Maryland State Envirothon

Wildlife Study Guide

Revised: February 2025

The Maryland Envirothon

Maryland Department of Natural Resources

This Wildlife Study Guide has been designed as a basic guide to wildlife ecology, management and legislation affecting wildlife in Maryland.

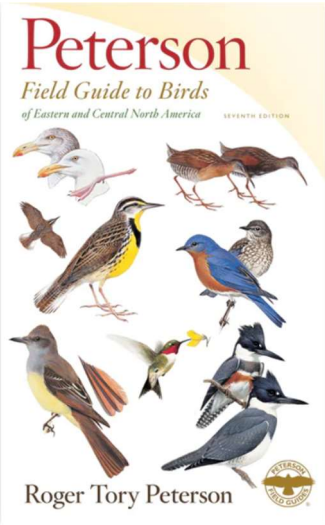
Green treefrog

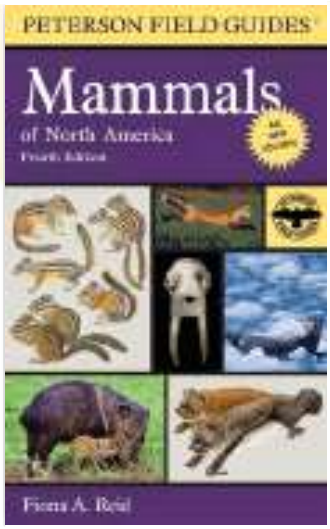
Northern goshawk chicks

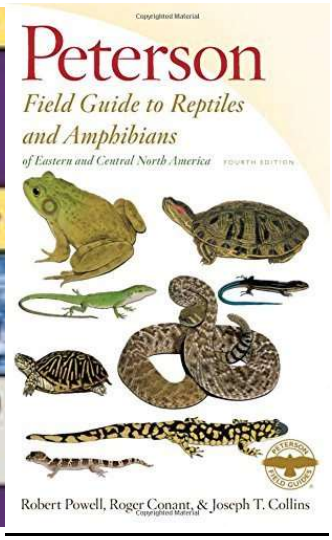
Key Point 1: Wildlife Identification

Identifying wildlife and wildlife signs using keys and/or field guides is essential for studying wildlife. The wildlife section focuses on birds, mammals and herps (reptiles and amphibians). Wildlife, however, encompasses any free-ranging, non-domestic animal including invertebrates and fish.

1. Bird Identification
2. Mammal Identification
3. Reptile and Amphibian Identification





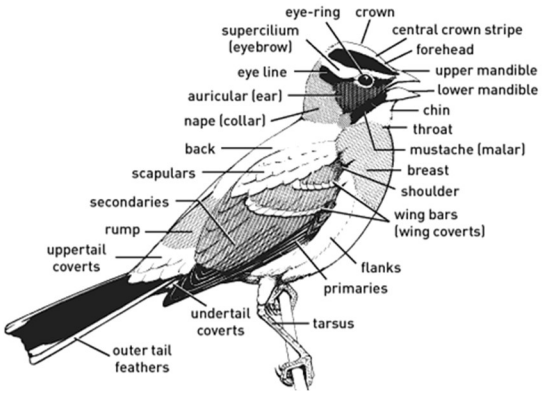


Identifying Birds

Field guides are a great way to identify local bird species. The Maryland Envirothon uses the Peterson Field Guide to Eastern Birds (7th edition) for bird identification. To identify birds, you should pay attention to 4 key features:

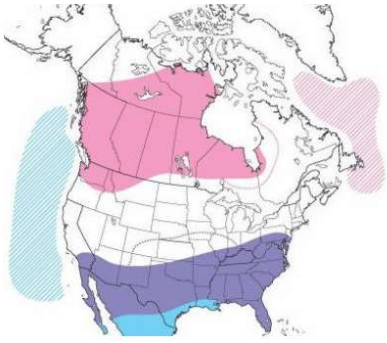
- Size & Shape
  - *Is the bird plump or slender? Were its wings rounded or pointed? What was the shape of its bill? Was it small like a warbler or hook-shaped like a bird of prey?*
- Color Pattern
  - *What field marks can you see? What was the color or pattern on the bird's chest? What color are its wings? What patterns does it have on its tail?*
- Behavior
  - *What was the bird doing while you saw it? Was it perched in a tree, darting after an insect, or wading in a wetland?*
- Habitat
  - *Where was the bird seen? In a forest? In a wetland?*

The guide is grouped by plates on starting on page 16. These plates correspond to species groupings such as Geese, Swans, and Ducks.



Each species account has a picture on the right page, sometimes with arrows pointing to outstanding field marks, and text on the left page. The text includes a description, actions, similar species, voice, range and habitat. Small range maps are located under the species name with a reference to a larger map at the back of the book. For example, M 7 refers to Map 7 in the index.

The following colors depict different ranges on the maps:



- **Red** = Breeding range
- **Blue** = Winter Range
- **Purple** = Resident year-round
- **Red dash** = irregular summer range
- **Blue dash**= irregular winter range
- **Purple dash**= irregular year-round range
- **Striped**= pelagic range

Scientific names are listed for each species while Family names are listed at the top of the left page. Sometimes, you have to flip back past a species account to determine its Family or Order

Identifying Mammals

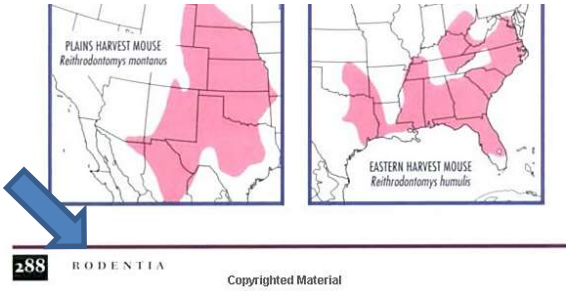
<u>The Maryland Envirothon uses the Peterson Field Guide to Mammals of North America (4th edition) for mammal identification. To identify mammals, you should pay attention to the same key features such as:</u>

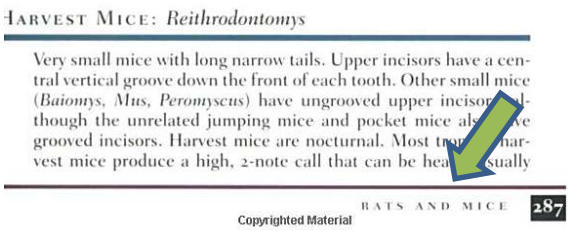
- Size and Shape
- Color Pattern
- Behavior
- Habitat

The Peterson Field Guide to Mammals of North America groups similar species on color plates at the beginning of the guide. Each plate has a color illustration of the mammal with key features pointed out by arrows. The text opposite of the color plates gives basic identification information and a page number for more detailed species accounts. It is helpful to learn species groupings to better use the guide. For example, knowing how a shrew is different from a mouse will make it easier to navigate the guide.

In the back of the guide, the species accounts list information such as habits, reproduction, similar species, and ranges. It is important to check ranges and read accounts of similar species before coming to a conclusion on identification. The Maryland Envirothon test will only include species found within Maryland.

The common names for mammal families are listed on the bottom of the right-hand pages in the back of the guide (green arrow). To find out the scientific Family names, turn backwards in the guide. Each Family will have a page describing the characteristics. Similarly, the scientific name for Orders will be listed on the left-hand pages in the back of the guide (blue arrow).

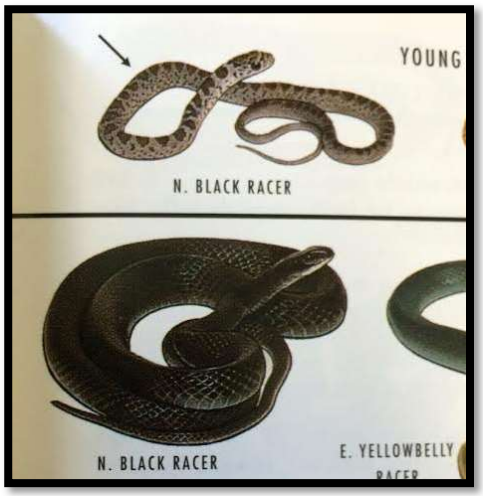




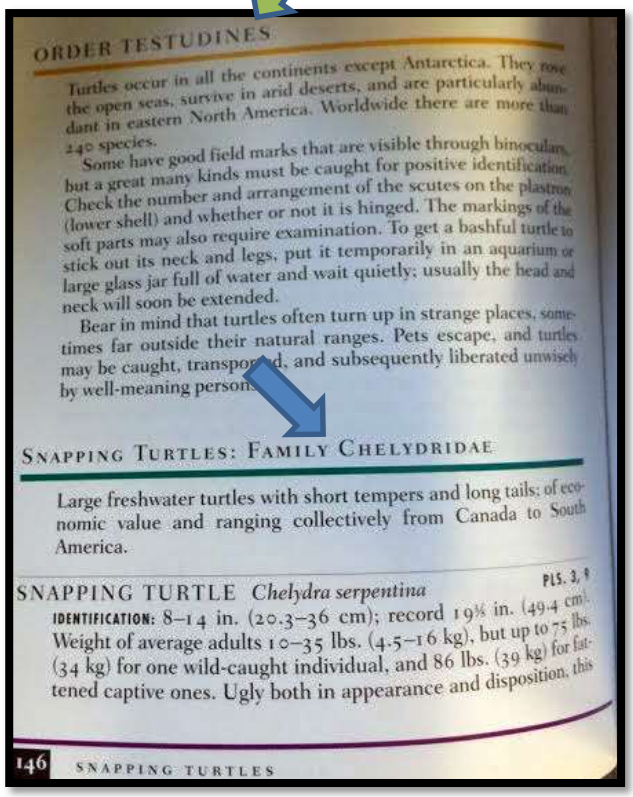
Identifying Reptiles and Amphibians

The Maryland Envirothon uses the Peterson Field Guide to Reptiles and Amphibians of Eastern/Central North America (4th edition). To identify reptiles and amphibians, you should pay attention to key features such as:

- Size and Shape
- Color Pattern
- Behavior
- Habitat



The Peterson Field Guide to Reptiles and Amphibians of Eastern/Central North America groups similar species on color plates at the beginning of the guide. Each plate has a color illustration of the animal with key features pointed out by arrows. The text opposite of the color plates gives basic identification information and a page number for more detailed species accounts.


ORDER TESTUDINES

Turtles occur in all the continents except Antarctica. They rove the open seas, survive in arid deserts, and are particularly abundant in eastern North America. Worldwide there are more than 240 species.

Some have good field marks that are visible through binoculars, but a great many kinds must be caught for positive identification. Check the number and arrangement of the scutes on the plastron (lower shell) and whether or not it is hinged. The markings of the soft parts may also require examination. To get a bashful turtle to stick out its neck and legs, put it temporarily in an aquarium or large glass jar full of water and wait quietly; usually the head and neck will soon be extended.

Bear in mind that turtles often turn up in strange places, sometimes far outside their natural ranges. Pets escape, and turtles may be caught, transported, and subsequently liberated unwisely by well-meaning persons.

SNAPPING TURTLES: FAMILY CHELYDRIDAE

Large freshwater turtles with short tempers and long tails; of economic value and ranging collectively from Canada to South America.

SNAPPING TURTLE *Chelydra serpentina* PLS. 3, 9

IDENTIFICATION: 8–14 in. (20.3–36 cm); record 19¾ in. (49.4 cm). Weight of average adults 10–35 lbs. (4.5–16 kg), but up to 75 lbs. (34 kg) for one wild-caught individual, and 86 lbs. (39 kg) for fattened captive ones. Ugly both in appearance and disposition, this

146 SNAPPING TURTLES

At the end of each major group (ex. Salamanders), the species accounts list information such as habits, habitat, reproduction, similar species, and ranges. It is important to check ranges and read accounts of similar species before coming to a conclusion on identification. Keep in mind, some juvenile turtles and juvenile snakes can look different from adults. The Maryland Envirothon test will only include species found within Maryland.

The common and scientific names for reptile and amphibian families are listed on the bottom of the left-hand pages in the species account pages. Each Family will have a page describing the characteristics (blue arrow). Similarly, the common name for Orders will be listed on the bottom of the right-hand pages. Turn past the Family pages to find the scientific names of the Order (green arrow).

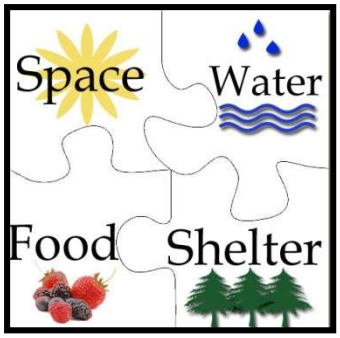
Key Point 2: Wildlife Ecology

Wildlife ecology is a branch of science dealing with the interrelationships of wildlife with their own species, with other species, and with their nonliving environment. This section of the study guide has been designed as an introduction to Wildlife Ecology for the Maryland State Envirothon. The following concepts are covered within this portion of the guide:

1. Habitat
2. Plant Succession and Its Effect on Wildlife
3. Edges and Contrast
4. Food Chains and Food Webs
5. Communities and Ecosystems
6. Species Richness and Diversity
7. Natural Selection and Adaptations
8. Wildlife Population Dynamics
9. Biodiversity

River otters

Habitat



Habitat refers to resources required by wildlife to survive and reproduce. These requirements include both physical and biological resources. The four basic habitat requirements are food, water, cover (shelter) and space. These requirements fit together like pieces in a puzzle.

Space is often a forgotten element in habitat. However, every species has a minimum "space" requirement. Space is needed to obtain life's necessities. A large predator, such a coyote, needs more space to meet its needs than a green frog. It should be noted that each species has its own set of specific habitat requirements. For example, the gray squirrel uses acorns for food while the woodpecker eats insects. Mallards use thick grass and forb cover for nesting, while brown thrashers nest in shrubs.

Habitat requirements for wildlife change during the seasons of the year. The food wildlife eat in the winter may be much different than what is consumed in the summer. For example, white-tailed deer eat leafy, herbaceous plants in the summer and switch to woody stems, buds, and acorns in winter. The cover wildlife need for nesting also may be much different than the cover needed to survive a winter storm.

Sometimes, groups of species tend to occur in similar types of habitats. These are known as habitat guilds. An example of a habitat guild would be grassland species which might include short-eared owls, grasshopper sparrows, and meadow voles. Other types of habitat guilds can include forest, wetland, urban/farmstead, edge/generalist guilds, and others.

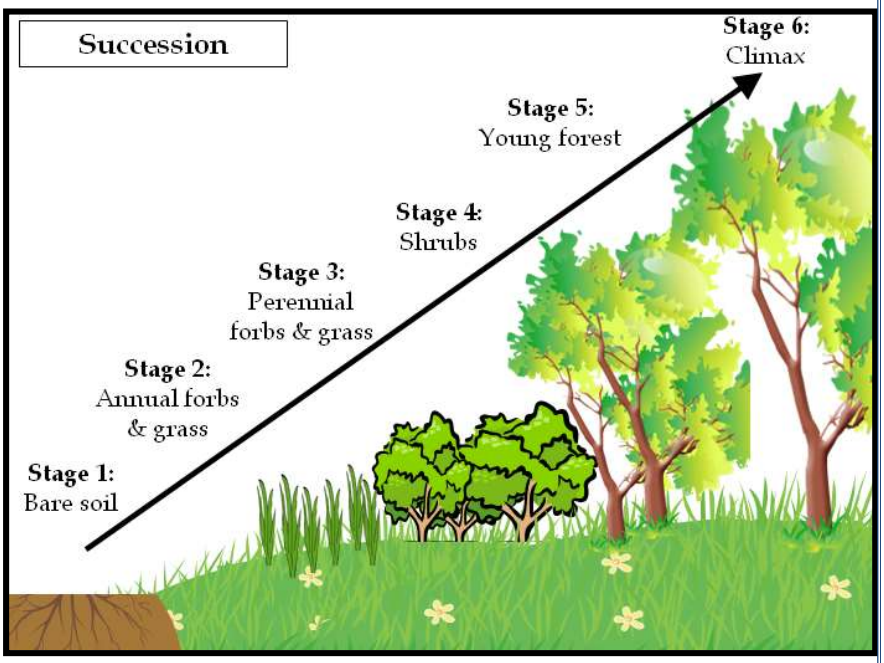
Many times, aerial photos are used to determine suitable wildlife habitat in an area. Aerial photos show general landscape composition as well as the interspersion and arrangement of vegetation types and successional stages. By understanding what habitat types certain species of wildlife prefer, you can infer which areas may be suitable for which species. For example, if you know that meadow voles prefer high grassland habitat, then a heavily forested landscape like Habitat B pictured to the right would not be suitable for them.

Plant Succession and Its Effect on Wildlife

Plant succession is the gradual change in plant species in a given area over time. Succession generally occurs in steps or stages until a stable or climax community is reached. Disturbance events such as fire, flooding, wind storms and grazing continually set back succession and the cycle will continue forward from the new starting point. Disturbance events can be natural or caused by humans (anthropogenic). In some cases, anthropogenic disturbance can mimic natural disturbance. In other cases, natural disturbances such as fires and floods are prevented from occurring by humans.

The rate succession occurs is dependent on factors such as climate, level of disturbance and species involved. Succession typically occurs rapidly in areas with warm temperatures and abundant rainfall such as deciduous forests in the eastern United States. Large-scale disturbances such as volcanoes can also cause succession to occur at a much slower rate than smaller disturbances like windfalls in a wooded area. In addition, some plant species grow much more rapidly than others which can alter the rate of succession.

Succession is very important in wildlife management as wildlife species typically depend on one or several successional stages to meet their various life requirements. Species such as scarlet tanagers and fishers are typically found in one or two successional stages while others like wild turkey and white-tailed deer require multiple successional stages.



Succession in terrestrial environments is generally broken into 6 different stages beginning with bare ground and ending with a climax community. These stages are:

1.) Bare ground
2.) Annual forbs and grasses
3.) Perennial forbs and grasses
4.) Shrubland
5.) Young forest
6.) Mature forest (climax)

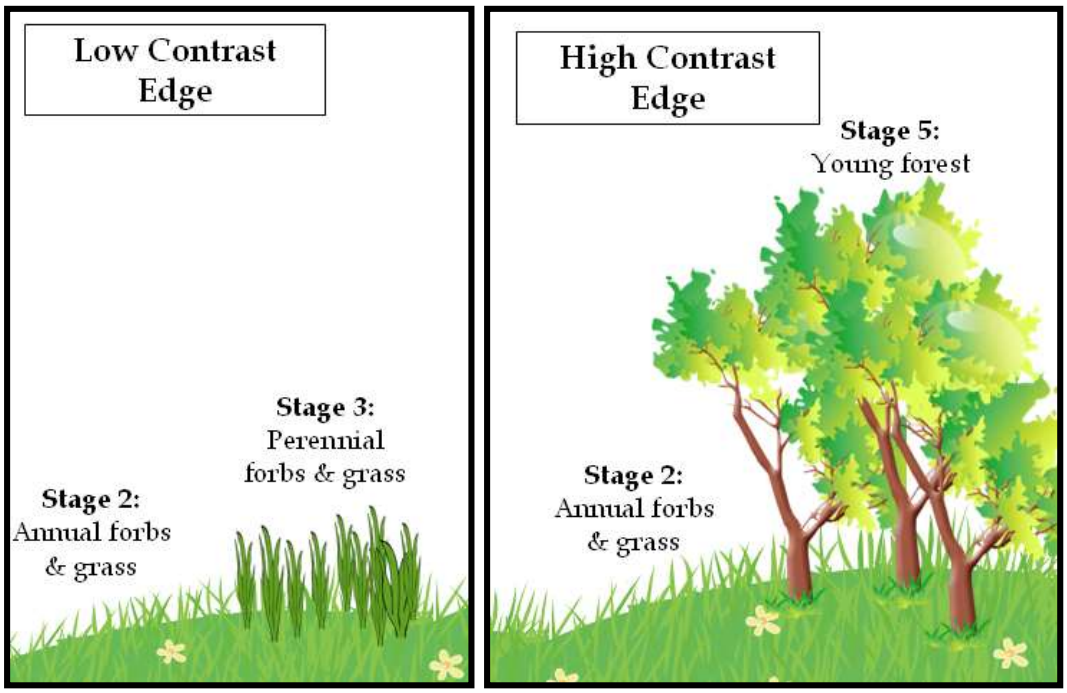
In some regions, natural factors such as the soil or climate will prevent succession from proceeding past a certain stage. For instance, in the short-grass prairie region, lack of precipitation often prevents succession from proceeding past stage 3 (perennial forbs and grasses). In this case, stage 3 would be considered the climax community.

Nature never gives up. Even abandoned concrete parking lots are eventually taken over by plants. Plants first grow in the cracks and around the edges, then, if left alone, a concrete parking lot will eventually become "habitat" for some wildlife species.

Edges and Contrast:

The boundary where two or more different types of vegetation or successional stages meet is called an edge or an ecotone. An example would be the area where a forest and a field meet. The transition between different vegetation types can be gradual or abrupt. In places where a gradual change occurs, an edge looks a little like both successional stages or vegetation types. Where abrupt changes occur, the edge is narrow.

Edges produced by successional stages that have extremely different types of vegetation are defined as having high contrast or a hard edge. An area where a young forest (Stage 5) meets an annual grass field (Stage 2) would be an example of high contrast. Many times, areas with high contrast edges have high species richness. However, the edge between an annual forb and grass field (Stage 2) and a perennial forb and grass field (State 3) would be a low contrast (or a soft edge) due to its gradual transition.



Edges attract many different wildlife species because the variety of food, cover, and other habitat requirements are arranged close together. This is due to the increased interspersion of vegetation along the edges. White-tailed deer, rabbits, and bobwhite quail benefit from increased edge habitat.

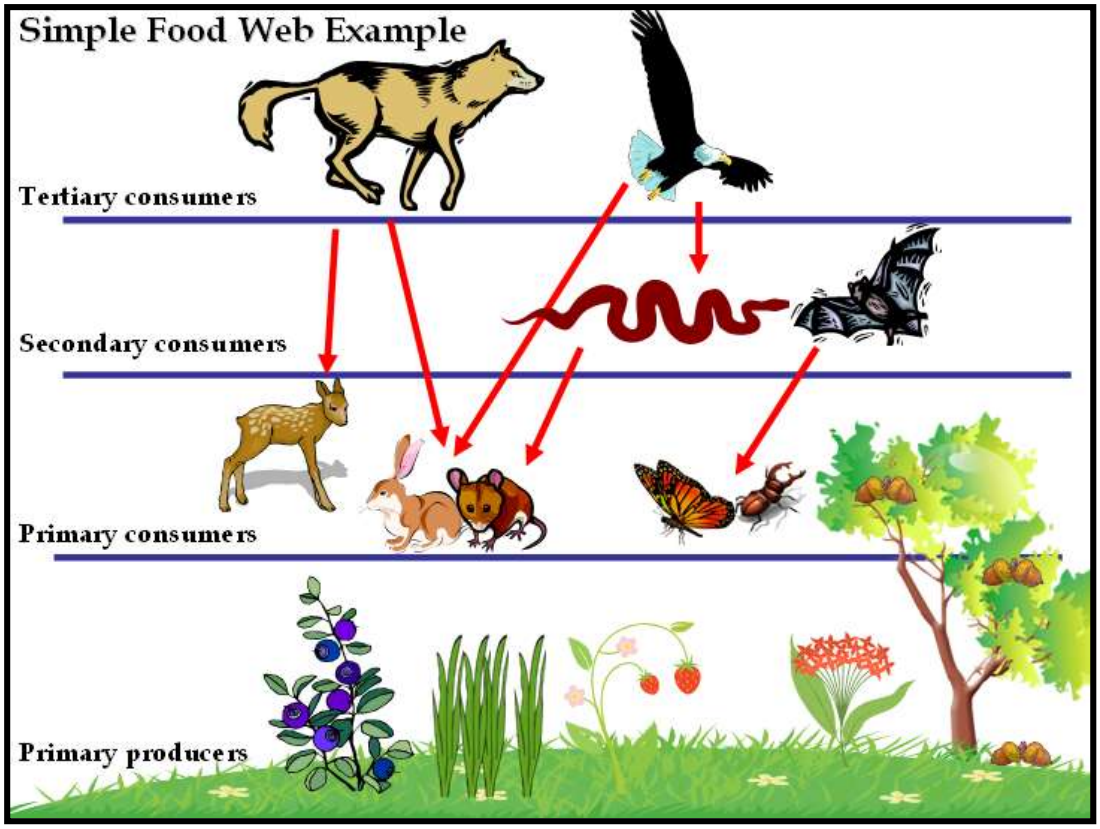
While some species benefit from edges, others do not. Thus, examining an aerial photo and counting the number of edges is not necessarily a good indicator of habitat quality.

Like other areas of wildlife management, it is best to research the needs of the focal species before altering the habitat. A balance of edge with blocks of vegetation in one successional stage is desirable. Areas with unbroken blocks that are 50 to 100 acres in size are considered to have a good balance of edge and unbroken blocks.

Food Chains and Food Webs

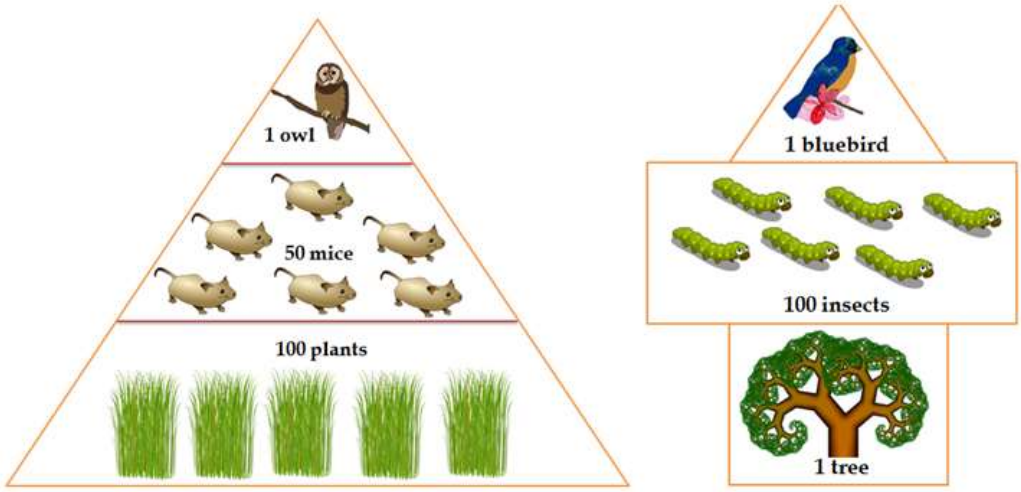
A food chain is a model that shows how energy is passed, in the form of food, from one organism to another. A series of connected food chains make up a food web. Food chains and webs are organized by trophic levels which are feeding positions in the web. At each level of the food chain, energy is lost because it is used by the organism itself for respiration. This energy loss limits the number of steps within a food chain.

The lowest trophic level contains the producers (autotrophs) which manufacture their own food and the decomposers which break down existing organic material. Plants generally fall into producer category while fungi are typically decomposers. The organisms which feed on plants and other producers are then considered to be primary consumers. Anything that eats a primary consumer is then considered to be a secondary consumer. Animals that eat secondary consumers are known as tertiary consumers. Food chains and food webs are, therefore, comprised of multiple predator and prey relationships.



Within the food chain, some organisms only consume plant material. These organisms are considered to be herbivores. Typically, herbivores are classified as primary consumers. This category includes species such as rabbits and white-tailed deer. Organisms that consume both plants and animals are defined as omnivores, while organisms which only eat other organisms are considered to be carnivores. Foxes, raccoons and opossums are omnivores while bobcats and cougars are carnivores. Some species, like the short-tailed shrew, only eat insects and invertebrates. These species are considered to be insectivores. Species that feed almost exclusively on seeds are considered to be granivores.

In most systems, the number of top-level consumers (secondary and tertiary) is much less than the number of primary consumers and producers. A pyramid of numbers shows the relative number of organisms at each stage of a food chain. Sometimes, a pyramid of numbers is not a very good representation. For example, in a food chain with a bluebird, insects, and an oak tree, there would typically be more insects feeding off a single tree which would skew the proportions (see figure below). Therefore, a pyramid of biomass can sometimes be a better representation of trophic levels. A pyramid of biomass shows the total mass of organisms at each stage of a food chain. In general, all producers have a higher biomass than the primary consumer, so a pyramid will always be produced.



Examples of a pyramid of numbers. The image on the right demonstrates how it can be skewed if just using numbers.

Communities and Ecosystems

A community is defined as all of the plants and animal populations living in a defined area. The composition of the community changes over time due to climate and plant

succession. Communities interact with abiotic (non-living) resources such as soil, air, water and sunlight. A tidal marsh is an example of a community. Tidal marshes are made up of wetland plants such as cattails, spadderdock, rushes and grasses in addition to animals such as wading birds, muskrats and turtles. These marshes are regularly flooded by the tides and have thick, organic soils. The size of various communities can vary greatly. For example, a decaying log can contain a community of mosses, invertebrates, fungi and bacteria. However, the decaying log community is much smaller than a tidal marsh community.

The interactions of communities and abiotic conditions form an ecosystem. Ecosystems have no particular size. An ecosystem can be as big as a rainforest or as little as a puddle.

Tidal marsh in Anne Arundel County

Species Richness and Diversity

A species is a type of organism whose members can interbreed and produce viable (reproductive) offspring. The number of different wildlife species found in an area is known as species richness. The combination of species richness and species abundance is known as species diversity. Many times, species diversity can be used to determine the health of an ecosystem. If an ecosystem has poor species diversity, then it may not be functioning properly. In general, the productivity of an ecosystem is greater when species diversity is higher.

Some species help maintain species diversity within an ecosystem. Species that play a critical role in maintaining structure of an ecological community are known as keystone species. Beavers are a keystone species in Maryland. Beavers create wetland habitat which is used for food and cover for a variety of other species.

Species which are confined to certain areas or regions are known as endemic species. One notable endemic – and now possibly extinct – species in Maryland is the Maryland darter (*Etheostoma sellare*). In addition to the Maryland darter, other Maryland endemics include several species of cave amphipods in the *Stygobromus* genus including *Stygobromus felleri* named after a Maryland Department of Natural Resources' biologist, Dan Feller, who first documented the species.

Natural Selection and Adaptations

Natural selection is the process whereby organisms better adapted to their environment tend to survive and produce more offspring. It is important to keep in mind that natural selection ***does not*** act on individuals; it acts on populations. Adaptations help organisms survive and reproduce in their ecological niche or habitat. Adaptations occur over many years. Adaptations can be physical, behavioral or physiological.

Long-tailed weasels have well-developed carnassials

A physical (anatomical) adaptation is one that entails a physical feature like the shape or color of an animal. Camouflage is an excellent example of a physical adaptation. Other example of physical adaptations include the well-developed carnassial teeth on mustelids (weasels) that help them shear flesh or the clear eyelids that beavers have to be able to see underwater.

Behavioral adaptations are adaptations that have been learned or inherited. Language, swarming and use of tools are all examples of behavioral adaptations. Other behavioral adaptations include activity times for animals. For example, animals can be diurnal (active during the day), nocturnal (active during the night), or crepuscular (active at dawn and dusk).

Physiological adaptations permit the organism to perform special functions. An example of this would be the production of venom by timber rattlesnakes. Another physiological adaptation is the process of estivation or when some animals enter a state of inactivity during prolonged periods of drought or high temperatures.

Wildlife Population Dynamics

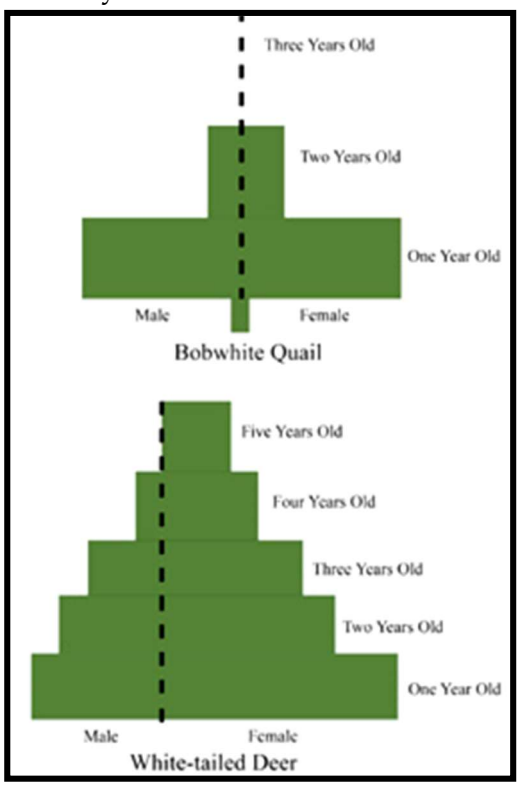
Populations are a group of organisms that occupy a certain area at a certain time. The factors and their interactions that control or influence a system or process are known as dynamics. Therefore, wildlife population dynamics are the study of factors and their interactions that control or influence the growth, stability, and decline of wildlife.

Wildlife population dynamics are mainly affected by factors such as births, deaths, immigration and emigration. The balance of births and immigrations with deaths and emigrations will result in zero population growth. However, if more individuals are added to a population, then the population will grow.

Natality is the production of new individuals in a population through birth or hatching. Natality can be affected by breeding age, mating habits and population density. For

example, rabbits have a higher natality than black bears because they can breed at a much younger age and more often than bears. The number of young born with each birthing (aka litter size) can also impact natality. The physical potential to reproduce is called fecundity. The actual number of offspring produced is known as fertility.

Conversely, mortality deals with the level of death within a population. Factors that cause mortality in wildlife populations include predation, disease and parasites, weather, starvation, pollution, hunting and accidents. Mortality can be either compensatory or additive. Compensatory mortality occurs when specific causes of death tend to balance or compensate each other. For example, bobwhite quail have great difficulty surviving severe winters. When severe winter occurs, many bobwhite quail die from exposure, and fewer animals will be taken by predators. Wildlife managers use the concept of compensatory mortality when establishing hunting and trapping regulations. In contrast, additive mortality is when one kind of mortality is added to the other sources of mortality. This type of mortality can lead to decline of wildlife populations.



Example of an age-structure pyramid for quail and deer

Natality and mortality are usually expressed as rates that reflect pressures to increase and decrease population size. The size of a population is impacted by many factors which vary over time. At a particular point in time, natality factors or mortality factors may dominate, causing a population to increase or decrease. Factors which cause natality and mortality can be predictable or unpredictable.

The proportion of young and old age classes reveals a lot about population dynamics. Generally, there should be a balance among the age classes, and the "proper" balance will vary by species and season. Normally, the age structure can be depicted by a triangle, with the numerous young on the bottom and the very few old animals at the top. "Age" might be measured in years, weeks, or days, depending upon the species considered. At the end of the food-rich season, the youngest age classes are usually at their highest density. The winter will kill many individuals, but usually the young and very old age classes experience the highest mortality rates. Humans sometimes have a strong impact on the age structure of a population. For example, hunting restrictions can be placed on antler sizes of bucks in an effort to increase the number of older, trophy bucks.

Sex ratios and mating systems can also impact wildlife population dynamics. The age-sex pyramids above show that the distributions of males vs females in the quail and deer populations are very different. For monogamous species, like bobwhite quail, sex ratios should be almost equally divided in healthy populations. In polygamous species (where one male mates with many females), then the sex ratio is usually skewed to where there are more females present than males. In wildlife management, it is important to be able to age and sex species to understand population dynamics

Biodiversity

Biodiversity is simply the variety of life on Earth. Biodiversity encompasses the numbers of plants, animals, fungi, microorganisms and their associated habitats. Biodiversity is important because it increases ecosystem productivity. Diverse ecosystems can also recover from disturbances easier and can provide more resources for people and wildlife.

Biodiversity can be broken into three main categories: genetic, species and ecosystem diversity. Genetic biodiversity refers to the total number of genetic characteristics in the genetic makeup of a species. Genes define the traits and behaviors shared by a species and also explain the differences found among the individuals within the species. Knowledge of genetic diversity can be a useful tool for managing biodiversity. Genetics can be used to assess the consequences of wildlife introductions, transplantations, stockings, and harvests. A species with a higher genetic biodiversity is more likely to be able to adapt to changing environments.

Species diversity is the combination of species richness and species abundance in a given area. Often, this is the documented form of diversity. For example, birding groups like the Maryland Ornithological Association often perform Christmas Bird Counts to assess diversity of birds in Maryland. Currently, over 15,000 species have been documented in Maryland!

Ecosystem biodiversity is all the different habitats, biological communities and ecological processes, as well as variation within individual ecosystems.

Two of the greatest threats to biodiversity today are habitat destruction and invasive species. The loss of biodiversity can impact the economy, recreation, and more.

Key Point 3: Conservation and Management of Wildlife

Before an individual can evaluate wildlife habitat and make management recommendations, some basic concepts about habitat and its relation to different wildlife species should be understood.

This section was designed as an introduction to wildlife management for Maryland State Envirothon participants. Many of the concepts have been simplified to give a broad overview of wildlife management. The following concepts are covered within this section:

1. Habitat Management
2. Home Range, Movements, and Migration
3. Habitat Loss, Fragmentation, and Degradation
4. Carrying Capacity
5. Wildlife Population Management and Strategies
6. Federal and State Roles for Managing Wildlife
7. Hunting and Trapping as a Wildlife Management Tools

A biologist conducts a controlled burn to manage for rare species

Habitat Management

Habitat is essential for wildlife, and sometimes to maximize the amount of wildlife using an area or to increase focal species, habitat management is necessary. Habitat management is any alteration to the focal area.

Planting for Wildlife

One common habitat practice is planting for wildlife. Planting projects can include planting for food or cover. Planting native warm season grasses provides long term benefits to many wildlife species, especially grassland species. Warm season grasses not only provide cover but also food for wildlife. Another habitat management action would be to plant shrubs to increase cover and to increase soft mast that will benefit many wildlife species.

Warm season grasses are important for many wildlife

Manipulating Plant Succession

Manipulating plant succession is another form of habitat management. One way to manipulate plant succession is through the use of controlled (aka prescribed) burns. This practice helps reduce leaf litter, release nutrients in the soil and kill or set back the growth of woody species. In areas where controlled burns are not feasible, frequent mowing may simulate some of the benefits of controlled burns. Habitat managers can also harvest timber to alter plant succession.

Habitats can also be managed by creating snags for cover, creating ponds or other water sources, controlling invasive species, etc. The possibilities are endless on how habitat can be managed. However, be sure to have a specific goal in mind before putting management practices in place.

Home Range, Movements and Migration

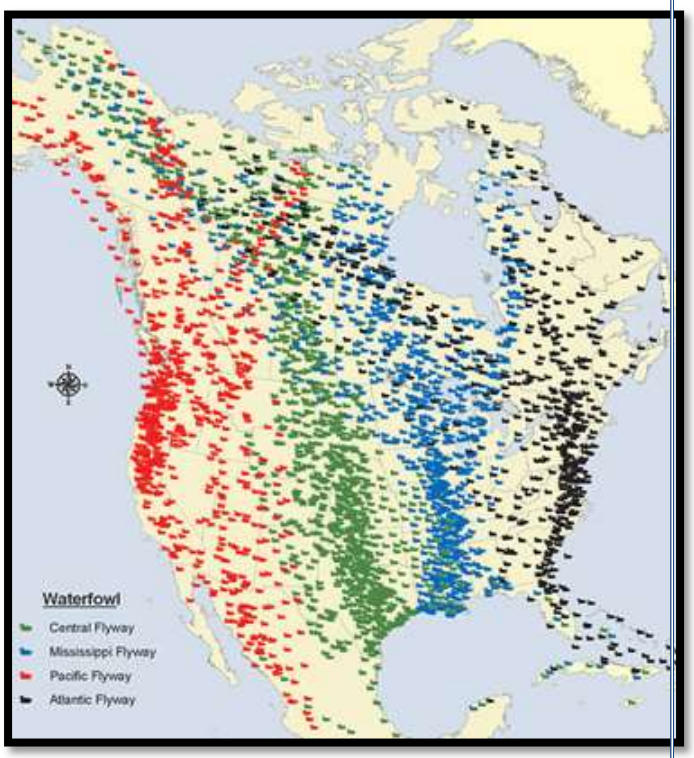
The home range of an animal is the area where an animal lives. For every species, home range size is related to habitat quality. In higher quality habitats, home ranges tend to be smaller as animals don't have to travel far to obtain necessary habitat components. Some species naturally have large home ranges, like cougars while others like shrews have relatively small home ranges.

Corridors are areas of continuous habitat that permit animals to travel securely from one habitat to another. As environments become more broken up (fragmented) from construction or roads, parking lots, urban areas, harvest of timber, clearing for agriculture, etc., small islands of vegetation remain.
Corridors allow animals to find and use the islands of suitable habitat. For example, in an urban area, relatively unbroken corridors found along riparian areas (areas between upland and aquatic habitats) and ravines allow wildlife to move into parks, and other suitable habitats. Preservation, maintenance, and creation of un-broken corridors are very important in wildlife habitat management.

For many animals, corridors are essential for migration. Migration is the periodic movement of an animal from the place where it has been living to a new area and its subsequent return journey. When animals migrate, it is usually to find food, water and/or a good place to breed.

The movement of migratory animals often corresponds with seasonal changes, though some species may migrate for shorter periods of time. Many animals migrate to northern regions during summer months. The long summer days in the northernmost portions of the world ensure a good food supply. As fall and colder weather approaches, many animals migrate south to find warm winter weather and available food. Here are three examples:

1. Ducks that nest in the northern United States must fly south to warmer climates to find food sources and wetlands that are not frozen during winter. The migration routes for birds are known as flyways. In Maryland, many of our migratory waterfowl travel along the Atlantic flyway.
2. Marbled salamanders spend most of their lives underground. However, in the fall, Marbled salamanders will migrate to seasonal wetlands known as vernal pools. Marbled salamanders will lay their eggs in the dry wetlands which hatch after spring rains fill the pools.
3. Many colorful songbirds such as Baltimore orioles and the scarlet tanager nest in U.S. forests but migrate to Central and South America and the Caribbean to spend the winter. These species are known as Neotropical migrants.



USFWS map of the 4 major waterfowl flyways in North America

Habitat Loss, Fragmentation, and Degradation

Habitat loss, fragmentation, and degradation are the largest threats to wildlife today. Impacts to habitat can be caused directly by such activities as the clearing of forests to grow crops or build homes, or indirectly, for example, by the introduction of invasive species or increased pollution run-off from development, yards, and fields.

Habitat fragmentation is the reduction of the total area of habitat in which a larger area is partitioned into smaller units. This fragmentation decreases the interior to edge ratio and isolates one fragment from other areas of habitat. Some species, such as forest interior dwelling species (aka FIDS), require large, unbroken tracts of land. FIDS include species like Neotropical migrants and mammals like the fisher. These species are negatively impacted by habitat fragmentation.

In addition to habitat loss and fragmentation, habitat also can become unsuitable for wildlife if it is degraded. Habitat degradation is the disruption of ecosystem processes so that they no longer support native wildlife. Examples of habitat degradation include: pollution from herbicides/ pesticides/ excess nutrient loading, invasive species, excessive grazing by livestock, soil erosion from mismanagement, depletion of water sources, etc.

A western Maryland stream impacted by acid mine drainage

Carrying Capacity

There is a limit to how many animals the habitat can support regardless of habitat management practices. That limit is called the habitat's "carrying capacity." The quantity and quality food, water, cover, and space determines the carrying capacity. If one basic requirement is in short supply, then the carrying capacity is lowered. Factors that prevent a population from growing any larger are known as limiting factors. By addressing limiting factors, a manager can increase the habitat's carrying capacity.

Carrying capacity varies from year to year and from season to season. Carrying capacity is usually greatest from late spring through fall. This is when most young are born and grow. With the coming of winter or summer drought, food and cover gradually diminish as does the habitat's carrying capacity.

More animals are produced each year than will survive to the next. When this happens, all extra or surplus animals will be lost in an existing habitat. Young wildlife and animals in poor health experience the highest death rates. Higher populations may also lead to greater chance of disease spreading through the populations. The obvious way to increase the number of animals is to increase the number born and reduce the number that die. However, if the habitat cannot support any more animals, then these efforts will fail. A long-term increase in population can only be accomplished by increasing the habitat's carrying capacity.

Many times, carrying capacity refers to biological carrying capacity. However, sometimes the environment can support more animals than people can deal with. Cultural carrying capacity depends on the attitudes of people. To give an example, the biological carrying capacity of white-tailed deer in an ideal habitat can be as high as 200 deer per square mile. However, humans in that area may not appreciate such a large herd of deer as the number of human-deer conflicts will increase.

Wildlife Population Management and Strategies

Wildlife populations are dynamic in nature and may vary naturally in distribution over time. Occasionally, due to a combination of factors, populations may increase beyond levels that the environment can sustain. Factors contributing to overabundant populations include isolated landscapes, absence of fire, altered predation regimes and increased access to food and water. Overabundant populations can degrade habitat, put pressure on other species, spread diseases, become nuisances to humans and occasionally may face mass starvation.

To ensure wildlife populations do not become overpopulated, wildlife managers must carefully monitor population levels. One way to control wildlife population levels is through the use of regulated hunting and trapping. If populations of a particular species are too low, then managers may utilize habitat management practices to increase habitat. One goal of wildlife management is to manage for a sustained yield. A sustained yield is the continuing yield of a biological resource, such as bear, by controlled periodic harvesting. Once managers have figured out approximately how

many animals (like bear) can be harvested each year while maintaining a constant population size, figuring out how many permits can be sold can be calculated relatively easily from harvest results from previous years.

To aid with wildlife management, some agencies classify game animals into particular groups. For example, in Maryland, species which have traditionally been hunted or trapped for their fur are known as furbearers. Similarly, the small game management classification includes eastern cottontail rabbits, squirrels, quail, ruffed grouse, pheasant and crow. Maryland's current management classifications and regulations can be found in the Guide to Hunting and Trapping.

One way to study population trends is to use a mark-recapture study. Mark-recapture studies help biologists estimate abundance or density of wildlife populations. The mark and recapture method involves capturing individuals in a natural population, marking them, returning them to that population, and subsequently recapturing some of them as a basis for estimating the size of the population at the time of marking and release. This procedure was first used by C.J.G. Petersen in studies of marine fishes and F.C. Lincoln in studies of waterfowl populations. It is often referred to as the Lincoln Index or the Petersen Index. The formula is based on the principle that if a proportion of the population was marked in some way, returned to the original population and then, after complete mixing, a second sample was taken, the proportion of marked individuals in the second sample would be the same as was marked initially in the total population. Typically, the equation for the mark-recapture study is as follows:

P=M*C/r

- P= Population
- M= # Marked at first capture
- c= # Trapped in subsequent capture
- R= # Recaptured

As an example, if a biologist wanted to estimate the population size of short-tailed shrews in an area, then he or she may want to do a mark-recapture study. If the biologist live-trapped and ear-tagged 15 short-tailed shrews during their first visit, then that number would represent 'M' in the equation or number marked at first capture. If the biologist caught 20 short-tailed shrews during the second sampling event, then that number would represent 'C' or the number trapped in subsequent capture. If 10 of those shrews had ear tags from the first sampling event, then that would represent 'R' or the number recaptured. To estimate population size of short-tailed shrews, then the equation would be as follows:

1. P= [(15*20)/10]
2. P= [300 / 10]
3. P= 30 short-tailed shrews

Of course, the accuracy of mark-recapture estimates relies on several assumptions such as the animals do not lose their marks, the chances for each individual in the population to be caught are equal and constant for both the initial and recapture periods, etc.

Federal and State Roles for Wildlife Management

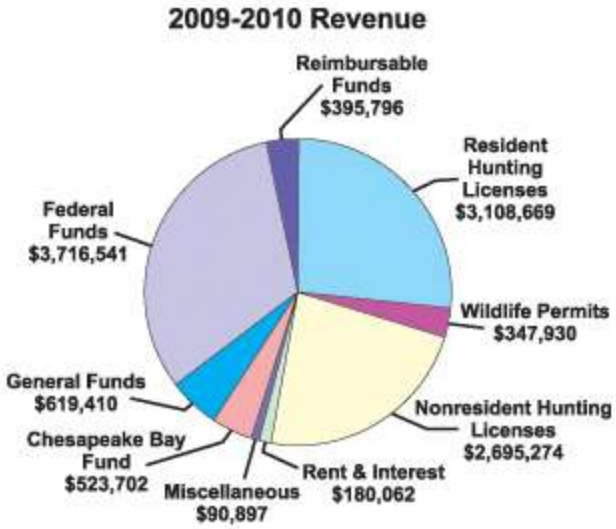
Federal Roles: United States Fish and Wildlife Service (USFWS)
The USFWS is an agency of federal government within the U.S. Department of the Interior which is dedicated to the management of fish, wildlife, and natural habitats. The mission of the agency is to work with others to conserve, protect, and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people. The USFWS enforces federal laws, protects endangered species, manages migratory birds, restores nationally significant fisheries, conserves and restores wildlife habitat, and distributes funds to state fish and wildlife agencies for management.

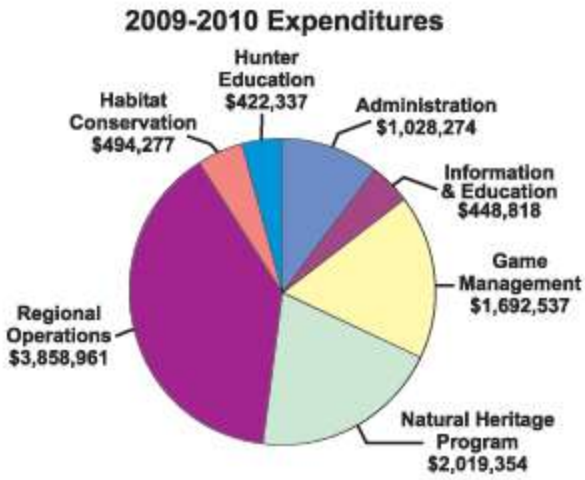
USFWS biologists study oysters

State Roles: Wildlife and Heritage Service, MD Dept of Natural Resources
The **mission** of the Maryland Wildlife and Heritage Service is to conserve Maryland's diverse native wildlife, plants and natural communities that support them, using scientific expertise and informed public input. Along with this the Service is charged with:

- Ensuring the long-term conservation of the full array of native ecosystems, natural communities and species (both animals and plants) that comprise the biological integrity of Maryland.

- Helping to educate the residents of Maryland about the laws that protect our natural resources and our citizens, as well as to help educate teachers and students and all Marylanders who are interested in the conservation of our state's natural and hunting heritage.
- Striking the necessary balance between the ecological needs of Maryland's wildlife and heritage resources, and the societal needs and desires of Maryland's citizens.





The majority of funding for Maryland's state wildlife programs comes from the sale of hunting licenses and stamps and from a dedicated, federal excise tax on sport hunting devices and ammunition. About 70% of Maryland's state budget for wildlife programs comes from these two sources. The federal aid funds are derived from an 11% excise tax on sport hunting devices and ammunition through the Pittman-Robertson Act (aka Federal Aid in Wildlife Restoration Act of 1937). For the past 60 years, sportsmen and women have been contributing to this fund through this excise tax mechanism.

Each state receives a share of the funds, which is administered by the U.S. Fish and Wildlife Service. Hunters' dollars are used for hunter education programs, enforcement of wildlife regulations, wildlife-related education programs and conservation programs. Other sources of funds include federal grants and the Chesapeake Bay and Endangered Species Fund, to which donations are made through the Maryland Income Tax Form.

Hunting and Trapping as Wildlife Management Tools

Hunting and trapping are valuable management tools for helping maintain healthy wildlife populations at or below the carrying capacity of the habitat. When animals

exceed the carrying capacity, the habitat may be damaged, and the excess animals will die. Hunting and trapping are closely regulated so that some of the excess animals in a population are removed each year. Thus, hunting and trapping can be used to manage many wildlife populations effectively and protect their habitat from damage.

Sport hunting and trapping also provide needed funding for wildlife management programs. The major sources of revenue are:

- The Pittman-Robertson Act, which provides federal money to state wildlife agencies through taxes collected on the sale of sporting arms and ammunition. A portion of Pittman-Robertson monies, specifically the taxes collected from the sale of archery equipment and handguns, goes to support state hunter education programs.
- The sale of hunting and trapping licenses and stamps.

All states have a mandatory hunter education program. In Maryland, a Certificate of Competency in Firearms and Hunting Safety is required to purchase a license. In addition, trappers must obtain a Certificate of Trapper Education. These courses ensure hunters and trappers are familiar with laws and ethics associated with hunting.

Hunting regulations, seasons, and public hunting lands may be found in the Guide to Hunting and Trapping.

Key Point 4: Wildlife and Society

Wildlife management is both an art and a science that deals with complex interactions within the environment. Wildlife biologists are tasked with balancing the needs of a diverse public with the needs for many species of wildlife and their habitats.

1. Exotic and Invasive Species
2. Rare, Threatened and Endangered Species
3. Wildlife Diseases
4. Wildlife Legislation

USFWS biologists and volunteers pull invasive water chestnut from a river

Exotic and Invasive Species

Occasionally, species have been introduced into areas and can sometimes limit diversity. Introduced species are known as non-native or exotic species. When exotic species pose biological, economic or human-health related harm, then they are considered to be an invasive species. It is important to note that not all exotic species are invasive.

Invasive species can be introduced either intentionally or unintentionally. Intentional introductions include released pets and livestock while unintentional introductions can occur through ballast water, fishing bait and horticultural escapees. Invasive species can alter hydrology (movement, distribution and quality of water), alter soil chemistry, decrease biodiversity, spread disease, and outcompete native species.

One invasive species in Maryland was the nutria (*Myocastor coypus*), a large semi-aquatic rodent from South America. Nutria consume the roots of wetland vegetation which results in erosion of wetlands. Thousands of acres of wetlands have been lost on the Eastern shore due to this animal's ravenous eating habits as well as to land subsidence. The loss of wetland habitat impacts many species which depend on wetlands for food and shelter resources. Through coordinated efforts, the nutria was declared eradicated in Maryland in 2022.

Nutria were an invasive species in Maryland

Additional Maryland invasive species include the northern snakehead, zebra mussel, tree of heaven, emerald ash borer, Japanese stiltgrass, and *Phragmites australis*.

Occasionally, species will be found far outside their expected breeding, wintering or migrating ranges. These are known as accidental species. Accidental species include manatees which occasionally show up in the Chesapeake Bay as well as birds which have been blown off course like Tropical Kingbirds.

Rare, Threatened and Endangered Species

Rare species are a group of organisms that are uncommon, scarce, or infrequently encountered. Often, these species are in danger of becoming extirpated (locally extinct) or extinct (gone forever). Species most in need of protection are classified as threatened or endangered. A species is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if

it is likely to become an endangered species within the foreseeable future. Species are ranked on global, national, and regional scales.

The Maryland Natural Heritage Program within the Wildlife and Heritage Service monitors, tracks, and manages the status of over 1,100 native plants and animals that are among the rarest and most in need of conservation efforts.

What Makes a Species Rare?
Species are rare due to a number of factors. The most common reasons for rarity include:

1. Habitat loss and degradation
2. Invasive species and competition
3. Habitat specificity
4. Low reproductive output
5. Over exploitation and persecution
6. Disease

Habitat loss and degradation are the primary threats to biodiversity today. Wild lupine (*Lupinus perennis*) is a State Threatened wildflower that has declined due to mowing, weed control, and fire suppression which has altered its habitat. In addition, overbrowsing by deer has led to its decline. The decline of wild lupine is also directly linked to the decline of the State Endangered frosted elfin (*Callophyrs irus*) which uses lupine plants as a host for its caterpillars.

Lupine is listed as Threatened in Maryland

Multiple laws protect rare, threatened, and endangered species at both national and state levels. The two most important pieces of legislation, however, are the Endangered Species Act of 1973 and the Nongame and Endangered Species Conservation Act.

Wildlife Diseases

Wildlife diseases are abnormal conditions that affect the normal function or structure of a wild animal. Wildlife diseases are highly variable and can be infectious, parasitic, toxic, physiological, congenital or degenerative. The infectious, disease spreading agents are known as pathogens, and pathogens can be transmitted from one host to another via vectors. Wildlife diseases can sometimes present a significant source of wildlife mortality as well as impact reproductive output and/or dispersal and migration. In addition, some diseases can be transmitted between humans and wildlife. These diseases are known as zoonotic**.** Therefore, it is important to understand wildlife diseases to properly manage wildlife species.

Chronic Wasting Disease:

Chronic wasting disease (CWD) is a naturally occurring disease of the brain and nervous system in deer, elk and moose (cervids). CWD is classified as transmissible spongiform encephalopathy (TSE) and attacks the brain of cervids, producing small lesions that eventually result in death of the infected animal. CWD was first recorded in Maryland in 2010 in Allegany County. Due to the detection of CWD in Allegany County, DNR has implemented a number of measures to limit the unintentional spread of the disease. These measures can be found in the Hunting and Trapping guide.

Deer with CWD

Rabies

Rabies is caused by a virus that infects the central nervous system in mammals. It is almost always transmitted through the bite of a rabid animal. The majority of rabies cases in the United States occur in wildlife including raccoons, skunks, foxes and bats. Rabies is invariably fatal; however, effective vaccines are available to protect people, pets and livestock. In some areas, oral rabies vaccine baits are distributed to vaccinate wildlife such as raccoons.

Ranaviruses

Ranaviruses are viruses of the genus *Ranavirus*. They impact cold-blooded animals including fish, reptiles and amphibians. Ranaviruses typically cause internal hemorrhaging which results in death of infected organisms. Ranaviruses likely represent the greatest pathogen threat to the biodiversity of amphibians in North America. Ranaviruses have been known about since the 1990s, and the first significant box turtle die-off in Maryland due to Ranaviruses was documented in 2008. Management recommendations include thoroughly disinfecting equipment (boots, waders, etc) before and after entering wetlands as well as not releasing captive animals and not relocating wild animals. In 2013, Ranaviruses have been documented in 7 Maryland counties.

Box turtle with ranavirus by: Scott Farnsworth

White-Nose Syndrome (WNS)

White-nose syndrome is a deadly fungal disease that affects hibernating bats. It is caused by the fungus *Pseudogymnoascus destructans*. Infected bats often display abnormal behaviors in their hibernation sites (hibernacula), such as movement toward

the mouth of caves and daytime flights during winter. These abnormal behaviors likely contribute to the loss of stored fat reserves before the end of hibernation which results in starvation. Current estimates of bat population declines in the northeastern US since the emergence of WNS are approximately 80%. WNS was found in Albany, New York in 2006 and was documented in Maryland in 2010. Management includes voluntary and mandatory cave closures as well as promoting bat conservation.

Wildlife Legislation

Laws can be federal or state laws. Federal laws are either outlined in the Constitution or written and passed by Congress. In contrast, State laws are written and passed by State legislatures. Wildlife laws may address individual species, a suite of species, habitats and/or broad areas. Laws are created by statutes that originate from legislative bills. Once laws are enacted, regulations are put in place to implement, interpret or make specific the law enforced. This section was designed as an introduction to wildlife legislation for Maryland State Envirothon participants. Many of the concepts have been simplified to give a broad overview of wildlife management. The following concepts are covered within this section of the guide:

1. Lacey Act of 1900
2. Migratory Bird Treaty Act of 1918
3. Federal Aid in Wildlife Restoration Act of 1937
4. Marine Mammal Protection Act of 1972
5. Endangered Species Act of 1973
6. MD Endangered Species

Lacey Act of 1900*

When the Lacey Act, named for Representative John Lacey of Iowa, was passed in 1900 it became the nation's first far-reaching federal wildlife protection law. The act was prompted by growing concern about interstate profiteering in illegally taken gameUnder the Lacey Act today, it is illegal to import, export, sell, acquire, or purchase fish, wildlife or plants taken, possessed, transported, or sold:

- in violation of U.S. or Indian law, or
- in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law.

The law covers all fish and wildlife and their parts or products, and plants protected by the Convention on International Trade in Endangered Species or State law. Commercial guiding and outfitting are considered "sales" under the Lacey Act.

The Lacey Act was amended in 1949 to prohibit import of wild vertebrates and other animals listed in the Act or declared by the Secretary of the Interior to be injurious, except under certain regulated conditions, such as for research or museum display.

The Act sets fines for violations involving imports or exports, or commercial violations. Officers enforcing the Lacey Act may carry firearms; make arrests; search and seize; issue subpoenas and warrants; and inspect vessels, vehicles, aircraft, packages, crates, and containers on arrival or departure from the United States. The law authorizes rewards for information leading to arrests, criminal convictions, civil penalties, or forfeiture of property, and for payment of costs of temporary care for fish, wildlife, or plants needed for court proceedings.

*excerpts from USFWS website, 2011

Migratory Bird Treaty Act (MBTA)*

The MBTA was born in an era when people adorned their hats with egret feathers, and signed their letters with pelican-quill pens. At the same time, sport hunters were pushing for a law that would unify state hunting regulations.

Through a far seeing coalition of hunters and conservationists, this Act assures the protection of a healthy environment for people, fish and wildlife, and helps Americans conserve and enjoy our living treasures.

Cerulean warblers are migratory birds

The Migratory Bird Treaty Act (MBTA) of 1918 implemented the 1916 convention between the United States and Great Britain for the protection of birds migrating between the U.S. and Canada. Similar conventions between the United States and Mexico (1936), Japan (1972) and the Union of Soviet Socialists Republics (1976) further expanded the scope of international protection of migratory birds. Each new treaty has been incorporated into the MBTA as an amendment and the provisions of the new treaty are implemented domestically. These four treaties and their enabling legislation (the MBTA) established Federal responsibilities for the protection of nearly all species of birds, their eggs and nests.

The MBTA makes it illegal for people to "take" migratory birds, their eggs, feathers or nests. Take is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof. The **Bald and Golden Eagle Protection Act** affords additional protection to all bald and golden eagles.

Migratory Birds and Habitat Programs primarily operate under the auspices of the MBTA. In total, 836 bird species are protected by the MBTA, 58 of which are currently legally hunted as game birds. A migratory bird is any species or family of birds that

live, reproduce or migrate within or across international borders at some point during their annual life cycle. The MBTA only protects native migratory bird species. Therefore, species such as European Starlings and House Sparrows are not protected under MBTA.

*excerpts from USFWS website, 2011

Federal Aid in Wildlife Restoration Act*
The Federal Aid in Wildlife Restoration Act of September 2, 1937, is commonly called the Pittman-Robertson Act. It has been amended several times, and provides Federal aid to States for management and restoration of wildlife.

The Federal Aid in Wildlife Restoration Act requires an 11 % excise tax on sporting arms and ammunition. These funds go to the Secretary of the Interior and are allocated to States on a formula basis to pay up to 75% of cost approved projects. Project activities include acquisition and improvement of wildlife habitat, introduction of wildlife into suitable habitat, research into wildlife problems, surveys and inventories of wildlife problems, acquisition and development of access facilities for public use and hunter education programs, including construction and operation of public target ranges.

One amendment approved in 1970, added provisions for the deposit of the 10 % tax on pistols and revolvers, one-half of which may be used by the States for hunter safety programs. This amendment also provided for development of comprehensive fish and wildlife management plans.

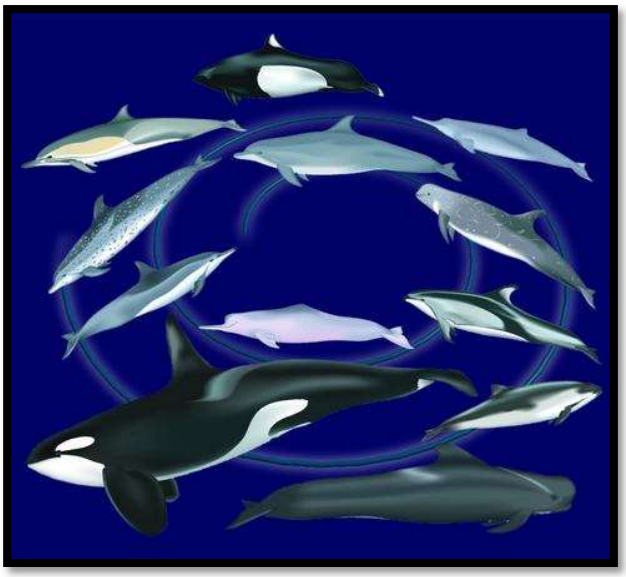
In 1972, the Act was further amended to add provisions for the deposit of the 11% excise tax on bows, arrows, and their parts and accessories for use in wildlife projects or hunter safety programs.

An amendment in 1984 contained a provision that expanded the tax on arrows to include those used in crossbows.

*excerpts from USFWS website, 2011

Marine Mammal Protection Act of 1972*

The Marine Mammal Protection Act (MMPA) was enacted on October 21, 1972. All marine mammals are protected under the MMPA.



The MMPA established a moratorium on the taking of marine mammals in U.S. waters. It defines "take" to mean "to hunt harass, capture, or kill" any marine mammal or attempt to do so. The inclusion of harassment in the definition was a groundbreaking action by Congress. Exceptions to the moratorium can be made through permitting actions for take incidental to commercial fishing and other nonfishing activities; for scientific research; and for public display at licensed institutions such as aquaria and science centers. The moratorium generally does not apply to Alaska natives who live on the Alaskan coast. The MMPA contains provisions allowing for take for subsistence use or to create and sell "authentic articles of handicrafts and clothing" without permits or authorizations.

Congress passed the Marine Mammal Protection Act of 1972 based on the following findings and policies:

- Some marine mammal species or stocks may be in danger of extinction or depletion as a result of human activities;
- These species or stocks must not be permitted to fall below their optimum sustainable population level ("depleted");
- Measures should be taken to replenish these species or stocks;
- There is inadequate knowledge of the ecology and population dynamics; and
- Marine mammals have proven to be resources of great international significance.

The MMPA was amended substantially in 1994 to provide for:

- Certain exceptions to the take prohibitions, including for small takes incidental to specified activities, when access by Alaska Natives to marine mammal subsistence resources can be preserved, and permits and authorizations for scientific research;
- A program to authorize and control the taking of marine mammals incidental to commercial fishing operations;
- Preparation of stock assessments for all marine mammal stocks in waters under U.S. jurisdiction; and
- Studies of pinniped-fishery interactions.

*excerpts from NOAA website, 2011

Endangered Species Act of 1973*

The Endangered Species Act of 1973 (ESA) was signed on December 28, 1973, and provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. The ESA replaced the Endangered Species Conservation Act of 1969; it has been amended several times.

A species is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future.

The listing of a species as endangered makes it illegal to "take" (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to do these things) that species. Similar prohibitions usually extend to threatened species. Federal agencies may be allowed limited take of species through interagency consultations with NMFS or USFWS. Non-federal individuals, agencies, or organizations may have limited take through special permits with conservation plans. Effects to the listed species must be minimized and in some cases conservation efforts are required to offset the take. NMFS' Office of Law Enforcement works with the U.S. Coast Guard and other partners to enforce and prosecute ESA violations.

There are approximately 1,970 total species listed under the ESA. Of these species, approximately 1,370 are found in part or entirely in the U.S. and its waters; the remainder are foreign species.

*excerpts from NOAA website, 2011

Bog turtles are listed as threatened under the ESA

Maryland Endangered Species

The Wildlife and Heritage Service Natural Heritage Program tracks the status of over 1,250 native plants and animals that are among the rarest in Maryland and most in need of conservation efforts as elements of our State's natural diversity. Of these species, the Maryland Department of Natural Resources officially recognizes 566 species and subspecies as endangered, threatened, in need of conservation, or endangered extirpated. Only 39, or 7% of the total tracked species, are listed by the U.S. Fish and Wildlife Service as nationally endangered or threatened.

The primary State law that allows and governs the listing of endangered species is the Nongame and Endangered Species Conservation Act. This Act is supported by regulations that contains the official State Threatened and Endangered Species list.

Secondarily, DNR's Fisheries Service maintains an official list of game and commercial fish species that are designated as threatened or endangered in Maryland.

Complete listings of the Rare, Threatened & Endangered Plants of Maryland and the Rare, Threatened, & Endangered Animals of Maryland include all species tracked by the Wildlife and Heritage Service Natural Heritage Program and indicate which species are federally listed and which are officially State listed. Compiled by Natural Heritage Program staff, these lists are the result of 20 years of data gathering from numerous sources, such as herbaria and museums, private collections, scientific literature, unpublished documents, reports from biologists and amateur naturalists, and from field work conducted by regional ecologists.

Since the time of European colonization in the 1600's, more than 500 species and subspecies of native animals and plants have become extinct in North America. Some of these had been abundant in the Chesapeake Bay region. Passenger pigeons blackened the sky during migration, Carolina parakeets roosted in coastal swamp forests, and heath hens boomed on rolling grassland hilltops.

Although Maryland harbors a rich variety of plant and animal life, the populations of many species have declined since colonization and many have been extirpated, including small whorled pogonia, chaffseed, gray wolf, and American bison.

Barking treefrogs are listed as Endangered in Maryland

MD Envirothon Wildlife Glossary

Abiotic – a non-living factor in an environment ie. light, water, temperature

Accipiter – A hawk of the genus *Accipiter*, characterized by short wings and a long tail

Accidental species- species found far outside its expected breeding, wintering or migrating range; for example, sometimes manatees will accidentally show up in the Chesapeake Bay or a Tropical kingbird will be blown off course and end up in Maryland

Adaptation- traits or behaviors that help organisms survive and reproduce in their ecological niche or habitat

Additive mortality- when one kind of mortality is added to the other sources of mortality. This type of mortality can lead to decline of wildlife populations.

Anthropogenic- human caused

Aquatic – growing, living in or frequenting water

Arboreal – tree dweller

Atlantic Flyway - a bird migration route that generally follows the Atlantic Coast of North America and the Appalachian Mountains

Autotroph – an organism capable of manufacturing its own food by synthesis of inorganic materials, as in photosynthesis; also known as a producer

Behavioral adaptation- learned or inherited adaptations that increase an organism's ability to survive and reproduce; ex: use of tools by primates

Bergman's rule – among forms of a particular species, body size tends to be larger in the cooler regions of its range and smaller in the warmer regions

Biodiversity- variety of life on Earth from plants, animals, microorganisms, fungi and their habitats

Biological carrying capacity- see carrying capacity

Brood – the offspring of a bird just hatched

Browse – (v) to eat the twigs and leaves of woody plants; (n) commonly used in wildlife management to signify brushy plants utilized by deer

Buteo – Any of the various hawks of the genus *Buteo,* characterized by broad wings and broad, rounded tails

Carapace – the upper or dorsal surface of a turtle's shell

Carnivore – An animal belonging to the order Carnivora, including predominantly meat-eating mammals

Carrion – the bodies of dead animals usually found in nature in a decaying state

Carrying capacity – the number of wildlife species that a given unit of habitat will support without damage to the habitat (aka biological carrying capacity)

Cast – to regurgitate indigestible prey remains

Circadian – designating a biological period of about 24 hours

Chronic Wasting Disease- a transmissible spongiform encephalopathy (TSE) of mule deer, white-tailed deer, elk, and moose

Climax community – the final community structure in plant succession

Clutch – eggs laid and incubated by a female bird per nesting

Community- all plant and animal populations living in a defined area

Compensatory mortality- occurs when one type of mortality largely replaces another kind of mortality in animal populations, while the total mortality rate of the population remains constant.

Consumptive use – any use that involves activity resulting in the loss of wildlife i.e. hunting

Contiguous forests – Forests that share an edge or boundary, touching

Corridors- areas of continuous habitat that permit animals to travel securely from one area to another

Coverts – One or more of a group of feathers covering the bases of the longer main feathers of a bird's wings or tail

Covey – a small group or flock, often a family group, of birds such as quail

Crepuscular – appearing or becoming active at dusk or dawn

Cultural carrying capacity- the maximum number of individuals of a species that the human population will tolerate

Dabbling ducks – duck species that principally feed in shallow water by "tipping up" or dabbling on the surface

Decomposers- organisms that break down existing organic material; ex: fungi

Depredation – the act of preying upon, mainly refers to wildlife damage to farmer's crops

Diurnal – A term used to describe an animal that is most active by day

Diving ducks – duck species that feed principally by diving below the surface

Dorsal – of or pertaining to the upper surface

Dump nest – eggs deposited by more than one female in a single nest

Ecosystem- formed by interactions of communities and abiotic conditions

Ecosystem diversity- total number of habitats, biological communities, ecological processes and variation in an ecosystem

Ecotone- the place where two or more different plant communities, successional stages or vegetative stages come together or meet (aka edge)

Edge – the place where two or more different plant communities, successional stages or vegetative stages come together or meet (aka ecotone)

Endangered- when a species is in danger of extinction throughout all or a significant portion of its range.

Endemic – confined to a certain area or region

Estivation – a state of inactivity during prolonged periods of drought or high temperatures

Exotic – non-native species that has been either introduced or escaped
Extirpated- locally extinct

Fecundity- physical potential to reproduce

Fertility- actual number of offspring produced

Flyway – fly routes established by migratory birds.

Focal species- a species primarily benefited by a project/contract action; Focal species may be a group of species, such as wildlife, or a subset of a species

Food chain or food web – the relationship between autotrophs, herbivores, and carnivores

Forest Interior Dwelling Species (FIDS)- species that require large, unbroken tracts of land for survival

Furbearers – species traditionally hunted or trapped for their fur. The Maryland DNR regulates the harvesting of 14 furbearing species: beaver, bobcat (closed season), coyote, fisher, gray fox, long-tailed weasel, mink, muskrat, nutria, opossum, otter, raccoon, red fox and skunk.

Genetic biodiversity- total number of genetic characteristics in the genetic makeup of a species

Granivore- species that feed almost exclusively on seeds

Guard hairs – Long, coarse hairs that forms a protective coating over an animal's under fur

Habitat- resources required by wildlife to survive and reproduce; includes food, water, shelter and space

Habitat guild- groups of species tend to occur in similar types of habitats

Harriers – Any of the various slender, narrow-winged hawks of the genus *Circus* which prey on small animals

Harvest – proportion or number of a wildlife population brought to bag by hunters; in wildlife management

Herbivore – An animal that eats plants

Herpetology – the scientific study of reptiles and amphibians as a branch of Zoology

Hibernation – passing the winter or a portion of it in a state of sleep

High contrast edge- edges between extremely different successional stages; also known as a hard edge

Home range- the area where an animal lives and travels in

Horizontal arrangement- see juxtaposition

Indigenous – a naturally occurring species

Insectivore – a mammal or organism that feeds on insects

Interspersion- mixing of areas with different successional stages

Invasive species- non-native (exotic) species which causes biological, economic or human-health related harm

Inventory – the process of counting or identifying animals

Juxtaposition- how areas in different successional stages or vegetation types are arranged in relation to each other (aka horizontal arrangement)

Keel – a ridge down the back or along the plastron of a turtle or a longitudinal ridge On a dorsal scale in certain snakes

Keystone species- a species that plays a critical role in maintaining the structure of an ecological community

Lateral – pertaining to the side

Limiting factor – anything that affects a species' population. It could result from causes in nature as well as human activities. Examples include food, water, shelter, space, disease, predation, climatic conditions, pollution, hunting, poaching and accidents

Litter – the number of young born with each birthing

Low contrast edge- edges between similar successional stages; also known as soft edge

Marsupial – A mammal of the order Marsupialia that includes kangaroos, opossums, bandicoots and wombats. These females have pouches that contain mammary glands and that shelter the young until fully developed

Melanistic – Abnormally dark pigmentation of the skin or other tissues. Black pigmented

Migration- periodic movement of an animal from the place where it has been living to a new area and its subsequent return journey

Molt – the process of shedding or replacing feathers

Monogamous – term used when one male breeds with one female

Mortality (death rate) – the number of animals that die each year

Natality (birth rate) – production of new individuals in a population through birth or hatching

Natural selection- process whereby organisms better adapted to their environment tend to survive and produce more offspring

Neotropical migrant- a species that breeds in North America but migrates to central and South America for the non-breeding season

Niche – that part of a habitat particularly suited to the requirements of a given species.

Nocturnal – active by night; the opposite of diurnal

Non-consumptive use – any use that does not directly kill wildlife, i.e. bird watching, hiking, photography

Non-native species- a species which is not native to a given area or region; also known as exotic

Omnivore – An animal or organism that feeds on both animal and plant matter

Ornithology – The scientific study of birds as a branch of zoology

Parasite – an organism that lives by deriving benefit (usually doing harm) from another organism.

Passerine – Birds of the order Passeriformes, which include perching birds and songbirds such as the jays, blackbirds, finches, warblers and sparrows

Pathogen- biological agent that causes disease or illness to its host

Pelage – The coat of a mammal, consisting of hair, fur, wool or other soft covering, as distinct from bare skin

Philopatry – annual homing to the same nesting area and often the same nest site

Physical adaptation- anatomical feature that increases organism's ability to survive and reproduce; ex: camouflage coloring in a prey species

Physiological adaptation- adaptations that allow organisms to perform special functions to increase ability to survive and reproduce; ex: venom production

Plant succession- gradual change in plant species over time

Plastron – The ventral surface of the shell of a turtle or tortoise

Polygamy or polygyny – term used when a male animal breeds with many females.

Population – the number of a particular species in a defined area

Population dynamics – factors regulating population levels including natality, productivity and mortality

Primary consumer- organisms which feed on plants and/or other producers

Rabies- a viral disease that affects the central nervous system of warm-blooded animals

Ranavirus- DNA-based viruses that impact cold-blooded animals

Recruitment – addition of a number of young to an adult population of breeders

Riparian area – the area of influence between upland habitats and aquatic habitats

SAV (submerged aquatic vegetation) – vascular plants that live and grow completely underwater

Scat – The excrement droppings of an animal

Secondary consumer- organisms that eat primary consumers

Small game- a management classification which includes eastern cottontail rabbits, squirrels, quail, ruffed grouse, pheasant and crow

Species – populations of animals that possess common characteristics that freely interbreed in nature and produce fertile offspring

Species diversity- the combination of species richness and species abundance in a given area

Species richness – the number of wildlife species found in a given area

Strata- groupings of vegetation based on height of plants

Sustained yield- the continuing yield of a biological resource, such as timber, by controlled periodic harvesting

Taxonomy – the science of the classification of animals or plants

Tertiary consumer- an animal that eats secondary consumers

Threatened- any species which are vulnerable to endangerment in the near future

Torpor – a state of decreased physiological activity in an animal, usually by a reduced body temperature and rate of metabolism

Trophic level – a feeding level in the food chain of an ecosystem characterized by organisms that occupy a similar functional position in the ecosystem

Vector- an organism that transmits a pathogen from reservoir to host

Ventral – of or pertaining to the lower surface

Vernal pool- seasonal or temporary wetland

Waterfowl – water birds, usually referring to ducks, geese and swans

Wildlife- all non-domesticated plants, animals and other organisms

Wildlife population dynamics- study of factors and their interactions that control or influence the growth, stability and decline of wildlife

White-nose Syndrome- a fungal disease that causes bats to rouse too frequently from torpor (temporary hibernation) and starve to death through excessive activity

Zoonotic- an infectious disease that is transmitted between species (sometimes by a vector) from animals to humans or from humans to other animals

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