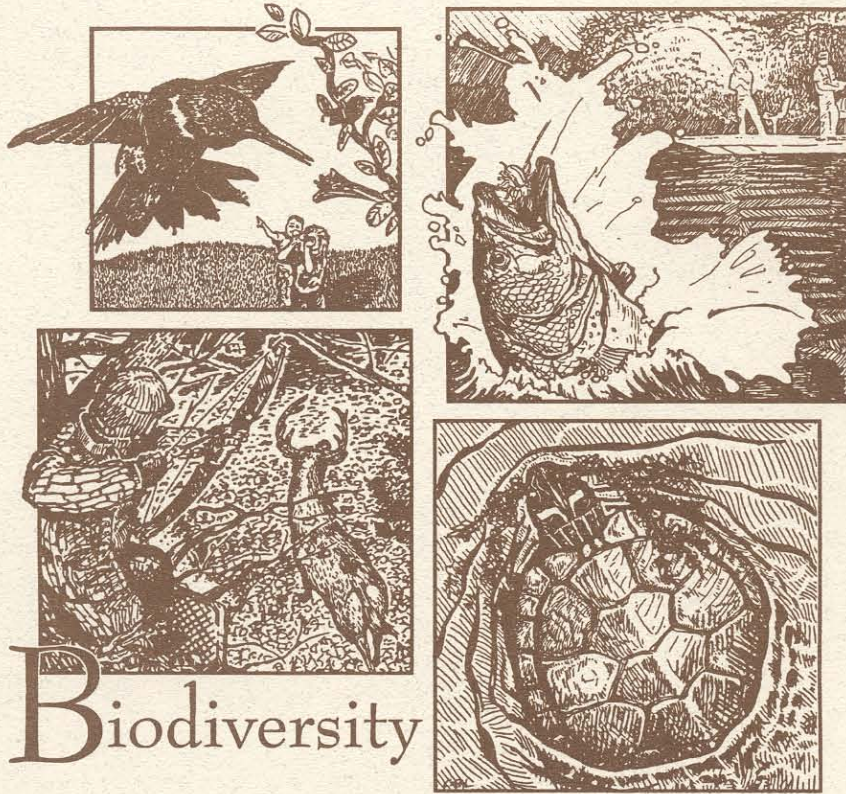




Biodiversity

Chapter 2: Why Is Biodiversity Important?

People value biodiversity in many ways. Some consider positive economic values, such as eco-tourism and resources, while others consider negative economic values like agricultural pests. Some value biodiversity for its aesthetic benefits and scenery; others have deep personal values for biodiversity. Most people have a mixture of these values. This variety of ways to place a value on biodiversity results in variations in how people attempt to conserve or use biodiversity. For this discussion, we identify values having little or no economic base, values of community processes and other values that are directly or indirectly economic.

Values Independent of Economics

Stewardship

The values most important to many people cannot be expressed in monetary terms but are derived from strong personal beliefs. This includes the ideas of practicing stewardship and conserving our natural heritage for future generations.

Many people believe the proper role of humans is one of respect for and stewardship of the environment. Consequently, humans should maintain biodiversity while using resources to meet their needs. This does not imply that humans should not use or benefit from

biodiversity, nor does it imply that it should be the emphasis of every decision or action. Rather, the role of steward is to use resources in a manner that also provides for the needs of biodiversity, rather than exploiting resources for short-term gains and ignoring biological impacts. This concept of stewardship is taught in many cultures and religions.

The stewardship concept includes the belief that each species should be allowed to survive or, at least, that they should not be driven to extinction by human influences. Concern for endangered species illustrates how widespread this value is. Many people are willing to forego some monetary gains to ensure survival of rare species.

A widely popularized value of biodiversity is the interdependence of all species for survival. No species, including humans, can survive in isolation from others. Therefore, if we allow some species to become extinct or endangered, we often threaten the existence of others as well, and humans are not exempt from this web of life. Insight into this interdependence is illustrated by long lists of endangered and threatened species or candidate species under study for listing as threatened or endangered. Many of these species occur together in communities that have been severely degraded or eradicated. For example, wetland communities have been destroyed by water pollution, alterations in river flow by dams and draining for other uses. Because of large declines in high-quality wetland communities, many wetland species have become rare or endangered.

Humans, too, are a part of the ecosystem and depend on it for survival. Like other species, humans require a set of environmental conditions to survive. Although we can isolate ourselves from environmental conditions to some extent, we still rely on a high amount of biodiversity to survive or maintain our standard of living. By allowing communities to be severely altered or become extinct, we are allowing irreversible changes to occur in our environment. If we address the problem now, we can avoid these irreversible degradations. However, if we ignore our dependence on biodiversity, we will not only lose plant and wildlife species, but our quality of life will decline and, ultimately, our existence may be threatened.

Natural Heritage

Biodiversity often has been portrayed as a treasure passed down from generation to generation with each generation being responsible for ensuring its continued existence. If we degrade biodiversity to gain short-term benefits, later generations will be unable to gain long-term values or enjoyment from these resources. One benefit of passing high levels of biodiversity to the next generation is watching children encounter new species and enjoy wildlife.



Texas horned lizards have been enjoyed by children for generations, but are increasingly rare today.

A good example is the Texas horned lizard, popularly known as “horny toad,” that occurs in Oklahoma. For generations, children have immensely enjoyed catching “horny toads,” playing with them as miniature cattle or “pocket pets,” and later releasing them. However, horned lizard populations have declined so drastically that they are a federal candidate for listing as endangered; because of their rarity, most children would not recognize them today. Although causes for this decline are not fully understood, several possibilities are suspected. The possible reduction of harvester

ants, the lizard's primary diet, in agricultural and urban areas is a possible factor. Other possible causes include loss of habitat, predation by domestic pets and capture for the pet trade. By directly and indirectly contributing to large declines in horned lizard populations, we have deprived our children of this traditional enjoyment.

Values of Community Processes

Community processes—such as water, nutrient and energy cycles—often produce human benefits that cannot be given a direct economic value. Healthy, highly diverse communities often perform these functions better than degraded or simplified communities. For example, a study in Minnesota showed that grasslands with many plant species outproduced simpler communities during a period of drought. Over a two-year period, rainfall decreased to less than half the average amount. Production on plots with more than nine plant species was half of normal, but plots with fewer than nine species produced as low as one-eighth the normal amount of forage. Diverse plots returned to normal production a year later, while the others required more than four years to recover.

Water and Soil Conservation

Healthy natural communities are important for conserving soil and water resources. Complex plant communities protect soils from wind erosion by decreasing wind velocities near the ground. Layers of foliage and dead plant material reduce raindrop velocity before they strike the ground, reducing erosion caused by raindrop impact. Plant roots and soil fungi bind soil particles together and decrease movement of soil by wind and water. Water flowing along the ground slows as it moves around plants and dead litter, reducing erosion. Plant roots and organisms that live or burrow underground loosen, enrich and aerate the soil, allowing water to percolate into the soil rather than run off.

Plant communities can affect local climates. Plants create shade and move water from their roots through their leaves, a process called **transpiration**, that lowers local temperatures. Plant communities also

reduce wind speeds, which moderates temperatures and reduces water loss. Heavily vegetated watersheds absorb water during high precipitation, reducing runoff flooding and extending the length of time for water to move through the system. They also moderate temperatures and evaporation, resulting in less severe floods and droughts in these areas.

Waste Disposal

Biodiversity performs a waste-disposal function. Biodegradable wastes depend on organisms to break them down. Degradation of these wastes reduces the strain on landfills and water treatment plants to meet increasing waste loads and returns them to forms able to support plant life. Man-made and natural wetlands act as treatment areas of waste water from a variety of sources, including urban sewage and paper mills. Under proper management and monitoring, wetlands, with their array of plants and other organisms, filter water and even break down pesticides and sewage and immobilize some heavy metals.

Community Stability

Interactions among species often are crucial to the existence of many species. An example is the importance of bats to cave communities, as mentioned in Chapter 1.

Solitary bees, butterflies and many other terrestrial insects pollinate a wide variety of flowering plants, including crops, fruit trees and garden plants. These activities are vital to the continuance of natural communities as well as agriculture. Without native insect pollinators, many plant species would be unable to reproduce and would become extinct. Some insects specialize on a single plant species and loss of either the plant or insect species would cause the loss of the other.

Prairie-dog towns also illustrate the importance of these interactions. Large prairie-dog towns host a myriad of species that are restricted to or reach their highest numbers in the towns. Burrows dug by prairie dogs serve as shelters for other animals like burrowing owls, foxes and a variety of reptiles and amphibians. Mammals and reptiles that need loose soil thrive in prairie-dog towns. Other species are attracted to the area to feed on prairie dogs and other small mammals.

Intense grazing by prairie dogs keeps vegetation short. Large herbivores, including bison, antelope, deer and cattle, are attracted to towns to feed on the new, more nutritious growth. A variety of plants adapted to disturbance grow in these towns and produce seeds important to birds and other wildlife. Queen's delight, a plant that produces high-energy seeds, occurs widely scattered throughout the prairie. However, in recently abandoned prairie dog towns, this plant becomes a dominant part of the plant community, producing an abundance of seeds. Scientists

have observed mourning dove, quail, lesser prairie-chicken and other seed-eating birds feeding in high numbers in these areas. Although yet unstudied, this may indicate a relationship between prairie dogs and high populations of seed-eating birds. Most Oklahoma prairie-dog colonies have been reduced in size, causing many other species to decline; for example, the endangered black-footed ferret depends upon prairie dogs for food and no longer occurs in Oklahoma.

Although the importance of bats and prairie dogs to their respective communities has been studied, so little is known about other species, especially invertebrates, that similar relationships probably exist without our knowledge. If we allow species to decline or become extinct, we might lose many other species as well, including those with obvious human benefits.

Recreation

The importance of wildlife for recreational purposes has been recognized for centuries and also has economic value. Many industries have been built around hunting and fishing opportunities that abound in the United States. Sporting-goods manufacturers and dealers have produced a wide variety of products available to sportsmen. Marinas, bait shops and lake-side developments rely on fishing interests for business. More recently, the value of other recreational opportunities such as hiking, wildlife watching and sight-seeing has been recognized, along with their associated industries. All these activities have economic values but are even more important to the individual for relaxation and recreational values. Quality recreational experiences and survival of their related industries depend on the existence of healthy, diverse natural communities.

Education

Biodiversity also is valuable for educational purposes both for generating additional knowledge and as a teaching tool. Biological and ecological research explore many aspects of biodiversity. Outdoor classrooms, field trips and other related activities are important teaching tools for giving students first-hand lessons on ecology, helping them to become responsible citizens of society.



Many species thrive in prairie-dog towns and form unique communities.

Indicators of Environmental Health

High levels of biodiversity are useful as indicators of environmental quality and suitability of the environment for humans. The classic example of using canaries to detect dangerous methane levels in coal mines, by analogy, can be used in more complex situations today. Species with low tolerances for pollutants or other forms of environmental degradation can be used to measure the health of the natural community or environment.

Native mussels are sensitive to water pollutants and can be used to monitor water quality of streams or other bodies of water. Declines in mussel populations may indicate problems requiring additional purification of drinking water.

Rangeland, sometimes called native grassland, makes up most of Oklahoma's land area, although it occurs in varying degrees of health. Rangeland is a broad category of native plant communities made of prairies and shrublands. Managers can assess the condition of herbaceous or woody vegetation by observing abundances of certain plant species that decline when overgrazed by large herbivores, such as cattle, deer, bison, elk or antelope. By observing population trends in these plant species, the landowner can alter the number of grazing animals using the area so the desired plant community is maintained or achieved.

Because species useful for environmental monitoring are very sensitive, they will be among the first species to become extinct if biodiversity is not conserved. Without these indicator species, we would be left with only a few expensive ways to monitor our environment to ensure our own survival.

Economic Values

Ecotourism

Many private and public groups now recognize the economic value and importance of **ecotourism**, when people visit an area specifically to enjoy its natural properties. State and national parks often create significant income for the local community from tourists they attract. Towns are discovering or developing new ways for the public to enjoy naturally

occurring phenomena. In Oklahoma, Grove holds an annual Pelican Festival during the migration of white pelicans, Sand Springs holds an annual Bald Eagle Festival when wintering eagles arrive and Idabel celebrates Leopard Darter Days. A city in Texas has begun a Hummingbird Festival that has grown from 200 attendees in 1989 to 3,500 people in 1994, bringing \$950,000 annually into the local economy.

An interesting example of ecotourism occurs near the Congress Avenue bridge crossing the Colorado River in Austin, Texas. A large nursery colony of Mexican free-tailed bats occurs in expansion seams under the bridge. These bats not only consume millions of insects each night but also attract thousands of tourists to the area to watch the bats emerge near dusk. The emergence can last an hour or more and several restaurants have rooms from which people may observe the bats. A local cruise company offers a boat cruise during the emergence. Tourists coming to view the bats provide a boost to the local community.

Locally Consumed Products

Most people readily attribute values to biodiversity by the products they harvest and consume themselves. The primary economic value derived from these is that the individual does not directly pay for the products, although licenses may be required. Because most are collected and used locally, it is very difficult to assign a monetary value to these resources because they are not sold commercially. However, the contributions of these products are very important to many people and would be very difficult and expensive to replace if they were lost.

These products include meat from game and fish consumed by sportsmen, reducing the need to purchase meat. A recent use of meat harvested by deer hunters in Oklahoma is the "Hunters Sharing the Harvest" program, whereby hunters donate venison for distribution to needy families. In 1993 hunters donated 1,747 pounds of venison, providing approximately 7,000 meals. Native mussels were widely used by Native Americans for food and are still used in some areas. Other native foods that are consumed include wild mushrooms, wild fruits (e.g., persimmons, elderberries, blackberries), nuts (walnuts and pecans) and greens (poke and lamb's quarters). Other common

products used by individuals are firewood and traditional home remedies such as ginseng and willow bark.

Among the most utilized resources that are part of Oklahoma's biodiversity are native plants that are used for livestock forage and hay. Use of these native plant communities is a direct economic value of biodiversity for the landowner. For example, hay from these native grasslands is sold as a commodity.



Native grasslands often are mowed for hay.

Commercial Products

Native plants and animals, components of biodiversity, also are used to provide commercial products. Industries built around these resources may provide the primary source of income for several communities. The value of these products is much greater than prices for raw materials. Their full value includes jobs they provide and the value of finished products. Although these resources are parts of Oklahoma's biodiversity, production or use of these elements often impacts the area's biodiversity, either by increasing it or, more often, by decreasing it.

The timber industry is very important to Oklahoma's economy, especially in southeastern counties. Most hardwoods are harvested from natural stands, with native tree species planted or allowed to regenerate to maintain forest productivity. Timber producers also rely on organisms in the soil to make nutrients available to growing trees.

Other products are gathered or harvested and sold as commodities. Black walnuts and pecans are gathered from wild or planted trees and sold as whole or cracked nuts. Hunters and trappers harvest wild furbearers, such as raccoons, opossums and skunks, and sell them to licensed furdealers. Demand for taxidermists to mount trophies and other wildlife has thrived along with hunting and fishing. Large fish not considered game fish are harvested by commercial fishermen for food. Shad, minnows, crayfish and earthworms are sold for fishing bait. Mussels are harvested and their shells are used for buttons and jewelry. Native turtles are sold in foreign markets as meat. Interest in wildflowers has increased dramatically, creating markets for seed collectors and producers to sell to people planting wildflowers in their gardens or for native prairie restoration. Some states are encouraging wildflowers along highways to increase their scenic value.

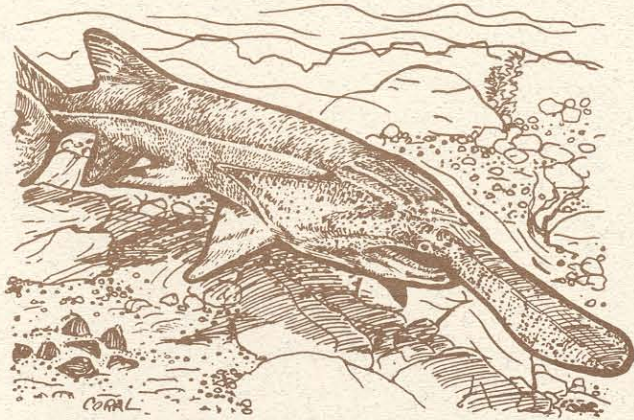
Medical Values

Continued existence of native species and populations is vital to advances in medical knowledge. More than half of the medicines currently used are either chemicals produced by plants to discourage herbivores and parasites, or synthetic copies of those chemicals. Hormones and other chemicals produced by animals also may be used for treatment of disease.

The eggs of gar, a fish considered worthless to most people, are extremely poisonous to humans. Scientists have tried to find ways to use the toxin in the eggs for treating human cancer, but to date have been unable to control the effects of the toxin. However, this chemical might prove useful in the future as technological advances are made.

Paddlefish are being raised in hatcheries because many of their spawning areas have been flooded by reservoirs. Hatchery operators cut through the belly to remove eggs, in a manner similar to a Cesarean sec-

tion. Although this type of wound would kill most fish species, paddlefish heal completely within a few days. While studying this rapid healing, scientists discovered several hormones that may prove useful for treatment of cancer in humans.



A hormone found in paddlefish may be useful as a treatment for cancer.

Another value of biodiversity is the use of species in the study of human disease. The armadillo is the only species other than humans known to contract leprosy. Therefore, the armadillo is extremely important for studying this disease and researching treatments for humans.

At present, only a small proportion of plants have been explored for possible medicinal uses. Therefore, if we allow many plant or animal species to become rare or extinct, we will lose the possible medicines they would have provided. Although not native to Oklahoma, products from the Pacific yew and rosy periwinkle, both endangered species, have proven effective in fighting cancer.

Agriculture

All plant and animal species raised domestically were developed from wild stocks. Because domestic breeds or varieties contain only a subset of the original genetic diversity, they often are crossed with wild stock to insert beneficial attributes into the domestic variety. For example, a population of wild maize may be resistant to a disease or insect that affects corn crops. Individuals from this resistant population may

be crossed with susceptible corn varieties to increase resistance. Bison are crossed with domestic cattle to produce animals called beefalo that are raised for meat production. If wild populations are indiscriminately destroyed, genetic diversity will be lost, reducing the possibility for improving domestic crops or livestock.

Biological Controls

A growing amount of interest has been generated recently by using natural enemies rather than man-made pesticides to control pest organisms—especially plants and insects—in agricultural and urban settings. This has been termed **biological control**. In simplified systems produced by large **monocultures**—areas that are dominated by a single plant species (e.g., agricultural fields)—pest species are not controlled by natural methods present in more complex systems.

Introduced species often become pests because they have few or no controlling natural enemies in their new environment. Examples of pest species include the carp, Russian wheat aphid, zebra mussel, gypsy moth, European starling and house sparrow. Biological control may be accomplished by introducing a controlling enemy or creating habitat for native species which might provide some control. Successful biological control has proven to be more economical than pesticides and more harmonious with the environment. Some forms of biological control for insect pests include songbirds, bats, nematodes, ladybird beetles (“ladybugs”), praying mantises, parasitic wasps and lacewings. Pest plants can be controlled by diseases and parasites, while rodent populations can be controlled by hawks, owls, snakes and other predators.

Use of Native Plants

Native trees and prairie plants often are used to landscape lawns for residents and businesses. Whether they were planted or retained during construction, these plants are a part of the area’s biodiversity. Native plants generally require less care (e.g., watering and fertilizing) because they are adapted for the environmental conditions of the site. Often, these plants not only enhance the appearance of lawns and provide shade, but also serve as nesting and foraging sites for birds and provide berries or nuts for wildlife. Wildflower gardens, which are gaining in popularity,

also provide nectar for butterflies and hummingbirds, and their seeds are eaten by songbirds.

Avoid Endangering Species

Another important personal and economical reason to conserve biodiversity at natural levels is to avoid endangering the survival of a species. Endangered species usually require expensive "emergency room" procedures to recover their numbers and ensure their survival. After a species has declined to such an extent that it is listed under the Endangered Species Act, expensive efforts and legal restrictions often must be employed until the species has recovered. By investing effort and money beforehand to keep natural communities common and diverse, we can avoid the expense and requirements involved in dealing with threatened or endangered species.

Future Value

One of the most compelling reasons for humans to conserve biodiversity is to retain the option of using living organisms in the future. Only a small proportion of plants and wildlife has been studied to determine potential uses by humans for food, medicine and other purposes. Although more than half of our pharmaceutical drugs were derived from plants, less than one percent of known plant species has been examined for the possibility of having a chemical useful to treat

diseases. Experiments on bacteria are beginning to show they could be extremely useful for a variety of uses, including detoxification of hazardous waste, breakdown of other wastes, manufacture of ethanol gasoline and production of a variety of chemicals. However, only a few species have been explored.

Other examples of future value are defense chemicals produced by native plants. These may become useful for purposes other than medicinal. Native **composites**, plants in the sunflower family, produce chemicals similar to the insecticide pyrethrum obtained from chrysanthemums, a non-native composite. Native Americans used walnut and hickory leaves to poison fish for food because the leaves contain a chemical similar to rotenone, which is derived from a South American plant. Walnut husks have been used as a potion for de-worming livestock. These naturally occurring chemicals perform efficiently and then degrade rapidly, reducing negative environmental impacts. Although chemicals from these native plants have not been developed commercially, they could become important in the future.

If we lose many species having no apparent human value now, we will lose all possible benefits these species could have provided in the future, thereby severely limiting our possibilities to further enhance the quality of life. By maintaining a high diversity of plants and animals, we ensure continuation of currently recognized benefits. We also preserve resources that might prove highly valuable in the future.