

Chapter 7: Forestry and Agricultural Management Can Enhance Biodiversity

Biodiversity is an important consideration in forestry and agricultural management since declines can constrain options for the landowner's lifetime and future generations. Decisions made today have consequences for future managers of the land as well. Because beauty is in the eye of the beholder,

simplification or other significant changes to a landscape may not be deemed attractive by future landowners. Loss of Oklahoma's biodiversity will leave our descendants with a very simplified landscape that they may view as undesirable. Changes that are very difficult or impossible to reverse, such as

loss of our biodiversity, should be avoided.

Maintenance of biodiversity tends to retain management flexibility, allow economic diversification and support the ability to take advantage of new markets. Loss of biodiversity reduces a land unit's probability of harboring newly discovered products such as medicines, pesticides or other compounds. Options for nontraditional enterprises, such as fee hunting or other recreational pursuits, are usually diminished with a reduction in biodiversity.

The vigor of species used for forestry and agricultural production strongly rely on regular input of new genetic material. Whether the goal is to introduce new characteristics or alleviate inbreeding problems, genes from wild populations are important to the development, maintenance and improvement of strains of plants and animals used in agricultural and forestry production. Producers recognize the dangers of using a single genetic type over a long period and compensate by trading bulls or planting multiple varieties of crops. Genetic diversity is important for resistance to disease or pests, capacity for adapting to changing environments or for survival across broader climatic conditions, and ability to survive epidemics and natural disasters. Maintaining wild populations of species from which commercial strains are developed is vital to sustaining the productivity of these operations.

Forestry and agricultural operations are intimately dependent upon the health of the ecosystem in which they occur. Nutrient and water cycles drive productivity of these operations and determine their viability. Functions performed by the species in healthy ecosystems ensure the health of these cycles and perform functions that would otherwise require chemical or mechanical methods. Healthy natural communities contain a variety of species that provide biological control of many pest species. Maintaining healthy communities also allows the producer to benefit from other relationships in the community, such as nitrogen-fixing legumes that capture nitrogen in the air and deposit it into the soil through the help of bacteria growing on their roots. Another example is **mycorrhizae**, a union of certain fungi with rootlets of

plants,

which enhance the ability of plants to take up moisture and nutrients, thereby increasing their growth rates.

By managing healthy natural communities as part of forestry and agricultural operations, landowners can often grow their products with lower economic inputs than are required under additional management techniques. Because natural communities are adapted to local conditions, they do not require large amounts of inputs to remain productive. Native plants in diverse communities require fewer pesticides because they are adapted to deal with local pests, whereas monocultures of any plant species require frequent application of pesticides and fertilizers. Pastures composed of native plants require much less maintenance than introduced grass pastures. Natural pine management for forestry production may be more suitable for the average landowner than capital- and labor-intensive plantation management. Native pecans, because of their genetic diversity, are generally less susceptible to disease than many planted varieties. Although managing an operation to maintain or increase biodiversity may not result in maximum production, requiring additional acres to produce

Practices that Benefit Biodiversity

Forestry and agricultural operations currently implement a variety of practices that protect or benefit biodiversity on their land. Many of these are associated with decreasing the impact of production on natural resources by protecting soil and water, often through erosion control. Producers are becoming increasingly aware of conservation issues and the need to include conservation concerns in their operations. Many landowners are excellent stewards and serve as examples of how production and biodiversity conservation can be integrated within a profitable operation.

Land-Management Practices

Because forestry and agriculture rely on natural processes to produce their commodities, many of the management practices conducted by responsible operations are directed toward maintaining healthy

comparable yields, the functions and adaptations of more natural communities might compensate by reducing the cost of production, resulting in similar net profits.

A side benefit of enhancing biodiversity within forestry and agricultural production could be fewer species becoming endangered and fewer regulations associated with listing a species. Habitat loss is the cause of most species declines and as humans find ways to include habitat requirements for fish and wildlife with their activities, fewer species will decline and some that currently are listed as threatened or endangered may recover. The Forestry and Agriculture Committee is continuing to investigate ways to use the functions of natural communities to the advantage of livestock, crop and timber production. The committee is trying to find ways that biodiversity may be viewed as an important asset to the landowner rather than a liability or inconvenience due to regulations associated with individual elements of biodiversity.

communities. For example, knowledgeable ranchers that use native rangeland for grazing pay special attention to the composition of the plant community to ensure that they do not overgraze the grasslands and lower their ability to produce weight gains in cattle. Responsible timber growers likewise carefully plan road construction and forestry activities to minimize erosion and stream siltation which would decrease future productivity of the site. These practices also tend to maintain the area's biodiversity.

Use of a well-designed rotational grazing program may maintain or enhance biodiversity of managed rangeland. Rather than grazing a pasture continuously throughout the year, which tends to eliminate the most palatable plant species, livestock are moved to a new pasture when the appropriate amount of forage growth has been removed from the current pasture. This gives plants rest periods to grow unmolested, restore their vigor and produce seed. It also produces a mosaic of plant heights that is beneficial to prairie wildlife species and more closely mimics the historical

grazing patterns of bison. When cattle are concentrated in the paddocks to achieve complete utilization of the forage, however, they often trample bird nests on the ground. Deferring grazing on some of the paddocks until July 15 will allow most of these birds to produce one clutch of young and result in minimal reductions in forage quality and livestock productivity. These birds and their young provide benefits by preying on local insects. Proper grazing ensures that the basic plant and soil resources are used in such a way as to continue to be productive.

Careful management of streams, rivers and other water bodies is important to commodity production



Responsible production often requires active vegetation manipulation to maintain productivity of the site. Unmanaged grasslands throughout much of the state are quickly invaded by eastern red cedar or ashe juniper, reducing their biodiversity and grazing productivity. Thinning pine stands to encourage rapid growth allows development of a good cover of grasses and shrubs and simulates conditions of a pine savanna. Landowners increasingly are using methods that mimic natural processes to control vegetation in these circumstances rather than using more expensive mechanical or chemical methods. Proper cattle

and vital to biodiversity. Fencing cattle from streams and farm ponds to allow only restricted access, or piping water away from these areas to tanks or newly developed freeze-proof water tanks helps maintain good plant communities around the stream and pond banks, since cattle cannot graze or rest there. This provides direct benefits to wetland, riparian and aquatic communities and ensures good-quality drinking water for the livestock and increased weight gains.

By filtering sediment before it reaches the pond, the buffering vegetation extends the pond's life as well. Streamside management zones are areas where forestry management practices are modified to protect water quality and benefit wildlife. Use of native grasses in waterways of crop fields provides habitat for grassland species and, if left unmowed until after the nesting season, often is the primary nesting cover after the crop has been harvested.

grazing may be used to approximate conditions present with grazing bison and may be an important factor in managing prairie communities. Prescribed fire is used increasingly in conjunction with grazing to



increase the health of grassland communities and also to reduce competition in pine stands. Proper use of these methods may increase biodiversity by restoring the functions that shaped these natural communities, allowing many species to thrive in these areas.

In some cases, chemical or mechanical inputs are necessary for managing vegetation. In instances where these tools are used to restore a diverse community, they may directly increase biodiversity.

In areas where red cedar has completely taken over a prairie community or where the use of fire is not possible, mechanical or chemical control of the cedar is necessary for restoring the prairie community. However, exotic plant species often invade disturbed areas and require additional controls to allow native plant species to return.

Processes of natural biological control maintain the so-called balance of nature. Introduction of a biological agent must be carefully studied to avoid displacing other biological controls or harming desirable plants or animals. Biological agents include large grazing animals to control various types of vegetation or insects to control noxious plants. For example, goats are used to control brush in many areas, but must be carefully monitored in order not to overuse desirable plants.

Managing for a diversity of native grass and forb species in fencerows, corners and waterways near crop fields will increase populations of predatory and parasitic insects that are natural enemies of many insect pests. Nectar-producing forbs attract a variety of insects that prey on various life stages of many

Many vertebrate species also provide valuable pest control, but may require additional structure, such as shrubs, trees, and natural or manmade cavities. Most young birds feed exclusively on insects. Bluebirds feed extensively on caterpillars and grasshoppers. Purple martins may provide good control of horseflies.

Bats, which can consume up to 600 insects per hour, are the major predator of night-flying insects, such as beetles, moths and mosquitoes. Bats may be attracted by erecting bat houses in suitable locations.

Although detailed studies have not been conducted on the economics of using biological control versus traditional chemical applications, use of natural enemies holds much promise for controlling pests, especially since many insect pests are developing resistance to insecticides. More work needs to be done to determine the effectiveness of these controls and provide additional information on managing for these beneficial species.

Government Services

Many government agencies provide numerous,

agricultural pests. These areas also serve as refuge sites when the field is harvested so the natural enemies will survive until the next crop is growing. As the insect pests (e.g., aphids) increase in the new crop, the natural enemies are able to move out of the refuge areas and exploit the new food sources. Although some of the insect pests also seek refuge in these prairie strips, they will help sustain predator populations so they can better respond when pest populations increase again. Insecticides should only be used sparingly in these areas to avoid destroying populations of beneficial insects.

Some of the most popular insects for pest control are ladybird beetles (Lady bugs), preying mantises, various parasitic wasps (including *Trichogramma*) and leather-wing soldier beetles. Many nectar-producing wildflowers, such as legumes and members of the Umbelliferae (parsley family) attract wasps. Elderberry and goldenrod attract leather-wing soldier beetles and other insects that feed on grasshopper eggs, cucumber beetles and various caterpillars. Leaving a duff layer on the ground provides areas for ladybird beetles to overwinter.

diverse services that benefit and enhance biodiversity.

Several agencies work with private consultants, contractors and individuals to provide training in biodiversity-conserving land-management techniques. Some agencies even offer financial incentives to encourage development and implementation of practices or plans to conserve biodiversity.

The Natural Resources Conservation Service (NRCS) and its partners, the various Conservation Districts of Oklahoma, as well as the Oklahoma Department of Agriculture & Forestry Services (ODA-FS) provide farm, ranch and forest management plans to landowners that include elements designed to protect and conserve biodiversity. The NRCS or Conservation District plans are being called **Whole Farm Plans** and emphasize the broadened focus on an ecosystems approach to agricultural land use. The NRCS and Conservation Districts also are heavily involved in planning, managing and restoring wetland and other important fish and wildlife habitats through the U.S. Fish & Wildlife Service's **Partners for Wildlife Program** and its own **Wetlands Reserve**

Program. Both of these programs focus on enhancing and restoring functioning wetland ecosystems, which are highly diverse and productive ecological communities.

The ODA-FS provides land management planning assistance focused primarily on the use and conservation of forested lands. These multidisciplinary Forest Stewardship Plans also recognize the values of an ecosystem approach to forestland management. This agency also assists cities, towns and groups across the state in developing community forest resources through its Urban and Community Forestry Program.

ODA-FS provides two other beneficial but less well known programs that are critically important to maintain and enhance Oklahoma's biodiversity. The Forest Regeneration Program has two primary thrusts that influence biodiversity. The first is preservation and enhancement of the genetic base of native tree species through the Forest Tree Improvement Center. This center works with native species such as loblolly pine, bur oak, hackberry and others to improve seedling planting survival, growth rates and performance of commercially important species. Seedlings are grown and distributed from the state Forest Regeneration Center to private landowners and others for windbreaks, wildlife habitat, riparian area

The Oklahoma Commissioners of the Land Office employs management planners to oversee its lands. These lands are most important to western Oklahoma, where ownership is concentrated. Many unique elements can be found on these lands, making their role in biodiversity conservation quite important. One example is the location of one of Oklahoma's two native stands of ponderosa pine on state-owned school land near Kenton.

These are just a few examples of the ways state, federal and local government agencies enhance biodiversity through policy, funding, program administration and enforcement efforts. Tribal governments are another governmental entity with considerable power to influence biodiversity in Oklahoma through conditions and restrictions on deeds, leases, easements and permits.

Education

restoration, erosion control and reforestation.

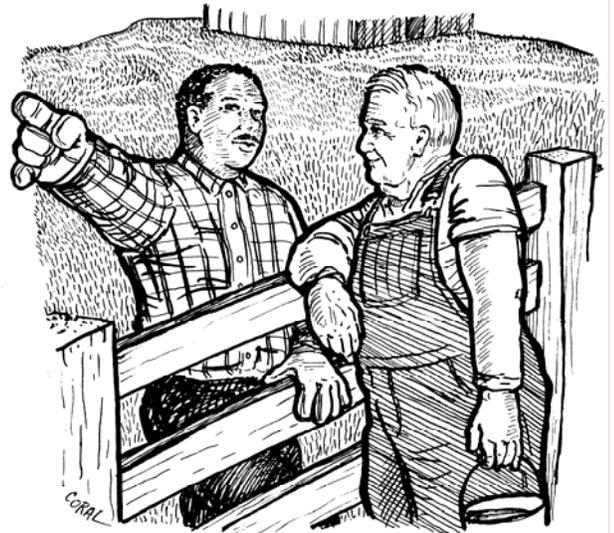
The ODA-FS's other important forestry program for protecting biodiversity is the Forest Wildfire Suppression Program. Today, this governmental service is sometimes viewed as counterproductive to biodiversity conservation. To fully appreciate its value to biodiversity, however, one only needs to look back in Oklahoma history as little as 65 years. Prior to active wildfire suppression, forested land in eastern Oklahoma was cut over and repeatedly burned much more frequently and intensely than naturally occurred. These human-induced wildfires effectively prohibited natural regeneration of forests. Since suppression of these unnatural fires, Oklahoma's forests have been allowed to recover and presently provide the basis for diverse wildlife communities and sustainable economies. Without fire suppression it is doubtful that this recovery could have occurred. Saying that fire suppression is good is not to say that all fire is bad. Only uncontrolled wildfires. Fire is a recognized land-management tool that can have a positive effect on biodiversity when used appropriately with proper safeguards and precautions. In fact, it is one of man's and nature's oldest land management tools and its use is expected to increase.

As with any field, informing managers about successful techniques is vital to the success of the industry. Various forestry and agricultural organizations have educational outreach programs that disseminate information about ways to manage land in a sustainable manner that enhances the entire ecosystem. For example, the Society for Range Management holds a number of range management workshops, meetings and seminars to distribute information about the best ways to manage rangelands to ensure greater production of livestock and wildlife.

The Noble Foundation enables individual farmers and ranchers to better understand resource management and achieve their goals through consultation, education, research and demonstration. The Kerr Center operates a variety of working livestock farms to demonstrate proper management of livestock and range. These and other organizations and government agencies actively promote responsible production that

targets long-term sustainability and ecosystem health rather than maximizing short-term profits. The trend of these efforts is toward the use of native species or natural communities, rather than attempting to import exotic species to cure the impacts of abuse. By focusing on long-term viability and using natural communities, these programs are showing landowners how they can incorporate biodiversity conservation into their management programs and profitably use it to their advantage.

Some of the most effective distribution of information occurs as landowners talk with one another on an informal basis. Neighbors share success stories about new techniques they are trying and discuss solutions to problems they experience. One-on-one discussion with people they know and see on a regular basis



usually results in more changes in practices on the ground than outreach programs from a distant institution. Neighbors can see firsthand how a particular management regime is working in their area.

Most landowners engaged in forestry and agriculture are closely tied to the land they work. Historically, these farms have been handed down to successive generations and many families are proud of the heritage associated with the family farm. Many of these landowners have a very strong sense of stewardship and wish to hand the land to their children in better condition than it was when they began managing the land. Because of the flexibility possible with private landowners, they are potentially the best conservationists in our state. Motivating landowners to spread information about successfully implementing biodiversity management will continue to be a most vital part of education in Oklahoma.

Ways to Improve Biodiversity in

Forestry & Agriculture

Waste Disposal

Raising livestock (e.g., cattle, swine, chickens and turkeys) in high densities produces large amounts of waste that, without proper management and retention, potentially can pollute streams, rivers, wetlands and groundwater. Confined animal feeding operations (CAFOs) are increasing in Oklahoma. Finding ways to safely store or dispose of animal wastes is the primary environmental concern associated with these operations. Currently, the waste is held in a lagoon and applied to fields as fertilizer. The volume of waste that can be applied is limited by the amount of nutrients the plants can absorb so that the nutrients do not build up in the soil and leach into streams or groundwater.

In addition to this common lagoon storage, some new methods are showing success. Experimentation has shown that artificial wetlands can be effective in removing excess nutrients and purifying wastewater. In one case, fish were raised for production in a pond fertilized with manure from a CAFO. Water from the fish pond was directed through a series of wetlands where plants and other organisms removed additional nutrients. In another example, wastes were separated hydraulically and solids were used as fertilizer. Liquid wastes were channeled into a canal system where duckweed removed nitrates, phosphorus and potassium. Duckweed was harvested and used as cattle feed, producing greater weight gains than observed in a control group fed other forages. Continued research and experimentation are needed to improve ways to use these wastes in order to protect water resources in a manner that also provides an economic benefit to the operation. Governmental agencies should experiment with these methods of handling wastewater in Oklahoma. Results and benefits of these alternative methods should be provided to CAFOs. If these techniques prove successful in the state, companies will be able to safely dispose of the wastes and biodiversity will be enhanced by the protection of aquatic communities.

One of the reasons exotic species pose such problems is that their natural enemies normally do not occur where they are introduced. One of the methods

and the presence of wetlands associated with treatment.

Other wastes, such as hydraulic fluid, oil and anti-freeze, should be disposed of in appropriate manners to avoid pollution of water resources. Landowners need to be informed of methods and locations to properly dispose of these substances.

Exotic Species and Pest Control

Some plants and animals such as livestock, annual ryegrass, wheat and some other annual plants have obvious human benefits, are easily controlled and pose little threat of escape or invasion of natural communities. However, smaller animals, perennial plants, and some noxious annuals may be more difficult to control. Most exotic species that have escaped into the wild have become major pests of forestry and agricultural operations and have caused severe problems for native plants and animals. These escaped exotics can quickly dominate an area and displace native species. Examples include musk thistle, Johnson grass, Japanese honeysuckle, kudzu, sericea, cheat grass, Japanese brome, rock doves (pigeons), house sparrows and European starlings. These and other exotic species cost landowners by requiring control, lowering commodity yields and consuming grains. Because additional species continue to be introduced, even under attempts to manage wildlife or provide other conservation benefits, extreme caution should be used before releasing species into the wild. Potential problems should be identified before a species is released, rather than waiting until it has become a pest. For example, Old World bluestems are promoted for pastures and hay fields. However, these species are already causing problems by displacing native prairie species. These grasses are even able to invade manicured Bermuda grass lawns. Once non-native species become established in the wild, they usually are almost impossible to eradicate.

of attempting to control exotic pests is to find natural enemies that attack only the pest species. Although much caution should be taken when introducing these

species to prevent additional problems, some successes have been demonstrated. A weevil species has been introduced to control exotic musk thistles, a major weed pest. Scientists currently are researching a parasitic fly that holds potential for controlling exotic fire ants without affecting native ant species. Other possibilities should be investigated and implemented after carefully ensuring that native species would not be harmed by the new introduction.

Other nonchemical or species-specific control measures are available and should be expanded. **Pheromones**, scents used by insects to attract mates, may be used to bait target species into traps where they may be killed. These have been developed for Japanese beetles, flies and several other insects. Because pheromones are unique to a given species, these traps have minimal impact on non-target species.

Additional research needs to be conducted on biological control of pests. Techniques to attract and maintain populations of predator insects need to be developed and distributed. Cost effectiveness of biological control in various situations should be determined. Landowners should be informed of the benefits of biological pest control and how to implement it. This area holds much potential and should be expanded.

The collapse of the fur and pelt industry has allowed furbearer populations to expand until, in some cases, they have become pests. Because natural predators are not present to check prey population growth, these species continue to spread into new areas, causing human conflicts and may create a hostile attitude toward wildlife and biodiversity. Beavers are a good example. Once widely trapped for the felt market, the beaver was extirpated from much of its range. Since fur and felt are no longer in fashion, beaver populations have rebounded. Although beaver activities in appropriate locations can produce valuable wetland habitat for a wide range of species, including watering areas for livestock, they commonly plug culverts and other drainageways, flooding roads, fields and other areas. Because a market for pelts does not exist, beavers are viewed as

Red cedar, a major pest for agriculture and biodiversity, can be used for a surprising array of

a nuisance rather than a resource. Little trapping is done to control their populations and experienced trappers who can remove problem colonies are difficult to find.

Markets should be developed to encourage population control of appropriate pest species. Whether the market is products, such as jewelry, fur or some other commodity, creating a value for these species will encourage population control and allow them to be viewed as an asset rather than as a nuisance. This not only will result in better management of the affected species, but also will improve the landowner attitude toward biodiversity as a whole.

Alternative Crop Markets

One of the reasons that native species may not be valued highly is the typically smaller markets for them than for products from introduced species. Development of markets for products made from native species would encourage their management.

Native plants should be investigated for economic uses. Some markets already exist for native plants, but these need to be expanded and new ones created. These markets would provide alternative crops and allow farmers to diversify their operation. Although many of Oklahoma's native plants are valuable for landscaping purposes and provide both aesthetic and wildlife value, very few are available through nurseries or greenhouses. Native wildflowers and grasses may be grown to produce seed, or potted for use in gardens or for cutflowers for florists. Native shrubs and trees may be raised in tree farms and supplied to nurseries. These species tend to be easier to produce and maintain than exotic species because they are adapted to Oklahoma's environment.

Medicinal properties of Oklahoma's native plants represent another area of potential for growth and development. Purple coneflowers, ginseng and a handful of other plants already have been shown to have medicinal qualities and associated markets. However, only a very small fraction of our plants has been reviewed for potential medicinal uses.

products. Shingles, siding, fences, closet liners and pet-bedding shavings are common products made

from red cedar. All Cedar Bird Feeders, a company in Noble, Oklahoma, builds a wide variety of bird feeders and houses from cedar. Oklahoma also has one company that presses cedar wood for its oil, which is used as a base for perfume. Some entrepreneurs produce a variety of cedar items to sell at craft shows and other outlets. Expansion of the market for red-cedar products would provide an economic incentive for removing cedars that have invaded many of Oklahoma's grasslands. Many landowners cannot afford to cut red cedar simply to increase biodiversity and, after the trees reach a certain height or density, they cannot be controlled effectively by prescribed fire. Although red cedar can be a valuable resource, the market is very localized. Products of this industry need to be marketed to increase their demand. Raw-log buyers need to be encouraged to locate throughout the state so landowners can sell their cedar within a reasonable distance. The supply of this resource is very large and widespread; a successful marketing program would allow the industry to expand and help restore Oklahoma's prairies.

Markets and products for hardwoods need to be increased to encourage landowners to reforest hardwood stands. By providing an increased economic value to these forest types, landowners would increase restoration efforts.

Markets for high-value crops that can be grown in small areas also need to be developed. These crops, such as herbs, could allow the landowner to achieve the same income on a smaller acreage. Land-management flexibility for the remaining acreage could be increased to include biodiversity considerations and alternative uses such as recreational leasing.

Development of these markets is a good opportunity for governmental agencies to assist

industries and landowners. In today's social climate, government is perceived, at times, as attempting to limit or restrain activities of landowners and industry.

While this view may be justified in some cases, agencies can be of ready assistance by providing information and technical assistance related to new markets. Agencies also should conduct research to develop production and processing techniques, alert industry leaders to the potential of these markets and inform landowners that these alternative revenue sources exist. Government agencies truly can benefit landowners and biodiversity simultaneously through these initiatives.

Conservation Practices

Landowners, especially those who own grasslands and savannas, should become adept at using prescribed burning in managing their land. Fire is a relatively inexpensive tool that, when used properly, can improve the health of natural communities, their biodiversity and economic productivity. Frequency, intensity and season of burns all interact to create different results from fires. On large acreages, sites should be rotated so that different areas are burned at different intervals and seasons. This results in a mosaic of burned and unburned areas. Unburned areas provide food and cover for livestock and wildlife while burned areas recover. Burn schedules should be carefully designed to maintain the long-term health of the community. Annual burning may eventually weaken the plants and lower the productivity of the area. Yearly spring burning over large areas is believed to be a factor in the decline of the greater prairie-chicken by removing all of its nesting cover. Yearly burning also may result in lowering productivity of these grasslands for cattle forage as the prairie grasses are weakened by too frequent fire.

One of the most obvious ways in which landowners can benefit biodiversity is to manage a portion of their property specifically for the conservation of biodiversity. Although this does not preclude livestock grazing or other compatible uses, it may require that these practices be altered. Whether managing specifically for game or other target species, managing for the health of natural communities of the ecoregion would provide significant benefits for biodiversity and can provide additional opportunities for the landowner. These areas may provide excellent hunting opportunities for the landowner, family and friends. The owner also may wish to develop some type of lease hunting enterprise. Watchable Wildlife Areas could be created to promote the diverse communities being managed and provide educational or recreational opportunities. These and other activities could be designed to take advantage of the rapidly growing ecotourism industry, whereby income can result from effectively managing biodiversity.

Native species should be used in operations as much as possible. Except in prairie areas, native trees may be used to create windbreaks to reduce erosion and modify temperatures. If possible, these could be planted so they connect two forest tracts and serve as a corridor for movement between them. In western Oklahoma where prairies dominate, forested windbreaks should use native tree species and be established with caution, because they could contribute to fragmenting the prairie community. Some native grasses, such as big bluestem, Indiangrass and switch grass, may grow high enough (8 to 10 feet [2.5-3.0 m]) to be used as windbreaks near wheat fields in prairie areas. Varieties that function well in this capacity should be developed to provide windbreaks and habitat for prairie species. Native prairie plants also may be used in waterways in crop fields. Buffalo grass, a native sod-forming grass, is especially suitable for waterways; native wildflowers could be interspersed to increase the diversity and attractiveness of these areas. Additional uses of native species in forestry and agricultural operations should be developed.

Because herbivores have been a part of Oklahoma

landscape for thousands of years, their activities can be important to maintaining our biodiversity. Elk and bison no longer are present as free-roaming populations, so cattle and other grazers can be used to enhance the diversity of an area by mimicking grazing patterns of these native species. Various rotational grazing schemes have been developed that give paddocks rest periods to allow recovery from grazing. By rotating grazing across an area, managers can create a diverse array of grasslands on their property. Controlled grazing in established pine stands can be used to maintain a pine savanna community. Proper use of other grazing animals, such as goats, may be an alternative for mechanical or chemical brush control. In all of these cases, the manager must monitor the grazing pressure and move the animals to a new location or paddock after the desired amount of vegetation has been removed. However, grazing pressures must be carefully monitored and controlled to avoid causing a negative impact. Streams, springs, ponds and other water bodies should be fenced to



prevent excessive grazing and trampling of riparian zones. Unmanaged grazing can result in serious degradation due to preferential overgrazing and trampling. For additional information about riparian habitat management, refer to Chapter 10: Water

Managers Can Enhance Biodiversity.

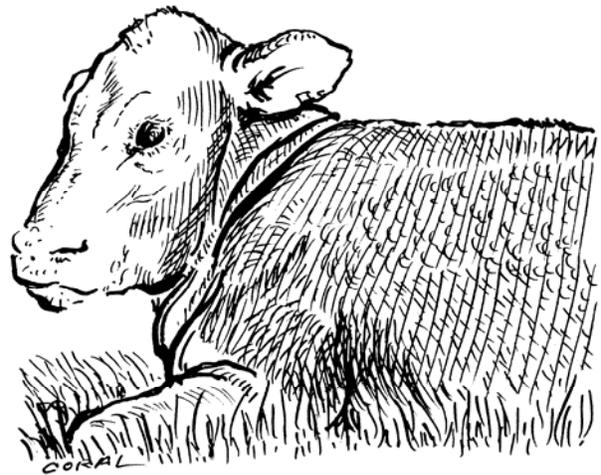
Management of natural stands of shortleaf pine can be profitable for nonindustrial landowners. Natural stand regeneration creates a more diverse community and is less labor-intensive than plantation management. The shortleaf pine savannas that once dominated southern and western slopes of the Ouachita Mountains lend themselves to good timber production. The savanna structure consists of scattered pines over a diverse grassland on the forest floor with little woody vegetation in the understory. This type of structure makes timber harvesting more simple than in areas with dense understory. Landowners can manage these savannas with prescribed fires and limited cattle grazing. Because a whole community of plants and animals depends on these savannas, increased management of shortleaf pine savannas will improve Oklahoma's biodiversity. Organizations working with non-industrial forest landowners should encourage these savannas' management as beneficial to biodiversity and as sources of income.

Dead wood, in the form of standing snags or downed logs or slash, is important habitat for a number of species, including cavity nesters, small mammals, reptiles and amphibians. Forest managers should concentrate on leaving snags and some of the slash during timber harvest or other management operations. Larger snags or downed logs are most valuable for wildlife and should be given special consideration.

Use of minimum or no-till techniques in grain production can have a number of benefits for biodiversity. The layer of dead vegetation left on the ground provides cover for a variety of small animals, including predators of insects. Reduced erosion from these areas also protects aquatic communities. Residue grain from harvesting is left on the surface where it is available to turkey, deer, quail, prairie-chickens and other wildlife. The reduced number of cultivation trips through the fields also decreases the mechanical destruction of bird nests.

Landowners should identify natural communities or habitats that may require special attention or management for biodiversity. Sensitive areas such as seeps,

springs, caves and glades should be located and given special management. Potential habitat of threatened or endangered species should be surveyed for their occurrence. If these species are found, the landowner should develop special management plans to ensure that operations do not harm these habitats. Although most landowners may not be familiar with these special features, they may contact the U.S. Fish



and Wildlife Service, Oklahoma Department of Wildlife Conservation, Oklahoma Biological Survey or Oklahoma Chapter of The Nature Conservancy for assistance in identifying special areas on their property.

Policy Changes Needed to Encourage Biodiversity Management

A variety of regulations has been enacted by a number of governmental agencies to protect valuable natural resources. However, in the process of protecting those resources, these regulations sometimes can become seemingly inflexible and actually do more harm than good by discouraging landowners from managing the affected resource.

One example is the threat of regulatory oversight for created wetlands. Landowners correctly believe that if they create wetlands or allow beavers to do so, those areas will be regulated and their use may be restricted in the future. This causes many landowners to aggressively prevent any wetlands from forming on their land so future management options will not be reduced. Although wetlands created for mitigation should be regulated, greater regulation flexibility for artificial or created wetlands would encourage landowners to manage wetlands on their land, resulting in a net gain in wetland habitat. This would not only encourage the development of wetlands for wildlife habitat, but also would encourage experimentation with wetlands for water treatment and other uses.

Because the development of conservation plans for a given tract of land requires significant amounts of time and effort on the part of both the landowner and government employee, plans should be extended to successive owners. Conservation efforts that are begun may be interrupted or abandoned if the land changes hands. Provisions need to be made to encourage or allow successive landowners to continue implementation of conservation plans so investments will not be lost. This also would prevent further delays in remedying problems, such as severe erosion.

Miscellaneous

The continued development of a statewide geographical information system would further the management of biodiversity in Oklahoma. The Oklahoma Gap Analysis project is using this technology to overlay maps and data relating to different subjects, such as distribution of species, crops, roads, vegetative cover types, streams, reservoirs and other information, would identify sites with special resources that should receive more attention, such as areas with unusually high diversity or rare species. This technology would be useful in designing management plans that would complement regional landscape patterns and provide connectivity among natural communities. A Geographic Information Council has been established to

Biodiversity concerns should be incorporated into all governmental cost-share programs. Whether addressing these concerns is required to participate in the program or higher incentives are given to landowners practicing biodiversity management, biodiversity concepts should be emphasized in these programs. Native species should be stressed over exotic species for all programs, including erosion control, and some incentive, such as higher payment or cost-share, should be used to encourage their use. Fencing should be included in cost-share agreements for building new farm ponds. Not only will the fencing improve the quality of the aquatic community in the pond, but it also will extend the useful life of the pond. Incentives to fence existing ponds also should be created.

facilitate the coordination of geographical information system programs conducted by state agencies in Oklahoma.

Rare or threatened natural communities should be restored in multiple localities to reduce the threat that a single event or activity in one area would completely destroy the entire community. Restoring sites to a rare community in multiple locations throughout its range also will help the community recover because more acreage would be occupied.

Government agencies and private forestry and agricultural organizations should continue and increase the promotion of **Whole farm management**. By managing all of the resources that occur on the land, the owner ensures that the land remains in a healthy condition. This includes addressing the needs of biodiversity or wildlife in management plans. Maintaining healthy natural communities will help the owner maintain the quality of the production sites. Whole farm management also retains the opportunities for diversification of income.

Economic benefits of implementing these recommendations should be researched. Because the economic efficiency of many of these practices have not been investigated, landowners may be reluctant to change from traditional methods of production. Some of these recommendations may actually result in reductions of total amounts of yield. However, input costs in the form of chemicals and labor may be

reduced to the extent of maintaining or increasing the net profit from the operation. This information needs to be available so landowners can see how implementing one or more of these recommendations might affect the economics of the operation.

Outreach

Methods of integrating biodiversity with forestry and agricultural production should be included in outreach efforts of various organizations that deal with landowners. Special efforts should be made to show landowners how biodiversity management can benefit them economically and improve the health of their

A series of demonstration projects should be developed on farms around the state to showcase practices that can be implemented within a region to integrate biodiversity conservation with agricultural production.

These farms should demonstrate profitability as well as biodiversity conservation. Grain farming, livestock grazing and forestry operations should be demonstrated, whether in separate operations or integrated within one operation. These may be public operations or private farms that are used to educate farmers about these practices. These sites would be especially valuable since they would directly show that biodiversity can be compatible with or even complement agricultural practices.

Landowners should be informed about how natural communities can be directly beneficial to them. Whether for fishing, hunting, grazing or other uses, most natural communities can provide some value to the landowner. For example, wetlands, often viewed as worthless, may provide flood control, groundwater recharge, hunting opportunities, and grazing during drought periods and other beneficial uses. Forested areas can provide firewood, lumber and hunting sites. These values of natural communities should be explored and used in discussions with landowners.

Educational efforts need to mention the proactive benefits of managing biodiversity. If declines in natural communities or species continue, the number of endangered species will rapidly increase. If these trends continue, the public concern for these species

land.

A series of workshops should be conducted to educate people who assist landowners about the importance of biodiversity and ways to enhance it within forestry and agricultural operations. The Natural Resources Conservation Service, conservation district offices, county extension offices, land grant universities and private agricultural research foundations are important contacts for disseminating information to landowners and should be the primary target for such workshops. Employees of these organizations could encourage landowners to consider biodiversity needs and encourage them to implement some of this plan's recommendations.

will ultimately be expressed in some manner of legislation or agency regulations. If the forestry and agricultural industries, which own large amounts of land in the state, consider biodiversity in their planning, these declines may be reversed. Not only would this benefit the resource and industry by maintaining a healthy

environment, but it also would put forth a very positive image for the industry.

A significant portion of Oklahoma is owned by part-time farmers who earn the majority of their income from jobs unrelated to their farming operations. Because their livelihood does not depend on the efficiency of their forestry or agricultural production, these landowners often tend to practice poorer management than larger landowners. However, these landowners also could promote biodiversity on their land to a greater extent because they have income from another source. Educational efforts directed toward the forestry and agricultural industry should include these part-time operators.

Demonstrations showing the benefits of incorporating biodiversity management should be conducted on weekends when part-time operators could attend. Absentee owners also should be targeted to inform them of ways to improve the biodiversity of their land.

Governmental agencies need input from landowners for programs designed to assist them with conservation activities. It often is difficult to obtain landowner input for these programs and public meetings usually are poorly attended. Because the goal of these programs is to provide technical, and sometimes monetary, support to the landowner, feedback is vital to ensure that these programs operate appropriately to achieve their goals.