Wildlife Management Practices (WMPs)

Various Wildlife Management Practices (WMPs) are used to manage wildlife and their habitat. This section describes WMPs and the potential effect they can have on wildlife habitat and populations. The WMPs are grouped according to type of practice (Habitat management, Population management, Pond/Stream Management, Additional WMPs for Urban areas) and listed in alphabetical order within each grouping. Contestants should be familiar with the WMPs and able to identify which WMPs might be recommended to improve habitat or adjust populations in the ecoregion used for the Invitational (or state or local contest). Several practices are commonly used in certain ecoregions, but not in others. It is beneficial to learn as much as possible about any WMP before recommending it.

Some WMPs may seem contradictory. **Landowner objectives, as well as specific information given by contest organizers, must be considered to determine the appropriate WMPs.** Some WMPs are not applicable in all ecoregions, even though some of the species may be the same. **Current conditions should be considered when deciding if a WMP needs to be applied within the next year. However, the benefits of a WMP may not be realized for years.** For example, planting trees in a field to provide habitat for eastern gray squirrels or acorns for wood ducks is a sound practice, but the benefit will not be realized for many years. In this manual, costs and budgets are not considered when recommending practices. However, in actual situations, wildlife managers must consider economics when planning and recommending WMPs.

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Habitat Management Practices

Conservation Easement

General description

A conservation easement is a legal agreement between a landowner and a land conservation organization (or "land trust") or government agency that places permanent restrictions on what can be done on a property. Landowners use conservation easements to permanently protect property from various land-uses (most notably future real estate development) that may degrade or destroy its natural resources. Common restrictions include limited or no new structures or roads can be built on the property. However, conservation easements offer flexibility. For example, if existing farmland is entered into a conservation easement, continued farming may be allowed while various vegetation types or habitat features are protected. In addition to the satisfaction of protecting the property in perpetuity, landowners also benefit by receiving reduced property taxes. Thus, landowners are much better able to continue to keep their land in the face of increasing property tax rates. Conservation easements do not transfer ownership of the property, but only place restrictions on what can be done on the property. The property can be sold, but the restrictions are maintained from owner to owner, in perpetuity.

Conservation easements are critically important in protecting property that contains or harbors rare vegetation types, habitat features, and endangered species. Examples include longleaf pine savanna, native grasslands, caves, and wetlands that provide habitat for species of conservation concern, such as red-cockaded woodpecker, gopher tortoise, grasshopper sparrow, Indiana bat, prairie-chickens, greater sage-grouse, marbled murrelet, and many others. Conservation easements are also a valuable tool in protecting land in areas where urban and suburban development is rapidly expanding. It is in these areas where property values are exceptionally high and the associated property tax rates often increase to the point landowners are no longer able to keep their property. The specific conservation purpose of the easement varies with the goals and objectives of the land trust or agency and the landowner. Common objectives include protection of a vegetation type or ecosystem, maintenance of a forested or riparian corridor, habitat for various wildlife species, wetland function, and water quality.

NOTE: Conservation easements can benefit any wildlife species, according to the area protected. However, for purposes of this program, ***Conservation Easement*** should be considered when evaluating property that is under threat of real estate development or some other major land-use change, such as surface mining or wind farming with turbines, which would degrade or alter its current natural resource value. Further, this practice should be restricted to those species that are in serious decline or are associated with rare vegetation types that are in need of protection.

Effect on habitat

- Maintain land in a natural state and protect it from real estate development.
- Protect rare vegetation types and habitat features, such as grasslands, wetlands, caves, and large forested tracts.
- Protect habitat for declining, threatened, or endangered wildlife species.
- Maintain corridors for migrating wildlife.
- Protect water quality, especially if riparian areas are included or if watersheds are protected.

Control Nonnative Invasive Vegetation

General description

Nonnative plants have been brought to North America for centuries. Some were introduced accidentally, but most were brought intentionally to provide livestock forage or to be used as ornamentals. Unfortunately, many nonnative plant species have become established and spread far beyond where they were initially introduced. This invasion has been detrimental to native plant communities because many nonnative plants out-compete native species for sunlight and nutrients and exclude them from a particular area. Exclusion of native plants has been detrimental for several wildlife species. Many nonnative invasive plant species do not provide suitable cover, structure, or food for wildlife. As usable space for wildlife decreases, so does the carrying capacity for that area. Thus, populations of certain wildlife species have declined as a result of nonnative invasive species.

Examples of nonnative trees that should be controlled include tree-of-heaven, mimosa, and paulownia. Examples of nonnative shrubs that should be controlled include Russian olive, privets, bush honeysuckle, saltcedar, and multiflora rose. Examples of nonnative vines that should be controlled include kudzu, Japanese honeysuckle, and Oriental bittersweet. Examples of nonnative grasses that should be controlled include tall fescue, bermudagrass, johnsongrass, cogongrass, and cheatgrass. Examples of nonnative forbs that should be controlled include sericea lespedeza, sicklepod, cocklebur, and spotted knapweed. Examples of invasive wetland plants include alligatorweed, purple loosestrife, phragmites, hydrilla, water hyacinth, Eurasian watermilfoil, and reed canarygrass.

Without management, nonnative invasive species continue to spread, limit plant species diversity and degrade wildlife habitat. Most often, herbicide applications are necessary to control nonnative invasive species. Some species can be controlled by hand-pulling or mechanical techniques. Of course, nonnative invasive species should never be planted.

There are few properties in the country that do not contain any nonnative species. When evaluating an area, consider the impact nonnative species are having on the native plant community and associated wildlife.

NOTE: When this WMP is recommended, it is implied that necessary action will be taken to implement the practice. For example, if this WMP is recommended to control mimosa or paulownia trees, it is not necessary to also recommend ***Chainsawing*** or ***Herbicide Applications*** (which are methods included in ***Set-back Succession***). Further, if this WMP is recommended to control nonnative grasses, such as tall fescue or bermudagrass, in a field to improve habitat for various wildlife species that might use the field, do not also recommend ***Herbicide Applications***. When evaluating ponds and other wetlands, implementing this practice applies only to plants within the pond or wetland, not the surrounding watershed (unless the surrounding watershed is also being considered).

Effect on habitat

- Killing nonnative plants where they limit growth of native plants can improve cover and increase foods for many wildlife species.
- Controlling nonnative invasive species often leads to increased plant species diversity, which can provide more types of cover and food for various wildlife species.
- Eliminating nonnative grasses that produce a dense structure at ground level will allow the seedbank to respond and result in better cover for nesting and brood rearing for several bird species, and also increase food availability for many wildlife species as various plants are stimulated and grow from the seedbank.

- Killing nonnative trees and shrubs can increase space for desirable tree and shrub species, which can lead to increased mast production.
- Nonnative species in ponds and wetlands may outcompete native plant species (such as phytoplankton) for nutrients, thereby reducing fish carrying capacity
- Certain nonnative species (such as giant salvinia) may effectively block sunlight and reduce oxygen content, resulting in fish kills

John Gruchy

Nonnative perennial cool-season grasses, such as this tall fescue, do not provide habitat for most wildlife species. Eradicating these undesirable grasses and allowing other plants to grow on the site is an extremely beneficial practice that enhances cover and increases food availability for many wildlife species.

Create Snags

General description

The presence of dying, dead, and down trees is critically important for a large number of wildlife species. Many birds, mammals, reptiles, amphibians, and a host of invertebrates and fungi are closely associated with (and some restricted to) standing dead trees or down woody material.

Standing dead trees are called *snags*. They provide perching sites and foraging opportunities for many bird species, such as red-tailed hawks, American kestrels, and bluebirds. Woodpeckers are attracted to snags to feed on the invertebrates under the bark and also to excavate cavities for nesting. Most woodpeckers are *primary excavators*. That is, they excavate cavities for nesting in snags. However, most woodpeckers need relatively soft wood for excavating. Thus, fungi aid woodpeckers by softening dead wood through decomposition. After woodpeckers nest and leave the cavity, other species may move in and use the cavity. These species are called *secondary cavity users*. Some secondary cavity users enlarge cavities to suit their needs. Most of the secondary cavity users are birds (such as prothonotary warblers and wood ducks), but there is a wide variety of secondary cavity users, from bats and bears, to various salamanders and snakes.

The value of snags does not end when they fall. Other wildlife species, such as salamanders, shrews, mice, and snakes, are closely associated with down woody material. These animals serve important ecosystem functions, such as nutrient recycling and prey for various predators. The food web in some ecosystems is thus strongly influenced by the presence of snags and down woody material.

In mature forests, snags and down woody material are usually available. However, if snags are limiting species that require cavities or down woody material, snags and down woody material may be created by killing some trees and leaving them standing. Trees can be killed and left standing by girdling the tree with a chainsaw or hatchet and applying the appropriate herbicide to the wound, or by topping the tree. Obviously, it is much easier to girdle a tree. Selection of trees to kill is important. Softwood species (such as conifers, poplars, and maples) and those trees that already have signs of injury and decay are good candidates because the wood is more easily excavated by woodpeckers and heart rot (rotting in the interior of the tree trunk) may have already begun.

Size of the snag is important. Larger diameter snags (>12 inches diameter) are suitable and used more often by a wider variety of wildlife species than smaller stems. Optimally, snags may be distributed throughout a stand, and may occur as individuals or as small clusters. Information on the number of snags per area is somewhat limited, but estimates suggest 5 – 15 snags per acre in forested areas will sustain populations of various woodpecker species, which thereby would sustain populations of secondary cavity users and other species associated with down woody material. Snags are also used in non-forested areas by other wildlife species not found in forests, such as bluebirds and American kestrels. Thus, snags may be created when they are limiting in both forested and open areas.

Effect on habitat

- Snags provide roosting and perching sites for many bird species.
- Snags provide insects as food for woodpeckers and other birds.
- Snags provide woodpeckers with sites for cavity construction.
- Secondary cavity species (such as bluebirds, owls, wood ducks, raccoons) may use old woodpecker cavities for nesting, roosting, or denning.
- When snags fall, they provide sites for denning, reproduction, foraging, and escape for various wildlife species.
- When snags fall, they provide drumming logs for ruffed grouse.
- Creating snags in forested areas allows additional sunlight to reach the forest floor, which stimulates additional groundcover that may provide forage, soft mast, and nesting cover for various wildlife species.

Craig Harper

Snags can be created by girdling the tree and spraying the wound with the appropriate herbicide. Snags provide perching, nesting, denning, and foraging sites for many wildlife species.

Delay Crop Harvest

General description

When landowners have an interest in wildlife, it may be beneficial to avoid harvesting crops during nesting and fawning seasons to reduce nest destruction and mortality. It is important to realize crop yield and quality are often reduced dramatically when harvest is delayed, especially when hay harvest is delayed until seedheads form. A much more important consideration than delaying crop harvest is making sure adequate usable space is available across the property for the focal wildlife species, which may mean reducing the amount of acreage cropped or hayed to increase acreage available for wildlife.

NOTE: this practice should be recommended only when a crop is present or is planned for the current growing season.

Effect of practice

Destroying fewer nests and young at a specific time, such as May/June when fawns and initial nests of songbirds are most vulnerable, can help maintain a sustainable population or population increase.

Blake Brown

Switchgrass grown for biofuels is normally harvested in November. Where wildlife is a consideration, native grass grown for biofuels should be harvested in March to provide cover through winter. Delaying the harvest until March should not reduce yield appreciably.

Edge feathering

General description

Edge feathering involves reducing tree density in woods adjacent to fields. Reducing the number of trees allows more sunlight to enter the forest canopy and stimulates the understory, which provides a more diverse structure of cover from the field into the woods.

Trees are usually thinned approximately 100 feet into the woods along at least one side, if not all sides, of the field where woods are adjacent. Trees are usually thinned more heavily in the 50 feet or so nearest the field (inner zone) by removing or killing at least 75 percent of the trees. Fewer trees (approximately 50 percent) are removed or killed 50 – 100 feet from the woods (outer zone). This gradation of tree density (few too many from field to forest) and sunlight availability (lots too little from field to forest) promotes an ecotone (an area with characteristics of two adjacent vegetation types) from field to forest.

Edge feathering can be implemented around any field with adjacent woods that have not already been thinned sufficiently. ***Edge Feathering*** and ***Establish Field Borders*** are excellent companion practices to enhance habitat for several wildlife species.

Effect on habitat

- nesting cover and escape cover are provided for various wildlife species
- foods (especially forage, browse, seed, and soft mast) are increased for various wildlife species

Field Borders

General description

Field borders are uncropped areas around crop fields or unhayed areas around hay fields designed to provide nesting, brooding and escape cover for many wildlife species. Field borders also help trap sedimentation and nutrient run-off. Field borders most often consist of native grasses and forbs, but may also include brambles and shrubs, depending on landowner objectives. Field buffers should be a minimum of 30 feet wide, but wider is better. Field borders up to 120 feet wide are highly desirable and recommended to provide adequate usable space for wildlife dependent upon early successional vegetation.

Field borders most often consist of native grasses and forbs, but might also include scattered brambles and shrubs depending on landowner objectives and focal wildlife species. Field borders may be established by allowing natural succession from the seedbank or by planting.

NOTE: ***Plant Native Grasses and Forbs*** or ***Plant Shrubs*** should not be recommended in order to establish ***Field Borders***. However, if there are existing field borders of undesirable species, such as tall fescue, bermudagrass, or sericea lespedeza, ***Control Nonnative Invasive Vegetation*** should be recommended to control those plants. Additional field borders should be recommended only if there are crop fields or hay fields without field borders, if additional field borders are needed around a field, or if existing field borders are too narrow.

Effect on habitat

- Provides increased usable space for many wildlife species
- Provides nesting and/or brooding cover for many songbirds, bobwhites, and wild turkeys
- Can provide increased forage and seed availability if desirable forbs are established
- Can prevent sedimentation and nutrient runoff

Craig Harper

Field buffers around crop fields provide increased usable space for species that require early successional cover. Field buffers don't have to be planted. Here, broomsedge, asters, and blackberry have established from the seedbank.

Forest Management

General description

A forest, unless relatively small, is most often a collection of stands. A forest stand is a contiguous group of trees that is usually designated with respect to species composition, site, and age-class distribution. Forests are managed by harvesting stands and allowing new stands to develop (forest regeneration), or by manipulating existing stands through partial cuts or thinning (timber stand improvement). *Silviculture* is the art and science of tending a forest. Managing forests for the appropriate structure (height and density of vegetation) and species composition (which trees and other plants are present) is essential when managing wildlife that use forested areas.

Forest Regeneration

Regenerating a forest stand involves harvesting the trees within the stand through various silvicultural methods *with the intention of renewing and maintaining that forest stand*. Stand age and health, as well as landowner objectives, determine when a stand should be regenerated. Following a regeneration harvest, a new forest is established through natural or artificial regeneration. Natural regeneration allows trees to grow back naturally from the site. Artificial regeneration involves planting trees.

The structure (and often the composition) of a forest stand changes when it is regenerated. Thus, some wildlife species benefit and others may not. For example, cottontails and northern bobwhite may use the cover and food resources available in a mixed hardwood stand recently clearcut, whereas eastern gray squirrels that were using that stand prior to harvest would have to move to another stand. At the same time, other species, such as wild turkeys and white-tailed deer, would use both the recently harvested stand as well as an adjacent mature stand of mixed hardwoods. When managing habitat for species that require young forest cover, such as ruffed grouse, it is crucial to regenerate stands over time and to make sure regenerating stands are dispersed across the area being managed.

NOTE: *Forest regeneration* should be recommended in order to regenerate stands and provide young forest cover — not to create "openings" or promote early successional communities. Regenerated forests result in new forests, **not** openings. Where additional early succession is needed, and the area is currently forested, ***Forest Regeneration*** should **not** be recommended for that objective. Instead, ***Set-back Succession* (*Chainsawing* and *Root Plowing*)** should be recommended.

The regeneration method recommended depends upon the forest type and composition, site quality, and landowner objectives. The **clearcut** regeneration method harvests all the trees in the stand. More sunlight is allowed into the forest floor with this method than with any other. Clearcutting generally releases shade-intolerant species (such as yellow poplar, black cherry, basswood) when present. The **shelterwood** regeneration method removes a predetermined number of trees to allow development of seedlings (regeneration) from the understory. Later (usually 6 to 8 years), the trees that were left standing (the shelterwood) are removed after the regeneration has developed (often 5 – 15 feet tall). The **seed-tree** regeneration method leaves a few seed-producing trees per acre to regenerate the new stand. This method is often used with pines and other species with lightweight, wind-carried seed. The seed trees are usually harvested after the crop of new trees (regeneration) becomes established. The **group selection** regeneration method harvests small groups of trees (no more than 2 acres) within a stand. This method creates more diverse structure within the stand and generally does not allow as

much light into the stand, which can allow both shade-tolerant and shade-intolerant trees to regenerate. The **single-tree selection** regeneration method harvests only select, individual trees out of the stand, not groups of trees. This method can create a diverse structure with small gaps in the forest canopy. This method generally regenerates shade-tolerant species in closed-canopy northern hardwood forests, but is also used to regenerate longleaf pine where prescribed fire is also used to control undesirable species.

Pines are most often planted (artificial regeneration) after harvest to establish a new stand. Hardwood stands are almost always regenerated naturally and not planted. A common exception is that bottomland hardwoods are often planted when reforesting a large bottomland field that was previously in row-crop agriculture.

Regardless of regeneration method used, it is important to make sure food, cover, and water for certain wildlife species are in close proximity. Regenerated stands should be adjacent to more-developed stands if providing travel corridors and space for wildlife that do not use young stands is a consideration. Also, whenever stands are harvested, it is important to leave relatively large standing dead trees (snags) and live trees with cavities for wildlife that might use them.

Craig Harper

Clearcutting removes all the overstory trees in a stand, allowing full sunlight onto the site. This 2-year-old mixed hardwood-pine forest was regenerated via clearcutting. It is now providing food and cover for many wildlife species, including black bear, bobcat, brown thrasher, eastern cottontail, great horned owl, white-tailed deer, wild turkey, and others.

Craig Harper

Not all trees are harvested initially when using the shelterwood method. Managers can leave trees that might provide an important food source, such as oaks, blackgum, black cherry, and persimmon, until the regeneration has developed. At that time, the remaining ovestory is harvested. Leaving mast-producing trees is an important consideration when managing for wildlife that eat acorns and other mast.

Craig Harper

The seed-tree method is most often used with pines. Scattered trees are left standing after the initial harvest. Wind scatters seed from these remaining trees across the harvested area and new pines establish naturally.

Dwayne Elmore

Group selection creates relatively small (<2 acres) canopy gaps within a stand. New trees regenerate naturally (without planting) in the openings. These small openings diversify the structure within the stand and are used by many wildlife species.

Craig Harper

Select, single trees are removed in single-tree selection. This method favors shade-tolerant species in hardwood stands. Thus, it is sometimes practiced in northern hardwood stands where species such as sugar maple, American beech, and white pine are managed. Single-tree selection is also practiced effectively in longleaf pine stands.


Craig Harper

Standing dead trees (snags), as well as relatively large live trees with cavities, should be left when practicing forest management to provide cavities and perches for various wildlife species. *Create Snags* should be recommended where additional snags are needed.

Effect on Habitat

- Forest regeneration produces new forest growth with greater stem density, which provides nesting and escape cover for several wildlife species.
- Clearcut, shelterwood, and seed-tree stimulate an initial flush of herbaceous growth for a few years until it is shaded out by the developing trees. Browse and soft mast are increased for a short time after harvest.
- Group selection creates considerable diversity in stand structure, providing characteristics of a young stand and an older stand. Browse and soft mast are increased in the group selection openings for a few years until regenerating trees reduce available sunlight to the forest floor.
- Single-tree selection maintains the overall structure of a mature forest, but an increase in understory growth where individual trees are removed will enhance nesting structure for some species and provide additional browse and soft mast.
- Regenerating stands provide cover for many prey species, which can benefit various predators.
- Snags and live den trees that are left standing provide perching, nesting, denning, and loafing sites for many wildlife species.
- The tops and slash of harvested trees remaining on the site provide what is called “down woody debris” or “coarse woody debris.” This material is very important for several reasons. As the material rots, nutrients from the organic material are returned to the soil for additional plants and animals to use. Not removing these nutrients from the site is important for ecological function. From a wildlife perspective, many reptiles and amphibians live in and under the decaying logs. Many small mammals also nest and den in and under decaying logs. Birds, such as wild turkeys and ruffed grouse, commonly nest adjacent to the brushy material and logs left behind, which simulate a tree blown over during a storm. Male ruffed grouse also use down logs as platforms to “drum” on and attract females. The brushy debris left behind after a logging operation also provides important cover for various species and actually helps forest regeneration as newly emerging seedlings are protected from browsing.

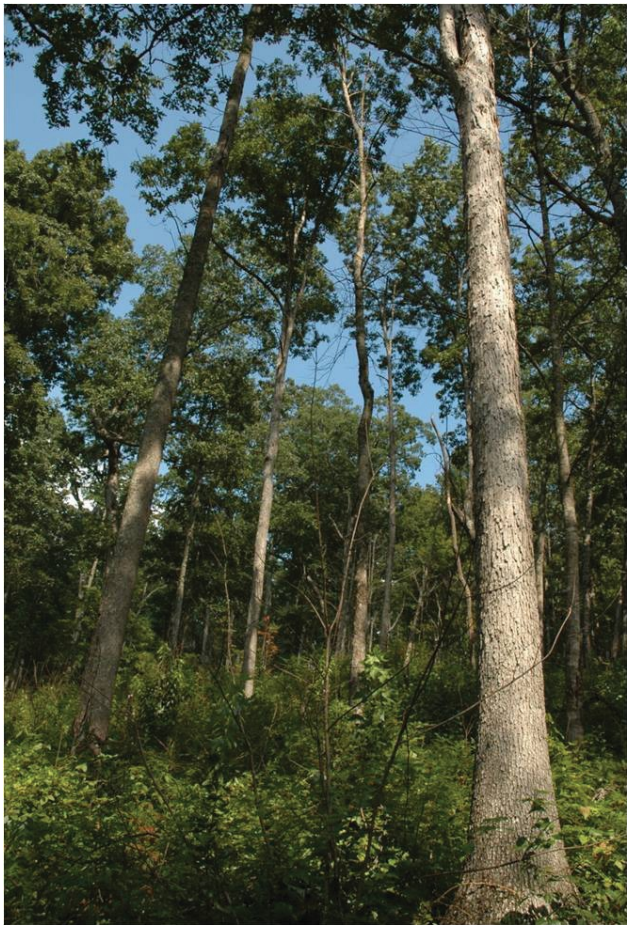
Timber Stand Improvement (TSI)

TSI may involve any of several practices used to improve the quality and composition of forest stands by shifting resources (sunlight and nutrients) to achieve an objective, which may include wildlife, timber, or aesthetics. TSI most often involves some type of **thinning**, which reduces overall tree density

to influence stand growth and development. **Improvement cuts** are implemented in stands past the sapling stage to improve composition and quality by removing undesirable trees. Regardless, when some trees are removed, the remaining trees are "released" from the adjacent competition for sunlight and nutrients, which often allows them to put on more volume and develop larger crowns that can provide more mast (such as acorns). Increased sunlight entering the forest canopy also allows the understory to better develop, which provides more cover and food (forage and soft mast) for various wildlife species.

Effect on habitat

- Increased understory growth enhances cover and provides additional forage, browse, and soft mast.
- Increased woody stem density in the midstory improves cover for some species.
- Trees retained following TSI are better able to grow larger crowns and produce additional mast.
- Snags and den trees that are left standing and down logs and other coarse woody debris left following TSI provide sites for feeding, denning, drumming, reproducing, hiding, and resting for many wildlife species.



Craig Harper

Timber stand improvement (TSI) can be implemented to remove undesirable trees and increase growth of selected trees that remain in the stand. Groundcover is stimulated when additional sunlight enters the stand, providing additional cover and food resources in the stand, which can be maintained with periodic prescribed fire.

Forest Road Maintenance

Forest roads (or "woods roads") are required for trucks and other equipment to enter the forest for management. Roads are easily constructed if none are present when regeneration harvests are implemented. However, critical consideration must be made to how roads are constructed. If not constructed properly, soil erosion is likely, which leads to sedimentation and nutrient run-off into streams, which results in reduced water quality. In fact, more than 95 percent of all soil erosion and sedimentation associated with forest management is a result of improperly constructed forest roads, not tree harvest. Forest roads should not be constructed with steep grades or perpendicular to slope. Roads should be constructed with a slight grade (not too steep). If roads are not constructed properly, they should be repaired or rebuilt.

The most important consideration when constructing forest roads in hilly or mountainous areas is getting water off the roads quickly. Rainwater is moved off forest roads most quickly if roads slant slightly to the downhill side. Diversion bars (similar to a speed bump on a school road) and broad-based dips with culverts also help divert water off roads in hilly or mountainous areas.

Forest roads may be vegetated to help prevent erosion and provide additional forage for various wildlife species. Roads may be vegetated with naturally occurring plants, or they may be planted to ensure adequate vegetation is present. Planting roads to wildlife-friendly vegetation, such as clovers, wheat, and oats, benefits many wildlife species by providing forage and associated invertebrates. Forest roads should not be planted to invasive species or plants that are not beneficial to wildlife (such as tall fescue). Adequate sunlight must be available in order for roads to support vegetation. If roads are completely shaded and additional vegetation is desired, trees may be removed along one or both sides of forest roads to provide adequate sunlight. Thinning trees along a forest road is called "daylighting." Usually, about 50 – 75 percent of the trees within 50 feet of the road are killed, felled, or harvested. Trees less desirable for wildlife are the ones targeted for removal. In addition to providing additional forage on the road, daylighted roads also provide additional browse, soft mast, and brushy cover in 50-foot-wide zones along the sides of roads, which is highly beneficial for some wildlife species.

Vegetation, whether naturally occurring or planted, on forest roads cannot stand very much vehicular traffic. Thus, those roads that receive considerable traffic from land managers may require gravel. Forest roads should also be gated where they intersect public roads to prevent trespassing and poaching (killing wildlife illegally).

Craig Harper

Forest roads should not be constructed perpendicular to slope. Roads such as this should be closed and planted to trees or shrubs.

Craig Harper

Forest roads, such as this one planted to clovers, provide nutritious forage as well as travel corridors for many wildlife species.

Craig Harper

This forest road was daylighted to provide additional browse, soft mast, and nesting cover for various wildlife species. The road was graveled to prevent erosion because it receives considerable traffic from land managers.

Leave Crop Unharvested

General description

Strips or blocks of grain or other crops (such as soybeans) can be left unharvested. This practice is especially valuable if the strips are left adjacent to cover. This practice should be recommended only if there is an unharvested crop present. It is not applicable to food plots.

Effect on habitat

- Provides additional food for many species, which can be particularly important when naturally occurring foods are in low supply and/or in years with poor acorn production.

Craig Harper

By leaving strips or blocks of grain unharvested, additional food is available for wildlife. Leaving this food resource can be an important consideration, especially in areas where winters are harsh.

Livestock Management

General description

The intensity and duration of livestock grazing directly impacts the structure (height and density) and composition of the vegetation community and, consequently, habitat quality for various wildlife species. Stocking rate is the amount of land allotted to each animal for the entire grazable portion of the year and is the most important consideration concerning livestock grazing management. Stocking rates are adjusted to manipulate the structure of vegetation to favor various wildlife species. Intensity and timing of grazing also favor various plant species over others. Thus, available nutrition for livestock and plant species diversity are also influenced by grazing intensity and duration. Heavier stocking rates typically result in shorter vegetation, more open structure, and earlier successional stages (annual and perennial grasses and forbs with little or no woody cover), whereas lighter stocking rates tend to favor taller vegetation, more dense structure, and more advanced successional stages (perennial grasses and forbs and considerable woody cover). Stocking rates are relative to different ecoregions. A heavy stocking rate in the Great Plains would be a light stocking rate in the eastern U.S. where annual precipitation is much greater.

This practice can also be used to exclude livestock from an area. Livestock distribution can be controlled with fencing, herding or fire. Livestock exclusion may be necessary for wildlife species that require considerable shrub cover. Livestock exclusion is necessary for many wildlife species that inhabit

forests, particularly those species that require a well-developed understory. Livestock exclusion is also required to protect sensitive areas, such as riparian zones and other wetlands where erosion, siltation, and livestock waste can cause problems for associated wildlife and fish and reduce water quality.

This practice should be recommended when evidence of livestock is present or information on livestock use is provided.

Effect on habitat

- Stocking rate can alter the vegetation structure and composition to favor various wildlife species.
- Livestock may be excluded from areas where advanced successional stages and increased vegetation structure is desirable for various wildlife species.
- Excluding livestock from riparian areas can help reduce siltation, turbidity and stream bank erosion, and reduce stream and pond pollution from livestock waste, which is beneficial for many wildlife and fish species. Excluding livestock from riparian areas may also improve habitat structure and composition for various wildlife species that use these areas.

Dwayne Elmore

Grazing can be used to manipulate cover for wildlife. Stocking rate greatly influences the vegetation composition and the resulting structure. Overgrazing severely limits cover and food resources for many species of wildlife. However, more bare ground and shorter structure is beneficial for some species.

Nesting Structures

General description

Some species den, nest, or roost in cavities they don't excavate themselves (such as bluebirds, wood ducks, and owls). If natural cavities are not available, artificial cavities (nest boxes) can be used. Many species need a certain kind of cavity (certain diameter of hole, depth, area) in a certain location (field, woods or water) and at a certain distance aboveground (height in feet). The particular design and placement of nest boxes often determines which wildlife species use the structures. Nest boxes should be monitored to ensure use by targeted species. Contact your county Extension office for specific designs of nest boxes and other artificial nesting/roosting structures.

NOTE: Nesting structures for Canada geese are not recommended because resident Canada geese have become too numerous and are a nuisance in many areas. In addition, nesting structures are not recommended for mallards. Instead, creation of high-quality nesting cover (native warm-season grasses and forbs) is required to impact population recruitment.

Effect on habitat

- In open areas, nest boxes are useful for bluebirds unless an abundance of nesting cavities in trees or fence posts are available. Nest boxes for bluebirds should not be placed any closer than 80 yards apart to prevent territorial fighting between males.
- Nesting structures near water sources provide secure nesting sites for wood ducks where trees with cavities suitable for nesting are limiting. Nest boxes for wood ducks should not be placed any closer than 100 yards apart and ideally, should not be visible from one box to another, to prevent dump-nesting by females not incubating a particular nest.

Craig Harper

Nest boxes provide artificial cavities for several species of birds. Nest boxes have been instrumental in helping bluebird and wood duck populations recover from drastically low levels in the early 1900s.

Plant Food Plots

General description

Food plots can be planted to provide a supplemental food source for many wildlife species when naturally occurring food is a limiting factor for maintaining or increasing the population. Food plots are also commonly planted for various game species to facilitate hunting. Regardless of reason for planting, a wide variety of wildlife species may benefit from food plots. In fact, food plots probably benefit more nongame species than game species. For example, all the seeds that are provided in bird feeders are also planted in food plots! Food plots are often planted to provide grains, such as corn, grain sorghum, and millets, and other plants with large energy-rich seed, such as sunflowers. Leafy forages, such as clovers, rape, chicory, jointvetch, winter peas, and lablab, are also commonly planted. Some plantings may provide both forage and grain or seed, such as soybeans, cowpeas, buckwheat, wheat, and oats. Food plots do not only benefit upland wildlife (such as deer, wild turkey, sparrows, and elk), but waterfowl as well. Canada geese, mallards, and American wigeon often feed in warm-season grain food plots and in winter wheat. Plots of millets, corn, rice, or grain sorghum may be flooded a few inches deep in the fall to provide an additional food source for many duck species through winter.

The size and shape of food plots and their distribution is largely determined by the focal species and habitat quality. Food plots may be long and narrow (150 to 400 feet long and 15 to 20 feet wide) or more blocky in shape (depending on the focal wildlife species and the type of food plot planted). Relatively small food plots located adjacent to escape cover and arranged in a linear shape may receive more use by animals with small home ranges and associated with brushy cover, such as cottontails or northern bobwhite. Larger food plots in more open areas may be necessary and receive more use by some species, such as elk, greater prairie-chicken, mallard, mourning dove, pronghorn, and sharp-tailed grouse. Regardless, if food is a limiting factor for a particular species, food plots should be distributed throughout the property in accordance with the minimum daily movement distances of the species. Further, if food is a limiting factor, it is critical to realize additional habitat management practices should be implemented to provide additional naturally occurring foods. In most situations, food plots should not be placed within view of property lines or public roads to discourage poaching and unnecessary stress on wildlife that may be using the food plots. Exclusion cages approximately 4 feet square and 4 feet tall may be placed in food plots to enable property managers to monitor planting success and amount of feeding pressure by wildlife.

NOTE: For purposes of this contest, ***Mowing***, ***Disking***, and ***Herbicide Applications*** are WMPs used to set-back succession. They should not be recommended in order to plant or maintain a food plot. If food plots are present on an area being evaluated and are in need of repair or replanting, ***Plant Food Plots*** should be recommended if they are still needed. However, if nonnative invasive species are present in a food plot, ***Control Nonnative Invasive Vegetation*** may be recommended. Many of the species listed above as commonly planted in food plots are nonnative, but they are not considered invasive.

Craig Harper

Warm-season grain plots, such as this corn, can provide an important source of energy through winter for many wildlife species.

Craig Harper

Warm-season forage plots, such as these soybeans, can provide an excellent source of protein (leaves) during summer and an energy source (beans) in winter.

Craig Harper

Cool-season food plots provide nutritious forage fall through spring when availability of naturally occurring forages may be relatively low. Depending on what is planted, such as this winter wheat, a nutritious seed source is also available the following late spring through summer.

Effect on habitat

- Grain food plots, especially corn and grain sorghum, as well as soybeans can supply a high-energy food source through fall and into late winter. Such a food source can influence winter survival for several wildlife species, especially during relatively cold winters and during years with low mast (acorn) production.
- In areas and seasons where nutritious forage is limiting, forage plots can supply highly digestible forage, which can be especially important during late summer and through winter and spring.

Plant Native Grasses and Forbs

General description

Native grasses and forbs are important for cover and food for many wildlife species. Native grasses and forbs represent early successional stages in all ecoregions and may represent the climax successional stage in some areas where shrub and tree growth is limited.

It may be necessary to plant native grasses and forbs in areas where there is not sufficient cover and where the seedbank (those seed occurring naturally in the soil) has been depleted and desirable native grasses and forbs do not occur naturally. An example of an area that may need planting is a field that has been in agricultural production for many years, often decades. Continued plowing and herbicide applications over many years can eventually deplete the seedbank of desirable native species and planting can expedite desirable groundcover.

Native grasses and forbs should not be recommended for planting if desirable native grasses and forbs are present and likely to provide adequate cover and food resources. Undesirable nonnative plants may be selectively removed through ***Control Nonnative Invasive Vegetation*** and thus release native grasses and forbs.

Plant Native Grasses and Forbs should not necessarily be recommended where additional early successional cover is needed. For example, in large forested areas where additional early successional cover might be required to provide habitat for some wildlife species, such as loggerhead shrike, northern bobwhite, or woodcock, it is likely that desirable native grasses, forbs, brambles, and other plants will establish from the seedbank after the forest is cleared by ***Chainsawing*** and ***Root-plowing*** (see ***Set-back Succession***).

Many nonnative grasses (such as tall fescue and bermudagrass) are not recommended for wildlife because they do not provide suitable cover or food for most wildlife, and their competitive nature often prevents native grasses and forbs from becoming established.

Examples of desirable native warm-season grasses

- broomsedge bluestem, little bluestem, blue bunch wheatgrass, big bluestem, sideoats grama, blue grama, switchgrass, indiangrass, buffalograss

Examples of desirable native cool-season grasses

- Virginia wildrye, Canada wildrye, povertygrass, low panicgrasses

Examples of invasive nonnative warm-season grasses

- bermudagrass, cogongrass, johnsongrass, crabgrass, dallisgrass, goosegrass

Examples of undesirable nonnative cool-season grasses

- tall fescue, orchardgrass, bromegrasses, timothy

Examples of desirable native forbs and brambles

- common ragweed, western ragweed, pokeweed, blackberry, dewberry, native lespedezas, beggar's-lice, old-field aster, partridge pea, Rocky Mountain beeplant, annual sunflower, perennial sunflowers, crotons

Examples of invasive nonnative forbs

- sericea lespedeza, curly dock, spotted knapweed, sicklepod, cocklebur

Craig Harper

Native grasses and forbs may be planted where sufficient and desirable native grass/forb cover is lacking.

Effect on habitat

- Native grasses and forbs provide nesting, bedding, roosting, and/or escape cover for many wildlife species, especially those that require early successional cover.
- Ground-nesting birds usually build their nests at the base of native bunchgrasses, such as broomsedge bluestem, little bluestem, or sideoats grama.
- Although some wildlife, such as elk, readily eat native grasses, forbs provide a greater food source for more species. Many forbs provide forage (leafy material) as well as a seed source. Forbs also provide optimal cover for many small wildlife species, including young upland game birds and cottontails.

Plant Shrubs

General description

Shrubs provide cover and soft mast, depending on species, that benefit many wildlife species, some of which are found only in shrublands or shrub cover. In large open areas, planting blocks or multiple rows of shrubs is beneficial for those species requiring additional shrub cover for nesting, loafing, or escape. Fruiting shrubs are beneficial for many species and can be planted in fencerows, hedgerows, field or woods borders, odd areas (such as field corners and gullies), riparian areas, and any other areas where soft mast may be lacking. Establishing hedgerows of shrubs to break-up fields is beneficial, especially when planted adjacent to high-quality early successional cover or a good food source (such as grain field). Shrubs should be planted in winter while they are still dormant. Shrubs should **not** be planted in the woods where there is not adequate sunlight for growth and development. Where additional shrub cover is needed in forested areas, ***Forest Management*** should be recommended.

Shrubs may be planted to create riparian buffers along streams and ponds. Vegetated buffers are important to maintain streambank stability as the roots of the vegetation along the stream help hold the soil in place along the stream. Additionally, the aboveground vegetation in buffers filters sediment from water moving into the stream or pond after rainfall events. Riparian buffers also may provide cover and travel corridors for various wildlife species. Finally, buffers of vegetation, especially trees and shrubs, provide shade to keep stream water temperatures during summer lower, which may benefit cold-water fish species. The minimum recommended width for riparian buffers is 100 feet, but width may vary with size and order of a stream, as well as topography and landowner objectives.

Effect on habitat

- Can provide additional food and cover for many wildlife species in areas where specific species of shrubs are lacking.
- Shrubs are an important component of travel corridors, which allow wildlife to move safely across open fields between two areas of cover.
- Establishing hedgerows with shrubs may be used to increase interspersion of cover types and create smaller fields in proximity that can be managed differently to meet the various food and cover requirements for different wildlife species.
- Shrub plantings may be useful in some urban settings where desirable cover or soft mast is lacking.
- Shrubs planted to develop a riparian buffer may reduce erosion and sedimentation.

Craig Harper

Shrub plantings, such as this hawthorn, provide nesting cover, escape cover, and an important source of soft mast.

Plant Trees

General description

Trees are planted to provide food (hard or soft mast) and cover for many wildlife species. Trees should be planted in winter while they are dormant. Planting a mixture of species is usually recommended when mast production is the objective. Planting a mixture reduces the chances of a mast failure in any given year. Ecoegion, site, and landowner objectives help determine which species are planted. Examples of hard mast producers that are important for wildlife include oaks, hickories, American beech, and pecan. Examples of soft mast producers that are important for wildlife include persimmon, black cherry, mulberry, apple, and pear.

Trees may be planted to create riparian buffers along streams and ponds. Vegetated buffers are important to maintain streambank stability as the roots of the vegetation along the stream help hold the soil in place along the stream. Additionally, the aboveground vegetation in buffers filters sediment from water moving into the stream or pond after rainfall events. Riparian buffers also may provide cover and travel corridors for various wildlife species. Finally, buffers of vegetation, especially trees and shrubs, provide shade to keep stream water temperatures during summer lower, which may benefit cold-water fish species. The minimum recommended width for riparian buffers is 100 feet, but width may vary with size and order of a stream, as well as topography and landowner objectives.

NOTE: It may not be appropriate to plant trees in some areas. Some species of wildlife, such as prairie-chickens avoid trees. Thus, in prairies that were historically treeless, planting trees is detrimental to some grassland species of wildlife.

Effect on habitat

- Provides hard or soft mast production, depending on the species planted.
- Large areas can be planted for afforestation (planting trees for a forest where there is currently no forest).
- Provides additional nesting, perching, denning, and roosting sites.
- Trees planted to develop a riparian buffer may reduce erosion and sedimentation.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David Mercker
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Hardwoods are most often regenerated naturally. That is, after harvesting, they grow back naturally from stump and root sprouts and seed. However, when afforestation is desired on large open areas with few to no trees, planting is the best method to ensure desirable species composition. Here, a large field that was in agricultural production for decades was planted to bottomland hardwood species.

Repair Spillway/Levee

General description

Low water levels can cause significant problems in ponds and impounded wetlands. Improperly constructed or damaged spillways can lead to excessive dam or levee erosion and excessive aquatic vegetation along fish pond margins. The spillway should be repaired if it is eroding or otherwise damaged, keeping the pond or impounded wetland level too low and increasing the chance of the dam eroding during heavy rains. In special cases, leaks around the spillway or levee structure can be stopped with the addition of special clays or plastic liners.

Trees should not be allowed to grow on dams or levees because tree roots can fracture the dam and eventually cause it to leak and break. However, if there is a large, mature tree on a dam, and the dam is not leaking, it should be left alone. Killing or felling the tree will cause the roots to rot and decay and thereby create airspace, which will more likely lead to the dam leaking or breaking. Thus, it is important to not allow trees to become established on dams, and it is important to kill or remove smaller trees (<10 inches diameter at breast height) before their root systems grow large.

Effect on habitat

- Eliminates erosion and sedimentation from spillway/levee
- Enables pond or impounded wetland to fill to appropriate level
- Precludes vegetation from establishing around the inside perimeter of a fish pond

Craig Harper

Tree roots can cause dams to fracture, leak, and eventually break.

Billy Higginbotham

This fish pond dam will likely have problems with leakage (if not already) and breakage if the trees are not killed or removed.

Set-back Succession

General description

Succession is the orderly and predictable series of changes in plant species composition through time and occurs in all natural communities. Habitat for many wildlife species is managed by setting back succession in an effort to retain the successional stage(s) beneficial for focal wildlife species. The three primary techniques used by wildlife managers to set-back succession are **fire**, **mechanical applications, and herbicide applications**. Each of these may be applicable for setting back succession in any ecoregion for various wildlife species, but they may not produce the same effect. One or more may be recommended over another depending on the situation. In some cases, more than one technique may be applied. The recommended technique for setting back succession should be specified and reasons given as to why a particular technique was recommended in the written management plan and oral reasons.

Grazing livestock also arrest or set-back succession. However, wildlife managers do not typically use livestock to set-back succession, but may recommend a stocking rate to livestock producers who are interested in wildlife. For the purposes of this program, ***Livestock Management*** is included as a separate WMP because livestock often need to be excluded from an area when managing for many wildlife species. Thus, there are just as many applications for ***Livestock Management*** to advance succession as there are to set-back succession.

Prescribed Fire

Prescribed fire is often the most effective and efficient method for managing succession and maintaining early successional plant communities. Prescribed fire can be used in fields, openings, grasslands, savannas, woodlands, and forests. Intensity, timing, and frequency of fire strongly influence vegetation composition and structure. High-intensity fires and burning in late summer and early fall tend to reduce woody composition more than low-intensity fires or burning in winter or spring. Low-intensity fire is recommended when burning a forest understory if damaging trees is undesirable. Like other methods, fire sets back succession temporarily. With the exception of intense fire, frequent burning over time, will change vegetation composition more so than less frequent burning. For example, if an area is burned every 2 years, annual and perennial herbaceous vegetation will be promoted. Where there is adequate rainfall, if that same area is burned every 5 years, considerable tree and shrub cover will be present. If burned every 10 years, the site will be dominated by trees and shrubs. Intensity and timing of fire dictate whether woody species are killed or if only the leaf litter is consumed.

Although a very beneficial practice, prescribed burning is not possible in all locations. Sites in close proximity to urban areas, hospitals, or busy roadways may not be suitable for burning because of safety and smoke management concerns. **Burning should be conducted only when danger of wildfire is low (when the wind, temperature, and humidity allow a controlled burn) and should be conducted under the close supervision of forestry or wildlife professionals experienced with using prescribed fire.** Where fire can be used, it is highly recommended over mowing or mulching to set-back or maintain succession.

Effect on Habitat

- Sets back the successional process by killing existing cover and stimulating fresh plant growth.
- Burning during the dormant season does not significantly alter vegetation composition unless fire intensity is high. Small woody stems may be top-killed, but usually resprout. Burning during the growing season and particularly the latter part of the growing season may more effectively kill small trees and shrubs and thus encourage more herbaceous cover.
- Burning early successional cover provides an open structure at ground level the following growing season, which is desirable for several small wildlife species, including young upland game birds. An open structure at ground level facilitates mobility and foraging under a canopy of native grasses and forbs.
- Consumes litter layer and understory fuels (such as dead leaves and grass), which reduces chance of wildfire and enables the seedbank to germinate.
- Improves seed and invertebrate availability for many species.
- Scarifies (breaks down outside coating) some seeds so they can germinate.
- May release nutrients (from ashes) into the soil.

Craig Harper

Prescribed fire is the desired method for setting back succession and manipulating the composition and structure of the understory or groundcover in forests, woodlands, and savannas where fire historically occurred. Fire intensity, fire frequency, and season of burning strongly influence the effect of fire on the vegetation community.

Mechanical applications

Disking

Disking sets back succession by mixing the upper soil layer and incorporating organic material into the soil, facilitating decomposition, and stimulating the seedbank. **This soil disturbance technique sets succession back to the earliest seral stage that will occur on a given site**. Disking is a relatively inexpensive and effective practice for exposing bare ground and promoting annual grasses and forbs from the seedbank in the growing season following disturbance. Disking reduces coverage of perennial grasses and forbs and brambles for a short time and promotes more annual species. Disking is usually conducted every few years to maintain annual and perennial forbs and grasses. Disking is most often implemented in fields or open areas, but also can be done in-between rows of planted pines to encourage herbaceous groundcover. Similar to controlled burning, timing of disking and disking intensity influence vegetation composition and structure.

NOTE: When using prescribed fire, firebreaks are commonly maintained by disking; however, ***Disking*** should not be recommended as a WMP to facilitate burning. Also, ***Disking*** should not be recommended to control nonnative grasses (such as tall fescue and bermudagrass). Instead, ***Control Nonnative Invasive Vegetation*** should be recommended to control nonnative invasive species.

Effect on habitat

- Maintains an early successional plant community dominated by grasses and forbs.
- Promotes fresh herbaceous growth and enhances forage and seed availability for many wildlife species.
- Sets back succession where perennial grasses and forbs, brambles, and woody species dominate the plant community.

Craig Harper

Disking sets back succession, facilitates decomposition, provides bare ground, and stimulates the seedbank, encouraging early successional species.

Chainsawing

A chainsaw or fellerbuncher may be used to kill or remove trees where trees are not desired for the focal wildlife species or where additional areas of early successional cover are desired. Trees not removed may be killed and left standing by girdling the tree and spraying an herbicide solution in the wound. Stumps of felled trees may be sprayed to prevent sprouting. However, even with herbicide treatment following cutting or girdling, woody sprouts often dominate the site after felling trees. ***Root-plowing*** with a bulldozer (see section below) after tree removal helps prevent

woody sprouting and ensure more herbaceous groundcover as opposed to sprouts and saplings of woody species.

NOTE: Implementing this practice implies the intention is to increase and maintain an earlier successional community, not a forest. Thus, ***Forest Management*** should not be recommended to set-back succession and maintain an early successional community. ***Forest Management*** should be recommended to manage and maintain a forest, either through ***Forest Regeneration*** or ***Timber Stand Improvement*** practices. Indeed, herbaceous cover (such as native grasses and forbs) is stimulated when trees are cut and seed from the seedbank germinates. However, the herbaceous community will be short-lived and woody species will dominate the site (especially on hardwood-dominated sites) unless tree removal is followed with additional treatment. Root-plowing following removal of hardwood trees significantly reduces woody sprouting. Periodic prescribed fire, additional mechanical disturbance (such as disking), or herbicide treatment then will be necessary to maintain an early successional community. ***Plant Native Grasses and Forbs*** should not be recommended when using ***Chainsawing*** or another mechanical method to reduce tree cover and increase early successional vegetation because herbaceous groundcover should establish naturally from the seedbank after tree removal.
NOTE: do not also recommend ***Create Snags*** when killing trees in an effort to increase early successional cover
NOTE: do not also recommend ***Herbicide Applications*** to spray girdled trees or tree stumps.

Effect on habitat

- Reduces tree density and encourages earlier successional plant communities.

Craig Harper

Chainsawing can be used to increase early successional cover in wooded areas. On this property, trees were cut, not harvested, and the site has been burned every 2 years to maintain early succession. Nothing was planted. A forest was converted to an early successional plant community.

Drum-chopping/Chaining/Root-plowing

All three of these techniques involve large equipment and are implemented to reduce woody cover and stimulate more herbaceous cover. They are typically used where shrubs and trees have grown too large for a rotary mower and where prescribed fire may not be applicable.

Drum-chopping (or roller-chopping) involves a bulldozer pulling a large drum (or roller) with sharp metal blades to knock down and chop large shrubs and small trees. It is a fairly common technique for managing brush cover in arid ecoregions, such as **Prairie Brushland** in south Texas.

Drum-chopping effectively reduces the size of brush and generally increases herbaceous growth. However, chopped brush usually resprouts (depending on species), and stem density of brush can actually be greater (but smaller size) following treatment.

Chaining involves pulling a very large chain strung between two bulldozers running parallel to each other (50 to 100 feet apart) to knock down shrubs and small trees. Brush is knocked over in the first pass, then a second pass in the opposite direction uproots the brush.

Root-plowing involves a bulldozer with a rear-mounted blade that cuts tree and shrub roots and brings them to the soil surface, which significantly reduces sprouting. This technique is often used in brush country, such as south Texas, but also can be used in forested areas of the eastern U.S. following tree removal where the intent is to convert a forested area to an early successional plant community. Root-plowing facilitates this process by reducing sprouting of woody species. In arid ecoregions, it may be several years before brush species re-establish following root-plowing.

Effect on habitat

- Sets-back succession by reducing dominance of small trees and shrubs, and promotes grasses, forbs, and brambles.
- Promotes more open structure.
- Forage availability and quality may be increased.
- Soft mast and seed production may be increased.
- Woody species usually resprout following drum-chopping, which can be used to maintain a certain height and amount of brush cover.

Craig Harper

Drum-chopping can be used to set back succession where shrubs and trees have gotten too large to allow disking or mowing and where the application of prescribed fire is not an option.

Mark Bartoskewitz

Chaining is often used in shrub country to reduce woody cover and increase herbaceous cover.

Mowing/Mulching

Mowing is most often accomplished with a large rotary mower mounted behind a tractor. Much less often, a mulching machine is used to reduce large shrubs and small trees to chips. To avoid disrupting nesting birds and destroying nesting cover or winter cover, mowing should not be conducted until late winter or early spring. When mowing is the only option for setting back succession, it should be conducted when it is apparent that undesirable woody species are encroaching in the field. In other words, mowing fields of grass is unnecessary. Mowing and mulching are not the best techniques for setting back succession because they promote a deep thatch layer that creates undesirable conditions at ground level for young game birds and ground-feeding songbirds. A thatch layer also limits germination of the seedbank and can reduce plant diversity. When possible, prescribed burning, disking, or herbicide applications should be used to set-back succession instead of mowing or mulching.

Effect on habitat

- Helps maintain perennial grasses and forbs and reduces height of encroaching woody species.
- Helps remove competition from various shrubs and small trees, allowing grasses and forbs to grow better. Maintains low brushy cover of various shrubs and small trees by encouraging resprouting.
- Can improve and maintain nesting cover for some bird species if conducted outside the nesting season.
- Causes thatch build-up, which reduces availability of invertebrates and seed to young quail, grouse, wild turkeys, and other ground-feeding birds. Thatch build-up also reduces the ability of these animals to move through the field and suppresses the seedbank, which can lead to decreased vegetation diversity.

Craig Harper

Mowing, or "bushhogging," sets back succession. However, accumulation of thatch provides undesirable conditions for many wildlife species and limits germination of the seedbank. Mowing is not a desirable practice to set-back succession, and should be used only when more desirable methods are not possible.

Herbicide Applications

Herbicide applications can be used to set-back succession and kill selected plants. Applications can be made to individual plants or broadcast over an area. There are many different types of herbicides available. The herbicides used in natural resources management are environmentally safe. Many herbicides are "selective" in that they only kill specific plants, not all plants. Thus, in many cases, selective herbicides can be used to remove specific undesirable plants from an area (such as small

trees in a field) and leave desirable plants. Herbicide applications thus can be used to adjust plant species composition in an area (such as a field or thinned pines) and improve habitat for many wildlife species.

NOTE: this practice is intended to set-back succession, not specifically to control nonnative species. Although herbicide applications are often used to control nonnative species, ***Control Nonnative Invasive Species*** should be recommended for that purpose.

Effect on habitat

- In some open areas, encroachment of hardwood trees reduces vegetative diversity and limits many plants important for wildlife. Proper herbicide applications control unwanted woody growth and encourage more herbaceous groundcover.
- Can be used to maintain grasses, forbs, and shrub cover, and thus increase foods and enhance cover for some wildlife species.
- Can be used to prevent unwanted hardwood growth in pine stands, particularly those that have been thinned to allow increased sunlight to reach the ground and stimulate herbaceous plants.

Craig Harper

Herbicide applications can be used to set-back succession. Selective herbicide applications, as shown here, can be used instead of mowing and help transition plant species composition toward more favorable species by killing undesirable species.

Tillage Management

General description

Tilling cropland can be delayed from fall until early summer to allow wildlife access to waste grain and to allow wildlife to use standing stubble and fallow vegetation for nesting. When fall tillage is necessary, inversion tillage (such as mold-board plowing, which turns soil over and covers crop residue) should be avoided. Instead, implements such as chisel plows that do not turn the soil over should be used. No-till agriculture would be recommended over any tillage method.

NOTE: This practice should be recommended only if a grain crop is present.

Effect of practice

- Increases supply of waste grain, which is eaten by many wildlife species, and may increase nesting success.

Craig Harper

Delaying tillage from fall into spring allows wildlife access to waste grain from harvested crops through winter.

Water Control Structures

General description

Various structures made of concrete, metal, or wood are used to control the water level in ponds and impounded wetlands. They are usually placed within a dam or dike. This practice should be recommended when inadequate or no structure is present on an existing dam or dike. This practice can also be used to control the water level of beaver ponds. A Clemson Beaver Pond Leveler can be placed through the beaver dam, restricting the pond level from exceeding a desired height and helping prevent flooding into undesirable areas, such as crop fields, roads, woods, etc.

Craig Harper

Water control structures allow manipulation of the water level in ponds and areas flooded for wildlife using a dike or levee.

Effect on habitat

- Allows ponds to be drained for managing water quality and control of unwanted fish.
- Allows management of water levels to increase or decrease the amount and type of aquatic vegetation in ponds and wetlands.
- Useful for creating a desirable mix (interspersion) of open water and emergent aquatic vegetation in wetlands.
- Can be used to create shallow water areas.
- Can be used to control water levels in flooded timber, drawing water down to prevent tree mortality.

Water Developments for Wildlife

General description

Water is a critical habitat component. Some wildlife species obtain necessary water from their diet, whereas others require free-standing water for drinking or for aquatic habitat (they live in water). Many species require a water source for obtaining food, reproduction, loafing, or escaping predators. Developing a source of water is a critical consideration for many wildlife species when little or no water is available. There are several ways to make water available to wildlife.

Small ponds can be created with backhoes or bulldozers. These are usually designed to collect water from runoff and/or precipitation, but may be created where there is an existing spring or seep, which facilitates water collection and helps ensure a reliable water supply. Side slopes for these ponds should be gentle to provide easy access for wildlife.
NOTE: these ponds are designed for various wildlife species, not fish.

Shallow impoundments may be created by constructing earthen dikes to retain water (usually run-off water from precipitation) in natural drainage areas. Placement of the dike is critical to avoid damage from floods and to collect sufficient water. When recommending shallow impoundments for waterfowl, bottomland areas (including grain fields and mature bottomland hardwoods) and existing wetlands should be considered for flooding. A water-control device in the dike allows the water level to be manipulated. Water can be removed from the field or woods prior to spring (similar to draining the water out of a bathtub) so the field can be planted again or so the trees will not die.
NOTE: When this practice is recommended, it is assumed an adequate water control structure will be included and should **not** be an additional recommendation.

Guzzlers and windmills are also used to provide water. Guzzlers are built by covering an area with an apron of fiberglass or some other material that sheds rain. Water is collected in a storage tank and slowly released into a trough from which wildlife can drink.

Small backyard ponds can be constructed in suburban backyards to provide water for a variety of wildlife. **Birdbaths** are also useful for providing water in Urban settings.

NOTE: ***Water Developments for Wildlife*** can be recommended when an additional water source is needed or when an existing water development for wildlife is essentially not functioning because it is in need of repair.

Craig Harper

Small ponds can be created where water is relatively scarce to provide water and habitat for several wildlife species.

Craig Harper

Shallow impoundments can provide excellent habitat for migrating and wintering waterfowl and other wildlife species.

Effect on habitat

- Can provide drinking water and wetland habitat.
- Grain fields or mature bottomland hardwoods flooded in fall/winter can provide important migrating and wintering areas with abundant food resources for waterfowl.
- Temporary flooding can improve existing open wetlands for nesting and brooding for some waterfowl, such as blue-winged teal and northern pintail.
- Temporary flooding can improve wooded and brushy areas for nesting and brooding wood ducks.
- Can provide a source of prey for many predators.

Craig Harper

Windmills are often used in the western U.S. to provide a water source for many wildlife species.

Population Management Practices

Decrease Harvest

General description

Regulated hunting, trapping and fishing regulations are primary tools used to manage many wildlife and fish species. State and federal wildlife agencies set regulations for hunting, trapping, and fishing seasons and bag and creel limits. Landowners can choose to take the maximum allowed or less than that, depending on local populations and personal management objectives.

Game birds and mammals

Decreasing harvest may be necessary when harvest data or observation data indicate populations are declining, especially in areas with good habitat. However, harvest through hunting and trapping are seldom the reason for declining wildlife populations. Rather, habitat quality is usually the reason for low or declining populations. If food, cover, water, or space is limiting, populations may remain low or decline. Appropriate habitat management practices should enhance habitat and allow populations to stabilize or increase.

Disease and, less often, unsustainable mortality from predation are other reasons for low or declining populations. If populations are low or declining because of predation, it is likely related to habitat (poor-quality cover) or possibly an abnormally high predator population. In this scenario, habitat management and possibly a reduction in the predator population can address low or declining game bird or mammal populations. Possible examples, though relatively rare, include abnormally high predation rates on deer fawns by coyotes or abnormally high predation rates on wild turkey eggs and poults from raccoons.

NOTE: ***Decrease Harvest*** is not an option for migratory species, such as waterfowl and mourning dove, because bag limits are set by the U.S. Fish and Wildlife Service and individual landowners cannot influence population levels of migratory species.

Largemouth bass/bluegill

Balanced Bass/Bluegill Populations

Documented via Seine Sampling: Young largemouth bass present. Many newly-hatched bluegills and some intermediate (3-5 inches) bluegill present.

Documented via Angler Sampling: Percentage Size Distributions (PSDs) – Between 40 percent and 70 percent of 8 inch or larger largemouth bass caught are also at least 12 inches long and 40 percent to 60 percent of 3 inch or larger bluegill caught are also at least 6 inches long.

Decrease Bass Harvest When:

Seine sampling reveals young bass may or may not be present, many intermediate bluegills in poor condition but no recent hatch of bluegills. If angling reveals few bass present but > 60 percent of the bass caught are at least 12 inches long while < 50 percent of bluegill are at least 6 inches long, return all bass.

Intended Result: The lack of bluegill reproduction and poor condition of intermediate bluegill suggests the bluegill population may be too high and food is a limiting factor. Reduce bass harvest (catch and release is ok) to increase predation pressure on intermediate-sized bluegills.

Decrease Bluegill Harvest When:
Seine sampling reveals no young bass present and many recently hatched bluegills but few intermediate bluegills present. If angling reveals < 20 percent of bass caught are at least 12 inches long and > 80 percent of bluegill are at least 6 inches long, return all bluegill.
Intended Result: Assess if other species of fish (such as green sunfish) may be competing with bluegill and if so, consider draining or renovating pond and restocking.

Cutthroat and Rainbow trout
Decrease trout harvest when seine and fishing records of a pond reveal that fish are in good condition or there are few medium and large fish and many small fish.

Coho salmon
A number of populations of Coho salmon in the southern portion of its range are in decline and have been listed as federally endangered or species of concern; therefore harvest is not allowed.

Increase Harvest

General description

Regulated hunting, trapping and fishing regulations are primary tools used to manage many wildlife and fish species. It is the responsibility of state and federal wildlife agencies to set hunting, trapping, and fishing seasons and bag and creel limits. Landowners can choose to take the maximum allowed or less than that, depending on local populations and personal management objectives.

Game birds and mammals

Increased harvest of game birds and mammals may be needed when animals show signs of stress and overpopulation, such as destruction of habitat by overgrazing or overbrowsing, poor body condition and weight loss, low reproductive rate, and increase in prevalence of parasites and diseases. Regulated hunting and trapping is the most effective and efficient practice to remove surplus animals and keep wildlife populations in balance with available habitat. When scientific data indicate animals are above carrying capacity, it is often necessary to increase harvest. Increased harvest through regulated hunting or trapping also can be used to reduce numbers of a particular game species if that species is causing damage to another species. Examples may include increased harvest of raccoon if they are limiting wild turkey recruitment, increased harvest of coyotes if they are limiting white-tailed deer recruitment, increased harvest of white-tailed deer if they are degrading habitat for various forest songbirds. See **NOTE** under ***Wildlife Damage Management Techniques*** on page 296 for discussion on determining whether to recommend ***Increase Harvest*** or ***Wildlife Damage Management Techniques***.

NOTE: ***Increase Harvest*** is not an option for migratory species, such as waterfowl and mourning dove, because bag limits are set by the U.S. Fish and Wildlife Service and individual landowners cannot influence population levels of migratory species.

Craig Harper

Increased harvest may be necessary where populations approach or exceed carrying capacity of the area being managed. When population reduction for white-tailed deer is necessary, the harvest should concentrate on females which will reduce animal numbers and can adjust the sex ratio.

Largemouth bass/bluegill

Balanced Bass/Bluegill Populations
Documented via Seine Sampling: Young largemouth bass present. Many newly-hatched bluegills and some intermediate (3-5 inches) bluegill present.
Documented via Angler Sampling: Percentage Size Distributions (PSDs) – Between 40 percent and 70 percent of 8 inch or larger largemouth bass caught are also at least 12 inches long and 40 percent to 60 percent of 3 inch or larger bluegill caught are also at least 6 inches long.

Increase bass harvest when:
Seine sampling reveals young bass may or may not be present while there are many recently hatched bluegills but few or no intermediate bluegills. If angling reveals < 20 percent of the bass caught are at least 12 inches long and in poor condition while > 50 percent of bluegill are at least 6 inches long, increase harvest of bass < 12 inches beginning with 10-20 per surface acre per year).
Intended result: The increase in bass harvest will reduce competition for food among small bass and allow the remaining small bass to grow more quickly making more of the forage resource available to them (bass can only swallow bluegill about one-third of their length, for example, a 12-inch-long bass can only consume bluegill < 4 inches long). **NOTE**: This existing pond scenario is desirable if the pond owner is willing to sacrifice bass size for a primary goal of producing large bluegill.

Increase bluegill harvest when:
Seine sampling reveals no recently hatched bluegills but many intermediate bluegills in poor condition present. If angling reveals 20 percent to 60 percent of bass caught are at least 12 inches long but < 50 percent of bluegill are at least 6 inches long, increase intermediate bluegill harvest by angling, seining and/or shoreline rotenone application.
Intended Result: Increased bluegill harvest should decrease competition for food among intermediate bluegill. Make sure excessive turbidity (visibility <15 inches) or weed growth (> 50 percent coverage of the pond) is not limiting largemouth bass access to bluegill.

Cutthroat and Rainbow trout
Needed when seine of angler harvest records reveal many small fish and in poor condition. In many areas, extremely cold water reduces trout growth. In these situations, increased harvest may not be beneficial.

Coho salmon
Coho salmon populations in Alaska remain robust and support thriving commercial and recreational fisheries. Harvest can be increased based on state and federal statutes when population estimates trend upward for these Alaskan populations.

Wildlife or Fish Survey

General description

Wildlife surveys

Monitoring trends of wildlife populations and physical attributes (such as body weight) is important for wildlife managers. Data on various species are routinely collected by wildlife biologists using observation counts, roadside counts, call counts, point counts, check-in stations, infrared-triggered cameras, transects, questionnaires, and other techniques. These data are used to prescribe future harvest or land management strategies.

Wildlife Survey Techniques

***Observation counts*:** species and number of animals are recorded as they are seen. Counts may be made while conducting other activities or during official observations, such as counting ducks on a wetland

***Roadside counts*:** usually involve driving a predetermined route and counting the number of individuals of a species while driving the route

***Call counts*:** recording the number of individuals or groups (such as a northern bobwhite covey) of a species while waiting and listening at a specific location

***Point counts*:** recording the numbers of a species observed or heard at specific, predetermined points along a transect

***Check-in station*:** data are collected from game animals when hunters bring the animals to an official check-in station, which may be at various places, such as a Wildlife Management Area or local country store

***Infrared-triggered cameras*:** "trail" cameras are placed in areas where animals frequent and the pictures are used to estimate population density, sex ratio, age structure, etc.

***Transects*:** predetermined routes are used to collect observation data, point counts, dropping ("pellet") counts, call counts, etc.

***Questionnaires*:** groups of people, such as hunters or school bus drivers, are asked about their observations of animals

Fish surveys

Pond balance should be checked during early summer by seining at intervals around the pond. Balance is determined by comparing age groups, condition, and numbers of bass and bluegill caught in the seine during the summer months, and from year-round angler catch records. Recent young-of-the-year fingerlings of both bass and bluegill collected in the seine indicate the fish population is balanced (see ***Decrease Harvest*** and ***Increase Harvest*** sections under WMPs for more information). Angler catch records should be used to record the numbers, total lengths, and weights (fish caught in the fall only) of all bass and bluegill harvested. Fish caught by hook-and-line can be evaluated on body condition or Relative Weight (fat, skinny, size of head in relation to body) and population size structures based on Percentage Size Distributions. Trout do not often reproduce in ponds, so overall health of the fish is used as an indicator of pond balance. Unwanted species (such as bullheads and crappie) also may be caught in the seine or when fishing, indicating the fish population may be killed (with Rotenone) or drained.

Seining is usually not effective for collecting fish in streams. Fish in streams are usually collected by electro-shocking or by fishing. Electro-shocking involves running a small electrical current between two conducting rods, which are moved up and down the stream. Stunned fish float to the

surface and the age, condition, and numbers are recorded to determine stream balance. The fish are then returned to the stream.

NOTE: Although information from wildlife and fish surveys is always important, surveys should not be recommended if information is provided by contest organizers that indicate a survey has been completed recently.


Craig Harper

Infrared-triggered cameras are a great tool to survey populations of several wildlife species.

Wildlife Damage Management Techniques

General description

Wildlife managers often have to manage wildlife to control damage. Wildlife damage management is most common in urban and suburban areas where wildlife and humans frequently interact. Examples of wildlife damage include woodpeckers hammering on the side of the house; bats or squirrels in the attic; snakes in the house; deer eating ornamental plants in the yard or depredating soybean crops; bobcats, coyotes, and owls preying on livestock or pets; rabbits and raccoons eating vegetable gardens; beavers killing trees or flooding crops and roads; red-winged blackbirds eating crops; bird strikes at airports; rock pigeons defecating on buildings; starlings roosting in urban trees and defecating on sidewalks; and Canada geese loitering on lawns and golf courses.

Wildlife managers use both lethal and nonlethal methods to control these problems. Fencing and other exclusion devices, habitat modifications, harassment techniques, scare tactics (such as propane cannons, dogs), and taste and odor repellents are examples of nonlethal methods. Changing human activity also can be effective. For example, removing the dog food or bird feeder from the deck is the easiest way to keep raccoons, rodents, and other wildlife off the deck. Often, nonlethal methods do not work and lethal methods are required. Lethal methods are intended to kill wildlife quickly without suffering and may include body-gripping traps, trap-and-euthanize (put to death without pain or suffering), shooting, and poisoning. There are advantages and disadvantages to both lethal and nonlethal management methods.

One advantage of lethal methods is they can immediately decrease the numbers of animals in a population that are causing damage or health hazards, thereby immediately reducing the damage or hazard. In some cases, only one or a few animals are causing the problem, and lethal methods can then eliminate the damage once the individual(s) causing the damage is eliminated. Nonlethal methods typically cause the animals causing the problem to move to another location. Although nonlethal methods may reduce or eliminate the problem at one location, the animal(s) causing the

problem may relocate and cause the same problem at a different location. An advantage of nonlethal methods is they are generally accepted by the public better than lethal methods and they can be more easily used in areas with high human density. Education can help the public understand the efficacy and sensibility of many lethal methods.

Regardless of the method used, there are some general guidelines that can increase the success of a wildlife damage management program. It is important to identify the species causing the damage. An integrated wildlife damage management program that employees two or more methods is strongly recommended, especially when using nonlethal methods. It is imperative to know all the local, state, and federal laws related to the species causing the problem and the wildlife damage management method(s).

NOTE: For the purposes of this contest, it sometimes can be confusing when deciding whether to recommend ***Increase Harvest*** or ***Wildlife Damage Management Techniques***. If the problem is related to an overabundant population of a game bird or mammal and hunting or trapping is allowed on the property, ***Increased Harvest*** should be recommended. If the problem is related to a nongame animal, or if regulated hunting or trapping is not allowed on the property, or if control is necessary outside the regulated hunting and trapping seasons, or if the problem is related to one or a few individual animals (whether game or nongame), then ***Wildlife Damage Management Techniques*** would be the appropriate practice to recommend. For example, if cottontails are causing problems in a garden, control would be necessary outside the regulated hunting or trapping season (fall and winter). Thus, ***Wildlife Damage Management Techniques*** could be recommended during spring or summer when the problem is occurring. ***Wildlife Damage Management Techniques*** should be used to control nongame and nonnative species for which there is no hunting or trapping season, such as woodpeckers damaging a building or house sparrows outcompeting bluebirds.

Although not common, ***Wildlife Damage Management Techniques*** could also be required if increased harvest has not been effective. Situations can occur where local regulated hunting and trapping pressure is not able to effectively lower a population and professional wildlife damage management specialists are needed to address the situation. Examples may include population reduction for white-tailed deer, raccoon, coyote, and American beaver. The person in charge of the contest will give you clues as to which WMP (***Increase Harvest*** or ***Wildlife Damage Management Techniques***) would be most appropriate.

Craig Harper

House sparrows often displace bluebirds from nest boxes constructed for bluebirds. This invasive nonnative species should be removed whenever possible.

Dwayne Elmore

Netting can be used to protect crops, such as grapes and blueberries, from birds and other wildlife.

Jim Phillips

Coyotes play an important role as a predator. However, they can be problematic in various situations. Problems associated with livestock depredation are often a result of one or a few local individuals. Problems associated with limiting recruitment of other wildlife species, such as white-tailed deer, are more often a result of a dense coyote population. Sustained *Increased Harvest* can help lower coyote populations. *Wildlife Damage Management Techniques* are employed to target problem individuals. Regardless, trapping is usually the recommended technique for controlling coyotes.

Fish Pond and Stream Management Practices

Construct Fish Pond

General description

Fish ponds can be created using dams, dikes, and levees to provide relatively permanent water for fish. Pond design varies, depending on the purpose for constructing the pond and the ecoregion where it is constructed. Ponds with a high-shoreline length to surface-area ratio provide maximum access to the pond by anglers. The local Extension office or Natural Resource Conservation Service office can provide design details.

This practice should be recommended when creating new fish ponds with relatively permanent water. When constructing ponds, artificial reefs can be included for additional cover. These structures are usually constructed of rock piles, sections of plastic or cement pipe (a minimum of 6 inches in diameter and 18 inches long), and brush piles. Artificial reefs are normally recommended only for ponds larger than 10 surface acres.

NOTE: ***Restock Fish Pond*** should not be checked when ***Construct Fish Pond*** is recommended.

Effect on Habitat

- Ponds provide habitat for some fish and wildlife species.

NOTE: Although many wildlife species may use ponds for various reasons, this practice and the other ***Fish Pond*** practices are intended primarily for fish habitat. For the purposes of this contest, when additional water or wetland habitat is needed for wildlife species, ***Water Developments for Wildlife*** should be recommended. This distinction avoids management conflicts when both fish and wildlife species are managed on the same property. For example, steep-sloping sides help reduce aquatic vegetation and favor balanced fish populations, whereas gentle-sloping banks with abundant emergent aquatic vegetation benefit various wildlife species, such as American bittern or wood duck.

Control Aquatic Vegetation

General description

Aquatic vegetation should be controlled when it begins to limit use of a fish pond for recreation or interferes with access. As surface area coverage by vegetation exceeds 33-50 percent, the ability of predator species (such as largemouth bass) to access forage species (such as bluegill) may become reduced and therefore negatively impact the balance of the fish populations. Prevention of rooted aquatic vegetation growth can be accomplished two ways: 1) Deepening the edges of the pond to a minimum of two to three feet with steep side slopes, which minimizes shallow water areas exposed to sunlight. Pond edges can be deepened in drained ponds with a bulldozer or tractor with rear blade or in existing ponds with a backhoe. The soil removed can be piled on the bank or levee and smoothed for planting with native grasses and forbs, and 2) Initiating a spring-through-fall fertility program, which reduces light transmission and prevents rooted submerged plants from becoming established (see **Fertilize/Lime Fish Pond** for more information). Existing aquatic vegetation can be controlled chemically, biologically, or mechanically. Chemical control is accomplished by applying a labeled

aquatic herbicide following identification of the targeted plant species. Biological control is also plant species specific. Potential biological control agents for aquatic vegetation include fish species (such as white amur/grass carp, tilapia) and insects (such as salvinia weevil). Regulations as to which biological control agents may be used vary from state to state. Mechanical control includes physically removing existing vegetation by seining, dragging with chains or ropes, cutting, and raking.

Effect on habitat

- Reduces rooted aquatic vegetation within and around the edge of a pond, making prey more easily available to predator fish.

Billy Higginbotham

Filamentous algae and cattails must be controlled in this pond before fertilization is possible. Dense cattails can also provide cover for many small fish and lead to an imbalanced fish pond.

Fertilize/Lime Fish Pond

General description

Fish ponds can be fertilized to increase natural food organisms (phytoplankton and zooplankton) and prevent rooted aquatic weeds from becoming established. However, every pond should not be fertilized. Fertilization should **not** be used in ponds infested with weeds, ponds with excessive water flow, turbid (muddy) ponds, or ponds that will not be fished heavily. If ponds are infested with weeds, fertilization will only increase weed growth and spread. If ponds have excessive water flow, fertilization will be diluted. Suspended mud in ponds blocks sunlight, preventing an algae bloom. If ponds are not fished sufficiently, the fish population will become out of balance and growth will become stunted.

Fertilization is needed in fish ponds with water clear enough that you can see clearly to 18 inches below the water surface. Total alkalinity (the measured of total bases expressed as carbonates) and pH of the pond water should be tested before beginning a fertilization program. Total alkalinity should be at least 20 parts per million (ppm) with a pH of 6.5 to 9.0. Total alkalinity and pH can be assessed by collecting water samples; pH can also be measured by collecting samples of the pond bottom (substrate) and having them tested. Agricultural limestone (calcium carbonate) should be applied evenly over the pond surface area per recommended rate.

Fish ponds should be fertilized in the spring when the water temperature reaches 60 F. For ponds with moderate hardness (50 mg/l to 100 mg/l calcium hardness), apply 15 pounds of 12-52-4 (or

its equivalent) powder, or one gallon of 11-37-0 liquid fertilizer, or 15 pounds of granular 0-46-0 per acre at two-week intervals, or until a good green color (phytoplankton bloom) develops in the pond. Make additional fertilizer applications (at the same rate per surface acre) every three to four weeks, or when the water clears (becomes less green). Fertilization may be continued until water temperatures drop below 60 F in the fall. Methods for applying fertilizer vary with the type of fertilizer used. Granular fertilizer must be distributed from a fertilizer platform. Liquid fertilizer should be mixed with pond water and broadcast from a boat for large ponds or from the bank of small ponds. Water soluble powdered fertilizers can be broadcast from a boat or from the bank.

Effect on habitat

- Pond fertilization stimulates phytoplankton production, which is the first step in the food chain of a fish pond.

Reduce Turbidity in Fish Pond

General description

Turbid or muddy water limits fish production because natural food organisms need sunlight to grow. Turbidity can be caused by sediment being washed in from the pond banks or watershed, cattle using the pond, feeding activities of bottom-dwelling fish, such as carp or buffalo fish, or negatively charged clay particles suspended in the water column.

Turbidity is most often caused by sedimentation (erosion) from the watershed or the pond bottom (cattle or fish) and will usually clear in a relatively short period of time. Reducing erosion in the watershed is best accomplished by reseeding relatively large bare areas of soil around the pond where there is evidence of erosion. Turbidity from pond sediments can be controlled by restricting cattle to a small area of the pond and eliminating bottom-dwelling fish.

Turbidity from suspension of negatively charged clay particles is a more difficult problem. The addition of positively charged compounds, such as limestone, gypsum, or alum crystals, can cause the clay particles to settle.

Effect on habitat

- Improves water quality by removing or settling silt.
- Allows sunlight to stimulate phytoplankton.

Restock Fish Pond

General description

Restocking a pond is a drastic measure and should only be considered after other management approaches have been attempted. Ponds containing wild fish species, such as carp, shad, green sunfish or bullhead catfish, should be restocked with a balanced predator-prey combination. Restocking should be done only after all fish in the pond have been removed, either by draining or applying a fish toxicant. In warm-water ponds, bluegill fingerlings should be stocked in late fall and bass fingerlings are stocked the following June. Although various states have different stocking recommendations, typical stocking rates are 1,000 bluegill and 100 bass per surface acre if the pond is to be fertilized, or 500 bluegill and 50 bass per surface acre if the pond will not be fertilized.

Effect on habitat

- Draining ponds and using fish toxicants remove unbalanced fish populations and allow establishment of desirable balanced fish populations.

Streams: Create pools

General description

Pools and riffles are important habitat features for various fishes that inhabit streams. Stream flow varies with elevational change and width of channel. Stream flow is faster where there is more elevational change and tends to be slower where the stream channel is wider. Flowing water carries material, such as gravel, sediment, and debris, and redistributes them along the stream course. Where the stream is wider and the water flow is reduced, the material is deposited and forms riffles. Riffles are preferred areas for spawning for many fish species and some fish species occur primarily in riffles.

Topography restricts stream channels and causes a stream to bend. Where this occurs, pools are created. Pools are deeper than the stream channel and the water flow is slower. Pools provide areas for fish to feed and find refuge from fast-moving water that requires more energy for swimming. Some fish species occur primarily in pools.

Large boulders, rocks, or logs can be placed strategically in streams to create pools and enhance habitat for some fish species where there are considerably more riffles than pools and the amount of pools in the stream is limiting for a species. Rocks must be large enough so small floods will not move them. Any structures put in a stream have the potential to alter stream currents in an undesirable manner. It is important that fish have the ability to move freely between pools and riffles. The placement and design of such structures should be done with advice from experts. Although some species can complete their life cycle within a small portion of the stream, other species, such as salmon, must migrate to the ocean and return to the stream to spawn.

Effect on habitat

- Used to create pools for various fish to hide, feed, and rest.
- If designed properly, can be used to reduce some kinds of stream erosion.

Streams: Remove Fish Barriers

General description

Remove or replace culverts or large dams that prevent fish passage upstream. Culverts with great drops below them or with water flowing too fast through them can block fish from going upstream. These culverts can be replaced with arched or bottomless culverts or with bridges. In some cases, “fish ladders” or steplog structures can allow fish passage around barriers.

Effect on habitat

- Allow fish to access and migrate within the stream system and between the stream and ocean to complete their life cycles.

Urban Wildlife Management Practices

Artificial Feeders

General description

Artificial feeders are used primarily to feed songbirds and butterflies for viewing purposes. A wide variety of feeder designs, methods, and foods are available. Most bird species prefer black-oil sunflower seeds and white proso millet. Species such as hairy woodpecker prefer suet (fat) rather than seeds. Some species, such as mourning dove and song sparrow, prefer to eat on the ground than on an elevated feeder.

It is important to realize artificial feeders can be hazardous to birds. Disease transmission is often problematic because feeders draw birds close together. Salmonellosis, aspergillosis, and mycoplasmal conjunctivitis are fatal diseases among songbirds and are readily transmitted at heavily used bird feeders. It is imperative to clean feeders regularly with hot soapy water and a mild bleach solution. In addition, feeders pose danger via nonnative predators, specifically house cats. Although house cats may be fed, they still hunt and kill millions of birds and small mammals each year. It is irresponsible to own a cat and leave it outside because of the unnatural pressure they put on native wildlife. Feral cats should be reported to local animal control officials, removed from the area, and euthanized.

Effect of practice

- Provides supplemental food source, primarily for viewing purposes.

Mowing

General description

Mowing with a lawnmower can maintain lawns and park-like settings in urban areas. Mowing is usually the only possible practice for maintaining openings in urban areas. Mowing is well-suited to maintain low-growing grasses and forbs. Many wildlife species inhabiting urban areas are attracted to yard-like settings, especially when interspersed with shrub and forest for cover and travel corridors.

Effect on Habitat

- Mowing maintains yards and grassy openings.
- Wide expanses of mowed areas do not provide adequate cover for some wildlife species; therefore, it is important to leave some areas unmowed or provide cover using islands of shrubs and flowers.

Craig Harper

Backyards can be arranged in various shapes and with various plantings and nest boxes so that they are more attractive and useful for wildlife.

Plant Flowers

General description

Annual and perennial forbs can be planted to attract a number of wildlife species. A variety of species will flower over a longer period. Species and varieties should be selected to provide food and cover throughout the year where possible. Forbs should be planted in proximity to other cover sources to make them readily available.

Effect on habitat

- Provides a supplemental source of food and cover.

Rooftop/Balcony Gardens

General description

In urban areas, residential green space may be limited. Urbanites can create rooftop or balcony gardens to provide additional food, water, and viewing opportunities. Although limited in space, the goal of rooftop or balcony gardens is to create habitat; thus, rooftop or balcony gardens should provide food, water, and cover for species that are adapted to the space restrictions. Moving water, such as a small waterfall, will attract more wildlife than stationary water.

Effect on Habitat

- Provides food, cover, and water, though in small amounts, for wildlife in urban areas.