or in close association with another organism. There are three basic types of symbiosis: mutualism, commensalism, and parasitism. *Mutualism* is a relationship in which both organisms benefit from the relationship. It can be thought of as sharing benefits, or a win-win relationship. Lichens are a symbiotic relationship between an algae and a fungus. The fungus provides the moisture and nutrients needed by the algae, and the algae makes the food for both. *Commensalism* is a relationship in which one organism benefits and the other organism is neither helped nor harmed. Mosses, ferns, and other plants called epiphytes grow attached to trees, where they get the light they need. They get moisture and nutrients washed down the tree. They do not take anything from the tree, so the tree is not harmed in any way, but the tree is not helped either. *Parasitism* is a relationship in which one organism benefits while the other is harmed. The parasite gets its food from the organism in or on which it lives. The host, the organism the parasite lives in or on, is rarely killed, but it is harmed, often being weakened by the parasite. Fleas, ticks, and lice are examples of parasites.

Competition Competition for the available resources, such as food, living space, and sunlight, occurs between most organisms. Trees compete for sunlight and mineral nutrients they need to grow. Red foxes and coyotes compete for the same small mammals, such as mice and rabbits that are their main food supply. Alien, or exotic, species often out-compete native species for available resources. Animals have adapted, and in many cases, become specialized to use a certain location or time of day for their hunting or food gathering to avoid excessive competition. When animals use different layers of a habitat it is called stratification of niches, or resource partitioning. An example would be warblers, which eat insects in trees. Each species reduces competition by spending at least half of its time feeding in only a certain layer of the tree. Another example of resource partitioning would be temporal partitioning such as owls(night) and hawks(day) do to use the small rodent food supply.

Territoriality is another type of competition that occurs between members of the same species. Cougars, foxes, wolves, deer, and many other species mark their territory with urine or scent from special glands, warning others to keep out. Birds, such as robins and blue jays, chase other birds of their species away from their territory. Territories are established for mating, feeding, raising young, or combinations of these activities. Territoriality helps to divide up needed resources by spacing out the members of the species, limiting competition for those resources. The size of the territory varies with the function, the species, and the resources available. Territories are different from home ranges. A home range is the area roamed through and is often not defended.

Habitat A habitat is the local environment in which the organism lives and must provide: Food Water Shelter/Cover, and Space. In addition, these four elements must be arranged appropriately to meet the needs of the organism. When all of these habitat factors are in good supply and good arrangement, they help the wildlife survive and do well. When one or more of the factors is in short supply or the arrangement is disturbed, it limits the number of wildlife that can survive and where they can survive. ***Food*** –This is the amount and types of food the organism eats. Each species needs certain kinds of food. Special terms are used for much of the wildlife food supply, such as mast, forb, browse, and forage. Mast, fruits or nuts used as a food source by wildlife, is divided into *hard mast* (nuts and acorns) and *soft mast* (fruits and berries). ***Water*** –All organisms need water. This may be surface water; as from streams, rivers, lakes, or dew; groundwater; or moisture from plants and their food. ***Shelter/Cover*** –Wildlife needs shelter for protection. Many species need different types of cover: *Escape Cover* –is cover, such as vines, trees, crevices, or burrows that hides, protects, or allows the wildlife to escape from predators. *Nesting Cover* –is cover that protects nesting sites such as grasses, downed logs, low shrubs, or thickets used by quail, grouse, rabbits, and many types of songbirds. *Brood Cover* –is cover, such as grasses, forbs, or low shrubs that provides protection for ground nesters to raise their young. *Roosting Cover* –is cover to provide safety while resting. Examples are coniferous trees for wild turkey, vine thickets for quail, and holes in dead standing trees (snags) for woodpeckers and many songbirds. *Winter Cover* –is cover, such as dense thickets for deer and quail, and den trees for bear, raccoons, and flying squirrels needed for surviving the winter. ***Space*** –This is the area needed for survival, and only a certain number of organisms can live in a certain area. ***Arrangement*** –This is how the food, cover, water, and space are located in an area; and this determines how many organisms can live there. The best arrangement is when the habitat factors are fairly close together with a lot of edge areas between them. The breaking up of habitat into smaller areas is called habitat fragmentation.

Carrying Capacity Carrying capacity is the maximum number and types of wildlife a habitat can support without the habitat being lowered in quality or destroyed. The factors that keep wildlife populations from increasing to the full number they could are shown in the following diagram. Whenever carrying capacity changes, for whatever reason, animals will either have to move on to another habitat or their numbers will decrease to a level the habitat can support.

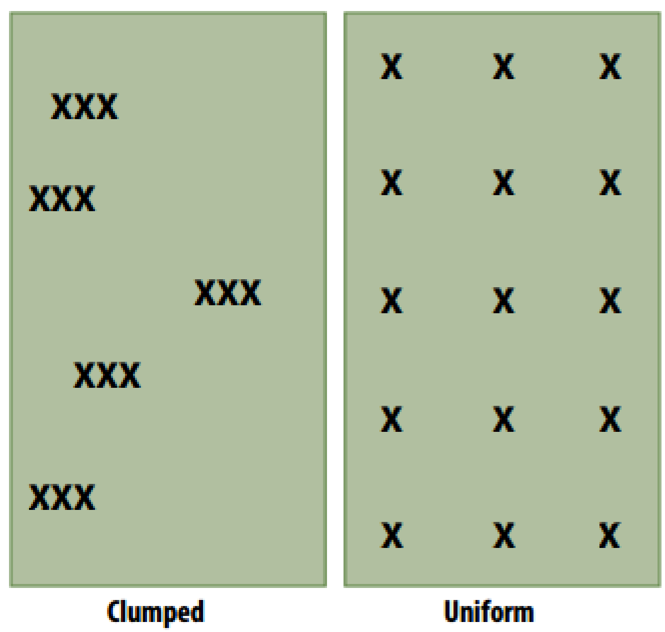


Generalists and Specialists Some animals can live in almost any habitat eat a variety of different foods and in close association with people and live very successfully. These animals are called generalists. Raccoons are good examples of generalists. Squirrels, mice and rats, opossums, skunks, and coyotes are other examples of generalists. These animals are not typically the ones that become threatened or endangered. Some animals, called specialists, require a highly specialized or specific habitat. Typically, the tropical rainforest comes to mind when specialists are being discussed. However, we have a well-known specialist in Georgia. The red-cockaded woodpecker, a resident of our longleaf pine forests, needs not just longleaf pine forests, but mature longleaf pines. This cavity nester prefers older trees with red-heart disease, which makes the inner wood softer and easier for the bird to dig out holes for nesting and shelter. The mature longleaf pine forests are also fairly open, with grassy or clear areas between the trees, which allow the woodpecker to hunt for the insects it needs. The Neuse River waterdog, a salamander, exists only in certain sections of the Neuse River in North Carolina. The hellbender, another salamander, lives in a few of our cold mountain and upper piedmont rivers. The red-cockaded woodpecker, hellbender, and Neuse River waterdog are endangered species. Specialists are most often the species that become threatened or endangered; because when their habitats are destroyed or fragmented, they cannot just move to another area due to their special habitat requirements.

Population Dynamics

Most people realize that some wildlife species can produce more offspring than others. Bobwhite quail are genetically programmed to lay an average of 14 eggs per clutch. Each species has a maximum genetic reproductive potential or *biotic potential*. Biotic potential describes a population's ability to grow over time through reproduction. Most bat species are likely to produce one offspring per year. In contrast, a female cottontail rabbit will have a litter size of approximately 5. If conditions are good, she may produce a second or even third litter before the summer is over. Cottontail rabbits have a much higher biotic potential or intrinsic rate of population increase than bats because they can add more members to their population over the same period of time. It is important to remember that with any habitat improvement project, animal numbers will respond only if the most restricting (limiting) habitat factor (food, water, cover) has been changed. Stated another way, a limiting factor is a basic requirement that is in short supply and that prevents or limits a particular wildlife population in an area from growing. Limiting factors are often difficult to determine beforehand, even for the most experienced wildlife professional. Part of the art of wildlife management is determining which factor(s) are preventing, for example, white-tailed deer from producing twins or preventing cottontail rabbits from producing 2 or 3 litters of 5. It becomes apparent that managing wildlife populations is linked to habitat management. While all wildlife populations sustain varying capabilities for growth in numbers, they all experience environmental constraints or decimating factors. These constraints may take the form of predators, disease, hunting, trapping, weather, or a combination of these factors. It is important to understand the differences between limiting factors and environmental constraints. A lack of food, cover, or water limits a population. Limiting factors may be a lack of appropriate nesting, brood, loafing, and winter cover for quail or cottontail rabbits to escape the harsh effects of weather or predation. Landowners who choose to reduce the size of individual grain fields in an attempt to reduce soil erosion could also increase the number of bobwhite quail or cottontail rabbits through an increase in the total length and width of hedgerows or field borders (improving cover). This, of course, assumes insufficient cover is the limiting factor for quail and rabbits. In many respects, providing critical limiting factors alleviates or reduces the potentially harmful effects of decimating factors on wildlife. *Decimating factors* can depress or reduce populations, but in most cases these factors do not control animal abundance. Decimating factors serve to offset a population's biotic potential and keep the numbers in balance with what the land is capable of supporting. A population may be depressed (by hunting, predators, or disease) to a level at which there are no factors limiting population growth. As the population size dwindles, environmental constraints exert less pressure on the population, and the population increases. This increase proceeds according to the species' biotic potential until such point that food, cover, or water become limiting.

Dispersion, Dispersal, and Density Wildlife do not recognize legal boundaries like humans do. Instead, wildlife move throughout areas according to the existence of natural or man-made boundaries (waterways, roads, or fences) and changes in the availability of suitable habitat. Animals tend to choose the best locations where they can find food, cover, and water. In so doing, animals concentrate in numbers in some habitats at the expense of other habitats. Dispersion refers to the location or pattern of animals in space, whether horizontally or vertically (figure at right)). The latter (vertical dispersion) is often ignored but is extremely important when examining the suitability of a habitat for songbirds. Wildlife populations distribute themselves over the landscape in 2 patterns of dispersion: clumped and uniform. All other distributions fall somewhere in between. Wildlife that form clumped distributions are often very social and live in family units. This is the most common type of dispersion because the animals are responding to the restricted availability of habitat. Common examples of clumped dispersion include a covey of bobwhite quail; a roosting colony of starlings, grackles, or blackbirds; or a coyote family unit (mated pair, pups from current year, and possibly yearlings). Other wildlife species, such as groundhogs, tend to be very asocial during much of the year and spread out more evenly or uniformly across the habitat (they are said to exhibit uniform dispersion). Very



often these species are highly territorial. A territory is formed when an individual, mated pair, or social group of animals uses an area exclusively and *actively defends* this area against other members of the same species. Movement of animals from one location to a new, permanent site is called dispersal. The movement and positioning of animals throughout a landscape strongly influences population density. Density refers to the number of animals present on a defined area at a point in time. Density is perhaps the most frequently obtained measurement of wildlife populations. There is a problem with using density, because it never remains constant. It changes throughout the year due to births, deaths, and the movements of animals in and out of the population. As a result, we are never certain that any time-specific measure of density is an accurate reflection of a population's performance. Density is usually estimated from a count of animals on a portion of the total area. This is then expanded to the entire site. If conditions and manpower permit, all of the animals are observed and counted across the area, presumably without error. This is referred to as a **census** and is a more refined version of determining population size. Often, it is just more efficient and cost effective to record animal signs (droppings, tracks, vocalizations) and use this as an indication of the abundance of a species. The latter approach is called an **index** of population size. An index is easier to obtain but does not yield a numerical value for the population. It only provides a relative idea of how common the animals are on a given property. It is important to do an index before and after modifying a site if you want to accurately measure the effectiveness of a habitat management prescription. Care should be used to ensure that the index is obtained when: 1) the population is most stable (not changing due to births or frequent dispersal movements); and 2) similar conditions exist (same time of year, time of day, and weather conditions).

Wildlife Population Parameters One of the easiest and most convenient methods of estimating or predicting population growth, decline, or stability is to measure the proportion of young to old in a population. This measure is called the population's age ratio. This information can then be depicted graphically in an age pyramid (Figure 2). Age ratios are commonly used to compare changes in a single population between years or within the same year for different populations. Wildlife agencies have used this method to estimate increases in white-tailed deer in the past. Although there can be exceptions, wildlife populations are likely to decline if they are top heavy or support a much larger number of adults than yearlings. This decline, over time, can be attributed to the small number of new individuals moving into the reproductive segment of the population. In contrast, a population that is essentially young will have a greater proportion of yearlings. The population will likely increase as maturation of the yearling class expands the reproductive segment of the population. Assessments of population age structure are most often applied to long-lived species (white-tailed deer) and generally require extensive efforts to obtain the complete age distribution for the population of animals. With relatively short-lived species (e.g. muskrats, quail, cottontail rabbits, woodcock, mourning dove), the information is more readily obtained but will be useful only into the next year because of the high death rates and rapid turnover of the populations. Age pyramids for small game show that a large percentage of the population never makes it to age 3. This tells the landowner and manager that you can't stockpile game (by not hunting in hopes of having a larger

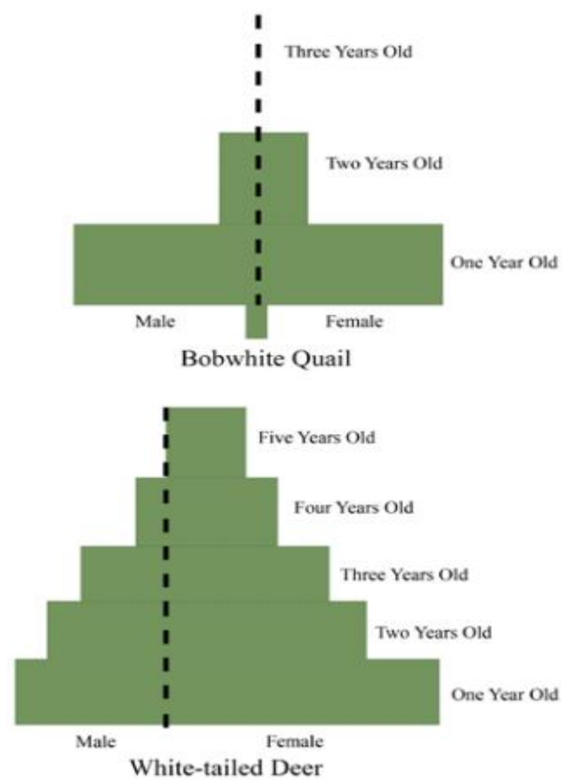


Figure 2. Age pyramids for bobwhite quail and white-tailed deer.

breeding population in the spring) unless there is sufficient habitat to support the animals. It also provides another important lesson: it is difficult to increase small game bird populations by stocking pen-raised birds (most of these birds will usually die over the first winter) unless the habitat is present to support a larger population. If the habitat is present, the birds may be present. *Sex ratios* are another feature of populations that wildlife managers examine carefully, because a disruption in the proportion of males to females can dramatically affect the reproductive success of a population. Sex ratios are most often expressed as the percentage of males in the population or the number of males per female. Sex ratio information is commonly used by wildlife agencies when managing big game herds. Agencies manipulate the ratios of bucks to does removed from the population each year in an attempt to yield the maximum number of animals that can be harvested. They must also maintain a sufficient number of bucks in the population to ensure a complete reproductive effort by does the following year. For a *polygynous* species, like white-tailed deer (one male can breed with several females), sex ratios are skewed or shifted to favor females in a harvested population. For a *monogamous* species, like Canada geese or coyotes (one male breeds with one female), a balanced sex ratio (50:50) is required for maximum production of offspring. For example, if the sex ratio is shifted to 40 males per 60 females in Canada geese, the population will exhibit only 66 percent production. In the case of a monogamous species, a sex-specific hunting season could devastate a population. However, even unharvested wildlife populations do not normally maintain an even sex ratio. Although data do not always support the following generalizations, many studies have shown that most mammals give birth to slightly more males than females; whereas, for birds the pattern is reversed, with more females born than males. Later in life, these trends tend to move toward a more even or 1:1 ratio.

Mortality Factors Common to all living creatures are the events of birth and death. Few animals in the wild die from old age. Instead they succumb to one of many factors that affect the members of their particular species. Mortality refers to the inherent loss of individuals from a population through death. Mortality is difficult to measure because carcasses are hard to locate. The fate of animals that disperse or move out of a population can seldom be determined. Consequently, it is more practical to measure survivorship, or the numbers of animals remaining alive, as these individuals can be located and accounted for. Wildlife species with a high reproductive potential, such as cottontail rabbits, tend to have low survivorship and high mortality at younger ages, therefore offsetting their high reproductive outputs. Animals with a lower reproductive potential, such as whitetailed deer, have higher survivorship of young, compensating for the smaller litter sizes.

Several mortality factors (e.g. disease, predation, exposure to severe weather, starvation or malnutrition, accidents, harvest) can be the proximate cause of how an individual animal meets its fate. While the proximate cause may be predation or exposure to severe weather, the ultimate cause may be related to a lack of sufficient cover to escape predators or the effects of adverse weather. Because habitat conditions, weather patterns, and populations of predators and prey are constantly changing, some factors that have a significant impact in one year may be less so the following year. Despite these inconsistencies, in many cases the overall reduction in population size from mortality factors across years remains the same. In effect, the specific causes of death tend to balance or compensate each other. Wildlife professionals call this phenomenon ***compensatory mortality***. Stated another way, one type of mortality largely replaces another kind of mortality in animal populations, while the total mortality rate of the population remains constant. Wildlife managers employ the concept of compensatory mortality when establishing hunting and trapping regulations. In compensatory mortality, hunting and trapping serve to replace the natural mortality factors operating on a population, and keep the population density in balance with what the habitat can effectively support. The portion of a wildlife population that is capable of being removed is called the *harvestable surplus*, that portion of the population that would invariably die from other causes.

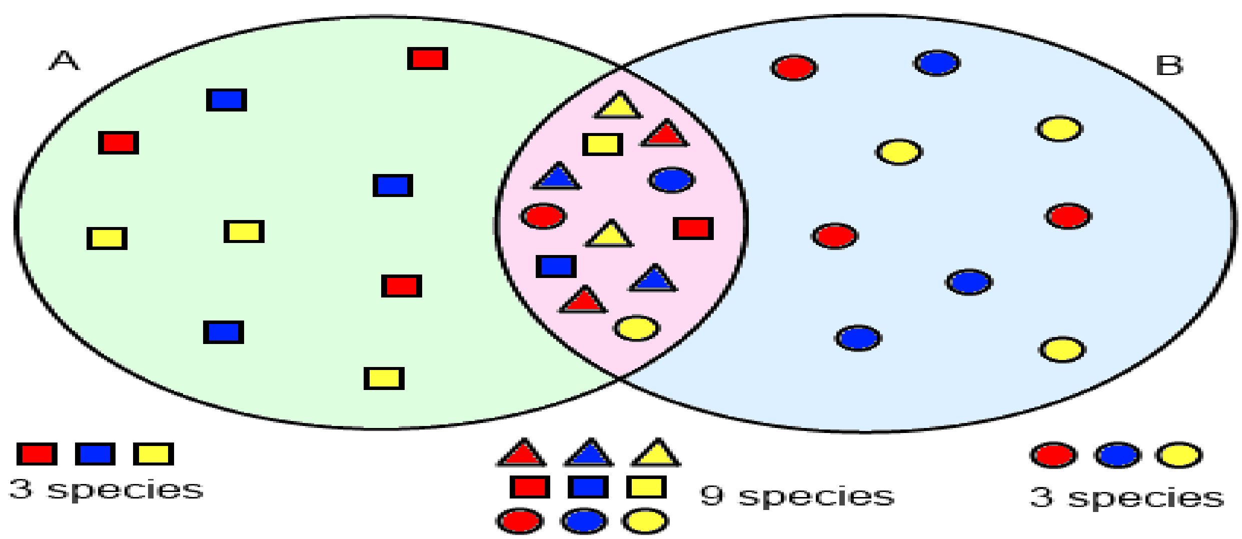
Data suggest that species with a high reproductive potential can have a larger percentage of the population harvested in any one year than species with a low reproductive potential, because their higher reproductive outputs will replenish the loss of animals more quickly. Muskrats are a perfect example. When large numbers of muskrats are removed by trapping, the population responds in these ways:

- the length of the breeding season is increased so more litters are produced,
- the number of offspring produced per litter increases, and
- surviving muskrats are less susceptible to disease or predation.

Regardless of which species we are talking about, man must regulate the removal of animals because all populations have a harvest level at which the mortality factors are no longer compensatory but additive. This means one kind of mortality is added to the other sources of mortality and it can go above the population's ability to replace itself. ***<u>One important note: regulated sport hunting has never resulted in a species being placed on the endangered or threatened species list</u>***. Commercial, market, or unregulated hunting has been responsible for, in some cases, the extinction of a wildlife species, such as the passenger pigeon.

Important Habitat Areas

Ecotones –Edge Effect As a community becomes more complex, the types of vegetation increase and a larger variety of species are able to live in the environment. A deciduous forest, being more complex than a meadow, offers animals greater diversity of food and types of cover. The variety of species found in a habitat is related to the number of possible niches available. A larger number of different species will be found in the deciduous forest than in the meadow. Species diversity, also called biodiversity, (the number of different species of organisms in an area) will also be greater at the margins of two communities than at the center of either community. Generally, the more isolated a community is or the more environmental stress there is on a community, such as harsh conditions or development by humans, the lower the diversity or variety of species. The area between two different types of habitats, such as between a forest and a field, will have vegetation from both habitats as well as vegetation, such as shrubs, not found in either. These transitional zones, where two or more communities meet and combine, are called ecotones or edges. Ecotones are often rich in species because of the large variety of niches and the fact that they hold species from the joining communities as well as their predators. Ecotones exist anywhere communities come together, such as a pine forest meeting a deciduous forest, a pasture meeting a forest, and along all types of wetlands including streams, ponds, lakes, swamps, and rivers. The change in variety and the number of species in these areas is known as the edge effect.



Wetlands Many wetlands have large areas of edge effect and some are almost all edge, the habitat where species from land and water combine. There are many animals that are not totally aquatic organisms. These animals are dependent on wetland areas for all or part of their life cycle or lifestyle. Mink, beaver, and muskrats are mammals that live in close association with wetland areas.
Riparian areas consist of the greenway of natural vegetation along streams and rivers. They provide access to water along with cover and many food sources. These special ecotones offer natural corridors through developed areas for many species. Riparian areas act as filters to help prevent water pollution. They shade the water keeping it cooler and allowing the water to hold more dissolved oxygen. They also increase the humidity, important for amphibians. Fallen leaves provide detritus an important food source for aquatic invertebrates.
Grassy fields and meadows Fields are like wetlands in that they attract many different species and are visited by animals that do not live there throughout the year. These animals may visit the field only at certain times of the day or during times when food supplies in other habitats are limited. The amount of sunlight fields receive makes them one of the first areas where the snow melts, revealing the grasses beneath. They may also green-up long before other types of food supplies are available in the spring. Both of these factors make fields important to wildlife by providing food when it is unavailable other places. The presence of insects and grasses entice many species of seed-eating and insectivorous birds including quail, killdeer, grouse, sparrows, flickers, bluebirds, wrens, meadowlarks, and wild turkey. At night, bats visit the fields to feed upon the numerous insects. Rabbits and groundhogs also find their needed food supply and nesting, escape, and resting cover here or nearby. Shrews, lizards, and skunks are attracted by abundant insects and grubs. Raccoons and opossums are common visitors, as are white tailed deer that forage here.
Forest clearings provide field type ecosystems which benefit many species, as discussed above. These clearings may be created naturally by the death and falling of old trees, allowing sunlight to reach the forest floor, or by wildfires that open up the forest floor to sunlight. Some clearings are man-made, the result of selectively cutting stands of trees or by clear-cutting sections of a forest. These important wildlife areas are also temporary, as they will eventually go through succession.
Snags and Downed Logs Snags and downed provide areas for nesting, roosting (resting), foraging (eating), perching, denning, escape cover, or territorial displays. A snag is a standing dead or dying tree. A downed log also known as a nurse log is a fallen tree that is lying on or near the forest floor. Snags, downed logs, and woody debris from them are natural occurrences in a mature forest (one over 60 years old). Salamanders will live and feed beneath moist, decaying logs. Cavity nesters are very dependent on snags. Woodpeckers, warblers, chickadees, bluebirds, wood ducks, owls, flying squirrels, and even some lizards use cavities as their homes. Some bat species rest and even winter under the bark of snag trees.

The broadest divisions of habitats are aquatic (water) and terrestrial (land), but there are two "other" habitats: aerial and subterranean. Subterranean habitats include soil and surface litter, caves, and underground cavities. Cave dwelling organisms include some species of salamanders, fish, snails, worms, insects, spiders and crustaceans. Aerial habitats are considered only temporary habitats for most organisms that use them. Bats are the only mammals that can really fly. Some birds stay" on the wing," or in flight most of their lives. They only come down to the surface to nest and raise their young. Examples of these birds include the albatross, petrels, and other seabirds. A few species of insects travel long distances by air, such as the monarch butterfly and painted lady butterfly. Some plants called epiphytes or "airplants" grow without contact with the soil. They grow on trees, roofs, or other surfaces. Bromeliads, some mosses, and orchids are epiphytes.

Creating and Preserving Habitat

There are many techniques being used to help protect and preserve habitats and to create new ones. Information on some of these practices, many of which create or maintain edges, follows.

♦ Buffer Strips –strips of permanent vegetation in or around edges of fields, particularly near streams or rivers. There are many different types of buffers including:

▫Filter Strips–grass/other vegetation traps sediment and pollutants before they reach waterways.
▫Shelterbelts/Field Windbreaks
▫Grassed Waterways
▫Living Snow Fences–shrubs/trees prevent wind and snow damage and trap snow for water.
▫Contour Grass trips
▫Cross-Wind Trap Strips –rows of vegetation.
▫Shallow Water Areas For Wildlife–areas of shallow water in or near crop fields, protected by permanent vegetation.
▫Field Borders–grassed areas along the edges of crop fields.
▫Alley Cropping –crops planted between rows of shrubs or trees.

♦ Streamside Management Zones or SMZ's–buffer strips of vegetation along streams or around other water bodies, where forestry practices require special care to protect water quality.

♦ Riparian Areas –areas of vegetation along streams and rivers.

♦ Food Plots or Wildlife Openings –cleared area of forest that are mowed or disked and planted with grasses and grains or contain native plants to meet food and cover needs of wildlife.

♦ Maintaining Edges –creating and maintaining edges can be done through many practices:

- When harvesting trees, make irregular shaped cuts or indentations to increase the amount of edge.
- Allow native vegetation to grow along fencerows, terraces, roadsides, gullies, or field borders.
- Allow fingers of native vegetation to creep out into pastures, fields, and other open areas.
- Plant vegetation or hedgerows to connect large forested areas to serve as cover and travel lanes or corridors for wildlife.
- Create brush piles in pastures, clearcuts, or other open areas for cover.
- Cut large trees and leave them on field edges to provide cover.
- Plant trees or shrubs to speed up the development of cover along edges.
- Cut firewood and do timber stand improvements in a way that will increase forest edge/openings.
- Prescribed burns to open up the forest and allow undergrowth and grasses sunlight.
- Selective cutting of trees or planting of various species.
- Mow to maintain grassy fields and various stages of succession.
- Individual homeowners and urban areas can landscape with shrubs and trees of various heights to provide vertical vegetation to increase wildlife habitat.
- Homeowners can landscape with native plants to provide food, water and cover for wildlife.

The U.S. Department of Agriculture offers many programs encouraging farmers to conserve soil and water resources for the benefit of wildlife. These programs include the Conservation Reserve Program, Conservation Reserve Enhancement Program, Wildlife Habitat Incentives Program, Wetlands Reserve Program, and Forest Stewardship Program. All of these programs help create edges and ecosystems where more habitat requirements for a larger variety of species are met.

Vertical Structure

In a forest or woodland, there may be three distinct layers of vegetation. The understory is composed of those plants growing near the ground, up to 4.5 feet tall. The understory may be very diverse and include grasses, forbs, ferns, sedges, shrubs and young trees. The midstory is represented primarily by shrubs and trees more than 4.5 feet tall yet below the overhead canopy. The overstory is made up of those trees in the canopy. How the different layers of vegetation are arranged in relation to each other is important to many wildlife species

Providing good vertical layering(stratification) is another way to provide a diverse habitat for wildlife

The individual homeowner can landscape with native plants, shrubs, and trees of varying sizes to meet habitat needs for many species. Old Christmas trees, brush, cut shrubs, or tree limbs can be used to provide important wildlife habitat. These materials placed in a stand of trees, along the edge of trees, or in a pile in an open area can provide important escape, resting, feeding, and nesting cover for birds and small mammals. They can also serve as important cover from winter snows or harsh weather for these animals. As they decay they attract insects adding to the wildlife food supply. The same materials sunk into lakes or ponds serve as important cover for various fish. These options are much more environmentally friendly uses of discarded trees and brush than burning them, which adds carbon dioxide and other pollutants to the atmosphere.

Succession and Wildlife Habitats will naturally change over time from one type of vegetation to another. This is known as succession, or biotic change. An abandoned field that is no longer farmed will first grow up in weeds and grasses. Over time, weeds and then shrubs will start growing along with the grasses. In time, small conifers will begin growing. The conifers eventually shade out the lower plants and a pine forest emerges. Small hardwood trees (deciduous trees) begin growing among the pines, and in time, a mixed forest develops. Eventually the deciduous trees will shade out young pines, killing them or making them weak and prone to diseases or insects. The deciduous trees also add a leaf cover to the forest floor, which keeps pine seeds from reaching mineral soil. Finally, a hardwood, oak-hickory forest habitat is established after the adult pines die off.

The first plants to begin growing are called the *pioneer species*, which are the weeds and grasses. The final community of natural vegetation that does not change unless disturbed is called the *climax community*. , The climax stage is the final stage of a site if no disturbance takes place. Disturbance events, such as fire, grazing, ice and wind storms, lightning and flooding—continually set back succession and the process starts over. Succession occurs rapidly in areas with warm temperatures and abundant rainfall. Habitats with the greatest variety of vegetation will meet the needs of a greater variety of species, but many species also need forest interior.

Plant succession is an important concept for wildlife managers because all wildlife species are associated with one or more successional stage. Some species—such as wild turkey, white-tailed deer and coyote—may use several successional stages to meet various life requirements. Others, such as grasshopper sparrow, sage-grouse and ovenbird—may only be found in one or two successional stages. This highlights the need to manage a particular successional stage for some species, and highlights the importance of having a diversity of vegetation types and successional stages, if a diversity of wildlife species is a goal or consideration. Although succession is set back through natural disturbance, many natural disturbance events have been altered by man. For example, levees have been built to prevent natural flooding, and great effort is expended to suppress and control fire. Also, extensive plantings of non-native sod-forming grasses have unnaturally altered or interrupted succession in nearly every region of the country. Because of their dense nature at ground level, the seedbank is suppressed and response (thus succession) is limited. Natural disturbance events have been altered and the compositional and structural changes of plants following disturbance events are fairly predictable within a given region. Thus, wildlife managers intentionally manipulate succession to provide the appropriate successional stage(s) for various wildlife species or groups of species. Wildlife management practices, such as prescribed burning, timber harvest, selective herbicide applications, grazing and disking— can be used in the absence or interruption of natural disturbance events. Alternatively, planting select plants and the lack of disturbance can be used to allow succession to advance.

Ponds and lakes, over a much longer period of time, will also go through succession. As sediment is carried into the pond, the bottom begins to fill in, and the water becomes shallower. The pond then can become a marsh, wet meadow, grassland, and finally a forest. As with the succession of a bare field, each habitat created in each of the steps of the pond succession provides for the needs of different species of plants and animals. Eventually it will no longer contain enough water to provide acceptable habitat for fish, water dwelling salamanders, aquatic turtles, or aquatic insects; but as it becomes unacceptable habitat for those species, it begins to provide habitat for others.

Pond Dynamics, Pond Balance and Stream Habitat

A properly managed pond can provide excellent fishing and can benefit many species of wildlife. The basics of a well-managed pond are properly stocking the right species, a balanced harvest, proper fertilization, a stable water level and aquatic weed control. Pond balance occurs when a balance between prey and predator fish is established and maintained. In most warm-water ponds, bluegill is the prey species and largemouth bass is the predator species. In cold-water ponds, a trout species is usually the predator, and insects and small fish are prey. Balance between predator and prey is achieved by establishing an adequate food chain for the prey species and controlling the prey and predator species numbers through fishing. Phytoplankton(microscopic algae) are the base of the pond food chain. Zooplankton and aquatic insects feed on phytoplankton, which are eaten by small fish. Small fish are eaten by larger fish. Managing phytoplankton through fertilizing and liming (if necessary) is the key to producing abundant and healthy fish populations. Suspended mud in ponds blocks sunlight, and algae cannot bloom. Excessive water exchange through the pond prevents adequate phytoplankton blooms because fertilization is diluted. Low water levels can cause significant problems also. Improperly constructed or damaged spillways can lead to excessive dam erosion. Low water levels, resulting from damaged spillways or improperly sloped banks, can lead to excessive aquatic vegetation along pond margins.

A stream can be defined as a body of water moving in a definite pattern and following the course of least resistance to a lower elevation. Because water volume and rate of land erosion fluctuate along the course of the stream, the bottom and shoreline are relatively unstable. As the water moves, it carries materials that have been picked up—such as gravel, sediment and debris—and redistributes them along the stream course. When water flow is restricted to a narrow area, the stream can create more erosion, resulting in deeper areas or pools. As the stream passes through wider passages, the water flow slows and material is deposited to form areas known as riffles. Pools and riffles are important habitat features for various fishes that inhabit streams. Pools provide areas for fish to feed and find refuge from fast-moving water that requires more energy for swimming. Riffles are usually preferred areas for spawning. It is important that fish have the ability to move freely between various features in the stream. While some species can complete their life cycle within a small portion of the stream, other species, such as salmon, must migrate to the ocean and return to the stream to spawn.

Wildlife Taxonomic Classification

The term wildlife can be used to signify all undomesticated organisms but more often it simply refers to undomesticated organisms belonging to the animal kingdom. The animal kingdom is subdivided into invertebrates and vertebrates. Invertebrates include:

- ♦ Sponges
- ♦ Stinging Celled Animals: jellyfish, anemones, and corals
- ♦ Mollusks –snails, clams, mussels, oysters, and scallops
- ♦ Nematodes –roundworms
- ♦ Flatworms –flukes, planaria, and tapeworms
- ♦ Segmented Worms –earthworms and leeches
- ♦ Spiny Skinned Animals –sea stars, sea urchins, and sand dollars
- ♦ Arthropods –insects, spiders, millipedes, centipedes, crabs, and lobsters

.

Vertebrates include:

- ♦ Fish
- ♦ Amphibians
- ♦ Reptiles
- ♦ Birds
- ♦ Mammals

Insects are the most numerous animals on earth. They make up about 85% of the population. they have jointed appendages, have exoskeletons, have three pairs of legs (6) and undergo metamorphosis, changing from egg to larva to nymph (or pupa), and finally into adult form. Insects that cause harm to humanity are known as pests. Throughout history various methods have been used to “control” them. Heavy metals, such as arsenic, were once used to poison them, much as our synthetic pesticides are designed to do today. Natural controls, which include climate, natural enemies (such as spiders and predatory insects), geographic or natural barriers, and availability of shelter, food and water supply may be used to help control insect populations. Another method is host resistance. Some animals and plants resist pests better than others. The use of these species for crops and domestic animals helps reduce pests’ numbers. Some plants seem to repel unwanted insects. Planting these species with or around crops can help reduce insect numbers. Chemical pesticides have been widely used in the past. We have learned that the heavy use of chemical pesticides eventually fails due to the development of natural resistance (known as the “pesticide treadmill”). Pesticides also kill beneficial organisms. Some chemicals have also been found to pollute surface waters and kill birds and other animals.

A new approach, ***integrated pest management (IPM),*** is being used to control insect pests while minimizing harm to the environment. This form of pest management uses a combination of methods to fight specific insect pests. The following are some components of integrated pest management:

- Biological controls - natural predators, such as bats, spiders, and other insects , sterilizing males and releasing them, or interfering with pest insects' reproductive cycles through the use of hormones or pheromones
- Non-toxic (non-poisonous) substances - lime put on infected plants –
- Chemical insecticides -only use if necessary –
- Agricultural methods – polycropping (multiple crops in one field), crop rotation, timing (avoid planting or harvesting when insects are around), trap crops
- Mechanical (physical) controls - traps, screens, barriers, fences, nets, radiation, and electricity can be used to help prevent the spread of pests

Insects are as important to man as they are pests to him. The insects that help man are called beneficial insects. Insects are our most important crop pollinators. Honeybees are perhaps the most widely recognized pollinators. In addition, they provide honey and wax –products widely used by man. Predatory insects are also beneficial to man and are used to help limit pest populations. Examples:

tachinid fly-armyworm	Rove beetles-fly maggots
braconid wasp-aphids	Lady beetles-aphids and scales.

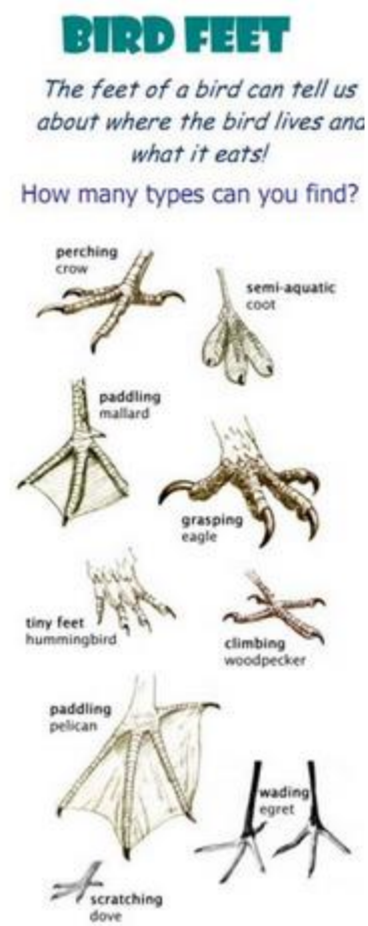
Many animals, such as birds, toads, frogs, lizards, shrews, moles, and bats depend on insects for food. Some birds eat their own weight in insects every day, and amphibians actually consume more insects than birds. A bat can consume up to 600 mosquitoes each night.

Fish Fish are vertebrate animals usually characterized by fins, scales, breathing with gills and living in water. Fish eggs must be in water, because they have no protective shell to prevent moisture loss. They are divided into fresh water and marine or saltwater species, depending upon their habitat. Sedimentation is America's top pollution problem. These sediments can cover the fish's eggs killing the developing young. They can also clog the gills of the fish, limiting their ability to "breathe". Chemical pollutants can kill fish or bioaccumulate in their bodies.

Amphibians Amphibians, which include frogs, toads, and salamanders, are vertebrate animals. Most are characterized by smooth, moist skin lacking scales, four legs, toes with no claws, exothermic or cold-blooded temperature regulation, and a double lifestyle–part in water and part on land. Amphibian eggs must be in water or very moist areas, because they have no protective covering to keep them from drying out. Most amphibians have an aquatic larval stage and almost all amphibians live in moist areas or in the water. Amphibians can also take in oxygen through their moist skin. This adaptation is used when they hibernate in the mud at the bottom of ponds or in the soil. Amphibians are all predators (eat insects) and are prey for many organisms.

Reptiles Reptiles are vertebrate animals with dry, glandless, scaled skin. They are exothermic and use internal fertilization. While most reptiles lay eggs, some snakes and a few lizards are ovoviviparous. They carry their eggs inside their bodies until the eggs hatch and have their young alive. Reptile eggs are large compared to those of fish and amphibians. The eggs have a leathery protective shell and large yolk unlike the eggs of fish and amphibians. Snakes and a few lizards are legless, but most reptiles have four limbs each with five clawed toes. Most reptiles live on land. The reptile's scaly skin helps keep it from losing water. A person who specializes in the study of amphibians and reptiles is a *herpetologist*.

Birds Birds are vertebrate animals characterized by feathers; hard-shelled eggs; bills with no teeth; the ability to maintain body warmth and, in most birds, the ability to fly. Birds can fluff up their feathers to trap air, which helps insulate them and keep them warm. The ability to fly requires light weight, which comes from hollow bones (some of the larger bones have internal struts for reinforcement). Another requirement for flight is excellent eyesight. Birds have the best visual acuity of all living things. The beaks and feet of birds are designed to fit their niche in their habitat. Raptors or birds of prey have long, sharp, curved claws called talons for grasping prey. Water birds have feet designed for swimming or wading. Climbing birds, such as woodpeckers, have two toes at the back of their foot that act as braces. Most birds only have one toe at the back of their foot. The beaks of birds are suited to their food source. Birds that eat small insects, such as warblers, have small, fine beaks. Birds that eat larger seeds, such as cardinals, have broad based, heavy beaks for crushing the seeds. Birds that dig for insects, such as woodpeckers, have long, narrow beaks. Birds of prey have hook-tipped, sharp beaks for tearing flesh.



Birds are commonly grouped as follows:

Flightless birds: Penguins, Ostriches, Kiwi

Waterfowl and Shorebirds: Wading birds, Swimmers, and Aerialists Water birds have oil glands or "powderdown" patches to keep their feathers waterproof. Smaller waders include sandpipers, plovers, snipe, rails, woodcock and killdeer. Long-legged waders include herons, cranes, egrets, ibises and spoonbills. Aerialists or seabirds include gulls, terns, pelicans. Swimmers are the ducks and duck-like birds including geese, swans, coots, loons and grebes. The Ducks are further subdivided into "*Puddle Ducks"* or Dabblers and *"Diving Ducks"* or Divers. Puddle ducks or dabblers are typically birds of fresh shallow marshes, ponds and rivers. Dabblers are sure-footed and can walk or run well on land. Their diet is mostly vegetable, and many of these ducks, like the mallard, pintail and wood duck are hunted for food. Diving ducks are found in larger, deeper lakes and rivers, and coastal bays and inlets. The diet of diving ducks includes fish, shellfish, mollusks and aquatic plants. Their diet makes most of them less desirable to sportsmen who hunt for food. Ducks and many other waterfowl are migratory birds. The term "flyway" is used to designate the migration routes of ducks. For management purposes, four waterfowl flyways were established in the United States in 1948. **The four flyways are –Atlantic, Mississippi, Central and Pacific**. r

Game Birds- are birds that are ground inhabitants with strong legs; feed mostly on seeds, berries and other vegetation; have short and rounded wings and hatch young that are fully covered in down and can run and feed. Game birds include quail, grouse, turkeys, pheasants and partridges.

Passerine (Perching) Birds – Often known as "songbirds."

Nonpasserine Land Birds – Pigeons, doves, cuckoos, hummingbirds, kingfishers, woodpeckers, swifts and nightjars are members of this group.

Birds of Prey –(raptors) These are the larger hunting birds with hooked beaks and sharp talons. While people often think of these birds as the meat eaters, the majority of birds prey on animals (insects, worms, fish, amphibians, mammals, reptiles and other birds). The other birds eat seeds, nuts, and vegetation. The raptors play an important role in controlling rodent populations. Raptors include:

Hawks:

- Accipiters –Bird hawks
- Harriers (known as the marsh hawk)- Mice, frogs, snakes, and crayfish.
- Buteos (Buzzard Hawks) –Mostly rodents and small mammals
- Eagles –Fish, waterfowl, small mammals, and carrion.
- Osprey –Fish. The only raptor that plunges into the water.
- Falcons –Birds, rodents and insects.
- Owls –Rodents and other mammals, birds, reptiles, fish and large insects. They are nocturnal and have large heads, flattened faces that form facial disks, and large eyes on the front of their head giving them good binocular vision.

Neotropical Migrants –Birds which winter in the tropics (Central America, South America, and the West Indies) and migrate to North America to mate and raise young.

All birds are oviparous, meaning they reproduce by laying eggs. The eggs are fertilized internally, enclosed in a shell, and usually laid in nests. Many birds establish territories before mating. Male bird coloration, posturing, dances or sounds may all be part of attracting a mate or establishing territory. Over 90% of birds are monogamous. Swans, eagles and geese pair for life. Both parents usually participate in nest building and care of the young. Parents take turns incubating and protecting the eggs or chicks while the other hunts for food. Some young are altricial, helpless at birth, such as cardinals, while others are precocial, covered with down and able to move, such as killdeer.

The most serious threat to birds today is habitat destruction. In addition to the loss of land and vegetation needed; contamination of air, land, water, and living organisms with pollutants such as pesticides and PCBs has threatened many species. Biomagnification is the accumulation of a chemical in an animal to a harmful level. The biomagnification of DDT in some avian predators threatened their survival. The birds laid thin-shelled eggs that did not provide good protection for the developing embryos. The birds most affected by DDT were the bald eagle, brown pelican, peregrine falcon, and osprey. Other chemicals that have impacted bird populations include PCBs and lead. The introduction of exotic species has also played a role in habitat destruction and loss of bird species. The introduced species often outcompetes native birds for needed resources and cavity-nesting sites. The introduction of the house sparrow and European starling had a devastating effect on North American cavity nesting birds, such as the eastern bluebird and wood duck, as did the cutting of forest and removal of snag trees.

Mammals Mammals are vertebrate animals that have hair, are endothermic and feed their young milk from mammary glands. Fur, called pelage, usually consists of two types of hair. Long guard hair protects an underlying dense coat of smaller, insulating under hair(undercoat). Most mammals are viviparous, which means they have live young. Mammals have reproductive cycles that help ensure internal fertilization and successful development of the young. Mammals of today are classified as monotremes, marsupials, and placentals. Monotremes are egg-laying (oviparous) mammals. Only two monotreme species live today, the echidna and the platypus. Marsupial mammals are viviparous, primitive placentals who bear their young alive. The young are born early and not fully developed. The young crawl into a pouch on the female’s belly where they feed and continue to develop. The only marsupial in North

America is the Opossum. Placental mammals are viviparous and have a specialized structure called a placenta, which nourishes the developing young until they are fully formed. The placenta allows nutrients, gases, and wastes to diffuse between the mother's and fetus's bloodstreams. Some placental mammals' young are helpless at birth (raccoons, foxes, squirrels). Other placental mammals' young can walk and run shortly after birth (deer, elk). Most mammals are placental mammals.

Hair is unique to mammals. Hair plays a role in sensory perception, temperature regulation, and communication. The pelage or hair of most mammals is dark on the upper side of the body and lighter on the underside of the body. This is called countershading. Countershading makes the mammals less visible to predators, under most conditions. Air trapped in air spaces in the hair shaft and between hair and the skin as mammals fluff up their fur provides an insulating layer. Mammals also have muscles, which cause the hair to stand on end in threatening situations. This ability gives the perception of increased size and strength, which is part of protective behavior. Glands found in the skin of mammals secrete oils that lubricate and waterproof the skin and hair. Most mammals also have sweat glands that release watery secretions used for evaporative cooling. There are scent or musk glands around the face, feet, or anus of many mammals. The secretions from these glands may be involved with defense, species and sex recognition, and territorial behavior.

Mammals react to unfavorable environments by migration, winter sleep, hibernation, aestivation (being inactive in dens or burrows), or use shade or water holes. These behaviors help them avoid excessively cold or hot conditions. Torpidity *Winter sleep* –A period of inactivity in which the mammal's body temperature remains near normal, and the mammal is easily aroused and fully active in a short period. (black bear) *Hibernation(Torpidity)* - A dormant state of decreased body temperature and metabolism in which certain animals pass the winter. The animals are not easily aroused. (little brown bat) *Aestivation* - A dormant state of decreased metabolism in which some animals endure hot, dry periods. *Migration* - Movement of animals, usually periodic round trips, from breeding to nonbreeding areas or to and from feeding grounds. There is a wide array of morphological, physiological, and behavioral adaptations for winter survival. A few examples are provided below:

- **Bergmann's Rule** states that northern species of a particular genus or similar class of birds or mammals tend to be larger in size, although this is not always true. Larger body size means a higher body mass-to-surface area ratio. It's easier to retain heat.
- Body appendages tend to get smaller in the north, as a heat conservation measure. Mammalian legs and snouts are frequently shorter and stouter.
- Specialized fat, called brown fat, is produced during the food-rich seasons and expended during cold seasons.
- Various "heat exchange" mechanisms can be found in animal circulatory systems that reduce heat loss to body extremities.
- Certain fish and herps produce chemicals within and between cell walls that can lower their freezing temperature a few degrees.
- Some mammals, such as flying squirrels and small rodents, will occupy collective dens to conserve body heat.
- Food preferences change with the season. Some browsers, such as white-tailed deer, have changes in digestive enzymes to cope with the different food sources. This is one of the reasons why biologists argue against winter deer feeding
- Ruffed grouse "snow roost" during periods of extreme cold. Snow provides a very effective barrier against severe cold. They will rest under the snow until the severe weather passes.
- Aquatic mammals, such as otter and mink, grow thick layers of insulating fat and have specialized fur. Similarly, ducks, geese, and swans have feathers and oil glands that keep water away from the

skin. Some have efficient circulatory heat exchangers between the body and the feet. It's usually not the cold that causes waterfowl to migrate. It's more a matter of food shortages.

- Birds and mammals undergo seasonal changes in feathers and pelage. Trappers know that winter pelts are the highest quality because they are thicker and have different kinds of hair.
- Muskrats and beaver construct shelters, partly for protection from severe weather.
- Many species of birds can adjust their internal body temperature downward to reduce the temperature gradient with environmental temperatures, thus reducing heat loss. They also tend to shiver a lot to maintain body temperatures.

Most mammals have four well-developed limbs with digits (fingers or toes) that end in nails, claws, or hoofs. The structure of the mammal's limbs tells much about the mammal's way of life, where they live, how they move, and how they escape predators or capture their prey.

- ➢ Plantigrade –(walkers) –walk with their entire foot touching the ground, and generally have powerful, short limbs. (bear, raccoons, shrews)
- ➢ Digitigrade –walk on their toes and "ball" of the foot, with the heel raised, lengthening their limbs and their stride, and providing power and speed. (predatory carnivores: foxes, wolves, and bobcat)
- ➢ Unguligrade –walk with only the tips of their toes on the ground. The number of bones of the feet and lower leg are greatly reduced which increases speed. The bones of the toes are enlarged and protected by strong hooves. These mammals depend on speed to escape. (deer, antelopes, elk)

Other mammals, such as rabbits and some mice species, combine speed when running and the ability to jump as means to escape predators. These mammals have large, elongated hind feet. Arboreal mammals have a variety of methods of movement. Opossums and monkeys cling to tree branches by using a prehensile tail or opposable digits. Squirrels climb and cling by use of sharp claws. Flying squirrels have the ability to glide because of folds of skin extending from their front legs to their back legs. Bats are the only truly flying mammal. *Fossorial* mammals live underground. These mammals have strong, often short forelimbs with broad front feet and long claws adapted for burrowing. Moles are fully fossorial while groundhogs are partially fossorial. Semi-aquatic and aquatic mammals are adapted to move or live in water. Semiaquatic mammals are active on land and in the water. Most of these mammals have hind feet that are webbed, and they usually have flattened tails. Some semi-aquatic mammals are the beaver, muskrat, nutria, and river otter. Fully aquatic mammals live only in the water, and the forelimbs are modified into flippers, hind limbs are absent, and the tail is modified into broad, flattened flukes. Whales, dolphins, porpoises, and manatees are examples.

There are four main kinds of teeth in mammals (incisors, canines, premolars and molars).
Carnivores tend to have long canines which are used to rip and tear meat, sometimes in a scissors like action. In addition, carnivores have sharp molars toward the back of the mouth, used to further rip and shred meat. Carnivores tend to have binocular vision, where their eyes are at the front of the head, which results in a smaller field of view, but allows for depth perception, needed to catch prey.

Herbivores tend to have well-developed flat premolars and molars, often with sharp ridges on the tops. Generally herbivores do not have canine teeth, and their incisors are usually large and used to snip off foliage from branches. Because herbivores are often prey for other animals, they generally have their eyes on the side of their head, which functions to give them a wider field of view, so that they can detect their prey earlier, and have a chance to flee.

Omnivores usually have a variety of all kinds of teeth. Humans, bears and raccoons are omnivores, since they eat all kinds of food (both meat and plant material) they need all kinds of teeth. Generally omnivores have eyes on the front of their heads like carnivores, in order to best catch their prey.

Among the concerns about human and wildlife interactions is the fact that warm-blooded mammals are carriers of rabies. The most commonly infected animals include raccoons, foxes, skunks, and bats. Mammals may also be carriers for ticks that are vectors for Rocky Mountain spotted fever or Lyme disease. Today, the greatest threats to mammals are habitat destruction and habitat fragmentation.

Foundation, Keystone, and Indicator Species Some species, such as the beaver and alligator, actually create habitat for other animals. They are known as foundation species. Others have an importance to an ecosystem that is far out of proportion to their numbers. These are known as keystone species. Many top level predators fit this description. Other species, such as amphibians and songbirds, have warned us of environmental problems. These animals are called indicator species.

Game and Non-game Species Wildlife is divided into game and non-game species. Game species are those that may be hunted or trapped according to wildlife regulations for seasons and limits. Non-game species are wildlife that are not hunted.

Migratory Patterns Migration is the periodic movement of animals over relatively long distances. Animals that migrate usually make one round trip between two areas each year. Migration is usually associated with breeding or feeding patterns. It is also a behavioral adaptation allowing animals to avoid harsh climatic conditions and to find the necessary food, shelter, or space throughout the year. Some long-distance migrating species store fat, equal to 50% of their body weight, for their nonstop migration. Some other species take longer periods to migrate and stop to feed and rest along the way. Migratory animals use three methods to find their way:

- Piloting –The movement from one familiar landmark to another. This method is used mostly for short distances and is not good for night or over ocean movement.
- Orientation –The animals detect compass directions and travel in a straight line path.
- Navigation –The determining of present location relative to other locations, as well as detecting compass direction. This is the most complex method. For orientation, some animals commonly use the sun for day movement and stars for night movement. Some birds detect magnetism and orient by internal magnetic compasses.

Activity Patterns and Cycles There are certain times of the day that species are active. These patterns can be divided into three types.

- Nocturnal –These animals are active at night.
- Diurnal –These are animals that are active during daylight hours.
- Crepuscular –These animals are active at dawn or dusk.

Organisms also have cycles or rhythms, which affect their behaviors.

- ✓ Light influences the cycles of daily activity, known as *circadian rhythms*. Included in these daily rhythms are activity and sleep, feeding and drinking, and changes in body temperature.
- ✓ The length of daylight, *photoperiod*, also affects behaviors in preparing for migration, hibernation, or winter sleep.
- ✓ Many species that live along seashores or in salt marshes are tied to *tidal (lunar)* cycles.

Animal Signs

Animals leave various forms of evidence of their presence. These signs can be used to identify what species inhabit or have passed through an area.

Tracks are obvious signs and are easily used to identify the species. The prints left by members of the dog family, such as wolves and coyotes, and those made by most mammals will have toe nail marks. Because of their retractable claws, tracks of members of the cat family will not have any nail marks.

Scat is the solid waste of animals.

Rubs or scrapes are marks left on trees or scars on saplings when animals break or bend some limbs, or bruise the bark.

Tooth marks or gnaw patterns left on trees or branches can be used to identify rodent species, such as the beaver, porcupine, mice, and squirrels, as well as other species including rabbits and moose.
Claw marks or scars on trees will be made by bears climbing or scratching and by bobcats and raccoons
Scratching marks on the ground may be used to indicate many species including bobcats and wild turkey.
Nut opening patterns are characteristics of various squirrel and mice species.
Burrows, dens, nests, lodges, and earth cores (or runways) show evidence of the presence of many species, some of which are beaver, muskrat, voles, badger, groundhog, tortoise, crayfish, mole crickets and squirrels.
Smells can indicate the presence or passing of skunk, weasel, or mink.
Wallows are made by deer, elk, and wild boar.
Hair found on rubs, in wallows, or on branches can help determine the animal species, as can ***feathers.***
Sounds, vocalizations, and calls are species specific and can be used to identify them.
Pellets are regurgitated, undigested matter commonly produced by owls, crows, and blue jays,
Food remnants and caches include feeding debris and stored food.

Endangered Species The Endangered Species Act was passed in 1973 to help save species facing the risk of extinction. The federal act defines endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range." A threatened species is "any species which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range." The causes of species becoming endangered include:

Habitat Destruction and Fragmentation

Invasive Species

Pollution

Population growth (human)

Overexploitation

Animals that specialize, rather than adapt to changing conditions are more vulnerable to extinction

Wildlife Management Today every government has laws to maintain wildlife. Many federal agencies including the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Forest Service share responsibility for wildlife management and work with state agencies to protect wildlife. The Georgia Department of Natural Resources(DNR) Wildlife Resources Division(WRD) has that responsibility at the state level Hunting is the main tool employed to manage wildlife populations, and hunters provide much of the funding for wildlife management programs. Wildlife management laws protect wildlife by:

- Making sure not too many hunted animals are killed (establishing limits and hunting seasons). –
- Making sure none of the animals that cannot be hunted are killed.
- Making sure wildlife habitat is not damaged.

Introduced (Alien Non-native) Species An alien species is one which is not native to an area but which has been introduced, usually by people. Some of these species are good and helpful and some are not good and can cause a lot of problems and/or damage. Some of these species become invasive and are called invasive species. Many of our crops are not native. The honeybee is not native to this country and was brought here from Africa or Europe. The brown trout (from Germany), the rainbow trout (from western US), the flathead catfish and the Russian wild boar are all non-native species. The startling and the English sparrow were introduced from England. Kudzu was introduced from the Orient and the Japanese honeysuckle from Japan. Some of the introductions were accidental while some were done on purpose. Some like the Dutch elm disease, which is destroying Elm trees or Chestnut blight that killed the magnificent American chestnut trees have caused billions of dollars in damages. The Zebra mussel is one alien species which has become invasive. It is such an efficient filter feeder, that it takes a lot of the available food out of the water which other native organisms need to survive. They are such prolific breeders that they also clog up intake water pipes and they hitch rides on boats to reach new waters. The Gypsy Moth, Emerald Ash borer, and Asian Long Horn Beetle are all destructive pests. Purple loosestrife has been clogging and replacing our wetland areas in the northeast. All of these alien species have been brought here by man, either accidentally or on purpose. Some of these species may still be here when man is long gone.

Focal Species There are two basic goals in wildlife habitat management. One is to provide the habitat requirements for a particular, or focal, wildlife species. The other, is to provide habitat requirements for multiple wildlife species in the same area. When evaluating habitat, you must first determine the focal species. Once the species is decided, determine the habitat requirements for the focal species and evaluate the capability of the area to provide those requirements. If one or more habitat requirements is in short supply or lacking, then various habitat wildlife management practices may be used to improve the area's ability to supply the needed requirements. When determining which wildlife management practices to apply, remember that wildlife management practices that improve habitat for some wildlife species may be detrimental to other wildlife species. It is impossible to manage an area for any one species or group of species that require similar habitat without influencing other species in some manner. For example, if you plan a clearcut in a deciduous forest to benefit ruffed grouse, you may also benefit wild turkey, white-tailed deer and Eastern cottontail, while species such as ovenbird, wood thrush and Eastern gray squirrel, which prefer unbroken mature deciduous forest, will be forced to use another area.

Species Richness, Evenness and Diversity Species richness is simply the number of species present in a sample, community, or taxonomic group. Species richness is one component of the concept of species diversity, which also incorporates evenness, that is, the relative abundance of species. One goal in wildlife management may be to provide habitat for as many different species as possible, as contrasted to managing for a maximum number of individuals within a species. Generally, habitat requirements are provided for more wildlife species when a variety of vegetation types and successional stages are present.

Gaining Biodiversity

Mutation

Mutations increase genetic diversity by altering the genetic material (almost always DNA) of organisms. Once mutations arise, they are passed on to the mutated organism's offspring, and in time may either disappear if the line dies out. Depending upon the specific mutation, the result can range from no effect whatsoever to the creation of an entirely new species. Although this gives rise to differences in organisms, it is an extremely slow process compared to the other ways in which local diversity increases. Ultimately, though, this is the only way in which diversity is truly created.

Speciation

The creation of a new species is known as speciation. The origin of new species naturally has the largest immediate effect on species-level diversity; the immediate changes to genetic and ecosystem diversity are minimal, though the effects will grow in time. Speciation can occur through several different means:

- **Geographical Isolation**: Geographical isolation, such as new mountain chains or a lake whose level lowers enough that it splits into two separate lakes, can divide a population into two separate populations. The two isolated populations continue to evolve separately from one another. Eventually they can diverge to a great enough degree, either through adaptation to their differing environments or through random mutations, that they are no longer able to interbreed and are considered to be different species.
- **Competition**: If a new resource, such as a new food source, becomes available to a population, some part of the population may become specialized in obtaining that resource. Being specialized

in obtaining either the new resource or the original resource may be better than trying to obtain both. If so, then the specialists would be better off mating with the other specialists on the same resource, as mating with someone who uses the other resources will result in offspring that aren't specialized for either resource and at a disadvantage. In time, there is a chance that the population will split into two species, each specialized on one of the two resources. This can happen, but it is probably a fairly rare event.

- **Polyploidy**: Speciation through polyploidy happens far more often in plants than in animals. Most species are diploid, meaning they have two ("di" meaning two) copies of each chromosome, one from each of their parents. An individual in a normally diploid species may have more copies of these chromosomes, being polyploid ("poly" meaning many), through errors at the cellular level. The additional copies of the chromosomes render them unable to produce functional offspring with normal members of their species. Plants often fertilize themselves to at least some extent, so polyploid species can arise from a single individual. This method of speciation is almost instantaneous, happening in a single generation.
- **Immigration**
  Immigration increases diversity as new individuals and perhaps even new species enter an area, increasing its diversity. The rate at which immigration happens depends on the size of the area in question, how many species are there already, and how close the area in question is to the source of immigration. Most species that immigrate to a new ecosystem have only minor effects on their new system, though some drastically change it. Zebra mussels, native to the Caspian Sea and Ural River, were first recognized in the Great Lakes in 1988. It is most likely that they were brought over in ballast water. Since then they have spread throughout the Great Lakes and beyond, killing native mussel populations and fouling all manner of pipes and intakes.

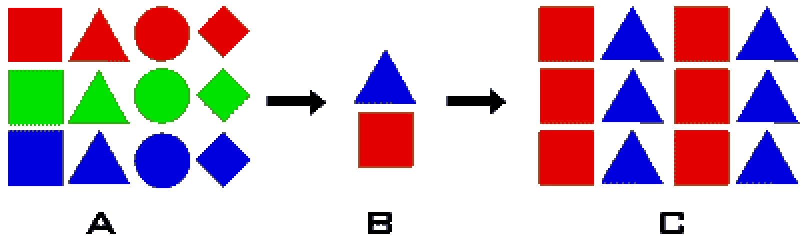
Losing Diversity

- **Extinction**
  Extinction is more an outcome than a process. Once a species goes extinct, all the diversity that it represented is lost forever. The vast majority of species that have ever existed are now extinct through natural processes, whether by mass extinction or by the more common individual extinction. Genes also go extinct if they fail to get passed on to the next generation, though it's not necessary for the entire species to go extinct as well. Ecosystems may be destroyed by severe disturbances, but they don't really go extinct unless the species that make them up are lost. Species can also go *locally* extinct; in this case, they are said to be *extirpated*. Although the local loss of diversity is the same, the species still exists elsewhere and may be able to return in the future through immigration

- **Competition**
  If one species outcompetes others to a dramatic extent, the result may be extirpation or perhaps even extinction of the other species and a reduction of diversity. Diversity, in the sense of evenness, will also be lowered if other species have their populations greatly reduced by a competitor or predator, even if the species aren't extirpated.
- **Disturbances**
  Disturbances can maintain diversity, but extremes can reduce diversity. Constant large-scale

disturbance can eliminate many populations and keeps an area at the early levels of succession, which have lower diversity. An area with no disturbances at all would end up completely at the final stage of succession. This would prevent the presence of the species that would normally be found at intermediate stages of succession, living in the disturbed areas.

- **Bottlenecks**



Genetic bottlenecks happen when many individuals in a population die. In the example to the right, the population initially has many different types of shapes and colors, representing genetic diversity (A). The few individuals that are left after most die (B) have a small amount of the genetic diversity that originally existed, as much of the genetic diversity was lost with the rest of the population. Although the population's numbers quickly recover (C), the genetic diversity is much slower to respond, which can cause problems if conditions change in the future, as the reserves of diversity that would be useful won't be there.

Biodiversity Trends

Of Georgia's more than 4,000 species of native or naturalized vascular plants and vertebrate animals, 32 species are known to be endemic to the state (i.e., restricted in their range of distribution to Georgia alone). Examples of species endemic to Georgia include: (1) the Etowah darter, a fish restricted to the upper reaches of the Etowah River (Coosa River basin) in Georgia; (2) hairy rattleweed, a plant in the legume family found in pine flatwoods habitats in scattered locations in Wayne and Brantley counties; and (3) the Pigeon Mountain salamander, found only on the eastern slopes of Pigeon Mountain in northwestern Georgia.

Approximately 440 species of vascular plants and vertebrate animals in Georgia are considered to be of critical conservation concern. In addition, 60 species of invertebrate animals and 12 species of nonvascular plants tracked by the Georgia Natural Heritage Program (a program of the GA DNR) are considered imperiled

Species previously found in Georgia and known to be extinct today include the Carolina parakeet and the passenger pigeon. Species considered close to extinction or possibly extinct include two birds (the ivory-billed woodpecker and Bachman's warbler), several freshwater mussels (the upland combshell, Ochlockonee arcmussel, fine-lined pocketbook, winged spike, and southern acornshell), and a number of plants (the roundleaf leafy liverwort, Porter's goldenrod, and Georgia beaksedge).

Land Use Change and Habitat Loss

The most significant factor contributing to the loss of biological diversity is the destruction or degradation of natural habitats. The rapid loss of native species populations is correlated with a burgeoning human population, rising per capita consumption of natural resources, and technological advances that increase the rate of habitat destruction.

Urban and suburban **development** has contributed greatly to habitat loss in Georgia. Increasing human population combined with sprawling development patterns has led to rapid loss of both terrestrial and aquatic habitats. In addition to direct mortality associated with destruction or degradation of habitats, the long-term effects of habitat fragmentation on populations can include higher levels of parasitism or predation, increased competition from "weedy" species, reduced **genetic** diversity, and greater vulnerability to natural catastrophes. In other words, those populations not wiped out directly by habitat destruction are often left weakened and vulnerable from habitat fragmentation.

What Can Be Done?
Projections indicate that the earth's human population may eventually level off at between 8 to 9 billion. If humans can curb their excessive consumption of natural resources and place greater emphasis on protection, restoration, and maintenance of the earth's remaining natural habitats, they may be able to salvage much of the earth's remaining biological diversity. However, the most optimistic predictions indicate a loss of hundreds of thousands of species by that time. The following initiatives are critical to protection of the world's natural heritage:

(1) increased emphasis on biological inventories, focusing on the identification and description of species, biotic communities, and ecosystems;
(2) greater commitment of human, financial, and technological resources to identify and protect those natural habitats that contribute most significantly to global biodiversity;
(3) further development and funding of conservation programs that emphasize public-private partnerships for broad-scale conservation of "working landscapes";
(4) greater emphasis on land-use planning to minimize impacts of future developments on natural habitats;
(5) increased collaboration between researchers and educators to heighten public awareness of the magnitude and significance of global biodiversity decline; and
(6) recognition of biodiversity protection as a global priority, and incorporation of this goal as a key component in international treaties and trade agreements.

Issues in Furbearer Management

There are three major issues involving the conservation and management of furbearers today: human population growth with its inevitable degradation and destruction of wildlife habitat; increasing public intolerance of furbearers in populated areas; and opposition from animal rights activists to any harvest or use of wildlife.

Loss of Habitat The first and most critical issue challenging furbearer conservation today is human population growth and the resultant degradation and destruction of wildlife habitat. Without adequate habitat, wildlife populations cannot be sustained. While no furbearer species is in immediate jeopardy due to habitat loss in North America (because furbearers are typically abundant, adaptable species often covering large geographic areas), the range of some populations has been reduced. Habitat destruction has eliminated the option to restore some species to areas where they once existed. Unlike habitat destruction, regulated trapping is a sustainable use of wildlife resources, and does not, in any way, jeopardize the continued existence of any wildlife population.

Public Intolerance While habitat loss is a direct threat to wildlife populations, it also has indirect consequences. As wildlife habitat continues to be fragmented and eliminated by development, wildlife managers are confronted with new challenges: coyotes killing pets, beavers cutting ornamental trees and flooding roads and driveways, raccoons invading buildings and threatening public health with diseases and parasites. These kinds of human-wildlife conflicts reduce public tolerance and appreciation of furbearers. While Biological Carrying Capacity (population level an area of habitat can support in the long term) for a furbearer species may be relatively high, the Cultural Carrying Capacity (population level the human population in the area will tolerate) may be lower. A growing dilemma is that furbearers, while of great recreational, economic, and intrinsic value to society, are also increasingly a public liability. The challenge — magnified in and near areas of dense human population — is to satisfy various constituents with different interests and concerns while conducting sound wildlife management. Unfortunately, due to

various environmental, economic and sociological factors, traditional fur trapping — which reduces animal damage at no cost to the public — tends to be a rural activity. The number of people newly involved in this cultural activity has declined in recent years, particularly in suburban and urban areas. With the decline of traditional fur trappers, "nuisance animal control" has become a growth industry. Businesses specializing in trapping and removal of "problem" animals are thriving in many areas. This trend is of concern to wildlife biologists, for it indicates that a growing segment of the public is coming to view furbearers as <u>problems</u> that should be removed and destroyed. Regulated trapping provides an important and effective method to meet the public's demand for reduction of furbearer damage
Animal Rights As wildlife managers are faced with having to rely more on regulated trapping for furbearer population management and damage control, animal rights activists demanding an end to trapping are appealing for public support. Those advocating "animal rights" would eliminate all trapping and use of furbearers. Without regulated trapping, the public would have far fewer reliable and economically practical options for solving wildlife damage problems associated with furbearers. Public Intolerance

Principles of Furbearer Management

Furbearer management programs in the United States and Canada are primarily conducted by state and provincial wildlife agencies. In the United States, most funding for furbearer management comes from two sources: hunting and trapping license revenues, and federal excise taxes on firearms, ammunition and archery equipment (federal aid). **Most wildlife management is not funded with general tax dollars.** Federal aid has been provided since passage of the **Federal Aid in Wildlife Restoration Act** (also known as **the Pittman-Robertson Act**) in 1937. Federal funds and the assistance of certain federal agencies are also available for wildlife damage management programs within each state.

Management plans and regulations restrict trapping seasons to periods when pelts are prime and the annual rearing of young is past. Historical records demonstrate how applied wildlife management sustains regulated harvests: populations and harvests of most furbearing species have generally increased in North America during this century(Beaver, for example) They have been restored to higher levels while sustaining a substantial, annual, regulated public harvest.

The main tenet of conservation is this: *Native wildlife populations are natural resources — biological wealth — that must be sustained and managed for the benefit of present and future generations*. If those wildlife populations are furbearer species, an important public benefit conservation provides is the opportunity to harvest some animals for food, fur or both. The harvest of animals for these purposes is among the most ancient and universal of human practices. North American wildlife conservation programs apply three basic principles in establishing and managing harvest of wild animals:

(1) the species is not endangered or threatened;
(2) the harvest techniques are acceptable;
(3) the killing of these wild animals serves a practical purpose

It is important to understand that the aim of professional wildlife management is to perpetuate and ensure the health of wildlife populations; not the survival of individuals within those populations. Wildlife management does not generally focus on individuals because individuals have short life spans. On the time scale that conservation is pledged to address, individuals do not endure. Populations do. Populations — provided with sufficient habitat and protected from excessive exploitation — are essentially immortal.

Photo courtesty Louisiana Dept. Wildlife & Fisheries

Nutria are large, semi-aquatic rodents with prodigious appetites. Regulated trapping of nutria helps prevent erosion of fragile wetlands while providing trappers with valuable food and fur.

Trapping can:

1) Hold furbearer populations in check and keep them stable or even reduce them if there is a need
2) Help protect endangered species by protecting their habitat
3) Provide disease control protection (limiting population size slows disease transmission)
4) Recreation/commercial/subsistence as a legitimate activity in and of itself.
5) Facilities protection from damage done either directly or indirectly by furbearers
6) Migratory bird protection,
7) Assists research efforts,
8) Provides a method for surveys/monitoring,
9) Public safety (removes animals that are or might become dangerous)
10) Control of feral animals and limiting damages done by them (including damage to endemic or native species)

Trapping is Highly Regulated

Within the United States and Canada, state, provincial or territorial fish and wildlife agencies have legal authority and pass laws governing furbearer resources. There are various types of laws that apply to trapping within each jurisdiction, and they are enforced by local environmental police, conservation officers and/or game wardens. Laws that regulate trapping by various means include the following:

- Mandatory licensing of trappers
- Mandatory daily checking of traps
- Mandatory trapper education
- Restricted seasons for trapping
- Restrictions on the size of traps
- Restricted areas for trapping certain species
- Restrictions on the types of traps
- Mandatory tagging of traps to identify owner

Professional wildlife biologists monitor the populations of furbearing animals. Scientific studies are conducted to ensure that these species are managed properly. In addition, research focused on the traps themselves identifies which traps work best with each species, and which need improvements. New and improved traps are continually being developed.

Hunter Education Requirements

Residents and non-residents born on or after January 1, 1961 must successfully complete a hunter education course prior to purchasing a season hunting license. However, a hunter education course is not required to purchase an Apprentice License or a three (3) day Combo Hunting/Fishing License. Hunter education courses certified or mandated by any state wildlife agency or Canadian province are accepted. Hunter Education is not required to hunt on one's own land or land of a parent or guardian. Course options include a FREE classroom course, a FREE CD-ROM course or three online courses (with varying fees). Students may request a copy of the FREE CD-ROM from any Game Management or Law Enforcement office.

Hunters Under Age 12
Hunters under age 12 are not required to complete a hunter education course. However, no one under age 12 may hunt unless under direct supervision, i.e. within sight or hearing of licensed adult (at least 18 yrs old) hunter. It is unlawful for an adult to permit their child/ ward under age 12 to hunt unsupervised.

Hunters Age 12 - 15
Must complete a hunter education course prior to hunting unless under direct supervision of a licensed adult hunter. It is unlawful for an adult to permit their child or ward (12-15) to hunt without adult supervision unless the child possesses a hunter education certificate while hunting.

Hunters Age 16 - 25
Must present a hunter education certificate when purchasing a season hunting license and must possess the certificate while hunting.

Hunters Over Age 25
Hunters over age 25 and born after January 1, 1961 must meet hunter education course requirements but need not present their hunter education certificate when buying a season hunting license or possess it while hunting.

Glossary (From *Working with Wildlife #13 North Carolina Cooperative Extension Service)*

Biological Diversity - The variety of life forms in a given area. Diversity can be categorized in terms of the number of species, the variety in the area's plant and animal communities, the genetic variability of the animals, or a combination of these elements.

Browse - Palatable twigs, shoots, leaves and buds of woody plants. Term often used to describe a category of deer foods.

Carnivores - The category of animals that prey or feed upon animals and insects. (carni-, flesh; vore-, eater)

Carrying Capacity - The maximum number of animals that a specific habitat or area can support without causing deterioration or degradation of that habitat.

Community - A collective term used to describe an assemblage of organisms living together

Cover A description of the protection and seclusion afforded by a combination of vegetation and topography. Some types of cover are:

- Brood Cover - Low vegetation such as grasses or forbs that afford protection for ground nesters to raise their young.
- Escape Cover - Thickets, vine mats, hollow trees, rock crevices, blowdowns or burrows that are a means of concealment from predators or hunters.
- Nesting Cover - Vegetation that protects nesting sites: forbs, grasses, logging slash, low shrubs, windrows or thickets for quail, grouse, many species of songbirds, and rabbits.
- Roosting Cover - Overnight cover such as coniferous stands for wild turkey, honeysuckle vines for quail, dense pine saplings and small poles for doves, beaver ponds for wood ducks, or old snags suitable for woodpeckers and many songbirds.
- Winter Cover - Cover required for over-wintering, such as den trees for squirrels, raccoons and bear, or dense evergreen thickets for deer.

Daylighting" - The cutting back of canopy and midstory vegetation that borders logging roads. By exposing road surfaces and edges to sunlight, "daylighting" promotes rapid regrowth of herbaceous and shrub species and increases edge complexity.

Den Tree (Cavity tree) - A tree that contains a weather-tight cavity used for nesting or protection.

Diversity - The distribution and abundance of different plant and animal communities and species within a given area.

Ecotone - The transition zone between communities, for example, the boundary between field and forest. Ecotones often are rich in species as they harbor species from adjoining communities and their predators.

Ecosystem Management - The concept of resource management that considers land, water, air, plants, and animals to be an entire system that should be managed as a whole. All of these elements are interrelated (including man).

Edge Effect - Refers to the diversity and abundance of the wildlife species that are attracted to areas where two or more vegetative types or age classes meet.

Endangered and Threatened Species - A species is endangered when the total number of remaining members may not be sufficient to produce enough offspring to ensure survival of the species. A threatened species exhibits declining or dangerously low populations but still has enough members to maintain or increase numbers

Forage - All browse and herbaceous plant foods that are available to animals.

Forest Type - Groups of tree species commonly growing in the same stand because their environmental requirements are similar.

Forb - Any herbaceous plant other than grasses or grass-like plants.

Habitat - An area that provides an animal or plant with adequate food, water, shelter, and living space.

Herbivores - The category of animals that feed on plants. (herbi-, plant; -vore, eater)

Home Range - The area used by an animal to fulfill its food, cover, water, and reproductive requirements.

Inclusion - Small areas within a stand which have an inherently different forest and management type than the stand in which they occur. They can be treated differently than the remainder of the stand.

Legumes - Plants that capture organic nitrogen from the air. These plants, which typically form seeds in pods include soybeans, peas, alfalfa, lespedeza, and locust.

Mast- Fruits or nuts used as a food source by wildlife.

- Hard mast is the fruit or nuts of trees such as oaks, beech, walnut, chinquapin, and hickories.
- Soft mast includes the fruits and berries of dogwood, viburnums, elderberry, huckleberry, spice bush, grape, raspberry, and blackberry

Neotropical Migrants - The category of migratory birds that spend the winter in Central and South America and return to North America to breed.

Nest Box/Structure - An artificial box, platform, or other structure that enhances the reproductive habitat for desirable species.

Plant or Habitat Diversity - A variety of food or cover for wildlife. Variation may occur at one point in time or over a period of time such as during the course of a season. Seasonal diversity of food and cover is often critical to the survival of a species.

Prescribed Burning - The controlled application of fire to wildland fuels to attain planned resource management objectives (brush control, wildfire hazard reduction, wildlife habitat improvements, etc.).

Prescribed Burning Cycle - The interval of time between prescribed burns. This frequency, along with intensity, largely determines the response of forbs, legumes and shrubs in the understory.

Omnivores - The category of animals that feed on both plants and animals. (omni-, all; - vore, eater)

Stewardship Management (Total Resource Management) - The practice of managing all the natural resources as a whole. Utilizing and enjoying the natural resources with responsibility and care for the future.

Streamside Management Zone (SMZ) - Buffer strips, filter strips, or riparian zones adjacent to water bodies. Width varies, but must be sufficient to effectively prevent sedimentation and retain stream water temperature and/or wildlife cover.

Succession - The change in species composition and community structure over time. (Example: the development of a stand from field to mature forest).

Successional Disking or Mowing - Mechanical methods of maintaining or promoting the regrowth of non-woody plants. Periodic mowing prevents brush from maturing to trees.

Transition Zone - The gradual progression of one habitat type into another. It occurs between upland and lowland. This band usually contains high-quality wildlife food including both soft and hard mast, as well as forage.

Understory - a). The layer formed by the crowns of smaller trees in a forest. b). The trees beneath the forest canopy.

Wildlife - A broad term that includes non-domesticated animals but not exclusively mammals, birds, reptiles, and amphibians.

Wildlife Openings - Openings maintained to meet food or cover needs for wildlife. They may contain native vegetation or planted crops and can be maintained by burning, disking, mowing, planting, or fertilizing.