

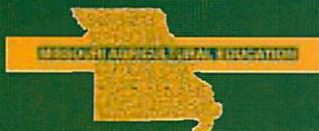


Fish and Wildlife Management

Student Reference
10-4853-S



In cooperation with
Agricultural Education Department of Practical Arts and Vocational-Technical Education
College of Education and College of Agriculture, Food and Natural Resources
University of Missouri-Columbia



Agricultural Education Section Division of Vocational and Adult Education
Department of Elementary and Secondary Education, Jefferson City, Missouri

Student Reference

FISH AND WILDLIFE MANAGEMENT

**Paul F. White
Curriculum Specialist
Missouri Department of Conservation**

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FOREWORD

The Fish and Wildlife Management course creates more diverse curriculum offerings for Agricultural Science II and advanced courses. An instructor's guide and student reference have been developed to facilitate the teaching/learning process.

The material consists of five units consisting of 21 competency-based lessons: Natural Resource Conservation, History of Fish and Wildlife Conservation in Missouri, Conservation Careers, Landowners and Sportsmen: Partners in Fish and Wildlife Management, Commercial Value, Recreational Value, Biological Value, Social Value, Esthetic Value, Scientific and Educational Values, Negative Value, Habitat Management Principles, Cropland Management, Grassland Management, Forest Management, Introduction to Wetlands, Stream Conservation, Pond Construction and Management, Agency Assistance, Bobwhite Quail, White-tailed Deer, Largemouth Bass, Bald Eagle, Introduction to Fish and Wildlife Protection and Legal Process. Additional activities are included on a habitat assessment system to reinforce the curriculum.

Bob R. Stewart
Professor and Coordinator
Agricultural Education
University of Missouri-Columbia

Terry Heiman
Director, Agricultural Education
Department of Elementary and
Secondary Education

FISH AND WILDLIFE MANAGEMENT

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UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

Lesson 1: Natural Resource Conservation

Definition of Natural Resources

Any portion of the natural environment that humans use for their benefit is a natural resource. Natural resources can be separated into two broad categories - renewable and non-renewable.

Renewable natural resources have the ability to sustain themselves through reproduction or are continued in supply by natural processes. Soil, water, sunlight, forests, fish and wildlife are renewable resources.

Non-renewable natural resources exist on the earth in finite quantities which cannot be increased. Examples are coal, natural gas, metals, petroleum and agricultural fertilizers such as potassium and phosphate. The conservation of non-renewable resources depends on the discovery of new deposits, development of substitutes, improvement of recycling methods and efficiency in using them.

Natural Resource Conservation

Conservation is the wise use of natural resources. "Wise use" means using the products of natural resources to provide the most benefit for the largest number of people for the longest time. Inherent in this definition, conservation does not include resource destruction even if it is highly profitable. Nor does conservation mean protecting or hoarding resources for the future which can be used today without the supply being depleted. Indeed, U.S. wealth and prosperity is largely dependent on the consumption of natural resources.

The U.S. public has had an instinctive grasp of "conserving" natural resources throughout history, although their knowledge and effectiveness was limited when compared to present-day standards. The term "conservation" was a little-known word in the dictionary prior to the late 1800s. The U.S. public had never heard of it, although references to conservation ideas and practices were evident.

As early as 1626 Plymouth Colony passed a regulation stating an "inconvenience was likely to arise" from a lack of timber and prohibited anyone from selling timber out of the colony without approval of authorities. Strict laws against forest fires were passed by several colonies in New England before 1650. Fire damage to young trees and the soil was recognized in a Massachusetts law in 1743.

Crisis Situations and Conservation

Unfortunately, U.S. history has proven that effective conservation efforts do not begin until a resource scarcity or crisis occurs. The dust storms of the 1930s prompted the federal government to initiate soil conservation programs. Forest conservation was sparked by the devastation of the eastern and midwestern forests by logging, clearing and fires. The Missouri Conservation Commission was established by alarmed citizens after prairie chicken, wild turkey, deer, beaver and grouse were nearly gone. Air and water pollution reached levels in the 1960s that gave rise to the Environmental Protection Agency. As a state and a nation, we have not responded to natural resource abuse until considerable damage was done.

Preservation Compared to Conservation

Preservation is a part of conservation. Natural treasures such as wilderness, unique geologic features, remnant plant communities and habitats for rare fish and wildlife species are conserved by protecting them from injury. Preservation measures are used when the natural resource being conserved is very limited or unique. These measures may be of relatively short duration or last indefinitely.

Missouri's deer seasons were completely closed from 1938 to 1944. This was an example of preservation used as a tool of conservation. During this period, the wise use of the state's deer population was to allow time for the deer to reproduce and increase their numbers. Missouri's present annual deer harvest of over 100,000 is testimony to the value of this brief period of preservation.

Some resources must be preserved indefinitely. Missouri's deer population of the 1930s and 1940s was fortunate by having ample habitat to expand into. Other species have more specific areas where they can survive. If their natural habitat has been severely altered or destroyed, they will exist only in small isolated areas where their needs can be met. An example is a designated "natural area" in Roaring River State Park which is legally preserved by the Missouri Department of Natural Resources for its outstanding natural features which include the endangered Ozark chinquapin tree (Castanea ozarkensis). Original native prairies of Missouri have become increasingly scarce. Native prairies are remnant plant communities which could be exterminated in the state if they are not protected. For this reason, the best examples of the original native prairies are being preserved as natural areas for future generations.

Natural Resource Conflicts

The wise use of a natural resource can be interpreted in many ways and is usually a debatable subject. A person's definition of wise use depends on an his/her individual perspective which is a product of economics, tradition and personal experiences. A farmer making a living from the land might consider it wasteful for native prairie areas to be preserved where corn and soybeans could be produced. Or, a logger or forest landowner may find it more profitable to harvest all the marketable trees in an area instead of taking a selective harvest to leave trees for future income, wildlife and watershed protection.

People advocating wilderness areas are frequently at odds with timber and mining companies when public land laws are debated in Congress. From the wilderness perspective, "wise use" means leaving an area alone. Companies whose business is harvesting natural resources contend wilderness areas waste our natural wealth. When managing natural resources, conflicting opinions and attitudes are inevitable.

The Role of Government in Conservation

A balance must be made between living in a clean and pure environment and using the earth's natural resources for human benefit. This is where the government plays an important role. Local, state and federal government agencies are involved. They act as moderators among competing uses, the protectors of public interests that conflict with selfish pursuits, and are sponsors of projects which the private sector cannot accomplish. Interestingly, while the government is the coordinator and manager of conservation programs, the application of conservation practices is usually done by individuals and corporations who use the resource. This partnership between the private and public sectors has made conservation what it is today.

Summary

Conservation is the wise use of renewable and non-renewable natural resources. Conservation efforts have historically been prompted by a resource scarcity or crisis.

The "wise use" concept is subject to different interpretations in specific situations. People have varying priorities and attitudes toward resource use which creates conflicting opinions. Government agencies act as moderators among competing uses so the natural resources will be used appropriately.

Preservation is a part of conservation. The "wise use" of a very limited or unique natural resource is to protect it from any damage. Preservation measures may be of short duration, or last indefinitely if the resource is unable to replenish itself.

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UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

Lesson 2: History of Fish and Wildlife Conservation in Missouri

Historical Natural Resource Trends

The abundance of fish and wildlife lured explorers and settlers to Missouri during the eighteenth and nineteenth centuries. The harvest of fish and wildlife for food, clothing, pelts and barter was a necessity of life for them. Early pioneers considered wild animals to be theirs for the taking at any time or place and with any method. Until the mid-nineteenth century, everyone considered forests, fish and wildlife to be truly inexhaustible. Federal and state game laws did not exist since it appeared that protecting wild animals was unnecessary.

U.S. resource trends - Immigrants to North America found a continent of vast forests, lush prairies, streams and lakes with clean water and unspoiled marshes and swamps. These pristine conditions supported an incredible abundance of fish and wildlife. From the early colonial days to the late 1800s, the "new" Americans settled the continent and harnessed its natural resources for their own use. The axe, plow, cow and gun were their tools.

The enormous supply of land and apparently inexhaustible natural resources led to abuse. By the end of the 1600s, market hunting (the large scale killing of wild animals for sale) began taking its toll on fish and wildlife in the colonies. Market hunters killed wild animals indiscriminately and were eventually a major factor in the decline of the American bison, elk, white-tailed deer, wild turkey and other species over the entire U.S. The passenger pigeon, once numbering in the billions, was hunted into extinction.

Settlers who followed the early explorers lived off the land until they carved a farm out of the wilderness. They used the remaining big game wildlife and then changed the natural environment by clearing the land. Although unrestricted harvesting and market hunting was very damaging, the massive alteration of habitat brought on by the clearing of natural vegetation was more significant in the decline of fish and wildlife.

Other natural resources were also affected. Without the protective prairie or forest cover, soil erosion accelerated dramatically and increased the turbidity of streams and lakes.

This had a substantial effect on fish populations. The brook trout, originally abundant in New England, was exterminated in many areas during colonial times due to siltation caused by forest destruction. The decline of fish and wildlife was not an isolated trend - it happened simultaneously with the abuse of other natural resources.

Missouri resource trends - Missouri experienced a history of human immigration and natural resource abuse which paralleled the pattern of the U.S. as a whole. Before the arrival of European Americans, Native American Indians thrived on the plentiful fish and wildlife found in the territory that is now Missouri. The first explorers - French trappers, traders and miners - recognized the astonishing diversity and abundance of Missouri's wild animals.

Missouri was a diverse ecological crossroads. Here, millions of acres of eastern hardwood and southern pine forests met. The forested Ozark mountains separated southeastern cypress swamps from western grasslands. Streams, swamps, rivers and marshes added even greater variety. Missouri's forests, wetlands and prairies furnished food and shelter for many species including American bison, elk, black bear, white-tailed deer, timber wolves, mountain lions, raccoons, muskrats, beaver, otter, squirrels and foxes. Passenger pigeons, prairie chickens, wild turkey, waterfowl and many species of fish and other aquatic life were present in large numbers.

The settling of Missouri during the 1800s was driven by the use of abundant natural resources. Fish and wildlife provided settlers with food and sometimes clothing. Farmers quickly discovered the fertile soil lying under the prairie sod could produce excellent crops. Forests were heavily logged to provide lumber and burned to create pasture for livestock. In essence, the natural vegetation of Missouri was altered or destroyed without anyone realizing the future impact.

In less than 150 years, 99.7 percent of Missouri's original 15 million acres of native prairie vanished under the plow. Roughly one-half of the forests were destroyed. In fact, the southeastern Ozark area was the lumbering capital of the world from 1880 to 1908. Large scale drainage of wetlands began during the late 1800s and continued well into the next century - particularly in the Missouri Bootheel.

The unrestrained abuse of Missouri's natural resources led to a "domino effect." For example, the clearing of forest cover destroyed more than trees. The trees had supplied forest wildlife with food and cover. At the same time, the tree leaves and roots protected the soil from erosion. With the forest cover removed, forest wildlife was forced out and soil erosion increased. Streams, rivers and lakes became more turbid with the increased silt load which damaged aquatic habitats.

The plowing of native prairies and drainage of wetlands had similar effects on other natural resources - some of which are not as apparent. One reason flooding along major rivers has increased is due to the destruction of wetlands. Swamps and marshes act as sponges on the landscape absorbing and holding water and then releasing it slowly. With wetlands greatly reduced, more water runoff reaches river systems in less time and severe flooding is more likely. Among other impacts, large scale drainage of wetlands yields three products; more severe flooding, decreased fish and wildlife habitat, and usually more agricultural land.



The loss of habitat was not the only reason Missouri's fish and wildlife populations were decreasing during the 1800s. Market hunting contributed substantially. The decline of the passenger pigeon, deer, wild turkey, ruffed grouse, black bear, timber wolf and prairie chicken were hastened by relentless market hunting. The carcasses of wild animals were sold like any other commodity. Trains rarely carried less than two tons of wild meat every return trip to the East. In 1885, St. Louis was established as the largest supplier of wild meat in the U.S. At that time, prairie chickens and ruffed grouse brought \$2.75 to \$3.00 per dozen, deer and turkeys were worth five to six cents per pound and 40 cents purchased a dozen squirrels. Fish populations were also affected by overharvesting. Commercial fishermen and citizens alike took fish in excessive numbers with no regard for spawning seasons or numbers taken.

By the turn of the twentieth century, it was obvious that Missouri's fish and wildlife populations were in trouble. In less than a 100 years, the American bison, timber wolf and passenger pigeon had been removed from the state. The passenger pigeon eventually became extinct. The last remaining concentration of elk had been killed by market-hunting Indians in 1840. Even deer and wild turkey were gone from most of the northern and western counties by 1890. About 1925, only 395 deer remained in 23 counties.

Missouri's fish and wildlife legacy was not one to be proud of during this period of history. The public began to sound the alarm for an effective state conservation program.

Missouri's First Conservation Attempts

The state began to officially recognize the shortage of fish and wildlife during the late 1800s. Through public pressure, mostly from influential sportsmen, Missouri's legislature passed the first statewide wildlife law on February 7, 1874. Titled "An Act for the Preservation of Game, Animals and Birds," this law established seasons for a few game species and prohibited the selling and purchasing of wildlife not in season.

The passage of the 1874 wildlife law appeared to be a result of a gathering controversy over market hunting. The "Act to Prevent the Destruction of Fish," passed the same year, tried to prohibit some wholesale fishing methods. Unfortunately, many people did not obey the new laws. The few attempts made to enforce the 1874 laws were unsuccessful and market hunting continued at a destructive rate.

Missouri's sportsmen were persistent in their efforts. In 1878, the legislature created the office of State Fish Commissioner and appropriated \$1,000 for his use in distributing fishes available for stocking purposes through the federal fish commission. In 1879, the state agency was expanded to a three man commission which was given authority to establish a fish hatchery. Among other species, the State Fish Commission distributed California salmon and California brook trout for stocking during 1881-82.

Although they were making a sincere effort to improve fish populations, most of their actions were unsuccessful. Fish and other aquatic organisms must be stocked in suitable habitat for them to survive and reproduce. Most of the fish were stocked in waters where the habitat was already deteriorated.

After a series of conservation successes and failures, the 1909 state legislature re-enacted the Walmsley law which was to remain the basis of Missouri's fish and wildlife laws until 1936. The new law established a State Game and Fish Commissioner and the Game and Fish Department. It also authorized the sale of hunting and fishing licenses to the public and channeled those revenues into a fish and wildlife protection fund.

It established open and closed seasons for most game species and furbearers, provided for protection of non-game birds and vested ownership of fish and wildlife to the state. Perhaps, most important, the 1909 law contained strict provisions eliminating the sale and commercial transportation of game, in effect calling a legal halt to the profitable market hunting.

The new Game and Fish Department enforced closed seasons and bag limits at the direction of the State Legislature. However, the steady decline of fish and wildlife continued. As an attempt to reverse this trend, extensive pen rearing of wildlife and restocking programs were initiated. These efforts proved to be futile. The fish and wildlife needed habitat to survive and the importance of habitat was unknown to conservation leaders at that time.

Politics limited the effectiveness of the Game and Fish Department. Employees were hired by the endorsement of the proper party leaders - the "spoils system" of political patronage. A complete turnover of personnel was expected every four years when the incoming governor filled the jobs with his friends. Furthermore, the department enforced fish and wildlife laws but lacked the power to make them. Political bickering in the state legislature caused proper conservation actions to be delayed or nonexistent.

Then came the drought years of the 1930s to climax the long years of natural resource abuse and neglect. Once abundant quail were cut down to scattered remnants. Famous Ozark bass streams were reduced to mere trickles. In the Ozark woodlands, fires raged across the parched hills all year long. The fish, forests and wildlife of Missouri were in terrible condition and a growing public dissatisfaction with the politically run Game and Fish Department was evident. Missouri's public was on the verge of demanding the state government develop an effective conservation program. A new era was about to unfold.

Creation of the Missouri Conservation Commission

By 1935, the ineffectiveness of Missouri's conservation programs had sportsmen very concerned. They formed an organization called the Restoration and Conservation Federation of Missouri to make substantial changes in how the state government administered conservation. This organization is known as the Conservation Federation of Missouri today.

Two primary objectives were established by the Federation: first, to separate fish and wildlife from politics; and second, to establish a Conservation Commission with authority for the "control, management, restoration, conservation and regulation of all wildlife, fish and forestry resources of the state." Provisions for the state park system were not included which reflected the sportmen's resentment at having their license dollars spent on something other than fish and wildlife restoration.

The Federation decided that sponsoring a constitutional amendment to be voted on by the public was the most effective means of accomplishing their objectives. This was an important decision. Although the Federation may have been able to get all their changes in a legislative law, the next legislature could repeal or amend it. A constitutional amendment was a method to make the changes permanent.

The Federation took its petition for a constitutional amendment directly to the public. Slogans such as "Save Wildlife! Vote Yes, Scratch No, on Proposition No. 4" and "Bring'em Back to Missouri" appeared on bumper stickers, newspaper advertisements, billboards and countless leaflets throughout the state. Endorsements were solicited from many organizations, including the American Legion, Veterans of Foreign Wars, Farm Bureau, Federation of Women's Clubs, garden clubs, and the chambers of commerce of St. Louis, Kansas City, Springfield and other cities.

On November 3, 1936, the conservation amendment carried the state by the largest majority accorded a constitutional amendment in state history. It became effective on July 1, 1937. This amendment, and the public's favorable attitude toward it, was a product of inadequate conservation efforts during the previous sixty years. Missouri citizens had insulated conservation from political interference and a new era was ushered in.

Organization of the Missouri Conservation Commission

The Conservation Commission is organized as specifically stated in the constitutional amendment. The Commission consists of four members appointed by the Governor with the advice and consent of the State Senate. Not more than two members may be from the same political party. Each commissioner serves a six year term and receives no salary or other compensation with the exception of traveling expenses when on official business.

The Commission appoints the Director of Conservation. The director, with the approval of the Commission, hires other assistants and employees as the Commission deems necessary. The group of employees hired by the Commission to implement conservation programs is known as the Missouri Department of Conservation.

Revenue Sources of the Missouri Department of Conservation

The constitutional amendment maintained the right of the state to collect hunting and fishing license fees and gave it to the Conservation Commission. License fees have been a major source of revenue for the Department of Conservation over its fifty year history.

The federal government has been another source of revenue. In 1937, the Pittman-Robertson Act placed a 10 percent federal excise tax on sporting arms and ammunition which is still in effect. A large portion of the money is returned to the states for research and the acquisition and development of wildlife habitat. Two amendments to the Pittman-Robertson Act in the early 1970s added excise taxes on handguns and archery gear.

Excise taxes on sport fishing tackle were initiated in 1950 by the Dingell-Johnson Act. A substantial part of these funds are also returned to the states for fish conservation programs including research projects. The Act was improved by the Wallop-Breaux amendment of 1984 which added excise taxes on boats, boat motors and marine fuel.

Other supplementary revenue from the federal government has been available in the past. The Clarke-McNary Act of 1924 provided federal funds on a matching basis to assist the states in fire protection, seedling tree production and watershed protection. Another example was the Commercial Fisheries Research and Development Act of 1946 which supplied funds for the promotion of state commercial fishery research and development projects.

For the first forty years of its existence, the Missouri Department of Conservation was primarily financed with sportsmen's license fees and excise taxes. Since sportsmen were paying for conservation efforts, the focus of most programs was on increasing fishing and hunting opportunity. By the late 1960s, public preferences were changing toward non-consumptive uses of fish and wildlife such as bird watching, bird feeding, photography and simply nature enjoyment. Public demand for different types of conservation activities were increasing. A strengthening and broadening of conservation programs was needed to serve the public, but adequate funding was not available.

The Conservation Federation of Missouri once again took a leading role by forming the Citizens Committee for Conservation. The committee's task was to find a way to finance an expanded state conservation program. They decided a conservation sales tax was appropriate since the general public would pay the bill and collect the benefits.

The sales tax proposal was quite revolutionary by asking for a constitutional amendment earmarking sales tax funds for conservation. In November of 1976, the one-eighth cent conservation sales tax passed by a 50.8 percent to 49.2 percent margin and became effective on July 1, 1977. Since 1977, the sales tax has constituted roughly two-thirds of the Missouri Department of Conservation's budget.

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UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

Lesson 3: Conservation Careers

Employers

The conservation of renewable natural resources is a diverse human endeavor with a broad range of career possibilities. The majority of careers exist with the federal government, state and local governments, and private companies or organizations. If you are interested in self-employment, there are a few opportunities to have your own business in natural resource conservation.

Federal Government - In 1977, the federal government collectively owned 751,184,000 acres of cropland, rangeland and forest land in the U.S. This is roughly one-third of the continent. Federal agencies have been established to properly manage the natural resources on these lands for the benefit of the general public. The Fish and Wildlife Service, Bureau of Land Management, Forest Service and National Park Service are examples of these agencies.

The federal government also has natural resource agencies which do not have primary responsibility for federal land. Their function is to provide specialized conservation assistance to private companies, individuals or units of government. The Soil Conservation Service (SCS) is a good example of this type of agency. SCS employees help landowners all over the U.S. to solve their soil erosion problems, but the agency does not manage federal land. Other federal agencies which fall into this category are the Environmental Protection Agency and Geological Survey.

State Government - The major employers of resource conservationists in the U.S. are the state conservation agencies. These agencies have broad powers and responsibilities which vary from state to state. They frequently own and manage state parks, wildlife areas, natural areas and forests. They also regulate wildlife harvest, administer state soil conservation programs, advise landowners on fish and wildlife management, assist educators in teaching conservation, clean-up toxic waste dumps, reclaim strip-mined land, manage fish populations in public reservoirs, etc. With all these responsibilities, state conservation agencies employ people with many kinds of skills, abilities and educational backgrounds.

Local Government - Local units of government may hire resource conservationists to specifically manage local resources. County soil conservation district boards frequently hire people to

assist Soil Conservation Service personnel implement local conservation programs. Also, municipalities sometimes hire foresters to manage city forests and park rangers to supervise operation of community parks.

Private Companies and Organizations - Many persons educated in resource management find employment in private enterprise. Large duck hunting clubs may hire a waterfowl biologist to manage the club's agricultural and wetland areas to provide the most hunting opportunity. Timber companies frequently hire foresters and forestry technicians to manage their woodland holdings. Also large financial institutions responsible for operating agricultural land may hire soil conservationists as land managers.

The passage of state and federal environmental laws in the 1970s prompted many companies to hire resource specialists of various types. Environmental impact studies had to be completed by companies to comply with the new laws. Usually, these studies are confined to assessing the environmental damage (if any) a company would create with a proposed set of actions.

Self-Employment - The opportunities for self-employment are limited and highly specialized. Instead of hiring their own specialists, large companies frequently pay private consulting firms to prepare environmental impact statements. A similar situation occurs when a company needs timber management advice but chooses not to put a forester on the payroll. They purchase the service they need from a private consulting firm.

Other possibilities for self-employment related to natural resources are suited for a supplementary source of income. Examples are operating your own shooting preserve, fee fishing area or engaging in free-lance writing and nature photography.

Educational Requirements for Professional Careers

Professional conservationists are people who have earned at least a bachelor's degree in the natural resource field and apply their knowledge and abilities in a resource career. They may be administrators, managers, researchers, law enforcement officers, educators or public relation specialists.

A college degree is a requirement to become a professional conservationist. As with other professions, prospective professionals must build a solid academic foundation while acquiring the basic skills and experience which will qualify them for employment. Many professional conservationists continue their education to earn a master's degree in their particular specialty such as fish, forest or wildlife management. An advanced degree gives a person a competitive edge when entering the job market after graduation. People who intend to do research or teach at the college level should plan to earn a doctorate level degree.

Natural resource conservation is a complex field. Professional conservationists must have a thorough knowledge of their particular specialty and have the ability to apply their knowledge in the "real world." Besides technical training, a college degree helps to broaden a person's understanding of how conservation meshes with the public's attitudes and values. This is the reason why classes in sociology, political science, economics and psychology are as important as training in ecology, fishery science, wildlife biology or forestry. Also, courses in English and public speaking are very important. A successful professional conservationist must be able to clearly communicate with the public and co-workers.

Conservation-related Job Opportunities

Many different types of skills, trades and specialized training are needed in natural resource conservation. A person wanting to enter the field does not necessarily have to earn a college diploma and become a professional. There are other ways to work for a conservation agency or organization. However, a professional career will probably be more stimulating, interesting and lucrative over the long-term because promotions are more likely.

The Missouri Department of Conservation is a good example of a conservation agency which is comprised of diverse occupations. Many of these positions are used as internal support to keep the agency operating smoothly. Examples of these types of positions are building maintenance technician, equipment mechanic, carpenter, administrative secretary, data entry operator, drafting technicians and survey crew technician. These positions are not unique to MDC. Many other agencies unrelated to conservation need people with these skills.

The Missouri Department of Conservation has positions dealing directly with natural resources which do not require a college degree. Examples are fish culture aide, fisheries assistant, tree nursery aide, forestry aide and forest management technician. These jobs include much outdoor work, but are relatively low-paying. Although a college degree is not required, an increasing number of recent college graduates use these positions as a way to get "hands-on" experience and are eventually promoted to higher positions.

The USDA Forest Service is an example of a federal conservation agency where much of the work is done by persons who are not professionals. The Forest Service needs a competent staff of technicians, aides, skilled workers, clerical personnel, and laborers to assist management in all phases of work. Skilled technicians might serve as fire dispatchers, timber cruisers, log scalers, survey party chiefs or road crew supervisors.

Forestry technicians are needed as firefighters, smokejumpers, recreation guards, tree nursery aides and research aides. Other skilled workers are needed as heavy equipment operators, carpenters, welders, electricians, mechanics, cooks, payroll clerks and warehouse workers. A great number of laborers are needed on tree planting crews, road and trail crews, and timber stand improvement crews.

Conservation agencies and organizations in both the public and private sector have similar occupational structures. For specific information and requirements, contact the agency of your choosing.

How to Start Building a Professional Conservation Career

A professional conservation career is built step-by-step. It begins when your interest for the outdoors develops into a strong desire to improve the environment. Many people with successful conservation careers recognized their sincere interest in natural resources during their teenage years. They began to find out what conservation job opportunities were available, how to prepare for them and then worked toward their goal. You can follow a similar path of early preparation. It will not assure that you will become a professional conservationist, but will help you decide for yourself as you become more familiar with the conservation field. The following suggestions are ways to explore the possibilities and prepare yourself.

Talk with professional conservationists - You can start by contacting local conservationists and ask for appointments to visit with them. Many conservationists are within easy driving distance from almost anywhere in Missouri. Your county Soil Conservation Service district conservationist is an excellent person to talk with if you have an interest in soil conservation. The Missouri Department of Conservation has a conservation agent in every county in the state who you can contact if you are considering a career in fish, wildlife or forest conservation. The Missouri Department of Conservation also has district foresters, conservation education consultants, wildlife area managers, fisheries management biologists, etc. throughout the state. Your local conservation agent will be able to put you in touch with them.

The purpose of talking with professional conservationists is to find out what they actually do in their jobs. Your visit with them will be most productive if you have a list of prepared questions to ask. Examples of good questions to ask are:

1. What job duties do you enjoy the most?
2. What job duties do you enjoy the least?
3. How did you prepare yourself for this position?
4. How would you describe a typical day in your job?

Most of these professionals will have a limited number of career brochures and pamphlets. Collect all the information which is available and begin assembling your own packet of career publications from various sources.

Talk with parents, teachers and guidance counselors - These individuals can frequently help you with good advice and encouragement as you consider a professional conservation career.

Seek out conservation experiences - Actively build your conservation knowledge through personal experience. A supervised occupational experience project (SOE) can be designed to accomplish this. Project examples are:

1. Forest management - This may involve measuring standing timber volume, timber stand improvement, marking trees for a harvest cut, planting trees, etc.
2. Wildlife management - a SOE in fish and wildlife management could involve estimating the size of a population with census techniques, managing a fee hunting or fishing area or implementing a habitat improvement plan.
3. Conservation-related - This category is closely associated with animal husbandry. Raising catfish in cages, propagating game birds or fur farming are examples.

Attending special conservation programs is another way to increase your experience. The Missouri Department of Conservation and the University of Missouri-Columbia co-sponsor the "Conservation Honors Program" for high school juniors who are interested in any aspect of natural resource conservation. Selected students participate in a one-week educational experience which introduces them to many aspects of conservation. Students must be in the top 15 percent of their class to be considered for this program so good grades are important. Attending MDC public programs such as Eagle Days or Prairie Days is also a good way to learn about conservation.

Recreational activities such as hunting, fishing, camping, bird watching, hiking, etc. also have value. These types of activities will acquaint you with the mysterious ways of the natural world and lead you to learn about conservation.

Develop communication skills - Much of the work performed by professional conservationists requires clear communications with other people. Begin developing your speaking and writing abilities in high school by taking extra courses in English and public speaking. Extracurricular activities such as speaking contests are also valuable training.

Build a good academic foundation - Take additional math and science courses in high school and strive to achieve good

grades - A's and B's. Agricultural skills and knowledge are also important.

Take college entry examinations - In the fall of your junior year, take the Preliminary Scholastic Aptitude Test (PSAT). This is good practice for taking the standardized college exam(s) (SAT, ACT, etc.) early in your senior year. Also, a PSAT score is one of the requirements for you to be considered for the "Conservation Honors Program."

Select a college or university - Select a college or university to attend early in your senior year. A list of major colleges and universities offering training in the conservation/environmental field is contained in the National Wildlife Federation's Conservation Directory which is published annually. Check with your school librarian or purchase a copy by writing to:

National Wildlife Federation
1412 Sixteenth Street, N.W.
Washington, DC 20036

Save money - Begin saving money for college from summer jobs or part-time work. During your senior year, investigate the availability of scholarships, grants and loans to ease the financial burden of college costs. Students who participate in the "Conservation Honors Program" are eligible to apply for a scholarship from the University of Missouri.

By following these eight suggestions, you can begin training yourself for a professional conservation career. A successful career rests on a good foundation which is laid during high school.

Personal Sacrifices and Benefits

A professional career in conservation should be viewed realistically from the beginning to avoid future discouragement. There are problems very similar to other types of employment; broken machinery, unresponsive supervisors and too much work to do are examples. Working in the conservation field requires personal sacrifices as well. But, there are rewards which can be found in no other profession.

Sacrifices - Earning a college degree for the opportunity to become a professional conservationist is a sacrifice in itself. It requires at least four years of diligent study with substantial monetary expense. If you choose to attend a college or university in another state, you will experience very high college costs if you remain a non-resident.

Sacrifices will need to be made after graduating from college. Securing employment in conservation is very competitive and new college graduates waiting months or even years for a job offer is

not uncommon. The number of people with good credentials trying to enter the conservation field has always exceeded the number of open positions. As a result, recent college graduates must find employment elsewhere and be persistent in their efforts to find a conservation position.

Professional conservationists usually have a series of related jobs as they are promoted during their careers. More responsibility, higher status and an increase in salary are all benefits of promotions. However, conservation employees of a single agency are usually dispersed in many locations. As such, taking a promotion will usually require moving a long distance to a new work location. Many professional conservationists will live three, four or five years in one location and then move. This is particularly true of federal employees and less so with state workers. It is stressful to a family to move frequently. Children must change schools, and spouses may have difficulty finding new employment. Established friendships are also difficult to maintain under these circumstances.

Benefits - Living in rural or remote areas and working in the outdoors is a characteristic of many conservation jobs. Many people have entered the conservation field for this reason. Some conservation employees are fortunate enough to live in the most scenic parts of the U.S.

Salaries and fringe benefits of conservation jobs are comparable to what is offered in other fields for the same amount of experience and education. You will not become rich as a conservationist, but it is very likely you will earn an acceptable income.

A professional career in conservation has rewards beyond a salary. There is a special sense of accomplishment when a well-planned conservation program is successful. A conservationist can take pride in cleaner water, well-managed forests, healthy wildlife populations or more outdoor recreation opportunities for the average citizen. These are personal dividends beyond what other types of jobs or careers are able to offer.

Conservation Careers: Federal and State Government

The majority of natural resource careers are generated by the government. The following information will briefly explain the missions of selected federal and state conservation agencies and the types of positions in each. An address and phone number is provided for each agency if you need more information.

The job titles listed for the individual agencies have been selected to characterize the type of work the agencies are involved with. Positions which exist in most government agencies have been omitted to avoid repetition. However, without these

positions the agencies could not function. Examples are: accountant, administrative secretary, computer programmer, computer analyst, clerk-typist, payroll clerk, building maintenance technician, personnel specialist, contract specialist, budget analyst, account clerk, data entry operator and equipment mechanic.

Federal Government

Department of the Interior

Fish and Wildlife Service (FWS) - The major responsibility of the Fish and Wildlife Service is the conservation and protection of fish and wildlife at the federal level. The FWS is composed of a headquarters office in Washington, D.C., seven regional offices, and a variety of field units and installations. These include national wildlife refuges comprising more than 34 million acres; major fish and wildlife laboratories and centers; cooperative research units at universities across the country; national fish hatcheries; and a nationwide network of wildlife law enforcement agents.

The FWS employs 5,000 full-time employees of which half are fishery biologists and wildlife biologists. Characteristic FWS job titles are: refuge manager, fishery biologist, wildlife biologist, research biologist, outdoor recreation planner, fishery and wildlife technician, biological technician and special agent (law enforcement).

For further information on FWS careers, contact:

Personnel Officer
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111
Phone: (612) 725-3585

Bureau of Land Management (BLM) - Established in 1946, the Bureau of Land Management is responsible for actively managing the resources on about 300 million acres of land, and subsurface resources underlying an additional 300 million acres of land. The BLM's functions are carried out in 12 state, 55 district and 153 area offices. Most of these offices are located in the western U.S. where the majority of public lands are found. The land the BLM manages contains a vast amount of natural resources including fossil fuels and other minerals, wildlife habitat, timber resources and forage for livestock.

The BLM employs 9,000 full-time personnel. Characteristic BLM job titles are: range conservationist, forester, wildlife

biologist, geologist, mining engineer, hydrologist, land law examiner, soil conservationist, mineral economist and recreation specialist.

For further information on BLM careers, contact:

Bureau of Land Management
Denver Service Center
Denver Federal Center
Building 50
Denver, Colorado 80225
Phone: (303) 236-6503

National Park Service (NPS) - The National Park Service is responsible for the protection, preservation and management of the 77 million acres in the national park system. The NPS has 330 areas spread over all 50 states, Puerto Rico, Guam and the Virgin Islands. In addition to 39 national parks, the national park system contains 171 historic areas, 37 recreational areas and 74 natural areas. Examples of the types of areas managed under the national park system are: national parks, battlefields, cemeteries, monuments, national lakeshores, national riverways, historic ruins, memorials and natural areas. With the exception of natural areas, the purpose of the NPS is to manage the national park system for public enjoyment without damaging the natural resources.

The NPS has nearly 11,000 full-time employees and hires 7,000 seasonal personnel. Characteristic NPS job titles are: park ranger, park police, park aid, park technician, wilderness ranger, archeologist, architect, snow ranger and landscape architect.

For further information on NPS careers, contact:

National Park Service
Room 2328
18th & C Streets, NW
Washington, D.C. 20240
Phone: (202) 343-4747

U.S. Geological Survey (USGS) - Established in 1879, the U.S. Geological Survey's primary responsibility is to research and provide information on the earth's crust in the U.S. This responsibility equates to many diverse activities. The USGS prepares topographic maps for public use; carries out geologic research for the general appraisal of mineral, ore and fuel resources; studies volcanic and earthquake phenomenon as a way to predict future activity; performs research on hydrologic problems related to the occurrence and distribution of both surface and ground water; classifies public lands as to their value for leasable fuels and minerals; and is responsible for supervising

mining operations on government-leased land. Characteristic USGS job titles are: geologist, geophysicist, hydrologist, cartographer and geochemist.

For further information on USGS careers, contact:

USGS Personnel Office
1400 Independence Avenue, MS-100
Rolla, MO 65401
Phone: (314) 341-0810

Department of Agriculture

Soil Conservation Service (SCS) - The primary task of the Soil Conservation Service is to provide soil conservation technical assistance to farmers, ranchers and other landowners. SCS is composed of a headquarters office in Washington, D.C., a central office in nearly every state, and field offices at the county level. The majority of SCS employees work directly with farmers and ranchers to help them solve soil and water conservation problems.

County level SCS employees are involved with a variety of duties. They hold public informational meetings, survey and layout conservation practices, help farmers prepare feasible conservation plans, write newspaper articles, and coordinate conservation efforts with local officials and other agencies. SCS has a primary role in implementing the conservation provisions of the Food and Agriculture Security Act of 1985 which includes the Conservation Reserve, Sodbuster, Swampbuster, and Conservation Compliance programs. SCS is also responsible for a nationwide soil survey program which requires the employment of many soil scientists.

The SCS employs approximately 14,000 full-time employees. Characteristic job titles are: soil conservationist, soil conservation technician, soil scientist, agricultural engineer, agronomist, engineering technician, soil conservation aide and range conservationist.

For further information on SCS careers, contact:

Soil Conservation Service
555 Vandiver Drive
Columbia, MO 65202
Phone: (314) 875-5214

Forest Service (FS) - The major responsibility of the Forest Service is to provide leadership in the management, protection and use of the national forest system. The national forest system encompasses 156 national forests, 19 national grasslands, and 16 land utilization projects for a total of 191 million acres--almost two-thirds of all federally owned lands.

The FS cooperates with state foresters, private forest owners, wood processors, and other federal agencies to focus scientific attention on forest resources. Forestry research is also carried out to discover new forest management and wood utilization techniques.

The FS is the largest and most diverse agency in the Department of Agriculture. The agency's 30,000 full-time employees, plus 15,000 temporary employees, constitute the federal government's major conservation organization. Roughly 5,500 foresters are employed by the FS followed by about 1,400 engineers in various specialties and about 1,600 biological scientists.

District foresters are the managers of our national forests. They plan and supervise management practices and the general operation of the forests under their jurisdiction. Much of the work done on forest lands is done by people who are not professional foresters. Examples of specific daily or seasonal tasks on our national forests are: fire fighting, road building, timber cruising, surveying, building construction and recreation area maintenance.

Characteristic FS job titles are: forester, forestry technician, engineer, range conservationist, soil scientist, wildlife biologist, fishery biologist, hydrologist, survey technician, biological technician, tree nursery aides and log scalers.

For further information on FS careers, contact:

USDA Forest Service
310 West Wisconsin Avenue, Room 500
Milwaukee, WI 53203

State Government

Missouri Department of Conservation (MDC) - Established in 1937 by a constitutional amendment, the Missouri Department of Conservation is responsible for the conservation of the state's fish, forest and wildlife resources. MDC employs over 1,000 people to accomplish this goal.

MDC is involved with a multitude of conservation activities such as: law enforcement, managing wildlife areas, locating and purchasing natural areas, providing conservation education programs for children of all ages, teaching hunter safety, helping farmers conserve fish, forest and wildlife resources, maintaining the river public access areas, monitoring fish and wildlife populations, setting regulations and seasons, managing fish populations in Missouri's lakes and rivers, investigating fish kills, providing fish to landowners for pond stocking, providing tree seedlings to the public for conservation plantings, etc.

Characteristic MDC job titles are conservation agent, wildlife area manager, fisheries management biologist, wildlife services biologist, district forester, resource forester, education consultant, fish hatchery manager, wildlife research biologist, biometrician and fisheries research biologist.

MDC also employs many people who have special skills but do not necessarily have a college degree. Examples are: wildlife area aide, fish culture aide, forestry aide, heavy equipment operator, tree nursery aide, drafting technician, fisheries assistant and sign processor.

For further information on MDC careers, contact:

Personnel Section
Missouri Department of Conservation
P.O. Box 180
Jefferson City, MO 65101
Phone: (314) 751-4115

Missouri Department of Natural Resources (DNR) - The responsibility for assuring the state's major resources (fish, forest and wildlife excluded) are wisely used belongs to the Department of Natural Resources. Air, water, land, minerals, energy, recreational resources and cultural resources are managed by DNR.

DNR is involved with many activities which includes: energy conservation; environmental programs in air pollution control, water pollution control, public drinking water, waste management, land reclamation, and soil and water conservation; collection of geologic information about mineral, water, energy and land resources; and management of Missouri's 74 state parks and historic sites.

Characteristic professional job titles are: environmental engineer, planner, environmental specialist, water specialist, land reclamation specialist, geologist, land surveyor, architect, historic site administrator, park superintendent, park naturalist, regional supervisor, energy engineer and public information specialist.

DNR also employs many people who have special skills but do not necessarily have a college degree. Examples are: energy technician, engineering technician, laboratory technician, technical instrument specialist, draftsman, land survey technician, park maintenance worker, heavy equipment operator and tourist guide.

For further information on DNR careers, contact:

Department of Natural Resources
Division of Management Services
P.O. Box 176
Jefferson City, MO 65101
Phone: (314) 751-3332

Summary

Natural resource conservation provides many different types of employment opportunities with government agencies and private organizations. People with many kinds of skills, abilities, and educational backgrounds are needed.

However, securing a conservation job is highly competitive - especially for professional positions. People interested in pursuing a professional conservation career must be willing to make personal sacrifices to achieve their chosen goals.

Nevertheless, a conservation career has much to offer those who are interested in conserving our natural resources and enjoy working with people.

Credits

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"Careers: Professional and Administrative Careers in the Forest Service." Forest Service, USDA.

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UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

Lesson 4: Landowners and Sportsmen: Partners in Fish and Wildlife Management

Ownership of Fish and Wildlife

The Wildlife Code of Missouri states: "The ownership of and title to all wildlife of and within the state, whether resident, migratory or imported, dead or alive, are hereby declared to be in the state of Missouri." As a government entity, the state of Missouri owns the fish and wildlife and holds them in trust for the benefit of the general public.

Access to Fish and Wildlife

Landowners control the public's access to fish and wildlife by deciding who will enter their property. This is a legal right of land ownership. Although the state has title to fish and wildlife, this does not mean the public has automatic access.

Landowners may be farmers, government agencies or private organizations and companies. Comparatively, farmers control access to more land and hunting opportunity than any other group. Over 66 percent of Missouri's 44 million acres is in farms while government land holdings amount to only 8 percent. Most Missouri hunters do at least part of their hunting on farms and other private land.

Fishing, canoeing and other aquatic recreation is generally more accessible. Missouri is blessed with farm ponds, large reservoirs, rivers and clear Ozark streams which collectively comprise over 900,000 acres of water. Rivers, streams and reservoirs account for 75 percent of this total acreage.

The streams and rivers are state property but the adjacent land is usually privately-owned. Accessibility was a problem 30 years ago. In response, the Missouri Department of Conservation has increased public use of rivers and streams by providing 273 river access areas at convenient locations.

Missouri's large reservoirs are open to many forms of outdoor recreation and have some of the most heavily fished waters in the state. The management of these reservoirs is accomplished by a cooperative effort from many government and private organizations.

Public accessibility to the 90,000 private ponds the Missouri Department of Conservation has stocked is at the pond owner's discretion. People who receive fish for stocking from the

Department of Conservation have agreed to allow a reasonable amount of fishing. However, the pond owner still decides whether or not a person may fish. Surveys indicate that private ponds provide 12 percent of the recreational fishing in the state today.

Acquiring and Keeping the Right to Fish and Hunt on Private Land

Fishing and hunting on private land is not a personal right - it is a privilege and a favor. You must obtain a landowner's permission to hunt or fish on his/her land.

Asking for permission does not guarantee you will receive it. There are several possible reasons. A landowner may have purchased the land as a personal fishing and hunting area. Or, perhaps family members or friends have been promised the exclusive recreational use of the land. Some farmers may not grant permission due to the careless actions of previous fishermen and hunters such as littering, harassing livestock, trampling crops or leaving gates open. Keep knocking on doors and talking with different landowners until you are successful.

When contacting landowners, the best approach is to look and act like a responsible sportsman. Landowners are more likely to grant permission to a courteous individual who appears to be respectful of other people's property. Also, ask for permission in person at least several months in advance. This is particularly true when asking for hunting privileges.

Once you get permission, be sure to learn the landowner's name and how to contact him/her. Take the opportunity to become acquainted. When the hunting season draws near, phone or personally visit the landowner to mutually agree upon dates you will be hunting on his/her property. If you want to hunt with friends, be sure to ask the landowner if you can bring a specified number of friends. Later, if you are unable to make the trip, call the landowners to report you won't be there as a gesture of common courtesy.

Be sure to thank landowners for their hospitality after you have finished hunting or fishing. This lets them know you are leaving and that you appreciate the privilege they have extended. Offer part of the fish and game you have harvested as a friendly gesture. You may want to do the extra favor of cleaning or dressing the animals for them.

After you arrive home, send the landowners a thank you card and try to reciprocate their kindness. Perhaps there is a favor you can do for them. Remembering them at Christmas with a gift is an excellent way to express your gratitude.

The first part of the National Rifle Association Code of Ethics is written for hunters but also applies to every outdoor user. Rule one sums up the proper sportsman's attitude toward landowners:

"I will consider myself as an invited guest of the landowner, seeking his permission and so conducting myself that I may be welcome in the future."

Trespassing

On January 1, 1979, Missouri's new criminal code became effective which consolidated and refined, among other things, the trespass laws. The trespass laws are now divided as to the degree of severity. Trespass in the first degree puts a heavy burden on the prosecutor or "state." Prosecution requires evidence that one entered the property knowingly, or that the property was completely fenced with locked gates, or frequently posted with clear, legible and very visible signs, and that the defendant be positively identified. Trespass in the first degree is a misdemeanor and carries a fine up to \$500 and/or a term not to exceed six months.

Trespass in the second degree is an infraction, not a misdemeanor, and is punishable by a maximum fine of \$200. It is not a crime and cannot be listed as a prior conviction. Statute 569.150, trespass in the second degree, reads that: "A person commits the offense of trespass in the second degree if he enters unlawfully on the real property of another." The legal counsel for the Department of Conservation states the following: "As you can see it is a very simple law requiring none of the posting, fencing, or warning requirements of trespassing in the first degree. The landowner need not show that the defendant was aware that he was on someone else's property. In other words, a person travels at his own risk when going upon private land. This statute is aimed at persons who do not bother to determine whose property they are on nor get permission to go on it."

Sportsmen Ethics

Everyone has a personal code of ethics they have developed through experience which guides their daily behavior. It is an internal compass pointing to what is right and what is wrong. When people violate their personal code of ethics, it frequently leads to their conscience bothering them.

A sportsman's code of ethics is a highly personal set of values which guides his behavior toward landowners, companions, private property and the fish and game he pursues. Adherence to a good code of ethics will result in a high level of safety, friendly landowner/sportsmen relations, and personal satisfaction.

Ten examples of what most people consider to be unethical behavior are:

1. Being disrespectful of a landowner's property.
2. Littering.
3. Leaving gates open.
4. Shooting a gun near livestock.
5. Not tracking a wounded animal.
6. Casting a fishing rod without taking precautions to avoid hooking someone.
7. Carelessly pointing your gun at a companion.
8. Shooting before you have absolutely identified the target.
9. Continuing to hunt or fish an area after a substantial harvest has been taken.
10. Throwing fish and game away after harvesting them.

A sportsman's code of ethics is a personal set of judgments on what is morally correct in different types of situations. Your unique personal code will become more refined as you gain more experience in fishing and hunting.

Legal vs. Ethical

"Legal" can be defined as judging behavior as being right or wrong based on a set of written laws. The Wildlife Code of Missouri details all the specific rules which apply to the use of fish and wildlife resources in the state. Violating any of these laws is an illegal act.

"Ethical" involves judging behavior as being right or wrong based on a set of moral values. A legal judgment is clearly defined as right or wrong, but an ethical judgment is rooted in values which may vary from one individual to another.

It is important to recognize that some activities may be legal and yet considered unethical by most people. Examples might be shooting ducks on the water or making undue noise near a fisherman. Another might be shooting a covey of quail on the ground.

In most cases, illegal acts are also unethical. Roadhunting deer at night with a jacklight, trespassing or needlessly destroying a landowners' property are examples which show disregard for both human and animal rights.

Credits

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UNIT II - FISH AND WILDLIFE VALUES

Lesson 1: Commercial Value

Basis of Commercial Value

The commercial value of fish and wildlife resources is based upon the legal sale of animals and their products or from supplying access to fish and wildlife populations. Trappers, hunters and commercial fishermen receive income from the furs and fish they harvest. Landowners may choose to sell hunting leases or fishing rights for supplemental income. Sporting goods stores, motels and restaurants derive some of their income from people engaged in fish and wildlife-associated recreation. The financial benefits from fish and wildlife resources are obviously shared by a diverse group of individuals and businesses.

Definition of Commercial Value

There is a distinct difference between the rate of income production and commercial value. The commercial value is the amount of financial investment it would require to match the annual net income generated by the resources. For instance, suppose you own 80 acres of cropland which usually makes an annual net income of \$5600 (\$70 per acre). If you were to sell the land and reinvest the payment, you would be losing money if the investment returned less than \$5600 per year. It will require a principal of \$80,000 at a 7% interest rate to generate \$5600 in annual interest payments ($80,000 \times .07 = 5600$). Therefore, the commercial value of the cropland is at least \$80,000. If you sell the cropland for less than \$80,000, you will be losing money.

This same economic analysis can be applied with fish and wildlife resources to determine their commercial value. Assume you own 80 acres of forest land which is excellent habitat for raccoon. You have been able to consistently harvest 12 raccoons from this area for many years. After your trapping expenses have been paid, your annual net income from trapping is \$250. It requires \$3570 at a 7% interest rate to generate an annual yield of \$250. Therefore, the commercial value of permanent trapping rights on your 80 acres would also be \$3570.

The commercial value of fish and wildlife resources is a theoretical valuation. In Missouri, fish and wildlife resources are held in trust by the state for the public to use. People may harvest, sell and enjoy fish and wildlife under regulations set by the Department of Conservation. Unlike land, wild fish and wildlife populations cannot be directly purchased; but may be used appropriately. For this reason, the annual net income generated from the many different uses of fish and wildlife populations is a practical measurement.

Multiplier Effect

The economic benefits of fish and wildlife resources are greater than the sum of all income derived from them. This is particularly true with local economies. Dollars spent on fish and wildlife-associated activities may be exchanged several times in the local economy. For example, some of the money spent by hunters on meals may in turn be spent by the restaurant owner to purchase food from a grocery store or wholesaler. Or, the money a commercial fisherman or trapper earns may be used to locally purchase new equipment or any number of domestic goods such as furniture or appliances.

This type of economic activity is called the multiplier effect. The money may change hands as many as three or four times before it is spent outside of a given area and ceases to circulate in the local economy. The local economy is stimulated every time the dollars are exchanged. For instance, the money spent by hunters on lodging in rural areas may be the extra source of income a motel owner needs to stay in business, thereby keeping several people employed. Farmers who make extra income by selling hunting leases or fishing rights may spend their earnings on farm-related expenses which support local agribusinesses.

Local economies are supported by a web of interlocking financial transactions. Income from fish and wildlife resources strengthens the economy's web and in some cases, forms the foundation for the local economy.

Fish and wildlife resources also make a substantial contribution to the statewide economy. Historically, fur was Missouri's first important cash crop and continues to have a place in the state's economy today. In 1978-79 over 450,000 pelts worth \$8.6 million were harvested in Missouri. Based on a multiplier effect of 6.67, this harvest value is considered to have stimulated Missouri's economy by about \$57 million.

Missouri's commercial fishermen caught 1,166,406 pounds of live fish during 1987 which had a wholesale value of at least \$332,000. Almost all of the harvest came from the Mississippi, Missouri and St. Francis Rivers. Commercial fishing is not allowed in large reservoirs such as Lake of the Ozarks, Pomme de Terre or Truman Lake.

Fee Hunting and Fishing

Charging recreational access to private lands is one way landowners can generate an economic return from the fish and wildlife resources on their land. Access fees for fish and wildlife recreation have grown in popularity over the U.S., but are not widespread. Differences in farm sizes, land-use patterns, landowner attitudes toward wildlife, participant expectations, and cultural traditions explain regional

differences in the prevalence of charging for fish and wildlife recreation. Less than one percent of Missouri farm operators charged access fees for hunting in 1982. In general, Missouri landowners are not captivated by the idea of making wildlife an income-generating product of their farm operations.

Four different types of access arrangements have been identified in Missouri which are:

1. Leases between sportsmen and "general landowners."
2. Fee hunting on private Licensed Shooting Areas (LSA's).
3. Fee fishing at private areas.
4. Fee hunting at commercial waterfowl areas which rent blinds or pits to hunters on a daily basis.

Landowner leases - According to the Missouri Department of Conservation, 382 Missouri landowners charged for hunting access and 95 charged for fishing access in 1986. Yearly leases were the most common and constituted two-thirds of all hunting concessions (Table 2.1). Seasonal leases were common for hunting access, but were used little for fishing access. Only a small number of landowners charged daily fees to hunt, while this was a common practice for fishing access (Table 2.1).

Table 2.1 - Number of landowner leases reported by Conservation Agents in Missouri, 1986.

Number <u>Species Hunted</u> <u>Leases(1)</u>	<u>Lease Type (Percent)</u>				Total <u>of</u>
	<u>Yearly</u>	<u>Seasonal</u>	<u>Daily</u>	<u>Unknown</u>	
Deer	53	36	46	6	194
Turkey	70	20	3	14	138
Squirrel	90	5	0	4	55
Quail	60	20	7	13	15
Rabbit	64	21	0	14	14
Pheasants	33	44	0	22	9
Furbearers	67	0	0	33	6
Bass	45	3	47	5	66
Catfish	44	3	48	5	62
Carp	52	3	40	5	58
Panfish	18	9	55	18	11

(1) Number of access leases exceeds number of landowners because of multiple lease arrangements.

Licensed shooting areas - There are 50 licensed shooting areas (LSA's) in Missouri which provide a unique experience to a small segment of the hunter market. These included 15 private, noncommercial operations which do not market public hunting, 13

commercial hunting areas marketing daily hunts, and seven limited membership club operations. Of the 15 noncommercial shooting operations, three LSA's were managed as kennel operations devoted to training bird dogs, and another three were managed by businesses for entertaining employees or clients.

Commercial LSA fee structures varied considerably, but generally included an entrance fee with associated bag limit, or a charge for birds released, with a minimum daily hunting fee. Clubs required an additional annual membership fee. Minimum payment required for a one-day hunt averaged \$50.76, but extremes ranged from no minimum to \$150.00. The prices charged for the over 30,000 game birds released statewide were quite consistent (Table 2.2). Annual club membership fees ranged more widely, from \$70.00 to \$420.00.

Table 2.2 - Average number, cost and price of game birds released per Licensed Shooting Area in Missouri, 1986.

<u>Species</u>	<u>Average Number Released</u>	<u>Cost/Bird</u>	<u>Price/Bird</u>
Pheasant	542	\$ 5.22	\$ 10.30
Quail	1,315	\$ 2.15	\$ 4.05
Chukar	256	\$ 3.44	\$ 6.95

Extra services were often included as part of these transactions. Most common was free use of a bird dog and guide, while priced services included lodging, meals, ammunition, licenses, trap shooting and field dressing.

About one-half of Missouri's commercial hunting operations were located within 50 miles of either Kansas City or St. Louis and drew clientele almost exclusively from these urban centers. On the average, about 23 percent of LSA sportsmen were non-Missouri residents, while 48 percent were local residents. Based on LSA operator response, the guarantee of seeing and getting a shot at birds and convenient access to the hunting area were the main reasons sportsmen were attracted to LSA's. However, LSA's attracted less than one percent of Missouri's quail and pheasant hunters in 1985-86.

Fee fishing areas - Based on a Missouri Department of Conservation study in 1986, nearly every fee fishing area in the state has a unique blend of fees and services, though three main fee structures were evident: (1) entrance fee with a limit on the number of fish caught; (2) a nominal entrance charge, and charge per pound of fish kept; and, (3) a charge per pound of fish kept. Entrance fees for the nine operations limiting the number of fish caught averaged \$4.07, ranging from \$2.00 to \$7.00 per person. These operation specialized in panfish, catfish, and carp, with none offering trout fishing.

A nominal entrance fee of \$1.00 was charged in the second fee structure class, with an average poundage fee of \$1.34 for catfish, and \$2.61 for trout. Interestingly, the poundage fees were similar in the areas without an entrance fee, with the average cost per pound of catfish at \$1.40, and trout at \$2.54 per pound.

Extra services were available to the visitor during the fee fishing experience. Bait sales and free picnicking sites were the most common services offered, available at two-thirds of the operations. Other common services noted were campsites, fish cleaning, or rod-and-reel rental. Less frequently, areas offered boat and motor rentals, swimming or lodging.

When asked to indicate the average daily expenditure per visitor, operations at the "entrance-fee only" areas estimated \$4.50, \$15.00 at areas charging on a "per pound basis only," and \$17.77 at areas charging entrance and poundage fees. Combining all estimates of daily expenditures at all areas yielded an average of \$11.69 per angler.

Fee fishing operations cater to a selected clientele. Less than one percent of all angler days in Missouri occurred on these areas. Large scale fee fishing operations maintained profitability by catering to an urban population with little free time. Smaller operations, which attract a primarily local clientele, seem to be victims of high operating costs and low returns, and an overall declining demand.

Commercial waterfowl areas - There were 19 commercial waterfowl areas in Missouri during 1986. Leasing waterfowl blinds and pits is an opportunity-oriented business adjacent to public waterfowl areas. The majority of hunters leasing blinds were those either unable to draw a site at the public area, or wished to avoid the inconvenience of waiting for a public site.

Thirteen commercial waterfowl area operators responded to a Missouri Department of Conservation survey. The 13 waterfowl areas maintained 145 blinds on 3,950 acres and attracted at least 1,535 hunters. Daily-fee waterfowl areas charged individual hunters a "gun fee", or charge per gun, and occasionally charged groups a "pit fee", or charge per waterfowl blind. About one-half of the daily-fee areas also leased pits or blinds on a seasonal basis. Daily gun fees varied from \$2.50 to \$25.00. The average pit fee for four hunters was \$34.00. Prices for seasonal leases varied considerably, from \$300 to \$3,000. Two or different seasonal lease prices were common and depended on pit location or customer relationship.

Advantages and Disadvantages of Hunting Leases

Missouri landowners are giving more consideration to selling hunting leases in recent years. As with any new business

enterprise, the advantages and disadvantages must be weighed carefully. As described earlier, hunting leases sell access to land - not the wildlife itself.

Advantages:

Extra income - Missouri landowners usually charge lease hunting fees from \$2 to \$6 per acre. The rate a landowner selects depends on the location of the farm and the quality of wildlife habitat. Many farmers charge on a per gun basis. An average fee for turkey or deer season is \$100 per gun.

More Protection from Poachers- the hunters who have paid for hunting privileges have a vested interest in the land they have leased. Especially if they live nearby, they are more prone to notice and report poaching activities.

Disadvantages:

Liability - hunters may suffer physical injury while pursuing their sport. This can potentially leave the landowner open for a lawsuit. Landowners should do the following to minimize the chance for hunter injury and to protect themselves from being sued if an injury does occur.

1. Take an inventory of dangerous conditions on the property. Either remove the hazards or warn the hunters by listing the hazards in a written lease.
2. Require the hunters to wear highly visible clothing to minimize shooting accidents.
3. Purchase liability insurance specifically for the hunting business.
4. Consult an attorney for advice. Make him/her part of your liability prevention team.

Personal recreation - if a landowner enjoys hunting, he/she may be forfeiting part or all of a valuable source of recreation for the economic return.

There are also advantages and disadvantages to the hunting public and to wildlife populations. If fee hunting became a widespread practice, lower to middle income hunters might be forced to abandon their hunting activities - or at least be relegated to poorer quality habitats. The best wildlife areas would command the highest prices and people most willing and capable of affording the expense would have the leases.

On the other hand, wildlife populations might be benefited with a fee hunting system. Farmers would be much more likely to actively manage the land for wildlife production because they would realize direct economic benefits. Today, this economic incentive is not readily available due to a cultural tradition of free access with landowner permission. This tradition allows most people to afford hunting as a sport but misallocates the production costs and benefits associated with wildlife population

because farmers sometimes have wildlife damage to their property. Wildlife eat row crops, may prey on livestock or damage orchards, and other tree plantings. This "cost of production" is difficult for landowners to recoup unless they charge for the recreational use of their land.

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UNIT II - FISH AND WILDLIFE VALUES

Lesson 2: Recreational Value

People enjoy the adventure, challenge and mystery involving contact with fish and wildlife. There are many different forms of fish and wildlife recreation to choose from. Some individuals are content to watch waterfowl on a lake in a city park while others may want to hunt elk in the Rocky Mountains. The recreational activities an individual selects are a matter of personal preference. In general, people derive benefits of entertainment, satisfaction and enhanced physical and mental health from participation in fish and wildlife-based recreation. These personal satisfactions and benefits are the reasons why people value their recreational experiences and are largely unmeasurable.

Measurement of Recreational Value

The monetary value of fish and wildlife recreation can be indirectly measured. Money spent by recreationists for fish and wildlife experiences indicates what the experiences are worth to them in an economic sense. Therefore, a convenient measure of recreational value is based upon the amount people will pay to participate in their chosen activities. Recreational value becomes commercial value when money is exchanged for supplies, equipment, clothing, etc. associated with the recreational experience.

The annual recreational value of all fish and wildlife resources in the U.S. is enormous. Preliminary results from a national survey conducted by the U.S. Fish and Wildlife Service indicated that a record 141 million Americans age 16 and over participated in fish and wildlife-associated recreation in 1985. These people spent over \$5 billion to participate in their chosen activities.

It is difficult to directly measure recreational value since fish and wildlife are state-owned. In most cases, individuals are willing to pay more for the personal satisfaction they derive from their recreational activities. This is illustrated by the relatively small fee for a hunting and/or fishing license when compared to the money spent on guns, ammunition, fishing rods, boats, gas, fishing lures, clothing, etc. The recreational value of fish and wildlife is underestimated when the amount people must pay is measured. A more accurate measurement is finding what they would be willing to pay if the price was raised.

Hunting and Fishing: Participation and Expenditures

Hunting and fishing are highly visible recreational uses of fish and wildlife which attract many participants. The 1985 National Survey of Fishing, Hunting and Wildlife-Associated Recreation conducted by the Fish and Wildlife Service reveals that 46.6 million (or more than one in four) adult Americans fished during the 1985 calendar year. The survey also states that 16.7 million adult Americans, or about one in ten, hunted during the same year. In Missouri, hunting attracts about one half million participants annually, or 10 percent of the state's population. Participation by fishermen in the state is estimated at around 1.3 million. Obviously, hunting and fishing are popular activities in the state and throughout the nation.

U.S. fishermen spent a total of \$28.2 billion on their sport during 1985 when all expenses were considered such as food, lodging, transportation, equipment, etc. This equates to an average expenditure of \$604 per fisherman. A total of 987.7 million days were spent on fishing with the average at 21 days per fisherman during the year.

Comparatively, U.S. hunters spent \$10.1 billion on their activities which also yielded a \$604 average expenditure per participant. Hunters were afield 335.1 million days with an average of 20 days per individual. These statistics illustrate that fishing is enjoyed by more people and generates more revenue than hunting.

The total fishermen expenditures in Missouri was nearly \$1 billion in 1985. When the value of recreation is measured by the participants' willingness to pay for it, then the recreational value of fishing in Missouri during 1985 was the same amount--nearly \$1 billion.

Nonconsumptive Uses of Fish and Wildlife in the U.S.

As described in Lesson 1, nonconsumptive uses of fish and wildlife are those that do not result in, or attempt the harvest of, an individual animal. There is a large array of nonconsumptive uses including birdwatching, birdfeeding, general wildlife observation, wildlife photography, nature walks and study, visits to zoos and membership in fish and wildlife organizations.

Participation in nonconsumptive activities is much larger than consumptive uses such as hunting, fishing and trapping. According to a preliminary report on the 1985 National Survey of Fishing, Hunting and Wildlife-Associated Recreation, 109.7 million American adults participated in fish and wildlife activities other than fishing and hunting. This is nearly double the participation level of hunting and fishing combined. Interestingly, the number of people participating in nonconsumptive activities in the U.S. is growing faster than consumptive uses. This is evidenced by a slight decrease

in hunting licenses sold in the U.S. at the same time nonconsumptive expenditures have substantially increased. Comparatively, the sale of hunting licenses in the U.S. decreased from 16.4 million in 1983 to 15.9 million during 1985. Part of the reason for this shift of fish and wildlife use is based on the increasing urbanization of the U.S. population. City dwellers, for the most part, have retained an active interest in wild animals and their habitats. However, they express this interest in a different manner by participating more heavily in nonconsumptive activities than rural people.

Of the 109.7 million American adults who participated in fish and wildlife activities other than fishing and hunting, 105.3 million participated around their homes, including 63.6 million who observed wildlife, 82.5 million who fed wild birds and 18.1 million who photographed wildlife. Based on these statistics, there are now more people who participate in one nonconsumptive use--wildlife photography--than in hunting. In 1985, American adults spent over \$14 billion on equipment such as binoculars, cameras, and birdfeeders; transportation; and other costs associated with nonconsumptive uses of fish and wildlife.

Nonconsumptive Uses of Fish and Wildlife in Missouri

The 2.5 million urban Missourians in St. Louis, Kansas City and Springfield also have a preference for nonconsumptive activities. A survey of adult residents in these three cities was funded by the Missouri Department of Conservation in 1980 to gain clues useful in serving the urban citizenry. Respondents were asked how many people in their households participated in each of 23 nature-oriented activities. The results are listed in Table 3.1.

TABLE 3.1 - Percentage of participation in nature-oriented activities

<u>Abbreviated activity description</u>	<u>St. Louis</u>	<u>Kansas City</u>	<u>Springfield</u>
Nature TV viewing	76%	84%	89%
Museum or zoo visit	80	77	77
Drive to enjoy scenery	66	73	73
Neighborhood walk	64	67	75
Feed birds near home	55	66	64
Read about nature	50	56	67
Watch birds near home	49	57	70
Fishing	45	53	59
Camping	47	46	58
Outdoor gardening	39	49	54
Boating	40	43	53
Hiking	40	39	45
Gathering nuts/green	27	34	43
Nature photography	26	29	30
Canoeing	27	23	26
Hunting	18	21	26

Target firearms	14	17	17
Gathering mushrooms	9	26	16
Tending fish aquarium	10	18	13
Backpacking	13	13	14
Target archery	8	7	9
Membership in groups	6	10	10
Trapping	1	1	1

The nature-oriented opportunities most readily available to urbanites were those with the largest number of participants. In the three-city area, seven activities had participation greater than 50 percent. "Watching programs on TV about the outdoors" had the highest involvement (80 percent), followed closely by "visiting museums or zoos" (78 percent). "Going for a pleasure drive to enjoy the scenery" ranked third (69 percent) and was the only activity in the top seven which might require travel out of the cities. Two wildlife activities with majority involvement were "feeding birds or other wildlife near home" (59 percent) and "taking time to watch birds or other wildlife near home" (53 percent).

Participation in the 16 remaining activities fell below 50 percent, though practically one-half (49 percent) of all respondents indicated fishing experience. Three other activities were wildlife-related: "nature photography," defined as photographing wildlife, wild flowers, trees or other natural things (27 percent); "hunting" (20 percent); and "trapping" (1 percent).

Methods of Taxing Recreational Value

All state fish and wildlife agencies are partially funded by taxes on the recreational value of hunting, fishing and trapping. The Pittman-Robertson Act places a 10 percent federal excise tax on sporting arms and ammunition. A large portion of the money is returned to the states for research and the acquisition and development of wildlife habitat. The purchase of sporting arms and ammunition (plus the excise tax) is a direct product of the recreational value of hunting. The same is true with the federal excise taxes on items associated with fishing covered under the Dingell-Johnson and Wallop-Breaux Acts. Sportsmen paid \$248 million in federal excise tax on their equipment in 1986.

The sale of hunting, fishing and trapping permits is another example of how the recreational value of fish and wildlife is used to generate revenue. The Missouri Department of Conservation had nearly \$14 million of permit sales in 1986. This accounted for 19 percent of the Department's total budget, but is only a tiny fraction of fish and wildlife-based recreational expenditures.

Missouri voters passed the conservation sales tax in 1976 based on all the fish and wildlife values they hold. Recreational values played an important role. There is little doubt that many people voted for the conservation sales tax as a means to maintain or increase their recreational uses of fish and wildlife resources.

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UNIT II - FISH AND WILDLIFE VALUES

Lesson 3: Biological Value

The biological value of all lifeforms on earth is derived from their ability to maintain a stable and healthy environment. All life is supported by a complex web of interactions between living organisms themselves and the earth's soil, water, air and minerals. In this lesson, the importance of living organisms will be discussed relative to their functions.

Nutrient Cycling

All lifeforms depend on a supply of mineral nutrients in a chemical form they can use. Microorganisms (fungi, bacteria, protozoa) chemically break down dead plants and animals, absorb some of the decomposition products and release mineral nutrients. They play an indispensable role in maintaining the earth's nutrient cycles.

Mineral nutrients such as nitrogen, potassium and sulfur flow through the environment in predictable cycles dependent upon the products of microorganisms. For instance, 78 percent of the earth's atmosphere is molecular nitrogen (N_2) which cannot be used by higher plants and animals. It must be converted to nitrate (NO_3) which is accomplished primarily through the activities of microorganisms. Rhizobium bacteria are capable of causing a direct transformation of N_2 to NO_3 . This type of specialized bacteria live in the root nodules of red clover, sweet clover, alfalfa and other plants in the legume family. The bacteria take in the molecular nitrogen (N_2) from the soil air and synthesize it to nitrate (NO_3). This process is referred to as "nitrogen-fixing" and is not solely accomplished by Rhizobium bacteria in root nodules. Blue-green algae, a microscopic plant, possesses nitrogen-fixing capabilities and is plentiful in soil and aquatic habitats. Also, there are free soil bacteria (Azotobacter, Clostridium) which are able to fix molecular nitrogen without the aid of a legume host plant.

Microorganisms are a key component of another pathway of the nitrogen cycle. When a plant or animal dies, it is decayed by bacteria, fungi and a host of invertebrates such as mites, millipedes and beetles. A complex chemical decomposition process occurs which releases the stored nitrogen in the protein of dead tissues for use by living plants and animals. The process involves many different species of bacteria. Without the activities of bacteria, the formation of nitrate (NO_3) would be biologically impossible.

Other mineral cycles are similarly dependent on the activities of microorganisms. The sulfur cycle is an example. Sulfate (SO_4)

is the available form of sulfur to plants and animals. It requires specialized sulfur bacteria to produce sulfate from animal excrement and dead tissue in a process similar to the nitrogen cycle.

Microorganisms are responsible for the functioning of mineral nutrient cycles. Without their activities, mineral nutrients would not be available to higher plants and animals and life on earth would cease.

Soil Maintenance

Animal life plays a necessary role in soil maintenance. As previously discussed, microorganisms and invertebrates provide the soil with available nitrogen for uptake by plants and eventual consumption by animals. Vertebrates and invertebrates help maintain the physical structure of the soil through their digging activities. This includes many species of insects, earthworms, nematodes, rodents and larger mammals.

The continuous mixing of the soil by animal life improves soil aeration, soil structure and fertility. Research has estimated that the earthworms existing on one acre may pass 15 tons of dry soil through their bodies annually. The excrement of earthworms is much higher in nutrients and organic matter than the surrounding soil. Thus, the soil is naturally fertilized by earthworm activity. Additionally, the holes and channels earthworms leave behind increase soil aeration and drainage throughout the soil profile. Many species of invertebrates and insects churn and mix the soil in a similar fashion.

Rodents mix and granulate the soil as they excavate tunnels in their search for food (insects, worms) and shelter. Examples of burrowing rodents in Missouri are: eastern mole; thirteen-lined ground squirrel; woodchuck; Franklin's ground squirrel; and woodland vole. The size and depth of a burrow depends upon the species using it and the soil conditions. The burrow system of a woodchuck may extend for more than 45 feet with several side entrances and enlarged chambers. The home of thirteen-lined ground squirrel is also a burrow with several outside entrances. The main entrance leads to a vertical tunnel that extends down from 1/2 foot to 4 feet. The tunnel then runs an irregular path roughly horizontal with the ground for up to 20 feet. Obviously, burrowing rodents are capable of extensively mixing the soil throughout the soil profile.

Rodents and other species of wildlife have affected the long term character of the soil through their food habits. Their plant-feeding and seed-storing activities may influence the growth and composition of plant species. A change in vegetation will affect animal life and ultimately, the soil.

Pollination

Pollination of many naturally-occurring plants and agricultural crops is dependent upon insects. This wildlife service cannot be underestimated. In the U.S., 90 crops valued at nearly \$4 billion depend upon insect pollination and 9 additional crops valued at \$4.5 billion are helped by insect pollination. Approximately a third of the food consumed in the U.S. is dependent on honey bee pollination.

Red clover is an example of an agricultural crop benefited by insect pollination. If a farmer wants to produce red clover seed, adequate plant pollination by honey bees and bumble bees is a necessity for good yields. When all factors for seed production are favorable, proper pollination of red clover by honey bees has the potential of doubling or tripling seed yields.

Honey bees were colonized in North America before 1638 and were originally more important as honey producers than as pollinators. The abundant native insect populations were able to handle plant pollination. However, most native insect populations decreased as North America was settled and converted to agriculture. Today an estimated 80 percent of the insect pollination of U.S. agricultural crops is performed by honey bees. However, thousands of species of native bees, wasps, butterflies, moths, flies, gnats and beetles pollinate plants in the natural environment and play a supporting role in the pollination of agricultural crops.

Seed Dispersal

The seeds of many native plants are dispersed and planted by wildlife. Fox squirrels and gray squirrels plant the tree species they prefer by burying the nuts as a future food source. Woodpeckers have a similar habit of storing acorns in tree cavities.

Seeds of many plants are designed for transport by wildlife. Beggar tick (Bidens) and cocklebur (Xanthium) seed capsules are examples of plant adaptations for seed dispersal. The seeds of these plants, and many others, become attached to the fur of wild animals and are later dropped far away from the parent plant.

Birds are an important source of seed dispersal over long distances. The delivery mechanism is the digestive tract. A bird may ingest a full crop of seed and expel the waste a day later miles away. Some of the seeds will not be digested and may germinate wherever they were deposited. The seeds of some plants will not germinate unless they are exposed to the digestive enzymes of a bird or animal. Unfortunately, this is one of the reasons for the spread of multiflora rose in recent years.

Natural Regulation

Natural regulation refers to nature's ability to regulate plant and animal population levels. Interactions within and between species, and their relationships to their habitats is the basis for regulation.

Natural regulation does not imply that plant and animal populations are perfectly in balance. Sometimes an imbalance has to occur before natural control mechanisms are triggered. An overpopulation of muskrats illustrates this point. During periods of drought, the living space and food supply used by a muskrat population may be seriously impaired. Frequently, the habitat is no longer capable of supporting the muskrat population. When this situation occurs, population control mechanisms are triggered. Fewer females bear litters and adult muskrats kill each other and their young. Due to the social tension, some muskrats migrate to other areas. These are population control mechanisms which do not function unless an overpopulation occurs. Populations of other species of wildlife react similarly.

The relationship between predator and prey species is another important form of natural regulation. Predators concentrate their activities on the old and sick members of a prey species. By doing so, predators maintain the genetic quality and health of prey populations through removal of inferior animals.

The effect predators have on limiting the number of animals in a prey species is varied. Predator/prey relationships are much more complex than they appear on the surface. Many people believe predators, such as the coyote, are responsible for fluctuations in small game populations. In many cases, a closer look will show the coyote is not the culprit. The elimination of brushy areas, fencerows and other habitat is the major factor in the abundance of small game. Also, the remaining habitat may lack adequate escape cover which makes the small game more vulnerable to predation.

Conversely, there are situations when predation plays an important role in maintaining a stable prey population. Stocking recommendations for ponds and lakes are based on this principle. A predator species of fish (largemouth bass) is usually stocked with a prey species (bluegill) at a predetermined rate most likely to achieve balanced populations. Without predation by largemouth bass, bluegill continue to multiply until an overpopulation occurs. The correct ratio of bass to bluegill will benefit both species and produce good fishing.

The natural regulation of plants and animals is a tremendous service to humans - particularly with regard to agriculture. Only 1 percent of insects are considered to be pests. The remaining 99 percent are controlled by natural enemies (predators) and other natural mechanisms.

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UNIT II - FISH AND WILDLIFE VALUES

Lesson 4: Social Value

Individual Benefit

The social benefits provided by fish and wildlife resources are closely related to their commercial, recreational and esthetic values. People participate in fish and wildlife activities for many different reasons. Sometimes the reason for participation is apparent as in the case of commercial fishermen - they fish to earn an income. The reasons fishermen, hunters, birdwatchers or wildlife photographers pursue their chosen activities is not as clear. The individual benefits they receive is a reflection of the values they hold. Examples of benefits are: food; companionship with friends; family togetherness; outdoor skill testing; solitude; enjoyment of the outdoors; and exercise. These benefits have a positive influence on the individual recreationist and society in general.

An individual's physical and mental health is improved by engaging in outdoor recreation as he/she captures sought-after benefits. For example, a deer hunter's physical condition may be improved after a week of strenuous hiking in the woods. His/her mental attitude will probably be further brightened by the successful harvest of an animal. The realized satisfactions of a deer hunt depends on the individual. The testing of stalking or shooting ability, camaraderie with hunting companions, or a feeling of self-sufficiency are examples of deer hunting satisfactions.

Both separate and similar satisfactions are gained from other outdoor recreation activities. Birdwatchers, hunters, fishermen, wildlife photographers and hikers share the common joy of being outside and having contact with fish and wildlife. Many recreationists gain satisfaction from family interactions while pursuing their activities. However, each activity possesses specific human satisfactions only it can provide. Birdwatchers have the satisfaction of adding to their life list of bird species; hunters experience the thrill of outwitting an animal; and wildlife photographers have lasting images - photographs - highlighting their accomplishments. Each activity has social value by promoting physical and mental health in the individual recreationist.

Community Benefit

When individuals realize commercial, recreational and esthetic benefits from fish and wildlife, there is additional value realized by the community in which they live.

Through the multiplier effect, the community as a whole improves its economic base when money is spent on fish and wildlife-associated recreation. The economic base will be in a better position to provide for community services like schools, libraries, medical facilities and recreation centers. Thus, fish and wildlife resources can directly improve the quality of life for all people - not just those who participate in the associated recreational activities.

Communities are greatly influenced by the attitudes of individuals. An individual is more likely to make a positive contribution to the community if he/she is healthy and happy. Fish and wildlife resources play a role in community maintenance by providing recreational activities people value. A recent national research project conducted by Central Missouri State University focused on evaluating various forms of leisure activities for their impact on individual mental health and improved communication within a family. Fishing was found to have a number of positive factors which make it one of the best shared activities. Fishing increased cooperation and communication among family members, friends and even strangers. It also helped to develop competition focused on doing your best, rather than beating someone else. Fishing, and other outdoor recreation, contribute to community stability by the extent they foster social interaction and individual satisfactions.

Cultural Differences

Humans have bonded together in groups since prehistoric times. Each group, large or small, developed its own view of the world through shared thoughts and ideas. A human culture is usually made possible through language, geographic boundaries, and a common historical and ethnic background. The people in a particular culture hold the same ideals and expectations of how life should be conducted.

Human cultures, past and present, view fish and wildlife resources differently. Native American Indian cultures were (and still are) closely tied to the land along with its fish and wildlife. Fish and wildlife were interwoven into the fabric of life through seasonal activities and religious ceremonies. For example, the Osage Indian tribe in Missouri followed an annual hunting cycle which began with a spring bear hunt. The members of the hunting party returned to the permanent village for the women to plant gardens in April. A summer hunt for buffalo or deer usually began in May and lasted until it was time to harvest the garden crops. The remaining part of the year was similarly structured to accommodate their reliance on fish and wildlife populations.

The mix of cultures in the U.S. today (excluding Indians) has an entirely different viewpoint. Most rural people regard fish and wildlife as a recreational product of the land while many urbanites have limited contact with the resources. Fish and wildlife is more closely aligned to a luxury than a necessity by most people.

There are more subtle forces at work which determine cultural viewpoints. No culture retains an identical set of values over a long period of time. Attitudes toward fish and wildlife change. Presently, the U.S. public is exhibiting approximately the same level of interest in fish and wildlife as it has in the past. However, nonconsumptive uses are on the increase, and consumptive uses are generally decreasing. This departure from traditional use patterns is the result of cultural changes such as increasing urbanization.

In conclusion, the attitudes, beliefs and expectations of human cultures form the framework on how fish and wildlife will be used and treated.

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UNIT II - FISH AND WILDLIFE VALUES

Lesson 5: Esthetic Value

The esthetic value of fish and wildlife resources is the most personal and most difficult (if not impossible) to measure. Esthetic value refers to the appreciation of fish and wildlife species for their sheer beauty or fascinating behavior. It is the same kind of appreciation humans have for works of art (sculpture, paintings, poetry) or natural things such as golden, autumn sunsets.

Eye of the Beholder

Nearly everyone appreciates the whistle of a bobwhite quail, the baritone call of bullfrogs in early summer or the V-shaped pattern of migrating ducks. Although most people enjoy such sights and sounds, their individual reactions are varied. Some people experience great pleasure and excitement from specific encounters with the natural world while others are mildly interested. Some people enjoy watching and listening to birds while others prefer to stalk wildlife with a camera or watch nature programs on television. The appreciation of all forms of beauty is in the "eye of the beholder."

Appreciation and Understanding

An individual's appreciation of fish and wildlife resources will grow as he/she learns more about the animals and their habitats. For instance, birdwatchers may find enjoyment by watching the antics of a flock of Canada geese on a lake or pond. A closer investigation will reveal that many of these "antics" are actually consistent postures the birds use to communicate with and control each other. With his/her interest aroused, the birdwatcher may be prompted to read about the life history of the Canada goose and develop a greater knowledge and appreciation of the species.

A squirrel hunter watching his/her quarry busily gathering and burying acorns may see more than meat for the skillet. He/she may also see how the forest he/she is experiencing now, was influenced by long-dead squirrels of over a century ago. Or he/she may peer into the future and speculate how the forest would change in the future if the squirrel population was eliminated. This type of appreciation comes with the understanding of a perceptive mind.

Existence Value

Esthetic value of fish and wildlife is not limited to actual contact with the animals. Many people are satisfied by knowing that fish and wildlife populations still exist and are being protected. For example, isn't a television program on grizzly bears more entertaining if you know they exist and you may be able to see one in the wild some day? Isn't it more interesting to read a magazine article about steelhead salmon fishing in Alaska if you know the salmon are still making their spectacular annual migrations? Existence value is based on human attitudes and perceptions; fish and wildlife do not have to be killed, watched or otherwise used to be appreciated.

Credits

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UNIT II - FISH AND WILDLIFE VALUES

Lesson 6: Scientific and Educational Values

Scientific Value

The scientific value of fish and wildlife resources is based on their ability to promote human health and scientific understanding. The study of fish and wildlife species has uncovered basic biological and agricultural concepts along with specific discoveries used in medicine.

Scientific understanding - The most basic principle of biology - the concept of evolution - was developed by studying existing and fossil plants and animals. Charles Darwin studied plants and animals in many parts of the world and formulated the concept of natural selection as part of the principle of evolution. His research and writings brought acceptance to the idea of evolution and upset previously held ideas concerning the origin of humans and other species. The concept of evolution had great impact on biology, religion and ethics.

As objects of study, fish and wildlife populations have contributed to other scientific knowledge such as population dynamics and animal behavior.

Medicine - Research on fish and wildlife species has yielded discoveries important to human medicine. For example, the human Rh blood factor was first discovered in rhesus monkeys. This discovery proved to be a medical breakthrough for certain blood transfusions. Rh-negative individuals who receive transfusions of Rh-positive blood have a substantial risk of death from blood clotting. Also, under some conditions the newborn child of a Rh-negative female will die of Rh disease if not treated promptly. The detection of the Rh factor in blood has saved many human lives and is a direct result of scientific research on rhesus monkeys.

A cure for cancer may very well be discovered in the ocean. The National Cancer Institute has studied thousands of chemicals from a variety of biological sources. This screening process has found more than 500 marine animal species to have biochemicals containing anticancer properties.

Additionally, nearly half of the prescription drugs used today contain compounds derived from a variety of natural sources such as fungi, insects, plants and marine animals.

Blind people may someday benefit from bat research. Bats are being used extensively in medical research to learn more about

their ability to navigate by sound waves. A bat's "sonar system" can identify a mosquito at 10 to 15 feet. When research unlocks the mystery of bat navigation, the discovery may eventually help blind individuals to "see."

Agriculture - Through fish and wildlife research, humans may gain insight in how to better manage plants and animals. The biological control of insect pests hinges on a thorough knowledge of natural predators, diseases, food sources and reproductive habits. The study of how wild animal populations react to environmental influences provides valuable information for safe and effective control measures. This is a cornerstone of integrated pest management (IPM) which combines biological, chemical and cultural pest control methods. IPM has strong ties to fish and wildlife research through its ecological approach to problem-solving.

Educational Value

The beauty and mystery of fish and wildlife have always fascinated humans. The educational value of fish and wildlife is rooted in the natural curiosity which humans have toward wild creatures. Both children and adults are frequently prompted by fish and wildlife experiences to learn more about the natural environment. Wild creatures have the ability to stimulate and motivate people to learn about the natural world. As people begin to understand ecological principles and consequences of environmental actions, they will also understand the impact of their own actions and develop an ecological conscience.

Research has shown that childhood experiences with animals are important factors in the development of adult attitudes toward fish and wildlife. From early childhood through youth, individuals are forming the foundation of their environmental values which will guide their behavior as adults. Conservation education is most effective during a person's childhood years because it is incorporated into their personal preferences, beliefs and attitudes. A balanced education program with conservation curriculum and direct fish and wildlife experiences will help students develop an appreciation and understanding of the natural world.

Credits

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UNIT II - FISH AND WILDLIFE VALUES

Lesson 7: Negative Value

All species have beneficial aspects. However, many species inevitably come into conflict with human interests. The negative value of fish and wildlife refers to the damaging effects of their activities. Damages to agricultural crops and the spread of human diseases are examples of the detrimental effects.

Birds

Bird damage to agricultural crops is a multimillion dollar problem in the U.S. During 1970 and 1971, birds caused a nationwide loss of 6.5 million bushels of corn. In California, birds destroyed approximately \$3.7 million of grapes during 1972.

Starlings create problems at livestock facilities by eating livestock feed. Data reported in 1968 from Colorado feedlots estimate the cost of cattle rations consumed during the winter by starlings to be \$84 per 1,000 starlings. Another report estimated that starlings in Idaho consumed a ton of cattle feed per hour.

Starlings have also been implicated in the spread of TGE (transmissible gastroenteritis or baby pig disease). This is of particular concern to hog producers. Recent tests show the TGE virus can pass through the digestive tract of starlings and remain infectious in their feces. Although it has not been scientifically proven, starlings may be capable of spreading TGE from one livestock facility to another.

Blackbirds feed on a variety of crops but tend to concentrate on corn and sunflowers. Fields located near large roosts may suffer over a 10 percent loss in yield due to blackbird feeding. Soybeans, wheat and hay are not a part of the blackbird's diet.

House sparrows eat agricultural grains in the field and in storage. They tend to feed in large numbers over small areas which creates considerable localized damage. House sparrows also damage crops by pecking seeds, seedlings, buds and flowers. They live in close association with man and are a factor in the spread of diseases (tuberculosis, encephalitis) and insect pests (fleas, lice). Their droppings and feathers contaminate stored grain in bins and elevators.

Mammals

White-tailed deer damage a wide variety of row crops, forage crops, fruit trees as well as stacked hay. In Wisconsin, a 1981 survey of farmers indicated the annual statewide deer damage was approximately \$10 million to \$15 million. A similar study in

Pennsylvania, put the annual crop loss at \$16 to \$30 million. Researchers have also estimated that the cost of deer vehicle collisions may exceed \$100 million each year in the U.S. and Canada.

Mice cause problems by entering homes and cabins. They build nests, store food and cause considerable damage to clothing, mattresses, paper and other materials suitable for nest building. They also contaminate human food they have access to. The greatest economic impact of deer mice (Peromyscus) is their destruction of conifer seed in forest reseeding operations. In west coast forest areas, Peromyscus seed predation has resulted in millions of dollars worth of damage. Laboratory studies have shown that a deer mouse in captivity will eat approximately 200 Douglas-fir seeds per day.

The burrowing activity of muskrats creates minor maintenance problems for pond dams and shoreline. However, economic loss to muskrat damage can be very high where rice and aquaculture crops are grown. In some states, muskrat damage may exceed \$1 million per year. Muskrats damage rice by burrowing through or into levees, eating large amounts of rice and cutting the rice plants for building houses.

Coyotes prey on domestic livestock such as poultry, hogs, sheep, goats and cattle. Livestock losses to coyotes usually are most serious during spring and summer months because of extra food needed by coyotes for their young. Coyotes are also noted for eating melon and cantaloupe crops.

Raccoons are a nuisance in some situations. They can cause considerable damage to garden crops, particularly sweetcorn. Raccoon damage to sweetcorn is characterized by many partially eaten ears with the husks pulled back. Raccoons also create problems in rural areas, towns and suburbs by attempting to live in buildings. In some cases, they will tear off shingles and boards to gain entrance.

Rabbits damage vegetation throughout the year. They eat flowers and vegetables in the spring and girdle valuable woody plants during fall and winter. Only a few crops such as corn, squash, cucumbers, tomatoes, peppers and potatoes are not consumed by rabbits. Young trees and shrubs in lawns, orchards, parks and forest plantations may be clipped off or girdled by rabbits. This is a particularly serious problem during long and harsh winters when other rabbit food sources are depleted.

Reptiles

Non-poisonous snakes are completely harmless to humans and cause no damage, except occasionally frightening people. They perform an important service to humans by preying on mice, rats and insects. Unfortunately, snakes have generated more fear and

misunderstanding than any other group of animals. Many people fail to recognize the beneficial activities of snakes.

Poisonous snakes have the capability of causing human injury or death. The human suffering inflicted by the bite of poisonous snakes is well-known. However, the number of snake bites and their consequences has been greatly exaggerated. About 1,000 people are bitten by rattlesnakes in the U.S. each year, with 3% or less being fatal. Approximately a dozen people die from rattlesnake venom each year in the U.S.

Wildlife Damage Control

The objective of wildlife damage control is to prevent wild animals from interfering with human endeavors. Complete eradication of a species from a given area is rarely necessary because wildlife damages are usually caused by a small number of individual animals, or simply from an overpopulation. Control efforts should be directed toward the "problem" animals - not the species as a whole.

Detailed investigations and careful observations are usually required to determine the offending species. It is easy to make incorrect assumptions concerning wildlife damage problems which may place blame on the wrong species. This frequently occurs when livestock is preyed upon in agricultural areas.

For example, many landowners automatically assume coyotes are to blame for predation on hogs, calves and sheep without looking closely at the evidence. Badly mutilated animals which have not been fed upon are quite possibly the victims of dogs. In situations where livestock are being lost to coyote predation, indiscriminately killing all coyotes is not the answer. Removing the individual "problem" coyotes by hunting or trapping near livestock areas is far more effective. The cause of wildlife damage must be correctly diagnosed before a method of control can be selected.

Wildlife Diseases

Wild animals are susceptible to a wide variety of infectious and parasitic organisms capable of causing disease. Some of these organisms are capable of infecting many wild and domestic animals and humans. Wild animals are sometimes directly involved in the spread of disease to humans.

Malaria is caused by a microorganism, Plasmodium malaric, which is injected into the human bloodstream by a mosquito. The microorganisms attack the hemoglobin in red blood cells.

Rats and mice are responsible for the spread of a number of diseases through contamination of human food with their urine and feces, or by way of fleas and mites. Rats and mice have been implicated in over 35 diseases such as rat-bite fever, leptospirosis, salmonellosis and trichinosis.

Plague is an infectious disease caused by bacteria. The disease causes fever and swelling of the lymph glands and may be fatal. It is transmitted by fleas and primarily affects rodents such as rats, ground squirrels and prairie dogs. The disease can be transmitted to man through the bite of infected fleas and is known as the bubonic or black plague. Plague has been documented in wild rodents in New Mexico, Colorado, Texas, Oklahoma and Kansas. Plague is a natural occurrence and is firmly entrenched in rodents over large areas.

Rabies is one of the oldest diseases known to man. It is a highly fatal virus disease which affects the central nervous system. Transmission of rabies from a sick animal to a healthy one is by infected saliva on broken skin or abrasions. The main reservoir of infection in the U.S. is in wild animals such as skunks, foxes, bats and raccoons. The skunk has the highest rate of infection.

Tularemia is a bacterial disease of rabbits and rodents which can be transmitted to humans. It is most commonly transmitted to man from cottontail rabbits. Transmission most often occurs through an open wound during the process of skinning the rabbit. Tularemia may also be contracted from incompletely cooked meat or through bites of ticks or flies.

Histoplasmosis is a respiratory disease in humans caused by inhaling spores from the fungus Histoplasma capsulatum. Although birds do not directly spread the disease, their feces enrich the soil and promote growth of the fungus. Histoplasmosis generally has the same symptoms as flu and can be treated with antibiotics.

Credits

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UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 1: Habitat Management Principles

Definition of Ecology

Ecology is the study of the structure and function of nature. It is a science that deals with the interrelationships of living organisms (including humans) and their environment. Ecology encompasses the interactions between all aspects of the environment including energy flows, food webs, nutrient cycles and population dynamics. The focus of ecology is to gain scientific understanding of how the earth sustains life. Conservation policies and programs are based on ecological principles.

Ecology deals with organizational units above the individual plant or animal and how these units interrelate to the non-living (abiotic) part of the environment. The basic ecological units are:

1. Habitat: the environment in which the life needs of an organism, population or community are supplied.
2. Niche: the role a species plays within its habitat and is determined by all aspects of its anatomy, physiology and behavior. (i.e. the niche of the American bison could be defined as large grazer.)
3. Population: a group of plants or animals of the same species living in a designated area.
4. Community: all of the plant and animal populations living in a designated area.
5. Ecosystem: comprised of the plant and animal communities interwoven with the non-living environment it depends upon.
6. Biosphere: the portion of the earth which supports life. It is all of the earth's ecosystems functioning together on a global scale.

Basic Fish and Wildlife Requirements

The basic needs of fish and wildlife are food, cover, water and space. Different species of fish and wildlife have different requirements in these four general categories.

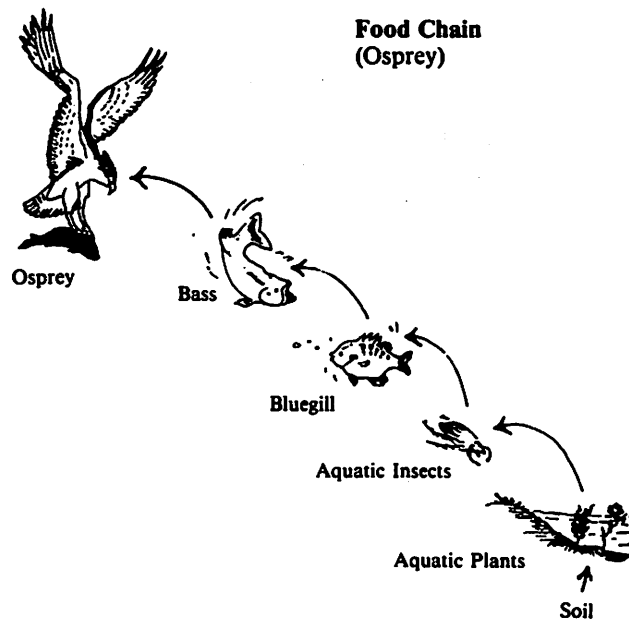
Food - The source of energy for nearly all living organisms is the sun. Green plants use raw materials from the air, water, and soil to convert a portion of the sun's energy falling upon their leaves into food energy through the process of photosynthesis. That portion of energy which is not utilized by the plants for their own metabolism is stored within plant tissues. This stored energy then becomes the source of food energy for all herbivores (plant-eating animals).

Similar to plants, the herbivores utilize a large portion of the energy acquired from the plants for their metabolic functions. The unused energy is stored within their animal tissues. Carnivores (meat-eating animals) then obtain their needed energy from that stored within the tissues of the herbivores or from omnivores (animals, including man, which eat both plant and animal tissues to obtain food energy).

As food energy is transferred from plants to herbivores, and from herbivores to carnivores, much of it is used up by the animals in their metabolic processes. Only a small portion of the stored food energy is actually passed on and available to the next level of energy users.

The series of transfers of food energy from one organism to another is called a food chain. Every food chain follows the same general pattern: green plants--->herbivore--->carnivore. Depending upon the organisms involved, a food chain may include one, two, or even three links of carnivores. All food chains, however, have a limited number of links because of the great loss of energy as it is transferred from one organism to another (Figure 1.1).

FIGURE 1.1 - Food Chain



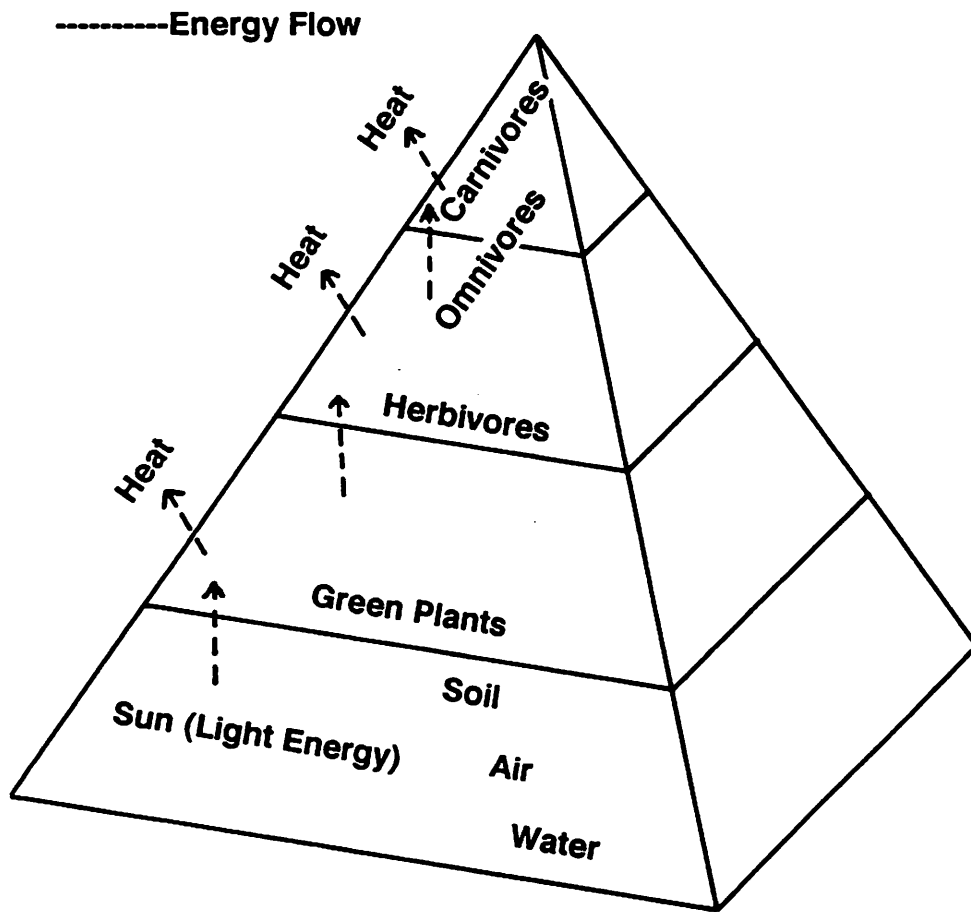
Credit: An Ecological Approach to Conservation Education.
Missouri Department of Conservation.

This process of energy flow is illustrated by the "biotic pyramid" (Figure 1.2). Its base represents the sun's energy, together with other raw materials of life: soil, water, and air.

Upon the base rests a segment which represents green plants - the organisms which convert the sun's energy into a form usable by animals. That segment is smaller than the base because only a small portion of the sun's energy is utilized by green plants.

Each higher step on the biotic pyramid is smaller than it's base due to the energy lost at each step. The top segment of the pyramid represents carnivores which are at the "top" level in the flow of energy. The animals at the top of the pyramid are generally fewer in number and larger in size than those below them.

FIGURE 1.2 - Biotic Pyramid



Credit: An Ecological Approach to Conservation Education.
Missouri Department of Conservation

Cover - Cover is defined as "the vegetation or other material used by wild animals for nesting, rearing of young, resting, escape from predators, or protection from adverse weather conditions." As with food, different animal species require different types of cover. Additionally, an individual species frequently has different cover requirements corresponding to the season of the year.

For example, prairie chickens prefer the open sweeps of permanent tall grass and only a minimum of brushy cover. Brushy draws, grassy areas along fence rows or edges of timber are also favored habitats. Roosting and nesting cover is composed of grass 10-18 inches in height, and sturdy enough to withstand strong winds and heavy precipitation. Open knolls with short grass cover are ideally suited for springtime courtship.

Bobwhite quail have distinctly different cover requirements. Instead of open grasslands, bobwhite quail prefer areas where croplands, grasslands, woodlands and brushy areas meet. They require diversified plant cover and are best adapted to early successional stages. Grassy and weedy areas of sparse to medium density are excellent brood-rearing cover while dense brush or woodland areas provide good winter cover.

Aquatic cover is usually rootwads, stickups, submerged tree branches, growing vegetation, and rock. Besides improving the habitat for fish food production, cover offers escape for young fish fry, shade and spawning sites. Good aquatic cover concentrates fish in an area by providing places where they can rest, feed, and escape from larger predators.

Water - Water is one of the basic needs of wildlife. It is necessary for animal life in an obtainable form, usually for drinking. Water is also extremely important in determining the type of vegetation which can be supported on a particular site. In turn, the vegetation defines the habitat type and consequently, the animal species living there. The scarcity or abundance of available water has a great impact on wildlife in the short-term for their physical needs and in the long-term for the establishment and maintenance of suitable habitat.

The quality and quantity of water has a profound effect on aquatic organisms. A stream, pond or lake is not an isolated vacuum. Each can only be as healthy as the watershed which drains into it. Siltation from agricultural activities, chemical dumping by industry, or sewage effluent from cities and individual septic systems degrade water quality. The resultant water turbidity and accumulation of toxic substances is detrimental to the entire aquatic ecosystem.

The quantity of water defines the size of aquatic habitats. Due to weather patterns, water level fluctuations in streams, ponds

and lakes cannot be avoided. However, man-made impoundments yield the opportunity to regulate water levels within limits. The ability to raise or lower water levels can be an effective tool in managing vegetation growths and spawning success. Generally, water level fluctuations should remain stable or should increase to benefit fish spawning. Falling water levels can easily destroy fish nests near shorelines by leaving them "high and dry." When the dams of large reservoirs block the flow of streams, provisions are often made to allow a minimum flow that will insure fish survival.

Space - Individual species have a specific amount of space they will use to find food, cover and water. The space requirements of an individual animal varies with the season of the year and quality of habitat. However, each species has a maximum distance it is capable of traveling to locate the necessities to survive.

The home range of an animal is the area it normally uses to locate food, water and cover. Its territory is a smaller area within the home range that it will defend - primarily from members of the same species. Many species of fish and wildlife exhibit territorialism of varying degrees.

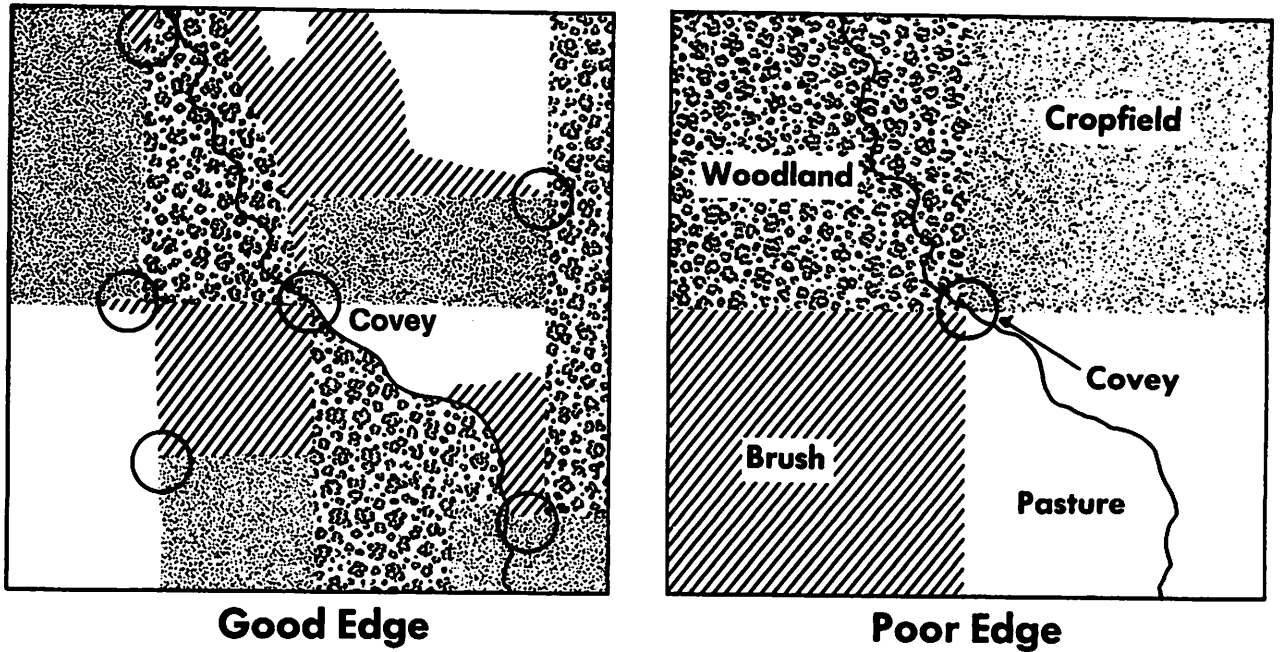
Colonial nesting birds and many species of fish do not maintain exclusive feeding areas, but still defend a territory in the immediate area surrounding their nests. Other birds, such as the robin, stake out a territory for mating, nesting and feeding during the breeding season. A robin territory is usually about a quarter of an acre.

Territorial spacing can serve as a mechanism to prevent a species from overcrowding its habitat. In territorial species, dispersal to new areas is likely to be the result of competition for living space.

Arrangement - The arrangement of food, cover and water in the habitat is very important for the survival of fish and wildlife. Food, cover and water must be interspersed throughout the habitat in adequate quantities for the animals to thrive. Without proper arrangement, the basic essentials are useless to fish and wildlife because the animals will have only limited access to them. Traveling long distances to secure food, water and cover will create extreme physiological stress and expose them to predation.

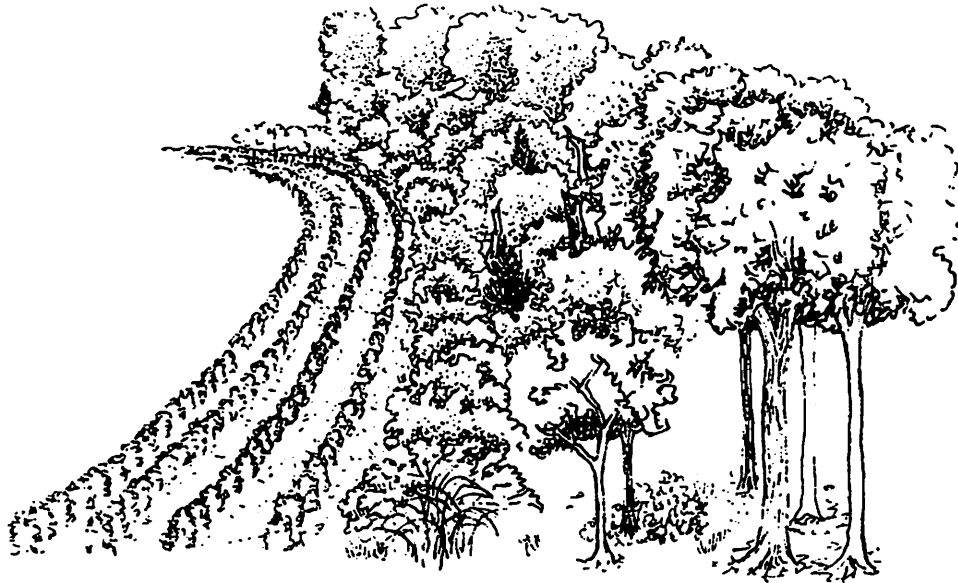
The concept of "edge" is closely related to the interspersion of food, cover and water. "Edge" refers to the transition between habitat or vegetation cover types, for example where a woodlot adjoins a field. Habitat with a large amount of edge is more capable of supplying food, cover and water in closer association than large tracts of the same vegetative type (Figure 1.3). Also, better habitat is created with an irregular edge between vegetative types as compared to a straight line.

Figure 1.3. - Comparison of Edge



The quality of edge between field and forest is measured by how gradually the transition of vegetative types occurs. An abrupt change from crop fields with relatively low ground cover to woodlots with comparatively tall, close-spaced trees is not good edge. A more gradual transition with a wider border of grasses, weeds, shrubs, vines and small trees is more valuable to wildlife as shown in Figure 1.4. Much more wildlife food in the form of berries, seeds, browse and insects is available along with better cover for nesting, brooding, etc. The gradual transition of habitat types is important in both fish and wildlife management.

Figure 1.4 - Edge with a Gradual Transition



Credit: "Forest Edge Wildlife Habitat." Missouri Department of Conservation.

Ecological Succession

The plant and animal community of an ecosystem consists of organisms best suited to living there. However, these are not necessarily the only organisms which could survive with that particular set of environmental conditions. The existing plant and animal species have simply excelled all competing species in the struggle for survival.

Ironically, organisms which successfully adapt to and become established within a given environment are responsible for their own failure to survive. The biotic community itself modifies and changes its own environment. After a length of time, environmental conditions are produced to which other organisms are better adapted than the original community members. These new organisms continue to alter the environment which results in their being succeeded by another set of organisms which are even better adapted to the changed conditions. This predictable process is known as ecological succession and ends with the establishment of a stable climax community which is capable of reproducing itself.

To illustrate ecological succession, imagine an area of bare rock. Lichens will grow on bare rock and are the first pioneer species. They slowly disintegrate the rock to form small pockets of soil where mosses flourish, forcing out the lichens. The mosses in turn create more soil and have water-holding capacity which are favorable conditions for small seed plants. The seed plants provide shelter for trees and shrubs which soon grow over

them and deprive them of sunlight, root space and nutrients. The process of ecological succession will continue until a climax community is achieved.

The series of communities which result in the development of a climax community is called a sere; each temporary community is known as a seral stage. Progression through a sere is an orderly process, and the community changes are generally directional and predictable. However, physical disturbances such as earthquakes, floods or human manipulation frequently set succession back to earlier seral stages.

During the process of ecological succession there are generalized trends of change in the function and structure of biotic communities. These trends are:

1. Diversity of plant and animal species increases as succession advances from one seral stage to another.
2. Early seral stages have higher net production of plant material than later stages.
3. The total biomass (total mass of plant and animal material) within the ecosystem increases as succession progresses toward the climax stage.

To illustrate an example of ecological succession in Missouri, assume a farmer has abandoned a cropfield originally cleared out of forest land. The field will be quickly invaded by "weeds" which require full sunlight and have the ability to produce abundant seeds (ragweed, goldenrod). Bobwhite quail, mice, song sparrows and cottontail rabbits prefer this type of habitat.

Over a period of 5-10 years, the herbaceous plants will gradually be replaced by woody shrubs such as coral berry and sumac. This transition stage of "weeds" and woody shrubs is called an old field in wildlife management terminology. These plants provide protection for seedling trees to become established. These initial trees will include species such as persimmon, honey locust, cedar, elm and sassafras. Examples of wildlife species best adapted to this seral stage include whitetail deer, ruffed grouse and woodcock.

The stable oak-hickory forest will not develop for perhaps another thirty years, and by the time the trees mature, it will have been more than a hundred years since the abandonment of the field. The forest then reaches a relatively stable climax community which provides habitat for forest wildlife species including squirrel, woodpecker and turkey.

The number and kinds of plants and animals making up a pond or lake also change through the process of succession. In early seral stages, organic mater from pioneer plants and animals begin to acculumate on the bottom of the pond and emergent plants (cattails, water lilies) begin to grow along the shoreline. After this, fish, dragonflies, snails and other aquatic organisms are able inhabit the pond environment. Over time, the organic

matter from aquatic vegetation begins to accumulate on the bottom of the pond causing a decrease in water depth. The shallower water depth changes the plant and animal species living in the pond. Eventually, emergent vegetation will cover the entire surface of what was once the pond and a marsh is created. The buildup of organic matter continues until the marsh is succeeded by land plants which proceed to go through more stages until a climax community is reached.

The relationship between succession and fish and wildlife resources is extremely important. Altering succession (setting it back) to an earlier stage is the basis of many wildlife management techniques. Many of the highly prized wildlife species such as whitetail deer, bobwhite quail, cottontail rabbits and ring-necked pheasants are adapted to early or middle successional stages. They are scarce in climax communities. Clearly, manipulation of succession is a basic wildlife management tool.

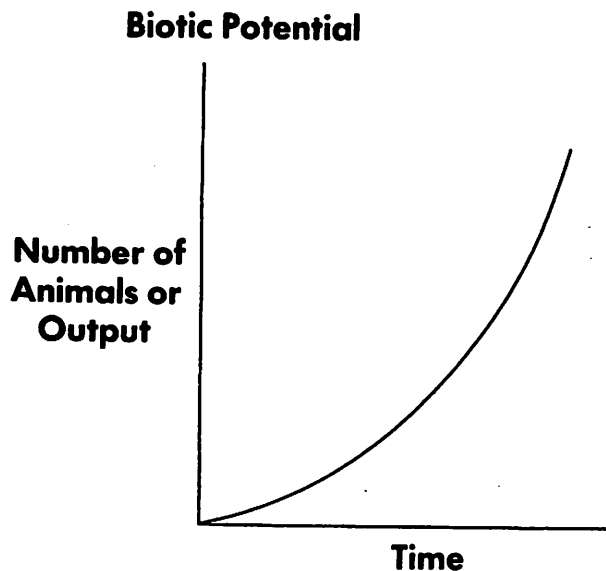
Natural succession of Missouri aquatic ecosystems is frequently more difficult to manage than succession on land. Much of the watershed of Missouri's lakes and reservoirs consists of agricultural land which has high soil erosion rates. The heavy silt load in runoff water is deposited on lake and pond bottoms thereby accelerating natural succession. The prerequisite to controlling succession in aquatic habitats is good land management in the associated watershed.

Biotic Potential and Environmental Resistance

Biotic potential refers to the inherent ability of a species to reproduce and survive in an ideal habitat (no predators, unlimited food, water, cover and space). Under ideal conditions a species can achieve its full biotic potential and for a time can show a growth rate that is exponential (growing at an ever increasing rate).

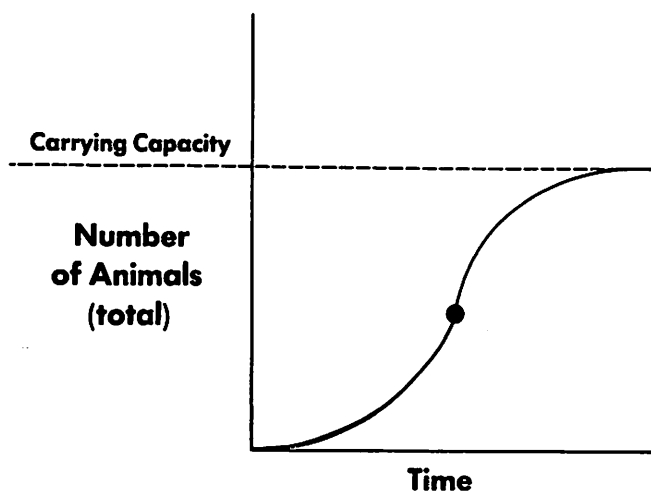
The growth rate is similar to compound interest. For example a financial investment will double in 10 years at a 7.2% interest rate compounded annually. The earned interest increases every year because interest is added to the principal and is earning interest. Figure 1.5 graphically illustrates the exponential growth which characterizes biotic potential.

Figure 1.5 - Biotic Potential



Obviously a fish or wildlife species can sustain such a high growth rate for only a limited time. Environmental resistance in the form of food, cover, water or space shortages eventually occur which decreases the birth rate and increases animal mortality or movement to other areas (emigration). Therefore, biotic potential and environment resistance are two opposing forces which determine population levels of all fish and wildlife species. Figure 1.6 shows the interplay of these two forces.

Figure 1.6 - Biotic Potential + Environment Resistance



Carrying Capacity and Limiting Factor

Carrying capacity is the maximum number of organisms which can be supported on a given area for a specified length of time. Carrying capacity may be interpreted in several ways: (1) The total number of organisms which can survive in a given habitat or an ecosystem; (2) The total number of organisms of a given functional type (i.e., plants; herbivores; carnivores) which can survive in a given habitat or ecosystem; (3) The total number of organisms of a given species which can survive in a given habitat or ecosystem. Of the three interpretations, the second and third are of most importance for fish and wildlife management.

As shown on Figure 1.6, carrying capacity is the dynamic equilibrium between biotic potential and environment resistance. Carrying capacity can be increased or decreased by the manipulation of the quality, quantity and location of food, cover and water. With wildlife management, this manipulation is frequently achieved by controlling succession which correlates directly to the type of vegetation present. Simply stated, to manage fish and wildlife the habitat must first be managed.

Carrying capacity can be likened to a bucket; it can only be filled so full. The only way to carry more is to obtain a larger bucket. The larger bucket is obtained in conservation terms by improving the qualities of the given habitat.

The strongest environment influence depressing a fish or wildlife population is called the limiting factor. In Missouri, the limiting factor for bobwhite quail and cottontail rabbit is usually the lack of adequate food and cover during the winter. The habitat is capable of sustaining higher populations if better winter habitat was made available. Therefore, when a limiting factor is identified and removed with habitat management, the carrying capacity for the species being managed increases.

However, if the limiting factor is removed another environment influence eventually limits the population at a higher level. In the case of bobwhite quail and cottontail rabbit, inadequate nesting areas might replace winter food and cover as the limiting factor.

Limiting factors also apply to aquatic habitats. A lack of suitable nesting sites in shallow water may be the limiting factor in the success of a largemouth bass population in a pond or lake. Or, a lack of game fish might be caused by heavy siltation and the resultant water turbidity which hampers the fishes foraging ability and smothers eggs in nests. In this case, the limiting factor is caused by an excess of a habitat feature rather than a shortage.

Summary

Conservation policies and programs are based on ecological principles. As such, fish and wildlife management is the application of these principles to the land.

Fish and wildlife are managed by first managing their habitat. The purpose of most fish and wildlife management is to increase populations by manipulating the habitat to provide the animals with a ready supply of food, cover, water and space. Each species has different habitat requirements and will have different responses to changes in their habitat.

The importance of habitat and how species exist according to habitat conditions can be summarized by the following statements

1. Fish and wildlife cannot be stockpiled beyond the carrying capacity.
2. More young will be produced than will survive.
3. The amount and quality of habitat determines the carrying capacity.

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UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 2: Cropland Management

Cropland provides the most benefits to wildlife when it is located adjacent to pastures, brushy draws and wooded areas. A good interspersion of these land uses will create more edge which many wildlife species find attractive. However, how a farmer manages his/her land also has a major impact on wildlife populations. The application and proper maintenance of soil conservation practices on crop fields increases the availability of food and cover to wildlife and conserves soil at the same time.

Crop Rotation

Growing different crops in a field over a period of years following a particular pattern is called crop rotation. A crop rotation of four or more years including small grains and forage crops has much to offer both farmers and wildlife. Crop rotations without small grains and forage crops are not as beneficial to wildlife.

Growing the same crop in a field year after year (monoculture) can allow for a build-up of crop diseases and insect pests. For example, corn rootworm is an insect pest which usually occurs only when corn is grown in the same field for two or more years. Rotating corn with other crops disrupts the life cycle of this insect pest and dramatically reduces the possibility of an outbreak and the need for insecticide use. Most soybean and corn diseases can be controlled or suppressed with a crop rotation.

Where crop fields are on a slope, longer rotations can be used to reduce soil erosion. A four year rotation of corn, soybeans, wheat, and red clover is a widely used cropping sequence on sloping ground. Soil erosion is reduced by the dense plant cover wheat and red clover provide throughout most the year. Red clover (or other forage legumes) has the extra benefit of adding nitrogen to the soil through symbiotic nitrogen-fixing bacteria on their root nodules.

Besides the agronomic benefits, crop rotations improve wildlife habitat by increasing the amount of edge and diversity of plant cover. Different crops grown in close association offer wildlife a variety of food and cover requirements at different times of the year. For example, legume hayfields are excellent nesting habitat for pheasant and quail in spring and early summer if mowing is delayed until July. These fields also provide a forage supply for deer, rabbits, woodchucks and smaller rodents. Waste grain on corn and soybean fields functions as a high energy food source for many species of wildlife during the winter months.

During mid-summer, wheat stubble makes good brood-rearing cover. The combination of various crops with other habitat types nearby is very important in supplying wildlife with food and cover at the time and place they need it.

Conservation Tillage

Conservation tillage is a broad term that refers to a number of tillage systems which maintain a portion of crop residue on the field surface for erosion control. The USDA Soil Conservation Service defines conservation tillage as "any tillage system which leaves at least 32 percent of the soil surface covered with crop residue at planting time." Crop residue is left on the soil surface by reducing the number of tillage operations or "passes" over the field. The ultimate conservation tillage system is no-till where primary and secondary tillage operations are eliminated.

Conservation tillage has gained support among farmers as a means to reduce soil losses and lower crop production expenses. Conservation tillage systems require fewer trips across a field which saves time, labor, fuel and machinery wear. Conservation tillage also maintains soil structure, reduces soil compaction, improves soil aeration and conserves soil moisture. In terms of expected yields, many studies have shown that no-till systems can equal or exceed yields with conventional tillage systems.

Conservation tillage generally has a positive effect on wildlife. Crop residues left undisturbed throughout the winter provide food and cover. Waste grain left after harvesting are a staple winter food source for wildlife such as pheasants and quail. Table 2.1 compares waste grain food abundance and amount of crop residue for corn tillage systems commonly used in Illinois. The table shows that fields receiving fall discing and/or chiseling typically have 70 to 80 percent less waste grain and 50 to 60 less percent residue than fields left undisturbed after harvest. Also, the table indicates that the type of implement used has a strong relationship to the amount of waste grain and crop residue left on the soil surface. A tandem disk leaves over six times as much waste grain on the soil surface than a chisel plow with twisted shanks. Fall tillage of any kind decreases the food and cover available to wildlife.

Table 2.1 also illustrates the impact of late fall weather conditions on the abundance of waste grain during the winter. The decline of 314 lbs./acre of waste grain on October 17 to 227 lbs./acre on November 30 under untilled conditions was caused by weather conditions. Warm temperatures and moist soils cause high rates of sprouting and decay of grain seeds - especially for soybeans. During the 4- to 6-week period from harvest to early December, about 36 percent of the waste corn and 71 percent of the waste soybeans disappear in a typical untilled field.

TABLE 2.1 - Comparisons of corn tillage systems commonly used in Illinois in relation to percent of the soil surface covered by crop residues and the abundance of waste corn (lbs./acre) potentially available to wildlife.

<u>Season & Tillage Practice</u>	<u>Ground Cover (% residue)</u>	<u>lbs of corn/acre (dry weight)</u>
HARVEST (October 17)	97	314
EARLY WINTER (November 30)		
Untilled	95	227
Disk (tanden)	88	170
Chisel (straight shank)	75	106
Chisel (twisted shank)	40	27
Chisel + disc	16	8

Credit: Illinois Natural History Survey

Many species of ground-nesting birds utilize crop residues on no-till fields. Researchers in Iowa and Indiana found a greater diversity and density of birds nesting in no-till fields than in conventionally tilled fields, and nesting success was comparable to idle areas such as fencerows.

Strip-cropping and Contour Farming

Strip-cropping is the practice of growing small grains, forages and row crops in alternate strips to reduce soil erosion. Contour farming is using a field in such a way that tillage operations, planting and harvesting follow the natural contours of the land. By itself, contour farming can reduce the rate of soil erosion up to one-half on gently sloping cropfields. Contour strip-cropping can reduce soil erosion by more than 75 percent and provides an economical alternative to terraces. The strips of legumes and small grains act as a filter that traps sediment and slows water runoff.

Contour strip-cropping - with its alternating strips of hay, small grains and row crops - will increase the interspersion of cover types. By developing a contour strip-cropping system in a large crop field, much more "edge" is created. Strips seeded to legumes serve as travel lanes and help wildlife make greater use of croplands. Legumes also provide nesting habitat and increase wildlife production if mowing is delayed until July.

On steep crop fields, permanent grass buffer strips should be maintained between the crop strips for adequate erosion protection. The grass strips should be seeded to a grass/legume mixture that is beneficial to wildlife. All of these mixtures provide high-quality hay with proper management. Switchgrass is especially popular. It is resistant to atrazine, hay yields are high, maintenance is low, and it provides good wildlife habitat.

Contour strip-cropping will greatly benefit wildlife when it is applied to a field which previously grew only one type of crop per year. However, if fencerows and brushy areas are removed to combine smaller fields into a large one, contour strip-cropping on the "new" field will probably not make up for the loss of habitat.

Field Borders

Borders of shrubs, grass or annual weeds along the edges of fields are very beneficial to many species of wildlife. Field borders provide wildlife with different cover types depending on how the borders are managed. Usually a field border strip is held at an earlier successional stage than the area surrounding it.

Field-ends and turn-rows are good areas to establish border strips without sacrificing farm income. The crop yields from these areas is frequently low due to soil compaction by farm equipment and soil erosion. Planting these areas to shrubs or simply letting them revert to natural vegetation provides valuable wildlife habitat.

Field borders can also be seeded to grass/legume mixtures beneficial to wildlife. A grass/legume border prevents field edge erosion, provides a space to turn farm equipment and a roadway along the edge of the field. This type of border also provides cover for ground-nesting birds like meadowlarks, vesper sparrows, bobwhite quail and pheasants. These areas should be mowed on two-year intervals during July to control woody sprouts.

Wooded fencerows and hedgerows are an excellent field border for wildlife; but compete with crops for sunlight, moisture and nutrients. The Soil Conservation Service found that a strip of land an average of 33 feet from wooded edges produced less than half the normal crop yield. With the invention of the root plow, farmers have the opportunity to increase crop yields without the removal of woody vegetation. A root plow is pulled by a tractor at the edge of the woody vegetation to prune the tree roots. The root pruning restricts the distance tree roots extend into the field and reduces their competition with agricultural crops.

Grass Waterways

Grass waterways are used as outlets for accumulated runoff water on crop fields. The grass in waterways provides a protective blanket for water to slide off a field without creating gullies. By using grass species and management techniques that benefit wildlife, you can control soil erosion and also provide for wildlife.

Many grass waterways in Missouri are seeded with tall fescue, a cool-season grass. Tall fescue is an excellent grass for controlling soil erosion. It is easy to establish and forms a thick blanket of vegetation. Unfortunately, tall fescue does provide poor wildlife habitat due to its excessively rank growth. Wildlife species prefer

grasses which have a less dense growth habit. The small tunnels and paths created in a less dense stand of grass is favored by ground-nesting wildlife. Native warm-season grasses (switchgrass, Indiangrass) and some cool-season grasses (redtop, smooth brome) are capable of supplying better wildlife habitat.

Waterways require maintenance to insure they continue to control soil erosion and provide wildlife benefits. Grass waterways should be mowed or hayed after July 1 to avoid destroying wildlife nests. Also, mowing is required to keep woody sprouts from invading.

Before grass waterways are constructed, careful consideration should be given to whether or not one is actually needed. A common practice is to remove all the brush and trees out of a natural draw to establish a grass waterway. If a substantial soil erosion problem does not exist, it is not good conservation to remove the natural vegetation. Wildlife will gain much more value from the brushy cover and very little soil will be conserved.

Terraces

A terrace is a man-made earthen embankment with a ridge and channel constructed across the slope of a field to intercept runoff water. The main purpose of a terrace system is to reduce erosion and manage water on cropland. Terraces divide long steep hillsides into a series of shorter slopes. The terrace channel is sloped toward a grass waterway, stable wooded draw, or underground outlet so that water runs off the field without eroding the soil.

The three types of terraces used in Missouri are broad-base, steep backslope and narrow-base. All three terrace types are effective in reducing erosion, however, only steep backsloped and narrow-based terraces provide habitat for wildlife. Both terrace types are best suited for steeper land with slopes greater than 8 percent.

The backside of steep backslope terraces and both sides of narrow-base terraces are planted to permanent vegetation. Many grass/legume mixtures are suitable for seeding these terraces. Switchgrass is a warm-season grass that works particularly well. Switchgrass can be burned periodically to control woody sprouts and it develops readily into travel lanes, nesting areas and cover for wildlife. As with strip-cropping, grass strips on terraces increase the amount of edge and make more of a crop field available to wildlife use.

Pesticide Use

With the adoption of conservation tillage, concerns have arisen about the increased use of agricultural chemicals and their possible side effects on wildlife populations. In order to control pests in no-till crops, many farmers have increased their use of pesticides. Chemicals currently on the market have been blamed for the decline in wildlife populations; however, the extent of their effect on wildlife is a topic of considerable debate. Herbicides can reduce the

wildlife food base on a farm by reducing weed seeds and associated insects, but they have little direct toxic effects on animals. Insecticides, however, can kill wildlife through either direct toxic effects or after eating poisoned insects.

Integrated pest management (IPM) may help to relieve some of the dependency on agricultural chemicals. With IPM, each crop and its pests are considered an ecological system. A control program is developed that integrates a variety of biological, chemical and cultural methods in proper sequence and timing. IPM uses natural control mechanisms like crop rotation, resistant crop varieties and predatory insect populations to supplement the use of chemicals.

Standing Grain for Winter Food

Annual grain food plots are especially valuable in areas that lack rowcropping. In areas where grain crops are grown, however, it is simpler to leave a few rows unharvested at the edge of a field than to make special plantings. Good winter cover should be nearby so wildlife will have easy access to the grain.

Four acres of standing grain per 40 acres of cropland is a general rule. The standing grain should be divided into strips and corner plantings close to good winter cover. A 10 to 30-foot strip is adequate in most cases. For small corners and odd areas, a quarter of an acre of standing grain will provide wildlife with the food they need.

Summary

Wildlife populations increase and decrease according to the quality and quantity of available habitat. Farmers have a choice of many land management practices they can use on cropland to improve wildlife habitat. Most of these practices conserve the soil and provide wildlife with food and cover. Relatively minor changes in the way a crop field is managed can make a major difference in terms of wildlife.

Crop fields can be improved for wildlife through the following practices:

1. Use crop rotation systems which utilize forage and small grain crops.
2. Establish conservation tillage systems.
3. Minimize herbicide applications.
4. Seed waterways, terraces and field borders to grasses and legumes beneficial to wildlife. Delay mowing until after the nesting season.
5. Preserve existing woody draws and fencerows to provide winter cover.
6. Let field corners and odd areas revert to natural vegetation.

7. Leave a minimum of one-quarter acre of grain crops unharvested for each 40 acres of crop field. Leave crops in patches or strips near available cover.
8. Establish strip-cropping systems.

The conservation practices applied to a crop field should be carefully planned to meet both farm income, soil conservation and wildlife production goals. On most fields, a combination of conservation practices is required.

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UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 3: Grassland Management

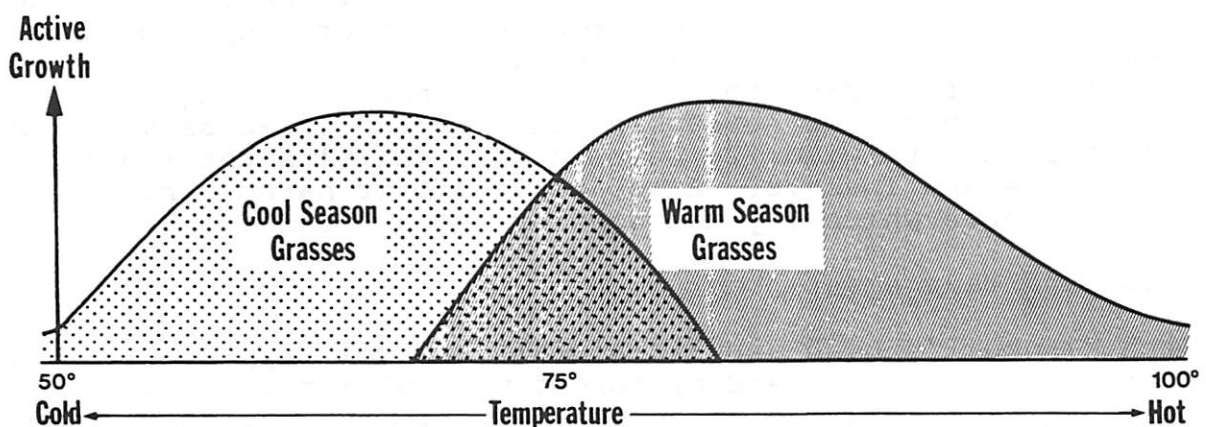
Grasslands provide livestock forage, erosion control, weed control, and critically important nesting and brood-rearing habitat for wildlife. Landowners must select the right grass species and the proper management techniques to attain these benefits.

Grassland Types

Grasses are considered to be cool-season or warm-season according to the time of year when their main growth period takes place. Cool-season grasses such as tall fescue, smooth brome, Kentucky bluegrass, orchardgrass and timothy grow best during the spring and fall when soil temperature is between 40 and 78 degrees Fahrenheit.

Many Missouri landowners are rediscovering that native warm-season grasses make a valuable addition to their existing forage systems. Warm-season grasses such as switchgrass, little bluestem, big bluestem and Indiangrass begin growth in late spring when the soil temperature reaches 60 degrees Fahrenheit. These grasses make most of their growth during the warmest months of the year when the soil temperature ranges up to 90 degrees Fahrenheit (Figure 3.1). Although warm-season grasses have a shorter growing season, they also have a higher optimal temperature for growth and make more efficient use of water and soil nutrients than cool-season grasses.

FIGURE 3.1 - Optimum Growth Periods of Grass Based on Temperature



Credit: "Grass: How it Grows." U.S. Department of Agriculture, Soil Conservation Service, 1968.

Native Prairies

Missouri's native prairies once covered nearly one-third of our state. Of the nearly thirteen million acres of grassland in Missouri, only 75,000 acres are native prairies that have never been plowed. Today, it is estimated that less than one percent of our original prairie still survives. Most of the original prairie has been replaced by either croplands or introduced cool-season grasses.

They are located primarily in west-central and southwest Missouri and may have up to 250 species of warm-season grasses, legumes and other plants. Some of the native prairies are used for grazing but many are hayed.

These small tracts are referred to as remnant native prairies and are vital to the survival of the prairie chicken and other associated wildlife species. The unique blend of native grasses, legumes and other plants on a healthy prairie provide cover and foods that are important for nesting and rearing of young.

Remnant native prairies are different from other grasslands by being natural communities. All other grasslands (including warm-season grass pastures) were at one time planted by farmers and contain far fewer plant and animal species.

Grassland Habitat

Each species of grass grows differently. Some grass species have low growing leaves and can grow in dense stands. Other grasses have elevated leaves and need more space to grow. These are the differences which affect their value for wildlife.

Wildlife use grasslands for foraging, nesting and roosting. When and how the grasses grow will affect their value for these uses. Most wildlife species prefer grasses which grow upright and allow them freedom of movement, yet spread to provide a canopy for concealment from predators. Many bird species using grasslands need bare ground for scratching and dusting. Excessive ground litter restricts wildlife movement and inhibits their ability to find seeds and insects. Also, heavy litter harbors numerous small rodents which may eat eggs or young birds in nests.

Grassland Management

With Missouri's high annual rainfall and soil types, grasslands soon change to brushland or forest without management. Some type of management activity is necessary to remove excess plant litter and to prevent shrubs or trees from invading.

Landowners have five tools to use for managing grassland which may be used singularly or in combination. These tools are: (1) grazing; (2) haying; (3) fertilizing; (4) overseeding; and in the case of warm-season grasses, (5) prescribed burning.

Grazing - Grazing removes excess plant growth, creates wildlife travel lanes and exposes bare ground for dusting and scratching areas. Proper grazing will help maintain the grass at a height appropriate for wildlife during most of the year. Excessive grazing eliminates food and cover plants and can destroy nests by livestock trampling. Light grazing is the best for wildlife and results in the most forage production over the long term.

Livestock are selective about the plants they eat. They tend to repeatedly graze nutritious and palatable plants and ignore others. When over half of a plant's leaf surface is removed, it will stop growing. As a result, the desirable plants decrease due to selective grazing while the unwanted plants continue to multiply and increase. The plants which flourish under heavy grazing are called "increasers" and plants which eventually disappear are called "decreasers."

Several grazing systems have been developed to better utilize pasture forage. Rotational grazing involves moving livestock from one pasture to another in a planned sequence. This allows the plants on the pastures being rested (without livestock) to grow and multiply before being grazed again. Pastures will be much more likely to contain desirable plants if a planned, rotational sequence is followed. Not only will this system allow some increase in livestock numbers, it also provides better wildlife habitat in the pastures being rested.

However, a rotational grazing system does not insure better wildlife habitat and livestock forage. The livestock stocking rate has more impact on beef production than the grazing system. In other words, the grass or forage must be adequate to support the livestock numbers regardless of other factors. For example, it is better to continuously graze ten cattle on 30 acres than rotate 25 cattle on two 15 acre tracts.

A rotational grazing system will utilize different forages at the time when they are their peak production, protein content and palatability. The use of warm-season grasses to supplement cool-season grasses and legumes during the hot summer months is a good example. This allows for more use of cool-season forages in the spring when they are higher in quality and gives them rest during the summer, so they can recharge for greater fall production. This rotation system also yields more total beef production per acre, since livestock gains are higher on the better quality warm-season grasses that grow during the summer.

Another advantage to wildlife is that warm-season grass pastures are usually not grazed until many of the nests are hatched. Even if nests remain when livestock is grazed, excess cover is removed slowly over the course of the summer. Although some nests may be lost to livestock trampling, the loss of a small percentage of the total nests is still better than having no nesting cover at all.

Warm-season grasses should not be grazed closer than 8 to 12 inches. Cool-season grasses, which don't get as tall, are commonly grazed to within two to four inches. Light grazing of cool-season grasses will often result in both overgrazed and undergrazed spots in a pasture. Warm-season grasses are usually grazed evenly from the top down (Table 3.1).

When moderately grazed, remnant native prairies will provide excellent summer forage. Livestock can begin grazing native prairies around May 15 when the vegetation is 8 to 10 inches tall. However, the vegetation should never be grazed below 8 inches in height and the livestock should be removed by August 15.

TABLE 3.1 - Optimum grazing heights and dates for cool-season and warm-season grasses

	<u>Initial height</u>	<u>Average turn-in date</u>	<u>Pull-off height</u>	<u>Average pull-out</u>
<u>Cool-season</u>				
Tall fescue	6-12"	March 15	3-4"	June 15
Smooth brome Alfalfa	Bud to first flower	April 15	3-5"	June 1
Orchardgrass Red clover	8-12"	April 15	4-5"	June 1
Timothy Redtop Lespedeza	6-12"	April 15	4-5"	June 15
<u>Warm-season</u>				
Switchgrass	10-16"	June 1	10-12"	August 1
Big bluestem	12-24"	June 10	8-10"	Sept. 1
Indiangrass	12-24"	July 1	8-10"	Sept. 1

Credits: Wildlife Management Handbook of Landowners. Missouri Department of Conservation, 1989.

Personal communication with James C. Henning, Forages Specialist, University Extension, University of Missouri-Columbia.

Haying - Haying removes excess vegetative growth and helps to control woody invasion. The haying period must allow sufficient time for regrowth to provide nesting cover for the following year.

The peak in quality of warm-season grasses is just after the peak of the hatch in late June or early July, so most nests have hatched before hay cutting begins. Grass regrowth after haying is nearly always enough to provide fair winter cover for wildlife and for nesting the following spring.

Landowners have options to choose from for hay production and livestock grazing schedules. The peak in quality of cool-season grasses and legumes occurs when wildlife nesting is also at its peak. This conflict results in the haying operation destroying nests and incubating hens. This fact has been documented for prairie chicken, ring-necked pheasant and turkey. Landowners can partially solve this problem by raising the cutting height to four inches.

Warm-season grasses are usually hayed around the first of July after most early nests have hatched and should be cut no shorter than five to six inches. The higher cutting height will miss many of the nests and hens. Also, warm-season grasses should not be hayed later than August 1 to allow time for regrowth. Table 3.2 shows the optimum dates and cutting heights for haying various forages.

Remnant native prairies also provide quality hay. Haying dates are more critical in prairies because it affects yield, quality of forage and the types of plants that will persist.

TABLE 3.2 - Optimum dates and cutting height for haying various forages

<u>Forage</u>	<u>Average date</u>	<u>Cutting height</u>	<u>Average yield tons/acre</u>
<u>Cool-season grass</u>			
Tall fescue	June 1	2-4"	1.5*
Smooth brome	June 1	3-4"	1.3
Orchardgrass	June 1	3-4"	1.6
Timothy	June 15	3-4"	1.3
Alfalfa	May 15	2-4"	6.0**
Red clover	June 1	2-4"	1.5
<u>Warm-season grass</u>			
Switchgrass	June 15	6"	3.9
Big bluestem	July 1	5-6"	2.3
Indiangrass	July 20	5-6"	2.2
Bermuda grass	June 15	2-3"	5.0***
Native prairie	July 1	3-4"	2.0

- * Second cuttings of tall fescue are sometimes possible in the fall. Yield is about half the spring cutting yield.
- ** May be cut four to five times during season about 1.5 tons/cutting.
- *** Total of two or three cuttings with 100 pounds of nitrogen/acre. Phosphorus and potassium levels must be closely monitored to avoid winter kill of bermuda grass.

Credit: Wildlife Management Handbook for Landowners. Missouri Department of Conservation, 1989.

Fertilizing - Fertilizer and agricultural limestone should be added to a pasture or hayland according to the results of a soil test.

Cool-season grasses do not use soil nutrients as efficiently as native warm-season grasses. For this reason, cool-season grasses require somewhat higher fertility levels and a higher soil pH.

However, studies have shown that the forage quality of big bluestem/Indiangrass hay can be improved by applying nitrogen fertilizers. Yields, crude protein and forage digestibility were increased when the grasses were fertilized with nitrogen. The major increases occurred at rates of 50 to 100 pounds of nitrogen per acre. The 50 pounds of nitrogen per acre rates resulted in the greatest return on the dollars invested in nitrogen fertilizers.

The health, vigor and productivity of native prairie remnants must be restored through proper management before a favorable response to fertilizer can be expected. Fertilizer can increase hay production, but it can also increase or create weed problems. A late spring burn will reduce competition from cool-season grasses and weeds prior to fertilizing. After burning, wait until the warm-season grasses have regrown to four to six inches before applying 30-40 pounds of nitrogen per acre. Fertilizing without a burn or prior to the four to six inch height will stimulate cool-season plants to take over the stand.

Over-Seeding with Legumes - Legumes are plants such as clovers and lespedezas that have the capacity to remove nitrogen from the air and place it in the soil where it becomes available for other plants. Legumes also improve the forage quality and value for both livestock and wildlife. For this reason, over-seeding legumes in established grass pastures will usually increase beef production and improve wildlife habitat.

Remnant native prairies already contain several beneficial legumes and should never be over-seeded as a means of attempting to increase productivity. However, legumes may be over-seeded in warm-season grass pastures during the first year after planting or after the grasses are established.

Prescribed burning - Prescribed burning is a fire used under specific conditions at the appropriate time to achieve a desired result. Fire is recognized as an important management tool for warm-season grass pastures and native prairies if handled properly. It recycles nutrients tied up in old growth, controls litter, evens out grazing distribution, stimulates seed production for both perennial and annuals, controls weeds and woody invasion, reduces wildlife nest predation and increases plant and insect diversity. Fire is so important in maintaining warm-season grass pastures and native prairies, that even with other management, fire will still periodically be needed. However, a fire at the wrong time can be very costly to both wildlife and forage production. Prescribed burning is not used in cool-season grass management.

Use fire with great caution. Warm-season grass plantings and native prairies will be made safer for prescribed fire by establishing a closely mowed cool-season grass border around the boundary to act as a firebreak. Also, don't burn without a definite plan and good instruction from a trained and experienced fire expert.

Summary

Grasses serve many useful purposes on a farm. They provide forage for livestock, erosion control, weed control and give wildlife a place to nest and rear their young. Landowners can achieve these benefits by carefully managing their grasslands. Original native prairies require different management techniques when compared to planted grasslands.

Credits

Wildlife Management Handbook for Landowners. Missouri Department of Conservation, 1989.

UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 4: Forest Management

Some forests and woodlots are teeming with wildlife, while others support only limited populations. The difference between good forest wildlife populations and meager ones is usually caused by the knowledge and attitude of different landowners. There are many management practices landowners can use to improve both timber production and wildlife production. All of these management practices vary somewhat in application, but follow basic ecological principles.

Livestock Grazing and Forest Land

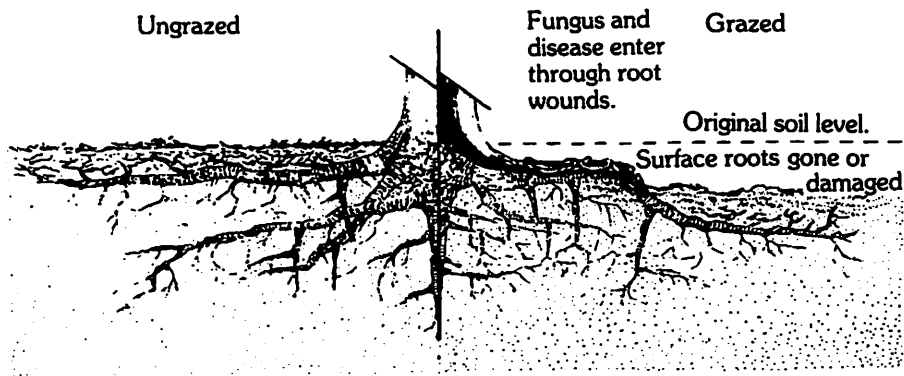
Much of the forest damage done by grazing is not readily visible to the casual observer and it usually shows up only as a long term effect. Damage to woodlands can take on many forms including damage to the trees, destruction of wildlife habitat, increased soil erosion and compaction.

Young tree seedlings and saplings are the first trees to suffer from grazing. Young trees representing the whole next generation are eaten and destroyed. Saplings are broken, stripped of bark and trampled. Even large trees suffer wounds from rubbing and the chipping of sharp hooves at the base of the trees.

Over the years, the appearance of a grazed woodland changes. As trees are harvested or die of old age, there are not any young trees to take their place. Some tree species that are more resistant to grazing may increase in number as the less resistant, but more valuable, oaks are grazed out. Hickories can tolerate more soil compaction than oaks and will survive better in grazed woodlands.

Churning feet of livestock mix the leaf litter layer into the soil and eventually expose bare soil to the elements of soil erosion. As the soil erodes from around the trees, some natural balances are upset. The flaring portion of the tree trunk is washed out of the ground exposing large roots to the damaging action of hooves. Small, hairlike feeder roots located several inches under the ground are exposed to trampling feet and are damaged (Figure 4.1).

FIGURE 4.1 - Tree root damage caused by grazing

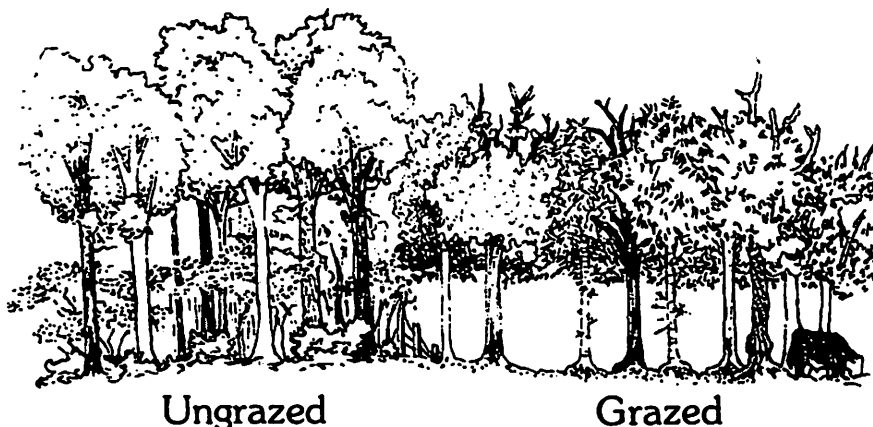


Credit: "Woodland Protection and Wildlife Management." Missouri Department of Conservation.

In addition to increasing erosion, years of livestock trampling compacts the upper soil layer. The small soil pores that allow air and water to move down to tree roots are sealed off. Rainwater that should infiltrate into the soil, now runs off the surface. Trees become weakened, lose vigor, slow their growth and are more likely to be attacked by insects or disease.

Wildlife food and cover disappears when hungry livestock consume and destroy forest trees and plants. Because there is little else for cattle to eat in the woods, the "browse line" in a grazed woodland is readily visible. Vegetation is consumed from ground level to as high as grazing animals can reach (Figure 4.2). This disrupts ecological succession by removing tree seedlings and decreases habitat diversity by eliminating the forest understory. In turn, the lack of habitat diversity limits the number and species of wildlife that can survive. Wildlife species needing thick timber edges and low growing plants are first to disappear in a grazed forest.

FIGURE 4.2 - Browse line



Credit: "Woodland Protection and Wildlife Management." Missouri Department of Conservation.

Food chains are also affected by grazing. Besides eliminating plants which produce food for wildlife, livestock competes directly with wildlife by eating the food that remains. For example, acorns are an important food source for wildlife and are the most preferred winter food of wild turkeys. Livestock diminishes the ability of oak trees to produce acorns through their grazing and trampling. When hogs and cattle are grazed in a forest, the entire acorn crop (and other tree seeds) may be consumed, leaving nothing for wildlife.

Wildlife, and the overall health of a forest, will be much improved if all types of livestock are excluded at all times. Bare soil and dead trees are the most serious results of using forest as a pasture. Substantial damage to wildlife habitat usually occurs long before these obvious signs of land abuse show up. Even grazing livestock in a forest for a short duration will damage wildlife habitat and future economic return from lumber products. Only one acre of well-managed pasture is worth between 20 to 40 acres of woods pasture. Money is best invested in the management of existing pasture while leaving the forest to grow trees and wildlife.

Forest Edge and Wildlife

Edge is defined as the transition zone between vegetation cover types, for example where a woodlot or forest adjoins a field. Such places offer combinations of food and cover that are critical to existence of many wildlife species. The amount, diversity and quality of edge in a given area is directly related to the abundance of wildlife.

Quality of edge is measured by how gradually the transition between vegetation cover types occurs. Most transitions in rural Missouri are abrupt changes from forest to fields. The change from crop fields or pasture with relatively low ground cover to forests with tall, closely-spaced trees is low quality edge. A more gradual transition with a wider border of grasses, weeds, shrubs, vines and small trees will improve the edge effect by placing more successional stages close together. Wildlife will find more food in the form of berries, seeds, browse and insects in this type of edge. Also, it provides better cover for nesting and escape from predators.

High quality forest edge can be created by planting small trees or shrubs within at least a 30-foot (preferably wider) strip of the forest edge. Another option is to allow the border to naturally revert back to native plants, supplemented by plantings if necessary. This natural process is usually rapid and reliable with the elimination of grazing, plowing and mowing. Conversion of heavy sod, such as fescue, to edge habitat can be hastened by plowing or discing the border strip to allow native species to invade.

Large trees within at least a 30-foot strip of the forest border should be removed or deadened. Some of the trees should be deadened and left to become standing snags. Other trees should be cut low to encourage sprouting at ground level. Also, the border strip does not have to be a uniform width or continuous in length. The most important edge characteristic is to have several seral stages of ecological succession represented.

Edge is not always literally at the border of forest and fields. Ungrazed openings or clearings within a large forest provide edge, and offer a greater variety of habitat. The wildlife benefits derived from these openings is dependent on their distribution, size and adjacent land use.

Five to ten acres of small clearings per 100 acres of forest is desirable, depending on the distribution of other open lands. These openings should range between one and three acres in size. Smaller woodlots are usually surrounded by pastures and crop fields which reduces the need for forest openings provided the fields are not overgrazed or fall plowed. Logging roads, utility right-of-ways, log landings or small clearcuts can provide open space in large forest areas.

Timber Stand Improvement

Timber stand improvement (TSI) is the removal of selected trees from a stand of timber to improve the health and growth rate of remaining trees. In most instances, an unmanaged timber stand becomes too crowded for optimum timber production. Although there may be enough water, nutrients and sunlight to keep trees alive, they may not grow at a desirable rate. TSI reduces competition in a stand and allows the landowner to decide which trees should be kept.

As with other forest management practices, TSI has a definite impact on wildlife by altering the vegetation. TSI must be carefully planned to achieve both increased timber production and higher quality wildlife habitat. Removing trees with only timber production as a goal can very well damage forest wildlife habitat. At times the decision to either leave or remove an individual tree will mean favoring wildlife at the expense of timber, or timber at the expense of wildlife.

Proper spacing of the trees to be left is the key to any TSI operation. Trees left too close together will soon become crowded and the benefits of ample growing space are not realized. Leaving trees too far apart wastes growing space and encourages the remaining trees to grow larger crowns at the expense of taller, straighter trunks for timber production. A good rule of thumb is to estimate the average diameter of a tree in the stand measuring the diameter at a height of four and a half feet above the ground. Multiply that figure by two, but call it feet

instead of inches. The answer would be the optimum distance between a tree and its nearest competitor. For example, if a tree is 11 inches in diameter, multiplying 11 by 2 will give the number of feet it should be from its nearest competitor.

There is much more involved in TSI than calculating the proper tree stand density. Choices must be made to improve the forest for wildlife. Wildlife is benefited by a diversity of tree species and sizes. Oaks with large, spreading crowns, are capable producing more acorns per tree than some of the taller, straighter oaks. Yet all oaks periodically have years of low acorn production. During these years such trees as hickories, walnut or pecan may provide a supplementary winter food source. Also, blackgum and eastern red cedar produce berries for wildlife which cannot feed on harder nuts. A variety of tree species provides the greatest chance for some wildlife food each year.

Wildlife nesting and cover comes in many forms depending on the species. Trees riddled with cavities and standing snags have no commercial value, but are extremely valuable for wildlife. They should be left standing if the TSI operation is to benefit wildlife.

The landowner should have his/her TSI goals firmly established before cutting a single tree. Timber production and wildlife habitat improvement can be accomplished by TSI when a landowner is willing to give both goals equal weight.

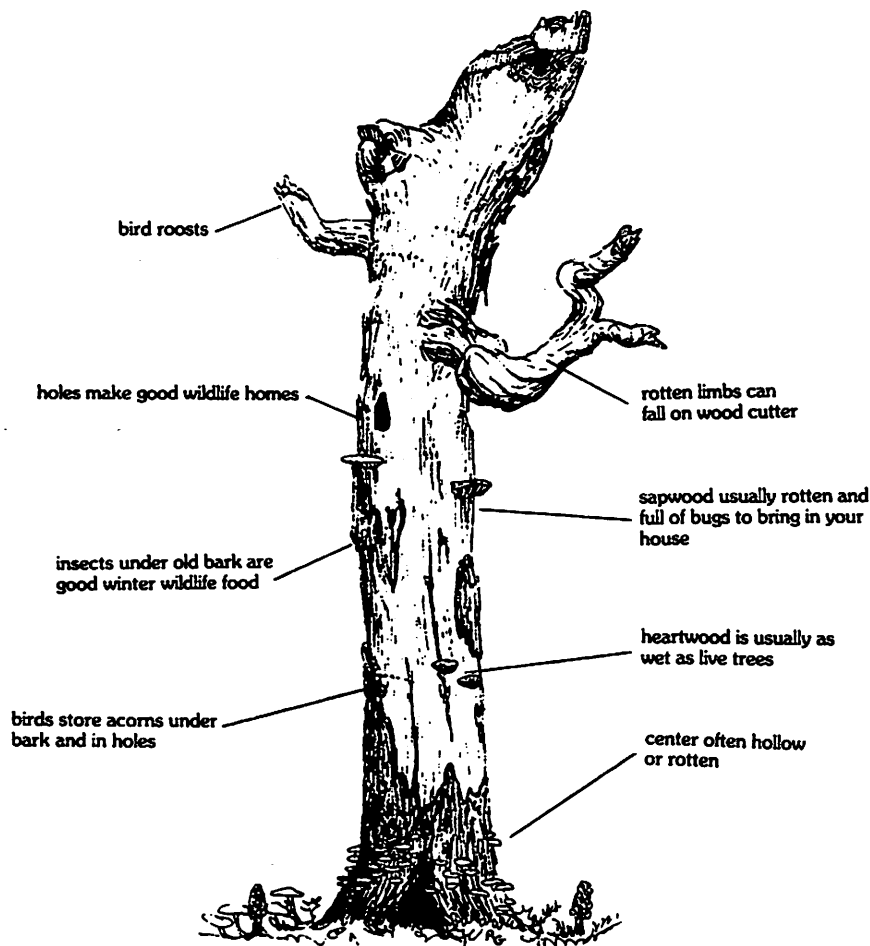
Snag and Den Trees

A snag is a standing dead tree. With or without an existing cavity, it is important to many species of wildlife. Den trees are live trees with a hollow cavity in the trunk or limbs. The cavities are produced naturally by a variety of causes. Snags and trees provide essential food and cover for many species of wildlife.

In Missouri, 89 wildlife species require snags and den trees for nesting, feeding and shelter. An additional 66 species depend on fallen woody material such as rotting logs, limbs and brushpiles. Snags, den trees and fallen woody material provide essential habitat for 30 percent of Missouri's wildlife species.

Once a tree dies, the slow process of decay begins. Birds use snags for a variety of activities including perching, feeding and nesting. As the heartwood in a snag softens, primary excavators such as woodpeckers excavate their own nest holes, which are later used by other wildlife species. Birds such as black-capped chickadees, American kestrels and screech owls are secondary cavity users and rely on cavities created by other animals or natural causes. Any dead tree will be used by some species of wildlife regardless of how many are present. A diversity of snag sizes is desirable to provide habitat to a variety of wildlife species (Figure 4.3).

FIGURE 4.3 - Wildlife use of a dead tree



Credit: "Cut Firewood and Improve Wildlife Habitat." Missouri Department of Conservation.

Several species of birds, mammals and reptiles use tree cavities throughout the year for nesting, escape cover and protection from the weather. The absence of adequate den trees and snags usually results in lower wildlife populations. At times, a scarcity of tree cavities can be the limiting factor for a particular wildlife species in a given area.

In a typical forest, trees with cavities are often in short supply. It is very important that existing or potential den trees be protected. Wolf trees - typically old, large-crowned trees - are likely to be den trees. White oak, post oak, and other members of the white oak group make the best den trees because they are long lived. However, other species such as black and red oaks, hickory, American elm, sugar maple, American sycamore, eastern cottonwood, blackgum, ash and basswood also make excellent den trees.

Timber Harvesting and Wildlife

The improvement of wildlife habitat can be compatible with growing and harvesting trees for a profit. Timber harvesting (including cutting firewood) is often an economical method for improving wildlife habitat. Combining basic principles of timber management with an understanding of wildlife needs will allow timber harvesting to be used as a wildlife management tool.

Uneven-age timber management - This timber management system attempts to keep a near equal balance of tree sizes from saplings to sawlogs intermingled throughout the forest. Partial or selective timber harvests at comparatively short intervals accompany this system. This type of harvesting usually compliments a landowner's multiple objectives and generally benefits wildlife by maintaining a diversity of tree species and sizes.

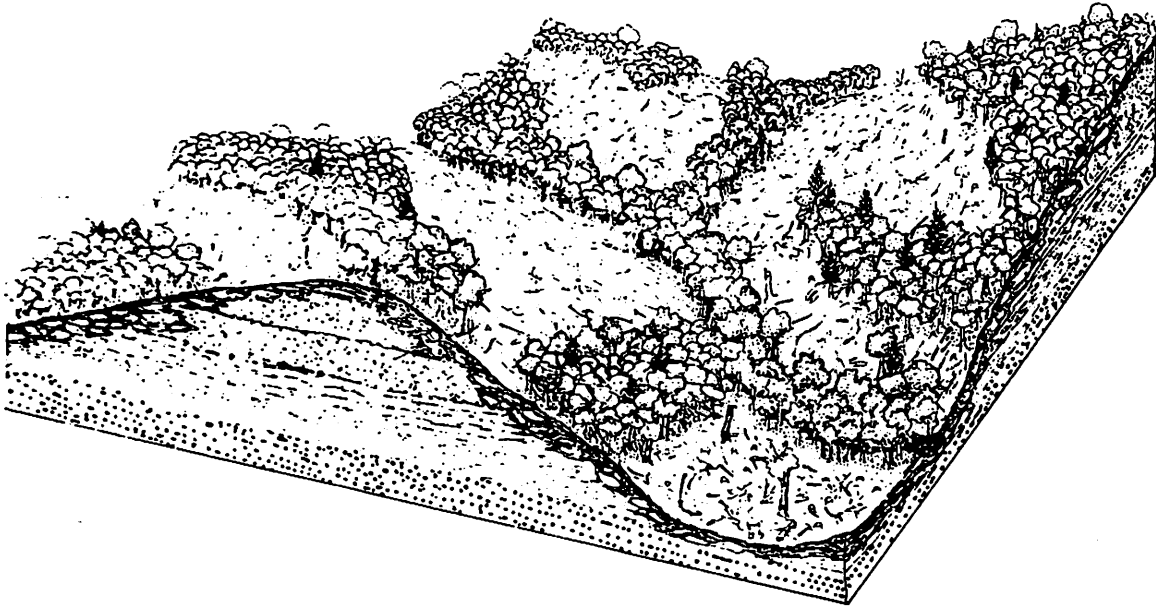
However, wildlife sometimes suffers with uneven-age timber management if precautions are not taken. Selective harvests involve the cutting of larger trees which produce wildlife foods such as acorns, walnuts, pecans, etc. Smaller trees begin to grow after a selective harvest, but frequently don't bear fruit. This can result in a period of greatly-reduced nut production. Foods for wildlife can be assured by leaving an occasional good nut-producing group of trees.

Small trees and plants in the forest understory also provide wildlife food. Examples are dogwood, huckleberry, spicebush, sumac, coralberry, blackhaw, serviceberry, etc. These species are often unnecessarily damaged or destroyed in normal logging activities. They can be protected by simply making the timber operator aware that they should be disturbed as little as possible. Also, careful removal of trees during harvest can allow more sunlight to reach understory plants and stimulate their growth.

A third and equally important source of forest wildlife food is commonly termed browse. This is a combination of plants, weeds, grasses, woody vines and shrubs found on or near the forest floor. Browse plays a vital role in the diets of many wildlife species. The amount of browse is directly proportional to the amount of sunlight that reaches the forest floor. For this reason, the uneven-age timber management system usually results in a shortage of browse. Harvesting only scattered trees does not open the tree canopy enough to allow adequate sunlight for good browse production. Harvesting groups of trees rather than individuals will reduce this problem. Another option is to overthin some portions of the timber stand.

Even-age timber management - Even-age timber management involves timber stands with all trees near the same age. This system is most commonly adopted by holders of large tracts of timber and is compatible with both timber production and wildlife (Figure 4.4).

FIGURE 4.4 - Clearcuts with wildlife benefits



Credit: "Timber Sales and Wildlife in Missouri." Missouri Department of Conservation.

Clearcutting of small stands (2 to 20 acres) for regeneration is the type of timber harvest most commonly associated with even-age management. Clearcutting can generate excellent wildlife habitat if properly planned and carried out. Poorly-planned, indiscriminate clearcutting not only severely impacts wildlife habitat, but may lead to excessive soil erosion; thereby destroying the area's ability to support a forest in the future.

The following considerations can be included into an even-aged management plan to benefit the overall wildlife habitat.

1. Clearcuts are most beneficial to wildlife when they are small in size (1 to 15 acres). If large acreages must be clearcut, do it over a period of years rather than all at once and cut in irregular patches.
2. Clearcuts, especially larger ones, should be irregular in shape and fitted to the landscape. This increases the amount of edge and improves esthetic quality.
3. Clearcuts scattered throughout a timber tract benefit more animals than those grouped together by providing better dispersion of wildlife food and cover.
4. Leave snags and dead trees along the edges within the clearcuts.
5. Leave a strip of natural vegetation on both sides of streams flowing through clearcuts.

Summary

Missouri's forests are used for multiple purposes. Most of these uses are compatible. Wildlife habitat can easily be created and improved in combination with other forest management priorities.

The attitude of landowners toward wildlife is a key element. Many opportunities are available to improve both wildlife habitat and timber production on forest lands. However, a landowner must seize the opportunities for his/her forest to provide the most benefits.

Credits

Wildlife Management Handbook for Landowners. Missouri Department of Conservation, 1989.

UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 5: Introduction to Wetlands

Wetlands are the most productive ecosystems in the world. Their value to countless species of wildlife is surpassed by no other type of habitat. Wetlands also play a vital role in maintaining water tables, stabilizing stream flows, and filtering sediments and pollutants.

What is a Wetland?

The term "wetland" refers to a broad range of different types of habitat including swamps, sloughs, marshes, rivers, ponds, lakes, seeps, potholes, bottomland forests, etc. These different types of wetlands have one characteristic in common; their soils are saturated or covered with water, at least periodically. Wetlands support water-loving vegetation which can be terrestrial or aquatic.

The water determines the nature of soil development and the type of plant and animal communities able to exist. The timing of soil saturation and the amount and source of water covering the soil determines the kind of wetland. Wetlands can be anything from a wet spot in a cropfield with smartweed and sedge to bald cypress swamps or large man-made reservoirs.

Wetland Destruction

Natural wetlands have been drained and destroyed at an alarming rate over the last 50 years. Recent surveys indicate that nearly half of the 215,000 acres of original wetlands in the U.S. have been lost as result of drainage and filling, and many of our remaining wetlands have deteriorated in quality because of siltation, pollution and alterations. According to the Fish and Wildlife Service, 1200 acres of wetland are still being lost in the U.S. every day. Missouri is not an exception to this trend. Of the original 2.4 million acres of forested lowlands in southeast Missouri, less than 60,000 acres, or two percent, remain today.

Wetland Benefits

Wildlife - Nearly 45 million ducks depend on wetlands scattered across the U.S. and Canada for their existence. As a direct result, two million waterfowl hunters participate in more than 15 million hunting days of recreation and spend \$1 billion on their sport each year in the U.S.

Several other groups of birds are frequently associated with wetlands. Among these are shorebirds, represented in Missouri by more than 40 migrant species. Examples are dowitchers, sandpipers and yellowlegs.

Over 200 species of fish live in Missouri's lakes, streams, ponds, rivers and other aquatic habitats. All of these habitats are considered to be wetlands. Approximately 1.3 million Missourians participate in fishing activities each year. Wetland areas also provide essential habitat for some of the 107 species of amphibians and reptiles living in Missouri.

Wetlands constitute the principal habitat for producing the annual crop of furbearing animals. Missouri's fur resources produced an average of \$6.5 million annually from 1978 to 1983.

Timber - In Missouri's Bootheel, wetlands can support bald cypress, tupelo and sweetgum. These trees are valuable, especially cypress because of its durability without preservative treatment. Pin oak and pecan are also important wetland trees. Both are significant as wildlife foods, and both species have value as lumber.

Water quality - Wetlands improve water quality by decreasing the level of soluble nutrients in water flowing through them. This process is accomplished when plants take up pollutants, store them and then use them as nutrients. For example, excess nitrogen and phosphorus from agricultural activities have been responsible for reduced water quality in many streams and lakes. But wetlands, acting as buffers, turn nitrogen into a gas. Wetland plants store nitrogen and phosphorus and use them for plant growth. When the plants die, the chemicals are released slowly.

Wetlands also improve water quality by acting as settling basins for upland runoff. Because of their low gradient and thick vegetation, wetlands slow the flow of water entering them, allowing suspended soil particles to settle out. The water is then released into adjacent streams and underground supplies. Unfortunately, the filtering action of wetlands may prematurely change them when runoff water has a heavy silt load from soil erosion in the watershed. Large amounts of soil deposition in wetland areas greatly accelerates ecological succession causing a drier, terrestrial habitat.

Flood control - Some types of wetlands function as gigantic sponges on the landscape. During periods of heavy rain or runoff, wetlands hold water and release it slowly by plant transpiration, water evaporation and seepage into the groundwater. By retaining water and releasing it gradually, wetlands reduce the total amount of water entering lower watersheds, and consequently reduce flood risk and peak flood flows.

Types of Wetland Plants

Water is the single most important physical factor affecting wetland plants and animals. The length of time and depth of water standing on a wetland area determines the type of vegetation able to exist. In turn, the vegetation defines what species of wildlife can inhabit the area. Water and vegetation also has a strong effect on soil development.

Many types of plants are adapted to living in wetlands. From microscopic algae to large pin oak trees, all species of wetland plants require a particular type of habitat to survive. Various groups of plants have evolved different strategies for living in different wetland conditions. They can be classified into six major groups.

Emergent - Plants that grow with their roots in wet soil or water during part or all of their life. Examples are cattail, cord grass, arrowhead, smartweed, sedges, rice cutgrass and hardstem bulrush. Trees adapted to wetland conditions are also be included in this broad classification. Examples are bald cypress, river birch, pecan, tupelo and pin oak. Of these trees, only bald cypress and tupelo can grow in standing water. River birch, pecan and pin oak prefer bottomland areas which are briefly flooded once or twice a year.

Floating-leaf plants - These plants are rooted in deeper water and tend to send up broad, floating leaves to the water surface. Nutrients move between leaves and massive tubers by flexible and slender stems that may be five or six feet long. Such plants can grow in much deeper water than emergents and can better tolerate fluctuating water levels. An example is the water lily.

Submergent plants - Plants that are generally rooted to the bottom but have their stems and leaves underwater. Many species flower at the water surface. Examples of submergent plants are pondweed, coontail and water milfoil.

Free floating plants - These plants are not rooted in soil and usually remain on the surface of the water. They are flowering plants with dangling roots that collect nutrients from the water. Free floating plant species are best represented by duckweed and water hyacinth.

Algae - Algae is considered separate from the other categories. Pond scums and the green hairy growths on submerged objects are the most obvious forms of algae. Algae are primitive, single-celled plants without true stems, leaves and roots. They are found in all natural waters under an incredible range of physical conditions. Algae come in three basic forms.

1. Planktonic algae are microscopic in size, occurring as single cells or filaments, and are the chief producers of oxygen in natural waters through photosynthesis.

2. Filamentous algae are long green threads which form floating mats or are attached to rocks, debris or other plants.
3. Macrophytic algae are green algae which resemble larger, rooted plants in appearance.

Wetland Protection

Although wetlands provide many benefits, humans have drained and destroyed many of them. Wetlands were regarded as "wasteland" which should be improved and put to another use. Some of this activity continues today. For this reason, the federal government has passed laws which partially stem the loss of wetlands. The federal authority comes from three laws.

Rivers and Harbors Act - Passed in 1899, this law established a U.S. Army Corps of Engineers permit system for any construction involving dredging, filling or obstructing of navigable waters. Originally, it did little to protect wetlands other than those that were navigable. Due to increasing public concern, the law was revised in 1968 to include evaluation of other factors such as the impact on fish, wildlife, pollution and esthetics.

Federal Water Pollution Control Act (Clean Water Act) - This act extended the Corps' regulatory jurisdiction to cover all waters of the U.S. The Environmental Protection Agency was made a partner in the new program with veto power and responsibility for establishing guidelines for protecting wetlands. To receive protection, an area must qualify as a wetland according to the Corps' definition, which sets criteria relating to soil, flooding and vegetation.

Food Security Act (Swampbuster Provision) - This law, passed in 1985, is aimed at discouraging the conversion of wetland areas for agricultural purposes. The swampbuster provisions direct the U.S. Department of Agriculture (USDA) to deny program benefits to farmers who convert wetlands to cropland use. USDA programs have been very popular among farmers - especially in recent years. Farmers who participate heavily in USDA programs will potentially lose thousands of dollars if they violate the swampbuster provisions.

For this reason, it is important for landowners to recognize the wetlands they have, and to understand the law. Wetlands are broadly defined under the swampbuster provision as: ". . . wetlands consist of soils that are covered with standing water or are saturated most of the year, and that support mostly water-loving plants." For more information, contact your local USDA Soil Conservation Service or Agricultural Stabilization and Conservation Service offices.

Wetland Development

Protection of existing wetlands should be a landowner's first priority in managing wetlands. However, many areas in Missouri have the potential for development into productive wetland communities. With minimal costs and construction, small wetland areas are possible without affecting existing farm operations. Through the use of low-profile levees, water control structures and existing water supplies, a landowner can develop a wetland area.

The most important element in selecting a wetland site is water supply. An adequate water source must be nearby to flood the area. The source may be a pond, lake, stream, river or well. The chosen site must also have a tight soil so the water will not seep away.

In most cases, low-profile levees will need to be constructed around the perimeter of the proposed wetland area in order to retain water on the site. Water control structures should be placed at one or more locations in the levee to regulate water depth.

As an example, a convenient wetland development project is possible in conjunction with farm ponds. Ponds or small lakes make excellent water sources for wetlands located in the flats below a pond's dam.

Many other wetland development projects are possible, but the majority require the same basic situation - a method of water control. Water depth is the primary physical influence on man-made or natural wetlands which determines the plants and animals able to inhabit the area. By controlling water depth, a wildlife manager or farmer can help nature build the type of wetland he/she wants.

Summary

Wetlands play an important role in maintaining wildlife populations, stabilizing stream flows, filtering out sediments and maintaining water tables. In addition to these ecological benefits, wetlands also provide humans with a multitude of recreational experiences, such as hunting, fishing, swimming, boating, etc.

The term "wetlands" has a broad definition. Landowners may have wetlands and not realize it. For instance, a pin oak bottomland forest which is seasonally flooded in the spring and/or fall is usually considered a wetland. With the passage of the Food Security Act of 1985, it is important for farmers to recognize wetlands on their land and to not damage them.

Credits

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UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 6: Stream Conservation

Streams play important roles in transportation, agriculture, hydroelectric power, public water supplies and fish and wildlife production. Historically, both Native American Indians and early settlers were drawn to streams for water, food and a source of convenient transportation. Due to our close association and reliance on streams, humans have long been interested in stream behavior for economic reasons. People quickly recognized that problems were created by unpredictable stream behavior and sought to control them with dams, levees and channelization.

Watersheds

A watershed is all the land area that contributes water runoff to a particular point on the landscape. Watersheds can be millions of acres or only fractions of an acre. It depends on the point of reference. The further downstream you are, the larger the area draining to that particular point.

The quality and quantity of surface water depends on the condition of the watershed. The entire aquatic system of a given area is only as healthy as the watershed draining into it.

1. Misuse of livestock wastes and/or pesticides in a lake, river, pond or stream watershed can cause pollution.
2. Accelerated soil erosion from agricultural activities or construction sites in a watershed causes excessive water turbidity and thereby degrades water quality.
3. Urban areas have extensive areas of asphalt and concrete. Rainfall cannot percolate through these impervious layers which creates excess runoff and more flooding.
4. Toxic waste dumps frequently contaminate surface and ground water. Water bodies downstream from these dumps are at risk.

Natural Stream Adjustments

Streams are in a constant state of change. They are delicately balanced mechanisms which must continually adjust to environmental conditions within their watersheds. The formation of sand bars, deepening of channels and streambank erosion are the most common methods a stream uses to compensate for changes in water flow rate and sediment load.

One of the characteristics of a well-balanced stream is a relatively constant streambed elevation. It can be disrupted by many factors and consequently create other problems. For example, urbanization creates extensive areas of concrete and asphalt which prohibit rainfall from infiltrating the soil. As a result, downstream flows during storms increase. The response of a stream will be to enlarge its channel due to bed scour and bank erosion to accommodate the increased flow.

The streambed acts as a foundation for its banks. In this example, the streamflow will scour out the bed and in the process undercut the bank. Eventually, the upper bank will no longer have support and slough off into the stream.

Streams will also adjust to an increase in sediment load from their watersheds. In this case, assume soil erosion has greatly accelerated in a stream's watershed and much more sediment is entering the channel. When the stream is not able to carry its sediment load any longer, material will be deposited on the streambed. The elevation of the bed will rise, thereby reducing the size of the channel. When the next flood comes, the stream will continue to compensate for the imbalance by trying to enlarge itself to carry the flood flow. As the enlargement process occurs, not only will the bed be scoured out, but both banks may be eroded as well.

As discussed, streams must adjust to the quality and quantity of water entering them which is controlled by land use in their watersheds. In agricultural areas, good soil conservation practices such as contour farming, conservation tillage, terraces, controlled grazing and grass waterways can play a major role in controlling local runoff. When soil conservation practices are widely used, they can change streamflow by reducing erosion and increasing the amount of rainfall infiltrating the soil. Peak floods and sediment loads will be reduced and thereby reduce bank erosion and streambed scouring.

Stream Channelization

In the past, and sometimes today, landowners attempt to solve a stream-related problem through channelization. Channelization is defined as: "the modification of stream channels for the purpose of flood control, land drainage, navigation and the prevention of erosion." Channeling usually consists of using a drag line to straighten, deepen and clear streambeds. In Missouri alone, more than 4,981 miles of stream have been channelized and more than 2,527 miles of streams have been eliminated.

Channelization of natural streams creates many more problems than it solves. Streamflow velocity increases dramatically in the channelized section which usually has a steeper gradient and no

obstructions to break the current. The increased water velocity scours and deepens the streambed. Eventually, the streambed cannot provide support to the banks and they begin to slough off. As a result, the channel becomes deeper and wider than it was before the channelization.

Furthermore, the adverse effects of channelization may travel far beyond the exact area of the stream where it was done. Given time, the lowering of the streambed will advance upstream until the entire stream system is affected. In agricultural areas, this "headcutting" process advances upstream until new gullies are formed in cropfields, pastures, etc.

Channelization can be credited with frequently alleviating flooding within the channelized section of stream. However, the rapid water velocity merely delivers the water more quickly downstream where flooding is intensified.

Stream channelization also adversely affects groundwater recharge and wetlands. The change associated with channelization can lower the groundwater table in some areas, especially during drought. With increases in water velocities and the rate of runoff, water has less time percolate into the ground. This eliminates or reduces groundwater and natural stream recharge. Adjacent wetlands may also be drained which robs the stream of a natural mechanism to hold water and provide flood control.

The wide variety of trees, shrubs and other plants which grow along stream banks are called riparian vegetation. Unfortunately, riparian vegetation is often destroyed during channelization activities. The stream and its associated riparian vegetation are dependent on one another for survival. The destruction of one may easily cause the destruction of the other.

Common riparian trees in Missouri are cottonwood, sycamore, silver maple, willow, river birch and hackberry. Acting as an organic filter, a streamside corridor of trees and other plants provide a leaf mat which removes sediment from runoff water. Trees, shrubs and grasses also help armor stream banks against erosion. They dissipate the force of flowing water and minimize bank erosion through the holding action of their root systems. Riparian vegetation is nature's way of protecting a streambank.

Fish and Wildlife Habitat Components in Streams

A healthy stream ecosystem provides a large number of specialized habitats for fish and wildlife populations. Any structural change in the stream's banks, bed or riparian vegetation will have an effect on the food and cover available to fish and wildlife.

Pools - Pools are the major stream habitat of most fish, and are needed in many shapes and sizes. The deep, slow-velocity pools with large amounts of overhanging vegetation can support the highest and most stable fish populations. However, other types of pools are frequently necessary to maintain good fish populations. For example, small pools with shallow water are needed by young fish as brooding areas.

Riffles - Riffles are characterized by shallow water depth, rapid water velocity and usually a gravel bottom. In many streams, riffles produce most of the fishes' aquatic food and form spawning areas.

The gravel associated with riffles is very important for spawning, incubation of fish eggs and production of aquatic insects. Nearly all fish living in Missouri streams prefer a gravel streambed as a nesting site.

Root wads, submerged trees - These are products of riparian vegetation which improve the aquatic habitat. Root wads and submerged trees provide valuable cover for fish and other aquatic animals. The logs, branches and twigs of these trees also provide a food source for aquatic insects which are at the beginning of the food chain.

Although root wads and submerged trees make good aquatic cover, they may need to be removed if they are causing problems in the stream. In some cases, they may encourage the formation of a log jam or "drift." Log jams are a natural occurrence which can be damaging to the stream by increasing siltation upstream, deflecting the stream current to the bank and by causing warm, stagnant water.

Streambank - Fish often congregate near the streambank for the edge effect it provides. This is especially true for bank undercuts and areas with overhanging vegetation. Both provide excellent cover for fish.

Riparian vegetation - Riparian vegetation plays an important role in regulating water temperature by shading the water surface. Water temperature governs most of the physical, chemical and biological processes that occur in streams. The types of aquatic life inhabiting streams, timing of fish reproduction, animal growth and development, and concentration of oxygen are directly influenced by water temperature.

The large variety of trees, shrubs and other plants, plus nearness of water, are qualities that make riparian woodlands important to wildlife. A variety of tree species provides wildlife with foods, dens, roosts and nesting sites. The species of trees that grow in the stream bottom are different from those

on upland areas, adding more plant diversity to the area. In the farming regions of Missouri a strip of riparian woodland may be the only woody cover to be found on landscapes dominated by fields and pastures.

Channelization Impacts on Fish and Wildlife

A healthy and productive stream ecosystem is composed of many individual habitats in close association. For instance, healthy streams generally have pools and riffles spaced at a distance of five to seven times the width of the stream. In turn, natural stream features are a product of how the stream watershed and the channel itself have been treated.

Channelization produces the maximum possible destruction of local stream habitat. Channelization usually converts a natural, winding stream with riffles, pools, cover, and abundant fish and wildlife, into a straight, featureless ditch. The resulting ditch contains no protective boulders, ledges, spawning gravel or streamside cover, and few fish or wild animals. Research conducted by a number of fish and wildlife agencies has found that channelization reduces a stream's capacity to produce fish by 70 to 85 percent. Additionally, the remaining fish tend to be smaller and more tolerant of poor habitat.

Few fish species will tolerate the increased water velocities, temperature and turbidity of a channelized stream. Increased sediment smothers fish eggs and covers gravel and other substrates used to produce fish food organisms.

The Chariton River provides a good example of the impact of channelization on fish populations. Most of it was channelized in the early 1940s, so it has had ample opportunity to make what recovery it can. The Missouri Department of Conservation studied the fish populations in the channelized portion and in the remaining natural portion during the early 1970s. The research revealed 21 species, a total of 1,428 fish, in sample areas in the natural stream. Only 13 species and 659 fish are found in sample areas of the channelized portion. In terms of catchable size fish and food fish, production in the channelized section was reduced 89 percent.

Clearing of trees, shrubs, grasses and other vegetation from the banks normally accompanies channel straightening. This robs the stream of nutrients that enrich it, destroys the canopy that shades the water from the summer sun and eliminates streamside habitat for wildlife such as deer, turkey and squirrel.

The negative impacts on fish and wildlife habitat usually occur both upstream and downstream from the channelized section. The increased sediment load and raised water temperatures will extend downstream. Undercutting of the banks is likely to happen due to bed scouring which gradually advances upstream throughout the

stream network. Also, bank undercutting causes streambanks to slough off which results in a wider channel and poorer habitat. Sometimes it takes many years for a stream to fully adjust and reach a new balance. In fact, the effects of channelization projects on the Missouri River fifty years ago are now being felt in its headwaters in Montana.

Stream Improvement

Although individual landowners cannot manage an entire stream watershed, they can improve the section of stream occurring on their property. With careful planning, successful stream improvement is possible.

Protect riparian vegetation - The easiest, most effective way to protect a stream is to maintain at least a 100 foot strip of riparian vegetation on both sides. Disturb the riparian strips as little as possible. However, there are situations where a landowner should selectively cut trees to improve the streams. Large trees likely to fall in the stream and create a blockage should be removed. Also, a thick stand of trees should sometimes be thinned to promote the growth of grasses and other plants.

Remove streamflow obstructions - Log jams and other obstructions alter the natural stream flow. When the flow is seriously impaired or bank erosion is accelerating, log jams should be removed.

Plant streambank vegetation - Where vegetation is lacking, a landowner can improve the stream by planting trees, shrubs and/or grasses. Below a stream's waterline, vegetation can effectively protect a streambank in two ways. First, the root system holds the soil together. Second, the exposed stalks, stems and branches deflect the force of the current away from the bank. Above the waterline, vegetation performs the same function of holding the soil with root systems and slowing water velocity. Planting vegetation is a convenient method of streambank stabilization because it is easy to establish and maintain. It is the only streambank protection method which is able to repair itself. The establishment of permanent vegetation is essential to the stability of many streambanks.

Several different growing conditions may occur in a relatively short vertical distance along the bank, depending upon its depth, steepness and soil type. Vegetation must be able to tolerate specific conditions. Examples of plants for planting on streambanks are:

1. Trees - black willow, eastern cottonwood, silver maple, green ash and river birch.
2. Shrubs - sandbar willow, basket willow, pussy willow, buttonbush, honeysuckle and silky dogwood.

3. Grasses - reeds canarygrass, redtop, prairie cordgrass and switchgrass.

For assistance with species selection, landowners should contact a Department of Conservation fishery biologist or their local USDA Soil Conservation Service or Cooperative Extension Service office.

Riprap - Riprap is natural rock dumped or hand placed on a streambank to prevent erosion. Three general approaches are used.

1. Riprap can be placed in a blanket at the base of the bank to minimize undercutting.
2. A blanket of riprap can be placed over the entire bank when economical rock is available.
3. Small dikes composed of riprap are built from the bank out into the stream to absorb the force of the current. These are called rock hardpoints.

When riprap is used, fish and wildlife habitat is generally benefited if rock hardpoints are used. Extensive bank shaping is not needed, and disturbance of existing vegetation is minimal when rock hardpoints are constructed instead of other riprap placement methods. Overall, better stream habitat is produced with rock hardpoints than with a shaped bank covered with a blanket of riprap.

Tree revetment - "Revetment" refers to the placement of stone, trees, blocks or sand bags on a streambed to prevent erosion. A tree revetment is probably the least expensive.

Large, whole trees placed lengthwise along eroding banks (at the waterline) with their butt ends pointed upstream can substantially reduce bank erosion. They also provide fish cover for a variety of fish species. The trees should be cabled at both ends and anchored to the bank. Tree revetments are not suitable on smaller streams where the streamflow will be greatly reduced by the placement of the trees.

Section 404 of the federal Clean Water Act states that a project involving the placement of rock, earth, root wads and other objects in a stream requires a permit from the Army Corps of Engineers. Before the Corps can issue a permit, the Missouri Department of Natural Resources must certify that the project will not violate state water quality standards.

Summary

Streams are complex features on the landscape. They are much more than merely drainage ditches. Upsetting the balance of a stream may cause serious problems as it attempts to maintain

itself by bed scouring and streambank erosion. The fish and wildlife supported by streams are adapted to the many habitats it provides. When humans attempt to "tame" a stream, they frequently set into motion a series of natural reactions which degrade both the stream's structural features and fish and wildlife habitat.

Credits

"Channelization - What Every Landowner Should Know." Missouri Department of Natural Resources.

"Stream Corridor Management - Dos and Don'ts." USDA Soil Conservation Service, 1986.

Landowner's Guide to Managing Streams in the Eastern United States. Blacksburg, Virginia: Virginia Polytechnic Institute and State University, 1985.

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Streambank Protection Guidelines. U.S. Army Engineer Waterways Experiment Station, 1984.

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UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 7: Pond Construction and Management

Missouri is blessed with more than 300,000 ponds. Ponds serve as gully erosion-control structures, livestock watering systems, fish and wildlife habitat, and sometimes as a source of irrigation water. They also provide much opportunity for human enjoyment and recreation. Nearly one-fourth of all fishing in Missouri takes place on these small, man-made impoundments. A good pond does not come about by accident, but by planning, knowledge and effort.

Pond Construction

Careful planning and proper construction are necessary for successful pond management. Landowners should give consideration to:

Site selection - Ponds should be constructed in a natural draw with a drainage area large enough to keep the pond filled, yet not so large that excessive runoff will destroy the dam. Ten acres of drainage area per one surface acre of water is a general rule of thumb.

The soil in the pond area must contain enough clay for building a water-tight dam and to prohibit seepage in the basin. The suitability of the soil can be checked with a soil probe. Outcroppings or subsurface layers of gravel or sand encourage seepage, and may lead to pond failure.

If several pond sites are suitable, select the most economical one. Clearing trees and brush from the dam and basin areas can be expensive as well as detrimental to local wildlife populations. Selecting a site with fewer trees and brush will help cut the cost of pond construction. Also, select a narrow draw which requires the least amount of earthmoving to attain the desired pond size.

Fishing ponds an acre in size usually produce the best fishing. Ponds less than one-quarter acre may produce much fishing pleasure but are easily overharvested. Unstable fish populations are usually a characteristic of these smaller ponds.

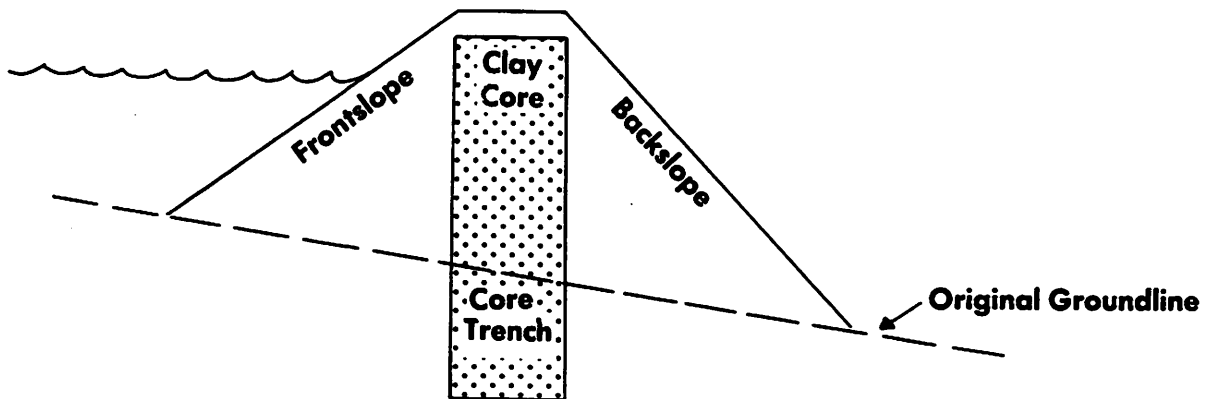
Also, select a site which can provide water depth of at least eight feet to protect fish during winter. Shallow ponds are especially subject to winter kill (a term used for fish death caused by oxygen depletion under the ice in winter), since they have less water volume.

The proposed pond drainage area should be adequately protected against soil erosion. Permanent plant cover is preferred, such as trees or grass. However, pond drainage areas used as cropland are suitable when soil erosion is reduced to acceptable limits through the use of conservation tillage, terraces, grass waterways, crop rotation and other soil conservation practices.

Public safety should also be considered during the site selection process. Pond dams should not be placed upstream from roads, homes or other areas of human activity without professional engineering assistance. A sudden flood caused by dam failure may result in the loss of human life.

Dam construction - Building a pond dam is much more than making a pile of dirt with a bulldozer. After the dam location is cleared, a core trench must be excavated to provide a water-tight foundation for the dam. In most cases, a core trench is the width of the bulldozer blade, and is cut down to a good clay or solid rock layer (Figure 7.1).

FIGURE 7.1 - Cross Section of Dam



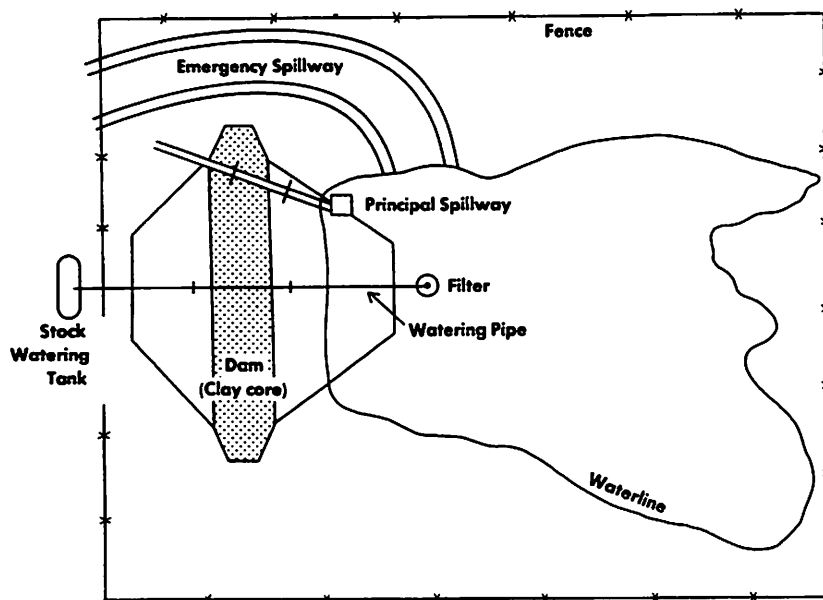
The dam embankment is constructed by building it up from the base in six inch layers to ensure good soil compaction. Soil with a high clay content from the basin (or nearby area) should be used in the dam. It should be placed in the center of the dam, in and above the core trench.

The surplus water entering a pond from its drainage area is released by spillways. Small ponds, with a drainage area of ten acres or less, usually require only an emergency spillway. An emergency spillway is a grassy strip at the end of the pond dam which is about two feet lower than the top of the dam. Surplus water is able to pass around the dam in an emergency spillway. The spillway should be wide and level enough to carry the water in a slow, shallow stream from three to six inches deep (Figure 7.2).

Some landowners install a trickle tube (small overflow pipe) in small ponds about one foot lower than the emergency spillway. A trickle tube is usually a six inch corrugated metal pipe. It will handle light overflow and establish a normal water level in the pond.

Larger ponds frequently use a combination of an emergency spillway and a pipe through the dam (principal spillway) to release surplus water. The design of larger ponds should be handled by the USDA Soil Conservation Service or a professional engineer. Such pond designs usually require careful measurements and mathematical calculations to arrive at proper pipe size and emergency spillway width and depth.

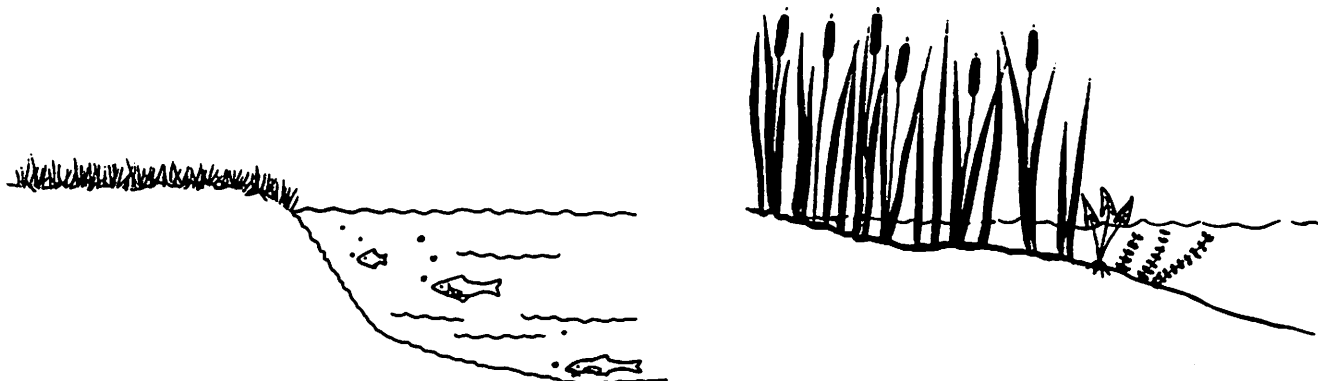
FIGURE 7.2 - Top View of Pond Layout



At the time of dam construction, a livestock watering pipe should be installed. This allows for the delivery of water to a watering tank below the dam which makes it possible to fence livestock away from the pond dam and shoreline. It can also be used to drain the pond in one or two weeks if it becomes necessary at some point in the future.

Basin excavation - Since most weed problems start in shallow water, deepening the pond edges at the waterline will provide some degree of weed control. Grading the edges to reach a four foot depth within 12 feet of the shoreline will reduce the chance for weed problems (Figure 7.3).

FIGURE 7.3 - Deepening Pond Edges for Weed Control



Future fish habitat can be improved during pond construction by leaving high spots at several locations in open water areas. This will encourage plant growth and provide fish habitat by creating plant interspersions. About 10 to 20 percent of the pond surface should have aquatic cover for optimum fish production. Some trees or brushpiles should be left in the pond basin to create more fish cover. These materials also provide additional places for production of aquatic insects for fish food.

Seeding - Lime and fertilize the dam and basin area according to soil test recommendations and lightly disc or harrow. Seed all the raw areas above the waterline with a seeding mixture recommended by the local Cooperative Extension Service or Soil Conservation Service office. After seeding, mulch the area with straw. The mulch should be pressed lightly into the ground with a corrugated roller or a disc will dull blades to anchor the straw stems.

Fencing - If livestock have access to the pond, build a fence immediately. Livestock will damage the pond seeding and may ruin the pond in the long-run by trampling the dam and shoreline. They will increase water muddiness which is detrimental to fish populations. Eliminating livestock from the pond area does not mean they will not have water - a livestock watering tank below the dam is for that purpose.

Pond Water

Fish and other aquatic animals need good quality water to live and reproduce in a pond. Many of the factors capable of causing poor water quality can be controlled by the landowner.

Dissolved oxygen - Like all animals, fish need oxygen to breathe. The oxygen used by fish is obtained from molecules of free oxygen gas (O₂) dissolved in the water, not from the atoms of oxygen chemically confined in the water molecule (H₂O). Fish are able to extract the dissolved oxygen by passing the water through their gills in much the same way that terrestrial animals extract oxygen from by passing it through their lungs. Dissolved oxygen (DO) normally gets into water by diffusion from air, by aeration of flowing water (especially in stream riffles and lake wave action), and as a by-product of photosynthesis by aquatic plants. The chief source of DO in most aquatic environments is aquatic plants.

Dissolved oxygen levels are particularly important in ponds. Generally, low DO levels are more critical in small streams and ponds during periods of extreme, prolonged heat or long, cold winters with much snowfall. Both of these conditions may lead to seasonal anaerobiosis, better known as "summer kill" and "winter kill". These conditions are caused by the complete destruction of dissolved oxygen in the water.

Summer fish kills occur when excessive aquatic plant growth dies and decomposes. The decomposition process uses dissolved oxygen, leaving a critical shortage of fish. Pond owners can usually avoid summer fish kills by controlling aquatic weeds before their growth becomes excessive.

Winter kill happens by the same process. It is caused by a great deal of shallow water, excessive aquatic plant growth, and extended periods of ice and heavy snow cover. Normally, sunlight passes through ice and maintains the dissolved oxygen content by promoting aquatic plant photosynthesis. Snow cover on top of ice blocks sunlight and the plants die and begin to decay, removing dissolved oxygen from the water. Fish may then suffocate. Pond owners can reduce winter kill by removing snow cover from the ice and controlling aquatic weeds.

Turbidity - Turbidity (muddiness) is most commonly caused by soil particles in the water. Soil particles may settle out on the eggs of aquatic animals and suffocate them; thereby reducing reproductive success. Muddy water will also prevent or retard growth of microscopic plant life (necessary for good fish production) by blocking sunlight. Decreased production of these basic foods causes a reduction in growth of larger insect feeds which in turn drastically reduces the growth rate of bass and

bluegills. Their growth is not only reduced from a small food supply but also because these fish are primarily sight feeders and must be able to see their food. Studies have shown that bass will grow five times faster in clear water. A pond is considered clear enough for good fish production if a person's fingers are still visible when placed two feet underwater.

Excessive water turbidity may be caused for a variety of reasons. As previously discussed, soil erosion in a pond's drainage area can be the primary cause of muddy water. Livestock also cause turbidity problems by trampling the shoreline or by wading into the pond and stirring up bottom sediment. Pond owners can avoid these problems by applying soil conservation practices in the watershed and excluding livestock from the pond area.

Muddy water can also be caused by bottom-feeding fish, like carp, buffalo and bullheads. These fish keep silt stirred up by rooting in the mud for food. The only remedy is to remove the fish and restock with non-bottom-feeders.

A common problem in Missouri ponds is clay turbidity. Heavy clay soils in the pond basin or on the shoreline release tiny clay particles which don't settle out. This type of problem is the most difficult to permanently correct. Pond owners can temporarily alleviate clay turbidity by placing two small bales of hay in the pond per surface acre of water at 14-day intervals. Weak organic acids are formed by the decaying vegetation and help settle out the clay particles. This method is most effective in the spring and early summer.

Livestock waste - In some situations, livestock waste is a serious threat to water quality. Manure, urine and rotting bedding material from barnyards, feedlots and pastures create problems when they enter an aquatic system in sufficient quantity.

Livestock waste degrades water quality in several ways. Dissolved oxygen is used up as the waste decomposes, thereby lowering the amount of oxygen available to aquatic organisms. Also, the decomposition process releases poisonous ammonia, methane and sulfur gases which are harmful to fish and other aquatic animals.

Livestock waste contains high amounts of nitrogen and phosphorus. When applied to the soil properly, livestock waste is a natural fertilizer. However, excess waste entering an aquatic system in runoff water frequently results in overfertilization. The growth of aquatic plants is greatly stimulated by the added nutrients and a weed infestation frequently occurs. Excessive plant growth usually degrades water quality by reducing dissolved oxygen at critical times of the year due to plant decomposition (i.e. summer kill, winter kill). Furthermore, fishing opportunity is diminished by the vegetation.

Pesticides - Similar to livestock wastes, pesticides are an agricultural asset if used properly. However, misuse of pesticides can cause environmental damage which may linger for many years.

Insecticides are a category of pesticides widely used by landowners to remove destructive agricultural insects. They are also the most poisonous of agricultural chemicals, and are responsible for the majority of pesticide-related fish kills in Missouri's ponds and streams when used improperly.

Pesticides can cause other damage to aquatic habitats. Low doses of certain pesticides can cripple fish, sterilize them, or increase their susceptibility to diseases and parasites. Additionally, some pesticides may not be toxic alone, but can become deadly when mixed with other compounds in the aquatic environment.

Basic guidelines for the safe use of pesticides include:

1. Follow the pesticide label instructions.
2. Use pesticides that naturally lose their toxicity after a short time.
3. Avoid pesticide applications near streams, ponds and other bodies of water.
4. Use soil conservation practices to limit water runoff.
5. Properly dispose of old or unused pesticides and their containers.

Benefits and Problems Associated with Aquatic Plants

Aquatic plants are the biological foundation of aquatic environments. They provide many types of cover for countless aquatic animals and are the first link in the food chain. Additionally, they protect shorelines from erosion and provide important cover and food to other wildlife such as ducks, geese, bullfrogs, muskrats, shorebirds, etc.

However, extensive plant growth can cause problems. Aquatic plants are considered beneficial until the pond owner decides they are interfering with an intended water use. The plants become weeds when this happens. As a general rule of thumb, aquatic plants should not cover more than 25 percent of a pond's surface area.

Aquatic plant control may eventually be necessary even though appropriate measures were taken during pond construction to discourage plant growth. Control methods include mechanical, biological and chemical treatments. The best method for any particular pond depends on the type of plant, cause of the problem (shallow water, high fertility, etc.), the primary use of the water (many chemicals are not cleared for use in irrigation or domestic water-supply) and the cost of treatment.

Mechanical control - This type of control consists of pulling, raking, cutting and digging the aquatic plants. This is similar to "weeding" a garden. For most effective control, nuisance plants should be removed prior to seed formation. Plants like cattails, rushes, water primrose, willows and water lilies may be kept under control by removing new growth. Free floating plants like algae and duckweeds can be temporarily reduced by seining with window-screen material.

Submergent plants can also be temporarily controlled with mechanical methods. Using a wooden brail with strands of barbed wire attached, and pulling it through a weed-bed is an effective thinning procedure. However, this technique may increase the area of plant growth faster than might normally occur, since some plant fragments may reroot and grow in previously plant-free areas.

Biological control - Control of many aquatic plants is possible by stocking three to five grass carp per surface acre when aquatic plants cover 20 to 40 percent of the pond. More grass carp need to be stocked for heavier plant coverage. Grass carp do not damage ponds as the common carp does, nor muddy the water or reproduce in ponds.

Grass carp are capable of eating two to three times their weight in plants each day. When properly stocked in ponds, they can control filamentous algae, duckweeds and submergent plants. However, do not expect an immediate response after stocking. It usually requires three years before a noticeable reduction in aquatic plants occurs.

Chemical control - Killing aquatic vegetation with herbicides is an effective method of control when the plants are positively identified, the area to be treated is known and the correct amount of chemical is applied. However, there is no all-purpose herbicide that solves plant problems forever.

When considering the use of herbicides, two important points should be understood: (1) the final authority on proper use of a herbicide is the product label, and (2) always follow all label directions and warnings. Do not use more or less of the required chemical than the label recommends.

Chemical dosage rates are based on the total volume of water to be treated. This takes several calculations. First, estimate the number of surface acres by measuring the number of square feet and dividing by 43,560. The number of square feet can be arrived at by multiplying the average treatment area width in feet by its average length. Secondly, the average water depth should be accurately estimated for the treatment area. The water volume equation is Average depth X Surface acres.

For example, assume a shoreline area to be treated is 500 feet long and 10 feet wide with an average depth of three feet. It will have .345 acre-feet of water volume.

$$10 \text{ ft.} \times 500 \text{ ft.} = 5,000 \text{ square feet}$$

$$\frac{5,000 \text{ square feet}}{43,560 \text{ (square feet in acre)}} = .115 \text{ acres}$$

$$.115 \text{ acres} \times 3 \text{ feet (average depth)} = .345 \text{ acre-feet}$$

If the chemical to be used has a label recommendation of 3 pounds of chemical per acre-foot, the total amount of chemical to use is slightly over one pound ($.345 \times 3 = 1.03$ pounds of chemical).

Fish Stocking

Good pond fishing doesn't just happen. It's more than building a dam, controlling aquatic vegetation and stocking fish. Fish stocking must be carefully planned to achieve balanced fish populations. This means getting the desired species in the proper ratio and in the right number to the pond.

The fish species stocked in a pond will determine the kinds of fishing opportunities available in the future. For instance, if using the fish for food is the primary goal of the pond owner, a stocking of only channel catfish may be best. The most common option that provides both food and good sport is the largemouth bass-bluegill-channel catfish combination. When properly managed, this combination has proved to be one of the better ones used in ponds.

It is important to stock the desired fish at the proper rate and ratio. Overstocking is a common reason for poor fish populations. Like so many cattle to an acre of pasture, there is a right number of fish for an acre of water. Stocking too many fish will exceed the carrying capacity of the pond.

The Missouri Department of Conservation's stocking recommendation for largemouth bass, bluegill, and channel catfish combination is 100 bass, 500 bluegill and 100 channel catfish fingerlings per surface acre. Stocking at a higher rate usually results in slow growth for all species - commonly called "stunting."

Getting the fish to the pond in good physical condition is also important. Fish that are stressed due to low oxygen in the water or rough handling may not survive. Extreme temperature shocks should be avoided at any time. The temperature difference between the pond water and the water the fish will be hauled in should not be more than ten degrees. Spring and fall are the best seasons to stock fish due to cool weather and water conditions.

Fish already in a pond should be eliminated before stocking. Pond owners should contact a Missouri Department of Conservation representative before attempting to renovate a pond. It is a waste of fish, time and money to stock a pond that already contains fish. The small hatchery fish will probably be eaten by the fish already present and fishing will not improve.

Water depth should be considered when stocking fish. Depending upon the severity of the winter, water depth should be a minimum of five feet to ensure over-winter survival following a fall stocking. However, as the fish become larger a pond needs to be at least eight feet deep for adequate fish survival.

Finally, protect the fish populations by prohibiting the introduction of other fish species. Crappie, green sunfish, bullheads and carp are four species to definitely avoid. Each species can ruin the pond. Crappie compete directly with bass for food, and green sunfish eat fish eggs. Bullheads and carp create muddy water which reduces light penetration needed for food production. Crappie, green sunfish and bullheads may also overpopulate and disrupt the forage/predator ratio for the whole pond.

Pond owners may receive fish for stocking from the Missouri Department of Conservation if certain requirements are met. Also, privately-owned fish hatcheries sell fish for stocking.

Fish Harvest

General recommendations - Pond owners must plan and regulate the harvest of fish to maintain stable fish populations. Too little or too much harvest will create an imbalance in the number and size of fish.

The first three years of life in the pond for the largemouth bass, bluegill and channel catfish are the most important. After the fish have been in the pond for a year, the bass should be eight to nine inches, the bluegill five to six inches and the channel catfish 11 to 12 inches. These are average figures.

The pond will not need further stocking except to replace channel catfish. Channel catfish have a very limited ability to reproduce in ponds and will need to be restocked after the original fish are caught. If the harvest is properly regulated, bass and bluegill will never need to be restocked.

Bass will spawn when they are one year old; however, they should not be harvested until they have been in the pond for two full years. If the bass are removed before they reproduce, they will be unable to establish a population. Even after two years have elapsed, it is still possible to overharvest bass when the pond

is opened to fishing. Many observations and studies have shown that a large portion of the adult bass populations in ponds recently opened to fishing may be harvested with little effort. If 65 to 80 percent of the bass are removed, the bluegill usually overpopulate the pond and bass fishing becomes poor.

Proper harvest rates are related to the number and size of fish in a pond. Studies have revealed that under good conditions 65 to 80 percent of the bass are present two years after a pond is stocked. Therefore, a one-acre pond that was stocked with 100 bass will have approximately 65 to 80 adult bass when it is opened to fishing.

The number of bass to harvest is also influenced by their growth rate. Since bass spawn the second spring they are in the pond, the first bass to hatch will be only eight to nine inches when the pond is three years old. When the pond is four years old, they will be 10 to 12 inches long. The result is that the original bass stocked must support the bass harvest for at least four years from the time of stocking.

A general recommendation for pond harvest is as follows: do not remove more than 20 percent of the bass stocked in a pond, beginning the third summer after stocking. As an example, a pond owner can harvest 20 bass in both the third and fourth years from a one-acre pond originally stocked with 100 bass.

Bluegill may be harvested anytime they are large enough to eat. A good pond should eventually yield 200 to 300 per acre per year. Many small bluegill are necessary for good bass growth. It takes four to five pounds of them to produce a pound of bass.

Checking fish populations - More specific harvest recommendations can be calculated when the pond is older by measuring and recording the length of largemouth bass and bluegill. Measuring fish lengths allows pond owners to recognize balanced or imbalanced fish populations.

An index of size distribution is the percentage of adult fish of quality size. For largemouth bass, minimum adult size is eight inches, and minimum quality size is 12 inches. If ten bass are caught that are longer than 12 inches, the percentage size distribution (PSD) is 20 (100×2 divided by 10). In other words, 20 percent of the ten largemouth bass are of quality size. A balanced largemouth bass population should have a PSD of 20 to 60.

The PSD for bluegill is measured the same way except the sizes are different. For bluegills, minimum adult size is three inches and minimum quality size is six inches. Therefore, if ten bluegills are caught with none six inches or longer, the PSD is 0. Balanced bluegill populations have a PSD of 50 to 80. This

means five to eight bluegills out of every ten caught should be six inches or longer.

When PSD values are calculated for all the bluegill and bass caught during a season, they will provide the pond owner with valuable information. For instance, a PSD value below 50 means more than 50 percent of bluegills caught by anglers are shorter than the quality size of six inches. A bluegill population composed of mostly small fish indicates there are not enough bass to eat them. In this case, the bass are probably depleted and need to be protected.

A reverse situation can also occur. A bluegill population of 90 or more indicates that nearly all of the smaller bluegill are being eaten by bass. Frequently, a high bluegill PSD accompanies a low bass PSD. This means there are too many bass under 12 inches which are eating too many bluegill. In this case, a pond owner should harvest only largemouth bass under 12 inches until PSD values show a balanced size distribution for both bluegill and bass.

Developing Other Pond Uses

Wildlife habitat development - Habitat for terrestrial wildlife can be created by planting trees and shrubs around the pond area. However, it is not advisable to plant them on a pond dam because their roots weaken the earthen embankment. Fencing off an area around the pond that is one and one-half times the water acreage permits development of good wildlife habitat.

Recreational development - Ponds provide areas for fishing, swimming, boating, ice skating and other water-oriented recreation. Safe recreational use of a pond can be improved by planning and developing the area.

During pond construction, swimming beaches can be formed to eliminate plant growth by using a method called "blanketing." Blanketing refers to covering portions of the pond bottom with a six-to eight-inch layer of sand or fine gravel. Plants cannot root themselves in this material. Best results are obtained when covering is done over black plastic sheeting. Also, smooth out sudden drop offs or deep holes in the swimming area prior to the placement of sand or gravel. When the pond is completed and full, swimming areas should be marked with a simple floating buoy system.

Many people are non-swimmers so safety equipment should be made available for "anyone" to use. An inner tube with a long rope tied to it is an excellent safety device. The tube can be thrown to a person in trouble and retrieved with the rope. A long pole or wooden plank, painted white, are good rescue equipment to help pull a person out of the water. All safety equipment should be kept in a single location near the use area for easy access.

Summary

Ponds can provide many benefits to landowners if they are constructed and managed properly. Just like pastures and cropfields, ponds must be managed by landowners to gain the most benefit.

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UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 8: Agency Assistance

Technical help for improving private land for wildlife is available from many sources. This assistance is free of charge and some financial help may be available if certain requirements are met.

Missouri Department of Conservation (MDC)

Field personnel within this agency may be contacted locally or by writing to: Missouri Department of Conservation, P.O. Box 180, Jefferson City, Missouri 65102-0180. All of the field positions, with the exception of conservation agent, serve multi-county areas.

Conservation agent - At least one conservation agent is assigned to each county. Some counties have more than one agent. The primary responsibility of MDC's 190 conservation agents is to enforce the rules and regulations of the Wildlife Code.

Conservation agents also assist private landowners with wildlife, fisheries and forest management. For example, they will give on habitat improvement recommendations, provide application forms for MDC's fish stocking program and distribute wildlife food plot seeding packets. Agents provide a wide range of services to the public. If a request for assistance is outside their expertise they will refer the interested person to the appropriate MDC specialist.

Educating the public about Missouri wildlife and wildlife regulations is part of a conservation agent's responsibility. They frequently give presentations to groups and appear on radio and television programs. A substantial portion of their education efforts are spent on hunter education classes.

Wildlife services biologists - These biologists are wildlife habitat specialists. At a landowner's request, they will make recommendations for improving wildlife habitat in the context of the owner's conservation goals. Wildlife services biologists give presentations to farmers' organizations, civic clubs and sportsmen's groups. They frequently assist agriculture instructors design and implement conservation programs. Wildlife services biologists also provide a limited number of trees, shrubs and seed to landowners interested in habitat improvement.

Wildlife damage control agents - There are three wildlife damage control agents in Missouri. They teach wildlife control techniques to landowners who are experiencing significant losses due to wildlife damage.

Fisheries management biologists - These individuals are mainly responsible for large impoundment and stream fisheries management. Fisheries management biologists also help private landowners solve aquatic resource problems by giving advice over the telephone or in person. Types of assistance include sampling fish populations, advising on aquatic weed control and streambank stabilization, providing fish stocking recommendations and other aspects of fisheries management.

Resource foresters - Their main duty is to assist landowners who request forest management help. Resource foresters will evaluate wooded areas and give advice on tree planting, timber stand improvement, tree harvesting, timber sales, tree insect control and other related advice.

Soil Conservation Service (SCS)

The Soil Conservation Service (SCS) is an agency of the U.S. Department of Agriculture. SCS is responsible for USDA programs relating to the conservation of the nation's soil and water resources. Nearly all counties in Missouri have a SCS field office. A district conservationist manages the SCS field office and usually has a staff of well-trained specialists (i.e. soil conservationist, soil conservation technician).

SCS employees provide conservation planning and engineering assistance to interested landowners. Their primary expertise lies in planning, designing and guiding the construction of soil conservation practices. However, they are also quite capable of giving sound advice in other resource areas. Landowners interested in information about terraces, diversions, conservation tillage systems, soils or pond construction should contact SCS. In most cases, SCS does not handle cost-share funds dealing with conservation practices.

SCS is a major participant in the implementation of the new federal conservation laws. The new laws include sodbuster, swampbuster, conservation reserve, and conservation compliance. The agency's role is to perform the technical services required by these programs.

Agricultural Stabilization and Conservation Service (ASCS)

The Agricultural Stabilization and Conservation Service (ASCS) is an agency of the U.S. Department of Agriculture. ASCS administers farm programs which provide crop loans, price supports and other financial assistance to farmers.

ASCS plays an important role in conservation. ASCS officials accept or reject rental bids from farmers interested in enrolling land in the Conservation Reserve Program (CRP). The agency also is responsible for paying CRP rental payments to farmers who have land enrolled in the program.

The Agricultural Conservation Program (ACP) is administered by ASCS. This program provides cost-share funds to farmers who build conservation programs according to Soil Conservation Service specifications. Examples of practices most counties will cost-share on are: terraces, grass waterways, diversions, tree planting, wildlife habitat development, etc. County ASCS offices set their own cost-share rates within certain limits recommended by higher authorities and select the practices eligible for cost-share funds.

Nearly all counties in Missouri have an ASCS office located in the same building with the Soil Conservation Service field office. These offices are usually located in the county seat.

The ASCS county executive director and a committee of three local farmers guide the programs to meet federal policy and local needs.

University Extension

University Extension, formerly called Missouri Cooperative Extension Service, has an office located in each county. This agency provides information to the public about agriculture, home economics, business and industry, and community development.

The University Extension has agricultural advisors stationed at many locations throughout the state who provide technical assistance on a broad range of agricultural questions. They will work individually with farmers or give presentations to groups on agricultural topics.

University Extension has a wide selection of printed material available to the public regarding agriculture, forestry, horticulture, wildlife conservation and wildlife damage to property and crops. This agency also will handle landowner requests for soil analysis.

Soil and Water Conservation District (SWCD)

The Soil and Water Conservation District's are county organizations under the Soil and Water District Commission of the Department of Natural Resources. Each District is guided by a board of directors who are unpaid volunteers elected by county residents. District boards usually hire a secretary and soil conservation specialists to carry out SWCD programs and to assist Soil Conservation Service in the design and construction of conservation practices. SCS and SWCD personnel are located in the same office.

SWCD's implement conservation cost-share programs with assistance from the Department of Natural Resources and USDA Soil

Conservation Service. These cost-share programs are separate from ASCS programs. State cost-share funds are spent on conservation practices such as terraces, diversions and grass waterways which meet SCS specifications.

Summary

The Missouri Department of Conservation, Soil Conservation Service, Agricultural Stabilization and Conservation Service, University Extension, and Soil and Water Conservation Districts are the primary government agencies which help landowners conserve their natural resources. They play different roles which tend to complement one another. Representatives of any of these agencies are aware of conservation programs available in Missouri and will direct landowners to the appropriate agency if the request is outside their expertise.

Credits

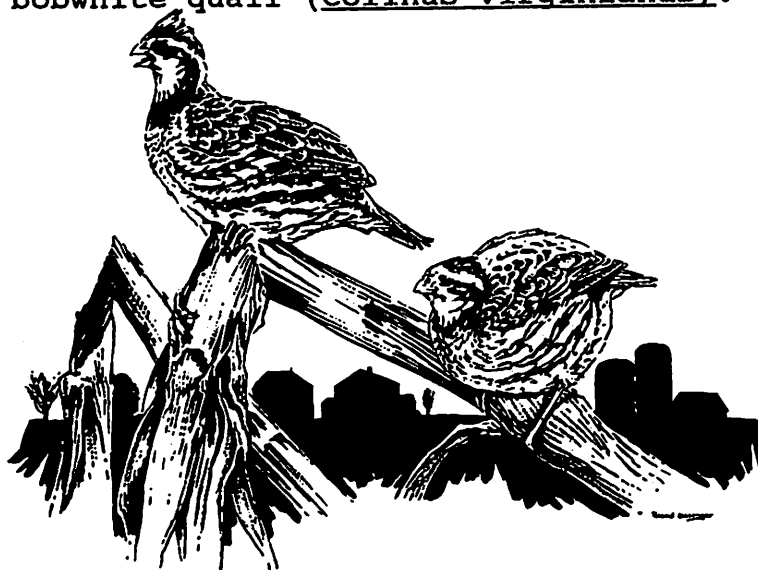
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UNIT IV - ANIMAL LIFE HISTORIES

Lesson 1: Bobwhite Quail (Upland Habitat)

The wildlife biologist views the farms, fields, prairies and most habitats that are not heavily forested or flooded as upland habitat. The mosaic of crop fields interlaced with fencerows, brushy thickets, small woodlots and pastures is a classic example of upland habitat.

Upland game species are usually those called farm game and include bobwhite quail, cottontail rabbit, pheasant and dove. Generally, habitat suitable for quail and rabbits is also suitable for other upland game and non-game species. This lesson focuses on the life history of one of the most popular upland game species--the bobwhite quail (Colinus virginianus).



Description

Size and sex criteria - The bobwhite quail is a small, brownish bird weighing from five to seven ounces with a height of seven to eight inches. The sex of adult quail is easily determined by conspicuous head and throat markings. The male has a white throat patch and a wide white stripe above the eyes. Both the patch and the stripe have a black or dark brown border which accents the whiteness. By contrast, females have tan to dusky brown markings on their heads and throats. Also, males tend to be slightly larger than females and have more distinctive plumage coloration.

Age criteria and longevity - The rapid growth rate and changing plumage of young quail provide the means to estimate their age to the nearest week. Determining a wild quail's age in years is rarely necessary because over 80 percent die before they are a year old. Few wild quail live beyond fourteen months. However, captive bobwhite quail can live up to four or five years.

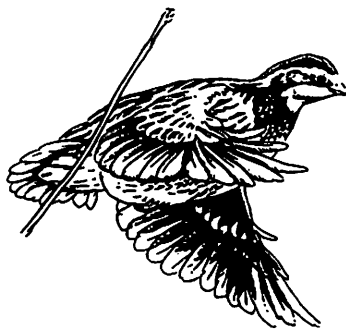
Noticeable stages of a quail's development can be seen for 16 weeks after hatching. The chicks are unable to fly during the first week of their lives and are covered with natal down. They are able to run shortly after hatching. By eight weeks the young birds are almost adult size, but have yet to develop the characteristic markings of male and female. At 16 weeks of age, the birds are full-grown with distinct head and throat markings.

Voice - Bobwhite quail have many different calls to communicate with each other. The most characteristic call of the bobwhite quail is the courtship/territory whistle of the male (bob-WHITE). This call serves as a challenge to other males in the vicinity and invites females to engage in the courtship ritual. Males continue to use the bob-WHITE call throughout the summer to maintain their respective territories before and after the nesting takes place.

Both male and female bobwhite use other calls for a variety of purposes. The well-known gather call (whoil-kee) is used by both sexes to regroup the covey after it has been flushed. This call is frequently heard in the evening when a covey is gathering to go to roost.

Bobwhite quail also have a soft chatter they utter when feeding or running and a universal alarm note to warn each other of danger (toil-ick-ick-ick). Quail also have a low purring sound they make when a covey is on the verge of taking wing.

Physical mobility - Bobwhite quail are capable of short bursts of rapid flight--sometimes reaching 40 to 50 miles per hour. They have short, cupped wings well-adapted to fast takeoffs. However, bobwhites prefer to stay on the ground and use their legs to escape predators, find food, etc. Although their flight is explosive and rapid, they are incapable of sustained flight.



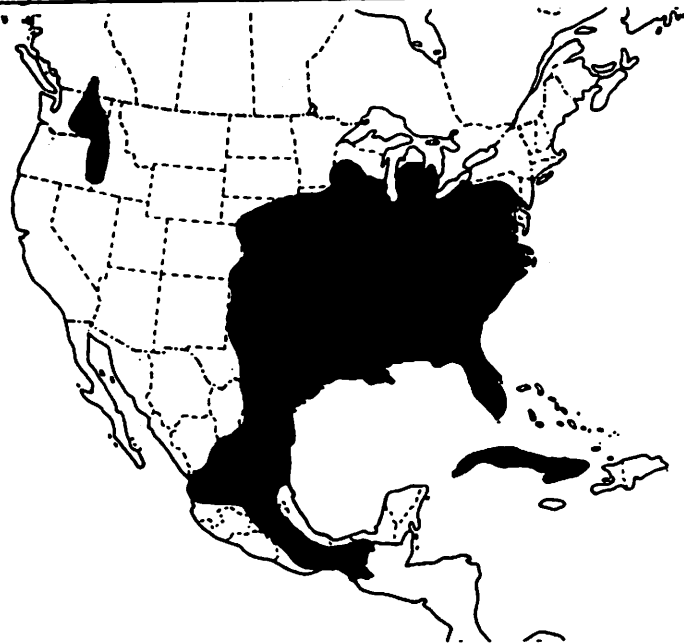
Distribution and Abundance

The bobwhite quail is found in every Missouri county. This species is not as numerous as it was only 20 years ago, but Missouri still has a quail population numbering in the millions. Hunters harvested approximately four million quail during the 1987 hunting season. Generally, quail populations are lowest in

the Ozarks because of the large amount of woodland and in the Bootheel where there is little woody winter cover. Extremely favorable habitat may carry densities of a quail per two to four acres. A bird per two to 12 acres provides favorable hunting opportunities.

Bobwhite quail are found over a large portion of North America. As the Figure 1.1 indicates, they cannot survive in the arid or mountainous areas of the western U.S., nor in the colder climates of northern states.

FIGURE 1.1 - Range of Bobwhite Quail



Habitat

Like other fish and wildlife species, bobwhite quail require a particular blend of environmental conditions to survive and prosper. They are a creature of early successional stages.

Bobwhite quail become most abundant where ample food sources are distributed in a combination of cropland, woodland, grassland and brushy cover. A thorough mix of these plant cover types provides the "edge" this species requires.

"Edge" refers to the area where plant cover types meet. Bobwhite quail need the edge provided by the border between crop fields, pastures, brushy areas and woodland. High quality edge places the quail's life requirements in a small area. This is extremely important because of this species' low mobility, limited flight range and reluctance to move. With adequate habitat, Missouri quail often spend their lives within several hundred yards of their hatching point.

Habits

Bobwhite quail have distinctive habits. They are gregarious birds which rely on each other for survival during most of the year.

One of the most noticeable habits of the bobwhite is the familiar bob-WHITE call of the male. The male uses this call in the spring and summer to establish and maintain a territory for breeding purposes. The bob-WHITE call is used to attract a female and also to challenge other males in the vicinity.

Males frequently fight over their territories when challenged by a rival male either before or after a female has arrived. They fight by flapping, scratching and pecking each other. However, these fights over territory rarely result in physical damage to either opponent. Fighting among bobwhite males is a part of nature's design for establishing territory, choosing a mate, defending the hen and the nest, and showing ownership of the chicks.

After a male has attracted a female, he struts and performs a courtship dance to initiate the breeding process. After mated, the pair stays together throughout the summer for egg laying, nesting and raising the chicks.

Both sexes share responsibility for raising the young. If the hen is killed during incubation, the male usually takes over incubating the eggs. The male also helps the hen raise the young after they hatch. For instance, both sexes will "brood" the chicks during a rainstorm or at night. Brooding consists of gathering the chicks under the parent's wings to keep them warm and/or prevent them from getting wet.

By early fall the chicks are grown and the family units begin to weaken. The birds start to wander in an effort to find other quail. This period of movement is called the "fall shuffle" and continues until coveys are formed in early winter and move to heavier winter cover.

"Coveying up" is essential to the quail's survival during the winter months. Coveys usually have an average of 13 to 16 birds which feed and roost as a unit. Coveys generally remain intact until mid- to late-March when the birds begin to leave for the breeding season. Coveys are dissolved by the end of April.

The roosting habit of bobwhite quail coveys is particularly interesting. The birds position themselves in a disc-like formation with their tails to the center and their heads pointed outward. Their wings are slightly raised and overlapped to seal the top, and thus trap body heat. This roosting habit helps a quail covey survive cold winter temperature which individual quail could not. On extremely cold winter days, a quail covey may remain in their roosting formation most of the daylight hours except to feed.



The quail's roosting formation is also valuable for predation detection. At any time, at least one or more of the birds are awake and will warn the others of danger if a predator is in the vicinity.

Quail are selective about their roosting location. They prefer vegetation about two feet tall which is open enough at ground level for flight from the roost. They also like to have some bare ground exposed with an open sky above. This type of condition usually exists in idle fields or at the edges of brushy thickets.

Bobwhite quail do not bath in water like many other bird species. Instead, they take dust baths to keep themselves clean and remove external parasites. "Dusting" is important to quail. They usually dust in an open area where more than 75 percent of the soil is bare and vegetation is less than one foot tall.

Food

Bobwhite quail eat a large variety of foods depending on the season of the year and what type of foods are available. The bobwhite's diet changes from at least 95 percent seeds and plant parts in winter to 70 percent in summer. Insects make up the remainder. Insects have a higher protein content than seeds, and the increase in insect consumption in spring coincides with a physiological change in the birds as the breeding season starts. The higher protein diet is needed by the hens and the newly-hatched chicks. Ground beetles, flies, ants, lady bugs, plant lice, aphids, etc. are examples of insects quail eat.

The availability of food largely determines what quail eat. Food habit studies in Missouri found that quail occurring in different parts of the state had varying diets. Korean lespedeza was the major food item in the Ozarks. Corn, soybeans and other cultivated crops comprised most of the quail's diet in the agricultural areas of northern Missouri.

The seeds of corn, soybeans, sorghum, wheat, common ragweed, croton, foxtail, beggar-tick and sumac are examples of foods which quail prefer in Missouri. Seeds of annual plants such as these provide about 80 percent of the quail's diet with the remaining 20 percent coming from perennial plants. Two important tree seeds consumed by quail are acorns and the seeds of the green-twig sassafras.

Importantly, bobwhite quail are not restricted by the distribution of specific kinds of plants within their geographic range. They consume a wide variety of foods and tend to eat what is readily available.

Reproduction

Bobwhite quail have a high reproductive rate when habitat conditions are favorable. This species can breed itself from scarcity into abundance within a one- or two-year period in excellent habitat.

Bobwhites nest on the ground. They prefer open locations as a nest site. Nests are usually found on areas where the ground is partially covered with vegetation. They avoid areas of thick and/or matted down vegetation because it restricts their movement on the ground.

The usual location for a nest is in dead grass or other vegetation of the previous summer. The nest may be in a thin spot in the grass or near a clump of grass. Upright stems near the nest must be thin enough for birds to get through easily and not more than 20 inches tall.

The male and female pick the nesting site and build the nest together. They form a shallow depression about two and a half inches deep and four to five inches across by scratching and pecking. The bottom of the cavity is filled with about one inch of dead plant material such as grass stems or tree leaves. The nest is completed with a "roof" of grass stems arched over the top.

A female will usually lay the first egg one or two days after the nest is completed. After that, she lays an egg (white in color) every day until 12 to 15 eggs are deposited in the nest. This is called the clutch--the total number of eggs to be incubated.

The female does not incubate any of the eggs until the last one is laid. By doing so, the embryos will begin development and subsequently hatch at the same time even though some of the eggs were laid two weeks apart.

The quail eggs require 23 days of incubation. During incubation the brooding bird turns the eggs with its feet, breast and bill. This prevents the embryo from sticking to one side of the shell.

The nesting cycle of the bobwhite requires 47 to 55 days to complete which includes nest building, egg laying, incubation and hatching. In normal weather the hatching peak is around June 15 with 65 to 75 percent of the annual crop produced during this month.

The loss of nests to weather, predators, etc. is somewhere between 60 and 70 percent. Bobwhite quail will make up to four successive attempts at raising a brood if their nests are destroyed. However, it is better if the first nesting attempt is successful. As the summer progresses, the hens become weaker as the egg laying continues and late-hatched chicks will not be fully grown when winter begins.

Adverse Factors

Bobwhite quail have many predators. The list of animals known to prey on quail is impressive: skunks, opossums, foxes, raccoons, cotton rats, weasels, mink, bobcats, ground squirrels, fox squirrels, gray squirrels, Cooper's hawks, sharp-shinned hawks, marsh hawks, great-horned owls, bluejays, crows and turkeys. Several species of snakes will eat eggs, chicks and adult quail. Housecats and dogs sometimes prey heavily on eggs and incubating adults.

Despite the long list of predators, they do not constitute a serious threat to bobwhite populations. For example, research on quail predation in Missouri during the 1950s revealed that fewer than one percent of 770 coyote stomachs contained quail; fewer than one in 100 housecat stomachs had quail; and just over two percent of 1000 red fox stomachs had quail remains. Although many animals will eat quail, no Missouri predator specializes in eating bobwhites.

Weather is second only to habitat in its effect on quail populations. Hot, dry summers reduce nesting success by causing embryos to start developing before the hen is finished laying eggs. The hen will leave the nest after two or three eggs are hatched and the remaining eggs will spoil or be eaten by predators. Also, excessive rain during the nesting season may keep eggs from hatching or drown newly-hatched chicks.

Severe winter weather has a devastating effect on bobwhite quail--particularly in the northern areas of their geographic range. Snow and ice can easily make the quail's food supply unavailable. Low temperature coupled with snow and ice can kill entire coveys.

The most critical factor for bobwhite quail is habitat which is helped or hindered by how farmers use the land. Short-term population changes are caused by severe winter weather, but the continued long-term decline has been caused by the loss of quality habitat.

Farming patterns with a variety of crops, small fields, brushy thickets, pasture and idle areas produce the "edge" the bobwhite require. Conversely, clean farming with its manicured fencerows and large fields is the bobwhite's most effective enemy.

Quality wildlife habitat can be compatible with agriculture. Many desired wildlife practices also provide good soil and water conservation. Well-managed grassed waterways and grassed backslope terraces provide nesting sites as well as conserve soil. Properly managed forage systems will yield both higher livestock profits and wildlife nesting cover. Conservation tillage conserves oil, tractor fuel and provides quail and other wildlife with winter food in the form of waste grain.

Summary

The bobwhite quail is a well-known and interesting upland game species. It coexists with hundreds of other animal species which live in upland habitat. The bobwhite quail's future, and the future of many other species, depend on how upland areas are used by humans.

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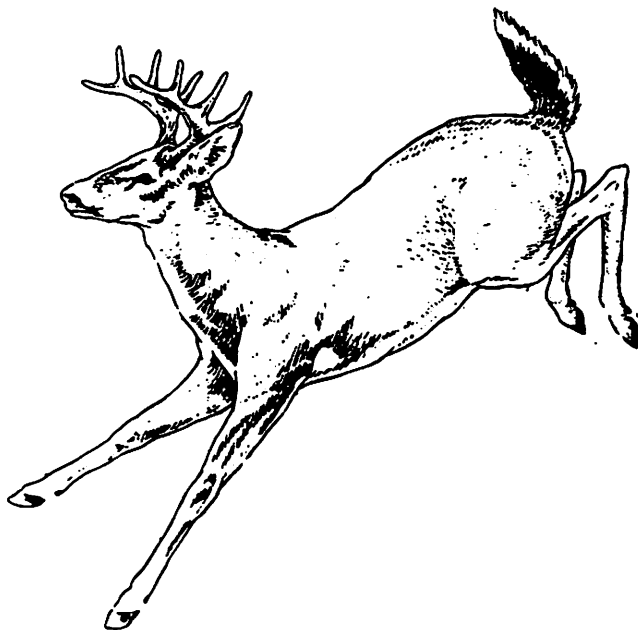
UNIT IV - ANIMAL LIFE HISTORIES

Lesson 2: White-tailed Deer (Forest Habitat)

Missouri's forest wildlife includes species such as the gray fox, white-tailed deer, eastern gray squirrel, fox squirrel, turkey, ruffed grouse and many kinds of woodpeckers. These species require forest cover over a substantial portion of their home ranges. However, most forest wildlife use crop fields, pastures and idle areas at various times.

Missouri contains many types of forest habitats. Some are in large, nearly continuous tracts such as in the Ozarks. Others are small woodlots in the agricultural regions of northern Missouri. Many are in between in size and associated with rough topography and stream corridors. Forest habitat in present-day Missouri exists as a land-use decision; mankind has chosen not to remove forest cover for agriculture, economic or timber production reasons.

This lesson explores the life history of a well-known forest game animal--the white-tailed deer (Odocoileus virginianus).



Description

Size and sex criteria - The white-tailed deer is easily recognized by its long legs and hoofed toes, moderately long and well-haired tail, large size and presence of antlers during part of the year in males. Antlers normally occur only in males. The penis and scrotum are absolute sex identification characteristics for all ages of deer because approximately three percent of females grow antlers. The sex of a deer cannot be identified by its track because there is no difference between the size and shape of buck and doe hoofs.

White-tailed deer continue to increase in weight until they are roughly six years old. Mature whitetail bucks in northern states usually weigh between 200 and 300 pounds with does weighing 25 to 40 percent less. The record weight for a buck in Missouri is 369 pounds.

Antler growth cycle - The increasing hours of daylight in spring stimulate the pituitary gland to initiate antler growth. The growth starts in April or May when the base of the antler is still covered with soft skin richly supplied with blood vessels.

The blood transports the calcium, phosphorus, protein and other materials from which the antlers are made. During growth, from the time the antlers first appear as "buds" until they assume their final size, the soft skin and the short hair covering each antler have a plushlike quality giving this stage the name "velvet."

Full size is reached in August or September, shortly before the breeding or "rutting" season. By this time a male sex hormone, testosterone, is being produced in increasing amounts and starts shedding of the velvet. In this process, the blood supply is cut off at the base of the antler and the velvet skin begins to dry and peel.

The buck rubs his antlers against trees and shrubs to remove the dead skin. When the skin has been shed, the bony core remains. The antlers are carried in this condition throughout the rut. At the end of the breeding season, usually from the last of December to mid-February, the antlers become loosened and are shed.

Age criteria, age ratio and longevity - Fawns are reddish brown or reddish yellow spotted with white. They are easily distinguished from adults until they lose their spotted coats which occurs between three and five months of age.

It is not possible to tell the age of a buck by the size of the antlers or number of points. Antler growth depends upon many factors such as the deer's age, the quality and quantity of food, injury, hormone regulation and heredity. Therefore, whitetail bucks of the same age may have markedly different "racks." In Missouri there have been exceptional cases of well-nourished yearlings having a total of 10 or 11 points.

The best means of age determination of deer in the field is by replacement and wear on the teeth. Aging by tooth replacement and wear is most accurate on fawns and yearlings. In Missouri, more than 90 percent of the harvest is composed of deer under four years of age.

Deer are in the prime of life between two and a half and seven and a half years of age. Some may live for about 15 years in the wild and up to 25 years under protection.

Voice and sounds - Adult deer are usually silent but make certain sounds on occasion. When scared, they sometimes give a loud, hoarse, high-pitched shriek. They frequently snort or blow, and adults of both sexes sometimes bleat. Females call their young by a low murmur, and the young bleat or "baa" to call their mother. Does and fawns both cry loudly if in pain. Adult males "bawl" sometimes when fighting, injured or restrained.

Bucks, does and fawns may stamp their feet on the ground; this occurs whether they are annoyed or not. Deer also communicate with each other by means of their scent glands, by various movements of their tail, ears, head, face and by their body posture.

Color - In summer, both sexes are reddish brown to tan with white markings about the throat, underbelly, legs and tail. The color pattern of the winter coat is similar to the summer one but is grayish to grayish brown.

Adults have two molts annually. The spring molt begins about the middle of March and continues until around the first of June. The summer coat is lightweight and consists of fine, short hairs that lie close to the skin. The fall molt begins from August to mid-September and is completed by early October. The hairs of this coat are long and heavy; each hair has many air spaces that act as insulation. The coat easily repels cold rain and wet snow in winter.

Glands - The tarsal glands, marked by a tuft of long, coarse hair on the inside of each hind leg at the ankle, produce an oily secretion with a strong odor. Fawns a week or so old, as well as adults, stand with their hind legs together, urinate down the insides of the legs so that the fluid saturates the hairs of the tarsal glands, and then rub the legs together. The urine scent along with the secretion from the tarsal glands, contributes to a body odor that may be recognized by other deer.

Another set of glands, the metatarsals, occurs on the outside of each hind leg between the ankle and hoof. They have an oily secretion with a pungent, musky odor which serves to identify resting spots used by the deer.

Pedal glands, lying between the two main toes on each foot, secrete a strong offensive odor throughout the year. The secretion is delivered to the hoofs by long hairs and scents the tracks of the animal.

Physical mobility - Deer normally walk, trot, or bound along in low, smooth jumps interspersed with an occasional high jump for observation. When startled they may run at speeds up to 35 miles per hour for three to four miles but are unable to maintain this pace for longer distances. Deer are expert jumpers, and when pressed can clear fences eight and a half feet tall.

White-tailed deer swim well and can attain a speed of 11 to 13 miles per hour. In summer, deer swim lower in the water than in winter. They are more buoyant in winter because the hairs of their coat have a hollow, air-filled core and because there is an accumulated layer of fat under the skin.

Distribution and Abundance

White-tailed deer are found in every Missouri county, although they are most abundant in the Missouri River hills in east-central Missouri, the river drainages of northeastern Missouri, and in the upper Osage River watershed. In recent years, Missouri has had an annual deer harvest of well over 100,000 animals.

The geographic range of the species is large (Figure 2.1). White-tailed deer inhabit every state in the U.S., with the possible exceptions of Alaska and Utah. The northward range extends well into Canada. To the south, white-tailed deer are found through Mexico, Central America and a portion of South America.

The white-tailed deer has 38 subspecies over its geographic range. Generally, northern subspecies are larger than their southern counterparts.

FIGURE 2.1 - Range of White-tailed Deer



Habitat

In Missouri as elsewhere in their North American range, white-tailed deer favor forested areas. However, they prefer timbered areas which border other habitat types rather than dense, unbroken forests. One of the main reasons for this habitat preference is that the great variety of foods desired by deer grows best along the margins of forested areas or clearings in the forest. In addition to native vegetation, deer utilize the food offered by agricultural crops adjacent to timbered areas.

Habits

White-tailed deer tend to have an average annual home range of one-half to one and one-half square miles. Some individuals, particularly bucks during rut, may cover a larger area. Local movements of deer in Missouri are related primarily to seasonal changes in food sources or cover. For example, where acorns are not abundant in their summer area, some deer may shift to localities where they are available in fall and winter. Also, the harvest of crops in the fall restricts cover availability in agricultural habitats.

Deer usually spend the day in concealing cover and rarely move about, but toward evening they come out to feed and drink. The main feeding period is just before dark in the evening. In summer deer feed about sunset, but in winter they start an hour or so before sunset. They tend to bed down for a few hours and then have another feeding period about dawn. On bright moonlight nights they may feed all night, but on dark nights they are more active early in the evening and again early in the morning.

Deer associate with each other loosely all year and during their contacts establish a relationship of dominance. This is seen mostly by means of postures and threats. The first signs of aggression are made by one deer laying the ears back against the neck and staring at the other deer while the head is slightly lowered. If one of the deer does not give way, the two deer may move toward one another, turning their sides. If the two deer are bucks, the interaction may be continued by threatening with lowered antlers and rushing at the adversary. If they are does, they may threaten by striking with one foot or by rearing up on the hind feet and attacking with both front feet.

Bucks mark their home range with rubs and scrapes. A buck rubs the velvet from his antlers and polishes the bony core by vigorously rubbing small trees. Rubs serve as signposts of the buck's presence.

Scrapes are made in leaves on the ground by pawing with the front feet. The buck urinates in or behind the scraped area, often mixing the urine with scent from the tarsal glands. Scrapes are usually made in areas where there are many rubs. They are often reworked by the buck and are defended from other males. Females may come to the scrapes and urinate in them to establish contact with the buck.

Bucks commonly fight during the rut. They seldom make repeated charges. Once their antler meet, they push and shove without making new contacts. Deer also fight with their front feet, using sharp-pointed hoofs to inflict wounds. Sites of combat are frequently marked by disturbed ground that the deer have torn up with their feet and antlers.

The large, well-haired tail serves many purposes. When the deer is running or bounding, it is held high and the white underhairs are erected as a signal of alarm to other members of the herd. After the deer has inspected the surroundings, the tail is flicked to indicate a lack of danger.

Foods

Deer are browsing animals, feeding chiefly on the leaves, twigs, and fruits of trees and shrubs and the foliage of herbaceous plants. They also consume seeds, mushrooms, mosses, lichens, succulent grasses, farm crops and sometimes small amounts of animal food like snails and fish. Over 450 different kinds of plants are known to be eaten by white-tailed deer in Missouri. However, only relatively few of these are used extensively.

From the time acorns first become available in September until they are gone, they are preferred by deer for food. During the fall and winter deer also feed on fruits of woody plants like sumacs and coralberry; the cultivated crops of corn, soybeans, wheat, rye and sorghum; the few remaining green leaves of grasses and sedges; and the twig tips of a few woody plants.

In the spring they return to the succulent vegetation of perennial forbs, shrubs and trees. They are particularly fond of the new growth of white and red elm, fragrant sumac, red clover, Virginia creeper, wild grapes, prickly lettuce and mushrooms. The summer diet consists largely of the leafy parts of fruits of annual and perennial plants including wild grapes, Korean lespedeza, dwarf sumac, Virginia creeper, red clover, pokeweed, persimmon and mushrooms.

Deer show a definite selection of plants and appear to take those that are most nutritious and palatable. This selectivity can have serious effects. In ranges having heavy concentrations of deer, overbrowsing occurs. The result is a lower level of nutrition in the herd and the elimination of these desirable foods from the range. Because many plants preferred by deer grow in openings of the forest, some may also be eliminated by changing conditions caused by too much shade. This natural type of plant succession is as important to the food supply of deer as overbrowsing.

The white-tailed deer is a ruminant with three so-called "stomachs" which are branches of the esophagus, and one true stomach. Food goes to the first "stomach" for temporary storage and is regurgitated to the mouth for further chewing in the form of moistening balls known as cud. It is then swallowed again and goes into the remaining stomachs where it is churned and prepared for digestion through the action of microorganisms.

Reproduction

The peak of mating or rutting season is in November. Does may come into heat as early as September. The heat period, or time of receptivity of females, lasts about 24 hours. Unmated does will continue to come into heat every 28 days during the breeding season.

Pregnancy lasts six and a half to seven months. The fawns are most often born in late May or early June. A doe usually has twins but sometimes may have a single offspring or triplets. At birth each fawn weighs between four and seven pounds and measures 17 to 19 inches in total length. Its eyes are open and it can stand feebly. The female leaves the fawns alone but stays within hearing distance of their calls. She nurses them frequently and licks them carefully. The young remain in the close vicinity of their birthplace for several weeks.

The fawns begin to follow the doe and start eating solid foods when they are about three to four weeks old. Weaning may begin about this time, although some fawns nurse until they are six months old. The young accompany the female until they are old enough to breed or until she has another litter.

During the summer the doe cares for the fawns while the yearlings stay together but do not rejoin her. In the fall, the yearling does join again with their mother and the fawns, forming the most common family unit. Yearling bucks seldom return to the doe but either remain alone or randomly associate with other bucks.

About half of the young females in Missouri become sexually mature at six to eight months of age and consequently breed in the year of their birth. These young females account for up to 30 percent of the annual increment to the whitetail population.

Adverse Factors

Next to humans, who are the most effective predators of deer in Missouri today, free-running dogs are the most serious threat. They do not always kill the deer, but may drive them out of their preferred habitat. While coyotes and bobcats prey on deer, the loss from these is not substantial.

White-tailed deer have their associated parasites as do most other animals. However, parasitism in deer is not a threat to the species. The following parasites have been reported from white-tailed deer in different parts of their North American range: roundworms, flukes, adult and larval tapeworms, mites, ticks, lice, and adult and larval flies.

A hemorrhagic disease, caused by a virus, has been documented in Missouri. Some of the diseases known to affect deer in other parts of their range are tuberculosis, tumorous growths, infection of the eyes producing temporary blindness, distemper, black tongue, hoof-and-mouth disease, hoof shedding, tularemia and pneumonia. Missouri deer do not contract or carry brucellosis.

The most important cause of accidental death is highway kill. In Missouri, the official highway kill for 1986 was 8,020.

Summary

The white-tailed deer is the most popular big game animal in North America and provides humans with food, sport and viewing enjoyment. Probably more than any other species, the white-tailed deer represents things wild and free to the human mind. It is an adaptable species which should continue to experience healthy populations in Missouri for many years to come.

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UNIT IV - ANIMAL LIFE HISTORIES

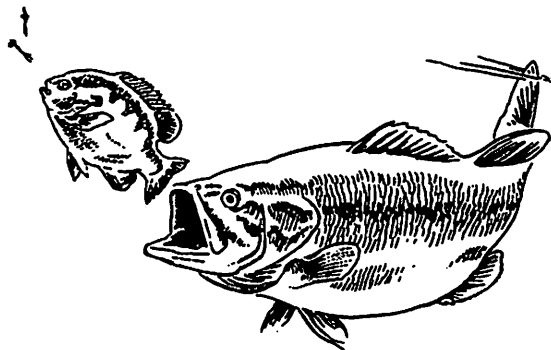
Lesson 3: Largemouth Bass (Aquatic Habitat)

Missouri has a rich diversity of aquatic habitats including farm ponds, large rivers, drainage ditches, reservoirs, streams and swamps. Each type of water body produces a set of living conditions which favors some plants and animals--and excludes others. For instance, the clear, fast-moving streams of the Ozarks contain 14 species of fish which are found nowhere else in the world.

The plants and animals living in a water body must be adapted to their surroundings or they will not survive. Channel catfish, flathead catfish and green sunfish are fish species which are well-adapted to the turbid, slow-moving streams of northern Missouri. Conversely, the smallmouth bass, northern hog sucker, rainbow darter and bigeye shiner are fish species adapted to the faster current and cleaner water of Ozark streams. Large reservoirs and rivers contain yet a different assemblage of plants and animals.

Aquatic habitats are defined by water. Its depth, temperature, clarity, nutrient level, velocity and fluctuations all have a large impact on aquatic organisms. According to Lagler (1977), "Water is a highway, byway, communications medium, nursery, playground, school, room, bed, board, drink, toilet, and grave for a fish. All the fishes' vital functions of feeding, digestion, assimilation, growth, responses to stimuli, and reproduction are dependent on water." This statement can also be partially applied to countless of other aquatic organisms including invertebrates, insects, crustaceans, amphibians and reptiles.

This lesson explores the life history of a well-known and highly adaptable sportfish--the largemouth bass (Micropterus salmoides).



Description

Body shape and mobility - The largemouth bass is a member of the sunfish family. Members of the sunfish family are characterized by deep, laterally compressed bodies and spiny-rayed fins. For their size, largemouth bass have a high ratio of fin surface toward the front of its body. This allows the bass to move quickly in almost any direction.

Largemouth bass are capable of explosive bursts of movement-- sometimes reaching 12 miles per hour. However, they are able to maintain this speed for only short periods.

Coloration - This species is easily recognized by its large mouth and dark stripe or blotches down the side. Its color varies depending on the clarity of the water. Largemouth bass living in turbid water are usually lighter in color than those found in clear water. Generally, largemouth bass have a dark green back with white on the belly. The color change from top to bottom is gradual. Also, small bass fingerlings have the capability to match the color of vegetation they are hiding in.

Growth and longevity - Like other fish species, largemouth bass continue to grow throughout their lives. The world record largemouth bass was caught in Georgia in 1932 and weighed 22 pounds 4 ounces. Missouri's record came from Bull Shoals Lake and weighed 13 pounds 14 ounces. In Missouri, a largemouth weighing more than five pounds is usually ten years of age or older.

The life expectancy for a bass is about eight to ten years, but some live longer. The average life span is five years. Females tend to live longer and grow faster than males.

Hearing - Largemouth bass can "hear" noises in the water, but it isn't the same type of hearing humans possess. Bass sense the slightest vibrations in water through their lateral lines. A bass possesses two lateral lines; one on each side its body that run from the gill cover to the tail. Nerve endings lying near the lateral line act as sensors to changes in water pressure and vibrations. The extent individual bass use their sense of hearing is dependent upon their habitat. Bass which live in turbid water are forced to use their sense of hearing more than fish living in clear water.

Sight - Bass have excellent eyesight and feed primarily by sight. They are sometimes able to see objects above the water surface and have been known to move toward a lure before it hits the water. Bass are able to see colors and distinguish red and green the best.

The curvature of the eye lenses allows five times more light to enter a bass eye than a human eye. Although bass do not have adjustable pupils and eyelids like humans and other animals, they are still able to compensate for different light conditions. The rod and cone light sensor cells in a bass eye move about in the eye pigment to adjust for varying amounts of light. However, bass cannot adjust to rapid changes in lighting as well as humans.

Bass have monocular vision which means each eye is controlled individually. This adaptation allows a bass to look in two directions at once.

Smell - The largemouth bass does not use its sense of smell extensively. Most fish have a well-developed sense of smell and there is no reason to assume bass are different. However, scent apparently is not as important as sight and hearing to the largemouth bass.

Distribution and Abundance

The largemouth bass was originally found over the eastern half of the U.S. Because it is an adaptable and popular sport fish, it has been stocked into many other areas. The largemouth is now established in all of the lower 48 states and in Hawaii. Its range extends from southern Canada to Mexico, Puerto Rico, Cuba and other Caribbean islands. It is found in every Missouri county. However, it is rare or absent in many streams of northwest Missouri.

Habitat

This fish species can tolerate a wide range of aquatic conditions. It can live in standing water or in a slow current; clear water or cloudy water; large reservoirs or small ponds; water with excessive vegetation growth or very little growth; and in fresh or brackish (slightly salty) water. The largemouth bass is extremely adaptable and is considered to be a nearly perfect stocking fish. It is particularly characteristic of man-made impoundments of all sizes, the permanent pools of small streams with low and intermittent flow and the quiet backwaters of large rivers.

Bass prefer to spend most of their time near cover such as submerged logs, growths of aquatic plants, dead trees standing in the water, etc. Cover protects them from penetrating sunlight rays and usually gives them a better chance to capture minnows, crayfish, worms and other foods. Cover near deeper water is preferred.

Largemouth bass favor water temperature between 65 and 75 degrees Fahrenheit, but will tolerate temperatures falling outside of this range.

Habits

Avid fishermen and fishery biologists are well-acquainted with the daily and seasonal habits of the largemouth bass. Although all largemouths follow general patterns of behavior, the activity of an individual bass at a particular time and place can frequently be unpredictable.

Largemouth bass are distinctly predatory fish. The movement of a small fish or other aquatic animal seems to be the main stimuli to cause a bass to strike. Bass wait for an unsuspecting small fish or other aquatic animal to swim by and then ambush it with an explosive charge. They do not chase their prey like a northern pike does.

Bass do not feed constantly. They feed two times a day--usually at dawn and dusk. However, bass will sometimes strike at lure or bait when they are not feeding as a reflex action. Bass have also been known to feed extensively before the approach of stormy weather.

Largemouth bass will move to find the most comfortable water temperature. On hot summer days, they will move to the cooler temperature in deeper water. They will also move to deeper water or shade to avoid the penetrating rays of sunlight.

Like other sunfish, largemouths do not form schools except for a brief period when they are young. Researchers have noticed a pecking order arrangement with regard to cover selection. The largest bass appear to occupy the heaviest and most desirable cover available in a particular habitat. Otherwise, the species shows very little social organization.

Bass exhibit a definite attachment to a particular pool or stretch of shoreline to which they will return after being moved or after voluntary absences. Often the same fish will be found at about the same location a year or more after its initial capture and may spend its entire life within a rather restricted area.

The activity level of largemouth bass is greatly reduced during the winter. Bass may eat less than one-tenth of their summer diet during the winter. In addition to the lower food intake, the digestion process takes much longer due to reduced body temperature.

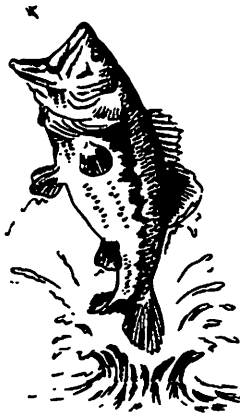
Food

Adult largemouth bass eat an incredible number of animals including small fish, crayfish, tadpoles, salamanders, worms, insects and frogs. After a bass has reached a six to eight inch length, it will consume almost any creature it can swallow. Mice and small birds in the water have also been eaten by largemouths.

In large reservoirs the largemouth bass depends heavily on gizzard shad as food.

Bass fry and fingerlings begin to feed on small animal life immediately after they hatch such as water fleas and other small crustaceans. As they become larger, they eat larger foods. Interestingly, bass fry are eaten by bluegill but the prey soon becomes the predator when the bass become larger than the bluegills.

Bass do not have a preference for a particular species of prey. Adult largemouth bass appear to eat the food which is the most plentiful and easiest to capture.



Reproduction

Largemouth bass spawn (reproduce) once each year. When the water reaches approximately 60 degrees Fahrenheit, the male bass begin to move into shallow water and begin searching for a nesting site. The male builds a nest in one foot to fifteen feet of water by fanning the sand, silt and other debris from a circular area with his tail. Nests in deeper water are found in the clear waters of large reservoirs. Rocky or gravelly bottoms are preferred for nest construction, but almost any type of bottom can be used as long as a firm, silt-free bed can be created. When completed, the nest may be from one to three feet in diameter.

When the water temperature reaches 65 to 70 degrees Fahrenheit (usually in late spring), the female will visit the nest voluntarily or under escort by the male. The male and female circle the nest, pausing briefly as the eggs are deposited and fertilized. During the spawning act, the female assumes a nearly horizontal position while the male remains upright depositing milt on the eggs. Several females may spawn in the same nest and one female may spawn in two or more nests with different males.

The male guards the nest from other aquatic organisms which eat bass eggs. Bluegills are the most effective predator of bass eggs. It is common to see a nesting bass surrounded by bluegills waiting for an opportunity to rush in and devour the eggs.

The male bass fans the eggs with his tail during the three to four day incubation period to keep them free of silt. The fry rise from the nest and begin to feed five to eight days after hatching. They form a tight school over the nest for four to five more days and then move to nearby cover. Schools break up in 26 to 31 days after hatching when the young bass are slightly over an inch long. The male bass becomes a cannibal at this time and eats some of his own offspring before the other small bass escape.

Adverse Factors

The largemouth bass is well-established Missouri with thriving populations in water bodies throughout the state. Adverse factors affecting largemouth bass are commonly on a localized level such as a population level imbalance in an impoundment or persistent poor water quality.

Fishery biologists and pond owners must carefully manage bass and bluegill populations or poor fishing results. Enforcement of length limits for bass is especially crucial for several years after an initial stocking.

Largemouth bass are somewhat tolerant of turbid water, but there is a limit to their adaptability. They cannot survive in excessively turbid water as catfish. In very turbid water, the bass has a difficult time feeding and its gills become clogged with silt causing death by suffocation.

Summary

Because of its widespread distribution and sporting qualities, the largemouth bass ranks as one of the most important North American warm-water sport fishes. Along with the crappies and white bass, it forms the backbone of the sport fishery in many large Missouri reservoirs and is stocked as the principal predatory fish in farm ponds.

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UNIT IV - ANIMAL LIFE HISTORIES

Lesson 4: Bald Eagle (Wetland Habitat)

Wetlands are the most productive ecosystems in the world. Their value to countless species of fish and wildlife is surpassed by no other type of habitat.

The term "wetland" refers to a broad range of different types of habitat including swamps, sloughs, marshes, rivers, ponds, lakes, seeps, potholes, bottomland forests, etc. These different types of wetlands have one characteristic in common; their soils are saturated or covered with water, at least periodically. Wetlands can be anything from a wet spot in a cropfield with smartweed and sedge to bald cypress swamps or large man-made reservoirs.

Many fish and wildlife species are attracted to, or require, certain types of wetlands. Frogs, snakes, fish, turtles, etc. usually need adequate wetland habitat only in their immediate surroundings. This is not true with all species. Migratory waterfowl, shorebirds and some birds of prey need suitable wetland resources thousands of miles apart to complete their annual cycle.

The bald eagle (*Haliaeetus leucocephalus*) is a species strongly associated with wetlands. It is transient user of many types of wetlands from Florida to Canadian provinces, but prefers open water areas. This lesson focuses on the life history of our national emblem--the bald eagle.



Description

Size and sex criteria - The bald eagle is one of the largest birds of prey in the world. A mature adult has a 6 1/2- to 8-foot wingspan and weighs 8 to 15 pounds. Male and female eagles are identical in coloration and are nearly the same size. It is impossible to identify the sex of a bald eagle in the field from physical characteristics alone.

The bald eagle has a large hooked beak perfectly suited to tearing the flesh from fish and other animals it captures. Its feet are as large as a human hand and have sharp talons two inches long.

Coloration, age criteria and longevity - An adult bald eagle has a white head, neck and tail; brownish black body plumage; yellow eye irises and feet; and a yellow beak. Bald eagles do not have these distinctive features until they are four years old. Younger individuals vary from solid dark brown to a generally mottled brown and white plumage. The average life span of the bald eagle is 30 years in the wild, but some individuals have lived up to 50 years in captivity.

Vision - The bald eagle possesses eyesight five to six times more acute than a human's. A prominent brow shades the eye for keener vision.

Voice - Vocalizations consist of a high, thin note which can be heard over a short distance and a creaky yelp sounding like a puppy. Bald eagles do not have the piercing scream of the red-tailed hawk.

Physical mobility - The bald eagle's normal flying speed is 20 to 40 miles per hour. However, it frequently captures prey by diving at high speeds up to 100 miles per hour. It can fly for long periods without rest by soaring on wind currents with little wing movement.

For such a large bird, the bald eagle is highly maneuverable in the air. It can attack other birds in the air and capture animals in the water or on the ground.

Distribution and Abundance

In 1782, the bald eagle was formally adopted as our national emblem. It was probably flourishing then, with as many as 20,000 nesting pairs in what is now the U.S. The number of bald eagles has greatly declined since then due to human encroachment, habitat destruction, environmental contamination and open persecution. The bald eagle's breeding range was reduced to Alaska, Canada, the Great Lakes states and the Pacific Northwest by the late 1800s. There are only 1,400 nesting pairs in the lower 48 states.

Missouri is one of the leading states for wintering bald eagles which migrate here from their northern breeding grounds. Numerous bald eagles were reported in and adjacent to Missouri during a recent winter, making our state second only to Washington in the number counted in the lower 48 states. Nearly 400 have been counted at Squaw Creek National Wildlife Refuge in northwest Missouri, one of the highest concentrations anywhere. However, bald eagles do not nest in Missouri as they did during the early 1800s.

Habitat

The bald eagle nests along lakes and streams in the remote, coniferous forests of Alaska, Canada, the Great Lakes states and the Pacific Northwest. They prefer to nest in wilderness areas far away from human civilization.

Bald eagles migrate each spring and fall. Although some individuals fly as far south as Florida, most bald eagles migrate to states west of the Mississippi River. They tend to become concentrated in areas which have open water such as large reservoirs and the tailraces of dams along major rivers. This species is much more tolerant of humans and each other during the winter months.

Habits

Bald eagles have interesting habits to match their impressive appearances. They are independent birds which have little use for each other's company except when concentrated on their wintering grounds. Family groups are rare because young eagles must fend for themselves soon after leaving the nest.

The majority of bald eagles will arrive in Missouri during December. In some cases, the individuals will return to the same locality each winter. They begin moving north again in late February, and it is rare to see an eagle in Missouri after April 1.

Communal roosts at night are a unique characteristic of the bald eagle on its wintering grounds. Even in areas where there are many perches, the birds will crowd together in one tree where they harass each other for the best positions.

Bald eagles mate for life. The male and female share the task of incubating the eggs and caring for the eaglets after they are hatched. The male usually captures prey and brings it back to the nest for the young to eat. In turn, the female feeds the eaglets and becomes angry if the male approaches too closely.

An eagle nest is called an aerie. It is usually in the top of a giant tree and may be used by the same pair of bald eagles for as long as 20 years. A pair of bald eagles will normally return to their nest in March after a four- to six-week migration. Enlarged annually, a bald eagle nest can become the largest of any North American bird--the record is 20 feet deep, 10 feet wide, and weighed two tons. The adult eagles will continue to enlarge the nest throughout the incubation period.

Food

Fish compose 60 to 90 percent of the bald eagle diet. Bald eagles capture fish by diving at the water surface and grasping fish near the top with their talons. They usually carry the captured fish to a nearby perch for eating.

Bald eagles prefer fish, but will eat other animals. They frequently follow waterfowl migrations and prey on ducks and geese as a secondary source of food. Bald eagles have the common predatory habit of capturing injured and crippled animals in place of pursuing healthy individuals. However, they are fully capable of capturing a duck or goose in flight and will eat rodents and other birds when necessary. Prey items weigh from three to five pounds because an eagle would have a difficult time carrying anything approaching one-half of its own weight.

They will also eat carrion--particularly during the winter when food may be scarce. Mammalian carrion is lowest on the bald eagle's preferred menu.

Ospreys are hawks which also specialize in capturing fish. Bald eagles have the habit of harassing ospreys until they drop the fish they are carrying to evade the attacking eagle. The eagle will then pursue the falling fish and sometimes catch it in the air for its next meal.

Their search for food is the primary reason bald eagles congregate during the winter. A favorite location is near the tailrace of a large dam. The water is open except in extremely cold weather, and there is a constant source of dead and stunned fish after passing through the dam gates or hydroelectric turbines.

Reproduction

Bald eagles have a low reproductive rate which characterizes species with relatively long life spans. Each pair of eagles produces two eaglets each year if their nest is successful.

A female usually lays two white eggs (rarely three) in late March or early April at three to four day intervals. The eggs are usually hatched at the end of April or early May. Eaglets leave the nest in 11 to 12 weeks.

The 35-day incubation period begins immediately after the first egg is laid and causes the eggs to hatch in the order they were deposited. The first hatched eaglet has a decided advantage over its sibling when fighting for food due to its larger size. There are documented cases where eaglets have attacked and killed their siblings in the nest.

The small eaglets increase in size from three inches to three feet within 90 days. Eagles are altricial birds which means they are nearly helpless after hatching and require parental care for an extended period. When the time comes, the adult eagles force their young to leave the nest by refusing to feed them. The eaglets eventually fly away from the nest, but will stay in the nearby vicinity for several weeks before setting off on their own. However, the eagle "family" does not stay together after the eaglets have left the nest.

Bald eagles will attack nearly anything approaching their nests, including humans. A pair of eagles will maintain a territory of one square mile surrounding the nest and will drive off other eagles and hawks invading the area.

Adverse Factors

The bald eagle is at the top of the food chain and humans are its most dangerous predator. Human disturbance and persecution during the 1800s and early 1900s eliminated the bald eagle from most of its breeding grounds in the lower 48 states.

The federal government has passed laws to protect the bald and golden eagles from humans. The federal Eagle Protection Act of 1975 makes it a felony to shoot an eagle. Persons convicted of killing an eagle are subject to a fine of up to \$5,000, imprisonment of up to one year, or both. Subsequent violations may result in fines up to \$10,000, two years in jail, or both. The same penalty applies for the possession of eagle parts or products without a permit.

Also, the federal government declared the bald eagle an endangered species in 1978 in 43 states, including Missouri. It has "threatened" status in Minnesota, Wisconsin, Michigan, Oregon and Washington. This species is not considered endangered or threatened in Alaska which has a breeding population of 10,000 bald eagles.

The use of chlorinated hydrocarbons pesticides (e.g. DDT, aldrin, dieldrin and heptachlor) during the 1950s and 1960s posed a serious threat to the bald eagle, osprey and many other species of fish and wildlife. These pesticides do not break down and may persist in the soil and water as toxic compounds for many years. Indiscriminate application of these chemicals directly killed millions of non-target birds, mammals and invertebrates.

Chlorinated hydrocarbons become more and more concentrated in the body tissue of animals living at successively higher levels in the food chain through a process called biological magnification. A documented case of this process occurred in Clear Lake, California which was sprayed with DDD (a close relative of DDT) during 1949, 1954 and 1957 at a concentration of .014 parts per million. Over 1,000 pairs of western grebes were residents on

Clear Lake prior to the spraying, but none remained by 1959. A scientific investigation found that the dead birds had a concentration of 1000 parts per million of DDD in their body fat. It was later discovered that the plankton in the lake concentrated the DDD 265 times which in turn was concentrated 500 times by the small fish which ate the plankton. By eating the contaminated fish, the western grebes concentrated the DDD 80,000 times which ultimately caused their death.

Although these pesticides rarely killed adult bald eagles, their effect was still harmful to the eagle population. Being at the top of the food chain, bald eagles and other birds of prey accumulated DDT and other chlorinated hydrocarbons in their body fat. The pesticide interfered with the production of egg shells in the female's body and caused thin shells to be produced. The fragile shells would frequently break before the incubation period was over. As a result, the bald eagle population suffered poor reproductive success. Fortunately, the federal government banned DDT in 1972 and placed restrictions on many other pesticides. Instances of pesticide poisoning have dramatically declined since then.

Summary

As our national emblem, the bald eagle represents strength and bravery. Although most people have respect for this species, its population declined over most of our country's history. It has been a victim of human "progress" and persecution. At the present time, the bald eagle population is stable and shows signs of increasing with modern conservation programs.

Beginning in 1981, the Missouri Department of Conservation in cooperation with the U.S Fish and Wildlife Service and Dickerson Park Zoo in Springfield has annually released young bald eagles in Missouri in an attempt to reestablish a breeding population. Eaglets six to seven weeks old are obtained from captive breeding facilities or healthy wild populations. If the program is successful, a permanent breeding population of bald eagles will inhabit parts of Missouri after an absence of 150 years.

Credits

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Wetmore, Alexander. Water, Prey and Game Birds of North America. Washington, DC: National Geographic Society, 1965.

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UNIT V - FISH AND WILDLIFE PROTECTION

Lesson 1: Introduction to Fish and Wildlife Protection

The protection of fish and wildlife resources is essential to their existence. History has proven that unregulated hunting, fishing and trapping can seriously damage fish and wildlife populations. The enforcement of laws regulating the harvest of wild animals was the first tool of fish and wildlife management.

Basic Objectives of Regulations

All fish and wildlife regulations are passed and enforced to reach one or more of the following objectives.

Protect the fish and wildlife resource - Protecting fish and wildlife populations is done by establishing harvesting seasons. Many species are protected with a closed-season over the entire year.

Distribute the harvest equally - Sportsmen are given an equal opportunity to share in the harvest through the enforcement of bag limits (number of animals taken in a day). Possession limits also help to distribute the harvest by restricting the number of animals a sportsmen may keep at any one time. For instance, no more than 16 bobwhite quail may be possessed by one person.

Exemptions from permit requirements are given to certain groups of people to encourage their participation in hunting and fishing. For example, any Missouri resident over age 65 may harvest wildlife (except ruffed grouse, turkey or deer) without a resident hunting permit. However, they must carry proof of their age and Missouri residency, such as a Missouri driver's license.

Equal harvest distribution is also achieved with regulations granting the use of special hunting methods to handicapped individuals.

Encourage ethical sportsmanship - This category of regulations contains the details of harvesting methods. These regulations are used to promote safety and to prohibit the use of certain types of harvesting methods and equipment.

Examples of Missouri regulations used for safety purposes include fluorescent orange clothing required of deer hunters, a safety sticker on the firearms of turkey hunters, and the prohibition of placing traps in paths used by people or domestic animals.

Certain types of harvesting methods and equipment are made illegal by regulations because they take advantage of animals when they are extremely vulnerable and/or result in the loss of wounded animals. Examples are of these regulations are:

1. Homes, dens or nests of furbearers shall not be destroyed.
2. Muzzleloading firearms used to hunt deer must be .40 caliber or larger.
3. No person shall pursue or shoot wildlife from a motor driven land vehicle or aircraft at any time.
4. No person shall use a spotlight, headlight or other artificial light on any highway or roadway for the purpose of spotting or locating wildlife when in the possession of any firearm, bow or other implement capable of harvesting wildlife.
5. Dogs may be used during open seasons in harvesting wildlife except deer, turkey, mink, muskrat and beaver.

Constitutional Authority of the Missouri Conservation Commission

Prior to the creation of the Missouri Conservation Commission with a constitutional amendment in 1937, all fish and wildlife statutes and regulations were made by the State Legislature. The Missouri Conservation Commission was given this authority in the constitutional amendment. The Commission is still the only state agency which has statutory power. This means the Commission can recommend, pass and enforce fish and wildlife regulations without legislative approval. The authority for making fish and wildlife regulations in many states is vested in their respective legislatures.

Although the Missouri Conservation Commission makes fish and wildlife regulations, it does not have the power to assign penalties for violations. Only the State Legislature has the authority to assign penalties to violations of the Wildlife Code of Missouri.

The Wildlife Code of Missouri is a small booklet which describes fish and wildlife regulations. It is available to the general public upon request. Some of the regulations are changed frequently as an adjustment to fluctuating fish and wildlife populations and public opinion.

The Missouri Conservation Commission is responsible for the enforcement of Wildlife Code. This is accomplished through the activities of approximately 175 conservation agents stationed at various locations throughout the state (usually one per county). However, conservation agents are not the only MDC employees who have the authority to enforce the Wildlife Code. Other MDC employees, such as wildlife area managers, usually have law enforcement authority, but it is not their main responsibility.

Missouri Department of Conservation employees who have the authority to enforce the Wildlife Code have limited legal power in other areas. Conservation agents must have a signed landowner complaint to arrest people for trespassing on private land. Also, conservation agents do not have the authority to enforce all-terrain vehicle laws on private land.

However, the Missouri Department of Conservation has full police power on land it owns, leases, manages or operates. Therefore, conservation agents have the right to enforce all state laws on stream and lake accesses, wildlife areas, state forests and natural areas.

Making Regulations

The Missouri Department of Conservation maintains a regulation committee which meets once a month to review suggested changes in the Wildlife Code. The committee is composed of the Department's top managers and administrators.

The regulation committee will review recommendations for changes in the Wildlife Code from a variety of sources including MDC administrators and/or lower level employees, individual citizens, special interest groups and magistrate courts. The committee bases its decisions on biological information on the topic in question with due regard for public opinion. However, the continued health of fish and wildlife populations is their first priority. The committee sometimes holds public hearings to gain more insight into the impact of specific regulations.

New or amended regulations are approved by the regulation committee and prepared in proper legal form and submitted to the Commission. After approval by the Commission and signatures, the new and/or amended regulations are filed with the Secretary of State. They become effective on any specified date not less than ten days after being filed.

In some cases, the Commission must adhere to federal guidelines when setting seasons and bag limits. Although the State of Missouri has title to all fish and wildlife in the state, the federal government has jurisdiction over migratory birds. The U.S. Fish and Wildlife Service recommends migratory bird harvest guidelines to the Commission each year (mourning dove, ducks, geese, etc.). The Commission has the option to be more restrictive than the federal guidelines, but cannot pass more liberal regulations.

Summary

Law enforcement is the foundation of fish and wildlife management. History has proven that uncontrolled harvest causes severe decline of fish and wildlife populations.

The Missouri Conservation Commission makes and enforces state fish and wildlife regulations collectively called the Wildlife Code. The actual enforcement is done by approximately 175 MDC conservation agents stationed at many locations throughout the state. By doing so, MDC ensures fish and wildlife populations are appropriately harvested; provides an equal opportunity for people to enjoy the resource; and encourages ethical sportsmanship.

Credits

Wildlife Code of Missouri. Missouri Department of Conservation, 1988.

Conservation Agent Training Manual. Missouri Department of Conservation, 1987.

UNIT V - FISH AND WILDLIFE PROTECTION

Lesson 2: Legal Process

The Missouri Department of Conservation follows due legal process when fish and wildlife violators are apprehended. With the exception of federal offenses, all violations are handled by the Missouri court system.

Legal Process

Arrest and court appearance - If a conservation agent finds an individual violating a regulation in the Wildlife Code, the agent has the authority to arrest or issue the person a "courtesy summons to appear in court." The person must then either appear in court on the specified date, provide a written waiver pleading guilty, or have an attorney appear on his/her behalf. The type of court appearance allowed is dependent upon the seriousness of the violation, and the policy of the associate circuit court having jurisdiction where the violation occurred. If the person does not appear in court on the specified date, provide a written waiver or have an attorney present, the judge may issue a warrant for his/her arrest. A conservation agent or local law enforcement officer will then serve the arrest warrant and take the person to the sheriff's office or police station where he/she will be required to post a court appearance bond.

The defendant may be given appearance options again or be required to appear in court on another specified date, and has the right to plead guilty or not guilty. If the plea is guilty, the judge shall assess the penalty. If the defendant pleads not guilty, he/she has the choice of appearing before a judge or having a trial by jury. After the defendant makes a choice, a trial date is usually set. Whatever the situation, a judge or jury will render a decision on the case.

Penalties - The four legal categories of violations in the Wildlife Code are: infraction, class A misdemeanor, class B misdemeanor and class D felony.

A class A misdemeanor has a maximum penalty of \$250 with no jail term or court record. An example is 2nd degree trespass.

The majority of violations of the Wildlife Code are class B misdemeanors which have a maximum penalty of \$500 and/or a jail term not to exceed 90 days. Examples of class B misdemeanor violations are: refusing inspection of a license or permit by a conservation agent; causing fish kills by polluting stream; using a shotgun with more than a three shot capacity; killing more than the bag limit in one day; or spotlighting deer.

The most serious violation of the Wildlife Code in a class D felony. An example is using explosives to kill fish which carries a fine between \$200 and \$1000 and/or up to two years imprisonment in the state penitentiary.

Use of collected fines - MDC conservation agents do not receive any of the money from fines collected for violations of the Wildlife Code. Instead, the money supports a variety of government services including:

1. Public schools within the court's jurisdiction (usually a county) receive all fine proceeds
2. Money collected for court costs are shared by:
 - a. County prosecutor's office
 - b. Sheriff's department
 - c. Operation of the court (including judge's salary)

Wildlife Donation from Conservation Agent

Conservation agents are responsible for disposing or giving away wildlife which are accidentally killed during closed seasons. The most common species officially reported is the white-tailed deer.

A road-killed deer should be reported to the local conservation agent or law enforcement immediately. The agent can release the deer into the driver's custody by completing a wildlife disposition form. Until this form is completed, it is illegal for anyone to take possession of the deer. If the driver does not want the deer carcass, the agent frequently gives it away to individuals and families who will make use of it. Unsalvageable deer are often disposed of by highway maintenance crews.

Conservation agents may sometimes have wildlife carcasses or pelts seized as evidence of illegal activities. After the evidence is shown in court, it is usually disposed of, or possibly given away for non-commercial use.

People who want to receive wildlife donations should contact their local conservation agent and express their interest. The most important point is to never take possession of a road-kill or any other wildlife during a closed season, when it is protected by law, or if you don't have the appropriate permit. Call the conservation agent for advice.

Summary

The Missouri Department of Conservation follows due legal process when apprehending fish and wildlife violators. The legal process follows a predictable path through the Missouri court system. However, associate circuit courts have considerable flexibility in assigning penalties.

MDC conservation agents do not receive any of the money generated from fines. All fine proceeds go to the public schools within the court's jurisdiction. Court costs associated with the prosecution of people who violate the Wildlife Code are used to maintain the county prosecutor's office, sheriff's office and the associate circuit court.

Credits

Wildlife Code of Missouri. Missouri Department of Conservation, current year.

Conservation Agent Training Manual. Missouri Department of Conservation, 1987.