7. *Inner city.* These are characterized by tall buildings with high roof tops, ledges and little vegetation.

Dominant vegetation: Because urban areas are found in all regions of the United States, it is difficult to identify dominant vegetation that is common across all regions. However, urban regions typically contain Stage 1 in the form of bare ground and paved areas, annuals (Stage 2) and perennials (Stage 3), most y in the form of forbs, flowers and grass, shrubs (Stage 4), and young (Stage 5) and mature (Stage 6) trees. The vegetation is as likely to be an introduced species as it is a native species. Additionally, vegetated areas are typically manipulated in a landscaped manner versus "letting nature take over" as in rural areas. Interspersion is an important concept to understand in urban areas due to the fragmented landscape from residential and commercial development.

Knowledge Area No. 2: **Wildlife Management Concepts and Terms**

Before evaluating wildlife habitat and making management recommendations, an understanding of fundamental concepts and terms is necessary. In this section, these concepts and terms are described in relation to the contest events. These concepts and terms should be used when justifying the selection of an aerial photo and when writing wildlife management and urban landscape plans.

Concepts

Habitat Requirements
Food Chains and Webs
Featured Species
Species Richness
Plant Succession and Its Effect on Wildlife
Vertical Structure (Layering)
Arrangement and Interspersion
Edges and Contrast
Corridors
Riparian Areas
Area Sensitive Species
Migration and Hope Range
Carrying Capacity
Pond Dynamics and Balance
Wildlife Damage Management

It is also important to understand and be able to define wildlife management. *Wildlife management* is both an art and a science that deals with complex interactions in the environment. It applies what is known about particular wildlife species to creating or enhancing its habitat.

Concept 1: Habitat Requirements

Wildlife species have life requirements that must be supplied by the habitat to ensure their well being. These are known as habitat requirements. The four basic habitat requirements are food, water, usable space (the area required to accommodate necessary movements of an animal – for example: breeding range, brood range, fall feeding area), and cover (shelter or protection from predators, severe weather, etc.). Each species has its own set of specific requirements.

For example, the gray squirrel uses acorns for food, while the woodpecker eats insects. Brown thrashers nest in shrubs, while bobwhites nest on the ground. Habitat requirements for wildlife change during the seasons of the year. The food they eat in the winter may be much different than what is eaten 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 deer need for rearing their young may be much different than the cover needed for protection from a winter storm.

Concept 2: Food Chains and Webs

Source: John R. Meyer, North Carolina State University

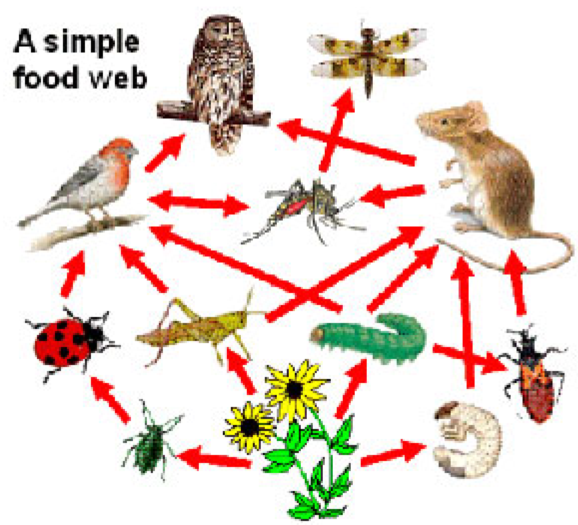
A *food chain* is the process through which nutrients pass from producers (green plants) to primary consumer (herbivore) to secondary consumer (predator on herbivore) to tertiary consumer (predator on predator). A *food web* is a network of interconnected food chains, which are the step-by-step passage of matter and energy (food) through an ecosystem.

Plants are primary producers in a food chain because they supply food at the lowest level of the food chain. It takes an enormous number of individual plants to support the other parts of a food web.

At the next level of a food chain are primary consumers, that is, plant-eating animals or herbivores. Primary consumers include rabbits, mice, deer and certain other mammals, some insects and fish, and dabbling ducks, geese and certain other birds.

Primary consumers are eaten by secondary consumers, or carnivores (meat-eaters). This group includes predators such as birds of prey, snakes, foxes, wild cats and people.

Secondary consumers are eaten by tertiary consumers, which may be predators or scavengers such as turkey vultures, crabs and sometimes people.



Source: John R. Meyer, North Carolina State University

Note that these categories are very broad and general. Many animals fit into more than one group, and there are more complex levels of the web.

Any of the food web components mentioned above can be broken down by decomposers, organisms such as bacteria and fungi that reduce dead plant or animal matter into smaller particles. A decaying plant, for example, will be broken down into nutrients that enrich the soil. This process supports the growth of more plants.

Concept 3: Featured Species

There are two basic goals in wildlife habitat management. One is to provide the best habitat possible for a particular featured wildlife species. The other, which is explained later in this handbook under the concept of Species Richness, is to provide habitat for as many different wildlife species as possible in an area.

When evaluating habitat for *featured species,* one must first decide which species are to be favored. This can be done in several ways. Landowners may have specific objectives for certain wildlife species, or the general public may have concerns about a particular game or endangered species. Once the species are selected, identify the habitat requirements for each particular species and evaluate the capability of the habitat or landscape to provide the requirements. If one or more of the habitat requirements is in short supply or lacking, than different habitat management practices may be used to improve the area's ability to supply the needed requirements. Occasionally, the desired species may be totally incompatible with the available habitat and management goals must be changed. For example, a farm with 100 acres of crop and hay fields would not be suitable habitat for managing for gray squirrels, which require mast producing trees in mature forests or woodlots.

It is usually best to select management practices that provide the habitat requirements that are most lacking and thus limiting the population (limiting factors). For instance, if a species requires trees for cover with water nearby and the habitat being evaluated has plenty of trees but no water, a management practice that supplies water will improve the habitat more effectively than planting trees. When determining which management practices to apply, remember that management practices that improve habitat for some wildlife species may be detrimental to other wildlife species. It is impossible to manage habitat for any one species without influencing other species in some manner. For example, if you plan a clear-cut in a deciduous forest area to benefit wild turkey, you may also benefit deer, cottontails and Northern bobwhite that utilize similar cutover areas for habitat, while populations of species like ovenbirds and prothonotary warblers which prefer mature deciduous forests, may decline.

Concept 4: Species Richness

Species richness is the number of different wildlife species found in an area. One goal in wildlife habitat management is to provide habitat for as many species and as many individuals of a species as possible, as contrasted to managing a feature species.

Lands that are high in species richness usually have many of the following characteristics:

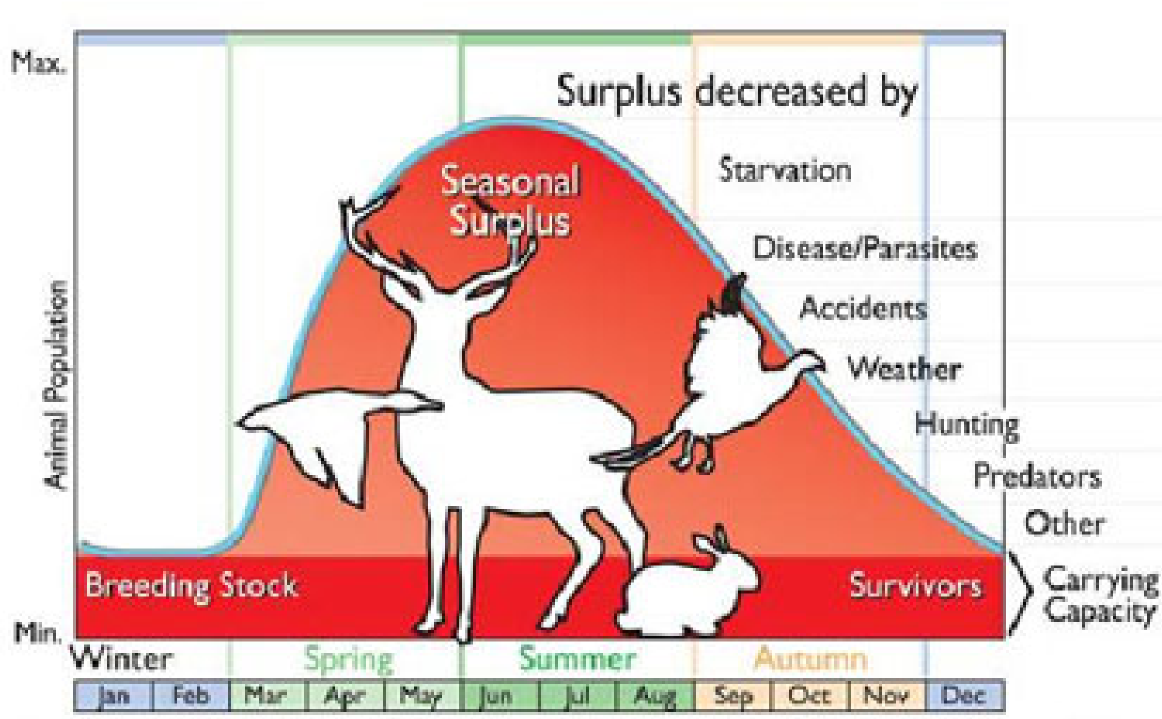
1. A mixture of areas in different successful stages.
2. A balance of edges with unbroken blocks of vegetation in one successional stage.
3. Unbroken or unfragmented areas of at least 10 to 40 acres.
4. Edges with low contrast. (See "soft edges" described in the section about Edges and Contrasts.)
5. A wide variety of vegetative layers present within each area. (For example, shrub layer, mid-story layer, lower canopy, upper canopy, etc. See the section about Vertical Layering.)

These characteristics can be used to estimate the relative number of different wildlife species that may be present in separate areas. They can also be used to identify necessary management practices to increase species richness. For example, consider an area that is a mature, older forest. The forest management plan proposes to harvest the trees by clear-cutting one-half of the area. Clearcuts of 40 acres that leave adjacent unharvested areas of 40 acres in size would be desirable. Strips or corridors of trees that link the larger unharvested areas together could be left uncut. (Learn more about these and other wildlife management practices in the chapter titled "Event III: On-Site Habitat Management Practices.")

Remember, when managing habitat for species richness, often it is not possible to provide the best habitat for featured species. Instead of providing the best habitat possible for a few species, the goal is to provide some habitat for as many species as possible.

Concept 5: Carrying Capacity

There is a limit to how many animals can live in a particular area. That limit is called the habitat's *carrying capacity*. The quantity and quality of food, water, cover and space determine the carrying capacity of an area. If one basic requirement is in short supply, carrying capacity is lowered. By adding the missing ingredient, a manager can increase the habitat's carrying capacity.



Carrying capacity varies from year to year and from season to season. It is usually greatest from late spring through fall when plant vegetation, insects and other food supplies and cover are most abundant. 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. Surplus animals are generally lost to starvation, disease and/or predation. Young wildlife and animals in poor health experience the highest death rates. Harvesting of game or fish for human consumption is one way to utilize the annual surplus. 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, those efforts will fail. A long-term increase in population can be accomplished only by increasing the habitat's carrying capacity. When the carrying capacity is increased, more wildlife will survive by improving the food, water, cover and/or space that a wildlife species needs.

In more urban areas, the *biological* carrying capacity may be able to support a given number of animals; however the human factor may demand that the population of a given wildlife species be lower because of wildlife damage issues. For example, white-tail deer populations can thrive in urban areas and thus the biological carrying capacity is very high because deer have adapted to feed successfully on ornamental plant material. However, home owners have low tolerance for deer feeding on expensive landscape plants and therefore the population of deer must be reduced to limit the damage. In this case, the *cultural* carrying capacity is much lower than the biological carrying capacity.

Concept 6: Riparian Buffers and Corridors

A *riparian buffer* is an area of trees, shrubs, forbs and grasses located adjacent to streams, lakes, ponds and wetlands. Riparian buffers are important for providing habitat and protecting water quality in streams and wetlands. The recommended minimum width is 100 feet; however the width may vary based on various factors including the size and order of stream, as well as topography.

Riparian buffers provide shade for summer cooling and cover in the stream or wetland. They provide *corridors* for wildlife to move from one habitat to another as well as providing nesting cover. Buffers slow overland flow of water and help maintain water quality. They provide structural diversity both adjacent to and within the stream. As trees die then fall into the stream, the large woody debris helps create pools and riffles, and provides cover for fish and other aquatic life. Leaves, stems, branches and large woody debris fall into streams, providing nutrition and habitat for aquatic insects, a major food source for fish and amphibians. Insects from the trees fall into the stream and provide a food source for fish, amphibians and other aquatic life. Tree roots improve soil and stream bank stability.

To develop a riparian buffer, implement practices such as planting grasses, forbs, shrubs and trees along streams and wetlands. Fencing off riparian areas from livestock grazing will allow succession to advance, creating a riparian buffer over time. When using forest management practices, especially those that create openings, consider leaving vegetation near bodies of water and promoting growth of existing vegetation near water.

Corridors are areas of continuous habitat that permit animals to travel securely from one habitat to another. In large expansive fields or open areas, riparian buffers, hedgerows or grown up fencerows can act as corridors for wildlife. When landscape becomes broken up (fragmented), only small islands of suitable vegetation might remain. Fragmentation may occur from road construction, urban development, timber harvesting, clearing for agriculture, hurricanes, wildfires, etc. Corridors provide protective travel, escape and nesting cover for certain wildlife species.

However, corridors can be harmful if they are too small, i.e., less than 100 yards wide. Predators may be attracted to the corridor edge and corridors then become unknowing traps for some animals. For example, the probability of predation increases by raccoons, skunks, bobcats, and coyotes in narrow corridors.

If properly developed, corridors allow animals to meet and mate with other animals of the same species but from different populations, thus maintaining genetic diversity. Corridors also allow animals to find and use islands of suitable habitat that are otherwise not available to them.

In an urban area, relatively unbroken corridors found along riparian areas and ravines allow wildlife to move into parks and other suitable habitats. Preservation, maintenance, and creation of uninterrupted corridors are very important in urban wildlife habitat management.

Concept 7: Brush piles, Thickets and Fencerows

A lack of cover is a limiting factor for many wildlife populations. Brush piles, thickets and overgrown fencerows are particularly useful for rabbits and quail in areas with little cover, especially in areas with plenty of food such as corn, soybean, grain sorghum and small grain fields. Escape cover can be provided along the edge between fields and woodlands.

A brush pile designed with travel lanes and a vacant center will attract more wildlife than one constructed haphazardly. Selecting poor locations for brush piles can result in population “sinks” when the number of births does not compensate for mortality losses. Avoid placing a brush pile in the middle of a 10-acre open field with no nearby brush piles, travel lanes or escape cover from predators. With careful planning, the proper design and placement of cover habitat can improve wildlife populations on your land.

Brush piles can be made from saplings or tree branches available from land clearing, timber harvest operations, tree pruning, etc. Locate brush piles along field edges and at the head of the draws where additional cover is nearby. Ideally-constructed brush piles are 12-15 feet in diameter and four to five feet high. Leave travel lanes and open spaces under your brush piles.

Crisscross logs to form a base then add increasingly smaller diameter wood, topping it off with a layer of twigs and branches until the interior cannot be seen. Another type of “living” brush pile is to cut halfway through the trunk of a small cedar or other bushy tree and push it over. This living brush pile provides cover for a number of wildlife species.

Fencerows next to grasslands or pastures provide food, escape cover and travel lanes for wildlife. Encourage woody fencerows by not spraying or mowing next to the fence. Songbirds which perch on fences will deposit seeds they have consumed. Planting clumps of trees and shrubs or spreading seeds of vines and shrubs along the fencerow can speed up the process. Top large trees to keep the fencerow thick with cover.

In large fields, thickets of shrubs and brambles, such as blackberries and wild plum, afford cover for cottontails, songbirds and quail. These clumps of shrubby thickets should be less than 250 feet apart or “softball-throwing” distance from each other to provide escape cover. Placing this type of cover in large fields greatly improves habitat availability and protection from predators, such as coyotes. Shrubs may need to be mowed in strips periodically to prevent trees from becoming established within the thickets.

Concept 8: Plant Succession and Its Effect on Wildlife

Vegetation and water form the critical components of wildlife habitat. Every acre of soil and water has a definite sequence in plant cover that occurs over time. The different stages of this sequence are called *successional stages*. We can generally predict the type of vegetation that will occur in each stage until a final or climax stage is reached. If not disturbed, the climax vegetation will remain the same for long periods of time. However, if people or nature disturbs the vegetation, soil or water level, then succession may be set back to an earlier stage and the cycle will continue forward from the new starting point.

Note that different wildlife species are often associated with the different stages of plant succession. Not all species require the climax stage. In fact, most species require two or more successional stages to meet all of their life requirements. In this handbook, areas in different stages of plant succession are often referred to as areas with different vegetation types or habitat types. In general, the stages of plant succession that occur on land are as follows:

Stage 1	**Bare ground**
Stage 2	**Annual forbs and/or grasses**
Stage 3	**Perennial forbs and grasses**
Stage 4	**Shrubs**
Stage 5	**Young woodland or trees**
Stage 6	**Mature woodland or trees**

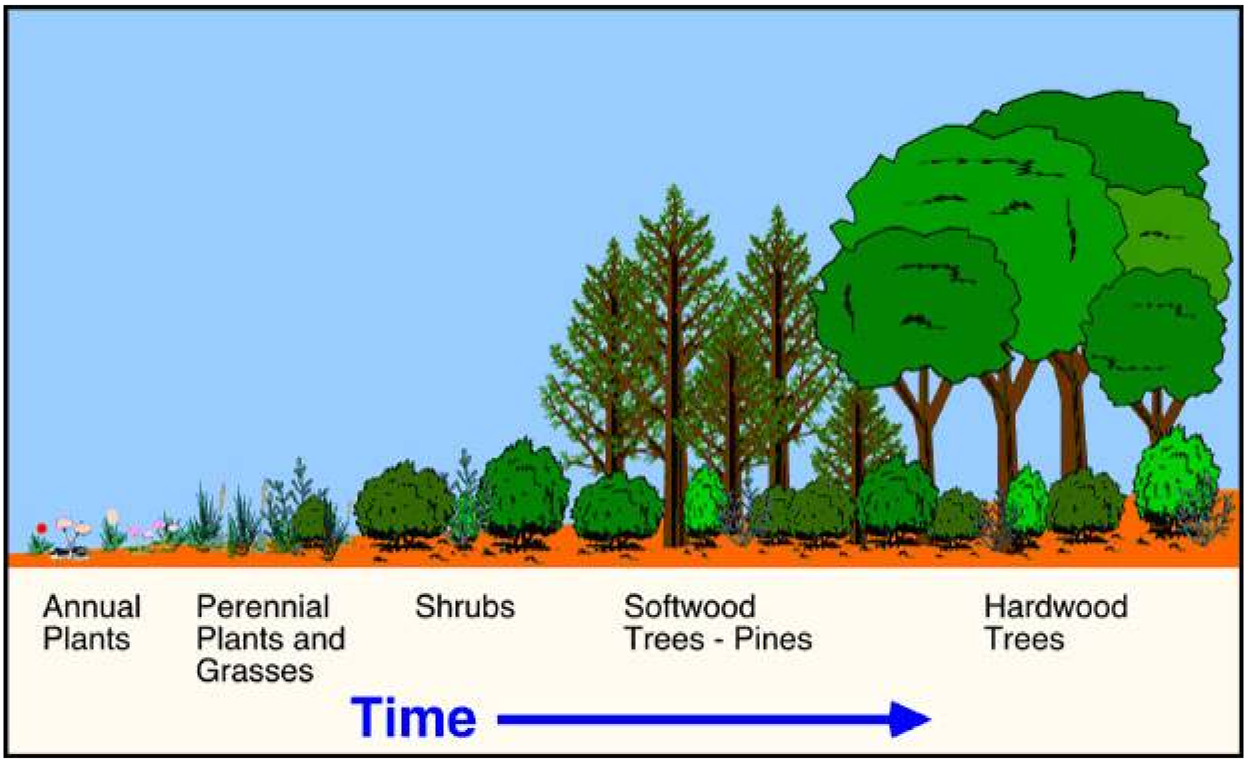
In some regions, natural factors such as the soil or the climate will prevent succession from proceeding past a certain stage. For instance, in the western United States in the Great Plains Shortgrass Prairie Region, lack of precipitation often prevents succession from proceeding past Stage 3. In this case, Stage 3 would be considered the climax stage.

Descriptions of typical successional stages found in different regions of Arkansas can be found in the Regions section of this chapter. A single step in plant succession may take weeks, months, years or even centuries, depending on a variety of natural and human caused factors. If vegetation is disturbed, succession will revert to an earlier stage and begin again.

Some wildlife species require periodic habitat disturbance to create conditions needed to survive. Disturbance can be caused by natural factors, such as insect or disease outbreaks, tornadoes, ice storms, hurricanes, avalanches or lightning fires. However, succession is more frequently altered by humans through a variety of habitat management practices: plowing (agriculture), prescribed burning, cutting of forests, grazing and clearing shrubby areas, all of which may mimic natural disturbances in many cases.

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

EXAMPLE OF PLANT SUCCESSION



Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Annual Plants	Perennial Plants	Shrubs	Young Woodland	Mature Woodland

Pidwirny, M. (2006). "Plant Succession". *Fundamentals of Physical Geography, 2nd Edition*. January 27, 2009. http://www.physicalgeography.net/fundamentals/9i.html

Concept 9: Vertical Structure (Layering)

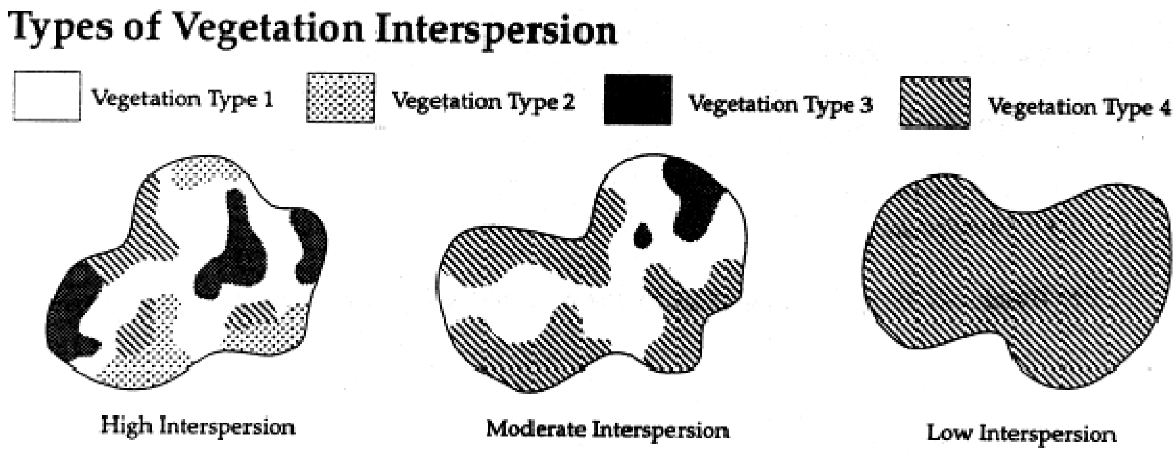
Vegetation can be classified by how it grows. Grasses and forbs generally grow close to the ground and make up the ground layer (up to three feet above the ground). The next higher level is usually composed of woody shrubs and is called the shrub layer (three feet to 10 feet above ground). The next layer is called the mid-story and is comprised of small diameter trees and larger shrubs (10 feet to 30 feet above ground). The tallest stratum is composed of trees and is called the tree canopy layer. This layer can sometimes be further delineated as the lower canopy (trees that are not the dominant trees in the stand) and the upper canopy (trees that are dominant with their entire crowns receiving sunlight).

How the different layers of vegetation are arranged in relation to each other is important to many wildlife species. For instance, some species may require an herbaceous layer for food but also need a tree canopy for cover. Not all areas in a single stage of succession are alike. For example, one woodland in Stage 6 of succession may have a variety of vertical layers comprised of grasses, forbs, shrubs and trees, while another Stage 6 woodland may have only one distinct layer of tall trees. The trees may be widely spaced or close together, with or without a shrub layer. Therefore, it is important to recognize the vertical structure when evaluating successional stages of wildlife habitat.

Concept 10: Arrangement and Interspersion

How different successional stages or vegetation types are situated in relation to each other (for example, size, shape, distribution of habitats) is often referred to as horizontal arrangement, or juxiposition. While some wildlife species obtain all their habitat requirements from only one successional stage, many wildlife species need more than one successional stage to provide all their habitat requirements. For example, wild turkeys utilize mature woodlands (Stage 6) for feeding, roosting at night and living in most of the year, but they often nest in or at the edge of dense brushy cover (Stages 4 and 5) created by clear-cuts. They also need grassy fields or grass/forb habitat (Stages 2 and 3) for brood rearing and insect foraging.

To be of value to a species, the required successional stages must be close to each other (within the species' *home range*) or linked by *corridors* to allow for safe travel to and from the different habitats. Managing for areas of different successional stages within a landscape is called *interspersion*. Usually, more interspersion supports a greater variety of wildlife. A way to measure interspersion will be described. The size and shape of different successional stages also influences the amount of edge habitat created and the stage’s usefulness for wildlife (see the concept *Edges and Contrast*).



Following is an example. Below are two areas of land. “A” is the section that is an old field, “B” is shrubs, “C” is young woodlands, and “D” is mature woodlands. Of the two land areas, which has higher interspersion? Why?

A	B
C	D

A	D	B	C
B	C	D	A
D	A	B	C
C	B	D	A

Answer: The area on the right has higher interspersion because more habitats of different successional stages are in close proximity to each other.

A way to measure and compare interspersion between areas, called in interspersion index, is explained later in this section under *No. 4: Interpreting Wildlife Habitat from Aerial Photographs*.

Concept 11: Edges and Contrast

The boundary where two or more types of vegetation or successional stages meet is called *edge*. Sometimes there is an abrupt change where one type of vegetation stops and another begins (see Figure 1), or the change can be less distinct, with a gradual transition from one stage to another (see Figure 2). In places where a gradual change occurs, the edge is wide and has characteristics of multiple successional stages or vegetation types. Where abrupt changes occur, the edge is narrow. Edges attract many different wildlife species because the variety of food, cover and other habitat requirements associated with each stage are arranged close together.

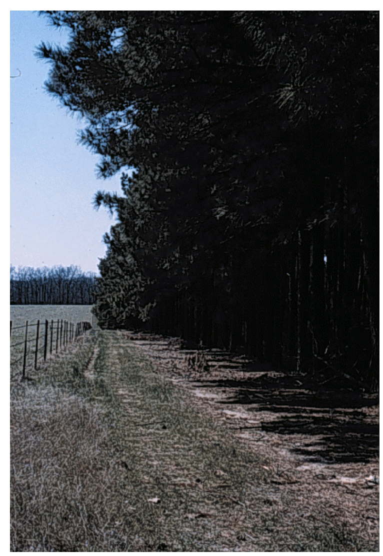


Figure 1. Abrupt edge with high contrast.

Edges that are produced when extremely different successional stages of vegetation meet are defined as having high contrast and are referred to as “hard edges”. There is high contrast where an area in Stage 2 (annual forbs and grasses) meets an area in Stage 6 (tall mature trees) of plant succession. An edge between Stages 2 and 3 has low contrast and is called a “soft edge” because one stage gradually transitions into the other. Edges with low contrast may have more different species (species richness) of wildlife than edges with high contrast. Edges with low contrast will benefit those wildlife species that need interspersion of several successional stages. In general, edge may benefit wildlife species that have low mobility and do not require large areas. However, creation of edge may be detrimental to some wildlife species, particularly area sensitive species (see Concept 8) or species requiring large tracts of unfragmented habitat in one successional stage.

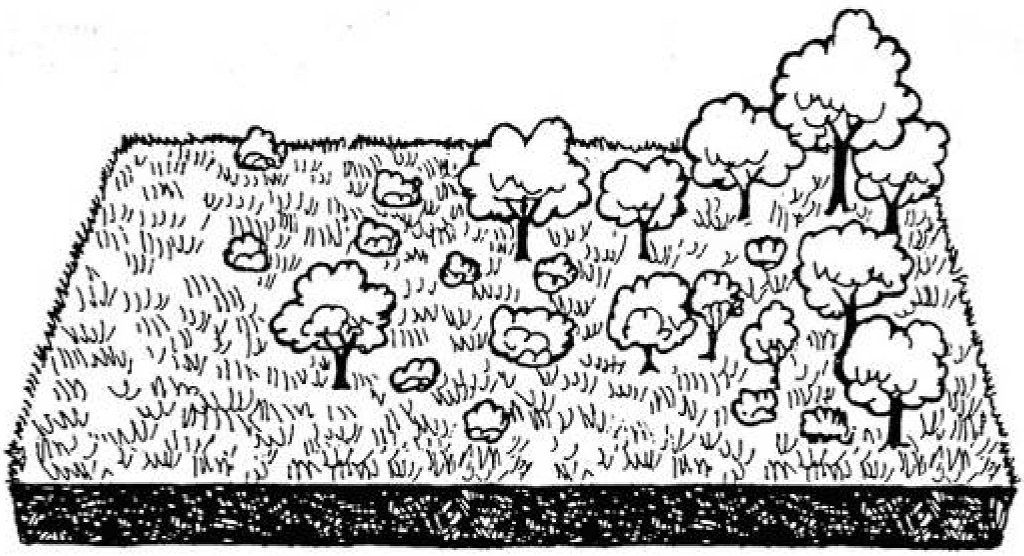


Figure 2. Gradual edge with low contrast

Concept 12: Area Sensitive Species

Edge is not beneficial for all wildlife. Some wildlife species need large, unbroken (unfragmented) areas in a certain successional stage to provide some or all of their habitat requirements. Such species are referred to as *area sensitive*. For these species, large areas of vegetation in one successional stage are desirable. A forest or rangeland in one successional stage that has at least 100 acres of unfragmented area is considered to be the minimum requirement for many area sensitive species. However, some species may require 1,000 acres or more at a minimum. Fragmentation is the disruption of areas of large, continuous habitat types either by man-made or natural processes.

Concept 13: Migration and Home Range

Some wildlife species travel during different seasons of the year and times of day. These actions are called daily or seasonal movements and occur within a given species’ home range. Deer and bear move, but they don’t migrate. Ducks, geese, some songbirds and American woodcock migrate. Daily and seasonal movements should not be confused with migration.

Wildlife are considered *migratory* when they move from one type of habitat to a completely different type of habitat. Migration distances may be short or very long depending on the species. This requires that necessary habitats are available along the route. For many species, corridors that provide areas for safe travel are very important during migration. Two examples of migration are:

- Hummingbirds fly from the East Coast of the United States down to South America for the winter months.
- 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.

Other animals reside in the same area all year. The area of constant use is referred to as an animal's *home range*. For example, in average habitat, a northern bobwhite spends most of its life on an area of approximately 80 acres. If habitat requirements of a species are met in a smaller area (i.e., the habitat is better) in a given locale, then the home range would be smaller.

Concept 14: Pond Dynamics and Balance

A properly managed pond can provide excellent fishing and can be a benefit to many species of wildlife. The basics of a well-managed pond are proper stocking of the right species and the right number of that species, a balanced harvest of fish, a correct fertilizer scheme, 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 sunfish are the prey species and largemouth bass are the predator species. In cold water ponds, trout are usually the predator species and insects and small fish are the prey. Balance between predator and prey is achieved by establishing an adequate food chain for the prey species and controlling the number of prey and predator species through fishing.

Phytoplankton (i.e., microscopic algae) are the base of the pond food chain. Zooplankton and aquatic insects feed on phytoplankton and they in turn are eaten by small fish. Small fish are eaten by larger fish and so on as in a food chain. Managing phytoplankton through fertilizing and liming (if necessary) is key to producing abundant and healthy fish populations. Suspended mud in ponds blocks sunlight, and algal blooms cannot be established. Excessive exchange of water through the pond prevents adequate phytoplankton blooms due to dilution of fertilizer additions.

Low water levels can cause significant problems as well. Improperly constructed or damaged spillways can lead to excessive erosion to the dam. Low water levels, due to either damaged spillways or improperly sloped banks, can lead to excessive aquatic vegetation along the margins.

Concept 15: Stream Habitats

A stream can be defined as a body of water moving in a more or less 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 such as gravel, sediment or debris that have been picked up and redistributed 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.

These pools and riffles are important habitat types for the various fish species 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 habitat for spawning.

It is important that fish have the ability to move freely between these various habitats in the stream.

Concept 16: Wildlife Damage Management

Professional wildlife biologists often have to manage wildlife to reduce or eliminate damaging behaviors or health hazards. Increasingly, wildlife damage management is most common in urban and suburban areas, where frequent interactions between humans and wildlife are due to their close proximity to each other. Examples of wildlife damage are coyotes that prey on livestock or pets, raccoons in chimneys or bats in attics, deer eating ornamental plants or colliding with vehicles, skunks under the house, snakes in the house, bird strikes at airports, herons eating catfish fingerlings at a fish farm, or starlings sitting in urban trees or dairy barns and defecating, creating a health hazard.

Wildlife damage management practices are divided into two general categories—lethal and non-lethal. Lethal practices are intended to kill wildlife in a manner that is quick and does not cause suffering. Lethal management practices include body-gripping traps, trapping and euthanizing (humanely putting to death), shooting, and poisoning. Non-lethal management practices are intended to reduce or eliminate wildlife damage or wildlife-caused health hazards using management practices that do not kill. Non-lethal management practices include noise-making harassment techniques (for example, propane cannons), visual harassment techniques (for example, eye-scare balloons or predator decoys), or techniques that combine both noise and visual harassment (for example, dogs), exclusion methods like fencing and chimney caps, taste and odor repellents, live trapping and relocation, habitat modification to deter damage-causing wildlife or to attract predators that prey on damage-causing wildlife, or changing human behaviors that attract damage-causing wildlife. Additional wildlife damage techniques that can be used fall into either the lethal or non-lethal category, depending on your point of view. These techniques are used to control reproduction in wildlife populations, and include sterilization, birth control and abortion-causing agents. Some reproductive control methods can only be used for research purposes, and all are relatively expensive.

There are advantages and disadvantages to using lethal and non-lethal management techniques. One advantage of lethal management practices is that they can permanently decrease the numbers of animals in a population that are causing damage or health hazards, thereby reducing the amount of damage. In some cases, one or a few animals are causing the problem, and lethal management can then eliminate the damage once the individuals causing the damage are killed. Non-lethal management techniques typically force the animals causing the problems to move to other locations. Although non-lethal techniques may reduce or eliminate the problem at the first location, the animals causing the problems may relocate and cause the same problems at a different location. One advantage of non-lethal techniques is that they are generally more accepted by the public than lethal techniques are, and they can be used in areas with high human density.

Regardless of what management practice is used to reduce or eliminate wildlife damage or health hazards, there are some general guidelines that can increase the success of a wildlife damage management program. Be absolutely positive that you have correctly identified the type of wildlife causing the damage. An integrated wildlife damage management program is strongly recommended, meaning the combination of two or more wildlife damage management practices. Wildlife are very much creatures of habit, and will get used to a foreign object in their area the longer that object is left there (this is called habituation). The more diverse and varied the management techniques used, the less chance for habituation to occur and the more successful the wildlife damage management program. Another factor that will increase the success of a wildlife damage management program and combat habituation is randomness. The more random the application of the wildlife management techniques, the more the successful one will be in reducing or eliminating damage because the wildlife will never be sure when it is safe to be in the area. Not all wildlife damage management practices are equally effective or applicable in all areas; many times it is necessary to develop a wildlife damage management program specific to the area where the problem is occurring. And finally, make sure you know all of the local, state and sometimes federal laws that regulate the wildlife you are trying to manage, especially when using lethal management techniques.

Wildlife damage management may be recommended in addition to the practice of increasing bag/creel limits if individual animals are causing damage or health hazards.

- Predator control techniques like relocation, trapping, toxicants on livestock collars, and selectively shooting only problem animals are commonly used and are effective.
- Non-lethal methods of predator control include livestock confinement and herding, use of guard dogs, and the use of exclusion fences.
- Methods of controlling herbivores (deer, rabbits, etc.) include exclusion, taste and odor repellents, harassment techniques, habitat modification, changing human behaviors that attract problem-causing wildlife, and shooting. Trapping and relocating large animals like deer and elk is not cost-effective.
- Methods of bird control include exclusion, taste and visual repellents, harassment techniques, habitat modification, changing human behaviors that attract damage-causing wildlife, trapping and relocating or euthanizing, and shooting.

Knowledge Area No. 3: **Wildlife Species and Habitat Needs**

Participants need to know as much information as possible about the species whose habitat they will be evaluating. Refer to *Activity I: Wildlife Identification* and the detailed information for each species. Each species has information on habitat preferences and requirements, as well as some incidental facts.

Some coaches indicate contestants have found it helpful to prepare index cards with species photos and habitat requirements in preparation for the contest. Others have worked as a team to prepare PowerPoint presentations, interactive quizzes or other learning tools.

Knowledge Area No. 4: **Interpreting Wildlife Habitat from Aerial Photographs**

Learning to interpret aerial photos allows participants to view areas of the state where they may not have a chance to visit personally. From topographic maps, aerial photos and satellite images they can see land forms, get an idea of the amounts and kinds of cover available, and see the availability of water. Looking closer at the maps, photos and images can show the amount and type of edge available, any barriers that might exist, agricultural fields, grassland and forest lands. Use of aerial photos before arriving at a contest site allows participants to