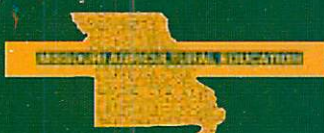


# Fish and Wildlife Management

**Instructor Guide**  
**10-4853-I**



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

**Instructor's Guide**

**FISH AND WILDLIFE MANAGEMENT**

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## ACKNOWLEDGMENTS

The Fish and Wildlife Management course represents a broadening of curriculum taught in Agricultural Science II and advanced courses. Its development was suggested by the MVATA Teaching Aids Committee and made possible through a cooperative effort with the Missouri Department of Conservation.

Special thanks are due to Fish and Wildlife Advisory Committee members for providing their valuable time and suggestions in developing this unit. The committee members consisted of Carl Button, Dennis Gutshall, Terry Heiman, Robert Parsons, Roger Slayton, Chris Stockhorst and David Wasser.

A group of Missouri Department of Conservation employees deserve special thanks for their help in providing technical information, reviewing the material and offering suggestions. They are Al Palladino, Carl Conway, Linda Eastwood-Erickson, Glen McCloud, Darrell Walden, Bill McGuire, David Pitts and Sam Kirby. David Besenger, Missouri Department of Conservation artist, provided many of the illustrations appearing in the student reference.

Special recognition is also given to the Harley Schlichting and Veronica Feilner for assisting the Advisory Committee in planning the course priorities. The staff at the Instructional Materials Laboratory is commended on the layout and printing of this unit.

## 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.

During the summer of 1981, the Missouri State Board of Education formally adopted the concept of "Instructional Management Systems (IMS) as a priority for the 1981-82 school year. To meet the demand for greater productivity and accountability, Dr. Frank Drake, Director of Vocational Education, applied the elements of IMS to form the "Vocational Instructional Management System" (VIMS). The VIMS process provides a framework to use in planning and organizing to assure excellence in Missouri's vocational education system by focusing greater attention on the management of teaching and learning.

To aid agriculture teachers in the implementation of VIMS, this guide incorporates the needed component parts to meet VIMS requirements. For ease of use, performance objectives and competencies have been included at the beginning of each unit, as well as being incorporated within each lesson. A competency profile has also been provided for convenient recordkeeping.

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Terry Heiman  
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Department of Elementary and  
Secondary Education

# FISH AND WILDLIFE MANAGEMENT

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## **FISH AND WILDLIFE MANAGEMENT**

### **UNIT I: INTRODUCTION TO FISH AND WILDLIFE CONSERVATION**

#### **LESSONS**

1. Natural Resource Conservation
2. History of Fish and Wildlife Conservation in Missouri
3. Conservation Careers
4. Landowners and Sportsmen: Partners in Fish and Wildlife Management

### **UNIT II: FISH AND WILDLIFE VALUES**

#### **LESSONS**

1. Commercial Value
2. Recreational Value
3. Biological Value
4. Social Value
5. Esthetic Value
6. Scientific and Educational Values
7. Negative Value

### **UNIT III: HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES**

#### **LESSONS**

1. Habitat Management Principles
2. Cropland Management
3. Grassland Management
4. Forest Management
5. Introduction to Wetlands
6. Stream Conservation
7. Pond Construction and Management
8. Agency Assistance



**UNIT IV: ANIMAL LIFE HISTORIES**

**LESSONS**

1. Bobwhite Quail
2. White-tailed Deer
3. Largemouth Bass
4. Bald Eagle

**UNIT V: FISH AND WILDLIFE PROTECTION**

**LESSONS**

1. Introduction to Fish and Wildlife Protection
2. Legal Process

**OBJECTIVES**

**UNIT I: NATURAL RESOURCE CONSERVATION**

1. The student will be able to define and describe natural resource conservation.
2. The student will be able to compare historical fish and wildlife trends and the public's response.
3. The student will be able to outline the variety of jobs in conservation organizations, educational requirements, employment opportunities and how to prepare for a professional conservation career.
4. The student will be able to distinguish the difference between basic fish and wildlife legalities and ethics.

**UNIT II: FISH AND WILDLIFE VALUES**

1. The student will calculate how the commercial value of fish and wildlife resources can benefit the economy and landowners.
2. The student will list the different recreational values of fish and wildlife resources.
3. The student will explain how naturally-occurring living organisms benefit humans and the environment.
4. The student will describe the social values and benefits associated with fish and wildlife resources.

5. The student will describe the esthetic value of fish and wildlife resources.
6. The student will describe scientific and educational values of fish and wildlife resources.
7. The student will evaluate the negative impacts wild animals have on humans and the objective of wildlife damage control.

#### UNIT III: HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

1. The student will be able to explain ecological principles and how they apply to fish and wildlife management.
2. The student will design a cropland management plan for wildlife.
3. The student will select grassland management practices that improve livestock forage and wildlife habitat.
4. The student will assess how forest management can be used to improve wildlife habitat.
5. The student will define and describe wetlands and their importance.
6. The student will describe stream behavior and relate how it affects fish and wildlife habitat.
7. The student will plan a pond using appropriate construction and management techniques.
8. The student will describe the government conservation assistance available to Missouri landowners.

#### UNIT IV: ANIMAL LIFE HISTORIES

1. The student will outline the life history of the bobwhite quail.
2. The student will outline the life history of the white-tailed deer.
3. The student will outline the life history of the largemouth bass.
4. The student will outline the life history of the bald eagle.

**UNIT V: FISH AND WILDLIFE PROTECTION**

1. The student will relate the reasons for fish and wildlife regulations and describe how they are made and enforced in Missouri.
2. The student will describe the legal process associated with fish and wildlife violations.

**COMPETENCIES**

**UNIT I NATURAL RESOURCE CONSERVATION**

1. Define and describe natural resource conservation.
2. Compare historical fish and wildlife trends and the public's response.
3. Outline the variety of jobs in conservation organizations, educational requirements, employment opportunities and how to prepare for a professional conservation career.
4. Distinguish the difference between basic fish and wildlife legalities and ethics.

**UNIT II: FISH AND WILDLIFE VALUES**

1. Calculate the commercial value of fish and wildlife resources and how it can benefit the economy and landowners.
2. List the different recreational values of fish and wildlife resources.
3. Explain how naturally-occurring living organisms benefit humans and the environment.
4. Describe the social values and benefits associated with fish and wildlife resources.
5. Describe the esthetic value of fish and wildlife resources.
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2. Outline the life history of the white-tailed deer.
3. Outline the life history of the largemouth bass.
4. Outline the life history of the bald eagle.

### UNIT V: FISH AND WILDLIFE PROTECTION

1. Relate the reasons for fish and wildlife regulations and describe how they are made and enforced in Missouri.
2. Describe the legal process associated with fish and wildlife violations.

### MOTIVATIONAL TECHNIQUE OR INTEREST APPROACH

1. Present visuals such as the programs on the Wildlife Management Series #1 videotape provided to agriculture instructors by the Missouri Department of Conservation.

2. Arrange field trips for your choice of the following activities: 1) observe wildlife management practices at a Missouri Department of Conservation state forest and/or wildlife area, 2) identify plants on natural prairie areas, 3) participate in Eagle days, 4) tour a farm to observe wildlife habitat and how farming operations affect it.
3. Invite conservation professionals to speak before the class.
4. Arrange to receive a wildlife donation from the Missouri Department of Conservation conservation agent in your county to use as a classroom demonstration.

### **EVALUATION**

1. Give short, objective tests following each lesson and a more in-depth objective test at the conclusion of the unit(s).
2. Observe the changes in behavior as evidence of an improved ability of students to deal with problems in this unit using background acquired from earlier units.
3. Observe students' attempts to solve related problems in their supervised agricultural experience programs. Record how students integrate fish and wildlife management into SAEs based on traditional farm enterprises.

### **REFERENCES AND MATERIALS**

1. Fish and Wildlife Management (Student Reference)  
  
Instructional Materials Laboratory  
University of Missouri-Columbia  
2316 Industrial Drive  
Columbia, Missouri 65202
2. Teacher references
  - a) Reid, George K.; Herbert S. Zim. Pond Life. New York, N.Y.: Western Publishing, Inc., 1967.
  - b) Missouri Department of Conservation publications\*
    - 1) The History of the Conservation Movement in Missouri (1986)

- 2) S.P.O.R.T. Ethics Class (1985)
- 3) Wildlife Management Handbook for Landowners (1991)
- 4) Conservation Careers (1989)
- 5) Missouri Pond Handbook (1982)
- 6) Aquatic Field and Classroom Activities (1988)
- 7) Fisheries Management (1986)
- 8) Aquatic Plant Management in Missouri (1986)
- 9) Prairie Life of Missouri (1992)
- 10) Wildlife Management in Missouri (1992)
- 11) A Summary of Missouri Hunting and Trapping Regulations (current year)
- 12) A Summary of Missouri Fishing Regulations (current year)
- 13) A Glossary of Selected Terms of Conservation, Ecology and Resource Use (1984)

c) Missouri Department of Conservation pamphlets\*

- 1) Native Grasses
- 2) Establishing Native Warm-Season Grasses
- 3) Native Grasses for Wildlife
- 4) Native Warm-Season Grasses for Missouri Stockmen
- 5) Managing Missouri's Hay Prairies
- 6) Questions about Native Warm-Season Grasses
- 7) Prairie Forbs
- 8) Principle Prairie Grasses
- 9) Timber and Wildlife Benefits on Private Land Series
  - (a) #2 - Forest Edge Wildlife Habitat
  - (b) #3 - Trees Along Streams
  - (c) #5 - Snag and Den Tree Management
  - (d) #6 - Cut Firewood and Improve Wildlife Habitat
  - (e) #7 - Timber and Sales and Wildlife in Missouri
  - (f) #10 - Woodland Protection and Wildlife Management
  - (g) #11 - Timber Stand Improvement

d) Videos (1/2 inch VHS) referenced in this unit which are available for free loan from the Missouri Department of Conservation, Media Library, P.O. Box 180, Jefferson City, MO 65102-0180. (These videos are not available to non-residents.)

- 1) Stream Sense (19 min.)
- 2) This is the Mallard (44 min.)
- 3) Waterfowl for the Future (16 min.)
- 4) Downstream (30 min.)
- 5) Guarding Our Living Environment (26 min.)
- 6) Dedicated to Conservation (12 min.)
- 7) Time Shadow - Encounters with the Whitetail (24 min.)

- 8) Quail Country (20 min.)
- 9) Agents in the Making (18 min.)
- 10) The Wealth in Wetlands (23 min.)

e) Videos (1/2 inch VHS) referenced in this unit which have distributed to agriculture instructors.

- 1) Farming and Wildlife: Bobwhite Quail (18 min.)
- 2) Farming and Wildlife: Prairie Chicken (14 1/2 min.)
- 3) Farming and Wildlife: Ring-necked Pheasant (15 min.)
- 4) Conservation Planning for Wildlife (13 1/2 min.)
- 5) Establishing and Managing Warm-Season Grasses (15 min.)
- 6) Private Prairie Restoration (5 1/2 min.)
- 7) The Root Plow Saves Crops and Wildlife (10 1/2 min.)
- 8) Annual Food Plots (12 min.)

f) Missouri Department of Conservation posters\*

- 1) Conservation Successes
- 2) Missouri Game Birds
- 3) Missouri Fishes
- 4) Toads and Frogs of Missouri
- 5) Missouri Mammals I
- 6) Helping Wildlife on the Farm
- 7) Missouri Pond Life
- 8) Missouri Stream Life

\*Single copies of all Missouri Department of Conservation publications, pamphlets and posters referenced in this unit are available free-of-charge to Missouri agriculture instructors. Write to the Department of Conservation, Education Division, P.O. Box 180, Jefferson City, MO 65102-0180.

FISH AND WILDLIFE MANAGEMENT UNIT

Agriculture Teacher Request Form

Name \_\_\_\_\_ School Name \_\_\_\_\_

School Street Address \_\_\_\_\_

City \_\_\_\_\_ State, Zip Code \_\_\_\_\_

The Missouri Department of Conservation will provide one copy of the following materials to agriculture teachers at no charge (they are not available to non-residents).

Check (x) the items desired and send the form to: Missouri Department of Conservation, Education Division, P.O. Box 180, Jefferson City, MO 65102-0180.

**Instructional Units**

- \_\_\_\_\_ The History of the Conservation Movement in Missouri
- \_\_\_\_\_ S.P.O.R.T. Ethics Class
- \_\_\_\_\_ Aquatic Field and Classroom Activities
- \_\_\_\_\_ Fisheries Management
- \_\_\_\_\_ Conservation Careers
- \_\_\_\_\_ Prairie Life of Missouri
- \_\_\_\_\_ Wildlife Management in Missouri
- \_\_\_\_\_ A Glossary of Selected Terms of Conservation, Ecology and Resource Use

**Booklets**

- \_\_\_\_\_ Missouri Pond Handbook
- \_\_\_\_\_ Aquatic Plant Handbook
- \_\_\_\_\_ A Summary of Missouri Hunting and Trapping Regulations (available in student quantity, indicate the number needed).
- \_\_\_\_\_ A Summary of Missouri Fishing Regulations (available in student quantity, indicate the number needed).



## **Pamphlets**

- \_\_\_\_\_ Native Grasses
- \_\_\_\_\_ Establishing Native Warm-Season Grasses
- \_\_\_\_\_ Native Grasses for Wildlife
- \_\_\_\_\_ Native Warm-Season Grasses for Missouri Stockmen
- \_\_\_\_\_ Managing Missouri's Hay Prairies
- \_\_\_\_\_ Questions About Native Warm-Season Grasses
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- \_\_\_\_\_ Cut Firewood and Improve Wildlife Habitat
- \_\_\_\_\_ Timber Sales and Wildlife in Missouri
- \_\_\_\_\_ Woodland Protection and Wildlife Management
- \_\_\_\_\_ Timber Stand Improvement

## **Posters**

- \_\_\_\_\_ Conservation Successes
- \_\_\_\_\_ Missouri Game Birds
- \_\_\_\_\_ Missouri Fishes
- \_\_\_\_\_ Toads and Frogs of Missouri
- \_\_\_\_\_ Missouri Mammals I
- \_\_\_\_\_ Missouri Stream Life
- \_\_\_\_\_ Missouri Pond Life
- \_\_\_\_\_ Helping Wildlife on the Farm

7/92

## Fish and Wildlife Management Unit - Major Competency Profile

**Directions:** Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each duty should reflect employability readiness rather than the grades given in class.

- Rating Scale:** **3 Mastered** - can work independently with no supervision  
**2 Requires Supervision** - can perform job completely with limited supervision  
**1 Not Mastered** - requires instruction and close supervision  
**N No Exposure** - no experience or skill in this area

xvii

3	2	1	N

- I. Natural Resource Conservation
  1. Define and describe natural resource conservation.
  2. Compare historical fish and wildlife trends and the public's response.
  3. Outline the variety of jobs in conservation organizations, educational requirements, employment opportunities and how to prepare for a professional conservation career.
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- II. Fish and Wildlife Values
  1. Calculate the commercial value of fish and wildlife resources and how it can benefit the economy and landowners.
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  7. Evaluate the negative impacts wild animals have on humans and the objective of wildlife damage control.
  
- III. Habitat Management Principles and Techniques
  1. Explain ecological principles and how they apply to fish and wildlife management.
  2. Design a cropland management plan for wildlife.
  3. Select grassland management practices that improve livestock forage and wildlife habitat.
  4. Assess how forest management can be used to improve wildlife habitat.
  5. Define and describe wetlands and their importance.
  6. Describe stream behavior and relate how it affects fish and wildlife habitat.
  7. Plan a pond using appropriate construction and management techniques.
  8. Describe the government conservation assistance available to Missouri landowners.
  
- IV. Animal Life Histories
  1. Outline life history of the bobwhite quail.
  2. Outline life history of the white-tailed deer.
  3. Outline life history of the largemouth bass.
  4. Outline the life history of the bald eagle.
  
- V. Fish and Wildlife Protection
  1. Relate the reasons for fish and wildlife regulations and describe how they are made and enforced in Missouri.
  2. Describe the legal process associated with fish and wildlife violations.

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Students:

Class/Section:

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I. Natural Resource Conservation
1. Define and describe natural resource conservation.
2. Compare historical fish and wildlife trends and the public's response.
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## UNIT I - INTRODUCTION TO FISH AND WILDLIFE MANAGEMENT

### Lesson 1: Natural Resource Conservation

Objective: The student will be able to define and describe natural resource conservation.

#### Study Questions

1. What is a natural resource?
2. What is natural resource conservation?
3. What situations in the past have created a need for conservation programs?
4. How are conservation and preservation alike?
5. Why are there conflicting opinions concerning the wise use of natural resources?
6. Why is the government involved with natural resource conservation?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Audiovisuals
  - a) "Guarding Our Living Environment" videotape (26 minutes). Available on loan from the Missouri Department of Conservation, Media Library, P.O. Box 180, Jefferson City, MO 65102-0180.

## UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

### Lesson 1: Natural Resource Conservation

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the unit.

##### B. Motivation

Ask the students to identify the natural resources they have used on that particular day. Then ask them if the government has initiated programs to conserve these resources. Show the Missouri Department of Conservation's "Guarding Our Living Environment" videotape.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Discuss the definition and importance of natural resources with the students.

#### What is a natural resource?

- a) Definition: Any portion of the natural environment that people use for their benefit is a natural resource.
  - b) Renewable natural resources have the ability to sustain themselves; soil, water, sunlight, forests, fish and wildlife are examples.
  - c) Non-renewable natural resources exist on earth in fixed quantities which cannot be increased; coal, metals, natural gas, petroleum, phosphate and potassium are examples.
2. Ask the students what the word "conservation" means to them and list their answers on the blackboard.

#### What is natural resource conservation?

- a) Definition: Conservation is the wise use of natural resources.

- b) Definition: "Wise use" means using the products of natural resources to provide the most benefit for the largest number of people for the longest time.
- c) U.S. wealth and prosperity is largely dependent on the consumption of natural resources.
- d) U.S. public has had an instinctive grasp of "conserving" natural resources since colonial days.
  - 1) In 1626, Plymouth Colony prohibited anyone from selling timber out of the colony without approval of authorities.
  - 2) Strict laws against forest fires were passed by several colonies in New England before 1650.
  - 3) Fire damage to young trees and the soil was recognized in a Massachusetts law in 1743.

3. Ask the students what type of past occurrences created a need for conservation programs.

**What situations in the past have created a need for conservation programs?**

- a) Effective conservation efforts do not begin until a resource scarcity or crisis occurs.
  - 1) Dust storms of the 1930s prompted the federal government to initiate soil conservation programs.
  - 2) Forest conservation began after the eastern and midwestern forests had been devastated.
  - 3) The Missouri Conservation Commission was created after prairie chicken, wild turkey, deer, beaver and grouse were nearly gone.
- b) As a state and a nation, we have not responded to natural resource problems until they have caused considerable damage.

4. Lead a discussion to find out the students' attitude toward preservation. Have them place a good or bad value judgment toward it. Point out that "preservation" is a part of "conservation."

**How are conservation and preservation alike?**

- a) Preservation is part of conservation.
- b) Preservation measures are used when the natural resource being conserved is very limited or unique and may be of short duration or last indefinitely.
  - 1) Missouri's deer population was preserved with a closed season from 1938 to 1944.
  - 2) Natural areas
    - (a) Roaring River State Park - Ozark chinquapin tree
    - (b) Original native prairies

5. Ask the students if it is always obvious what the wise use of a resource is.

**Why are there conflicting opinions concerning the wise use of natural resources?**

- a) People have different interpretations of "wise use" for several reasons; economics, traditions and personal experiences.
  - b) Conflicting opinions and attitudes are inevitable in natural resource management.
6. Ask the students to list examples of government activity related to natural resources. For each example, have the students decide if the government was helpful.

**Why is the government involved with natural resource management?**

- a) Local, state and federal agencies act as moderators among competing uses, the protector of public interests that conflict with selfish pursuits, and are sponsors of projects which the private sector cannot accomplish.
- b) Government agencies usually coordinate conservation programs. The application of conservation practices is frequently done by individuals and corporations who use the resource.
- c) The partnership between the private and public sectors has made conservation what it is today.

F. Other activities

G. Conclusion

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

Conserving these resources is simply using them wisely. Although conservation ideas and laws were in use since colonial days, the term "conservation" was not used until the late 1800s. U.S. history has proven that effective conservation efforts do not begin until a resource scarcity or crisis occurs.

The wise use of a natural resource is usually a debatable subject. The government acts as a referee to protect the resources and to divide resource benefits equally.

H. Competency

Define and describe natural resource conservation.

I. Answers to Evaluation

1. a
2. c
3. d
4. b
5. e



Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION**

**Lesson 1: Natural Resource Conservation**

**EVALUATION**

**Complete the following statements by circling the letter of the best answer.**

1. \_\_\_\_\_ are non-renewable natural resources.
  - a. Coal and petroleum
  - b. Fish and wildlife
  - c. Forests
  - d. Soils
  - e. all of the above
  
2. Conservation is the \_\_\_\_\_ of natural resources.
  - a. preservation
  - b. systematic abuse
  - c. wise use
  - d. non-use
  - e. destruction
  
3. Preservation is \_\_\_\_\_ conservation.
  - a. the opposite of
  - b. not related to
  - c. identical to
  - d. part of
  - e. an enemy of
  
4. Conflicting opinions and attitudes are \_\_\_\_\_ in natural resource management.
  - a. rare
  - b. inevitable
  - c. don't exist
  - d. not allowed
  - e. easy to resolve

5. The local, state and federal government are \_\_\_\_\_ in natural resource management.

- a. moderators among competing uses
- b. protectors of public interests
- c. sponsors of large conservation projects
- d. coordinators of conservation programs
- e. all of the above

## UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

### Lesson 2: History of Fish and Wildlife Conservation in Missouri

**Objective:** The student will be able to compare historical fish and wildlife trends and the public's response.

#### Study Questions

1. What was the trend of fish, wildlife and related natural resources in the U.S. and Missouri prior to 1900?
2. What were Missouri's first conservation attempts?
3. How and why was the Missouri Conservation Commission created?
4. How is the Missouri Conservation Commission organized?
5. How is the Department of Conservation funded?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. The History of the Conservation Movement in Missouri. Missouri Department of Conservation, 1986.
3. Poster
  - a) Conservation Successes (with guide). Missouri Department of Conservation, 1983.

## UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

### Lesson 2: History of Fish and Wildlife Conservation in Missouri

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Ask the students to estimate the number of years the wild turkey has been hunted in Missouri. Point out the wild turkey was originally abundant in Missouri, but progressively declined due to overhunting and habitat loss. By 1952, there were only 2,500 turkeys in the entire state. Scientific wildlife management (including restocking efforts) has reestablished this species. The wild turkey season was reopened in 1960 and the statewide population has continued to prosper since then.

To emphasize the growth of fish and wildlife populations, have a person who hunted and fished during the 1920s and 1930s talk to the class. Ask him/her to compare past and present fish and wildlife abundance from personal experience.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Explain the historical natural resource trends and illustrate how the resources are interconnected. Emphasize the importance of habitat.

**What was the trend of fish, wildlife and related natural resources in the U.S. and Missouri prior to 1900?**

- a) Early pioneer attitudes toward fish and wildlife
- b) U.S. resource trends
  - 1) European immigrants found an unspoiled wilderness rich in natural resources.
  - 2) Enormous supply of land led to natural resource abuse.
    - a) Market hunting
    - b) Clearing of natural vegetation on unsuitable areas caused soil erosion, destroyed wildlife habitat and impacted other natural resources.

- c) Missouri resource trends paralleled the pattern of the U.S.
  - 1) First explorers found an astonishing diversity and abundance of fish and wildlife.
  - 2) Missouri was a diverse ecological crossroad; eastern hardwood and southern pine forests, Ozark mountains, southeastern cypress swamps and western grasslands.
  - 3) Natural resources were substantially altered or destroyed by logging, grazing, burning and plowing. Habitat alteration was the primary reason fish and wildlife populations decreased.
    - (a) 99.7 percent of Missouri's original 15 million acres of native prairie vanished under the plow.
    - (b) Roughly one-half of the forests were destroyed.
    - (c) Large scale drainage of wetlands.
  - 4) Market hunting contributed to the decline of fish and wildlife populations during the 1800s.
    - (a) Carcasses of wild animals were sold like any other commodity. In 1885, St. Louis was established as the largest supplier of wild meat in the U.S.
    - (b) The decline of the passenger pigeon, deer, wild turkey, ruffed grouse, black bear, timber wolf and prairie chicken was hastened by market hunting.
    - (c) Commercial fishermen and citizens alike took fish in excessive numbers with no regard for spawning seasons or numbers taken.
  - 5) The public began to sound the alarm for an effective state conservation program by the turn of the twentieth century.

- 2. Discuss with students the evolution of conservation in Missouri. Emphasize the original Game and Fish Department was not the same as the Department of Conservation.

**What were Missouri's first conservation attempts?**

- a) Missouri began to officially recognize the shortage of fish and wildlife during the late 1800s.
  - 1) 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.

- 2) The "Act to Prevent the Destruction of Fish" also passed in 1874. It tried to prohibit some wholesale fishing methods.
  - 3) Few attempts were made to enforce the 1874 laws.
  - 4) Office of State Fish Commissioner was created in 1878.
    - (a) Three-man fish commission was established in 1879.
    - (b) Commission was primarily concerned with building fish hatcheries and stocking fish.
  - b) Missouri's legislature re-enacted the Walmsley law in 1909 which remained the basis of state fish and wildlife laws until 1936.
    - 1) Established a State Game and Fish Commissioner and the Game and Fish Department.
    - 2) Authorized the sale of hunting and fishing licenses to the public and channeled those revenues into a fish and wildlife protection fund.
    - 3) Vested ownership of fish and wildlife in the state and contained strict provisions eliminating the sale and commercial transportation of wildlife.
  - c) Steady decline of fish and wildlife continued.
    - 1) Conservation programs did not address the most important factor - habitat.
    - 2) Politics limited the effectiveness of the Game and Fish Department.
3. Ask the students how and why the Missouri Conservation Commission was created. Note that the Commission's establishment had broad public support.

**How and why was the Missouri Conservation Commission created?**

- a) Missouri sportsmen formed the "Restoration and Conservation Federation of Missouri" to make substantial changes in how the state government administered conservation.
  - 1) The Federation goals were to remove fish and wildlife conservation from politics and 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."
  - 2) The Federation decided to sponsor a constitutional amendment to be voted on by the public and campaigned for it throughout the state.

- b) On November 3, 1936, the conservation amendment carried the state by the largest majority accorded a constitutional amendment in Missouri's history.
4. Ask the students to describe how Missouri Conservation Commissioners are appointed. Explain the difference between the Commission and the Department of Conservation.

**How is the Missouri Conservation Commission organized?**

- a) The Conservation Commission is organized as stated in the constitutional amendment.
    - 1) The Commission consists of four members appointed by the Governor with the advice and consent of the State Senate.
    - 2) Not more than two members may be from the same political party.
    - 3) Each commissioner serves a six year term and receives no salary or other compensation with the exception of traveling expenses when on official business.
  - b) The Commission appoints the Director of Conservation.
    - 1) The director hires other assistants and employees with the approval of the Commission.
    - 2) The group of employees hired by the Commission is known as the Missouri Department of Conservation.
5. Ask the students who pays for the operation of the Missouri Department of Conservation. Emphasize the diverse sources of revenue and how the sources have changed with time.

**How is the Department of Conservation funded?**

- a) The federal government is a source of revenue.
  - 1) In 1937, the Pittman-Robertson Act placed a 10 percent federal excise tax on sporting arms and ammunition.
    - (a) Large portion of the money is returned to the states for wildlife projects.
    - (b) Two amendments to the Act in the early 1970s added excise taxes on handguns and archery gear.
  - 2) Dingell-Johnson Act in 1950 initiated federal excise taxes on sport fishing tackle.
    - (a) Large portion of the money is returned to the states for fish conservation projects.
    - (b) The Act was improved by the Wallop-Breaux amendment of 1984 which added excise taxes on boats, boat motors and marine fuel.

- 3) Other federal sources of revenue
  - (a) Clarke-McNary Act of 1924 provided matching funds to the states for fire protection, seedling tree production and watershed protection.
  - (b) Commercial Fisheries Research and Development Act of 1946 provided funds for the promotion of state commercial fishery research and development projects.
- b) Missouri sportsmen and citizens
  - 1) For the first forty years of its existence, the Missouri Department of Conservation was primarily financed with hunting and fishing license fees.
  - 2) The Conservation Federation of Missouri took a leading role in the early 1970s to find different revenue sources to finance an expanded state conservation program. A conservation sales tax was considered appropriate since the general public would pay the bill and collect the benefits.
  - 3) 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 two-thirds of the Missouri Department of Conservation's budget.

F. Other activities

G. Conclusion

Missouri's fish, forest and wildlife resources have undergone tremendous change since the state was settled. During the 1800s, massive habitat alteration and heavy logging severely damaged the state's resources. Missourians became alarmed about the accelerating resource decline in the late 1800s and initiated conservation efforts. From 1874 to 1936, a series of government laws and programs were tried to stem the loss of fish, forests and wildlife.

The Missouri Conservation Commission was created by a constitutional amendment voted on by the public in November, 1936. The Commission was considered necessary in order to save Missouri resources.



**H. Competency**

Compare historical fish and wildlife trends and the public's response.

**I. Answers to Evaluation**

1. b
2. d
3. e
4. c
5. a
6. c
7. d
8. b
9. d
10. b

Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION**

**Lesson 2: History of Fish and Wildlife Conservation in Missouri**

**EVALUATION**

**Complete the following statements by circling the letter of the best answer.**

1. The primary reason for the decline of fish and wildlife populations during the 1800s was \_\_\_\_\_.
  - a. Weather
  - b. Habitat alteration
  - c. Market hunting
  - d. Disease epidemic
  - e. the Civil War
  
2. \_\_\_\_\_ percent of Missouri's original native prairie has been destroyed by plowing.
  - a. 10.9%
  - b. 49.2%
  - c. 66.3%
  - d. 99.7%
  - e. 1.0%

**Write the letter of the correct answer in each blank.**

3. \_\_\_\_\_ The year Missouri's legislature passed the first statewide wildlife law. a. 1936
  
4. \_\_\_\_\_ The year Missouri's original Game and Fish Department was established. b. 1954
  
5. \_\_\_\_\_ The year the Missouri Conservation Commission was created? c. 1909
  
- \_\_\_\_\_ d. 1823
  
- \_\_\_\_\_ e. 1874

6. The Missouri Conservation Commission was created by a \_\_\_\_\_.
- governor decree
  - supreme court decision
  - constitutional amendment
  - caucus of state legislators
  - treaty
7. The group of employees hired by the Conservation Commission is called the \_\_\_\_\_.
- Conservation Federation of Missouri
  - U.S. Fish and Wildlife Service
  - Missouri Department of Natural Resources
  - Missouri Department of Conservation
  - National Wildlife Federation
8. The Missouri Conservation Commission consists of four members who are appointed by the \_\_\_\_\_.
- National Wildlife Federation
  - Governor
  - public
  - Director of Conservation
  - Secretary of State
9. For the first 40 years of its existence, the Missouri Department of Conservation was primarily financed by \_\_\_\_\_.
- the conservation sales tax
  - donations from private organizations
  - the State Legislature
  - funds from hunting and fishing licenses
  - none of the above
10. The \_\_\_\_\_ has provided two-thirds of the Missouri Department of Conservation's budget since 1977.
- federal excise tax
  - conservation sales tax
  - funds from hunting and fishing licenses
  - State Legislature
  - windfall profits tax

## UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

### Lesson 3: Conservation Careers

Objective: The student will be able to outline the variety of jobs in conservation organizations, educational requirements, employment opportunities and how to prepare for a professional conservation career.

#### Study Questions

1. Who do you work for in the conservation field?
2. What education is required for professional conservation careers?
3. What conservation-related job opportunities are available without a college degree?
4. How do you start building a professional conservation career?
5. What personal sacrifices and satisfaction will you probably experience with a career in conservation?
6. What are examples of professional and technical conservation careers in the federal and state government?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Conservation Careers. Missouri Department of Conservation, 1989.
3. Transparency Masters
  - a) TM 3.1: Federal Land Ownership in the U.S.
  - b) TM 3.2: How to Start Building a Professional Conservation Career
4. Audiovisuals available on loan from the Missouri Department of Conservation, Media Library, P.O. Box 180, Jefferson City, MO 65102-0180.
  - a) "Dedicated to Conservation" videotape (12 minutes)
  - b) "Agents in the Making" videotape (18 minutes)

## UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

### Lesson 3: Conservation Careers

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

Ask the students how they envision the normal working day of a person employed in the natural resource field. Then ask them what type of skills, education and abilities are required for a career in natural resources. Show "Dedicated to Conservation" videotape and/or "To Work with the Forest" 16 mm film.

After the audiovisual(s), ask the students if they are personally acquainted with a professional conservationist. Point out that becoming a conservationist requires dedication and perseverance beginning in high school.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Discuss the broad categories of organizations which hire people to do conservation work. Show TM 3.1.

**Who do you work for in the conservation field?**

##### a) Federal government

- 1) The federal government owns one-third of the continent and has established agencies to properly manage these lands for the benefit of the public.
  - (a) Fish and Wildlife Service
  - (b) Bureau of Land Management
  - (c) Forest Service
  - (d) National Park Service
- 2) 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.
  - (a) Soil Conservation Service
  - (b) Environmental Protection Agency

- (c) Geological Survey
  - b) State government
    - 1) State conservation agencies are the major employers of natural resource conservationists.
    - 2) State conservation agencies have broad responsibilities which vary from state to state. Examples of responsibilities are: clean-up of toxic waste dumps, administration of state soil conservation programs, assisting educators in teaching conservation, performing law enforcement of conservation regulations, etc.
  - c) Local government - Local units of government may hire resource conservationists: for example, foresters are needed to manage city forests, and park rangers are hired to supervise the operation of community parks.
  - d) Private companies and organizations
    - 1) Some private companies and organizations have full-time conservationist positions. Examples of these positions are: waterfowl biologist for a duck hunting club, forester for a timber company, or soil conservationist for a banking institution.
    - 2) Environmental laws in the 1970s created more opportunity in private enterprise.
  - e) Self-employment
    - 1) Opportunities for self-employment are limited and highly specialized.
      - (a) Private environmental consulting firms
      - (b) Private timber management consulting firms
    - 2) Supplementary source of income
      - (a) Shooting preserve
      - (b) Fee fishing area
      - (c) Nature photography
2. Ask the students what is required to be considered a professional conservationist. Explain how a college education will make them better conservationists.

**What education is required for professional conservation careers?**

- a) 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.
- b) Value of a college degree
  - 1) Technical training
  - 2) Broadens a person's understanding of how conservation meshes with the public's attitudes and values
  - 3) Develops communication skills

3. Discuss the types of conservation-related jobs which do not require a college degree.

**What conservation-related job opportunities are available without a college degree?**

- a) Many different types of skills, trades and specialized training are needed in natural resource conservation which do not require a college degree.
- 1) Missouri Department of Conservation is a good example of a conservation agency which is comprised of diverse occupations.
    - (a) Internal support positions; building maintenance technician, equipment mechanic, administrative secretary, data entry operator, etc.
    - (b) Conservation positions; fish culture aide, fisheries assistant, tree nursery aide, etc.
    - (c) Without a college degree, chances for promotions are diminished.
  - 2) Conservation agencies and organizations in both the public and private sector have similar occupational structures.
4. Ask the students if they are interested in pursuing a professional career in conservation. Explain how they can start working toward their goals immediately. Use TM 3.2.

**How do you start building a professional conservation career?**

- a) Talk with professional conservationists.
- 1) Contact local conservationists and ask for appointments to visit them.
    - (a) Soil Conservation Service; district conservationist
    - (b) Missouri Department of Conservation; conservation agent
  - 2) The purpose of talking with professional conservationists is to find out what they do in their jobs.
    - (a) What job duties do they enjoy the most?
    - (b) What job duties do they enjoy the least?
    - (c) How did they prepare for the position?
    - (d) What is a typical day in their jobs?
- b) Talk with parents, teachers and guidance counselors.
- c) Seek out conservation experiences.
- 1) Develop a supervised occupation experience project related to conservation.
  - 2) Attend special conservation programs such as the Conservation Honors Program, Eagle Days or Prairie Days.

- 3) Participate in recreational activities such as hunting, fishing, camping, hiking, etc. which will lead to learning about conservation.
  - d) Develop communications skills
    - 1) Much of the work performed by professional conservationists requires clear communications with other people.
    - 2) Begin developing speaking and writing skills in high school by taking extra courses in English and public speaking.
  - e) Build a good academic foundation along with agricultural skills and knowledge.
  - f) Take college entrance examinations.
  - g) Select a college or university to attend early in the senior year.
  - h) Save money from part-time work and investigate the availability of scholarships and grants.
5. Ask the students what they would and would not like about a conservation career. Point out that there are both personal sacrifices and benefits.

**What personal sacrifices and satisfaction will you probably experience with a career in conservation?**

- a) Sacrifices
  - 1) Earning a college degree for the opportunity to become a professional conservationist.
  - 2) Securing employment in conservation is very competitive.
    - (a) Number of people with good credentials has always exceeded the number of open positions.
    - (b) Recent college graduates should be willing to wait for conservation employment - sometimes for years. To gain work experience they frequently start a career by working at a conservation job which does not require a college degree.
  - 3) Moving to different locations is frequently a requirement of career advancement.
- b) Benefits
  - 1) Living in rural or remote areas
  - 2) Salaries and fringe benefits of conservation jobs are comparable to what is offered in other fields for the same amount of education and experience.
  - 3) Personal sense of accomplishment when a well-planned conservation program is successful.



6. Ask the students what conservation jobs they are familiar with in the vicinity. Point out the conservation agencies which have a presence in your county.

**What are examples of professional and technical conservation careers in the federal and state government?**

a) Federal government

1) Department of the Interior

(a) Fish and Wildlife Service (FWS)

(1) Major responsibility is the conservation and protection of fish and wildlife at the federal level.

a) Manages national wildlife refuges (34 million acres).

b) Operates fish and wildlife laboratories, cooperative research units at universities and national fish hatcheries.

c) Maintains a nationwide network of wildlife law enforcement agents.

(2) FWS employs 5,000 full-time employees.

a) Half the employees are fishery biologists and wildlife biologists.

b) 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).

c) For further information on FWS careers, contact: Personnel Officer, U.S. Fish and Wildlife Service, Federal Building-Fort Snelling, Twin Cities, MN 55111. Phone: (612) 725-3585

(b) Bureau of Land Management (BLM)

(1) Responsible for managing 300 million acres of land, and subsurface resources underlying an additional 300 million acres of land in the western U.S.

(2) BLM employs 9,000 full-time personnel.

a) Employees manage many different natural resources.

- b) Characteristic BLM job titles are: range conservationist, forester, wildlife biologist, geologist, mining engineer, hydrologist, land law examiner, soil conservationist, mineral economist and recreation specialist.
  - c) For further information on BLM careers, contact: Bureau of Land Management, Denver Service Center, Denver Federal Center, Building 50, Denver, CO 80225  
Phone: (303) 236-6503
- (c) National Park Service (NPS)
- (1) Responsible for the protection, preservation and management of the 77 million acres in the national park system.
  - (2) National park system has 330 units which include: national parks, battlefields, cemeteries, monuments, national lakeshores, national riverways, historic ruins, memorials and natural areas.
  - (3) NPS employs nearly 11,000 full-time employees.
    - a) Hires an additional 7,000 seasonal personnel.
    - b) Characteristic NPS job titles are: park ranger, park police, park aid, park technician, wilderness ranger, archeologist, architect, snow ranger and landscape architect.
    - c) For further information on NPS careers, contact: National Park Service, Room 2328, 18th & C Streets NW, Washington D.C. 20240.  
Phone: (202) 343-4747
- (d) U.S. Geological Survey (USGS)
- (1) Primary responsibility is to research and provide information on the earth's crust in the U.S. USGS does not manage land of its own.
  - (2) Involved with many diverse activities which include: topographic map preparation; geologic research for general appraisal of mineral, ore and fuel resources; volcano and earthquake research; hydrologic research concerning ground and surface water;

public land classification as to their value for leasable fuels and minerals; and supervision of mining operations on government-leased land.

- (a) Characteristic USGS job titles are: geologist, geophysicist, hydrologist, cartographer and geochemist.
- (b) For further information on USGS careers, contact: USGS Personnel Office, 1400 Independence Avenue-MS-100, Rolla, MO 65401.  
Phone: (314) 341-0810

2) Department of Agriculture

(a) Soil Conservation Service (SCS)

- (1) Primary task is to provide soil conservation assistance to farmers, ranchers and other landowners. SCS does not manage land of its own.
  - a) Majority of SCS employees work directly with farmers and ranchers to help them solve soil and water conservation problems.
  - b) SCS employees in field offices have many duties. Examples are: survey and layout conservation practices, help farmers prepare feasible conservation plans, hold public informational meetings and coordinate conservation efforts with local officials and other agencies.
  - c) 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.
  - d) SCS is also responsible for a nationwide soil survey program.
- (2) SCS employs approximately 14,000 full-time employees.
  - a) Characteristic SCS job titles are: soil conservationist, soil conservation technician, soil scientist, agricultural engineer, agronomist, engineering technician, soil conservation aide and range conservationist.

- b) For further information on SCS careers, contact: Soil Conservation Service, 555 Vandiver Drive, Columbia, MO 65202. Phone: (314) 875-5214
  - (b) Forest Service (FS)
    - (1) Major responsibility is to provide leadership in the management, protection and use of the national forest system (191 million acres).
      - a) National forest system encompasses nearly two-thirds of all federally owned lands.
      - b) FS is also involved in forestry research.
    - (2) FS is the largest and most diverse agency in the Department of Agriculture.
    - (3) FS employs approximately 30,000 full-time employees.
      - a) Hires an additional 15,000 temporary employees.
      - b) More foresters (5,500) are employed in the FS than any other occupational title.
      - c) Characteristic FS job titles are: forester, forestry technician, engineer, range conservationist, soil scientist, wildlife biologist, fishery biologist, hydrologist, survey technician, biological technician, tree nursery aide and log scaler.
      - d) For further information on FS careers, contact: USDA Forest Service, 310 West Wisconsin Avenue-Room 500, Milwaukee, WI 53203
- b) State government
  - 1) Missouri Department of Conservation (MDC)
    - (a) MDC is responsible for the conservation of the state's fish, forest and wildlife resources.
    - (b) MDC is involved in a multitude of conservation activities. Examples are: 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, 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.

- (c) MDC employs over 1,000 full-time employees.
  - (1) Characteristic professional 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, fisheries research biologist.
  - (2) MDC also employs 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 and fisheries assistant.
  - (3) For further information on MDC careers contact: Personnel Section, Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102-0180.  
Phone: (314) 751-4115
- 2) Missouri Department of Natural Resources
  - (a) Responsible for assuring the state's major resources (excluding fish, forest and wildlife) are wisely used.
  - (b) DNR is involved in many activities pertaining to the conservation of air, water, land, minerals, energy, recreational resources and cultural resources.
    - (1) Environmental programs in air and water pollution control, public drinking water, waste management, land reclamation, soil and water conservation, and energy conservation.
    - (2) Collects geologic information about mineral, water, energy and land resources.
    - (3) Manages Missouri's 74 state parks and historic sites.
    - (4) Characteristic job titles are:

environmental engineer, planner, environmental specialist, water specialist, land reclamation specialist, geologist, land surveyor, architect, historic site administrator, park superintendent and park naturalist.

- (5) DNR also employs 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.
- (6) 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

#### F. Other activities

1. Invite local resource specialists to talk with the class about conservation career opportunities. A personal discussion concerning benefits and sacrifices of conservation employment will help give the students a realistic outlook.
2. Tour a local Missouri Department of Conservation wildlife area and ask the area manager to concentrate discussion on job duties and responsibilities.
3. Have each student give a verbal and/or written report on the duties and responsibilities of a particular conservation agency or job title.

#### G. Conclusion

A professional conservation career requires a considerable amount of education and perseverance. The number of college-educated natural resource specialists seeking employment has always exceeded the number of job vacancies.

Conservation agencies hire people with varying skills, trades and specialized training. Many conservation-related jobs do not require a college education. Examples are: administrative secretary, fish culture aide, forestry technician, data entry operator, and soil conservation technician.

## H. Competency

Outline the variety of jobs in conservation organizations, educational requirements, employment opportunities and how to prepare for a professional conservation career.

## I. Answers to Evaluation

1. a
2. a
3. e
4. c
5. e
6. Four of the following: talk with professional conservationists; talk with parents, teachers, and guidance counselors; seek out conservation experiences; develop communication skills; build a good academic foundation; take college entry examinations; select a college or university; save money.

Name \_\_\_\_\_

Date \_\_\_\_\_

UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

Lesson 3: Conservation Careers

EVALUATION

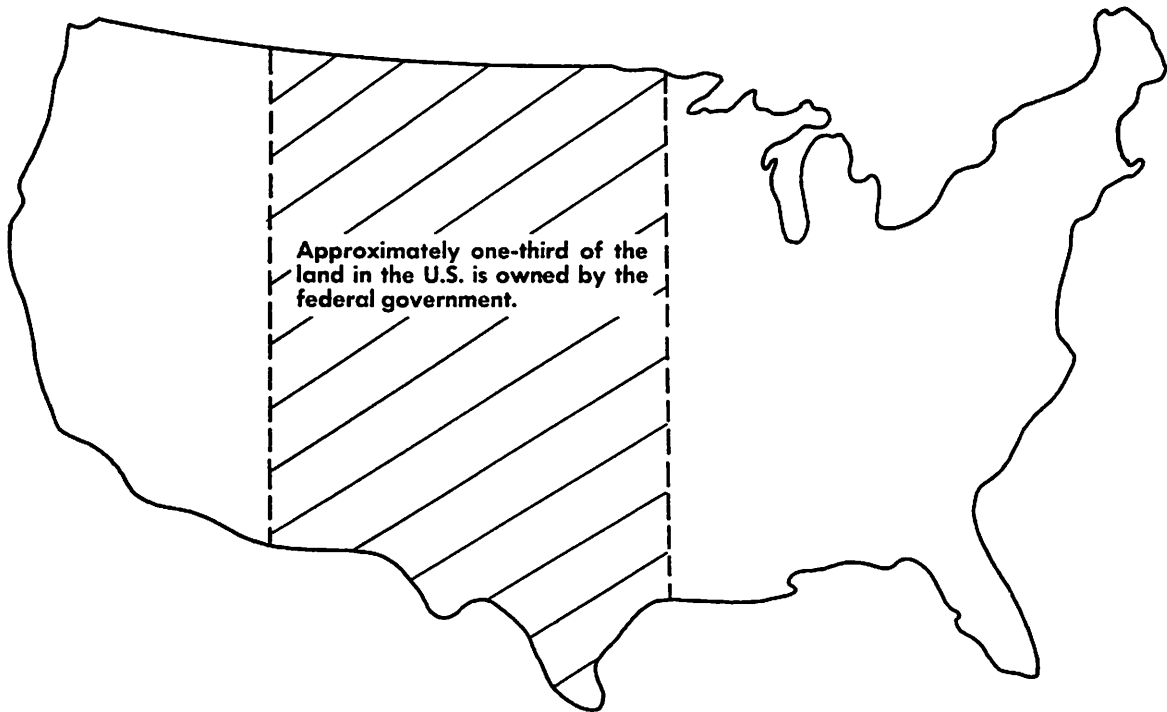
Circle the letter that best corresponds to the best answer.

1. \_\_\_\_\_ are the major employers of natural resource conservationists.
  - a. State agencies
  - b. Federal agencies
  - c. County governments
  - d. Private companies
  - e. none of the above
  
2. A professional conservationist must have earned at least a \_\_\_\_\_.
  - a. bachelor's degree
  - b. master's degree
  - c. high school diploma
  - d. doctorate degree
  - e. none of the above
  
3. Conservation agencies hire people who have earned a \_\_\_\_\_.
  - a. bachelor's degree
  - b. master's degree
  - c. high school diploma
  - d. associate's degree
  - e. all of the above
  
4. The number of people trying to enter the conservation field has always \_\_\_\_\_ the number of open positions.
  - a. been less than
  - b. increased
  - c. exceeded
  - d. been equal to
  - e. none of the above
  
5. Which of the following is a state agency?
  - a. Fish and Wildlife Service
  - b. Soil Conservation Service
  - c. Bureau of Land Management
  - d. Forest Service
  - e. none of the above

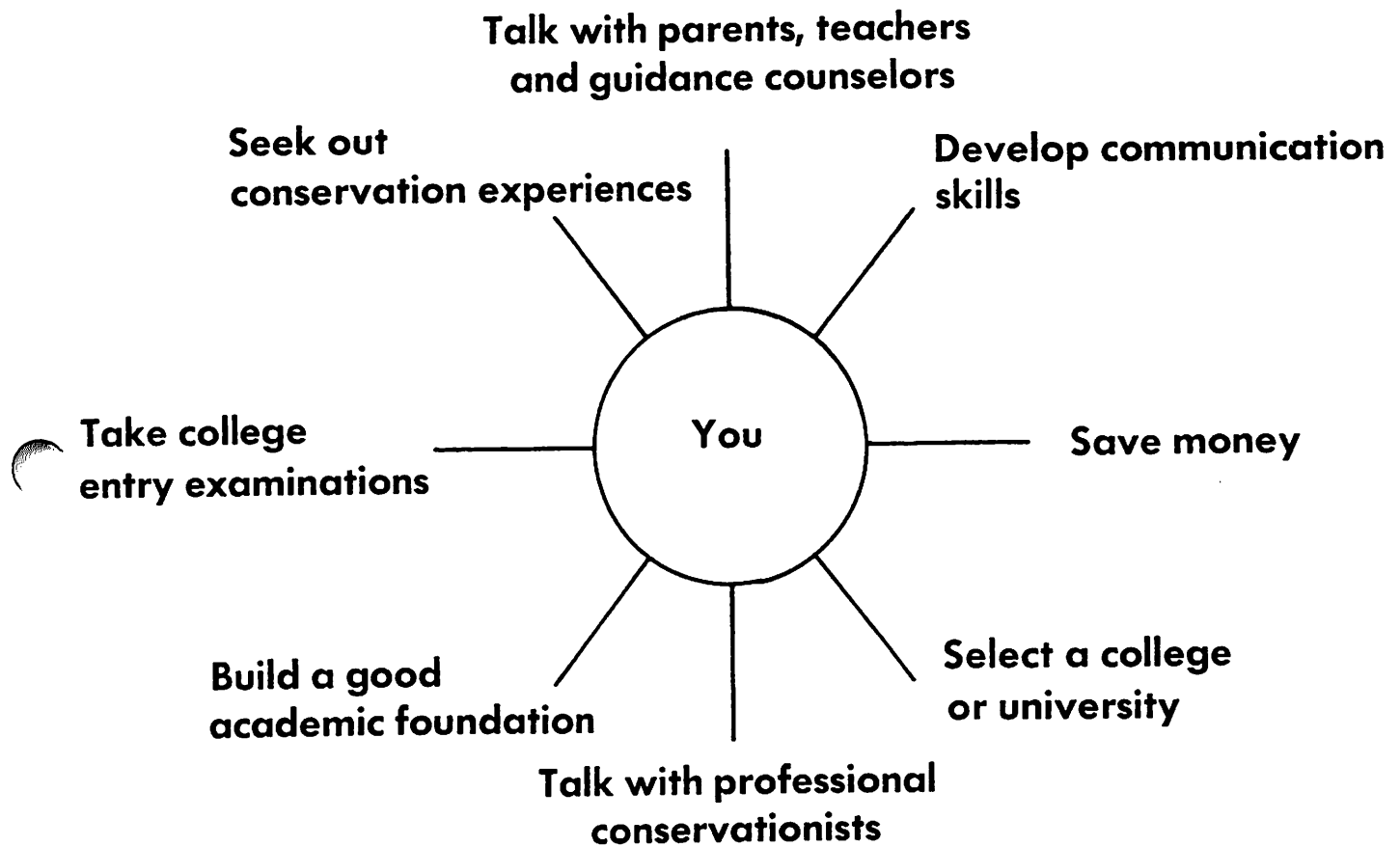


6. List four ways to begin preparing yourself for a professional conservation career.

# Federal Land Ownership in the U.S.



# How to Start Building A Professional Conservation Career



## UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

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

Objective: The student will be able to distinguish the difference between basic fish and wildlife legalities and ethics.

#### Study Questions

1. Who owns fish and wildlife in Missouri?
2. Who controls access to fish and wildlife in Missouri?
3. How can you acquire and keep the right to fish and hunt on private property?
4. What are the two degrees of trespassing?
5. What is a sportsman's code of ethics?
6. What is the difference between "legal" and "ethical?"

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. S.P.O.R.T. Ethics Class. Missouri Department of Conservation, 1985.
3. Activity
  - a) Activity 4.1: Defining Ethics

## UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION

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

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Ask the students, "Who do the deer belong to?" When a hunter harvests a deer, does it belong to him/her? Who owned the deer before it was harvested? Does the ownership of a deer change every time the animal crosses property lines? If the class states many different opinions, list them on the chalkboard.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students if people have legal title to the fish and wildlife on land they own.

#### Who owns fish and wildlife in Missouri?

- a) 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."
  - b) The State of Missouri owns the fish and wildlife and holds them in trust for the benefit of the general public.
2. Discuss the difference between the ownership and access to fish and wildlife. Point out that Missouri farmers control access to more land than any other group.

#### Who controls access to fish and wildlife in Missouri?

- a) Landowners control the public's access to fish and wildlife by deciding who will enter their property.
  - 1) Landowners may be farmers, government agencies or private organizations and companies.

- 2) Farmers control access to more land and hunting opportunity than any other group.
  - 3) Fishing, canoeing and other aquatic recreation is generally more accessible.
    - (a) Missouri has over 900,000 acres of water.
    - (b) Rivers, streams and reservoirs account for 75 percent of surface water resource.
    - (c) Missouri Department of Conservation has increased public use of rivers and streams by providing 273 river access areas.
    - (d) The management of Missouri's large reservoirs is accomplished by a cooperative effort from many government and private organizations.
    - (e) Public accessibility to the 90,000 private ponds the Missouri Department of Conservation has stocked is at the pond owner's discretion. Private ponds provide 12 percent of the recreational fishing in the state today.
3. Ask the students where they have hunted and fished in the past. Did they have permission? Ask them who they would grant fishing or hunting privileges to if they owned land.

**How can you acquire and keep the right to fish and hunt on private property?**

- a) Fishing and hunting on private land is not a personal right - it is a privilege and a favor.
  - 1) You should obtain a landowner's permission to hunt or fish.
  - 2) Asking for permission does not guarantee you will receive it.
    - (a) Landowner may have purchased the land as a personal hunting and fishing area.
    - (b) Landowner may have promised hunting and fishing privileges to friends or family members.
    - (c) Farmers may not grant permission due to the careless actions of previous fishermen and hunters.
  - 3) When contacting landowners, look and act like a responsible sportsman.
    - (a) Landowners are more likely to grant permission to a courteous individual who appears to be respectful of other people's property.
    - (b) Ask for permission (in person) several months in advance. This is particularly true when asking for hunting privileges.

- (c) Learn the landowner's name and find out how to contact him/her.
  - (d) 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.
  - (e) If you are unable to make the trip, call the landowner and tell him/her you won't be there.
- b) Treat the landowners with courtesy.
- 1) Thank the landowners for their hospitality after you have finished hunting or fishing to let them know you appreciate the privilege they have extended to you.
  - 2) Offer the landowner part of the fish and game you have harvested as a friendly gesture.
  - 3) Send landowners a thank you card when you arrive at home and try to reciprocate their kindness. Remembering them at Christmas is an excellent way to express your gratitude.
4. Ask the students if they consider trespassing a crime. If their parents own land, ask the students for specific examples of trespassing problems.

**What are the two degrees of trespassing?**

- a) Trespass in the first degree
  - 1) Trespass in the first degree puts a heavy burden on the prosecutor or "state."
    - (a) Prosecution requires evidence that a person 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.
    - (b) Trespass in the first degree is a misdemeanor and carries a fine up to \$500 and/or a term not to exceed six months.
- b) Trespass in the second degree
  - 1) The trespass in the second degree statute reads that: "A person commits the offense of trespass in the second degree if he enters unlawfully on the real property of another."
    - (a) Does not require the posting, fencing, or warning requirements of trespassing in the first degree.
    - (b) The landowner does not need to show that the defendant was aware that he was on someone else's property.

- (c) The trespass in the second degree statute is aimed at people who do not bother to determine whose property they are on nor get permission to go on it.
  - (d) Trespass 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.
5. Ask the students to list examples of ethical fishing and hunting behavior.

**What is a sportsman's code of ethics?**

- a) Everyone has a personal code of ethics they have developed through experience which guides their daily behavior.
    - 1) A personal code of ethics points to what is right and what is wrong.
    - 2) When people violate their personal code of ethics, their consciences may bother them.
  - b) A sportsman's code of ethics is a highly personal set of values which guide his/her behavior toward landowners, companions, private property and the fish and game.
  - c) Examples of what most people consider to be unethical behavior are:
    - 1) Carelessly pointing your gun at a companion.
    - 2) Littering.
    - 3) Leaving gates open.
    - 4) Shooting quail or pheasants on the ground.
    - 5) Making unnecessary noises near a fisherman.
6. Ask the students if all legal acts are ethical. Point out that a legal act is well-defined by law and ethical behavior is based on individual judgment.

**What is the difference between "legal" and "ethical?"**

- a) "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.
- b) "Ethical" involves judging behavior as being right or wrong based on a set of moral values which may vary from one individual to another.
- c) Some activities may be legal and yet considered unethical by most people.
  - 1) Shooting ducks on the water.
  - 2) Shooting a covey of quail on the ground.
  - 3) Making unnecessary noises near a fisherman.
- d) In most cases, illegal acts are also unethical.



F. Other activities

G. Conclusion

Outdoor users need to conduct themselves in a responsible manner when engaging in their chosen recreational activities. This is particularly true with hunting and fishing.

Responsible sportsmen adhere to the legal aspects of their sport and demonstrate ethical behavior. In doing so they protect themselves, landowners and their sport.

H. Competency

Distinguish the difference between basic fish and wildlife legalities and ethics.

I. Answers to Evaluation

1. a
2. b
3. d
4. c
5. c
6. a
7. b
8. d
9. d

Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT I - INTRODUCTION TO FISH AND WILDLIFE CONSERVATION**

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

**EVALUATION**

**Circle the letter which corresponds to the best answer.**

1. Who owns Missouri's fish and wildlife?
  - a. State of Missouri
  - b. Department of Conservation
  - c. Landowners
  - d. Hunters, fishermen and trappers.
  - e. U.S. Fish and Wildlife Service
  
2. Who controls access to more land and hunting opportunity than any other group?
  - a. Missouri Department of Conservation
  - b. Farmers
  - c. USDA Forest Service
  - d. Conservation Federation of Missouri
  - e. Medical doctors and lawyers
  
3. How much of Missouri's land area does the government own?
  - a. 1%
  - b. 20%
  - c. 40%
  - d. 8%
  - e. 75%
  
4. A pond owner who asks the Department of Conservation to stock a pond must do one of the following:
  - a. Let anyone fish who wants to.
  - b. Prohibit anyone from fishing in the pond.
  - c. Allow a reasonable amount of fishing in the pond.
  - d. Sell the fish to the Conservation Department when they are grown.
  - e. Eat the fish when they are grown.

5. Private ponds provide \_\_\_\_\_ percent of the recreational fishing in Missouri.
- a. 1
  - b. 40
  - c. 12
  - d. 75
  - e. none of the above
6. In rural areas, land adjacent to streams and rivers is usually owned by \_\_\_\_\_.
- a. farmers
  - b. the Department of Conservation
  - c. the Department of Natural Resources
  - d. the Division of Inland Waterways
  - e. none of the above
7. Fishing and hunting on private land you don't own is not a right - it is \_\_\_\_\_.
- a. a public right
  - b. a privilege extended by the landowner
  - c. a state law
  - d. an American tradition
  - e. crime
8. Trespass in the first degree carries up to a \_\_\_\_\_ fine.
- a. \$10
  - b. \$100
  - c. \$200
  - d. \$500
  - e. \$1000
9. An ethical judgment is not clearly defined as right or wrong since \_\_\_\_\_ are involved.
- a. conservation agents
  - b. county prosecutors
  - c. state laws
  - d. moral values
  - e. court systems

## Defining Ethics

Read the following aloud to the class.

Jane, Ben, Harold, and Cathy live in the same county. They all grew up together and went to the local high school in their small community. As high school students they learned to hunt and since becoming adults they have continued the sport. How and why they hunt differ, however.

Jane has five children and has had trouble finding a steady job. She admits that she sometimes takes game out of season or more than her limit, but she needs the food for her family. Times are rough, she says, and a person has to feed her family however she can.

Ben was very competitive in school and prides himself in always doing better than anyone else. He loves to hunt but he always wants the biggest and the most. He frequently brags that he always takes his limit. What he doesn't need he leaves in the field, throws away, gives to friends, or sometimes sells.

Harold lives in an expensive home and drives an expensive car. He has many debts. Although he has a good job, he's always looking for a way to make extra money. What he shoots he usually sells. Harold doesn't pay much attention to legal seasons. His philosophy is just not to get caught.

Cathy owns a farm in the country. She has had continual problems with deer eating her corn. She has contacted the Conservation Department and received suggestions of what to do, but she still feels that deer are overabundant and are pests that need to be destroyed. She spotlights deer whenever she can, shoots them, and throws them into a ditch. She says every deer she kills is one less deer to eat her valuable crops.

### Discussion

Divide the class into groups of five or six. Though the actions of all individuals are illegal, have the group discuss whether their behavior is ethical or unethical. Have each group rank the people's behavior. Allow 10 minutes.

Call time after 10 minutes. Write the individual's names on the blackboard or a large sheet of paper. Ask each group to tell how the characters ranked and list the rankings after each name. Did the groups agree on whether or not the men acted ethically or unethically? Did their rankings agree or disagree? Did any character rank consistently the same? Have the groups defend their choices. Point out that frequently with ethical decisions there is no black and white. Ethical judgments are based on values and individuals have different value systems. Therefore, there may be no right or wrong answer to this activity.

**Credit:** S.P.O.R.T. Ethics Class. Missouri Department of Conservation, 1985.

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 1: Commercial Value

**Objective:** The student will calculate how the commercial value of fish and wildlife resources can benefit the economy and landowners.

#### Study Questions

1. What is the commercial value of fish and wildlife resources based upon?
2. What is the difference between annual net income and commercial value?
3. How does the multiplier effect work?
4. What are the different types of fee hunting and fee fishing in Missouri?
5. What are the advantages and disadvantages of hunting leases?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.

## FISH AND WILDLIFE MANAGEMENT

### UNIT II - FISH AND WILDLIFE VALUES

#### Lesson 1: Commercial Value

##### TEACHING PROCEDURES

###### A. Review

Review the previous lesson.

###### B. Motivation

Charging recreational access to private land is one way landowners can generate an economic return from the fish and wildlife resources on their land. Ask the students if they, or any members of their families, have purchased or sold recreational access.

If some of the students are trappers, ask them what they would pay a landowner to trap muskrats in a pond. What factors would have influence on their decision?

From a commercial perspective, the amount of investment in time, money and effort should be weighed against the anticipated earnings from fur sales. However, if a person enjoys trapping as a recreational activity, he/she may not be so concerned about monetary gain. Point out that their own set of personal values defines their answer(s).

The lesson "Commercial Value" is the first in a series of seven lessons which explain the different types of fish and wildlife values.

###### C. Assignment

###### D. Supervised study

###### E. Discussion

1. Ask the students what they consider to be examples of the commercial value of fish and wildlife resources. Point out that commercial value does not include personal gain from illegal activities.

**What is the commercial value of fish and wildlife resources based upon?**

- a) Commercial value is based upon the legal sale of animals and their products or from supplying access to fish and wildlife populations.

- 1) Trappers, hunters and commercial fishermen receive income from the furs and fish they harvest.
  - 2) Landowners sell fishing and hunting leases and other access privileges.
  - 3) Businesses sell equipment, clothing, food, etc. to people engaged in recreational activities.
- b) Financial benefits from fish and wildlife resources are shared by a diverse group of individuals and businesses.

2. Ask the students to estimate the commercial value of 80 acres of cropland capable of growing corn and soybeans. Point out the difference between commercial value and annual net income.

**What is the difference between annual net income and commercial value?**

- a) Commercial value is the amount of financial investment it would require to match the annual net income of a fixed capital asset.
- b) The commercial value of fish and wildlife resources is equal to the amount of financial investment needed to generate an equivalent annual net income.
- c) The annual net income generated from the many different uses of fish and wildlife is a practical measurement because fish and wildlife cannot be directly purchased; but may be used appropriately.

3. Ask the students to develop a flow chart of where their money circulates after purchasing a car or another expensive item.

**How does the multiplier effect work?**

- a) Dollars spent on fish and wildlife-associated activities will be exchanged several times in the local economy. This economic activity is called the multiplier effect.
  - 1) The economy is stimulated each time the dollars are exchanged.
  - 2) The economic benefits of fish and wildlife resources are much greater than the sum of resource-based transactions. The money will continue to circulate and generate economic activity.
  - 3) In some cases, income from fish and wildlife resources forms the foundation of the local economy.
- b) Fur was Missouri's first cash crop and continues to have a place in the state's economy today.

- 1) In 1978-79, pelts worth \$8.6 million were harvested in Missouri.
  - 2) Based on a multiplier effect of 6.67, this harvest value stimulated Missouri's economy by \$57 million.
  - c) The 1,166,406 pounds of live fish harvested by commercial fishermen in 1987 had a wholesale value of \$332,000.
4. Ask the students if they are aware of fee hunting or fee fishing areas or arrangements in the area. If local custom has stifled this type of activity, you could ask the students why landowners don't charge.

**What are the different types of fee hunting and fee fishing in Missouri?**

- a) 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.
- b) In general, Missouri landowners are not captivated by the idea of making wildlife an income-generating product of their farm operations. Less than one percent of Missouri farm operators charged access fees in 1982.
- c) 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.
- d) Landowner leases
  - (1) According to the Missouri Department of Conservation, 382 Missouri landowners charged for hunting access and 95 charged for fishing access in 1986.
  - (2) Yearly leases were the most common and constituted two-thirds of all hunting concessions.
  - (3) Seasonal leases were common for hunting access.
  - (4) Only a small number of landowners charged daily fees to hunt, while this was a common practice for fishing access.



- e) Licensed shooting areas
  - (1) There are 50 licensed shooting areas (LSA's) in Missouri which provide a unique experience to a small segment of the hunter market.
  - (2) Commercial licensed shooting area fee structures generally included an entrance fee with associated bag limit, or a charge for birds released, with a minimum daily hunting fee.
  - (3) Minimum payment required for a one-day hunt averaged \$50.76, but extremes ranged from no minimum to \$150.00.
  - (4) About one-half of Missouri's licensed shooting areas were located within 50 miles of either Kansas City or St. Louis and drew clientele almost exclusively from these urban centers in 1985-86.
  - (5) Licensed shooting areas attracted less than one percent of Missouri's quail and pheasant hunters in 1985-86.
- f) Fee fishing areas
  - (1) Three main fee structures were evident in Missouri during 1986.
    - (a) A entrance fee with a limit on the number of fish caught.
    - (b) A nominal entrance fee, and charge per pound of fish kept.
  - (2) Combining all estimates of daily expenditures at all areas yielded an average of \$11.69 per angler.
  - (3) Less than one percent of all angler days in Missouri occurred on these areas.
  - (4) Large scale fee fishing operations catered to an urban population with little free time.
  - (5) Small operations, which attract a primarily local clientele, seem to be victims of high operating costs, low returns, and an overall declining demand.
- g) Commercial waterfowl areas
  - (1) There were 19 commercial waterfowl areas in Missouri during 1986 which leased waterfowl pits and blinds.
  - (2) Leasing waterfowl blinds and pits is an opportunity-oriented business adjacent to public waterfowl areas.
  - (3) There are two types of fee structures:
    - Daily-fee and seasonal lease.
      - (a) Daily-fee charged individual hunters a "gun fee" and occasionally charged a "pit fee" for groups of hunters. Daily gun fees varied from \$2.50 to \$25.00. The average pit fee for four hunters was \$34.00.
      - (b) Prices for seasonal leases varied from \$300 to \$3,000.

5. Ask the students if they would sell hunting leases on land they own. Guide the discussion to emphasize hunting leases should be approached in a business-like fashion. Point out a landowner may be held liable for many types of hunter accidents occurring on his/her land. Fee hunting arrangements will increase the landowner's liability.

**What are the advantages and disadvantages of hunting leases?**

- a) Advantages of fee hunting (landowner perspective).
- (1) Extra income
    - (a) Missouri landowners usually charge lease hunting fees from \$2 to \$6 per acre.
    - (b) Some Missouri landowners charge on a per gun basis. An average fee for turkey or deer season is \$100 per gun.
  - (2) More protection from poachers. Hunters who have paid for hunting leases will be more prone to notice and report poaching activities.
- b) Disadvantages of fee hunting (landowner perspective).
- (1) Liability--if hunters suffer physical injury while pursuing their sport, the landowner can potentially be open for a lawsuit. Landowners should do the following to minimize the chance for hunter injury and to protect themselves from liability:
    - (a) 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.
    - (b) Require the hunters to wear highly visible clothing to minimize shooting accidents.
    - (c) Purchase liability insurance specifically for the hunting business.
    - (d) Consult an attorney for advice. Make him/her part of your liability prevention team.
  - (2) 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.
- c) If fee hunting became a widespread practice, lower to middle income hunters might be forced to abandon their hunting activities--or at least relegated to poorer quality habitats.
- d) 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 benefit.

**F. Other activities**

1. Invite the operator of a fee fishing or fee hunting area to speak before the class concerning his/her business.
2. Select an appropriate landowner and have him/her explain how he/she sells hunting leases and the advantages and disadvantages.

**G. Conclusion**

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. Commercial value is different from the annual net income derived from fish and wildlife resources, farmland or other capital assets. The commercial value of a capital asset is the amount of financial investment it would require to match the annual net income generated by the asset.

Another component of commercial value is the multiplier effect created by money spent on fish and wildlife-associated products and recreation. The money exchanged continues to circulate thereby stimulating the local and state economies.

The commercial value of fish and wildlife resources is derived from:

1. Expenditures on fish and wildlife-associated recreation. (includes fee hunting and fee fishing.)
2. Sale of furs.
3. Sale of fish captured commercially.

**H. Competency**

Calculate the commercial value of fish and wildlife resources and how it can benefit the economy and landowners.

**I. Answers to Evaluation**

1. d
2. b
3. c
4. b
5. a
6. a
7. b
8. a
9. c
10. c

Name \_\_\_\_\_

Date \_\_\_\_\_

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 1: Commercial Value

#### EVALUATION

Circle the letter that corresponds to the best answer.

1. Which of the following is not included in the commercial value of fish and wildlife?
  - a. Sale of hunting and fishing leases
  - b. Sale of furs
  - c. Sale of fish caught commercially
  - d. Sale of venison
  - e. Sale of guns and ammunition
  
2. Which of the following is the multiplier effect based on?
  - a. The reproductive rate of fish and wildlife populations.
  - b. The number of times money is exchanged in the economy.
  - c. The accelerating decline of fish and wildlife populations.
  - d. The conservation sales tax.
  - e. Reproductive rate of wildlife populations.
  
3. The 1978-79 Missouri fur harvest was worth \$8.6 million. By how much did this harvest stimulate the states economy?
  - a. \$ 8.6 million
  - b. \$17.2 million
  - c. \$57.0 million
  - d. \$ 1.0 billion
  - e. none of the above
  
4. What is the most popular type of lease hunting arrangement among Missouri landowners?
  - a. Daily lease
  - b. Yearly leases
  - c. Seasonal leases
  - d. Charge per animal harvested
  - e. Monthly leases

5. What percentage of Missouri's quail and pheasant hunters were attracted to licensed shooting areas in 1985-86?
  - a. 1%
  - b. 25%
  - c. 50%
  - d. 75%
  - e. none of the above
  
6. Where are most large scale fee fishing operations located in Missouri?
  - a. Near urban areas
  - b. Adjacent to large reservoirs
  - c. Within 50 miles of Jefferson City
  - d. In a narrow strip near the Arkansas border
  - e. none of the above
  
7. Most commercial waterfowl areas are located near \_\_\_\_\_.
  - a. St. Louis
  - b. public waterfowl areas
  - c. northwest Missouri
  - d. Iowa
  - e. Illinois
  
8. Missouri landowners usually charge for lease hunting on a \_\_\_\_\_ basis.
  - a. per acre
  - b. per hour
  - c. per animal harvested
  - d. per pound of meat harvested
  - e. per month
  
9. Which is a landowner disadvantage of fee hunting?
  - a. Higher property taxes
  - b. Must buy an expensive license to legally charge for hunting privileges
  - c. Increased liability for hunter safety and actions
  - d. Loss of income
  - e. Government intervention
  
10. Why would wildlife populations probably benefit from more fee hunting in the state?
  - a. Less hunting pressure
  - b. Fewer poachers
  - c. Landowners would have an economic incentive to manage wildlife
  - d. Missouri Department of Conservation would receive more revenue
  - e. none of the above

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 2: Recreational Value

Objective: The student will list the different recreational values of fish and wildlife resources.

#### Study Questions

1. How is the recreational value of fish and wildlife resources measured?
2. What are the participation and expenditure levels of hunters and fishermen?
3. What are the participation levels for nonconsumptive uses of fish and wildlife in the U.S.?
4. What nonconsumptive uses of fish and wildlife are preferred by Missouri urban residents?
5. How is the recreational value of fish and wildlife resources taxed?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 2: Recreational Value

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Ask the students to estimate how much money they spent the previous year on fish and wildlife-associated recreation. Include licenses, clothing, birdseed, birdfeeders, habitat improvement expenditures, firearms, ammunition, fishing rods and lures, traps, magazine subscriptions, books, etc. Add their estimates for a classroom total.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students how the recreational value of fish and wildlife resources is measured.

#### **How is the recreational value of fish and wildlife resources measured?**

- a) Recreational value is indirectly measured by the amount people will spend on their chosen activities.
  - 1) A survey by the U.S. Fish and Wildlife Service indicated that 141 million Americans age 16 and over participated in fish and wildlife-associated recreation in 1985. They spent over \$55 billion.
  - 2) Difficult to directly measure recreational value.
    - (a) Fish and wildlife are state-owned so there is not a marketplace to establish comparative worth.
    - (b) Recreational value of fish and wildlife is underestimated when the amount people must pay is measured. A more accurate measurement is finding out what they would be willing to pay if the price was raised.

2. Take a student poll of their participation in hunting and fishing activities and compare the class percentage to nationwide averages (25 percent fish; 10 percent hunt).

**What are the participation and expenditure levels of hunters and fishermen?**

- a) The 1985 National Survey of Fishing, Hunting and Wildlife-Associated Recreation conducted by the Fish and Wildlife Service revealed that:
- 1) 46.6 million (25 percent) adult Americans fished in 1985.
  - 2) 16.7 million (10 percent) adult Americans hunted in 1985.
  - 3) U.S. fishermen spent \$28.2 billion on their sport in 1985 when all expenses were considered such as food, lodging, transportation, equipment, etc.
  - 4) U.S. hunters spent \$10.1 billion on their sport in 1985.
  - 5) Both fishermen and hunters spent an average of \$604 in 1985 per participant.
  - 6) Fishing is enjoyed by more people and generates more revenue than hunting.
- b) Missouri statistics on hunting and fishing are similar to U.S. averages.
- 1) Approximately 1.3 million (26 percent) of Missourians participate in fishing.
  - 2) Approximately one-half million (10 percent) of Missourians participate in hunting.
  - 3) Missouri fishermen spent nearly \$1 billion on fishing in 1985.
3. Ask the students to list examples of nonconsumptive uses of fish and wildlife. Ask them to guess if the public's interest in nonconsumptive uses is increasing, decreasing or staying even.

**What are the participation levels for nonconsumptive uses of fish and wildlife in the U.S.?**

- a) Nonconsumptive uses of fish and wildlife are those that do not result in, or attempt the harvest of, an individual animal.
- 1) Birdwatching
  - 2) Birdfeeding
  - 3) General wildlife observation
  - 4) Wildlife photography
  - 5) Nature walks and study
  - 6) Visits to zoos
  - 7) Membership in fish and wildlife organizations



- b) Participation in nonconsumptive activities is much larger than consumptive uses such as hunting, fishing or trapping.
  - 1) 109.7 million American adults participated in fish and wildlife activities other than fishing and hunting during 1985.
    - (a) Participation in nonconsumptive activities is nearly twice the hunting and fishing level.
    - (b) The number of people participating in nonconsumptive activities in the U.S. is growing faster than consumptive uses.
      - (1) 63.6 million people observed wildlife in 1985.
      - (2) 82.5 million people fed birds in 1985.
      - (3) 18.1 million people photographed wildlife in 1985.
  - 2) Part of the reason for the popularity of nonconsumptive uses is based on the increasing urbanization of the U.S. population.
  - 3) 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.
- 4. Ask the student what kinds of nature-oriented activities urban Missourians participate in most frequently. Ask for reasons why such activities would be favored.

**What nonconsumptive uses of fish and wildlife are preferred by Missouri urban residents?**

- a) A survey of adult residents in St. Louis, Kansas City, and Springfield was funded by the Missouri Department of Conservation in 1980 to find out the nature-oriented recreation preferences of the people.
  - (1) The nature-oriented opportunities most readily available to urbanites were those with the largest number of participants.
  - (2) Seven activities out of 23 had participation greater than 50 percent.
    - (a) "Watching programs on TV about the outdoors" had the highest involvement (80 percent).
    - (b) "Visiting museums or zoos" (78 percent).
    - (c) "Feeding birds or other wildlife near home" (59 percent).

- (3) All traditional consumptive uses fell below 50 percent participation.
  - (a) Fishing (49 percent).
  - (b) Hunting (20 percent).
  - (c) Trapping (1 percent).

5. Ask the students if they are aware of any taxes they pay on their recreational uses of fish and wildlife.

**How is the recreational value of fish and wildlife resources taxed?**

- (1) All state fish and wildlife agencies are partially funded by taxes on the recreational value of hunting, fishing and trapping.
  - a) Federal excise taxes on sporting equipment associated with hunting and fishing is returned to the states for conservation projects. \$248 million was collected in the U.S. during 1985.
    - (1) Pittman-Robertson Act places a 10 percent federal excise tax on sporting arms and ammunition.
    - (2) Dingell-Johnson Act places an excise tax on sport fishing tackle, boats, boat motors, and marine fuel.
  - b) Sale of hunting, fishing and trapping permits.
    - (1) The Missouri Department of Conservation had nearly \$14 million of permit sales in 1986.
    - (2) Permit sales accounted for 19 percent of the Missouri Department of Conservation budget in 1986.
  - c) Missouri conservation sales tax
    - (1) Missouri voters passed the conservation sales tax in 1976 based on all the fish and wildlife values they hold.
    - (2) Many people voted for the conservation sales tax as a means to maintain or increase their recreational uses of fish and wildlife resources.

**F. Other activities**

1. Have the students develop a list of expenses they would incur to participate in a recreational activity such as turkey hunting, bluegill fishing or birdfeeding. Have them assume they have to buy the equipment necessary to participate.
2. Have the students list their favorite fish and wildlife-associated recreational activities. Develop a table similar to Table 3.1 to illustrate their preferences.

## G. Conclusion

The recreational value of fish and wildlife resources is derived from the personal satisfactions and benefits people receive from fish and wildlife experiences. Money spent by recreationists indicates what these experiences are worth to them.

There are consumptive and nonconsumptive uses of fish and wildlife. Both of these uses have large participation and expenditure levels. In recent years nonconsumptive uses have grown in popularity.

## H. Competency

List the different recreational values of fish and wildlife resources.

## I. Answers to Evaluation

1. d
2. a
3. c
4. b
5. d
6. a
7. c
8. a
9. d
10. c

Name \_\_\_\_\_

Date \_\_\_\_\_

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 2: Recreational Value

#### EVALUATION

Circle the letter of the best answer.

1. What is an indirect measure of the recreational value of fish and wildlife resources?
  - a. Pounds of meat harvested
  - b. How much the government spends on hunting and fishing areas
  - c. The total number of animals in a wildlife population.
  - d. The amount people will pay to participate in their chosen activities.
  - e. Fur auctions
  
2. How much money did American adults spend in 1985 to participate in fish and wildlife-associated recreation?
  - a. \$55 billion
  - b. \$11 million
  - c. \$ 3 billion
  - d. \$ 1 million
  - e. \$100,000
  
3. Which of the following is not a consumptive use of wildlife?
  - a. Fishing
  - b. Hunting
  - c. Birdfeeding
  - d. Trapping
  - e. none of the above
  
4. Which of the following activities has the highest participation in Missouri?
  - a. Trapping
  - b. Fishing
  - c. Hunting
  - d. Taxidermy
  - e. Trap shooting

5. How much money did Missouri fishermen spend on their fishing activities during 1985?
- \$ 1 million
  - \$ 12 million
  - \$127 million
  - \$ 1 billion
  - \$ 10 billion
6. Participation in nonconsumptive activities is \_\_\_\_\_ consumptive uses such as hunting and fishing.
- much larger than
  - slightly larger than
  - substantially smaller than
  - about equal to
  - none of the above
7. Why are nonconsumptive uses of fish and wildlife increasing in popularity?
- Fewer wild animals
  - Restrictive government regulations
  - More people are living in cities
  - Fishing and hunting cause extinction of wild animals
  - none of the above
8. What characteristic of nature-oriented recreation did people in St. Louis, Kansas City, and Springfield consider most important?
- Readily available
  - Rural setting
  - Opportunity to shoot an animal
  - Solitude
  - Good weather
9. The Pittman-Robertson Act created a federal excise tax on \_\_\_\_\_.
- hunting clothes
  - hunting licenses and permits
  - poachers
  - sporting firearms and ammunition
  - none of the above
10. What percentage of the Missouri Department of Conservation's budget comes from the sale of hunting, fishing and trapping licenses?
- 5%
  - 49%
  - 19%
  - 80%
  - 100%

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 3: Biological Value

**Objective:** The student will explain how naturally-occurring living organisms benefit humans and the environment.

#### Study Questions

1. What role do microorganisms play in supplying plants and animals with mineral nutrients?
2. How does animal life affect soil formation and maintenance?
3. Why are some insects important to agriculture?
4. How are plant seeds dispersed by wildlife?
5. What is natural regulation?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 3: Biological Value

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Bring a honey bee to the class in a glass jar and have the students look at it. Ask them what biological importance the bee possesses (plant pollination). Follow-up by asking the students the annual monetary value of the honey bee's pollination services to U.S. agricultural crops (\$4 billion).

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students if microorganisms are essential for life on earth.

**What role do microorganisms play in supplying plants and animals with mineral nutrients?**

- a) Microorganisms are indispensable for maintaining the earth's nutrient cycles.
  - 1) Microorganisms (fungi, bacteria, protozoa) chemically break down dead plants and animals, absorb some of the decomposition products and release mineral nutrients.
  - 2) Mineral nutrients such as nitrogen, potassium and sulfur flow through the environment in predictable cycles.
- b) Nitrogen cycle
  - 1) Earth's atmosphere is 78 percent molecular nitrogen ( $N_2$ ) which is unavailable to plants and animals.
  - 2) Molecular nitrogen is converted to nitrate ( $NO_3$ ) by the activities of microorganisms.
  - 3) Nitrate ( $NO_3$ ) is the form of nitrogen used by plants and animals.
  - 4) "Nitrogen-fixing" is the conversion of molecular nitrogen to nitrate.

- (a) Rhizobium are nitrogen-fixing bacteria which 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<sub>2</sub>) from the soil air and synthesize it to nitrate (NO<sub>3</sub>).
  - (b) Blue-green algae has nitrogen-fixing capabilities and is plentiful in soil and aquatic habitats.
  - (c) Free soil bacteria (Azotobacter, Clostridium) are able to fix molecular nitrogen without the aid of a host plant.
- 5) Microorganisms release stored nitrogen in the protein of dead tissues to be used by living plants and animals.
- (a) Bacteria, fungi and a host of invertebrates such as mites, millipedes and beetles perform the decomposition process.
  - (b) Decomposition is a complex chemical process with nitrogen and many other mineral nutrients being released as a product.
- 6) Other mineral cycles are similarly dependent on the activities of microorganisms (sulfur).
- 7) Life on earth is dependent upon mineral cycles.
2. Ask the students what kind of creatures live in the soil. What effect do these creatures have on the soil profile?

**How does animal life affect soil maintenance?**

- a) Insects, earthworms, nematodes, rodents and larger mammals help maintain the physical structure of the soil through their digging activities.
  - 1) The continuous mixing of the soil by animal life improves soil aeration, soil structure and fertility.
    - (a) Earthworms existing on one acre may pass 15 tons of dry soil through their bodies annually.
      - (1) Earthworm excrement is much higher in nutrients and organic matter than the surrounding soil.
      - (2) Earthworm holes and channels improve soil aeration and drainage throughout the soil profile.
    - (b) Many species of invertebrates and insects mix the soil in a similar fashion.
    - (c) Rodents mix and granulate the soil as they dig tunnels in their search for food and shelter.



- (1) Examples of burrowing rodents in Missouri are: eastern mole; thirteen-lined ground squirrel; woodchuck; Franklin's ground squirrel; and woodland vole.
  - (2) Burrowing rodents are capable of extensively mixing the soil throughout the soil profile.
- 2) Rodents and other species of wildlife have affected the long-term character of the soil through their food habits.
  - (a) Wildlife's plant-feeding and seed-storing activities may influence the growth and composition of plant species.
  - (b) A change in vegetation will affect animal life and ultimately, the soil.
3. Ask the students if they regard insects as beneficial or as pests. Point out that insect damage to agricultural crops is caused by a very small percentage of insect species. Emphasize that insects pollinate many crops and native plants.

**Why are some insects important to agriculture?**

- a) Pollination of many naturally-occurring plants and agricultural crops is dependent upon insects.
    - (1) 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 significantly benefited by insect pollination.
    - (2) Approximately a third of the food consumed in the U.S. is dependent on honey bee pollination.
    - (3) An estimated 80 percent of the insect pollination of U.S. agricultural crops is performed by honey bees.
    - (4) Proper pollination of red clover by honey bees has the potential of doubling or tripling seed yields.
  - b) 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.
4. Ask the students why cockleburs and beggar ticks stick to their clothing. Point out the reason for the spines and the seed coats is a plant species survival mechanism - seed dispersal.

### How are plant seeds dispersed by wildlife?

- a) Fox and gray squirrels inadvertently plant the tree species they prefer by burying the nuts as a future food source.
  - b) Seeds of many plants are adapted for transport by wildlife.
    - (1) Beggar tick (Bidens) and cocklebur (Xanthium) have seed capsules with spines designed to attach to the fur of wild animals.
    - (2) Seeds are dropped far away from the parent plant.
  - c) Birds disperse seeds over long distances.
    - (1) Delivery mechanism is the digestive tract.
      - (a) Birds ingest seeds and expel the waste a day later miles away.
      - (b) Some of the seeds are not digested and will germinate wherever they are dropped.
    - (2) 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.
5. Ask the students why the earth is not covered with flies, mice, etc. Point out that nature regulates the populations of living things - but it isn't always perfect.

### What is natural regulation?

- a) Natural regulation refers to nature's ability to regulate plant and animal populations. Interactions within and between species and their relationships to their habitat is the basis for regulation.
- b) Natural regulation does not imply that plant and animal populations are always in balance. Sometimes an imbalance has to occur before natural control mechanisms are triggered.
  - (1) Muskrat population example.
    - (a) Drought may reduce living space and food supply of a muskrat population
    - (b) Habitat can no longer support the population.
    - (c) Fewer females bear litters and adult muskrats kill each other and their and their young.
    - (d) Some muskrats migrate to other areas.
    - (e) These are population control mechanisms which do not function unless an overpopulation occurs.
  - (2) Populations of other species of wildlife react similarly.

- c) Predator/prey relationships
  - (1) Predators maintain the genetic quality and health of prey species by removing inferior animals (sick, old, injured).
  - (2) The effect predators have on limiting the number of animals in a prey population is varied.
    - (a) Predation may not have as much effect as it may appear. The removal or alteration of a prey species habitat may make the animals more vulnerable to predation (Coyote example).
    - (b) A proper predator/prey relationship may promote stability in both populations. Stocking recommendations for ponds and lakes include the correct ratio of predator and prey species to achieve balanced populations (Bass/bluegill example).
- d) Natural regulation is a tremendous service to humans with regard to insect populations. Only 1 percent of insects are considered to be pests. The remaining 99 percent are controlled by natural enemies (predators) and other natural mechanisms.

#### F. Other activities

1. Have the students fill a small container with soil and search for soil organisms such as earthworms, millipedes, grubs, etc.
2. Have each student make a collection of plant seed capsules designed for transport by wildlife.
3. Invite a local beekeeper to talk with the class to emphasize how honey bees pollinate crops.

#### G. Conclusion

The biological value of fish, wildlife and other natural living creatures is frequently underestimated. The processes and functions these creatures perform are essential to life on earth (particularly microorganisms) and are not recognized by many people.

The environment consists of an infinite number of interrelationships between plants, animals and their habitats. Humans need to be aware of these relationships to gain the most efficient use of natural resources.

## H. Competency

Explain how naturally-occurring living organisms benefit humans and the environment.

## I. Answers to Evaluation

1. a
2. d
3. c
4. c
5. a
6. b
7. b
8. b
9. c
10. a

Name \_\_\_\_\_

Date \_\_\_\_\_

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 3: Biological Value

#### EVALUATION

Complete the following statements by circling the letter of the best answer.

1. \_\_\_\_\_ are indispensable for maintaining the earth's nutrient cycles.
  - a. Microorganisms
  - b. Tillage operations
  - c. Weather patterns
  - d. Agricultural fertilizers
  - e. Fish
  
2. Which of the following organisms are capable of "nitrogen-fixing"?
  - a. Mushrooms
  - b. Earthworms
  - c. Rhizobium bacteria
  - d. Grass
  - e. all of the above
  
3. The continuous \_\_\_\_\_ of the soil by animal life improve soil aeration, structure and fertility.
  - a. compaction
  - b. erosion
  - c. mixing
  - d. degradation
  - e. none of the above
  
4. Earthworms existing on one acre may pass up to \_\_\_\_\_ tons of dry soil through their bodies each year.
  - a. 1/2
  - b. 2
  - c. 15
  - d. 75
  - e. 150

5. In the U.S., how many types of agricultural crops depend upon insect pollination?
- a. 90
  - b. 18
  - c. 37
  - d. 5
  - e. none
6. An estimated \_\_\_\_\_ percent of the insect pollination of U.S. agricultural crops is performed by honey bees.
- a. 10
  - b. 80
  - c. 40
  - d. 50
  - e. none of the above
7. The spines on a cocklebur seed capsule are a plant adaptation for \_\_\_\_\_.
- a. insect attraction
  - b. seed dispersal
  - c. effective pollination
  - d. wildlife consumption
  - e. growth regulation
8. Natural regulation refers to:
- a. Hunting
  - b. The balance of nature
  - c. The Missouri Department of Conservation Wildlife Code
  - d. Hibernation
  - e. none of the above
9. The effect predators have on limiting the number of animals in a prey population is \_\_\_\_\_.
- a. minimal
  - b. excessive
  - c. varied
  - d. the most important factor in wildlife management
  - e. none of the above
10. What percentage of insect species are controlled entirely by natural enemies (predators) and other natural mechanisms?
- a. 99%
  - b. 50%
  - c. 75%
  - d. 30%
  - e. 1%

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 4: Social Value

**Objective:** The student will describe the social values and benefits associated with fish and wildlife resources.

#### Study Questions

1. Why do people participate in fish and wildlife-associated recreation?
2. How are communities improved by fish and wildlife resources?
3. How do cultural influences determine the treatment of fish and wildlife resources?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 4: Social Value

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Ask the students how a small community is benefited by the revenue generated by fish and wildlife resources. How are bonds between family members and friends strengthened by participation in fish and wildlife-associated recreation?

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students why they enjoy hunting, fishing, trapping or bird feeding. When a student gives you an answer, continue asking "why" questions until a clear and simple benefit is uncovered. (Meat, testing outdoor skills, exercise, etc.)

**Why do people participate in fish and wildlife-associated recreation?**

- a) People participate in fish and wildlife activities for different reasons.
  - 1) Commercial fishermen fish to earn an income.
  - 2) Reasons why hunters, fishermen, birdwatchers or wildlife photographers pursue their chosen activities are not always clear. The individual benefits they receive is a reflection of the values they hold. Benefit examples are:
    - (a) Food
    - (b) Companionship with friends
    - (c) Family togetherness
    - (d) Outdoor skill testing
    - (e) Solitude
    - (f) Enjoyment of the outdoors
    - (g) Exercise
- b) Benefits have a positive influence on the individual recreationist and society in general.



- c) An individual's physical and mental health is improved by engaging in outdoor recreation as he/she captures sought-after benefits.
  - d) Each outdoor recreational activity has social value by promoting physical and mental health in an individual.
2. Ask the students how their community would be affected by the elimination of fish and wildlife recreational activities.

**How are communities improved by fish and wildlife resources?**

- a) When individuals realize benefits from fish and wildlife, there is additional economic value realized by the community in which they live.
    - (1) The community improves its economic base when money is spent on fish and wildlife-associated recreation (multiplier effect).
    - (2) Economic base will be in a better position to provide community services like schools, libraries, medical facilities and recreation centers.
    - (3) Fish and wildlife resources can directly improve the quality of life for all people - not just those who participate in associated recreational activities.
  - b) 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 by providing recreational activities people value.
    - (1) In a national research project, fishing was found to have many positive social factors.
      - (a) Increased cooperation and communication among family members, friends and strangers.
      - (b) Helped to develop competition focused on doing your best, rather than beating someone else.
    - (2) Fishing, and other outdoor recreation, contribute to community stability by the extent they foster social interaction and individual satisfactions.
3. Ask the students to compare the treatment of fish and wildlife resources by Native American Indians with that of U.S. citizens today.

**How do cultural influences determine the treatment of fish and wildlife resources?**

- a) 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.
- b) Human cultures, past and present, view fish and wildlife resources differently.
  - (1) Native American Indian culture was 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.
  - (2) The majority of U.S. citizens today regard fish and wildlife as a luxury product rather than a necessity.
  - (3) Subtle forces are at work which determine cultural viewpoints.
    - (a) No culture retains an identical set of values over a long period of time. Attitudes toward fish and wildlife change.
    - (b) Trend in the U.S. is toward a higher rate of nonconsumptive use. Part of the reason is increasing urbanization.
- d) The attitudes, beliefs and expectations of human cultures form the framework on how fish and wildlife resources will be used and treated.

**F. Other activities**

1. Have the students consider the social value of their personal experiences with fish and wildlife. Did they enjoy the challenge, interaction with friends, family togetherness or exercise?
2. Have a person well-versed in Indian history explain specific details of how fish and wildlife played a crucial role in the Indian lifestyle.

**G. Conclusion**

The social benefits imparted by fish and wildlife resources have a positive influence on both individuals and communities. An individual's physical and mental health is improved by engaging in outdoor recreation as he/she captures sought-after benefits. The satisfaction of the recreation experiences improves an individual's attitude which, in turn, fosters positive contributions to the community. On a larger scale, the attitudes, beliefs and expectations of human cultures form the framework on how fish and wildlife will be used and treated.

H. Competency

Describe the social values and benefits associated with fish and wildlife resources.

I. Answers to Evaluation

1. d
2. a
3. b
4. d
5. b
6. a

Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT II - FISH AND WILDLIFE VALUES**

**Lesson 4: Social Value**

**EVALUATION**

**Circle the letter of the best answer.**

1. Why do people participate in fish and wildlife-associated recreation?
  - a. Food
  - b. Solitude
  - c. Family togetherness
  - d. Outdoor skill testing
  - e. All of the above
  
2. Fish and wildlife recreational activities have \_\_\_\_\_ value by improving physical and mental health of an individual.
  - a. social
  - b. biological
  - c. esthetic
  - d. commercial
  - e. none of the above
  
3. Fish and wildlife resources can directly improve the quality of life for \_\_\_\_\_ people in a community.
  - a. some
  - b. all
  - c. outdoor-oriented
  - d. a small percentage of
  - e. wealthy
  
4. How does fishing contribute to community stability?
  - a. Helps to develop healthy competitive spirit.
  - b. Stimulates economic activity.
  - c. Increases cooperation and communication among family members.
  - d. Provides recreational activities people value.
  - e. all of the above

5. Separate human cultures view fish and wildlife \_\_\_\_\_.
- a. the same
  - b. differently
  - c. as a nuisance
  - d. with an uncaring attitude
  - e. with hatred
6. With the passage of time, human attitudes toward fish and wildlife resources \_\_\_\_\_.
- a. change
  - b. never change
  - c. improve
  - d. worsen
  - e. become apathetic

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 5: Esthetic Value

**Objective:** The student will describe the esthetic value of fish and wildlife resources.

#### Study Questions

1. Why do people have varied individual reactions to nature's beauty?
2. How is a person's appreciation of nature enhanced by greater understanding and knowledge?
3. What is existence value?

#### References

1. Fish and Wildlife Management (Student Reference).  
University of Missouri-Columbia: Instructional  
Material's Laboratory, 1989.

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 5: Esthetic Value

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Ask the students what season of the year they enjoy the most and the reasons why. Does the smell of freshly-tilled soil in the spring put money in the bank? Does the evening call of a whip-poor-whill have anything to do with the business of farming? Do brilliant fall colors make the land more valuable? Point out that these are esthetic values of farming and are usually part of the reason why farmers enjoy their occupation. Fish and wildlife resources have esthetic values to be enjoyed by anyone who has the inclination.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students why people have varied individual reactions to nature's beauty.

**Why do people have varied individual reactions to nature's beauty?**

- a) Some people experience great pleasure and excitement from specific encounters with the natural world while others are mildly interested.
  - b) The appreciation of all forms of beauty is in the "eye of the beholder."
2. Ask the students if they appreciate or have an interest in things they are familiar with.

**How is a person's appreciation of fish and wildlife resources enhanced by greater understanding and knowledge?**

- a) An individual's appreciation of fish and wildlife resources will grow as he/she learns more about the animals and their habitats.
  - 1) Reasons behind animal behavior (Canada goose example).
  - 2) Speculate on the impact fish and wildlife species have had on other resources (squirrel example). This type of appreciation comes with the understanding of a perceptive mind.
3. Ask the students if they would like to see grizzly bears or the salmon migration in Alaska.

**What is existence value?**

- a) Esthetic value of fish and wildlife resources is not limited to actual contact with the animals.
  - 1) Many people are satisfied by knowing that fish and wildlife populations still exist and are being protected.
  - 2) 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.

**F. Other activities**

**G. Conclusion**

The esthetic value of fish and wildlife is the most personal and most difficult to measure of the value categories. The appreciation of all forms of beauty is the "eye of the beholder."

**H. Competency**

Describe the esthetic value of fish and wildlife resources.

**I. Answers to Evaluation**

1. d
2. b
3. a
4. b



Name \_\_\_\_\_

Date \_\_\_\_\_

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 5: Esthetic Value

#### EVALUATION

Circle the letter that corresponds to the best answer.

1. The esthetic value of fish and wildlife resources is \_\_\_\_\_ to measure.
  - a. simple
  - b. costly
  - c. convenient
  - d. difficult
  - e. none of the above
  
2. The esthetic value of the natural environment is based on the appreciation of \_\_\_\_\_.
  - a. money
  - b. beauty
  - c. land prices
  - d. the Missouri Department of Conservation
  - e. none of the above
  
3. An individual's appreciation of fish and wildlife resources will \_\_\_\_\_ as he/she learns more about the animals and their habitats.
  - a. increase
  - b. stagnant
  - c. not change
  - d. stop
  - e. none of the above
  
4. Human satisfaction gained by knowing that fish and wildlife populations still exist and are being protected is called \_\_\_\_\_ value.
  - a. religious
  - b. existence
  - c. biological
  - d. social
  - e. commercial

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 6: Scientific and Educational Values

**Objective:** The student will describe scientific and educational values of fish and wildlife resources.

#### Study Questions

1. How have fish and wildlife resources contributed to scientific understanding?
2. How have fish and wildlife resources improved human health?
3. How is integrated pest management related to fish and wildlife research?
4. Why are fish and wildlife especially important to conservation education?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 6: Scientific and Educational Values

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Ask the students how their lives would change if they lost their sight. After a short discussion, have them shut their eyes. Tap on the chalkboard and ask if they can tell how far away it is. What if they had the magical ability to "tap" distant objects in rapid succession to gauge the distance. Would this help them move about more safely if they were blind? Compare this exercise to the sonar system in bats. Bats have been the object of medical research to discover exactly how their sonar systems function. This research has the potential of unlocking the secrets of echolocation. It may be possible in the future for scientist to invent a device to help blind people to "see" using the principles of echolocation in bats.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students if they know of any major scientific discoveries which were based on fish and wildlife resources.

**How have fish and wildlife resources contributed to scientific understanding?**

- a) The concept of evolution was developed by studying existing and fossil plants and animals.
  - 1) Evolution is a basic principle of biology.
  - 2) Charles Darwin studied plants and animals in many parts of the world and developed the concept of natural selection as a component of evolution.
  - 3) The concept of evolution had great impact on biology, religion and ethics.
- b) Fish and wildlife populations have contributed to other scientific knowledge such as population dynamics and animal behavior.

2. Ask the students if they are aware of any medical advances based on fish and wildlife research.

**How have fish and wildlife resources improved human health?**

- a) Human Rh blood factor was first discovered in rhesus monkeys.
- 1) Discovery of Rh blood factor was a medical breakthrough.
    - (a) Rh-negative individuals who receive Rh-positive blood transfusions have a substantial risk of blood clotting.
    - (b) Under some conditions the newborn child of a Rh-negative female will die of Rh disease.
    - (c) Detection of Rh blood factor in blood has saved many human lives.
  - 2) Cure for cancer may come from the ocean.
    - (a) National Cancer Institute has studied thousands of chemicals from many biological sources.
    - (b) Over 500 marine animal species have biochemicals containing anticancer properties.
  - 3) Nearly half of the prescription drugs used today contain compounds are derived from a variety of natural sources such as fungi, insects, plants and marine animals.
  - 4) Blind people may someday benefit from bat research.
    - (a) Bats are being used extensively in medical research to learn more about their ability to navigate by sound waves.
    - (b) The principles of bat navigation could potentially lead to the invention of a device to help blind people use "echolocation."

3. Ask the students how agricultural pests are controlled. Review some of the agricultural benefits of insects mentioned in Lesson 3: Biological Value. Integrated pest management works with natural processes along with chemicals and cultural practices to control pests.

**How is integrated pest management related to fish and wildlife research?**

- a) Humans gain insight in how to better manage plants and animals through fish and wildlife research.
- 1) Biological control of insect pests hinges on a thorough knowledge of natural predators, diseases, food sources and reproductive habits.

- 2) The study of how wild animal populations react to environmental influences provides valuable information for safe and effective control measures.
  - b) Integrated pest management has strong ties to fish and wildlife research by combining biological, chemical and cultural pest control measures. It takes an ecological approach to problem-solving.
4. Ask the students why people enjoy and want to learn about the outdoors. Point out that fish and wildlife resources creates much of the interest in the outdoors.

**Why are fish and wildlife especially important to conservation education?**

- a) The educational value of fish and wildlife is rooted in the natural curiosity which humans have toward wild creatures.
- b) Wild creatures have the ability to stimulate and motivate people to learn about natural resources.
  - 1) People will learn ecological principles and understand the environmental impact of their own actions.
  - 2) People will develop an ecological conscience.
- c) Conservation education is most effective during a person's childhood years because the conservation values will be incorporated into their personal preferences, beliefs and attitudes.

**F. Other activities**

**G. Conclusion**

The scientific value of a particular wild animal species is impossible to measure. Many species once considered worthless have made invaluable contributions to medical science or became important to agriculture in ways we did not understand. Each species is a unique and valuable source of genetic material which may provide a great service to humans in the future.

**Competency**

Describe the scientific and educational values of fish and wildlife resources.

**I. Answers to Evaluation**

1. d
2. b
3. a
4. d
5. c

Name \_\_\_\_\_

Date \_\_\_\_\_

UNIT II - FISH AND WILDLIFE VALUES

Lesson 6: Scientific and Educational Values

EVALUATION

Circle the letter that corresponds to the best answer.

1. What basic biological principle was developed from the study of fish and wildlife species?
  - a. Theory of Relativity
  - b. Newton's Law
  - c. Law of Diminishing Returns
  - d. Evolution
  - e. all of the above
  
2. How many marine animals have anticancer biochemicals?
  - a. 30
  - b. 500
  - c. 150
  - d. 75
  - e. 1
  
3. Nearly \_\_\_\_\_ percent of the prescription drugs used today contain compounds derived from a variety of natural sources such as fungi, insects, plant and marine animals.
  - a. 50%
  - b. 25%
  - c. 90%
  - d. 10%
  - e. 1%
  
4. Integrated pest management uses \_\_\_\_\_ control techniques.
  - a. Biological
  - b. Chemical
  - c. Cultural
  - d. all of the above
  - e. none of the above

5. The educational value of fish and wildlife is rooted in the \_\_\_\_\_ which humans have toward wild creatures.

- a. fear
- b. apathy
- c. curiosity
- d. consumptive use
- e. none of the above

## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 7: Negative Value

**Objective:** The student will evaluate the negative impacts wild animals have on humans and the objective of wildlife damage control.

#### Study Questions

1. What types of agricultural damages are birds responsible for?
2. How do mammals come into conflict with human interests?
3. What types of damages are reptiles responsible for?
4. What is the objective of wildlife damage control?
5. What types of wildlife diseases are transmitted to humans?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.



## UNIT II - FISH AND WILDLIFE VALUES

### Lesson 7: Negative Value

#### TEACHING PROCEDURES

##### A. Review

Review the previous lesson.

##### B. Motivation

Ask the students if their families have experienced any kind of property damage caused by wildlife.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students if birds have damaged their agricultural crops. How is the damage done?

**What types of agricultural damages are birds responsible for?**

- a) Bird damage to agricultural crops is a multimillion dollar problem in the U.S.
  - 1) Birds caused a nationwide loss of 6.5 million bushels of corn during 1970 and 1971.
  - 2) In California, birds destroyed \$3.7 million of grapes in 1972.
- b) Starlings create problems.
  - 1) Eat livestock feed
  - 2) Implicated in the spread of TGE (transmissible gastroenteritis). TGE virus can pass through the digestive tract of starlings and remain infectious in their feces.
- c) Blackbirds feed on a variety of crops.
  - 1) Concentrate on corn and sunflowers.
  - 2) Fields located near large roosts may suffer over a 10 percent loss in yield due to blackbird feeding.
  - 3) Soybeans, wheat and hay are not part of the blackbird's diet.
- d) House sparrows eat agricultural grains in the field and in storage.
  - 1) Also damage crops by pecking seeds, seedlings, buds and flowers.

- 2) Contribute to the spread of human diseases (tuberculosis, encephalitis) and insect pests (fleas, lice).
  - 3) Their droppings and feathers contaminate stored grain.
2. Ask the students to estimate the damage wild mammals inflicted on their parent's land or other property last year.

**How do mammals come into conflict with human interests?**

- a) White-tailed deer damage a wide variety of row crops, forage crops, fruit trees as well as stacked hay.
  - 1) A 1981 survey of Wisconsin farmers indicated the annual statewide deer damage was about \$10 to \$15 million.
  - 2) A similar study in Pennsylvania put the annual crop loss at \$16 to \$30 million.
  - 3) The cost of deer vehicle collisions is estimated at \$100 million per year for the U.S. and Canada.
- b) Mice
  - 1) Cause considerable damage to clothing, mattresses, paper and other materials suitable for nest-building.
  - 2) Contaminate human food.
  - 3) Deer mice (Peromyscus) destroy conifer seeds in forest reseedling operations. Seed predation has resulted in millions of dollars worth of damage in west coast forest areas.
- c) Muskrats
  - 1) Burrowing activity creates minor maintenance problems for pond dams and shorelines.
  - 2) In some states, muskrat damage may exceed \$1 million per year. Economic loss to muskrat damage can be very high in rice and aquaculture producing areas.
- d) Coyotes
  - 1) Prey on domestic livestock.
  - 2) Livestock losses to coyotes are highest in the summer months when they are raising their young.
  - 3) Coyotes also eat melon and cantaloupe crops.
- e) Raccoons
  - 1) May cause considerable damage to garden crops such as sweetcorn.
  - 2) May create problems in rural areas, towns and suburbs by attempting to live in buildings.
- f) Rabbits
  - 1) Damage vegetation throughout the year.
  - 2) Eat flowers and vegetables in the spring.
  - 3) Girdle valuable trees and shrubs during the winter.

3. Ask the students what they usually do with snakes when they find them. If the students kill snakes, ask them why they do it.

**What types of damages are reptiles responsible for?**

- a) Non-poisonous snakes
    - 1) Completely harmless to humans and cause no damage except for occasionally frightening people.
    - 2) Perform an important service to humans by preying on mice, rats and insects.
  - b) Poisonous snakes
    - 1) Have the capability of causing human injury or death.
    - 2) Number of snake bites and their consequences has been greatly exaggerated.
      - (a) About 1,000 people are bitten by rattlesnakes in the U.S. each year.
      - (b) Approximately a dozen people die from rattlesnake venom each year in the U.S.
4. Ask the students if they would shoot all raccoons in their neighborhood (or on their farm) if several raccoons were in the process of ruining a large sweetcorn patch. Point out that killing any raccoon during a closed-season requires a special permit, and should be used as a last resort. The objective is to control the damage - not kill raccoons. Repellent devices to keep the animals from entering the sweetcorn patch or removal by live-trapping should be tried first.

**What is the objective of wildlife damage control?**

- a) The objective of wildlife damage control is to prevent wild animals from interfering with human endeavors.
  - 1) Complete eradication of a species from a given area is rarely necessary.
  - 2) Damages are usually caused by a small number of individual animals, or simply from an overpopulation.
  - 3) Control efforts should be directed toward the "problem" animals - not the species as a whole.
- b) It is easy to make incorrect assumptions concerning wildlife damage problems which may place blame on the wrong species.
  - 1) Many landowners automatically assume coyotes are to blame for livestock predation without looking closely at the evidence.
    - (a) Badly mutilated animals which have not been fed upon are possibly the victims of dogs.
    - (b) Indiscriminately killing all coyotes is not the answer to coyote predation.

- (c) Removing the individual "problem" coyotes by hunting or trapping near livestock areas is far more effective.
  - 2) The cause of wildlife damage problems must be correctly diagnosed before a method of control can be selected.
5. Ask the students if they are aware of any diseases infecting wild animals which can be transmitted to humans.

**What types of wildlife diseases are transmitted to humans?**

- a) Wild animals are susceptible to a wide variety of infectious and parasitic organisms capable of causing disease and transmitting diseases to humans.
- b) Malaria
  - 1) Caused by a microorganism, Plasmodium malaric, which is injected into the human bloodstream by a mosquito.
  - 2) Microorganisms attack the hemoglobin in red blood cells.
- c) Plague
  - 1) Infectious disease caused by bacteria transmitted by the bite of infected fleas.
  - 2) Causes fever and swelling of the lymph glands and may be fatal.
  - 3) Is know as the bubonic or black plague.
  - 4) Primarily affects rodents such as rats, ground squirrels and prairie dogs.
- d) Rabies
  - 1) Oldest disease know to man.
  - 2) Highly fatal virus disease which affects the central nervous system.
  - 3) Transmission is by infected saliva on broken skin or abrasions.
  - 4) Main reservoir of rabies virus is in wild animals such as skunks, foxes, bats and raccoons. Skunks have the highest rate of infection.
- e) Tularemia
  - 1) Bacterial disease of rabbits and rodents which can be transmitted to humans.
  - 2) Most commonly transmitted to man by cottontail rabbits during the skinning process.
  - 3) Tularemia may also be contracted from incompletely cooked meat or through bites of ticks or flies.
- f) Histoplasmosis
  - 1) Respiratory disease in humans caused by inhaling spores from the fungus Histoplasma capsalatum.
  - 2) Although birds do not directly spread the fungus, their feces enrich the soil and promote growth of the fungus.

F. Other activities

1. Invite a local veterinarian to speak to the class about local diseases of wild animals which can be transmitted to humans or livestock.

G. Conclusion

Wild animals inevitably come into conflict with human interests. A common human response to damage caused by wild animals is to exterminate the problem species from an area. This is not necessary and sometimes it is foolish. Livestock depredation by coyotes is usually caused by a few individual coyotes which habitually prey on livestock. Removal of the entire coyote population through poisoning or shooting is not necessary. In a similar fashion, the control of wildlife damage should be targeted to the specific individual animals causing problems as much as possible.

H. Competency

Evaluate the negative impacts wild animals have on humans and the objective of wildlife damage control.

I. Answers to Evaluation

1. d
2. a
3. d
4. b
5. c
6. a
7. c
8. b
9. a

Name \_\_\_\_\_

Date \_\_\_\_\_

UNIT II - FISH AND WILDLIFE VALUES

Lesson 7: Negative Value

EVALUATION

Circle the letter that corresponds to the best answer.

1. What livestock disease have starlings been accused of spreading?
  - a. Brucellosis
  - b. Hoof and mouth disease
  - c. Rabies
  - d. TGE
  - e. Epilepsy
  
2. Which is the preferred food of blackbirds?
  - a. Corn
  - b. Soybeans
  - c. Wheat
  - d. Alfalfa
  - e. Apples
  
3. Wisconsin farmers estimated the annual statewide deer damage was about \_\_\_\_\_ in 1981.
  - a. \$100,000
  - b. \$1 million
  - c. \$750,000
  - d. \$15 million
  - e. none of the above
  
4. What kind of damages are non-poisonous snakes responsible for?
  - a. Spread of disease
  - b. None (harmless to humans)
  - c. Depress quail populations
  - d. Burrowing activity under building foundations
  - e. none of the above
  
5. Approximately how many people die from rattlesnake bites in the U.S. each year?
  - a. 100
  - b. 550
  - c. 12
  - d. 1,100
  - e. 21,000

6. Which disease is the most fatal to humans?
  - a. Rabies
  - b. Tularemia
  - c. Histoplasmosis
  - d. Malaria
  - e. TGE
  
7. What disease can be transmitted to humans by skinning cottontail rabbits?
  - a. Rabies
  - b. Bubonic plague
  - c. Tularemia
  - d. Histoplasmosis
  - e. Polio
  
8. What animal has the highest rate of rabies infection?
  - a. Raccoon
  - b. Skunk
  - c. Bat
  - d. Rat
  - e. Humans
  
9. What is the objective of wildlife damage control?
  - a. Prevent animal(s) from interfering with human endeavors.
  - b. Eliminate the species causing damages.
  - c. Kill all animals which may be causing the damage.
  - d. Reduce wildlife populations permanently.
  - e. none of the above

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 1: Habitat Management Principles

Objective: The student will be able to explain ecological principles and how they apply to fish and wildlife management.

#### Study Questions

1. What is ecology?
2. What are the basic habitat requirements of fish and wildlife?
3. How does ecological succession change the environment?
4. What are the two opposing forces which determine the population levels for all fish and wildlife species?
5. Why does the limiting factor determine the carrying capacity of the habitat?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. A Glossary of Selected Terms of Conservation, Ecology and Resource Use, Missouri Department of Conservation, 1984.
3. Wildlife Management in Missouri. Missouri Department of Conservation, 1992.
4. Transparency Masters
  - a) TM 1.1: Food Chain
  - b) TM 1.2: Biotic Pyramid
  - c) TM 1.3: Comparison of Edge
  - d) TM 1.4: Gradual Transition of Edge
  - e) TM 1.5: Biotic Potential
  - f) TM 1.6: Biotic Potential + Environmental Resistance
5. Work Sheet
  - a) WS 1.1: Understanding Limiting Factors
6. Audiovisuals
  - a) "Farming and Wildlife: Bobwhite Quail" videotape (18 minutes). A copy of this program has been distributed to all Missouri agriculture instructors.



## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 1: Habitat Management Principles

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the unit.

##### B. Motivation

Ask the students why rainbow trout do not naturally live in Missouri streams or why ring-necked pheasants are not found in the Ozarks. Point out that these species are not adapted to live in these areas. They require different living conditions than the environment is capable of providing. Sometimes the reason is fairly obvious, as in the case of the rainbow trout. This species of fish cannot physically survive in most of Missouri's streams because of warm temperatures and low oxygen content. Other times the reason is not readily apparent. Point out that wild animals must have all their life needs met in an area to survive and reproduce. Show the Missouri Department of Conservation's "Farming and Wildlife: Bobwhite Quail" videotape to illustrate this concept.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students for a definition of ecology.

#### What is ecology?

- a) Ecology is the study of the structure and function of nature.
  - 1) It deals with the interrelationships of living organisms (including humans) and their environment.
  - 2) The focus of ecology is to gain scientific understanding of how the earth sustains life.
  - 3) Conservation policies and programs are based on ecological principles.
- b) 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.

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

2. Ask the students to list the four basic requirements of fish and wildlife. Point out that each species is unique and has its own set of specialized habitat requirements to survive.

**What are the basic habitat requirements of fish and wildlife?**

- a) Food (Use TM 1.1 and TM 1.2)
- 1) The source of energy for nearly all living organisms is the sun. Green plants convert sunlight to food energy and store part of the energy in their tissues.
  - 2) Herbivores (plant-eating animals) obtain food energy by consuming plants.
  - 3) Carnivores (meat-eating animals) obtain food energy by consuming herbivores or omnivores (animals which eat both plant and animals).
  - 4) The series of transfers of food energy from one organism to another is called a food chain and follows the same general pattern: green plants----> herbivores----> carnivores
  - 5) All food chains are limited to a few links. There is a loss of energy at every step because it must be used for the metabolic functions of the plants and animals.
  - 6) The animals at the "top" of the biotic pyramid are generally fewer in number and larger in size than those below them.

b) Cover

- 1) 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."
- 2) Different animal species require different types of cover. Also, an individual species frequently has different cover requirements corresponding to the seasons of the year.
  - (a) Prairie chickens prefer the open spaces of permanent tall grass and only a minimum of brushy cover. Open knolls with short grass cover are ideally suited for springtime courtship.
  - (b) Bobwhite quail prefer areas where croplands, grasslands, woodlands and brushy areas meet. Dense brush or woodland areas provide good winter cover.
  - (c) Aquatic cover is usually rootwads, stickups, submerged tree branches, growing vegetation, and rock. Good aquatic cover concentrates fish in an area by providing places where they can rest, feed, and escape from larger predators.

c) Water

- 1) Water is one of the basic needs of wildlife.
  - (a) Water for drinking is essential for most animal life.
  - (b) Water determines what type of vegetation can be supported on a particular site. The vegetation defines the habitat type and consequently, the animal species living there.
- 2) The quality and quantity of water has a profound effect on aquatic organisms.
  - (a) A stream, pond or lake is only as healthy as the watershed draining into it. Siltation, sewage effluent and other pollution are detrimental to the entire aquatic ecosystem.
  - (b) The quantity of water defines the size of aquatic habitats. Water level fluctuations cannot be avoided. However, man-made impoundments give the opportunity to regulate water levels in lakes and streams.

d) Space

- 1) Individual species have a specific amount of space they will use to find food, water and cover.
- 2) The space requirements of an animal varies with the season of the year and quality of habitat.
- 3) The home range of an animal is the area it normally uses to locate food, water and cover.

- 4) An animal's territory is a smaller area within the home range that it will defend--primarily from members of the same species.
  - (a) Some species are more territorial than others.
  - (b) Different species maintain different sizes of territories. Colonial nesting birds defend an area immediately around their nests while a robin maintain a quarter of an acre territory during the breeding season.
  - (c) Territorial spacing can serve as a mechanism to prevent a species from overcrowding its habitat. The competition for living space will result in dispersal to new areas.
- e) Arrangement (TM 1.3 and TM 1.4)
  - 1) Food, water and cover must be interspersed throughout the habitat for the animals to thrive. Without proper arrangement, these basic essentials are useless because the animals will have limited access to them.
  - 2) "Edge" refers to the transition between habitat or vegetation cover types.
    - (a) The concept of "edge" is closely related to the interspersion of food, cover and water.
    - (b) Habitat with a large amount of edge will supply more food, cover and water for more species than large tracts of the same vegetative type.
    - (c) Better habitat is created with an irregular edge between vegetative types as compared to a straight line.
  - 3) The quality of edge between field and forest is measured by how gradually the transition of vegetative types occurs.
    - (a) A gradual transition with a wider border of grasses, weeds, shrubs, vines and small trees is more valuable to wildlife.
    - (b) Much more wildlife food and cover is available in an edge with a gradual transition.

3. Ask the students if they have noticed how the vegetation changes on an area that is allowed to "grow up" over a period of time. Point out that they were witnessing an example of ecological succession.

**How does ecological succession change the environment?**

- a) Ecological succession is a natural and predictable process which ends with the establishment of a stable climax community capable of reproducing itself.

- 1) Plants and animals adapted to a given environment are responsible for their own eventual failure to survive.
  - 2) The biotic community itself modifies and changes its own environment and produces a set of conditions to which other organisms are better adapted.
  - 3) A "new" community becomes established and continues to alter the environment which results in their being succeeded by another set of organisms even better adapted to the changed conditions.
  - 4) Ecological succession will continue until a community is created which can reproduce itself- the climax community.
  - 5) The series of communities which result in the development of a climax community is called a sere; each temporary community is called a seral stage.
- b) Ecological succession on bare rock.
- 1) Lichens will grow on bare rock and are the first pioneer species.
  - 2) Lichens slowly disintegrate the rock to form small pockets of soil where mosses flourish, forcing out the lichens.
  - 3) Mosses in turn create favorable conditions for small seed plants.
  - 4) The seed plants provide shelter for trees and shrubs which soon grow over them and deprive them of sunlight, root space and nutrients.
- c) Ecological succession of an abandoned cropfield originally cleared out of forest.
- 1) Field will quickly be invaded by "weeds" which require full sunlight (ragweed, goldenrod). Bobwhite quail, song sparrows and cottontail rabbits prefer this type of habitat.
  - 2) Over a period of 5-10 years, the herbaceous plants will gradually be replaced by woody shrubs. This transitional stage of "weeds" and woody shrubs is called an old field in wildlife management terminology.
  - 3) The woody shrubs will provide protection for seedling trees to become established. These initial trees will include species such as persimmon, honey locust, cedar, elm and sassafras. Wildlife species best adapted to this seral stage include whitetail deer, ruffed grouse and woodcock.
  - 4) A climax oak-hickory forest will eventually develop. Forest wildlife species such as squirrel, woodpecker and turkey are best adapted to a climax oak-hickory forest.

- d) Ecological succession of a pond or lake.
    - 1) In early seral stages, organic matter from pioneer plants and animals begin to accumulate on the bottom and emergent plants (cattails, water lilies) begin to grow along the shoreline.
    - 2) Fish, dragonflies, snails and other organisms populate the pond or lake.
    - 3) Over time, the organic matter from aquatic vegetation accumulates and causes a decrease in water depth.
    - 4) The shallower water depth changes the plant and animal species living in the pond or lake.
    - 5) Eventually, emergent vegetation will cover the entire surface of what was once the pond and a marsh is created.
    - 6) The buildup of organic matter continues until the marsh is succeeded by land plants which proceed to go through more seral stages until a climax community is reached.
    - 7) Ecological succession in aquatic environments is accelerated by high soil erosion rates in the associated watersheds.
  - e) As ecological succession progresses, there are changes in the function and structure of biotic communities.
    - 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.
  - f) The relationship between ecological succession and fish and wildlife is extremely important.
    - 1) Manipulation of succession is a basic wildlife management tool.
    - 2) Altering succession (setting it back) to an earlier stage is the basis of many wildlife management techniques.
    - 3) Whitetail deer, bobwhite quail, cottontail rabbits and ring-necked pheasants are adapted to early or middle successional stages.
4. Ask the students why wild animals do not keep on reproducing until they devour all vegetation or otherwise destroy their habitat(s). Point out that their ideal reproduction rate (biotic potential) is kept in check by predation, disease, starvation, etc. (environmental resistance.)

**What are the two opposing forces which determine the population levels for all fish and wildlife species?**

- a) Biotic potential refers to the maximum reproductive rate of a species in an ideal habitat (no predators, unlimited food, water, cover and space).
    - 1) A species very rarely experiences its biotic potential - even for a short time.
    - 2) Only under ideal conditions can a species achieve the exponential growth rate associated with its biotic potential. (TM 1.5)
  - b) Environmental resistance in the form of food, cover, water or space shortages eventually occurs.
    - 1) Birth rate decreases and animal mortality increases.
    - 2) Animals move to other areas (emigration).
  - c) Biotic potential and environmental resistance are two opposing forces which determine population levels of all fish and wildlife species. (TM 1.6)
5. Ask the students if food, water, cover and space are equally available to a species in a given habitat. Point out that there is usually one which is in shorter supply and limits the size of the population.

**Why does the limiting factor determine the carrying capacity of the habitat?**

- a) Carrying capacity is the maximum number of organisms which can be supported on a given area for a specified length of time.
- b) Carrying capacity may be interpreted in several ways:
  - 1) Total number of organisms can which survive in a given habitat or ecosystem.
  - 2) Total number of organisms of a particular type (i.e., plants; herbivores; carnivores) which can survive in a given habitat or ecosystem.
  - 3) Total number of organisms of a given species which can survive in a given habitat or ecosystem.
- c) Carrying capacity can be increased or decreased by the manipulation of food, water and cover. This manipulation is frequently achieved by controlling succession.
- d) The limiting factor is the strongest influence depressing a fish or wildlife population and therefore, defines carrying capacity.
- e) If the limiting factor is removed another environment influence eventually limits the population at a higher level.

## F. Other activities

1. Arrange a tour on a local farm to observe wildlife habitat. Ask a MDC representative to attend to explain the various aspects of the habitat.
2. Schedule a visit to a MDC wildlife area and ask the wildlife area manager to show the class different types of wildlife management practices. In a later classroom session, guide a student discussion to uncover the principles the individual practices are based on (i.e. edge, limiting factors, carrying capacity, interspersion, ecological succession, etc).
3. Separate the class into groups of four and assign a fish or wildlife species to each group. Have the groups prepare a written and/or oral report on the food, cover, water and space requirements the species will need over a year's time. Each student should be responsible for one of the four habitat components.

## G. Conclusion

Fish and wildlife management practices are frequently used to maintain or increase wild animal populations. There are many different types of practices used to increase the food, cover, water and space available to fish and wildlife species. Although these practices vary considerably with the habitat type, they follow the same ecological principles. Ecological principles form the foundation of fish and wildlife management.

## H. Competency

Explain ecological principles and how they apply to fish and wildlife management.

## I. Answers to Evaluation

1. a
2. b
3. e
4. c
5. b
6. b
7. a
8. a
9. b
10. c



J. Answers to work sheet

1. 40
2. 30
3. 30
4. 10

Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES**

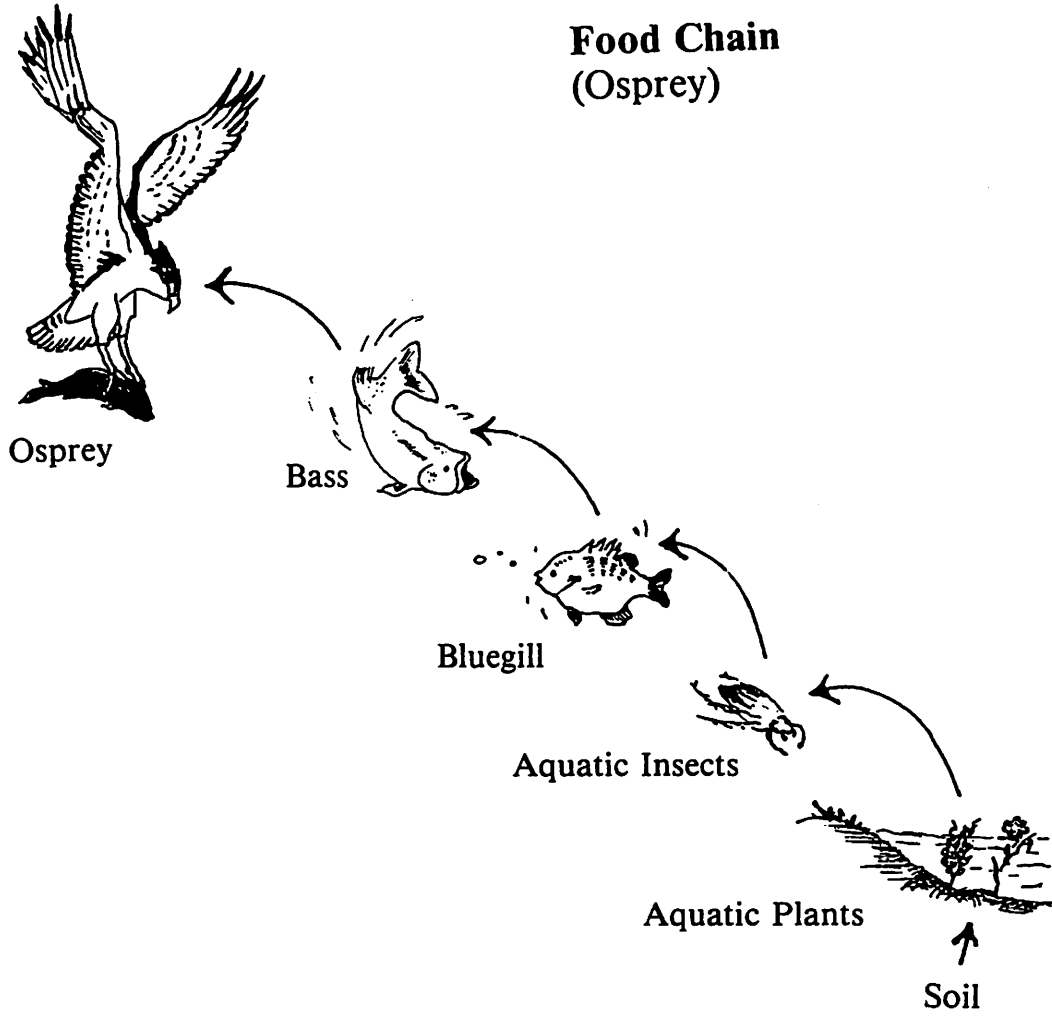
**Lesson 1: Habitat Management Principles**

**EVALUATION**

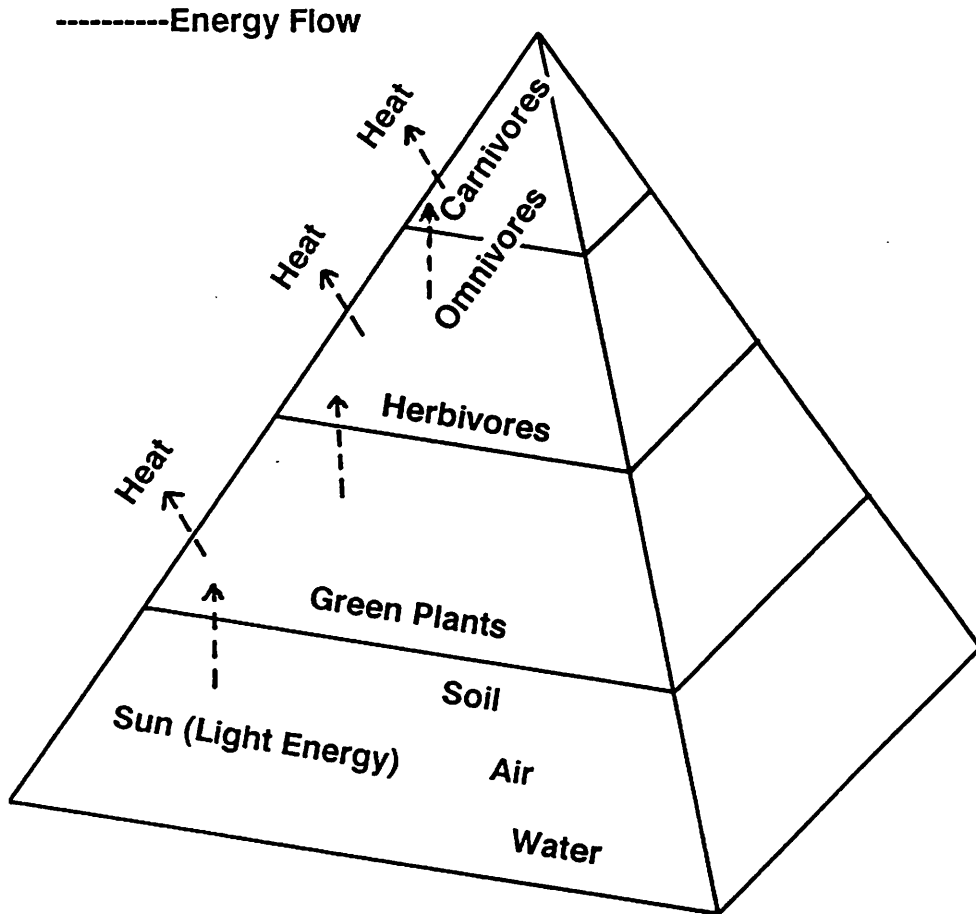
**Circle the letter that corresponds to the best answer.**

1. The primary aim of ecology is to understand \_\_\_\_\_.
  - a. how the earth sustains life
  - b. endangered species
  - c. agricultural production
  - d. why people enjoy fish and wildlife
  - e. fish reproduction
  
2. In a given ecological community, herbivores are \_\_\_\_\_ than carnivores.
  - a. fewer in number
  - b. more numerous
  - c. higher on the food chain
  - d. higher on the biotic pyramid
  - e. less important
  
3. Cover is vegetation or other material used by wild animals for \_\_\_\_\_.
  - a. nesting
  - b. escape from predators
  - c. protection from adverse weather conditions
  - d. rearing of young
  - e. all of the above
  
4. Water determines what kind of \_\_\_\_\_ can be supported on a site and therefore, the habitat type.
  - a. birds
  - b. mammals
  - c. vegetation
  - d. microorganisms
  - e. none of the above

5. The \_\_\_\_\_ of an animal is the area it normally uses to find food, water and cover.
- territory
  - home range
  - geographic range
  - colony
  - all of the above
6. Food, water and cover must be \_\_\_\_\_ in the habitat for fish and wildlife to gain the most benefit.
- centrally located
  - interspersed
  - confined to designated areas
  - artificially placed
  - none of the above
7. The final stage of ecological succession is the \_\_\_\_\_ stage.
- climax
  - seral
  - primary
  - biotic
  - apex
8. Manipulation of ecological succession is \_\_\_\_\_.
- an important wildlife management tool
  - not biologically possible
  - done only in forested areas
  - not related to fish and wildlife management
  - dangerous
9. A habitat's carrying capacity of a particular wildlife species can be increased by \_\_\_\_\_.
- stocking more animals
  - removing the limiting factor
  - prohibiting all human intervention
  - killing all predators
  - winter feeding
10. A fish or wildlife population will \_\_\_\_\_ if the limiting factor is removed.
- decrease
  - experience its biotic potential
  - rise to a higher level and stabilize
  - not be affected
  - none of the above

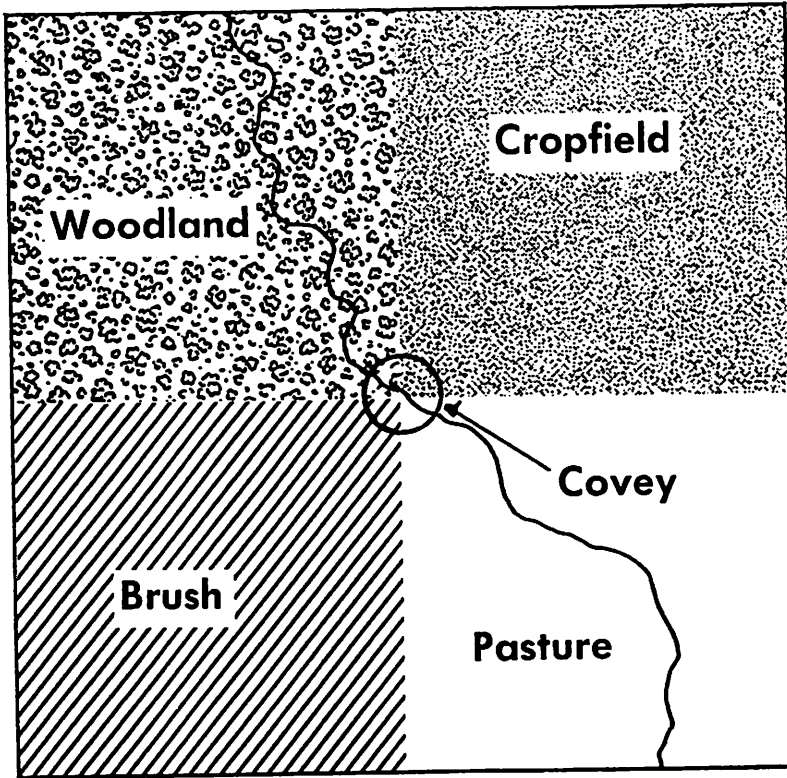


# Biotic Pyramid

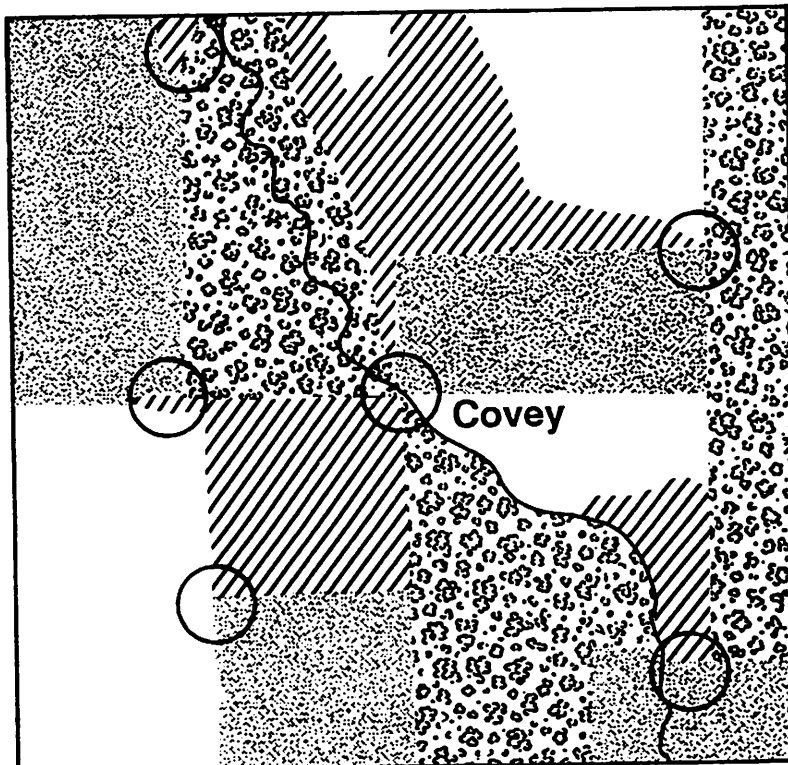


Credit: *An Ecological Approach to Conservation Education*. Missouri Department of Conservation.

### Comparison of Edge

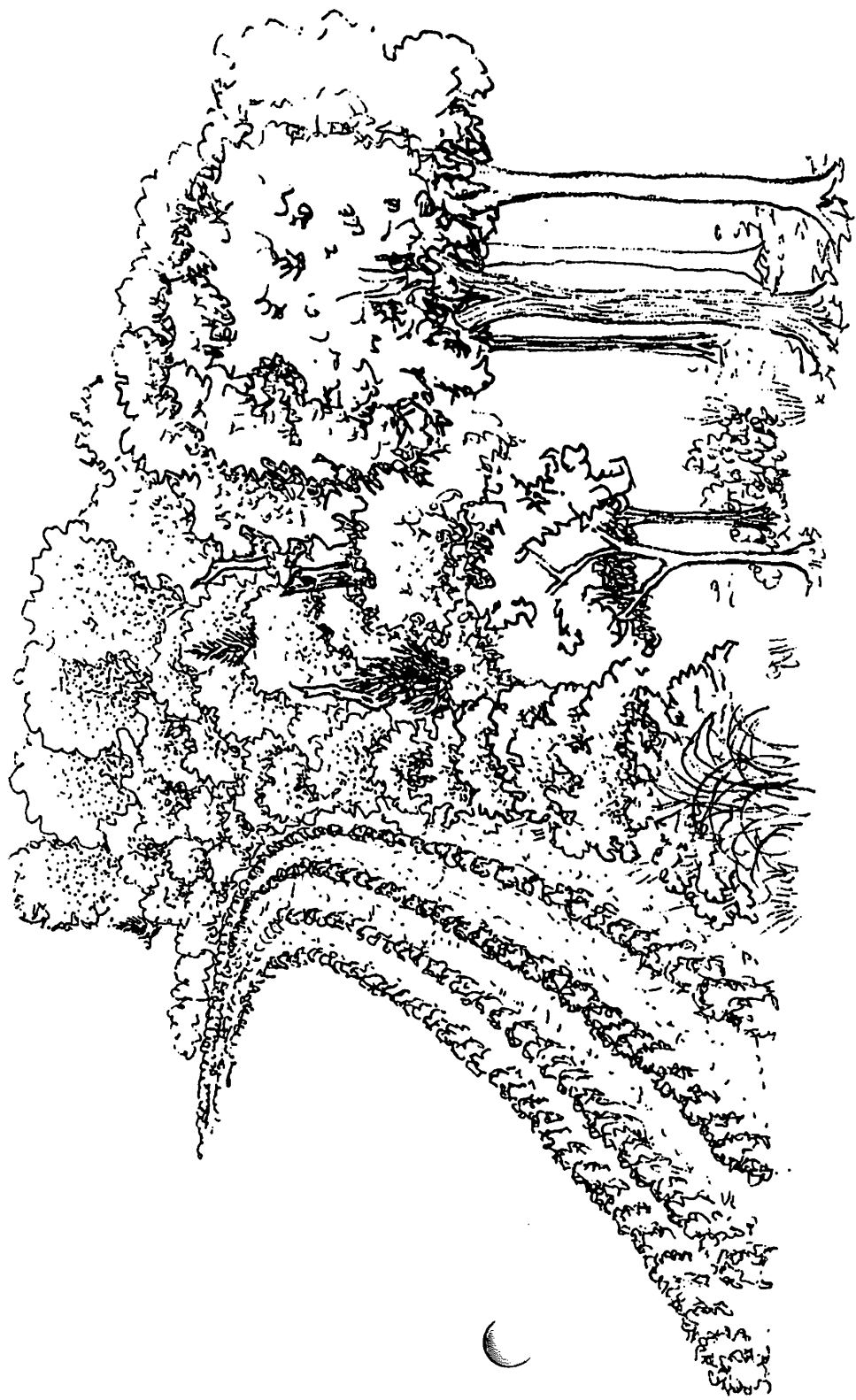


**Poor Edge**



**Good Edge**

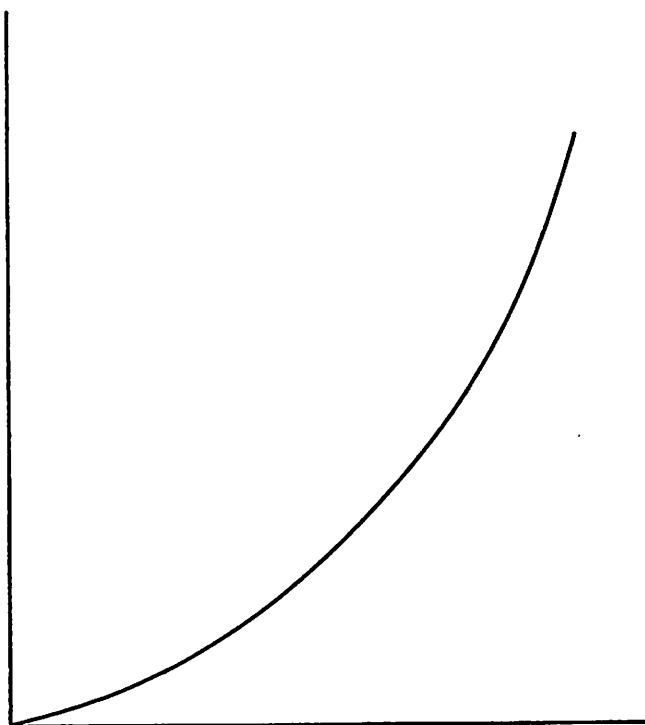
## Gradual Transition of Edge



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

### Biotic Potential

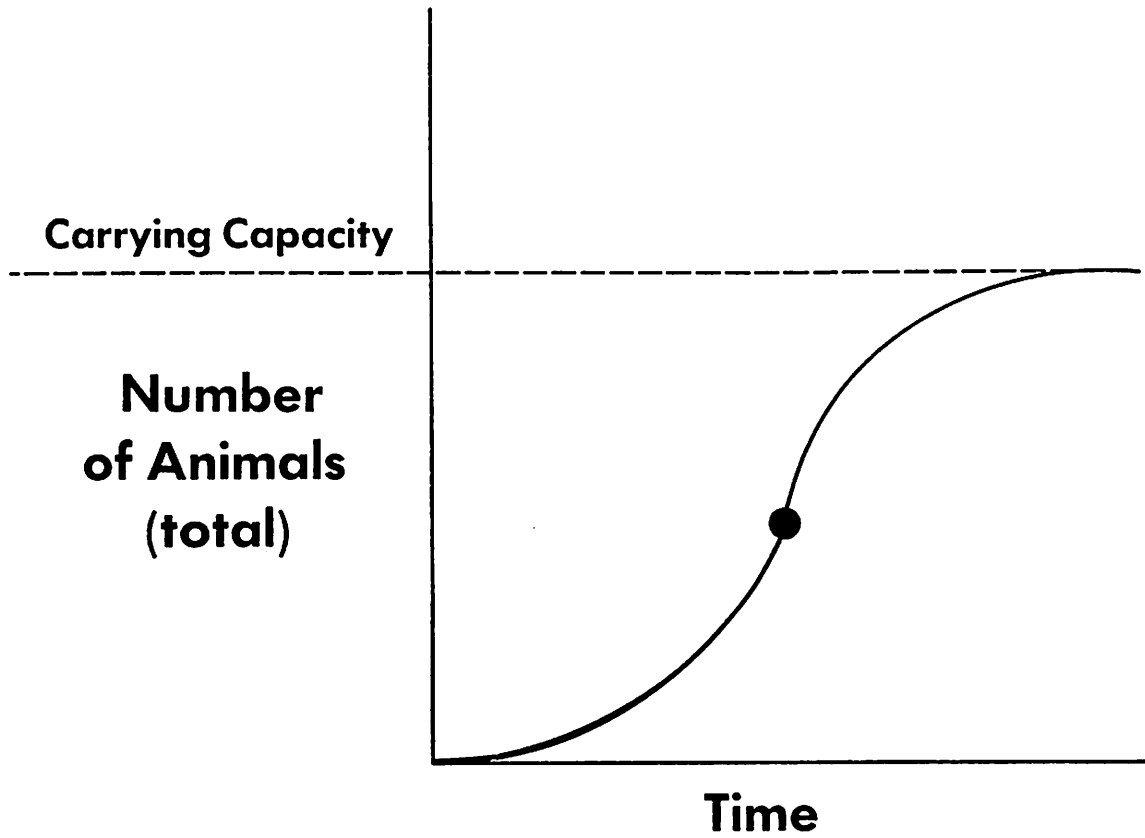
Number of  
Animals or  
Output



Time



## Biotic Potential + Environmental Resistance



## UNDERSTANDING LIMITING FACTORS

Assume a 200 acre farm will support 50 cottontail rabbits if the following general habitat components are maintained:

- a. 100 units of winter cover (brushpiles, thick weedy growth).
- b. 100 units of nesting cover (grassy areas).
- c. 100 units of food throughout the year.
- d. 100 units of groundhog dens for protection during severe winter weather.

If any of the four habitat components are increased or reduced by two units, the rabbit population will increase or decrease by one animal. For instance, if the nesting cover is reduced by 10 units the area will support 45 rabbits instead of 50.

1. If winter cover is reduced to 80 units it becomes the limiting factor and the rabbit population is reduced to \_\_\_\_\_.
2. If winter cover is reduced to 80 units and a drought reduces food to 60 units, the carrying capacity of the area will be \_\_\_\_\_ rabbits.
3. Assume winter cover is restored to 100 units but food remains at 60 units. In this case, the area will support \_\_\_\_\_ rabbits.
4. If there is 20 units of winter cover, 40 units of nesting cover, 60 units of food and 100 units of groundhog dens, the area will support \_\_\_\_\_ rabbits.

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 2: Cropland Management

Objective: The student will design a cropland management plan for wildlife.

#### Study Questions

1. Why does a crop rotation benefit wildlife?
2. How do conservation tillage systems provide wildlife with food and cover?
3. Why does contour strip-cropping improve wildlife habitat?
4. What are the three types of vegetation a landowner can use in a field border?
5. How do grass waterways benefit wildlife?
6. Why do broad-base terraces provide few wildlife benefits?
7. How do agricultural chemicals affect wildlife?
8. Why should winter cover be close to standing grain left for wildlife?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Wildlife Management Handbook for Landowners. Missouri Department of Conservation, 1991.
3. "Helping Wildlife on the Farm" poster. Missouri Department of Conservation.
4. Work Sheet
  - a) WS 2.1: Cropland Habitat Appraisal

## 5. Audiovisuals

- a) "Annual Food Plots" videotape (12 minutes)
- b) "Conservation Planning for Wildlife" videotape (13 1/2 minutes)
- c) "Farming and Wildlife - Pheasant" videotape (15 minutes)
- d) "The Root Plow Saves Crops and Wildlife" videotape (10 1/2 minutes)

Note: a) through d) listed above have been distributed to all Missouri agriculture instructors by the Missouri Department of Conservation.

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 2: Cropland Management

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson.

##### B. Motivation

Ask the students if they have examined the "crop" of a bobwhite quail, mourning dove or ring-necked pheasant. In most cases, the "crop" will contain a mixture of wild plant and agricultural seeds. This could be illustrated by having the students dissect the "crops" of legally harvested game birds and identify the seeds. Point out that row crops provide an important high energy food source for many wildlife species.

Be sure not to ignore other wildlife benefits crop fields provide. This could be emphasized by asking the students if they have seen wildlife nests destroyed during hay cutting in clover fields.

Summarize by pointing out that cropland is a habitat component which provides multiple wildlife benefits - particularly when it is managed properly.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students how a crop rotation could help wildlife.

#### Why does a crop rotation benefit wildlife?

- a) Crop rotation is growing different crops in a field over a period of years following a particular pattern.
- b) A crop rotation of four or more years including small grains and forage crops has much to offer farmers.
  - 1) Rotating crops disrupts the life cycle of many insect pests.
  - 2) Most soybean and corn diseases can be controlled or suppressed with a crop rotation.

- 3) Longer rotations with small grains and forages help to control soil erosion.
- 4) Forage legumes add nitrogen to the soil through symbiotic nitrogen-fixing bacteria on their root nodules.
- c) Crop rotations improve wildlife habitat by increasing the amount of edge and diversity of plant cover.
  - 1) Different crops grown in close association offer wildlife a variety of food and cover requirements at different times of the year.
    - (a) Legume hay fields offer excellent nesting habitat and a forage supply.
    - (b) Waste grain on corn and soybean fields functions as a high energy food source for many species of wildlife during the winter months.
    - (c) Wheat stubble makes good brood-rearing cover.
  - 2) 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.

2. Ask the students for a definition of conservation tillage. Point out that conservation tillage is more than leaving crop residues on a field over the winter - residue must remain on the soil surface after planting.

**How do conservation tillage systems provide wildlife with food and cover?**

- a) 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."
- b) Agronomic benefits of conservation tillage.
  - 1) Reduces soil loss.
  - 2) Maintains soil structure.
  - 3) Improves soil aeration.
  - 4) Conserves soil moisture.
  - 5) Reduces soil compaction.
  - 6) Lowers crop production expenses.
- c) Crop residues left undisturbed throughout the winter provide wildlife with food and cover.
  - 1) Waste grain left after harvesting are a staple winter food source for wildlife such as pheasants and quail.
    - (a) Fields receiving fall discing and/or chiseling typically have 70 to 80 percent less waste grain and 50 to 60 percent less residue than fields left undisturbed after harvest.

- (b) The type of implement used has a strong relationship to the amount of water grain and crop residue left on the soil surface. (A tandem disk leaves over six times as much waste grain on the soil surface as a chisel plow with twisted shanks.)
  - (c) 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.
  - (d) Fall tillage of any kind decreases the food and cover available to wildlife.
- 2) Many species of ground-nesting birds utilize crop residues on no-till fields.
- (a) Researchers in Iowa and Indiana found a greater diversity and density of birds nesting in no-till fields than in conventionally tilled fields.
  - (b) Nesting success was comparable to idle areas such as fencerows.

3. Ask the students if they have seen contour strip-cropping on fields. Point out that different crops vary in their ability to hold the soil and provide wildlife with food and cover. Strip-cropping creates a diversity of crops in the same field.

**Why does contour strip-cropping improve wildlife habitat?**

- a) Strip-cropping is the practice of growing small grains, forages and row crops in alternate strips to reduce soil erosion.
  - 1) Contour farming can reduce the rate of soil erosion up to one-half on gently sloping croplands.
  - 2) Contour strip-cropping can reduce soil erosion by 75 percent and provides an economical alternative to terraces.
- b) Contour strip-cropping - with its alternating strips of hay, small grains and row crops - increases the interspersed cover types.
  - 1) More "edge" is created.
  - 2) Strips seeded to legumes serve as travel lanes and help wildlife make greater use of croplands.
  - 3) Legumes also provide nesting habitat and increase wildlife production if mowing is delayed until July.

- 4) Permanent grass buffer strips should be maintained between crop strips for adequate erosion protection on steep fields. These grass strips should be seeded to a grass/legume mixture that is beneficial to wildlife.
  - c) 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.
4. Reemphasize the importance of edge between habitat types. Point out that field borders may consist of different types of vegetation and are excellent edge-producers.

**What are the three types of vegetation a landowner can use in a field border?**

- a) Borders of shrubs, grass or annual weeds along the edges of fields are very beneficial to many species of wildlife.
  - 1) Field borders provide wildlife with different cover types depending on how the borders are managed.
  - 2) A field border is usually held in an earlier successional stage than the area surrounding it.
- b) Field-ends and turn-rows are good areas to establish field borders.
  - 1) Crop yields from these areas is frequently low due to soil compaction by farm equipment and soil erosion.
  - 2) Planting these areas to shrubs or simply letting them revert to natural vegetation provides valuable wildlife habitat.
- c) Field borders can be seeded to grass/legume mixtures beneficial to wildlife.
  - 1) Prevents field edge erosion.
  - 2) Provides a roadway at the edge of the field.
  - 3) Provides nesting cover for birds like meadowlarks, vesper sparrows, bobwhite quail and pheasants.
- d) Wooded fencerows and hedgerows are an excellent field border; but compete with crops.
  - 1) 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.
  - 2) A root plow restricts the distance tree roots extend into the field and reduces their competition with agricultural crops.



5. Ask the students why farmers install grass waterways. Point out that grass waterways are to be used for controlling a soil erosion problem. Bulldozing a non-eroding brushy draw for establishment of a grass waterway to make a field more "farmable" is not good conservation.

**How do grass waterways benefit wildlife?**

- a) Grass waterways are used as outlets for accumulated runoff water on crop fields to reduce soil erosion.
  - b) Grass waterways can benefit wildlife by using certain grass species and management techniques.
    - 1) Tall fescue is an excellent grass for erosion control but provides poor wildlife habitat due to its excessively rank growth.
    - 2) Native warm-season grasses (switchgrass, Indiangrass) and some cool-season grasses (redtop, smooth brome) are capable of supplying better wildlife habitat. These grasses offer more open space on the ground which wildlife favors.
    - 3) Grass waterways should be mowed or hayed after July 1 to avoid destroying wildlife nests. Mowing keeps woody sprouts from invading.
  - c) When a substantial soil erosion problem does not exist, it is not good conservation to remove natural vegetation to install a grass waterway.
6. Ask the students if they have seen or farmed a field with a set of terraces. Point out that terraces control soil erosion by shortening slope lengths. Compare terraces with strip-cropping for further illustration.

**Why do broad-base terraces provide few wildlife benefits?**

- a) A terrace is a man-made earthen embankment with a ridge and channel constructed across the slope to intercept runoff water.
  - 1) Main purpose is to reduce erosion by shortening slope lengths.
  - 2) Three types of terraces used in Missouri are:
    - (a) Broad-base
    - (b) Steep backslope
    - (c) Narrow-base
  - 3) The backside of steep backslope terraces and both sides of narrow-base terraces are planted to permanent vegetation. Seeding mixtures beneficial to wildlife can be used to create habitat.
  - 4) Grass strips on terraces increase the amount of edge and make more of a crop field available to wildlife use.

- 5) Switchgrass works particularly well.
  - 6) Broad-base terraces are not seeded to grass and therefore, supply minimal wildlife benefits.
7. Ask the students for their opinions on how pesticides affect wildlife. Lead a discussion on the benefits and drawbacks of pesticides. Point out that pesticides undergo careful testing by the Environmental Protection Agency before being released to the public.

**How do agricultural chemicals affect wildlife?**

- a) Concerns have arisen about the increased use of agricultural chemicals and their possible side effects on wildlife populations.
    - 1) Some farmers have increased their use of pesticides to control pests in no-till crops.
    - 2) Pesticide's effect on wildlife is a topic of much debate.
      - (a) Herbicides can reduce the wildlife food base on a farm by reducing weed seeds and associated insects. However, they have little direct toxic effects on animals.
      - (b) Insecticides can kill wildlife through either direct toxic effects or after eating poisoned insects.
  - b) Integrated pest management (IPM) may help to relieve some of the dependency on agricultural chemicals.
    - 1) Each crop and its pests are considered an ecological system.
    - 2) A control program is developed that integrates a variety of biological, chemical and cultural methods in proper sequence and timing.
    - 3) IPM uses a combination of natural control mechanisms like crop rotation, resistant crop varieties and predatory insect populations to supplement the use of chemicals.
8. Ask the students if they have planted food plots. Guide a discussion regarding the amount of wildlife use the food plots received. Point out that a man-made food supply must be near good cover.

**Why should winter cover be close to standing grain left for wildlife?**

- a) Good winter cover should be close to standing grain or food plots so wildlife will have easy access to the food supply.
- b) Annual grain food plots are especially valuable in areas that lack rowcropping.

- c) It is simpler to leave a few rows unharvested at the edge of a crop field than to make special food plot plantings.
  - 1) Four acres of standing grain per 40 acres of cropland is a general rule.
  - 2) For small corners and odd areas, a quarter of an acre of standing grain will provide wildlife with the food they need.

#### F. Other activities

1. Tour a nearby farm which has a good mix of land uses and soil conservation practices.
2. Have an experienced farmer describe the details of his/her conservation tillage system.
3. Show conservation videotapes.
  - a. "Annual Food Plots"
  - b. "Conservation Planning for Wildlife"
  - c. "Farming and Wildlife - Pheasant"
  - d. "The Root Plow Saves Crops and Wildlife"

#### G. Conclusion

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.

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.

#### H. Competency

Design a cropland management plan for wildlife.

#### I. Answers to Evaluation

1. a
2. d
3. d
4. a
5. c
6. c
7. a
8. d
9. c
10. a

Name \_\_\_\_\_

Date \_\_\_\_\_

### UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

#### Lesson 2: Cropland Management

#### EVALUATION

Circle the letter which corresponds to the best answer.

1. Crop rotations without \_\_\_\_\_ are not as beneficial to wildlife.
  - a. small grains and legumes
  - b. fall tillage
  - c. herbicide applications
  - d. spring tillage
  - e. government subsidies
  
2. Conservation tillage is "any tillage system which leaves at least 32 percent of the soil surface covered with crop residue at \_\_\_\_\_ time."
  - a. harvesting
  - b. cultivation
  - c. plowing
  - d. planting
  - e. Christmas
  
3. Waste grain on a crop field is decreased by \_\_\_\_\_.
  - a. warm temperatures
  - b. soil moisture
  - c. tillage
  - d. premature sprouting
  - e. all of the above
  
4. Contour strip-cropping is a good practice to increase \_\_\_\_\_ in a field.
  - a. edge
  - b. brushy cover
  - c. erosion
  - d. wildlife mortality
  - e. the number of straight rows

5. Which of the following is not a vegetation used in field borders along crop fields.
- Shrubs
  - Grasses and legumes
  - Rowcrops
  - Woody fencerows
  - none of the above
6. Grass waterways are capable of providing wildlife with \_\_\_\_\_ cover.
- conservation
  - winter
  - nesting
  - escape
  - none of the above
7. Terraces supply wildlife habitat if they are \_\_\_\_\_.
- seeded to grass.
  - on the contour.
  - drained into a tile line.
  - closely spaced.
  - paid for by the government
8. The effect of agricultural chemicals on wildlife populations is \_\_\_\_\_.
- enormous
  - minimal
  - unfounded
  - a topic of considerable debate.
  - none of the above
9. \_\_\_\_\_ can kill wildlife through direct toxic effects when used on crop fields.
- Fungicides
  - Algaecides
  - Insecticides
  - Herbicides
  - all of the above
10. Standing grain and food plots should be close to \_\_\_\_\_ cover.
- winter
  - nesting
  - brooding
  - roosting
  - conservation

**CROPLAND HABITAT APPRAISAL****TEACHING SUGGESTIONS**

This work sheet is based on the Wildlife Habitat Appraisal Guide (WHAG) developed and used by the Missouri Department of Conservation. WHAG is a systematic habitat appraisal system used to evaluate the suitability of existing wildlife habitat and can also be used to make habitat improvement recommendations.

The cropland habitat components important to the bobwhite quail are featured in this activity to help reinforce the concepts presented in the lesson. Impress upon your students that this activity evaluates only the habitat condition of an individual field for one species--the bobwhite quail. The WHAG forms used by professional biologists are designed to evaluate all habitats on a farm including forest, cropland, old field, wetland and grassland. If you or your students are interested in evaluating the habitat quality on an entire farm for a particular species, contact the local conservation agent or wildlife services biologist for WHAG training.

It is recommended for instructors to complete the work sheet on the selected area before the students. The appraisal system requires a large measure of personal judgment in evaluating individual habitat features. For this reason, the work sheet will not be a reliable testing device. However, it will give a good indication if the students recognize good or bad habitat when they see it. Try to select a site with obvious habitat features which correspond to the items on the work sheet.

Reviewing the completed work sheets with the students at a later classroom session is highly recommended. Place emphasis on the reasons why individual habitat features affect wildlife. For instance, a higher rating is given to a cropfield with no fall tillage because the crop residues provide valuable cover and food during the winter months. Another example involves the wildlife benefits provided by a crop rotation with small grains, row crop and legumes (rotating crops gives wildlife different types of food and cover at different times of the year).

Name \_\_\_\_\_

Date \_\_\_\_\_

**CROPLAND HABITAT APPRAISAL**

**TARGET SPECIES: BOBWHITE QUAIL**

Circle the number which corresponds to your evaluation of each habitat feature. Add your numbers and enter the total at the place indicated at the end of the activity.

a) Extent of edge\*

- 0 No border
- 2 Border circling <25 percent of field
- 6 Border circling 25-50 percent of field
- 8 Border circling 50-75 percent of field
- 10 Border circling >75 percent of field

\*Border refers to woody (brush, windbreaks, hedgerow, etc.) or herbaceous (weeds, grasses, etc.) strips of vegetation between habitat types. The strip must be a minimum of five feet in width to be counted as a border. Estimate the percent of the field surrounded by a border as defined.

b) Estimate the percent of the field that is covered by winter or escape cover including dense brushy areas, brushpiles, fallen logs, etc.

- 1 No cover present
- 2 1-5 percent of the field has winter/escape cover
- 5 More than 5 percent of the field has winter/escape cover or the field is less than 10 acres with a border around 75 percent or more of the edge.

c) Cropping practices

- 1 Completely harvested, heavy herbicide use (no weeds)
- 3 Completely harvested, little herbicide use (weedy)
- 5 1/4 - 1 acre of food plot or unharvested grain per 40 acres of cropland
- 7 1 - 4 acres of food plot or unharvested grain per 40 acres cropland
- 10 More than 4 acres of food plot or unharvested grain per 40 acres cropland

d) Cropfield management

- 1 Fall moldboard plowing
- 4 Fall discing or winter wheat (conventional tillage)
- 6 Crop residues grazed, chopped or baled
- 8 Chisel plowing once in fall or no-till winter wheat
- 10 No fall tillage, residues undisturbed

e) Crop rotation

- 1 Continuous row crop or continuous small grain
- 3 Small grains-row crop
- 5 Small grains-row crop-legume (meadow)

f) Estimate the distance from the center of the cropfield to the edge of the nearest hayfield or pasture.

- 1 Over 1 mile to a heavily used pasture or hayfield
- 3 1/2 to 1 mile distance to pasture or hayfield with moderate use
- 5 Less than a 1/2 mile to a lightly used pasture or hayfield with a good mix of different plant species

\_\_\_\_\_ TOTAL SCORE

\_\_\_\_\_ 45 \_\_\_\_\_ MAXIMUM POINTS POSSIBLE

$$\frac{\text{TOTAL SCORE}}{\text{MAXIMUM POINTS POSSIBLE}} = \frac{\quad}{45} =$$

Circle the score you calculated and the corresponding rating.

	Score	.75-1.0	0.50-0.75	0.25-0.50	0.25
Habitat Quality	Rating	Excellent	Good	Fair	Poor



## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 3: Grassland Management

Objective: The student will select grassland practices that improve livestock forage and wildlife habitat.

#### Study Questions

1. What is the difference between cool-season grasses and warm-season grasses?
2. How are native prairies different from other grasslands?
3. How does grassland plant growth affect wildlife?
4. How can the five "tools" of grassland management be used to increase livestock forage production and wildlife benefits?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Wildlife Management Handbook for Landowners. Missouri Department of Conservation, 1991.
3. Prairie Life of Missouri. Missouri Department of Conservation, 1992.
4. Missouri Department of Conservation pamphlets
  - a) Native Grasses
  - b) Establishing Native Warm-Season Grasses
  - c) Native Grasses for Wildlife
  - d) Native Warm-Season Grasses for Missouri Stockmen
  - e) Managing Missouri's Hay Prairies
  - f) Questions about Native Warm-Season Grasses
  - g) Prairie Forbs
  - h) Principle Prairie Grasses
5. Transparency Master
  - a) TM 3.1: Pasture Calendar
6. Work Sheet
  - a) WS 3.1: Grassland Habitat Appraisal

## 7. Audiovisuals

- a) "Establishing and Managing Warm-Season Grasses" videotape (15 minutes)
- b) "Farming and Wildlife: Prairie Chicken" videotape (14 1/2 minutes)
- c) "Private Prairie Restoration" videotape (5 1/2 minutes)

Note: a) through c) listed above have been distributed to Missouri agriculture instructors by the Missouri Department of Conservation.

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 3: Grassland Management

#### TEACHING PROCEDURES

##### A. Introduction

Review the previous lesson.

##### B. Motivation

Ask the students if pasture and hayland have specialized management requirements. Point out that forage crops need to be given careful consideration to maximize production and wildlife benefits.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students why tall fescue pastures turn brown in the summer even when there is adequate soil moisture. Point out that tall fescue is a cool-season grass.

**What is the difference between cool-season grasses and warm-season grasses?**

- a) Grasses are lumped into two groups according to the time of year in which their main growth period takes place.
  - 1) Cool-season grasses grow best during the spring and fall when soil temperature is between 40 and 78 degrees Fahrenheit.
    - (a) Smooth bromegrass
    - (b) Tall fescue
    - (c) Kentucky bluegrass
    - (d) Orchardgrass
  - 2) Warm-season grasses grow best during the summer when soil temperature is between 60 and 90 degrees Fahrenheit.
    - (a) Big bluestem
    - (b) Little bluestem
    - (c) Indiangrass
    - (d) Switchgrass
- b) Warm-season grasses make more efficient use of water and soil nutrients than cool-season grasses.

2. Ask the students if they have ever seen a true native prairie. Point out that a few species of native grass in a pasture does not necessarily mean it is a native prairie.

**How are native prairies different from other grasslands?**

- a) Native prairies once covered over two-thirds of Missouri.
  - b) Today, there are only 75,000 acres of native prairies in Missouri which have not been plowed and replaced with croplands or introduced cool-season grasses.
  - c) Remnant native prairies are located primarily in west-central and southwest Missouri.
    - 1) May have up to 250 species of warm-season grasses, legumes and other plants.
    - 2) Remnant native prairies are vital to the survival of the prairie chicken and associated wildlife species.
  - d) 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.
3. Ask the students if they have noticed the growth habit of different grass species. Have them describe the height and density of grass stands they are familiar with.

**How does the grassland plant growth affect wildlife?**

- a) Each species of grass grows differently.
    - 1) May grow in dense stands and have low-growing leaves.
    - 2) May grow in clumpy stands and have elevated leaves.
  - b) Wildlife use grasslands for foraging, nesting, dusting and roosting. The grass must allow wildlife with freedom of movement, yet spread to provide a canopy for concealment from predators.
    - 1) Most wildlife species prefer grasses which grow upright.
    - 2) Excessive ground litter restricts wildlife movement and inhibits their ability to find seeds and insects.
    - 3) Heavy ground litter harbors small rodents which eat eggs or young birds in nests.
3. Ask the students to describe how pastures and/or hay lands are managed by local farmers. Point out that there are distinct reasons why grazing, haying, fertilizing, overseeding and prescribed burning are done at particular times.

**How can the five "tools" of grassland management be used to increase livestock forage production and wildlife benefits?**

- a) With Missouri's high annual rainfall and soil types, grasslands soon change to brushland or forest without management.
- b) Grassland management tools are: grazing, haying, fertilizing, overseeding and prescribed burning.
- c) Grazing
  - 1) Grazing removes excess plant growth, creates wildlife travel lanes and exposes bare ground for dusting and scratching areas.
  - 2) Light grazing is the best for wildlife and results in the most forage production over the long term.
  - 3) Livestock are selective about the plants they eat.
    - (a) Tend to repeatedly graze nutritious and palatable plants and ignore others.
    - (b) Desirable plants decrease due to selective grazing while the unwanted plants continue to multiply and increase.
    - (c) Plants which flourish under heavy grazing are called "increasers."
    - (d) Plants which eventually disappear under heavy grazing are called "decreasers."
  - 4) Rotational grazing defined
    - (a) Involves moving livestock from one pasture to another in a planned sequence.
    - (b) Plants on pastures being rested (without livestock) will grow and multiply before being grazed again.
    - (c) Rotational grazing will allow some increase in livestock numbers and improve wildlife habitat.
    - (d) Rotational grazing does not insure better wildlife habitat and livestock forage--grass or forage must be adequate to support the livestock numbers regardless of other factors.
  - 5) Rotational grazing advantages
    - (a) Utilize different forages at the time when they are at their peak production, protein content and palatability.
    - (b) Warm-season grasses and legumes are used to supplement cool-season grasses during the hot summer months.
    - (c) Another advantage to wildlife is that warm-season grass pastures are usually not grazed until many of the nests are hatched.

- 6) Grazing heights
  - (a) Warm-season grasses should not be grazed closer than 8 to 12 inches.
  - (b) Cool-season grasses, which don't get as tall, are commonly grazed to within two to four inches.
- d) Haying
  - 1) The peak in quality of warm-season grasses is just after the peak of the hatch in late June or early July, so most of the nests have hatched before hay cutting begins.
  - 2) Haying cool-season grasses and legumes for peak quality often conflicts with nesting wildlife in May or June. Landowners can partially reduce nest destruction by raising the cutting height to four inches.
  - 3) 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.
    - (a) Higher cutting height will miss most of the hens and chicks.
    - (b) Warm-season grasses should not be hayed later than August 1 to allow time for regrowth. Late haying will weaken the stand.
  - 4) Haying dates are more critical for remnant native prairies because it affects yield, quality of forage and the types of plants that persist.
- f) Fertilizing
  - 1) Cool-season grasses do not use soil nutrients as efficiently as native warm-season grasses and require somewhat higher fertility and soil pH.
  - 2) Yield, crude protein and forage digestibility of warm-season grasses can be improved with applications of nitrogen.
  - 3) Health, vigor and productivity of remnant native prairies must be restored through proper management before a favorable response to fertilizer can be expected.
    - (a) Fertilizer can increase hay production, but it can also create weed problems.
    - (b) A late spring burn will reduce competition from cool-season grasses and weeds prior to fertilizing.
- g) Over-seeding with legumes
  - 1) Over-seeding legumes in established grass pastures will usually increase beef production and improve wildlife habitat.
    - (a) Legumes have the capacity to remove nitrogen from the air and place it in the soil where it becomes available for other plants.
    - (b) Legumes improve the forage quality and value for both livestock and wildlife.

- f) Prescribed burning
  - 1) Prescribed burning is a fire used under specific conditions at the appropriate time to achieve a desired result.
  - 2) Fire is recognized as an important management tool for warm-season grass pastures and native prairies if handled properly.
    - (a) Recycles nutrients tied up in old plant growth
    - (b) Decreases build-up of old plant growth
    - (c) Stimulates seed production
    - (d) Controls weeds and woody invasion
    - (e) Reduces wildlife nest predation
    - (f) Increases plant and insect diversity
  - 3) Fire is needed in combination with other management tools.
  - 4) Use fire with great caution.
    - (a) Establish a closely-mowed cool-season grass border around the boundary to act as a firebreak.
    - (b) Don't use fire without a definite plan and good instruction from a trained and experienced expert.
    - (c) A fire at the wrong time can be very costly to both wildlife and forage production.
  - 5) Prescribed burning is not used in cool-season grass management.

#### F. Other activities

1. Missouri Department of Conservation offers a prescribed burn training session for landowners who have warm-season grasses. Agriculture education instructors are invited to attend. For more information contact the local Soil Conservation Service office or MDC wildlife services biologist.
2. Missouri Department of Conservation offers the quarterly Native Warm-Season Grass Newsletter to provide readers with up-to-date information. It is available to Missouri residents on a free subscription basis by writing to: Missouri Department of Conservation, Wildlife Division, P.O. Box 180, Jefferson City, MO 65102-0180. Not available in classroom quantity.
3. Show the "Establishing and Managing Warm-Season Grasses" videotape.
4. Show the "Farming and Wildlife: Prairie Chicken" videotape.
5. Show the "Private Prairie Restoration" videotape.

6. Locate a nearby native prairie and take the students on a plant identification field trip. Invite a MDC representative as a technical expert if you are unfamiliar with prairie plants.
7. Have a local farmer describe how his/her forage management system integrates cool-season with warm-season grasses.

#### G. Conclusion

Wildlife populations increase and decrease according to the quality and quantity of available habitat. Similarly, the success of livestock enterprises also hinges on the quality and quantity of forage crops. With careful planning and management, farmers can boost both forage production and wildlife populations by using warm-season grasses in their forage system. Farmers with native prairies can do the same by using appropriate management practices.

#### H. Competency

Select grassland practices that improve livestock forage and wildlife habitat.

#### I. Answers to Evaluation

1. b
2. b
3. a
4. c
5. a
6. a
7. b
8. a
9. e
10. a



Name \_\_\_\_\_

Date \_\_\_\_\_

### UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

#### Lesson 3: Grassland Management

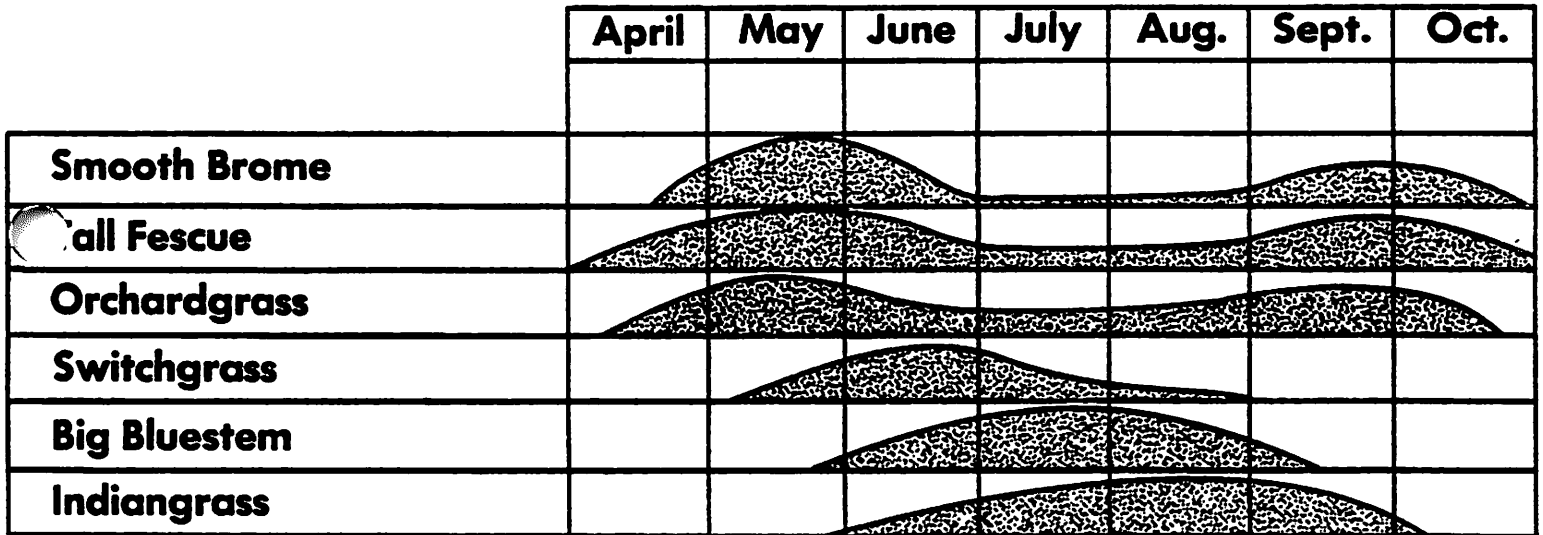
#### EVALUATION

Complete the following statements by circling the letter of the best answer.

1. Cool-season grasses grow best during the \_\_\_\_\_ and \_\_\_\_\_.
  - a. summer and fall
  - b. spring and fall
  - c. spring and summer
  - d. late winter and early spring
  - e. none of the above
  
2. Wildlife prefer grasses which \_\_\_\_\_.
  - a. grow in very dense stands close to the ground.
  - b. grow in less dense stands with upright leaves.
  - c. grow in extremely sparse stands with over 50 percent bare ground.
  - d. have nutritious berries.
  - e. none of the above.
  
3. Warm-season grasses should not be grazed closer than \_\_\_\_\_ inches.
  - a. 8 to 12
  - b. 2 to 4
  - c. 20 to 24
  - d. 30 or more
  - e. none of the above
  
4. In a pasture rotation system, warm-season grasses are used to supplement cool-season grasses during the \_\_\_\_\_.
  - a. winter
  - b. spring
  - c. summer
  - d. fall

5. Warm-season grasses are especially useful to wildlife for \_\_\_\_\_.
- nesting and brood-rearing cover
  - food
  - winter cover
  - maintenance of territories
  - none of the above
6. The peak quality of warm-season grasses is just after the peak of wildlife hatching in \_\_\_\_\_.
- July
  - September
  - May
  - April
  - November
7. Burning a warm-season grass pasture or hayfield should be \_\_\_\_\_.
- stopped
  - done at specific times to benefit wildlife and increase forage production
  - done in August every year
  - done in October every three years
  - done at anytime
8. Cutting hay on native prairies during September will \_\_\_\_\_.
- weaken the prairie plants
  - improve wildlife habitat
  - increase hay production next year
  - reduce the need for fertilizer
  - none of the above
9. Periodically burning a native prairie under proper conditions benefits wildlife by \_\_\_\_\_.
- making nests harder for predators to find
  - improving conditions for animal mobility
  - exposing bare areas for dusting
  - removing excess plant growth
  - all of the above
10. Overgrazing or excessive haying will cause undesirable plants to \_\_\_\_\_.
- increase
  - decrease
  - completely die out
  - retain their existing level of abundance
  - become palatable to livestock

### Pasture Calendar



**GRASSLAND HABITAT APPRAISAL****TEACHING SUGGESTIONS**

This work sheet is based on the Wildlife Habitat Appraisal Guide (WHAG) developed and used by the Missouri Department of Conservation. WHAG is a systematic habitat appraisal system used to evaluate the suitability of existing wildlife habitat and can also be used to make habitat improvement recommendations.

The grassland habitat components important to cottontail rabbits are featured in this activity to help reinforce the concepts presented in the lesson. Impress upon your students that this activity evaluates only the habitat condition of an individual field for one species--the cottontail rabbit. The WHAG forms used by professional biologists are designed to evaluate all habitats on a farm including forest, cropland, old field, wetland and grassland. If you or your students are interested in evaluating the habitat quality on an entire farm for a particular species, contact the local conservation agent or wildlife services biologist for WHAG training.

It is recommended for instructors to complete the work sheet on the selected area before the students. The appraisal system requires a large measure of personal judgment in evaluating individual habitat features. For this reason, the work sheet will not be a reliable testing device. However, it will give a good indication if the students recognize good or bad habitat when they see it. Try to select a site with obvious habitat features which correspond to the items on the work sheet.

Reviewing the completed work sheets with the students at a later classroom session is highly recommended. Place emphasis on the reasons why individual habitat features affect wildlife. For instance, a higher rating was given for a higher percentage of legumes because these plants are a preferred food of the cottontail rabbit. Another example involves the distance to other habitat types such as forest or cropfields. This corresponds to the food and cover interspersation concept discussed in Lesson 1: Habitat Management Principles.

Name

Date

**GRASSLAND HABITAT APPRAISAL**

**TARGET SPECIES: COTTONTAIL RABBIT**

Circle the number which corresponds to your evaluation of each habitat feature. Add your numbers and enter the total at the place indicated at the end of the activity.

a) Extent of edge\*

- 0 No border
- 2 Border circling <25 percent of field
- 6 Border circling 25-50 percent of field
- 8 Border circling 50-75 percent of field
- 10 Border circling >75 percent of field

\*Border refers to woody (brush, windbreaks, hedgerows, etc.) or herbaceous (weeds, grasses, etc.) strips of vegetation between habitat types. The strip must be a minimum of five feet in width to be counted as a border. Estimate the percent of the field surrounded by a border as defined.

b) Estimate the percent of the field that is covered by winter or escape cover including dense brushy areas, brushpiles, fallen logs, etc.

- 1 No cover present
- 5 1-10 percent of the field has winter/escape cover
- 10 More than 10 percent of the field has winter/escape cover or the field is less than 10 acres with a border around 75 percent or more of the edge.

c) Estimate the percent canopy coverage of shrubs and herbaceous vegetation 6 inches to 18 inches tall.\*

- 1 Less than 10 percent or more than 75 percent
- 3 10-25 percent or 50-75 percent
- 5 25-50 percent

\*An area with more than 60 percent coverage will be difficult for quail, rabbits and turkeys to walk through.

d) Estimate how heavily the area is being grazed or hayed.\*

- 1 Heavy use
- 5 Moderate use
- 10 Light use

\*Moderate use is defined as leaving a 3-6 inch over winter height of cool-season grasses and a 8-12 inch over winter height of warm-season grasses. Example: Three cuttings of cool-season grass is heavy use; two cuttings is moderate use; and one cutting is light use under normal moisture conditions.

e) Estimate the percent of ground covered or shaded by both native and introduced legumes.\*

- 1 Less than 5 percent or more than 50 percent
- 5 5-25 percent
- 10 25-50 percent

\*Legumes are an important food plant group and include alfalfa, clovers, tick trefoils, Korean lespedeza, etc.

f) Rank the pasture/hayland habitat to the closest description.\*

- 1 Fescue (more than 50 percent fescue)
- 4 Native grass or bluegrass
- 6 Mixed warm-season grasses and herbaceous plants
- 8 Cool and warm-season grasses
- 10 Mixed cool-season grasses or predominantly legumes

\*Any mixture of both cool-season grass(es) and legume(s) would be rated in the category, "Mixed Cool-Season Grasses or Predominantly Legumes."

g) Estimate the distance from the center of the pasture-hayfield to the edge of the nearest cropfield.

- 1 Over 500 feet to cropfield or any distance to a cropfield which has been fall moldboard plowed
- 4 250-500 feet to chiseled or disced cropfield
- 6 Less than 250 feet to chiseled or disced cropfield
- 8 250-500 feet to cropfield with no fall tillage or with a crop of winter wheat
- 10 Less than 250 feet to cropfield with no fall tillage or with a crop of winter wheat

h) Field Size (circle the percent of field within 250 feet of dense woody cover or ungrazed woodland).

- 1 0-25 percent
- 4 25 to 50 percent
- 6 50-75 percent
- 10 75 to 100 percent

\_\_\_\_\_ TOTAL SCORE

75 MAXIMUM POINTS POSSIBLE

$$\frac{\text{TOTAL SCORE}}{\text{MAXIMUM POINTS POSSIBLE}} = \frac{\quad}{75} =$$

Circle the score you calculated and the corresponding rating.

	Score	0.75-1.0	0.50-0.75	0.25-0.50	0-0.25
Habitat Quality	Rating	Excellent	Good	Fair	Poor

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 4: Forest Management

Objective: The student will assess how forest management can be used to improve wildlife habitat.

#### Study Questions

1. How does livestock grazing affect the overall health of a forest and wildlife habitat?
2. How can a landowner improve forest edge?
3. How can timber stand improvement be planned to improve wildlife habitat?
4. Why are snag and den trees important to wildlife?
5. What impact does timber harvesting have on wildlife habitat?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Wildlife Management Handbook for Landowners. Missouri Department of Conservation, 1991.
3. Missouri Department of Conservation: Timber and Wildlife Benefits on Private Land Series.
  - a) #2 - Forest Edge Wildlife Habitat
  - b) #5 - Snag and Den Tree Management
  - c) #6 - Cut Firewood and Improve Wildlife Habitat
  - d) #7 - Timber Sales and Wildlife in Missouri
  - e) #10 - Woodland Protection and Wildlife Management
  - f) #11 - Timber Stand Improvement
4. Work Sheet
  - a) WS 4.1: Forest Habitat Appraisal



## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 4: Forest Management

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson.

##### B. Motivation

Ask the students why some woodlands provide income from timber sales along with plenty of hunting opportunities and others seem to be a liability. Point out that trees and wildlife respond to good management techniques just like agricultural crops such as corn, soybeans or forages. To emphasize this point, ask the students what their corn or soybean fields would yield if hogs were allowed to roam over them. Similarly, a forest is damaged if livestock grazing is permitted.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to describe the effects of grazing livestock on forest land.

**How does livestock grazing affect the overall health of a forest and wildlife habitat?**

- a) 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.
- b) Grazing damage to woodlands can take on many forms including damage to the trees, and increased soil erosion and compaction.
  - 1) Young trees representing the whole next generation are eaten and destroyed.
  - 2) Large trees suffer wounds from rubbing and the chipping of sharp hooves at the base of the trees.
  - 3) Livestock trample the leaf litter layer until bare soil is exposed. Soil erosion exposes large roots to the damaging action of hooves.
  - 4) Soil becomes compacted and decreases the amount of air and water in the soil. Trees become weakened.

- 5) As trees are harvested or die of old age, there are not any young trees to take their place. Tree species more resistant to grazing will increase in number.
- c) Wildlife habitat is damaged by grazing livestock on forest land.
  - 1) Wildlife food and cover disappears when livestock consume and destroy forest trees and plants.
    - (a) A "browse line" appears when vegetation is consumed from ground level to as high as grazing animals can reach.
    - (b) Livestock grazing disrupts ecological succession by removing tree seedlings and decreases habitat diversity by eliminating the forest understory.
    - (c) The lack of habitat diversity limits the number and species of wildlife that can survive.
  - 2) Food chains are affected by grazing. Besides eliminating plants which produce food for wildlife, livestock competes directly with wildlife by eating the food that remains.
    - (a) Livestock eat acorns - the most preferred winter food of wild turkeys and eaten by a wide variety of wildlife species.
    - (b) Livestock diminishes the ability of oak trees to produce acorns through their grazing and trampling.
  - 3) Wildlife, and the overall health of a forest, will be much improved if all types of livestock are excluded at all times.
    - (a) Substantial damage to wildlife habitat will usually occur long before obvious signs of land abuse show up.
    - (b) Even grazing livestock in a forest for a short duration will damage wildlife habitat and future timber production.

2. Ask the student to explain why "edge" is important to wildlife. Point out that landowners determine how much edge exists on their land.

**How can a landowner improve forest edge?**

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

- b) Quality of edge is measured by how gradually the transition between vegetation cover types occurs.
    - 1) Most transitions in Missouri are abrupt changes from forest to fields. This is low quality edge.
    - 2) Gradual transitions with a wider border of grasses, weeds, shrubs, vines and small trees will improve the edge effect by placing more successional stages close together.
    - 3) Wildlife will find more kinds of food and cover in an edge with a gradual transition.
  - c) High quality forest edge can be created by:
    - 1) Planting small trees or shrubs within at least (preferably wider) strip of the forest edge.
    - 2) Allow the border to naturally revert back to native plants.
    - 3) Remove or deaden large trees within at least a 30-foot strip of the forest border leaving some of the trees as standing snags.
    - 4) Cut some of the trees low to encourage sprouting at ground level.
  - d) Edge is not always at the border of forest and fields.
    - 1) Ungrazed openings or clearings of one to three acres within a large forest provide edge.
    - 2) Five to ten acres of small clearings per 100 acres of forest is desirable, depending on the distribution of other open lands. Smaller woodlots surrounded by pastures and crop fields usually do not need small clearings.
    - 3) Logging roads, utility right-of-ways, log landings or small clearcuts can provide open space in large forest areas.
3. Ask the students if they have experience in weeding a garden. Point out that timber stand improvement is the process of "weeding" the forest.

**How can timber stand improvement be planned to improve wildlife habitat?**

- a) 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.
  - 1) Unmanaged timber stands frequently become too crowded for optimum timber production.
  - 2) TSI reduces competition in a stand and allows the landowner to decide which trees should be kept.
  - 3) TSI has a definite impact on wildlife by altering the vegetation.
- b) TSI must be carefully planned to achieve both increased timber production and higher quality wildlife habitat.

- 1) Tree spacing
    - (a) Trees left too close together will soon become crowded.
    - (b) Leaving trees too far apart wastes growing space and encourages remaining trees to grow larger crowns at the expense of taller, straighter trunks.
    - (c) A good rule of thumb is to estimate the average diameter of a tree at four and a half feet above ground. Multiply that figure by two to arrive at the optimum distance between a tree and its nearest competitor (in feet).
  - 2) Wildlife considerations
    - (a) Wildlife is benefited by a diversity of tree sizes and species. A variety of tree species provides the greatest chance for some wildlife food each year.
    - (b) Occasionally leave oaks with large, spreading crowns even though they are inefficient timber producers. They produce more acorns for wildlife.
    - (c) Leave trees such as hickory, walnut, pecan, blackgum and eastern red cedar to provide additional wildlife food.
    - (d) Trees riddled with cavities and standing snags have no commercial value, but are extremely valuable for wildlife. Some should be left for wildlife.
4. Ask the students to make a list of wildlife species in Missouri which use snags and den trees. Point out that 89 Missouri species use snags and den trees for nesting, feeding and shelter.

**Why are snag and den trees important to wildlife?**

- a) A snag is a standing dead tree and a den tree is a live tree with a hollow cavity in the trunk or limbs. Both types of trees provide essential food and cover for many species of wildlife.
  - 1) In Missouri, 89 wildlife species require snags and den trees for nesting, feeding and shelter.
  - 2) An additional 66 species depend on fallen woody material such as brushpiles, rotting logs and limbs.
  - 3) Snags, den trees and fallen woody material provide essential habitat for 30 percent of Missouri's wildlife species.
  - 4) Birds, mammals and reptiles use tree cavities.

- b) 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.
- 1) White oak, post oak, and other members of the white oak group make the best den trees because they are long lived.
  - 2) Black and red oaks, hickory, American elm, sugar maple, American sycamore, eastern cottonwood, blackgum, ash and basswood also make excellent den trees.
5. Ask the students to describe the impression they had of timber harvesting operations they have witnessed. Draw upon their response to point out that all timber harvesting operations are not the same. Some are poorly executed and others actually improve the forest in the long run.

**What impact does timber harvesting have on wildlife habitat?**

- a) The improvement of wildlife habitat can be compatible with growing and harvesting trees for a profit. Timber harvesting is often an economical method for improving wildlife habitat.
- b) Uneven-age timber management
  - 1) This timber management system attempts to keep a near equal balance of tree sizes from saplings to sawlogs intermingled throughout the forest.
    - (a) Partial or selective timber harvests at short intervals are possible.
    - (b) Generally benefits wildlife by maintaining a diversity of tree species and sizes.
  - 2) Wildlife sometimes suffers with uneven-age timber management if precautions are not taken.
    - (a) A period of greatly-reduced nut production can result when larger trees are harvested. The remaining smaller trees bear little, if any, fruit. Foods for wildlife can be assured by leaving an occasional good nut-producing group of trees.
    - (b) Small trees and plants in the forest understory also provide wildlife food. Examples are: dogwood; huckleberry; spicebush; sumac; coralberry; blackhaw; serviceberry; etc. Protect them during timber harvesting operations.
    - (c) Browse is a combination of plants, weeds, grasses, woody vines and shrubs found on or near the forest floor. It plays a vital role in the diets of many wildlife species.

Uneven-age timber management may result in a shortage of browse because the tree canopy is rarely opened up.

- c) Even-age timber management
  - 1) Even-age timber management involves timber stands with all trees near the same age. Used on large tracts of timber and is compatible with both timber production and wildlife.
  - 2) Clearcutting of small stands (2 to 20 acres) for regeneration is the most common harvesting technique.
    - (a) Clearcutting can produce excellent wildlife habitat if properly planned.
    - (b) 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.
  - 3) Wildlife considerations in even-age timber management.
    - (a) Clearcuts are most beneficial to wildlife when they are small in size (1 to 15 acres).
    - (b) Clearcuts should be irregular in shape and fitted to the landscape to increase edge and visual attractiveness.
    - (c) Scatter clearcuts throughout a larger timber tract for better dispersion of wildlife food and cover.
    - (d) Leave snags and dead trees along the edges within the clearcuts.
    - (e) Leave a strip of natural vegetation on both sides of streams flowing through clearcuts.

#### F. Other activities

1. Tour a nearby forest area to demonstrate the planning associated with a timber stand improvement. Ask a MDC representative to show what trees should be cut and left - and the reasons why.
2. Tour a nearby forest area which has had a recent timber harvest. Select an area where you can present both the pros and cons of timber harvesting. Ask a MDC representative to attend for further explanation.
3. Have the student take photographs of "browse lines" on grazed forests.
4. Take the students on a tree identification exercise in the schoolyard or nearby forest area.

## G. Conclusion

The forested areas on Missouri farms provide valuable wildlife habitat, but have the potential for providing even more. Protection from grazing, timber stand improvement, forest edge improvement and well-planned timber harvests are tools landowners can use to improve timber production and wildlife. A forest with healthy wildlife populations does not have to be treated as a nature preserve. Simply integrating wildlife considerations into the overall forest management plan will improve wildlife habitat.

## H. Competency

Assess how forest management can be used to improve wildlife habitat.

## I. Answers to Evaluation

1. b
2. e
3. b
4. b
5. a
6. b
7. a
8. e
9. b
10. b

Name \_\_\_\_\_

Date \_\_\_\_\_

UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

Lesson 4: Forest Management

EVALUATION

Complete the following statements by circling the letter of the best answer.

1. Grazing livestock in a forest \_\_\_\_\_ wildlife habitat and the overall health of the forest.
  - a. improves
  - b. damages
  - c. has no effect on
  - d. diversifies
  - e. none of the above
  
2. A characteristic of high quality edge is \_\_\_\_\_.
  - a. a gradual transition of cover types
  - b. placing several successional stages close together
  - c. habitat diversity
  - d. good interspersions of cover types
  - e. all of the above
  
3. Livestock should be excluded from forest areas \_\_\_\_\_.
  - a. during the spring
  - b. at all times
  - c. at two year intervals
  - d. through spring, summer and fall
  - e. when the ground is frozen
  
4. Timber stand improvement involves \_\_\_\_\_ the forest.
  - a. fertilizing
  - b. "weeding"
  - c. planting
  - d. burning
  - e. all of the above



5. Forests with a good mix of tree species and sizes generally support more wildlife because of \_\_\_\_\_.
- habitat diversity
  - ecological succession
  - soil type
  - the rapid tree growth rate
  - none of the above
6. In Missouri, \_\_\_\_\_ wildlife species require snag and den trees for nesting, feeding and shelter.
- 155
  - 89
  - 25
  - 17
  - only 2
7. Snags, den trees and fallen woody material provide essential habitat for \_\_\_\_\_ percent of Missouri's wildlife species.
- 30
  - 10
  - 5
  - 60
  - 99
8. Uneven-age forest management may reduce \_\_\_\_\_ if precautions are not taken.
- nut production
  - browse
  - forest understory
  - wildlife habitat
  - all of the above
9. Clearcuts are most beneficial to wildlife when they are \_\_\_\_\_ acres in size.
- 50 to 100
  - 1 to 15
  - 25 to 50
  - 150 to 200
  - 1,000
10. Scattering small clearcuts through a large timber tract will \_\_\_\_\_.
- damage wildlife habitat
  - increase dispersion of wildlife food and cover
  - create soil erosion
  - have no effect on wildlife
  - none of the above

## FOREST HABITAT APPRAISAL

## TEACHING SUGGESTIONS

This work sheet is based on the Wildlife Habitat Appraisal Guide (WHAG) developed and used by the Missouri Department of Conservation. WHAG is a systematic habitat appraisal system used to evaluate the suitability of existing wildlife habitat and can also be used to make habitat improvement recommendations.

The forest habitat components important to wild turkeys are featured in this activity to help reinforce the concepts presented in the lesson. Impress upon your students that this activity evaluates only the habitat condition of an individual field for one species--the eastern wild turkey. The WHAG forms used by professional biologists are designed to evaluate all habitats on a farm including forest, cropland, old field, wetland and grassland. If you or your students are interested in evaluating the habitat quality on an entire farm for a particular species, contact the local conservation agent or wildlife services biologist for WHAG training.

It is recommended for instructors to complete the work sheet on the selected area before the students. The appraisal system requires a large measure of personal judgment in evaluating individual habitat features. For this reason, the work sheet will not be a reliable testing device. However, it will give a good indication if the students recognize good or bad habitat when they see it. Try to select a site with obvious habitat features which correspond to the items on the work sheet.

Reviewing the completed work sheets with the students at a later classroom session is highly recommended. Place emphasis on the reasons why individual habitat features affect wildlife. For instance, a higher rating is given when the edge of a forest has a border of brush, weeds or grasses. This relates back to the concept of "edge" presented in previous lessons. The importance of reliable food sources is shown by the higher rating received by a forest with equally mixed white and black oaks (consistent acorn production is more likely with a good mix of different oak species).

WS 4.1

Name \_\_\_\_\_

Date \_\_\_\_\_

**FOREST HABITAT APPRAISAL**

**TARGET SPECIES: EASTERN WILD TURKEY**

Circle the number which corresponds to your evaluation of each habitat feature. Add your numbers and enter the total at the place indicated at the end of the activity.

a) Extent of edge\*

- 0 No border
- 2 Border circling <25 percent of woodlot
- 6 Border circling 25-50 percent of woodlot
- 8 Border circling 50-75 percent of woodlot
- 10 Border circling >75 percent of woodlot

\*Border refers to woody (brush, windbreaks, hedgerow, etc.) or herbaceous (weeds, grasses, etc.) strips of vegetation between habitat types. The strip must be minimum of five feet in width to be counted as a border. Estimate the percent of the field surrounded by a border as defined.

b) Estimate the percent canopy coverage of shrubs and herbaceous vegetation 6 inches to 18 inches tall.

- 1 Less than 10 percent or more than 75 percent
- 3 10-25 percent or 50-75 percent
- 5 25-50 percent

c) Estimate woodland size class and canopy coverage\*

- 1 Reproduction
- 3 Pole--closed canopy
- 5 Pole--open canopy
- 8 Sawtimber--closed canopy (more than 50 percent coverage)
- 10 Sawtimber--open canopy (less than 50 percent coverage)

**\*Size class** is defined as the diameter at breast height (DBH) category in which 50 percent or more of the trees occur. Size classes are: (1) Sawtimber: Greater than 9" DBH; (2) Pole: 2" to 9" DBH; and (3) Reproduction: 0" to 2" DBH.

**\*Canopy coverage** is defined as the degree to which foliage and branches of the forest overstory prevent sunlight from reaching the forest floor. An open canopy is one having less than 50 percent coverage and a closed canopy is one with greater than 50 percent coverage.

- d) Estimate the percentage of white and black oaks in the forest overstory.
- 1 Species other than oaks are dominant (less than 50 percent oaks)
  - 4 More than 75 percent of trees are in the white oak group
  - 7 More than 75 percent of trees are in the black oak group
  - 10 Equally mixed white and black oaks
- e) Estimate the percent of the forest area occupied by openings or clearings having 0 to 10 percent canopy coverage.\*
- 1 Less than 5 percent or more than 45 percent
  - 3 5-10 percent or 30-45 percent
  - 5 10-30 percent
- \*Score 5 points for woodlands less than 40 acres in size because openings are not required in small wooded tracts to enhance food and cover.**
- f) Estimate the amount of livestock grazing the area has been subjected to within the past year.
- 1 Heavy grazing
  - 1 Light to moderate grazing
  - 10 No grazing
- g) Estimate the distance from the center of the woodland to the edge of the nearest hayfield or pasture.
- 1 Over 1 mile to a heavily used pasture or hayfield
  - 3 1/2 to 1 mile distance to pasture or hayfield with moderate use
  - 5 Less than a 1/2 mile to a lightly used pasture or hayfield with a good mix of different plant species

h) Estimate the distance from the center of the woodland to the edge of the nearest cropfield.

- 1 More than 1 mile to a cropfield or all nearby cropfields have been moldboard plowed in the fall.  
a crop of winter wheat
- 4 1/2-1 mile to a cropfield which has been fall disced or chiseled
- 6 Less than 1/2 mile to a cropfield which has been fall disced or chiseled
- 8 1/2-1 mile to a cropfield with no fall tillage or a crop of winter wheat
- 10 Less than 1/2 mile to a cropfield with no fall tillage or a crop of winter wheat

\_\_\_\_\_ TOTAL SCORE

\_\_\_\_\_ 65 MAXIMUM POINTS POSSIBLE

$$\frac{\text{TOTAL SCORE}}{\text{MAXIMUM POINTS POSSIBLE}} = \frac{\quad}{65} =$$

Circle the score you calculated and the corresponding rating.

	Score	0.75-1.0	0.50-0.75	0.25-0.50	0-0.25
Habitat Quality	Rating	Excellent	Good	Fair	Poor

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 5: Introduction to Wetlands

Objective: The student will define and describe wetlands and their importance.

#### Study Questions

1. What is a wetland?
2. How have humans treated wetlands?
3. What benefits do wetlands provide?
4. What are the five general types of wetland vegetation?
5. What federal law have been passed to protect wetlands?
6. What are the basic requirements to construct a wetland?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Wildlife Management Handbook for Landowners. Missouri Department of Conservation, 1991.
3. Reid, George K.; Herbert S. Zim. Pond Life. New York, N.Y.: Western Publishing, Inc., 1967.
4. "Toads and Frogs of Missouri" poster (20 species). Missouri Department of Conservation.
5. Audiovisuals available on loan from the Missouri Department of Conservation, Media Library, P.O. Box 180, Jefferson City, MO 65102-0180.
  - a) "This is the Mallard" videotape (44 minutes)
  - b) "Waterfowl for the Future" videotape (16 minutes)
  - c) "The Wealth in Wetlands" videotape (23 minutes)

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 5: Introduction to Wetlands

#### TEACHING PROCEDURES

##### A. Review

Review previous lesson.

##### B. Motivation

Ask the students how they envision a wetland. Point out that the term "wetland" is a broad definition covering a wide range of habitats. Give reference to the swampbuster provisions of the Food Security Act of 1985 as a personal, economic motivation.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Point out local examples of wetlands. Try to include different types of wetlands.

#### What is a wetland?

- a) The term "wetland" refers to a broad range of different types of habitats including swamps, sloughs, marshes, rivers, ponds, lakes, seeps, potholes and bottomland forests.
  - 1) All wetlands have soils which are saturated or covered with water, at least periodically.
  - 2) Wetlands support water-loving vegetation which can be either terrestrial or aquatic.
- b) Water determines the nature of soil development and the type of plant and animal communities able to exist.
  - 1) The timing of soil saturation and the amount and source of water covering the soil determines the kind of wetland.
  - 2) Wetlands have many different appearances.

2. Ask the students if they have ever witnessed the drainage of a wet area in a crop field, pasture or bottomland forest. Explain that many wetlands have been destroyed in the past and are still being destroyed today.

**How have humans treated wetlands?**

- a) Natural wetlands have been destroyed at an alarming rate over the last 50 years.
  - 1) Recent surveys indicate that nearly half of the 127 million acres of original wetlands in the U.S. have been lost as a result of draining or filling.
  - 2) According to the U.S. Fish and Wildlife Service, 1200 acres of wetland are still being lost in the U.S. every day.
  - 3) Of the original 2.4 million acres of forested lowlands in southeast Missouri, less than 60,000 acres, or two percent, remain today.
3. Ask the students if wetlands have any value. Categorize their responses into economic, recreational, ecological, etc.

**What benefits do wetlands provide?**

- a) Wildlife
  - 1) Nearly 45 million ducks depend on wetlands scattered across the U.S. and Canada for their existence.
  - 2) Wetlands provide habitat for shorebirds, represented in Missouri by more than 40 migrant species. Examples are dowitchers, sandpipers and yellowlegs.
  - 3) Over 200 species of fish live in Missouri's lakes, streams, ponds, river and other wetland areas. Approximately 1.3 million Missourians fish every year.
  - 4) Wetland areas provide essential habitat to some of the 107 species of amphibians and reptiles living in Missouri.
  - 5) Wetlands constitute the principal habitat for producing furbearing animals. Missouri's fur resources produced an average of \$6.5 million annually from 1978 to 1983.
- b) Timber
  - 1) In Missouri's Bootheel, wetlands can support baldcypress, tupelo and sweetgum. These trees are valuable.
  - 2) Pin oak and pecan are important wetland trees occurring in bottomland forests over a large part of the state. These species, and others, have value as lumber.



- c) Water quality
    - 1) Wetlands improve water quality by decreasing the level of soluble nutrients in water flowing through them.
      - (a) This process is accomplished when plants take up pollutants, store them and then use them as nutrients.
      - (b) Wetland plants store excess nitrogen and phosphorus frequently caused by agricultural activities. When the plants die, the chemicals are released slowly.
    - 2) Wetlands improve water quality by acting as settling basins for upland runoff.
      - (a) The low gradient and thick vegetation of most wetlands slow the flow of water which causes suspended soil particles to settle out.
      - (b) Wetlands slowly release water into adjacent streams and underground supplies.
    - 3) The filtering action of wetlands may prematurely change them when runoff water has a heavy silt load from soil erosion in the watershed.
      - (a) Ecological succession is accelerated by soil deposition.
      - (b) Drier, terrestrial habitat will evolve.
  - d) Flood control
    - 1) Some types of wetlands function as gigantic sponges.
    - 2) Some types of wetlands hold runoff water and release it slowly. This reduces the total amount of water entering lower watersheds and therefore, reduces flood risk.
4. Emphasize that water has dramatic influences on what a wetland looks like. Even small differences in duration of flooding or depth of standing water alters the wetland vegetation.

**What are the five general types of wetland vegetation?**

- a) Water is the single most important physical factor affecting wetland plants and animals.
  - 1) The length of time and depth of water standing on a wetland area determines the plants and animals able to inhabit the area.
  - 2) Water and vegetation also have a strong influence on soil development.
- b) Wetlands have a wide range of plants. Various groups of plants have evolved different strategies for living in different wetland conditions.
  - 1) Emergent plants grow with their roots in wet soil or water during part or all of their life.

- (a) Examples are cattail, prairie cordgrass, arrowhead, sedges, rice cutgrass and hardstem bulrush.
  - (b) Trees adapted to wetland conditions are also included in this group. Bald cypress and tupelo can grow in standing water. Pin oak, river birch and pecan are examples of trees which prefer moist bottomland areas.
  - 2) Floating-leaf plants are rooted in deeper water that tend to send up broad, floating leaves to the water surface.
    - (a) Nutrients move between leaves and massive tubers by flexible and slender stems that may be five or six feet long.
    - (b) Water lily is a floating-leaf plant. Such plants can grow in much deeper water than emergents and can better tolerate fluctuating water levels.
  - 3) Submergent plants are generally rooted to the bottom but have their stems and leaves underwater. Examples are pondweed, coontail and water milfoil.
  - 4) Free floating plants are not rooted in the soil and usually remain on the surface of the water.
    - (a) These plants have dangling roots that collect nutrients from the water.
    - (b) Examples are duckweed and water hyacinth.
  - 5) Algae
    - (a) Pond scums and green hairy growths on submerged objects are the most obvious forms of algae.
    - (b) Algae are primitive, single-celled plants without true stems, leaves or roots.
    - (c) Algae are found in all natural waters under an incredible range of physical conditions. They are the chief producers of oxygen in natural waters.
    - (d) The three types of algae are: planktonic; filamentous; and macrophytic.
5. Ask the students if they are aware of any government regulations prohibiting the destruction of wetlands. Point out that this responsibility rests with the federal government.

**What federal laws have been passed to protect wetlands?**

- a) River and Harbors Act of 1899
  - 1) Established a U.S. Army Corps of Engineers permit system for any construction involving dredging, filling or obstructing of navigable waters.

- 2) The law was much improved by a revision in 1968 which included the evaluation of other factors such as the impact on fish, wildlife, pollution and esthetics.
  - b) Federal Water Pollution Control Act (Clean Water Act) of 1972.
    - 1) Extended the Corps' regulatory jurisdiction over all waters of the U.S.
    - 2) Environmental Protection Agency was included as a partner to the Corp in wetland protection.
  - c) Food Security Act of 1985 (Swampbuster Provision)
    - 1) The swampbuster provision is aimed at discouraging the conversion of wetland areas for agricultural purposes.
      - (a) The U.S. Department of Agriculture is directed to deny program benefits to farmers who convert wetlands to cropland use.
      - (b) Farmers who participate heavily in USDA programs will potentially lose thousands of dollars if they violate the swampbuster provision.
    - 2) Farmers need to recognize the wetlands they have and understand the law.
      - (a) Wetlands are broadly defined under the swampbuster provisions 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."
      - (b) For more information, contact your local SCS or ASCS office.
6. Ask the students if wetlands have to be naturally created to be of value. Point out that landowners can construct their own wetlands and with careful management, will be equal to a natural wetland.

**What are the basic requirements to construct a wetland?**

- a) Many areas in Missouri have the potential for development into productive wetland communities.
  - 1) Small wetland areas are possible without affecting existing farm operations.
  - 2) Wetland areas can be constructed with minimal cost if site conditions are favorable.
- b) Requirements for wetland construction
  - 1) Water supply is the most important element.
    - (a) Adequate water source must be nearby to flood the area.
    - (b) Water source may be a pond, lake, stream, river or well.

- 2) The wetland site must have a tight soil capable of holding water.
  - 3) Low-profile levees need to be constructed around the perimeter of the proposed wetland area so water can be retained.
- c) The fundamental requirement is constructing a system of water control.

#### F. Other activities

1. Invite your local SCS district conservationist to give presentation on the swampbuster provisions of the 1985 Food Security Act. Ask him/her to include examples of typical wetlands occurring in the county.
2. Schedule a field trip to a nearby pond which has a heavy growth of wetland vegetation (algae, emergents, submergents, etc.) Take along rakes and other tools to collect a sample. Identify the plants as to what group they are in and species. Ask a MDC representative to attend for further explanation.
3. Tour a marsh or swamp with interpretive facilities if one exists nearby.
4. Select a past or present example of wetland destruction in the vicinity and give the background history. Separate the students into groups and arrange for a structured debate. One group should be for leaving the wetland alone, another group should be for converting the area to another land use and the third group should function as negotiators who make the final decision.

#### G. Conclusion

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 provide recreational benefits such as fishing, hunting, trapping, swimming, boating, etc.

The key element in wetland destruction is economics. Many times, the conversion of a wetland to another land use is profitable for the landowner, but damaging to society in terms of more downstream flooding, reduced groundwater and polluted surface water. This is the primary reason why the federal government has passed laws to partially protect wetlands.

#### H. Competency

Define and describe wetlands and their importance.

I. Answers to Evaluation

1. b
2. c
3. a
4. e
5. a
6. a
7. c
8. b
9. a
10. a

Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES**

**Lesson 5: Introduction to Wetlands**

**EVALUATION**

**Circle the letter that corresponds to the best answer.**

1. According to the U.S. Fish and Wildlife Service, \_\_\_\_\_ acres of wetlands are being lost in the U.S. every day.
  - a. 300
  - b. 1,200
  - c. 10,000
  - d. 75,000
  - e. 125,000
  
2. By definition, wetlands always have \_\_\_\_\_.
  - a. standing water
  - b. cattails
  - c. soils which are saturated or covered with water, at least periodically.
  - d. trees
  - e. fish
  
3. \_\_\_\_\_ is the most important physical factor affecting the vegetation a wetland will support.
  - a. Water
  - b. Soil fertility
  - c. Soil depth
  - d. Wildlife
  - e. none of the above
  
4. \_\_\_\_\_ are classified as wetlands.
  - a. Ponds and lakes
  - b. Marshes and swamps
  - c. Streams, rivers and sloughs
  - d. Bottomland forests
  - e. All of the above

5. Wetland plants usually \_\_\_\_\_ pollutants and sediment in water.
- decrease
  - increase
  - have no effect on
  - completely remove
  - none of the above
6. Emergent plants grow with \_\_\_\_\_
- their roots in wet soil or water during part or all of their life
  - their roots extending to deeper water
  - their leaves and stems underwater
  - no roots
  - none of the above
7. \_\_\_\_\_ are the chief producer of oxygen in natural waters.
- Emergent plants
  - Fish
  - Algae
  - Trees
  - none of the above
8. The swampbuster provision of the 1985 Food Security Act is aimed at \_\_\_\_\_.
- stopping all wetland destruction.
  - discouraging the conversion of wetlands for agricultural purposes.
  - improving all existing wetlands.
  - draining wetlands for future crop production.
  - creating more federal wildlife refuges
9. \_\_\_\_\_ is in charge of enforcing "swampbuster."
- U.S. Department of Agriculture
  - Missouri Department of Conservation
  - Army Corps of Engineers
  - Environmental Protection Agency
  - National Guard
10. \_\_\_\_\_ is the most important element for a man-made wetland area.
- An adequate water source
  - A system of low-profile levees
  - A water control structure
  - Sandy soil
  - None of the above

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 6: Stream Conservation

Objective: The student will describe stream behavior and how it affects fish and wildlife habitat.

#### Study Questions

1. What is a watershed?
2. How do streams adjust to environmental changes?
3. How does channelization affect a stream?
4. What are important components of fish and wildlife habitat in streams?
5. How does stream channelization affect fish and wildlife?
6. How can a landowner improve a stream?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Missouri Department of Conservation: Timber and Wildlife Benefits on Private Land Series
  - a) #3 - Trees Along Streams
3. "Missouri Stream Life" poster. Missouri Department of Conservation.
4. Transparency Master
  - a) TM 6.1: Status of Alterations of Missouri's Major Streams
5. Work Sheet
  - a) WS 6.1: Stream Habitat Assessment Device
  - b) WS 6.2: Estimating Stream Velocity
6. Audiovisuals available on loan from the Missouri Department of Conservation, Media Library, P.O. Box 180, Jefferson City, MO 65102-0180
  - a) "Stream Sense" videotape (19 minutes)
  - b) "Downstream" videotape (30 minutes)



## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 6: Stream Conservation

#### TEACHING PROCEDURES

##### A. Introduction

Review previous lesson.

##### B. Motivation

Ask the students if they have witnessed serious streambank erosion or other stream-related problems. Respond to their answers by asking them why these problems occur. Point out that many stream-related "problems" are caused by land use practices and human alteration of streams.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students where water in the Missouri River originated. Point out that some of the water comes from as far away as eastern Montana and southern Canada. Explain that a watershed is defined as the surface area draining to a particular point. The watersheds of particular streams and rivers become larger as you travel downstream. For instance, the Missouri River has a larger watershed at St. Louis than at Kansas City.

#### What is a watershed?

- a) 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.
- b) The quality and quantity of surface water at a particular point depends on the condition of the watershed.
  - 1) Misuse of livestock wastes and/or pesticides in a river, stream, lake or pond watershed causes 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 with 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.
  - c) Ponds, rivers, streams and other water bodies are only as healthy as their watersheds.
2. Ask the students why streams suddenly erode their banks or change course. Point out that these are usually symptoms of larger problems.

**How do streams adjust to environmental changes?**

- a) Streams are delicately balanced mechanisms which continually adjust to environmental conditions within their watersheds.
- b) Streams are in a constant state of change to compensate for changes in water flow rate or sediment load.
  - 1) Erode their banks
  - 2) Deepen or fill in their channels
- c) One characteristic of a well-balanced stream is a relatively constant streambed elevation which can be disrupted by many factors. Streams must adjust to the quality and quantity of water entering them.
  - 1) Increased runoff created by extensive urbanization causes a stream to enlarge its channel due to bed scour and bank erosion.
    - (a) Streambed acts as a foundation for its banks.
    - (b) The upper bank will not have support and slough off into the stream when the bed scours out.
  - 2) Streams will adjust to an increase in sediment load.
    - (a) When a stream is not able to carry its sediment load, material will be deposited.
    - (b) The streambed will rise and reduce the size of the channel.
    - (c) The stream will enlarge its channel by scouring out the bed or eroding the banks.
- d) Good soil conservation practices can play major role in controlling local runoff.
  - 1) When widely used, soil conservation practices can change streamflow by reducing erosion and increasing the amount of rainfall infiltrating the soil.
  - 2) Peak floods and sediment loads will be reduced and thereby reduce bank erosion and bed scouring.

3. Ask the students if they have seen a stream which has been straightened with a large portion of the natural vegetation removed from its banks. Point out that this is an example of channelization.

**How does channelization affect a stream?**

- a) Sometimes landowners attempt to solve a stream-related problem through channelization.
- 1) Channelization is the modification of stream channels for the purpose of flood control, land drainage, navigation and the prevention of erosion.
  - 2) Channeling usually consists of using a drag line to straighten, deepen and clear stream beds.
  - 3) In Missouri, more than 4,981 miles of stream have been channelized and more than 2,527 miles of streams have been eliminated (TM 6.1).
- b) Channelization of natural streams creates more problems than it solves.
- 1) Streamflow velocity increases in the channelized section due to a steeper gradient and no obstructions to break the current.
    - (a) Increased water velocity scours and deepens streambeds.
    - (b) Banks slough off
    - (c) Channel becomes deeper and wider than it was before channelization
  - 2) Adverse effects of channelization may travel far beyond the exact section of the stream where it was done.
    - (a) Lowering of the streambed advances upstream until the entire stream network is affected
    - (b) "Headcutting" process continues beyond the stream channels. New gullies may be created in crop fields, pastures, etc.
    - (c) Channelization frequently decreases flooding within the channelized section, but intensifies flooding downstream.
    - (d) Groundwater levels may be lowered which reduces natural stream recharge and may destroy nearby wetlands.
  - 3) Riparian vegetation is the wide variety of trees, shrubs and other plants which grow along stream banks.
    - (a) The stream and its associated riparian vegetation are dependent on one another for survival.
    - (b) Riparian vegetation protects stream banks from erosion and removes sediment from runoff water.

- (c) Common riparian trees in Missouri are cottonwood, sycamore, silver maple, willow, river birch and hackberry.
  - (d) Riparian vegetation is often destroyed during channelization activities.
4. Ask the students if the basic ecological concepts (i.e. food chain, edge, diversity) presented in Lesson 1 apply to stream habitats. Point out that stream habitat follows the same rules, but habitat components look different.

**What are important components of fish and wildlife habitat in streams?**

- a) Pools are the major stream habitat of most fish.
  - 1) Deep, slow-velocity pools with large amounts of overhanging vegetation can support the highest and most stable fish populations.
  - 2) Small pools with shallow water are needed by young fish as brooding areas.
- b) Riffles are characterized by shallow water depth, rapid water velocity and usually a gravel bottom.
  - 1) In many streams, riffles produce most of the fishes' aquatic food.
  - 2) Nearly all fish living in Missouri streams prefer a gravel streambed as a nesting site.
  - 3) Riffles are very important for spawning, incubation of fish eggs and production of aquatic insects.
- c) Root wads and submerged trees provide valuable cover for fish and other aquatic organisms.
  - 1) Logs, branches and twigs of these trees provide a food source for aquatic insects which are at the beginning of the food chain.
  - 2) Roots wads and submerged trees may need to be removed if they are causing problems in the stream such as log jams. Log jams may increase siltation upstream, create bank erosion and cause stagnant water.
  - 3) Fish congregate near the streambank for the edge effect it provides. Bank undercuts and areas with overhanging vegetation are excellent cover.
  - 4) Riparian vegetation plays an important role in regulating water temperature by shading the water surface. Water temperature governs:
    - (a) Types of aquatic life inhabiting a stream
    - (b) Fish growth
    - (c) Timing of fish reproduction
    - (d) Oxygen concentration
  - 5) Riparian woodlands have a variety of tree species which provide food, dens, roosting and nesting sites to many wildlife species.

- (a) Riparian woodlands add diversity to the landscape by supporting tree species not found elsewhere
  - (b) In farming regions of Missouri a strip of riparian woodland may be the only woody cover found on the landscape.
5. Ask the students what happens to fish and wildlife when streams are channelized. Point out that natural streams provide the best habitat.

**How does stream channelization affect fish and wildlife?**

- a) Channelization produces the maximum possible destruction of local stream habitat.
    - 1) Channelization usually converts a natural, winding stream with riffles, pools and cover into a straight, featureless ditch.
    - 2) Reduces a stream's capacity to produce fish by 75 to 85 percent.
    - 3) Remaining fish tend to be smaller and more tolerant of poor habitat.
  - b) Few fish species will tolerate the increased water velocities, temperature and turbidity of a channelized stream.
    - 1) Increased sediment cover fish eggs and covers gravel.
    - 2) Clearing of riparian vegetation destroys the canopy that shades the water surface and water temperature increases.
  - c) Destruction of riparian vegetation eliminates streamside habitat for wildlife such as deer, turkey and squirrel.
  - d) Negative impacts on fish and wildlife habitat usually extend both upstream and downstream.
    - 1) Bed scouring and bank undercutting will advance upstream.
    - 2) Increased sediment load and raised water temperatures will extend downstream.
6. Ask the students what an individual landowner can do to improve streams on his/her property.

**How can a landowner improve a stream?**

- a) Protect riparian vegetation
  - 1) Easiest, most effective method.
  - 2) Maintain at least a 100 foot strip of riparian vegetation on both banks.
  - 3) Prohibit grazing, clearing or other disturbance.
  - 4) Selectively cut trees likely to fall in the stream and create problems.

- 5) A thick stand of trees should sometimes be thinned to promote growth of grasses and other plants.
- b) Remove streamflow obstructions
  - 1) Log jams and other obstructions may alter streamflow.
  - 2) Remove log jams when stream flow is seriously impaired.
- c) Plant streambank vegetation
  - 1) Where vegetation is lacking, a stream can be improved by planting trees, shrubs and/or grasses.
  - 2) Vegetation protects a streambank in two ways:
    - (a) The root system holds the soil together.
    - (b) Exposed stalks, stems and branches deflect and absorb the force of the current.
  - 3) Planting vegetation is a convenient method of streambank stabilization because it is easy to establish and maintain.
  - 4) Planting vegetation is the only streambank protection method capable of repairing itself.
  - 5) Examples of plants suitable for planting on streambanks are:
    - (a) Trees - black willow, eastern cottonwood, silver maple, green ash and river birch.
    - (b) Shrubs - sandbar, willow, basket willow, pussy willows, buttonbush, honeysuckle and silky dogwood.
    - (c) Grasses - reeds canarygrass, redtop, prairie cordgrass, switchgrass.
- d) Riprap is natural rock dumped or hand placed on a streambank to prevent erosion. Three general placement methods are used.
  - 1) Riprap can be placed in a blanket at the base of the bank to minimize under cutting.
  - 2) Blanket of riprap can be placed over entire bank.
  - 3) Rock hardpoints are small dikes composed of riprap are built from the bank out into the stream to absorb the force of the current.
    - (a) Extensive bank shaping is not needed.
    - (b) Disturbance of existing vegetation is minimal.
    - (c) Better stream habitat is produced with rock hard points than the other placement methods.
- e) Tree revetment
  - 1) "Revetment" refers to the placement of stone, trees, blocks or sand bags on a streambed to prevent erosion.
  - 2) Large, whole trees are placed lengthwise along eroding banks with their butt ends pointed upstream can substantially reduce bank erosion.

- (a) Provides fish cover to a variety of species.
  - (b) Trees should be cabled at both ends and anchored to the bank.
  - (c) Tree revetments are not suitable on smaller streams where the stream flow will be greatly reduced.
- f) Permits
- 1) A project involving the placement of rock, earth, rootwads and other objects in a stream requires a permit from the Army Corps of Engineers.
  - 2) Missouri Department of Natural Resources must certify the project does not violate state water quality standards.

F. Other activities

- 1. Take the students on a field trip to a nearby stream. Invite a Department of Conservation fishery biologist to attend and explain the aquatic habitat.
- 2. Find out where a local streambank stabilization project has been undertaken and arrange for a field trip.
- 3. Have the students make a leaf collection of riparian trees.
- 4. Assess stream habitat. (WS 6.1)
- 4. Measure stream velocity. (WS 6.2)
- 5. Show "Stream Sense" and "Downstream" videotapes.
- 6. Order two or three topographic maps from the U.S. Geological Survey for your local area. Have the students lightly draw in watershed boundaries (with a pencil) on the maps. You may want to mark particular points for them to start from. This is a difficult exercise which will develop the students' ability to understand and interpret contour lines.
- 7. Purchase an aerial photo from your local Agricultural Stabilization and Conservation Service (ASCS) office. Make copies and distribute a map to each student. Show the students the point on the map where you want them to start drawing in watershed boundaries. This exercise is more intuitive than the topographic maps which have contour lines. You may want to consult with a Soil Conservation Service employee for training in estimating watersheds if you are unfamiliar with the process.

8. Some Soil Conservation Service field offices have several sets of aerial photos for the entire county. Each set is produced at ten-year intervals. Ask your local SCS district conservationist to make copies of maps which show the same area over a period of time. The students can examine the maps for urban development, forest clearing, field contouring, etc. They can then make a judgment as to whether the land use changes in a particular watershed have been improved or degraded water quality.

#### G. Conclusion

Streams are natural features on the landscape which do much more than carry water. People need to be aware of the complexities of stream dynamics before attempting to "improve" the stream. Stream improvements are usually more successful if they resemble or imitate natural processes such as revegetating banks.

#### H. Competency

Describe stream behavior and how it affects fish and wildlife habitat.

#### I. Answers to Evaluation

1. c
2. e
3. a
4. c
5. b
6. c
7. a
8. e
9. a
10. d



Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES**

**Lesson 6: Stream Conservation**

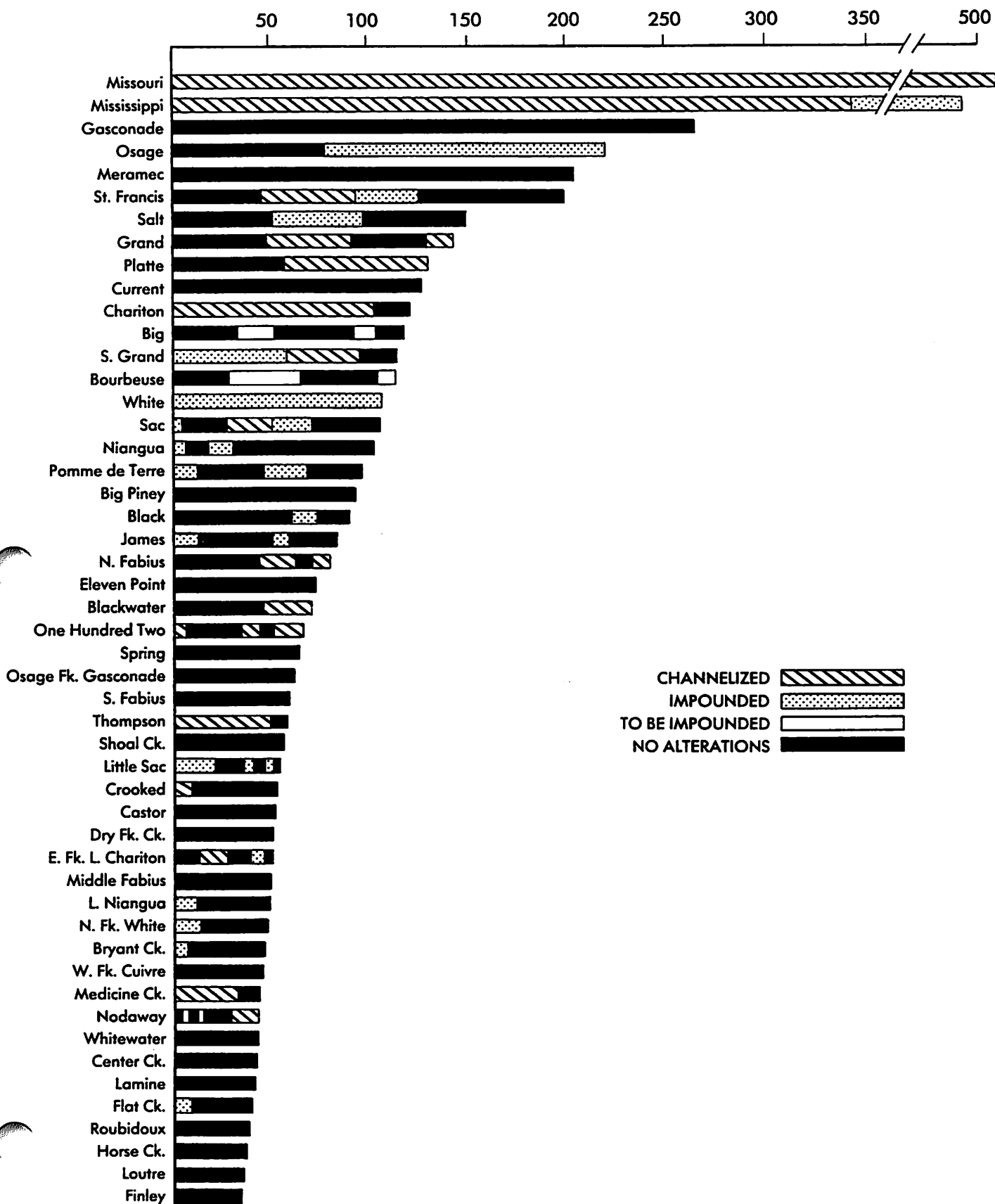
**EVALUATION**

**Complete the following statements by circling the letter of the best answer.**

1. Streams are in a constant state of \_\_\_\_\_.
  - a. equilibrium
  - b. decline
  - c. change
  - d. erosion
  - e. none of the above
  
2. If a stream experiences a permanent increase in water flow, it will respond by \_\_\_\_\_.
  - a. scouring its bed
  - b. enlarging its channel
  - c. eroding its banks
  - d. flooding more frequently
  - e. all of the above
  
3. Channelization \_\_\_\_\_ natural streams.
  - a. damages
  - b. improves
  - c. has no effect on
  - d. is recommended on
  - e. conserves
  
4. \_\_\_\_\_ are the major stream habitat of most fish.
  - a. Sloughs
  - b. Log jams
  - c. Pools
  - d. Riffles
  - e. none of the above

5. \_\_\_\_\_ produce most of the fishes' food and are very important for spawning.
- a. Pools
  - b. Riffles
  - c. Root wads
  - d. Overhanging banks
  - e. none of the above
6. Channelization reduces a stream's capacity to produce fish by \_\_\_\_\_.
- a. 5 to 10 percent
  - b. 25 to 30 percent
  - c. 75 to 85 percent
  - d. 1 to 2 percent
  - e. none of the above
7. Channelization frequently \_\_\_\_\_ flooding in downstream areas.
- a. increases
  - b. decreases
  - c. has no effect on
  - d. completely stops
  - e. none of the above
8. Riparian vegetation plays an important role in \_\_\_\_\_.
- a. regulating water temperature
  - b. providing wildlife habitat
  - c. stabilizing streambanks
  - d. filtering sediment
  - e. all of the above
9. \_\_\_\_\_ is the easiest and most effective method of streambank stabilization.
- a. Protecting riparian vegetation
  - b. Removing log jams
  - c. Riprap blanketing
  - d. Tree revetment
  - e. Placing old car bodies and tires on the bank
10. Landowners must contact the Missouri Department of Natural Resources and the \_\_\_\_\_ before initiating projects involving the placement of rock, earth, rootwads and other objects in a stream.
- a. Soil Conservation Service
  - b. Agricultural Stabilization and Conservation Service
  - c. Cooperative Extension Service
  - d. U.S. Army Corps of Engineers
  - e. Coast Guard

# STATUS OF ALTERATIONS ON MISSOURI'S MAJOR STREAMS (1986)



**STREAM HABITAT ASSESSMENT DEVICE**

**TEACHING SUGGESTIONS**

The Missouri Department of Conservation has recently developed the "Stream Habitat Assessment Device" (SHAD). It is designed to categorize the overall quality of stream habitats, but does not require detailed scientific studies. Unlike the work sheets in previous lessons, SHAD evaluates the habitat without a reference to one particular species.

The SHAD work sheet reinforces the concepts taught in this lesson and brings a measure of reality to stream degradation. Categories such as "riparian area bare of vegetation or used for row crop production" will stimulate a lasting mental image and hopefully cause a permanent negative connotation to these types of practices.

The SHAD work sheet is identical to the forms professional fishery biologists use to evaluate stream habitats. If you have questions about the work sheet, the local conservation agent will be able to direct you to the fishery biologist serving your section of the state for assistance.

It is recommended for instructors to complete the work sheet on the selected area before the students. The answers to some of the assessment categories requiring the students to approach the water should be announced before the exercise begins (e.g. pool depth). Select a safe site with obvious habitat features which correspond to the items on the work sheet.

Reviewing the completed work sheets with the students at a later classroom session is highly recommended. Place emphasis on the interrelationships of the habitat features. For instance, if the riparian area is bare of vegetation the stream banks will erode more. In turn, the streambed will silt in and cause the channel to migrate. Stress the cause and effect nature of stream systems.

STREAM HABITAT ASSESSMENT DEVICE

STREAMBANKS	A	B	C	D	E		A	B	C	D	E
Streambank Erosion	No evidence of erosion or bank caving; bank soils protected or soil type erosion resistant	Insignificant small areas, mostly healed over; bank slightly eroding	Moderate frequency and size; slumping and caving evident- erosion potential in all storm events banks moderately eroding	Massive failings in isolated areas; banks highly eroding	Massive failings in most of the reach; banks highly eroding	Right Bank	5	5	3	1	0
						Left Bank	5	5	3	1	0
Streambank Erosion Protection	Streambanks comprised of trees and shrubs sufficient to protect bank	Streambanks dominated by grass, sparse trees and shrubs; vegetation not adequate to hold banks in catastrophic events	Very thin grass, no trees and shrubs; bank literally bare			Right Bank	5	3	1		
						Left Bank	5	3	1		
RIPARIAN CONDITION											
Width of Riparian Area	>100 FT	50-100 FT	25-50 FT	5-25 FT	No Riparian Vegetation	Right Bank	5	4	3	1	0
						Left Bank	5	4	3	1	0
Riparian Vegetation Quality	Riparian area composed of trees with a good forest floor vegetative community or adequate leaf litter layer	Riparian area lacking trees, but shrubs and ground vegetation thick; forest floor vegetative community or adequate leaf litter layer sufficient to filter sediment from runoff	Riparian area lacking trees and shrubs; grasses and forbs must be sufficient to filter sediment from runoff	Riparian area bare of vegetation or used for row crop production		Right Bank	5	3	1	0	
						Left Bank	5	3	1	0	
Management of Riparian Area	No grazing; cattle access limited to fenced crossings; no row cropping; timber harvest does not jeopardize corridor functioning	Moderate grazing; cover adequate to trap sediment and protect banks; not row cropped, but hayland may be present; timber harvest occurring but root system not compromised	Severe grazing-cattle have free access to stream; vegetation grazed and trampled; area heavily row cropped; timber harvest excessive and compromises root system			Right Bank	5	3	1		
						Left Bank	5	3	1		

CHANNEL CONDITION											
Depth Distribution	Pools Average >3 FT. in depth	Pools Average 3-1.5 FT. in depth	Pools Average (1.5 FT. in depth		Channel	5	3	1			
Percent Pools	40-60% pools in 1/4 mi. reach	20-40% or 60-80% pools in 1/4 mi. reach	(20% or) 80% pools in 1/4 mi. reach		Channel	5	3	1			
Instream Cover	Abundant; >10 rootwads, submerged timber snags, or rocks >2' in diameter or >15% banks undercut in 1/4 mile reach	Intermediate; 5-10 rootwads, submerged timber snags, rocks >2' in diameter or 5-15% banks undercut in 1/4 mile reach	Minimum; 5 rootwads, submerged, timber snags, rocks >2' in diameter or (5% banks undercut in 1/4 mile reach	Reach has no instream cover	Channel width <50'	5	4	2	0		
					Channel width 50-150'	5	4	1	0		
					Channel width >150'	5	3	1	0		
STREAMBED											
Streambed Condition	No unstabilized material in channel with substrates of rock, rubble, gravel or firm alluvium	Quiet areas covered by unstable materials	Pools shallow, filled with unconsolidated silt, sand or gravel; riffles contain noticeable silt deposits	Streambed completely covered with varying thicknesses of trans- ported material such as sand, silt or gravel- very unstable	Evaluation Reach	10	7	4	1		
WATER QUALITY											
Water Quality	No pollution out- falls, excessive sediment from crop- fields, feedlot drainage, stripmine runoff or other non- point problems; no fish kills reported	Occasional signs of nutrient oversupply or excessive sediment/ pollutants from run- off; fishkills occur infrequently	Frequent signs of nutrient oversupply or excessive sediment/ pollutants from run- off; fish kills occur frequently (1 out of 7 years)	Grossly polluted waters with fish kills occurring annually	Evaluation Reach	20	15	7	0		
CHANNEL ALTERATION											
Channel Alteration	No channelization clearing and snagging or channel paving	Channel alterations >40 years old and not maintained; stream channel essentially natural	(25% of reach channel- ized; old channel not blocked and still functioning	25-50% of reach chan- nelized; obvious velocity or erosion problems in reach	>50% of reach channelized	Evaluation Reach	10	8	5	1	0

### HABITAT COMPONENTS

Component	A Component Score Total	B Factor	A/B Component Index
Streambanks, Right		10	
Streambanks, Left		10	
Riparian, Right		15	
Riparian, Left		15	
Channel		15	
Total		65	*

\*Overall habitat quality will be the total component index value unless any of the components or the habitat modifiers are rated in the "Degraded" range. Then, this lower value becomes the value of overall habitat quality.

### HABITAT MODIFIERS

Modifiers	A Points	B Factor	A/B Index
Streambed		10	
Water Quality		20	
Channel Alteration		10	
Total		40	*

III-111

### INDEX INTERPRETATION

1.0 - 0.7	Good
0.7 - 0.4	Needs Improvement
< 0.4	Degraded

OVERALL HABITAT QUALITY:

### Estimating Stream Water Velocity

The velocity of water in a stream, commonly expressed in feet per second, is the distance it travels during an interval of time. Velocity can be measured with a stopwatch, measuring tape and an orange.

Measure off a 25 foot length of stream and mark it with small stakes or surveying flags on the bank. Toss an orange in the stream at the upstream mark and use the stopwatch to measure how many seconds elapse for it to travel the 25 foot distance. (Oranges have the same density as water and float at about the same rate as water moves)

1. How many seconds did it take for the orange to float 25 feet?
2. What is the water velocity in feet per second?



## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 7: Pond Construction and Management

Objective: The student will plan a pond using appropriate construction and management techniques.

#### Study Questions

1. What are characteristics of good pond construction?
2. What causes poor water quality in ponds and how can it be corrected?
3. What benefits and problems are associated with aquatic plants in ponds?
4. How should fish be stocked in a pond?
5. How should fish harvest be managed?
6. How can a pond area be improved for wildlife and recreation?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Missouri Pond Handbook. Missouri Department of Conservation, 1982.
3. Aquatic Field and Classroom Activities. Missouri Department of Conservation, 1988.
4. Fisheries Management. Missouri Department of Conservation, 1986.
5. Aquatic Plant Management in Missouri. Missouri Department of Conservation, 1986.
6. "Missouri Pond Life" poster. Missouri Department of Conservation.
7. Transparency Master
  - a) TM 7.1: Top View of Dam and Pond Basin
  - b) TM 7.2: Factors Affecting Water Quality

8. Work Sheet

- a) WS 7.1: Percentage Size Distribution

9. Handouts

- a) HO 7.1: Missouri Department of Conservation Pond Stocking Policy
- b) HO 7.2: Weed Grapple
- c) HO 7.3: Secchi Disk

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 7: Pond Construction and Management

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson.

##### B. Motivation

Ask the students if they have a favorite pond they fish in. Point out that a pond must be constructed and managed properly to produce good fishing. It does not happen by chance.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to give examples of proper pond construction techniques.

**What are characteristics of good pond construction?**

##### a) Site selection

- 1) Select a site which will have an appropriate drainage area/pond water surface ratio. Ten acres of drainage area per one surface acre of water is a general rule of thumb.
- 2) Soil in the pond area must contain enough clay to prohibit seepage. Sites with outcroppings or subsurface layers of gravel or sand should be avoided.
- 3) Narrow draws with few trees and brush are usually best for economical pond construction.
- 4) Fishing ponds should be at least an acre in size when full. Balanced fish populations are difficult to maintain in smaller ponds.
- 5) Select a site which can provide a water depth of at least eight feet to protect fish during winter.
- 6) Pond drainage area should be adequately protected against soil erosion.
- 7) Pond dams should not be placed upstream from roads, homes or other areas of human activity without professional engineering assistance.

##### b) Dam construction

- 1) After the dam location is cleared, a core trench

- must be excavated down to a good clay or solid rock layer to provide a water-tight foundation for the dam.
- 2) Soil with a high clay content from the basin (or nearby area) should be placed in the center of the dam, in and above the core trench.
  - 3) Surplus water entering a pond is released by spillways.
    - (a) 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 (TM 7.1)
    - (b) Ponds with a drainage area of ten acres or less usually require only an emergency spillway.
    - (c) A trickle tube (usually six inch corrugated metal pipe) can be installed lower than the emergency spillway. It will handle light overflow and establish a normal water level in the pond.
    - (d) 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.
  - 4) Install a livestock watering system.
    - (a) Delivers water to a watering tank below the dam which makes it possible to fence livestock away from the pond dam and shoreline.
    - (b) Can also be used to drain the pond in one or two weeks if it becomes necessary.
- c) Basin excavation
- 1) Deepen pond edges at the waterline to provide some degree of weed control.
  - 2) Leaving high spots at several locations in open water areas 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.
  - 3) Some trees or brushpiles should be left in the pond basin to create more fish cover.
- d) Seeding
- 1) Lime and fertilize the dam and basin area according to soil test recommendations.
  - 2) Seed all raw areas above the waterline with a seeding mixture recommended by the local University Extension Service or Soil Conservation Service office.
  - 3) Mulch the seeded area with straw and press the straw stems into the ground with a corrugated

roller or a disk with dull blades.

- e) Fencing
    - 1) 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.
    - 2) Livestock will increase water muddiness which is detrimental to fish populations.
2. Ask the students to describe the impact water quality has on fish and other aquatic animals. Point out that good water quality is required for healthy fish populations (TM 7.2).

**What causes poor water quality in ponds and how can it be corrected?**

- a) Dissolved oxygen
  - 1) The oxygen used by fish is obtained from molecules of free oxygen gas (O<sub>2</sub>) dissolved in the water; not from the atoms of oxygen chemically confined in the water molecule.
  - 2) The chief source of dissolved oxygen in most aquatic environments is aquatic plants.
  - 3) Periods of extreme, prolonged heat or long, cold winters with much snowfall may completely remove dissolved oxygen in water.
  - 4) Summer fish kills occur when excessive plant growth dies and decomposes. The decomposition process uses up the dissolved oxygen.
  - 5) Winter fish kills occur in a pond when there is a great deal of shallow water, excessive aquatic plant growth, and extended periods of ice and heavy snow cover.
    - (a) Snow cover on top of ice blocks sunlight and aquatic plants cease photosynthesis and die.
    - (b) Dissolved oxygen is removed from the water by the decaying plants. Fish may then suffocate from lack of oxygen.
  - 6) Removing snow cover on ponds and controlling aquatic weeds will reduce the chances for fish kills.
- b) Turbidity
  - 1) Turbidity (muddiness) is most commonly caused by soil particles in the water and creates problems for aquatic animals.
    - (a) Soil particles may settle out on the eggs of aquatic animals and suffocate them.
    - (b) Muddy water reduces the growth of microscopic plant life by blocking sunlight. This affects the entire aquatic food chain.

- (c) Sight-feeding fish (bass, bluegill) will not be able to feed as easily. Studies have shown that bass will grow five times faster in clear water (HO 7.3).
- 2) Causes and treatments for turbidity
  - (a) Soil erosion in the pond's watershed and livestock damage cause turbidity. Pond owners can avoid these problems by applying soil conservation practices and excluding livestock from the pond area.
  - (b) Bottom-feeding fish like carp, buffalo and bullheads 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.
  - (c) Clay turbidity is a product of heavy clay soils in the pond basin or on the shoreline. It is difficult to correct. Pond owners can alleviate the problem by placing two small bales of hay in the pond per surface acre of water at 14-day intervals during the spring and summer.
- c) Livestock waste
  - 1) Manure, urine and rotting bedding material from barnyards, feedlots and pastures create problems when they enter an aquatic system in sufficient quantity.
    - (a) Dissolved oxygen is depleted as the waste decomposes.
    - (b) Decomposition process releases poisonous ammonia, methane and sulfur gases which are harmful to aquatic organisms.
  - 2) Livestock waste contains high amounts of nitrogen and phosphorus.
    - (a) Excellent soil fertilizer when used properly.
    - (b) Excess livestock waste stimulates aquatic plant growth. Dissolved oxygen is reduced due to decomposing plant material.
- 4) Pesticides
  - 1) Pesticides are beneficial if used properly. Misuse can cause environmental damage.
  - 2) Insecticides are the most poisonous agricultural chemicals and are responsible for the majority of pesticide-related fish kills.
    - (a) Low doses of pesticides can cripple fish, sterilize them, or increase their susceptibility to diseases and parasites.
    - (b) Pesticides may not be toxic alone, but can become deadly when mixed with other compounds in the water.

- 3) Basic guidelines for the safe use of pesticides:
  - (a) Follow the pesticide label instructions.
  - (b) Use pesticides that naturally lose their toxicity after a short time.
  - (c) Avoid pesticide applications near streams, ponds and other bodies of water.
  - (d) Use soil conservation practices to limit water runoff.
  - (e) Properly dispose of old or unused pesticides and their containers.
3. Ask the students if aquatic weeds are good or bad. Point out that aquatic vegetation is necessary for fish production. However, the vegetation should be controlled when it covers more than 25 percent of the pond surface.

**What are the benefits and problems associated with aquatic plants?**

- a) Aquatic plants are the biological foundation of aquatic environments.
  - 1) Provide many types of cover for countless aquatic animals and are the first link in the food chain.
  - 2) Protect shorelines from erosion and provide important cover and food to other wildlife such as ducks, geese, bullfrogs, muskrats, shorebirds, etc.
  - 3) Extensive plant growth can cause problems.
    - (a) Aquatic plants are considered beneficial until they interfere with an intended water use.
    - (b) As a general rule, aquatic plants become "weeds" when they cover more than 25 percent of a pond's surface.
  - 4) Aquatic plant control may eventually be necessary even though appropriate measures were taken during pond construction to discourage plant growth.
- a) Mechanical control
  - 1) Similar to "weeding" a garden. This type of control consists of pulling, raking, cutting and digging the aquatic plants.
  - 2) Nuisance plants should be removed prior to seed formation.
  - 3) Mechanical methods are adapted to controlling cattails, rushes, water primrose, willows and water lilies.
  - 4) Free floating plants like algae and duckweeds can be temporarily reduced by seining with window-screen material.
  - 5) Submergent plants can be temporarily controlled by underwater raking.

- b) Biological control
  - 1) Biological control of filamentous algae, duckweeds and submergent plants is possible by stocking grass carp. They are capable of eating two or three times their weight in plants each day.
  - 2) Grass carp do not muddy the water or reproduce in ponds.
  - 3) Three to five grass carp are needed 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.
  - 4) It usually requires two to three years before a noticeable reduction in aquatic plants occurs.
- c) Chemical control
  - 1) Killing aquatic vegetation is an effective method of control when plants are positively identified, the area to be treated is known and the correct amount of chemical is applied.
  - 2) There is no all-purpose herbicide that solves plant problems forever.
  - 3) Herbicide use
    - (a) The final authority on proper use of a herbicide is the product label.
    - (b) Always follow all label directions and warnings.
  - 4) Chemical dosage rates are based on the total volume of water to be treated (WS 7.1).

- 4. Ask the students if a well-constructed pond will automatically develop good fishing. Point out that a pond must be stocked with the correct number and species of fish.

**How should fish be stocked in a pond?**

- a) Good fish stocking requires getting the desired species in the proper ratio and in the right number to the pond.
  - 1) The most common pond stocking combination in Missouri is largemouth bass-bluegill-channel catfish.
  - 2) The stocking recommendation per pond surface acre for the largemouth bass-bluegill-channel catfish combination is 100 bass, 500 bluegill and 100 channel catfish.
  - 3) Overstocking is a common reason for poor fish populations. Stocking at a higher rate creates a population imbalance which usually results in slow growth for all species - commonly called "stunting."



- 4) Fish should not be stressed due to low oxygen, rough handling, or extreme temperature changes. Spring and fall are the best seasons to stock fish due to cool weather and water conditions.
  - 5) Fish already in a pond should be eliminated before stocking. It is a waste of fish, time and money to stock a pond that already contains fish.
  - 6) Water depth should be a minimum of five feet to ensure winter survival following a fall stocking. An eight-foot depth is needed as the fish grow larger.
  - 7) Protect the fish populations by prohibiting the introduction of other fish species.
    - (a) Crappie compete with bass for food.
    - (b) Green sunfish eat fish eggs.
    - (c) Bullheads and carp muddy the water.
  - 8) Pond owners may receive fish for stocking from the Missouri Department of Conservation if certain requirements are met (HO 7.1), or purchase fish from privately-owned hatcheries.
5. Ask the students if fish harvest has any impact on fish populations. Point out that proper harvesting is required to maintain stable fish populations.

**How should fish harvest be managed?**

- a) Additional stockings
  - 1) If harvest is properly regulated, bass and bluegill will never need to be restocked.
  - 2) Channel catfish have a very limited ability to reproduce in ponds and will need to be restocked after the original fish are caught.
- b) Time of harvest
  - 1) 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.
  - 2) Bluegill and channel catfish may be harvested anytime they are large enough to eat. A good pond will eventually yield 200 to 300 bluegills per acre per year.
- c) Rate of harvest
  - 1) Harvest rates are related to the number and size of fish in a pond.
  - 2) Studies have shown that under good conditions 65 to 80 percent of the bass are present two years after a pond is stocked.
    - (a) Adult bass populations in ponds recently opened to fishing are easily overharvested.
    - (b) If 65 to 80 percent of the bass are removed, the bluegill will usually overpopulate.

- 3) The original bass stocked must support the bass harvest for at least four years until their offspring are large enough to catch.
  - (a) General recommendation is to not remove more than 20 percent of the bass stocked in a pond, beginning the third summer after stocking.
  - (b) A pond owner can harvest 20 bass in both the third and fourth years from a one-acre pond originally stocked with 100 bass.
- d) Developing specific harvest recommendations in older ponds.
  - 1) Measuring and recording the length of largemouth bass and bluegill allows pond owners to recognize balanced and unbalanced fish populations.
  - 2) Percentage size distribution (PSD)
    - (a) Measures the percentage of quality size adult fish.
    - (b) For largemouth bass, minimum adult size is eight inches and minimum quality size is 12 inches.
    - (c) A largemouth PSD of 20 means that 20 percent of the catch was 12 inches or larger. A balanced bass population will have a PSD of 20 to 60.
    - (d) For bluegills, minimum adult size is three inches and minimum quality size is six inches. Balanced bluegill populations have a PSD of 50 to 80.
  - 3) Harvest implications of PSD values
    - (a) Measure fish lengths for a season. Basing recommendations on the catch from one fishing trip is not good management.
    - (b) A bluegill PSD below 50 means there are too many small bluegill. The bass are probably depleted and need to be protected.
    - (c) A high bluegill PSD (90 or more) usually is accompanied by a low bass PSD. This means there are too many bass under 12 inches eating small bluegill. Pond owner should restrict bass harvest to individuals under 12 inches (WS 7.1).
6. Ask the students if other pond uses are compatible with fishing. Point out that ponds are capable of supplying multiple uses if planned and managed accordingly.

**How can a pond area be improved for wildlife and recreations?**

- a) Wildlife habitat development
  - 1) Habitat for terrestrial wildlife can be created by planting trees and shrubs in the pond area.

- 2) Don't plant trees or shrubs on the pond dam because their roots weaken the embankment.
  - 3) Fencing off an area around the pond that is one to one and one-half times the water acreage permits development of wildlife habitat.
- b) Recreational development
- 1) Safe recreational use of a pond (swimming, boating, ice skating, fishing) can be improved by planning and developing the area.
  - 2) During pond construction, swimming beaches can be formed to smooth out sudden drop offs and blanketed with sand or gravel to eliminate plant growth.
  - 3) Swimming areas should be marked with a simple buoy system.
  - 4) Many people are non-swimmers so safety equipment should be made available for "anyone" to use.
    - (a) Inner tube with a long rope attached to it.
    - (b) A long pole or wooden plank, painted white, are good rescue equipment to help pull a person out of the water.
    - (c) All safety equipment should be kept in a single location near the use area for easy access.

#### F. Other activities

1. Have the students make a weed grapple (HO 7.2).
2. Have the students make a secchi disc (HO 7.3) and plan a field trip to a nearby pond or stream for a "hands-on" activity. If a field trip is not possible, bring several five-gallon buckets to the classroom and fill them with water of varying turbidity. Have the students lower the secchi discs in the buckets to see how they measure turbidity.
3. Ask for volunteers to fish a pond with a good largemouth bass/bluegill population during after-school hours. Have them record all the bass and bluegill lengths and give the information to the class. Each student should calculate PSD and make general management recommendations. Emphasize that the fish lengths should be measured over an entire season for the best representation of the fish populations.
4. Contact a Department of Conservation fishery biologist to give a pond management presentation to the class.
5. Schedule a field visit to a well-managed pond and ask the pond owner to give a description of his/her management techniques.

**G. Conclusion**

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.

**H. Competency**

Plan a pond using appropriate construction and management techniques.

**I. Answers to Evaluation**

1. b
2. a
3. e
4. c
5. a
6. c
7. b
8. c
9. a
10. a

**J. Answers to Work Sheet**

1. Bluegill PSD - 90  
Bass PSD - 10
2. Fish populations are out of balance. Pond owner should restrict bass harvest to fish under 12 inches.

Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES**

**Lesson 7: Pond Construction and Management**

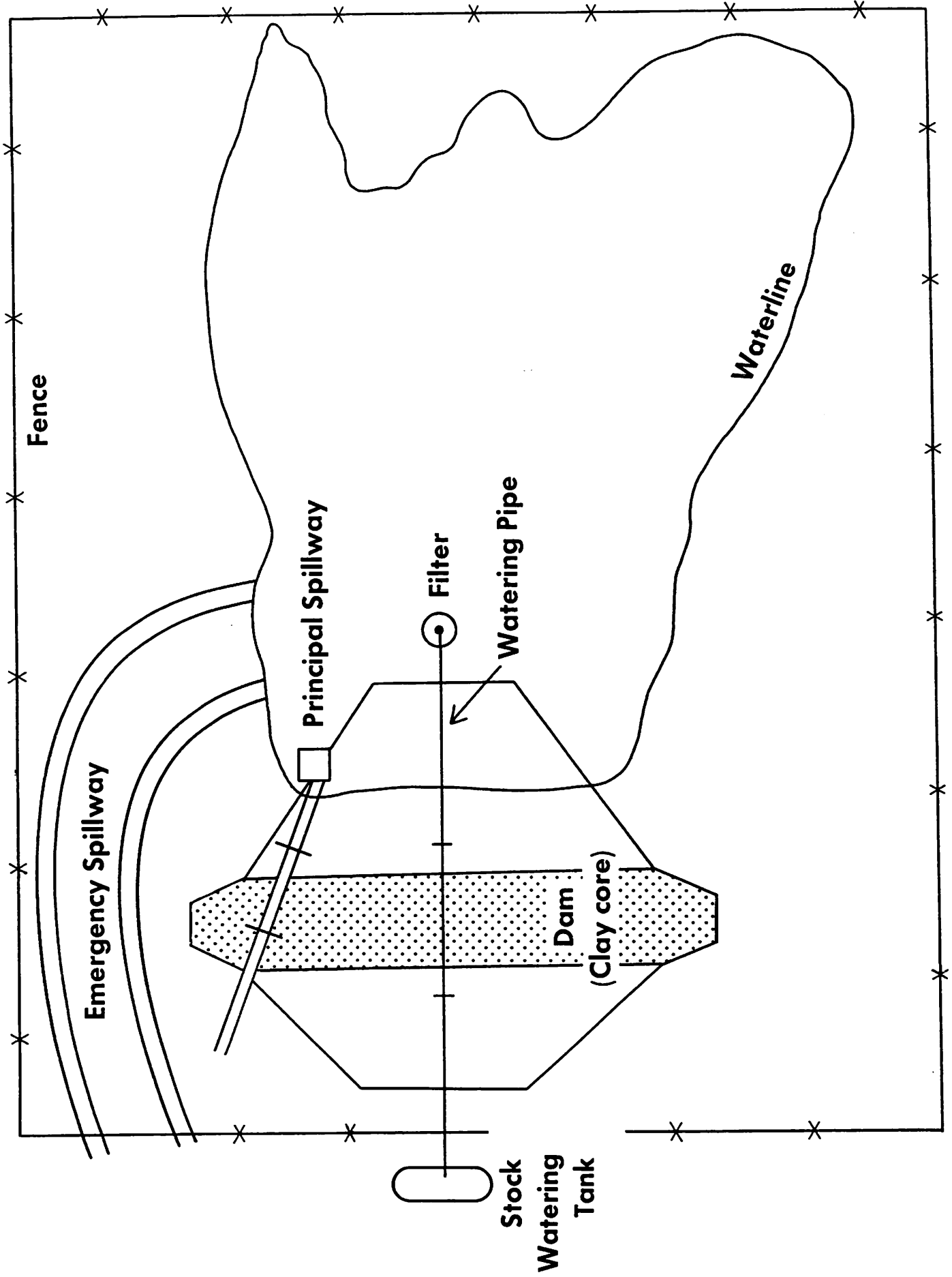
**EVALUATION**

**Circle the letter that corresponds to the best answer.**

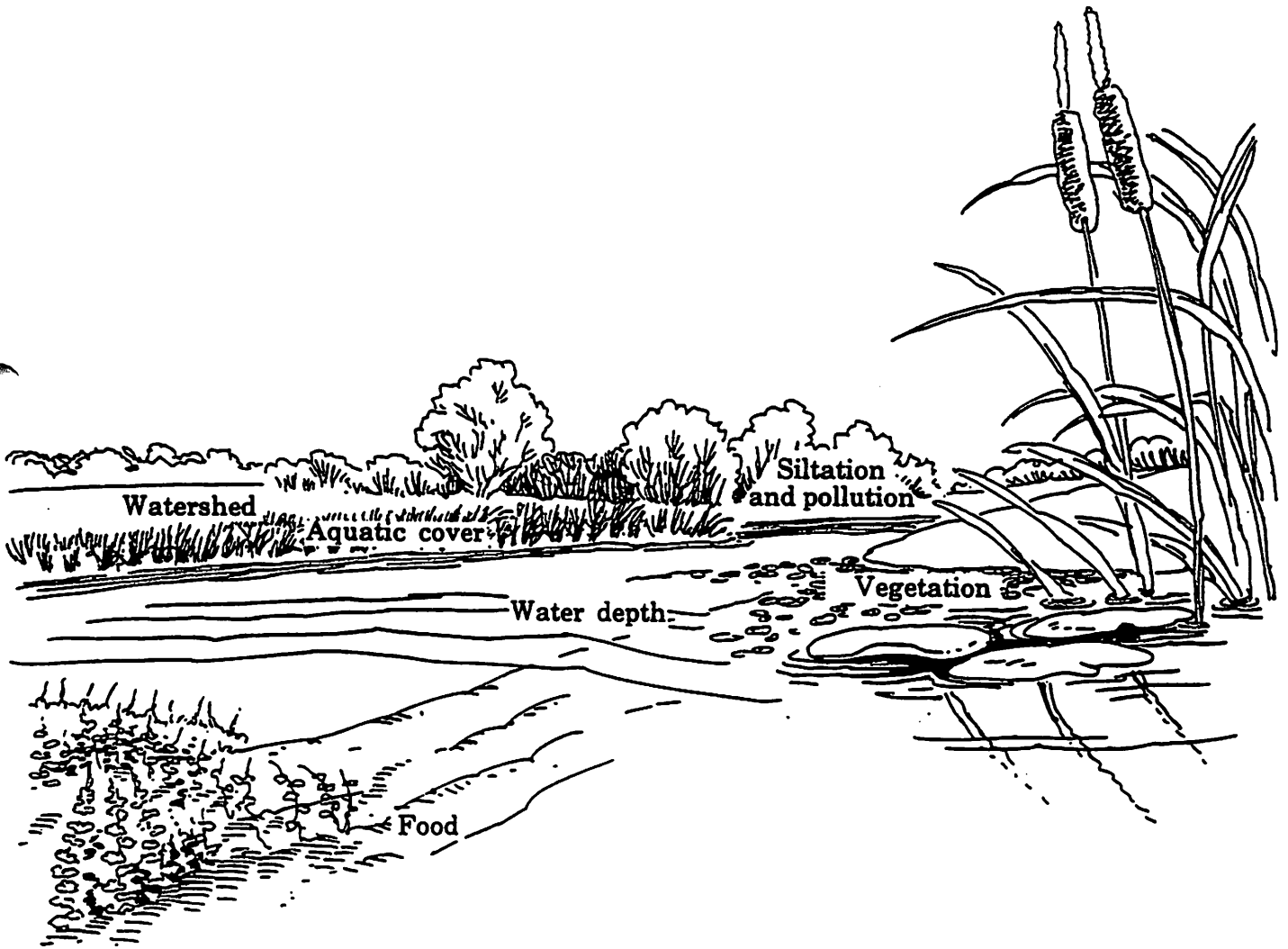
1. When selecting a pond site, \_\_\_\_\_ acres of drainage area per one surface acre of water is the general rule of thumb.
  - a. 50
  - b. 10
  - c. 2
  - d. 75
  - e. 100
  
2. A pond dam core trench is a requirement to control \_\_\_\_\_.
  - a. seepage
  - b. fish populations
  - c. livestock damage
  - d. siltation
  - e. construction costs
  
3. Livestock damage ponds by \_\_\_\_\_.
  - a. trampling the shoreline
  - b. wading and stirring up bottom sediments
  - c. polluting the water with waste
  - d. causing water muddiness
  - e. all of the above
  
4. The chances for winter kill can be reduced by \_\_\_\_\_.
  - a. feeding fish through the ice
  - b. stocking more fish
  - c. removing snow from the ice
  - d. shallow water
  - e. all of the above

5. Muddy water affects the entire aquatic food chain by \_\_\_\_\_.
- reducing photosynthesis of microscopic plant life
  - suffocating large aquatic plants
  - killing all fish
  - making it easier for bass to capture bluegills
  - killing livestock
6. Aquatic plants should be controlled if they cover more than \_\_\_\_\_ percent of the pond surface.
- 5
  - 10
  - 20
  - 50
  - 90
7. The final authority on proper use of a herbicide is the \_\_\_\_\_.
- Missouri Department of Conservation
  - product label
  - Surgeon General
  - USDA Soil Conservation Service
  - none of the above
8. \_\_\_\_\_ is the most common fish stocking combination used for Missouri ponds.
- Carp-bluegill-bullhead
  - Crappie-bluegill-green sunfish
  - Largemouth bass-bluegill-channel catfish
  - Largemouth bass-bluegill-crappie
  - Carp-bullhead
9. A largemouth bass percentage size distribution (PSD) of 80 indicates that \_\_\_\_\_ percent of the bass are over 12 inches.
- 80
  - 20
  - 40
  - 10
  - none of the above
10. \_\_\_\_\_ should not be harvested until they have been in a pond for two full years.
- Largemouth bass
  - Green sunfish
  - Crappie
  - Channel catfish
  - Bullheads

# Top View of Pond Layout



# Factors Affecting Water Quality



**Credit:** *Aquatic Field and Classroom Activities*. Missouri Department of Conservation.



**PERCENTAGE SIZE DISTRIBUTION**

1. A pond owner has kept accurate records of all fish caught from his/her pond during the spring and summer. The number and size of fish are:

3" - 5.9" bluegill	10
>6" bluegill	90
8" - 11.9" largemouth bass	45
>12" largemouth bass	5

The PSD of the bluegill population \_\_\_\_\_.

The PSD of the bass population \_\_\_\_\_.

2. Are the fish populations out of balance? If a population imbalance exists, what harvesting technique can be used to stabilize the populations?

MISSOURI DEPARTMENT OF CONSERVATION  
Pond and Small Lake Stocking Policy

The development of new waters, stocked and managed according to the recommendations of this Department, is recognized as an effective way of providing more fishing opportunity. Stocking will depend on agreement by the landowners that they will permit reasonable use for fishing, subject to their permission. Within it means, the Department will furnish, without charge, fingerling fish to stock new or renovated lakes and ponds meeting the following minimum requirements:

1. Must be at least eight feet deep in deepest part of pond.
2. Water and shoreline must be protected from livestock use. Ponds over 5 acres in surface area need not be fenced.
3. Dam must be constructed for permanency and water tightness, and drainage area should be adequate but not excessive for water storage.
4. Fish, except forage minnows such as the fathead minnow, must not be present prior to stocking. Ponds which have been stocked accidentally with undesirable fish or old "unbalanced" ponds can be renovated by extermination of all fish life. Chemicals for this purpose are provided at cost by the Department. This must be done with permission of and under the direction of the Department.

The recommended species combination is largemouth bass, bluegill, and channel catfish. Stocking rates are based on biological and physical factors of the pond and its watershed. Different areas of the state vary in their ability to produce a crop, in this case fish, because of differences in soil fertility. The Department of Conservation representative inspecting the pond will determine the stocking rate to provide optimum numbers of fast-growing fish. The maximum stocking rate provided by the Department is 100 largemouth bass, 500 bluegill and 100 channel catfish per surface acre of water. Natural reproduction is adequate to replenish those fish removed by fishing (except catfish) providing the pond is properly managed. It is illegal to transport or liberate any wildlife, including fish, into the wild except as permitted by the Wildlife Code of Missouri.

Applications for pond stocking are available from conservation agents and offices of some agricultural agencies. The application must be submitted to the local conservation agent no later than July 15 for fall stocking. Applicants will be notified by letter as to approval or rejection of their pond for stocking by the Department. Distribution of the fingerling bluegill and channel catfish will be made in September or October at a central meeting point in the county where the pond is located. Pond owners will be notified by letter regarding the date of delivery. The following spring (June) pond owners will be notified of delivery of fingerling largemouth bass at central distribution points. Either the owner or his designated representative may pick up fish at this time. Owners who fail to pick up their bluegill and catfish will not receive bass at the spring delivery. If the landowner prefers, he may purchase fish from a commercial source.

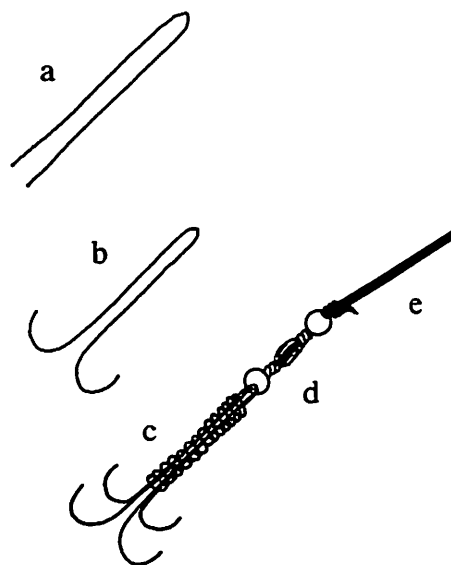
## How to Construct Your Own Aquatic Sampling Equipment

### Weed Grapple

A *weed grapple* is used to collect samples of submerged aquatic plants that are not otherwise accessible from shore. To construct a weed grapple, you will need:

- two 3-ft. lengths of No. 9 wire (or two heavy coat hangers that have been taken apart—use wire cutters to remove the hook and wire twist and then straighten the hangers)
- lightweight, rust-proof wire
- a large, brass fishing swivel
- a 25-ft. length of nylon cord
- a pair of pliers
- a large lead sinker (optional)

1. Use the pliers to bend each wire in half (a) and then form a large hook at both ends of each wire (b).
2. Securely fasten the two sections together with lightweight wire so that the grapple has four arms or hooks (c).
3. Use lightweight wire to attach a fishing swivel to the top loop of the grapple (d). The swivel prevents the line from twisting.
4. Tie one end of the nylon cord to the swivel (e).
5. Optional: A large lead sinker may be attached to the grapple so that it will more easily sink to the bottom.



#### How to use the weed grapple:

Toss the grapple into the water and allow it to settle to the bottom. Be sure to hold the free end of the cord to avoid losing the grapple. Retrieve the grapple, pulling it along the bottom of the pond or stream. Examine the vegetation that has been hooked and look for vegetation types and animal life (larva, eggs, inadvertently trapped adult invertebrates, etc.).

**CAUTION:** Use the weed grapple safely. Toss it so as to avoid others working near you.

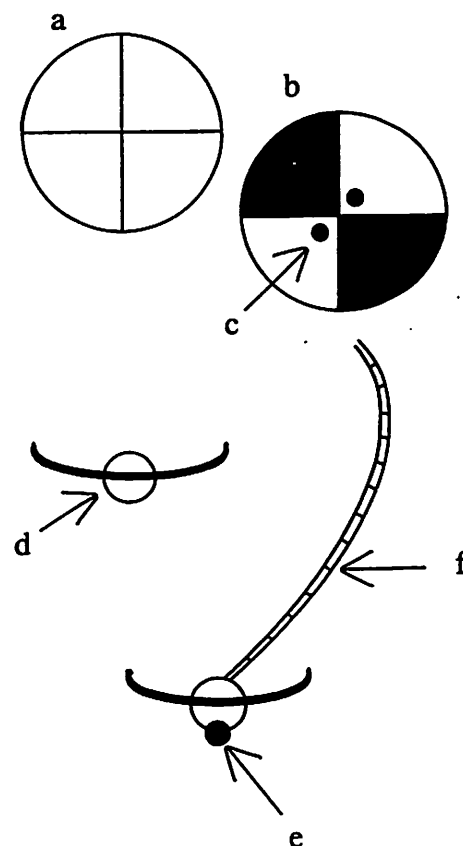
**Credit:** *An Ecological Approach to Conservation Education*. Missouri Department of Conservation.

## Secchi Disc

A *Secchi disc* is used to determine water visibility and light penetration. To construct a Secchi disc, you will need:

- a lid cut from one end of a 3 lb. coffee can, with burrs filed off
- white and black water-proof paint
- a hammer and nail
- medium-weight wire
- an 8-oz. lead sinker
- pre-measured and marked cord (cord marked at one inch intervals with water-proof ink)

1. Divide the lid into four equal parts (a). Paint the quadrants, alternating with black and white paint (b).
  2. Use the hammer and nail to make two holes near the center of the lid (c). Use the medium-weight wire to make a loop through the holes (d).
  3. Attach the lead sinker to the wire loop on the bottom of the disc (e).
- Attach the pre-measured and marked cord to the wire loop on the top of the disc (f).



### How to use the Secchi disc:

Lower the Secchi disc into the water just until it can no longer be seen. Note the water mark on the line and count the increments to obtain the measurement. Record the measurement for water visibility and light penetration.

**Credit:** *Aquatic Field and Classroom Activities*. Missouri Department of Conservation.

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 8: Agency Assistance

Objective: The student will describe the government conservation assistance available to Missouri landowners.

#### Study Questions

1. What services are available from the Missouri Department of Conservation?
2. How does the Soil Conservation Service (SCS) assist landowners?
3. What are the main functions of the Agricultural Stabilization and Conservation Service (ASCS)?
4. What kind of assistance does the University Extension offer the public?
5. What unit of government handles state cost-share funds for conservation practices?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. Audiovisuals
  - a) "Dedicated to Conservation" videotape (12 minutes). Available on loan from the Missouri Department of Conservation, Media Library, P.O. Box 180, Jefferson City, MO 65102-0180.

## UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

### Lesson 8: Agency Assistance

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson.

##### B. Motivation

Ask the students if they have ever wanted conservation help but did not know who to ask for assistance. Point out that there are government agencies which have well-trained people to help landowners and the general public with conservation projects. Each agency has its particular expertise.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students if they know any Missouri Department of Conservation employees. Do they know what type of job that person has? Point out that MDC has many different types of specialists who are ready to help landowners.

**What types of services are available from the Missouri Department of Conservation?**

##### a) Conservation agent

- 1) At least one conservation agent is assigned to each county.
- 2) The primary responsibility of MDC's 190 conservation agents is to enforce the rules and regulations of the Wildlife Code.
- 3) Conservation agents also assist private landowners with wildlife, fisheries and forest management.
  - (a) Habitat improvement recommendations
  - (b) Provide application forms for fish stocking
  - (c) Distribute wildlife food plot packets
  - (d) Refer landowner to appropriate specialist

- 4) Educating the public about Missouri wildlife and wildlife regulations is part of a conservation agent's responsibility.
    - (a) Radio and television programs
    - (b) Presentations to group
    - (c) Hunter education classes
  - b) Wildlife services biologists
    - 1) Are wildlife habitat specialists who serve multi-county areas.
    - 2) At a landowner's request, a biologist will make recommendations for improving wildlife habitat in the context of the owner's conservation goals.
    - 3) Give presentations to farmers' organizations, sportmen's groups and civic clubs.
    - 4) Assist agriculture instructors design and implement conservation programs.
    - 5) Provide a limited number of trees, shrubs and seed to landowners interested in habitat improvement.
  - c) Wildlife damage control agents
    - 1) Missouri has three of these agents.
    - 2) Wildlife damage control agents teach wildlife control techniques to landowners who are experiencing significant losses due to wildlife damage.
  - d) Fisheries management biologists
    - 1) Mainly responsible for large impoundment and stream fisheries management.
    - 2) Help private landowners solve aquatic resource problems by giving advice over the telephone or in person.
    - 3) Examples of assistance include:
      - (a) Sampling fish populations
      - (b) Advising on aquatic weed control
      - (c) Streambank stabilization
      - (d) Fish stocking recommendations
  - e) Resource foresters
    - 1) Assist landowners who request forest management help.
    - 2) Give advice on tree planting, timber stand improvement, tree harvesting, timber sales, tree insect control and related advice.
2. Ask the students if they are familiar with the local Soil Conservation Service office. Point out that SCS is a federal agency.

**How does the Soil Conservation Service (SCS) assist landowners?**

- a) The Soil Conservation Service (SCS) is an agency of the U.S. Department of Agriculture.
- b) Nearly all Missouri counties have a SCS field

office. Field offices are managed by district conservationists.

- c) SCS provides conservation planning and engineering assistance to interested landowners.
  - d) Primary expertise lies in planning, designing and guiding the construction of conservation practices.
  - e) SCS is a major participant in the implementation of the new federal conservation laws (sodbuster, swampbuster, conservation reserve, and conservation compliance).
3. Ask the students if they are aware of the different programs through which farmers receive payments from the federal government. The Agricultural Stabilization and Conservation Service (ASCS) is the agency that administers most of those programs.

**What are the main functions of the Agricultural Stabilization and Conservation Service (ASCS)?**

- a) The Agricultural Stabilization and Conservation Service (ASCS) is an agency of the U.S. Department of Agriculture.
- b) ASCS administers farm programs which provide crop loans, price supports and other financial assistance to farmers.
- c) ASCS plays an important role in conservation.
  - 1) Accepts or rejects bids from farmers interested in enrolling land in the Conservation Reserve Program (CRP). The agency also pays the rental payments to farmers with CRP land.
  - 2) Administers the Agricultural Conservation Program (ACP).
    - (a) Provides federal cost-share funds to farmers who build conservation practices according to Soil Conservation Service specifications.
    - (b) ASCS county offices set their own cost-share rates within certain limits set by higher authorities, and select practices eligible for cost-share funds.
    - (c) Examples of practices most counties will cost-share on are: terraces, diversions, grass waterways, wildlife habitat improvement, etc.
- d) Nearly all counties in Missouri have an ASCS office located in the same building with the SCS field office.
- e) The ASCS county executive director and a committee of three local farmers guide the county programs to meet federal policy and local needs.



4. Point out that the Missouri Cooperative Extension Service is now called the University Extension.

**What kind of assistance does the University Extension offer the public?**

- a) There is a University Extension office in each Missouri county.
  - b) This agency provides information to the public about agriculture, home economics, business and industry, and community development.
  - c) Agricultural advisers are stationed at many locations throughout the state who provide technical assistance on a broad range of agricultural questions.
    - 1) Advisers will work individually with farmers or will give presentations to groups.
    - 2) Handle soil analysis requests.
  - d) University Extension has a wide selection of printed material available to the public regarding agriculture, forestry, horticulture and wildlife conservation.
5. Ask the students if the state has any cost-share money for the construction of conservation practices.

**What unit of government handles state cost-share funds for conservation practices?**

- a) Soil and Water Conservation Districts (SWCD'S) are county organizations under the Soil and Water District Commission of the Department of Natural Resources.
- b) Each district is guided by a board of directors who are unpaid volunteers elected by county residents.
- c) Districts boards usually hire trained people to carry out SWCD programs and to assist Soil Conservation Service personnel in the design and construction of soil conservation practices.
- d) SCS and SWCD personnel are located in the same office.
- e) SWCD's implement state cost-share programs with the assistance of the Department of Natural Resources and Soil Conservation Service.
  - 1) These programs are separate from ASCS programs.
  - 2) State cost-share funds are spent on conservation practices such as terraces, diversions, grass waterways, wildlife habitat improvement, etc.

F. Other activities

1. Take the students on a field trip to local conservation offices. When making the arrangements, ask to have an employee present to explain what types of service the office offers.
2. Invite a landowner who has extensively used government conservation services to speak to the class.

G. Conclusion

The state and federal government offers many services to help landowners improve their natural resources. Landowners need to be aware of the services available to them. Representatives from any of the five agencies listed in this lesson will be able to point a landowner in the right direction to receive the assistance he/she is interested in.

H. Competency

Describe the government conservation assistance available to Missouri landowners.

I. Answers to Evaluation

1. a
2. a
3. e
4. b
5. c

Name \_\_\_\_\_

Date \_\_\_\_\_

### UNIT III - HABITAT MANAGEMENT PRINCIPLES AND TECHNIQUES

#### Lesson 8: Agency Assistance

#### EVALUATION

Complete the following statements by circling the letter of the best answer.

1. MDC \_\_\_\_\_ are responsible for enforcing the rules and regulations of the Wildlife Code.
  - a. conservation agents
  - b. district conservationists
  - c. wildlife services biologists
  - d. resource foresters
  - e. soil conservation technicians
  
2. Hunter education classes are the responsibility of \_\_\_\_\_.
  - a. conservation agents
  - b. district conservationists
  - c. wildlife services biologists
  - d. the Department of Natural Resources
  - e. none of the above
  
3. The Soil Conservation Service pays landowners for constructing \_\_\_\_\_.
  - a. terraces
  - b. diversions
  - c. grass waterways
  - d. grade stabilization structures
  - e. none of the above
  
4. The \_\_\_\_\_ pays part of the cost of eligible conservation practices when landowners have followed the proper procedure.
  - a. SCS
  - b. ASCS
  - c. University Extension
  - d. Army Corps of Engineers
  - e. all of the above

5. State cost-share funds are handled by \_\_\_\_\_.

- a. SCS
- b. ASCS
- c. SWCD's
- d. University Extension
- e. U.S. Fish and Wildlife Service

#### UNIT IV - ANIMAL LIFE HISTORIES

The following four lessons describe the life histories of the bobwhite quail, white-tailed deer, largemouth bass and bald eagle. Each species represents a member of upland, forest, aquatic and wetland habitat.

The lessons are arranged in the same format. Instructors who wish to teach the life histories of other species are encouraged to use this format for consistency. Some of the references listed on the lesson title pages will be very helpful in developing additional lessons.

## UNIT IV - ANIMAL LIFE HISTORIES

### Lesson 1: Bobwhite Quail (Upland Habitat)

Objective: The student will outline the life history of the bobwhite quail.

#### Study Questions

1. What does the bobwhite quail look and sound like?
2. How widely distributed and abundant are bobwhite quail?
3. What type of habitat do bobwhite quail require?
4. What kind of behavioral habits do bobwhite quail have?
5. What foods do bobwhite quail eat?
6. What are characteristics of the bobwhite quail's reproductive cycle?
7. How do adverse factors influence bobwhite quail populations?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. "Missouri Game Birds" poster (17 species). Missouri Department of Conservation.
3. Transparency Master
  - a) TM 1.1: Range of Bobwhite Quail
4. Audiovisuals
  - a) "Quail Country videotape (20 minutes). Available on loan from the Missouri Department of Conservation, Media Library, P.O. Box 180, Jefferson City, MO 65102-0180.
  - b) "Farming and Wildlife--Bobwhite Quail" videotape (18 minutes). Agriculture teachers have been supplied with a personal copy of this program.

## UNIT IV - ANIMAL LIFE HISTORIES

### Lesson 1: Bobwhite Quail (Upland Habitat)

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson by defining the term "life history."

##### B. Motivation

Take a student poll to find out how many students have hunted bobwhite quail. How many have at least seen or heard bobwhites? Develop a discussion around the experiences the students have had with quail. For instance, where and when have they found quail nests? What do quail tracks look like? How can you tell the difference between a male and female bobwhite quail? Point out that quail have characteristic ways they react with each other and their habitat.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to describe a bobwhite quail.

**What does the bobwhite quail look and sound like?**

##### a) Size and sex criteria

- 1) Bobwhite quail are small, brownish birds weighing from five to seven ounces with a height of seven to eight inches.
- 2) Sex of adult quail is determined by head and throat markings.
  - (a) Male has a white throat patch and a wide white stripe above the eyes.
  - (b) Females have tan to dusky brown markings on their heads and throats.
  - (c) Males tend to be slightly larger than females and have more distinctive plumage coloration.

##### b) Age criteria and longevity

- 1) Rapid growth rate and changing plumage of young quail provide a means to estimate their age to the nearest week (HO 1.1).
- 2) Over 80 percent of wild quail die before they are a year old.
  - (a) Few wild quail live beyond 14 months.
  - (b) Captive bobwhites can live up to four or five years.

- 3) Noticeable stages of a quail's development can be seen for 16 weeks after hatching.
  - (a) Chicks are unable to fly during the first week after hatching and are covered with natal down.
  - (b) Young quail are almost adult size by eight weeks.
  - (c) At 16 weeks of age, quail are full-grown with distinctive head and throat markings.

c) Voice

- 1) Most characteristic call of the bobwhite is the courtship/territory whistle of the male (bob-WHITE).
  - (a) Serves as a challenge to other males in the vicinity and invites females to engage in the courtship.
  - (b) Males continue to use the bob-WHITE call throughout the summer to maintain their respective territories before and after the nesting process.
- 2) Both male and female use the gather call (whoil-kee) to regroup the covey after it has been flushed.
- 3) Bobwhite quail also have a soft chatter they use when feeding or running.
- 4) A universal alarm note (toil-ick-ick-ick) is used to warn each other of danger.
- 5) Quail have a low purring sound they make when a covey is on the verge of taking wing.

d) Physical mobility

- 1) Bobwhite quail are capable of short bursts of flight--sometimes reaching 40 to 50 miles per hour.
  - (a) Quail have short, cupped wings well-adapted to fast take off.
  - (b) Prefer to stay on the ground and use their legs to escape predators, find food, etc.
- 2) Bobwhite quail are incapable of sustained flight.

2. As the students if they think bobwhite quail are found in North Dakota, Minnesota or Canada. Point out the bobwhite is not found everywhere.

**How widely distributed and abundant are bobwhite quail?**

- a) Quail are found in every Missouri county.
  - 1) Missouri's quail population is in the millions.
    - (a) Hunters harvested approximately four million quail during the 1987 hunting season.
    - (b) Quail are not as numerous as they were 20 years ago
  - 2) Generally, quail populations are lowest in the Ozarks because of the large amount of woodland and in the Bootheel where there is little woody



- cover.
- 3) Extremely favorable habitat may carry densities of a quail per two to four acres. A bird per two to 12 acres provides favorable hunting conditions.
- b) Bobwhite quail are found over a large portion of North America (TM 1.1).
    - 1) Bobwhites cannot survive in the arid or mountainous areas of the western U.S.
    - 2) Bobwhites cannot withstand the colder climates of the northern states.
3. Ask the students to describe areas where they have found bobwhite quail. More than likely, the students will describe weedy or brushy cover which functions primarily as winter cover. Point out that quail, as well as other wildlife species, depend on different components of their habitat at different times of the year. Quail need grassy areas for nesting, bare soil for dusting, etc.

**What type of habitat do bobwhite quail require?**

- a) Bobwhite quail become most abundant where ample food sources are distributed in a combination of cropland, woodland, grassland and brushy cover. They are a creature of early successional stages.
  - b) A thorough mix of these plant cover types provides the "edge" this species requires.
    - 1) "Edge" refers to the area where plant cover types meet.
      - (a) Bobwhites need the "edge" provided by the border between crop fields, pastures, brushy areas and woodland.
      - (b) High quality edge places the quail's life requirements in a small area.
      - (c) "Edge" is extremely important because of the quail's low mobility, limited flight range and reluctance to move.
    - 2) Missouri quail often spend their lives within several hundred yards of their hatching point.
4. Explain that bobwhite quail, as a species, has developed particular habits as survival mechanisms.

**What kind of behavioral habits do bobwhite quail have?**

- a) One of the most noticeable habits of the bobwhite is the familiar bob-WHITE call of the male.
  - 1) Males use the call in the spring and summer to establish and maintain a territory for breeding purposes, attract a female and challenge other males in the vicinity.

- b) Territories and courtship
- 1) Males frequently fight over their territories when challenged by a rival male either before or after a female has arrived.
    - (a) Fights over territory rarely result in physical injury.
    - (b) Fighting among males is necessary for establishing territory, defending the hen and the nest, and showing ownership of the nest.
  - 2) Male 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 chicks.
  - 3) Nesting and brooding
    - (a) Both sexes share responsibility for raising the young.
    - (b) Male takes over incubating the eggs if the hen is killed.
    - (c) Both parents will "brood" the chicks to protect them. Brooding consists of gathering the chicks under the parent's wings to keep them warm and/or prevent them from getting wet.
  - 4) Covey formation
    - (a) The chicks are grown by early fall and family bonds begin to weaken.
    - (b) The "fall shuffle" is when individual quail begin to wander in search of other quail.
    - (c) Quail group together in coveys by early winter.
    - (d) Coveys contain an average of 123 to 16 individual birds and function as a unit during winter months.
    - (e) Coveys generally remain intact until mid- to late-March when pairs and single males begin to leave for the breeding season. Coveys are dissolved by the end of April.
  - 5) Roosting
    - (a) Quail roost by positioning themselves in a disc-like formation with their tails to the center and heads pointed outward.
    - (b) They slightly raise and overlap their wings to trap body heat.
    - (c) This type of roosting habit helps a quail covey survive cold winter temperatures an individual quail could not withstand.
    - (d) A quail covey may remain in their roosting formation all day on extremely cold days.
    - (e) Roosting habit is also valuable for predator detection.

- (f) Quail coveys usually roost in idle fields or the edges of brushy thickets where vegetation is two feet tall and somewhat sparse at ground level. They prefer an open sky above.
- 6) Dusting
  - (a) Bobwhite quail do not bathe in water like many other bird species.
  - (b) Quail take dust baths to keep themselves clean and remove external parasites.
  - (c) Quail usually dust in an open area where more than 75 percent of the soil is bare, and vegetation is less than a foot tall.
- 5. Ask the students who hunt quail if they have examined the seeds in a quail's crop. Ask them what kind of seeds were in the crop and make a list on the chalkboard. Point out that the contents of the crop of the same bird would vary with the seasons of the year. Also, have the students theorize about the diet composition of quail in the Ozarks versus the Bootheel.

**What foods do bobwhite quail eat?**

- a) Bobwhite quail eat a variety of foods depending on the season of the year and what type of foods are available.
  - 1) 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.
  - 2) Insects have a higher protein content than seeds, and the increase in insect consumption in spring coincides with the increased protein needs of egg-laying hens and newly-hatched chicks.
  - 3) Ground beetles, flies, ants, lady bugs, plant lice, aphids, etc. are examples of insects eaten by quail.
- b) 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.
  - 1) Korean lespedeza was a major food item for quail in the Ozarks.
  - 2) Corn, soybeans and other cultivated crops comprised most of the quail's diet in the agricultural areas of northern Missouri.
  - 3) Other plant seeds eaten by quail in Missouri are wheat, common ragweed, croton, foxtail, sumac, green-twig sassafras and acorns from oak trees.
  - 4) Seeds of annual plants provide about 80 percent of the quail's diet and 20 percent comes from perennial plants.

- 5) Bobwhite quail are not restricted by the distribution of specific kinds of plants within their geographic range.
6. Ask the students if they have seen a brood of newly hatched quail chicks. Point out that many things in the quail reproductive cycle must be successfully completed before a brood is produced.

**What are characteristics of the bobwhite quail's reproductive cycle.**

- a) Bobwhite quail have a high reproductive rate when habitat conditions are favorable.
- b) Nest site
  - 1) Bobwhites nest on the ground.
  - 2) Prefer open locations in areas where the ground is partially covered with vegetation.
    - (a) Quail avoid areas with thick and/or matted down vegetation because it restricts their movement on the ground.
    - (b) Usual location for a nest is in a thin spot in dead grass or near a clump of grass.
    - (c) Male and female select the nesting site.
- c) Nest structure
  - 1) Male and female build the nest together.
  - 2) They form a shallow depression about two and a half inches deep and four to five inches across.
  - 3) Bottom of nest cavity is filled with one inch of dead plant material (grass stems, tree leaves, etc.).
  - 4) Nest is completed with a "roof" of grass stems arched over the top.
- d) Egg laying and incubation
  - 1) Female will usually lay the first egg one or two days after the nest is completed.
  - 2) Female continues to lay an egg every day until 12 to 15 eggs are deposited.
    - (a) Eggs are white.
    - (b) Female does not incubate the eggs until all eggs are laid. Final number of eggs in a nest the female will incubate is called the "clutch."
    - (c) Embryos do not begin to develop until incubation begins. This allows all eggs to hatch at about the same time.
    - (d) Eggs require 23 days of incubation.
- e) Nesting cycle of the bobwhite requires 47 to 55 days which includes nest building, egg laying, incubation and hatching.
  - 1) In normal weather, the hatching peak is around June 15 with 65 to 75 percent of the annual crop produced during this month.

- 2) Loss of the nest to weather, predation, etc. is somewhere between 60 and 70 percent.
  - 3) If the first nest is unsuccessful, a pair of bobwhites will renest up to four times to raise a brood. They raise only one brood per year.
7. Ask the students why bobwhite quail have a high reproductive rate. Point out that this species has a high mortality rate which is offset by its reproductive capability.

**What adverse factors influence bobwhite quail populations?**

- a) The list of animals known to prey on bobwhite quail (eggs, chicks and/or adults) is impressive: skunks, opossums, foxes, coyotes, 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, turkeys, several species of snakes, housecats and dogs.
  - 1) Despite this long list of predators, they do not constitute a serious threat to bobwhite populations.
  - 2) Research on quail predation in Missouri revealed that:
    - (a) Fewer than one percent of 770 coyote stomachs contained quail.
    - (b) Fewer than one percent of housecat stomachs contained quail.
    - (c) Just over two percent of 1000 red fox stomachs contained quail.
  - 3) Although many animals will eat quail, no Missouri predator specializes in eating bobwhites.
- b) Weather is second only to habitat in its effect on quail populations.
  - 1) Hot, dry summers reduce nesting success by causing embryos to start developing before the hen is finished laying a clutch. This results in the hen leaving the nest after two or three eggs are hatched.
  - 2) Excessive rain during the nesting season may keep eggs from hatching or drown newly hatched chicks.
  - 3) Snow and ice make the quail's food supply unavailable. Low temperatures coupled with snow and ice can kill entire coveys.
- c) Most critical factor for bobwhite quail is habitat.
  - 1) Quail habitat is helped or hindered by how farmers use the land.
    - (a) Short-term population changes are caused by severe winter weather, but the continued long-term quail decline has been caused by the loss of quality habitat.

- (b) Farming patterns with a variety of crops, small fields, brushy thickets, pasture and idle areas produce the "edge" the bobwhite require.
  - (c) Clean farming with its manicured fencerows and large fields is the bobwhite's most effective enemy.
- 2) Quality wildlife habitat can be compatible with farm profits and soil conservation.
- (a) Well-managed grassed waterways and grassed backslope terraces.
  - (b) Properly managed forage systems will yield both high livestock profits and wildlife nesting cover.
  - (c) Conservation tillage conserves soil, tractor fuel and provides wildlife with winter food from waste grain.

#### F. Other activities

1. If you are teaching this lesson during the spring, encourage your students to do an early morning study of bobwhite courtship calls. Have them prepare a report of the date, time and location of each call. A hand-drawn map of their study area showing the data they collect would be a good exercise. If you have an area near the school with a quail population, you have the option of setting up an annual class activity. Keep track of the calling census over the years and you may be able to teach an actual example of population fluctuations.
2. During the quail season, you can supplement this lesson by bringing in a quail specimen for observation and/or dissection. You could also have the students bring in the crops of quail they legally harvest and analyze the contents.
3. Visit your county Agricultural Stabilization and Conservation Service (ASCS) office and purchase an aerial photo and make a copy for each student. Have the students make circles at areas on the map where several cover types meet such as the corner of woodlot, pasture and crop field. Point out that these are probable locations where quail could survive.
4. Have the students prepare a report describing the life of an individual quail through a calendar year.
5. Show the videotape "Bobwhite Through the Year" before teaching the lesson. "Farming and Wildlife: Bobwhite Quail" is more appropriate after the lesson has been taught.

## G. Conclusion

The bobwhite quail is only one wildlife species which lives in upland habitat. Although the quail is a conspicuous game species, it does not have any more ecological importance than other lifeforms.

The bobwhite quail and other upland species prefer habitat in early successional stages. Most wildlife management practices geared toward upland game species are designed to maintain plant cover in early successional stages.

The study of animal life histories will show the students why particular characteristics of habitat are important to a species. In the case of bobwhite quail, the students can easily see the why a close interspersion of plant cover types is important. Grassy areas for nesting, bare soil for dusting, sparse vegetation for roosting and woody cover for winter survival must all be within a quarter of a mile for bobwhite quail to survive.

## H. Competency

Outline the life history of the bobwhite quail.

## I. Answers to Evaluation

1. b
2. e
3. c
4. b
5. b
6. c
7. b
8. a
9. a
10. e

Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT IV - ANIMAL LIFE HISTORIES**

**Lesson 1: Bobwhite Quail (Upland Habitat)**

**EVALUATION**

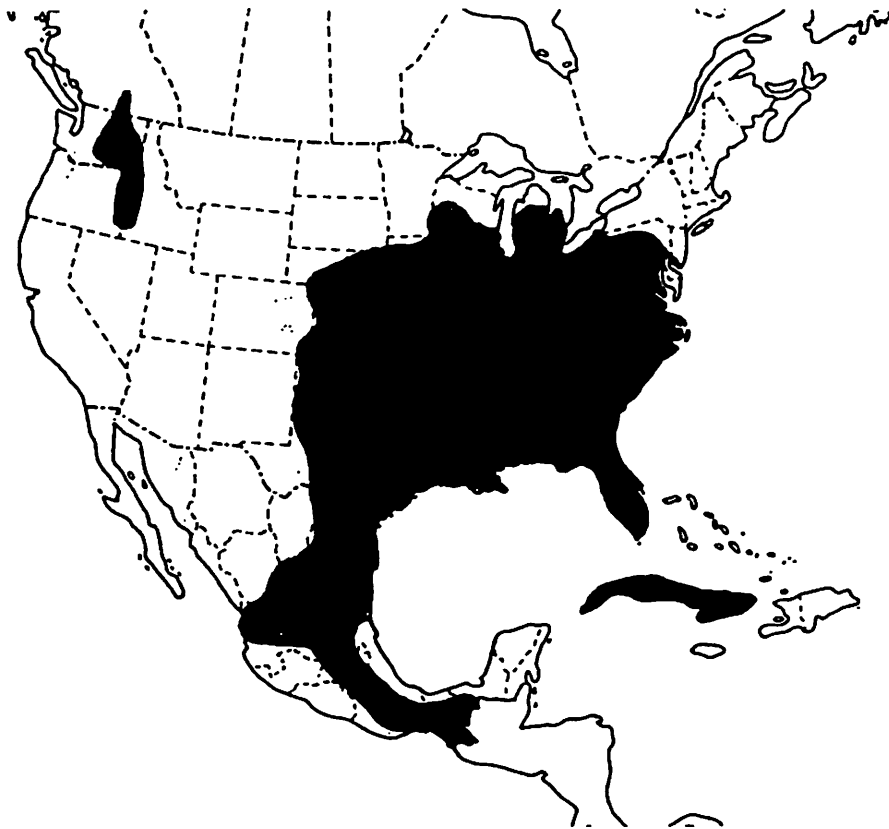
**Complete the following statements by circling the letter of the best answer.**

1. The \_\_\_\_\_ is not an upland game species.
  - a. mourning dove
  - b. white-tailed deer
  - c. bobwhite quail
  - d. ring-necked pheasant
  - e. cottontail rabbit
  
2. \_\_\_\_\_ percent of wild bobwhite quail die before they are a year old.
  - a. 10
  - b. 25
  - c. 40
  - d. 50
  - e. 80
  
3. Bobwhite quail are capable of short bursts of rapid flight reaching \_\_\_\_\_ miles per hour.
  - a. 10
  - b. 25
  - c. 50
  - d. 75
  - e. 90
  
4. Bobwhite quail are found \_\_\_\_\_ in Missouri.
  - a. north of the Missouri River
  - b. in every county
  - c. only in areas where corn and soybeans are grown
  - d. south of the Missouri River
  - e. none of the above



5. With adequate habitat, Missouri quail often spend their lives within \_\_\_\_\_ of their hatching point.
- a. one mile
  - b. several hundred yards
  - c. two miles
  - d. 50 feet
  - e. none of the above
6. Coveys are formed during the \_\_\_\_\_.
- a. spring
  - b. summer
  - c. fall
  - d. breeding season
  - e. none of the above
7. During the summer, about \_\_\_\_\_ percent of an adult quail's diet consists of insects.
- a. 5
  - b. 30
  - c. 50
  - d. 75
  - e. 90
8. Bobwhite quail nest \_\_\_\_\_.
- a. on the ground
  - b. in small shrubs
  - c. near the top of large trees
  - d. in tree cavities
  - e. all of the above
9. A pair of bobwhite quail will raise \_\_\_\_\_ brood per year.
- a. one
  - b. two
  - c. three
  - d. four
  - e. five
10. \_\_\_\_\_ have been responsible for the long-term reduction of bobwhite quail populations in Missouri.
- a. Coyotes
  - b. Hawks
  - c. Foxes and raccoons
  - d. Weather conditions
  - e. Clean farming and other habitat removal

# Range of Bobwhite Quail



## UNIT IV - ANIMAL LIFE HISTORIES

### Lesson 2: White-tailed Deer (Forest Habitat)

Objective: The student will outline the life history of the white-tailed deer.

#### Study Questions

1. What are physical characteristics of white-tailed deer?
2. How widely distributed are white-tailed deer?
3. What type of habitat do white-tailed deer require?
4. What kind of behavioral habits do white-tailed deer have?
5. What foods do whitetails eat?
6. What are characteristics of the white-tailed deer's reproductive cycle?
7. What are adverse factors affecting whitetails in Missouri?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. "Missouri Mammals I" poster. Missouri Department of Conservation.
3. Transparency Master
  - a) TM 2.1: Range of White-tailed Deer
4. Audiovisual
  - a) "Time Shadow - Encounters with the Whitetail" videotape (24 minutes). Available on loan from the Missouri Department of Conservation, Media Library, P.O. Box 180, Jefferson City, MO 65102-0180.

## UNIT IV - ANIMAL LIFE HISTORIES

### Lesson 2: White-tailed Deer (Forest Habitat)

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson.

##### B. Motivation

Ask the students to list particular deer habits and characteristics. Most of the students will probably give answers which revolve around deer behavior during late fall such as antler rubs and scrapes. Point out that deer have daily and annual cycles which guide their behavior. To truly understand deer, a person has to learn how they live throughout the year.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to describe a white-tailed deer. Follow-up by asking specific questions based on their answers. For instance, if a student describes a deer as having antlers, ask if antlers are grown every year or what time of year they are grown.

**What are physical characteristics of white-tailed deer?**

##### a) Size and sex criteria

- 1) Recognized by long legs and hooved toes, moderately long and well-haired tail, large size and presence of antlers during part of the year in males.
- 2) Antlers normally occur only in males but approximately three percent of females also have antlers.
- 3) The penis and scrotum are absolute sex identification characteristics for all ages of deer.
- 4) The sex of a deer cannot be identified by its track.
- 5) White-tailed deer continue to increase in weight until they are roughly six years old.
  - (a) Mature bucks in northern states usually weigh between 200 and 300 pounds with does weighing 25 to 40 percent less.

- (b) The record weight for a buck in Missouri is 369 pounds.
- b) Antler growth cycle
  - 1) Antler growth starts in April or May.
    - (a) Antlers first appear as "buds."
    - (b) Soft skin and short hair cover each antler as they are growing throughout the spring and summer (velvet).
    - (c) Blood transports the calcium, phosphorus, protein and other materials from which antlers are made.
  - 2) Full antler size is reached in August or September.
    - (a) Increasing amounts of the male hormone testosterone causes antlers to start shedding the velvet.
    - (b) Buck rubs antlers on trees to remove the dead skin.
    - (c) When the skin is shed, the bony core remains.
    - (d) Antlers are carried throughout the "rut" and are shed from the last of December to mid-February.
- c) Age criteria, age ratio and longevity
  - 1) Fawns are reddish brown to reddish yellow and have spots until they are three to five months of age.
  - 2) It is not possible to tell the age of a buck by the size of the antlers or the number of points.
    - (a) Antler growth depends on the deer's age, the quality and quantity of food, injury, hormone regulation and heredity.
    - (b) In Missouri there have been exceptional cases of well-nourished yearlings having a total of 10 or 11 points.
  - 3) The best means of age determination of deer in the field is by replacement and wear.
    - (a) Most accurate on fawns and yearlings.
    - (b) In Missouri, more than 90 percent of the harvest is composed of deer under four years of age.
  - 4) Deer are in the prime of life between two and a half and seven and a half years of age. Some may live for 15 years in the wild and up to 25 years under protection.
- d) Voice and sounds
  - 1) When scared, deer sometimes give a loud, hoarse, high-pitched shriek.
  - 2) Adults of both sexes may snort or bleat.
  - 3) Bucks, does and fawns may stamp their feet on the ground; this occurs whether they are annoyed or not.

- 4) Deer also communicate with scent glands and various movements of their tail, ears, head, face and body posture.
- e) Color
  - 1) In summer, both sexes are reddish brown to tan with white markings about the throat, underbelly, legs and tail.
  - 2) Winter coat is grayish to grayish brown.
  - 3) Adults have two molts annually.
    - (a) Winter coat is shed from the middle of March to around the first of June.
    - (b) The fall molt begins from August to mid-September and is completed by early October.
- f) Glands
  - 1) Tarsal glands
    - (a) Marked by a tuft of long, coarse hair on the inside of each hind leg at the ankle.
    - (b) Produce an oily secretion with a strong odor.
    - (c) Deer urinate down the inside of their hind legs to saturate the tarsal glands which causes a body odor that may be recognized by other deer.
  - 2) Metatarsal glands
    - (a) Located on the outside of each hind leg between the ankle and hoof.
    - (b) Have an oily secretion with a pungent, musky odor which serves to identify resting spots used by deer.
  - 3) Pedal glands
    - (a) Located between the two main toes on each foot.
    - (b) Secrete a strong offensive odor throughout the year.
- g) Physical mobility
  - 1) Deer normally walk, trot, or bound along in low, smooth jumps with an occasional high jump for observation.
    - (a) May run at speeds up to 35 miles an hour when startled.
    - (b) Deer are expert jumpers. They can clear fences eight and a half feet tall.
    - (c) White-tailed deer are good swimmers and can attain speeds of 11 to 13 miles per hour.

2. Ask the students if they think white-tailed deer are found in Mexico and Central America. Point out that whitetails have a very large range which includes almost all of the lower 48 states, a large portion of Canada and most of Mexico and Central America.

**How widely distributed are white-tailed deer?**

- a) White-tailed deer are found in every Missouri county.
    - 1) Most abundant in the Missouri River hills in east-central Missouri, the river drainages of northeastern Missouri, and in the upper Osage River watershed.
    - 2) In recent years, Missouri has had an annual deer harvest of well over 100,000 animals.
  - b) White-tailed deer have a large geographic range.
    - 1) Whitetails inhabit every state in the U.S. with the possible exceptions of Alaska and Utah.
    - 2) The northward range extends well into Canada.
    - 3) Whitetails are also found through Mexico, Central America and a portion of South America (TM 2.1).
  - c) The white-tailed deer has 38 subspecies over its geographic range. Northern subspecies are larger than their southern counterparts.
3. Ask the students to describe good deer habitat. Point out that whitetails are found near forested areas but heavily use other types of habitats. Explain that deer do not require wilderness areas to survive. They prosper in agricultural regions which have a good mix of land uses and can even live in wooded tracts in suburban areas.

**What type of habitat do white-tailed deer require?**

- a) White-tailed deer prefer forested areas.
    - 1) Prefer timbered areas which border other habitat types rather than dense, unbroken forests.
    - 2) A great variety of foods desired by deer grows best along margins of forested areas and clearings in the forest.
  - b) In addition to native vegetation, deer utilize the food offered by agricultural crops adjacent to timbered areas.
4. Ask the students to describe specific details of deer behavior. Point out that deer have predictable patterns of behavior on a daily and annual basis.

**What kind of behavioral habits do white-tailed deer have?**

- a) White-tailed deer tend to have an average annual home range of one-half to one and one-half square miles.
  - 1) Bucks may cover a larger area during rut.
  - 2) Local movements of deer in Missouri are related primarily to seasonal changes in food sources or cover.

- b) Daily activity
  - 1) Rarely move about during the day.
  - 2) Come out to feed and drink toward evening.
  - 3) Bed down for a few hours during the night and feed again about dawn.
  - 4) May feed all night if there is bright moonlight.
- c) Social behavior
  - 1) Deer associate loosely with each other all year.
  - 2) Establish a dominance relationship through postures and threats.
    - (a) First signs of aggression are made by one deer laying the ears back and staring at the other deer with the head slightly lowered.
    - (b) Bucks may continue by threatening with lowered antlers and rushing toward one another.
    - (c) Does may threaten by striking with one foot or by rearing up on the hind feet and attacking with both front feet.
  - 3) Bucks mark their home range with rubs and scrapes.
    - (a) Scrapes are made in leaves on the ground by pawing with the front feet.
    - (b) Scrapes are often reworked by males and are defended from other males.
    - (c) Females come to the scrapes and urinate in them to establish contact with the buck.
  - 4) Rut
    - (a) Bucks commonly fight during rut.
    - (b) Push and shove each other with antlers.
  - 5) Danger signals
    - (a) The tail is held high when a deer is running as a signal of alarm to other deer.
    - (b) The tail is flicked to indicate the lack of danger.

5. Point out that deer eat a wide variety of foods. Their diets change with the seasons and food availability.

**What foods do whitetails eat?**

- a) General diet
  - 1) Deer are browsing animals, feeding chiefly on leaves, twigs, and fruits of trees and shrubs and the foliage of herbaceous plants.
    - (a) Deer also consume seeds, mushrooms, lichens, succulent grasses, farm crops and sometimes small amounts of animal foods like snails and fish.
    - (b) Over 450 different kinds of plants are known to be eaten by deer in Missouri but only a few of these are used extensively.



- b) Winter diet
    - 1) Acorns are the preferred food.
    - 2) Winter diet also includes:
      - (a) Fruits of woody plants like sumacs and coralberry.
      - (b) Cultivated crops of corn, soybeans, wheat, rye and sorghum.
      - (c) Remaining green leaves of grasses and sedges.
      - (d) Twigs of a few woody plants.
  - c) Spring and summer diet
    - 1) Feed on succulent vegetation of perennial forbs, shrubs and trees in the spring.
      - (a) Fond of the new growth of white and red elm, fragrant sumac and red clover.
      - (b) Also feed on Virginia creeper, wild grapes, prickly lettuce and mushrooms.
    - 2) Summer diet consists largely of the leafy parts of fruits of annual and perennial plants.
      - (a) Wild grapes, Korean lespedeza, dwarf sumac and Virginia creeper.
      - (b) Red clover, pokeweed, persimmon and mushrooms.
  - d) Food selection
    - 1) Deer show a definite selection of plants and appear to take those that are most nutritious and palatable.
      - (a) Food selectivity can cause overbrowsing.
      - (b) Overbrowsing depletes food supply and results in a lower level of nutrition in the deer herd.
    - 2) Natural succession in forests can reduce the food available to deer because most of their food is associated with early seral stages.
  - e) Digestive tract
    - 1) Deer are ruminants with three so-called "stomachs" which are branches of the esophagus, and one true stomach.
    - 2) Food from the first stomach is regurgitated to the mouth for further chewing in the form of moistened balls known as cud.
    - 3) After chewing, cud is swallowed and passes through the digestive system.
6. Ask the students if they have ever seen a fawn in the wild. Follow-up by asking what it looked like and how it acted.

**What are characteristics of the white-tailed deer's reproductive cycle?**

- a) Breeding season (rut)
    - 1) Peak of breeding season is in November.
    - 2) Does come into heat as early as September.
    - 3) Heat period lasts for 24 hours and unmated does will continue to come into heat every 28 days during the breeding season.
  - b) Pregnancy and birth
    - 1) Gestation period is six to seven and a half months.
    - 2) Fawns are born in late May or early June.
      - (a) Doe usually has twins but sometimes may have a single offspring or triplets.
      - (b) At birth a fawn weighs between four and seven pounds and measures 17 to 19 inches.
      - (c) Females leaves the fawns alone but stays within hearing distance.
      - (d) Young remain in the close vicinity of their birthplace for several weeks.
    - 3) Family units
      - (a) Most common family unit is a doe and her fawns along with her fawns (now yearlings) from the previous year.
      - (b) Yearling bucks seldom accompany their mother. They stay alone or randomly associate with other bucks except during rut.
    - 4) About half of the young female deer in Missouri become sexually mature at six to eight months of age and consequently breed in the year of their birth.
7. Point out that the white-tailed deer are doing quite well in Missouri at the present time.

**What are adverse factors affecting whitetails in Missouri?**

- a) Predators
  - 1) Humans are the most effective predators.
  - 2) Free-running dogs are the second most effective predators.
  - 3) Bobcats and coyotes prey on deer, but the loss is not substantial.
- b) Parasites
  - 1) Parasites are not a threat to Missouri's deer population.
  - 2) Examples of parasites infecting deer are: roundworms, flukes, adult and larval tapeworms, mites, ticks, lice, and adult and larval flies.

c) Diseases

- 1) Missouri deer do not contract or carry brucellosis.
- 2) Diseases known to affect deer outside of Missouri include tuberculosis, tumorous growths, distemper, black tongue, hoof-and-mouth disease and others.
- 3) The most important cause of accidental death is highway kill. In Missouri, the official highway kill for 1986 was 8,020.

F. Other activities

1. If you are teaching this lesson during the fall, you may want to take the class on a field trip to observe buck rubs and scrapes. Locate the rubs and scrapes ahead of time and make arrangements for a class visit with the landowner if it is private land.
2. Examine the stomach contents of a legally harvested deer. If you and your students are not deer hunters, consider getting a wildlife donation from the local conservation agent.
3. Have the students prepare reports describing the life of an individual deer through the calendar year. Assign students either a buck or a doe. In a later classroom session, emphasize the social differences between bucks and does.
4. Tan a deer hide as a shop project.
5. Show the videotape "Time Shadow - Encounters with the Whitetail." Available on loan from the Missouri Department of Conservation Film Loan Library, P.O. Box 180, Jefferson City, MO 65102-0180.
6. Show the videotape "Venison Processing: A Meatcutter's Way." Available on loan from the Missouri Vocational Resource Center, 10 Industrial Education Building, University of Missouri-Columbia, Columbia, MO 65211.

G. Conclusion

The white-tailed deer is the most popular big game animal in North America and provides humans with food, sport and viewing enjoyment. It prefers forested areas which border other habitat types rather than dense, unbroken timber.

Missouri whitetails have progressed from a statewide population of 395 in 1925 to a harvest of over 100,000 deer during recent firearm seasons. The white-tailed deer renaissance is one of the greatest success stories of wildlife management, and testimony to the species' resilience. It is an adaptable creature which should continue to experience healthy populations in Missouri for many years to come.

H. Competency

Outline the life history of the white-tailed deer.

I. Answers to Evaluation

1. c
2. a
3. d
4. e
5. c
6. d
7. a
8. d
9. b
10. b

Name \_\_\_\_\_

Date \_\_\_\_\_

UNIT IV - ANIMAL LIFE HISTORIES

Lesson 2: White-tailed Deer (Forest Habitat)

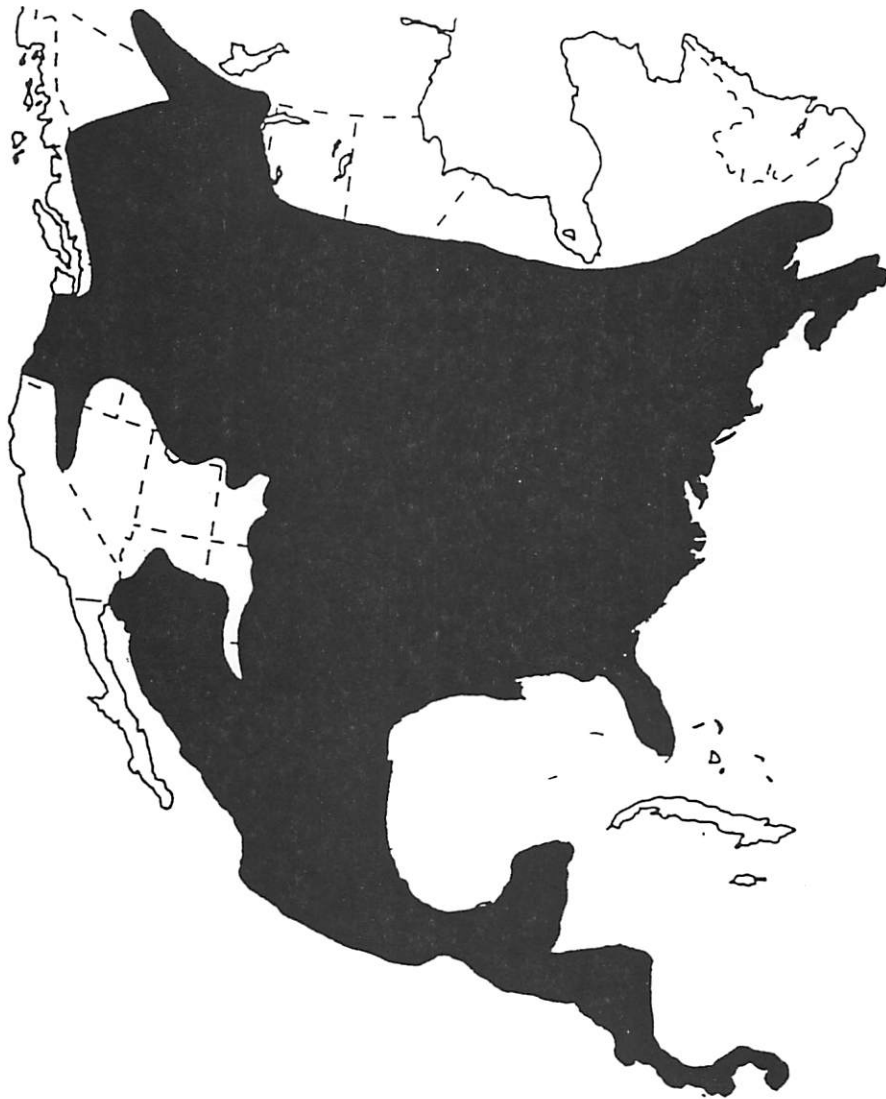
EVALUATION

Complete the following statements by circling the letter of the best answer.

1. The \_\_\_\_\_ is not a forest game species.
  - a. raccoon
  - b. gray fox
  - c. muskrat
  - d. white-tailed deer
  - e. gray and fox squirrels
  
2. Up to \_\_\_ percent of female white-tailed deer have antlers.
  - a. 3
  - b. 10
  - c. 20
  - d. 50
  - e. none of the above
  
3. Bucks usually lose their antlers during \_\_\_\_\_.
  - a. spring
  - b. summer
  - c. fall
  - d. winter
  - e. none of the above
  
4. A 12-point buck is \_\_\_\_\_ years old.
  - a. 12
  - b. 6
  - c. 4
  - d. 2
  - e. none of the above
  
5. In recent years, Missouri has had an annual deer harvest of over \_\_\_\_\_ animals.
  - a. 10,000
  - b. 50,000
  - c. 100,000
  - d. 250,000
  - e. 500,000

6. White-tailed deer prefer \_\_\_\_\_.
- a. dense, unbroken forests
  - b. areas with at least 90 percent rowcrops
  - c. large tracts of coniferous forests
  - d. forested areas which border other habitat types
  - e. all of the above
7. White-tailed deer tend to have an average home range of \_\_\_\_\_.
- a. 1/2 to 1 1/2 square miles
  - b. 5 to 10 square miles
  - c. 40 acres
  - d. 20 to 30 square miles
  - e. none of the above
8. Over \_\_\_\_\_ plants are known to be eaten by whitetails in Missouri.
- a. 25
  - b. 50
  - c. 100
  - d. 450
  - e. none of the above
9. The most common family unit consists of \_\_\_\_\_.
- a. Adult bucks and does
  - b. Does with her fawns and yearlings
  - c. Bucks with fawns
  - d. Bucks and does with their fawns
  - e. none of the above
10. \_\_\_\_\_ are the most effective predators on white-tailed deer in Missouri.
- a. Coyotes
  - b. Humans
  - c. Dogs
  - d. Bobcats
  - e. Mountain lions

# Range of the White-tailed Deer in North and Central America



## UNIT IV - ANIMAL LIFE HISTORIES

### Lesson 3: Largemouth Bass (Aquatic Habitat)

**Objective:** The student will outline the life history of the largemouth bass.

#### Study Questions

1. What are physical characteristics of the largemouth bass?
2. How widely distributed and abundant are largemouth bass?
3. What type of aquatic habitats do largemouth bass live in?
4. What kind of behavioral habits do largemouth bass have?
5. What foods do largemouth bass eat?
6. What are characteristics of the largemouth bass reproductive cycle?
7. How do adverse factors influence largemouth bass populations?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. "Missouri Fishes" poster (18 species). Missouri Department of Conservation.
3. Missouri Pond Handbook. Missouri Department of Conservation, 1982.



## UNIT IV - ANIMAL LIFE HISTORIES

### Lesson 3: Largemouth Bass (Aquatic Habitat)

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson with a general description of Missouri's aquatic resources.

##### B. Motivation

Ask the students to list examples of largemouth bass behavior. Point out that experienced bass fishermen have a thorough knowledge of how bass react to their habitat on a daily and seasonal basis. Understanding the reasons why bass have certain behavior make it possible for fishery managers and fishermen to predict where the fish are, what they are feeding on, etc. Studying the life history of the largemouth bass will help the students become better fishermen and provide more insight for managing farm ponds for healthy fish populations.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to rank the relative importance of sight, smell, touch and hearing to a bass.

**What are physical characteristics of the largemouth bass?**

##### a) Body shape and mobility

- 1) Member of the sunfish family.
  - (a) Deep, laterally compressed bodies.
  - (b) Spiny-rayed fins.
- 2) Largemouth bass have a high ratio of fin surface toward the front of their bodies. This allows quick movement in almost any direction.
- 3) Can swim at speeds up to 12 miles per hour.
- 4) Built for rapid bursts of movement.

##### b) Coloration

- 1) Have a large mouth with a dark stripe or blotches down the side.
- 2) Largemouth bass have a dark green back with white on the belly.
- 3) Color varies depending on the clarity of the water. Largemouth bass living in turbid water are lighter in color than those found in clear water.

- 4) Bass fingerlings can match the color of vegetation they are hiding in.
  - c) Growth and longevity
    - 1) Like other fish species, largemouth bass continue to grow throughout their lives.
    - 2) The world record largemouth bass weighed 22 pounds 4 ounces.
    - 3) Missouri's record largemouth bass weighed 13 pounds 14 ounces and was caught in Bull Shoals Lake.
    - 4) Life expectancy for a largemouth bass is eight to ten years.
      - (a) In Missouri, a largemouth weighing more than five pounds is usually ten years of age or older.
      - (b) Average life span is five years.
      - (c) Females tend to grow faster and live longer than males.
  - d) Hearing
    - 1) Bass sense the slightest vibrations in water through their lateral lines.
      - (a) A bass possesses two lateral lines; one on each side of its body.
      - (b) Nerve endings lying near the lateral line act as sensors to changes in water pressure and vibrations.
    - 2) Bass living in turbid water are forced to use their sense of hearing more than fish living in clear water.
  - e) Sight
    - 1) Bass have excellent eyesight and feed primarily by sight.
    - 2) Are able to see colors and distinguish red and green the best.
    - 3) Curvature of the eye lenses allows five times more light to enter a bass eye than a human eye.
    - 4) Bass have monocular vision which means each eye is controlled individually.
  - f) Smell
    - 1) The largemouth bass does not use its sense of smell extensively.
    - 2) Sight and hearing are more important than smell to a bass.
2. Ask to students to speculate on the distribution of the largemouth bass. Point out that this is a highly adaptable species which has expanded its range due to stocking.

**How widely distributed and abundant are largemouth bass?**

- a) Largemouth bass were originally found over the eastern half of the U.S.

- b) The largemouth is now established in all of the lower 48 states and in Hawaii.
  - 1) Its range extends from southern Canada to Mexico, Puerto Rico, Cuba and other Caribbean islands.
  - 2) It is found in every Missouri county. However, it is rare or absent in many streams of northwest Missouri.
3. Ask the students to describe the type of aquatic habitats where they have caught largemouths (pond, lake or stream; water clear or turbid; sparse or dense aquatic vegetation). Point out that bass (and other fish species) search for particular areas within the aquatic habitat to satisfy their needs.

**What type of aquatic habitats do largemouth bass live in?**

- a) Largemouth bass tolerate a wide range of aquatic conditions. They are extremely adaptable.
    - 1) Considered to be a nearly perfect stocking fish.
    - 2) Particularly characteristic of man-made impoundments of all sizes, the permanent pools of small streams with low flow and the backwaters of large rivers.
  - b) 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.
    - 1) Cover protects them from penetrating rays of sunlight.
    - 2) Cover near deeper water is preferred.
  - c) Largemouth bass favor water temperature between 65 and 75 degrees Fahrenheit, but will tolerate temperatures falling outside of this range.
4. Ask the students to describe some of their favorite fish stories. Follow-up by asking why the fish were easy to catch on that day. Point out that a fisherman has to have a good understanding of basic aquatic ecology and fish behavior to consistently catch fish.

**What kind of behavioral habits do largemouth bass have?**

- a) Largemouth bass are predators.
  - 1) Bass feed two times a day--usually at dawn and dusk.
    - (a) Primary stimuli causing bass to strike is the movement of prey animals.
    - (b) Bass may feed extensively before the approach of stormy weather.
- b) Largemouth bass will move to find the most comfortable water temperature.

- c) The species shows little social organization.
    - 1) Biggest individuals occupy areas with the best cover.
    - 2) Adults do not form schools.
  - d) Largemouth bass show definite attachment to a particular or stretch of shoreline. An individual bass may spend its life in a rather restricted area.
  - e) The activity level of largemouth bass is greatly reduced during the winter.
    - 1) Bass may eat less than one-tenth of their summer diet during the winter.
    - 2) Digestion process takes much longer due to reduced body temperature.
5. Ask the students to make a list aquatic organisms a largemouth bass would eat.

**What foods do largemouth bass eat?**

- a) Adult largemouth bass eat an incredible number of animals including small fish, crayfish, tadpoles, salamanders, worms, insects and frogs.
    - 1) After a bass has reached a six to eight inch length, it will consume almost any creature it can swallow.
    - 2) In large reservoirs the bass depends heavily on gizzard shad as food.
  - b) Bass fry and fingerlings eat water fleas and other small crustaceans.
  - c) The bluegill is an important prey species in many ponds and lakes.
  - d) Bass do not have a preference for a particular species of prey. Adult largemouth bass appear to eat food which is the most plentiful and easiest to capture.
6. Point out that many factors must work in unison for largemouth bass to successfully spawn.

**What are characteristics of the largemouth bass reproductive cycle?**

- a) Largemouth bass spawn once each year.
- b) Nest building
  - 1) Male bass moves into shallow water and search for a nesting site when the water temperature reaches 60 degrees Fahrenheit.
  - 2) Male bass 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.

- 3) Rocky or gravelly bottoms are preferred for nest construction.
  - 4) When completed, the nest may be from one to three feet in diameter.
- c) Spawning
- 1) The female will visit the nest voluntarily or under escort by the male when water temperature reaches 65 to 70 degrees Fahrenheit.
  - 2) During the spawning act, the female assumes a nearly horizontal position while the male remains upright depositing milt on the eggs.
  - 3) Several females may spawn in the same nest and one female may spawn in two or more nests with different males.
- d) Incubation
- 1) The male guards the nest from other aquatic organisms which eat bass eggs.
  - 2) Bluegills are the most effective predator of bass eggs.
  - 3) Male bass fans the eggs with his tail during the three to four day incubation period to keep them free of silt.
  - 4) 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.
  - 5) Schools break up in 26 to 31 days after hatching when the young bass are about one inch long.
  - 6) Male bass becomes a cannibal at about a month after hatching and eats part of his offspring.
7. Point out that the largemouth bass has a bright future in Missouri.

**How do adverse factors influence largemouth bass populations?**

- a) The largemouth bass is well-established throughout the state.
- b) Adverse factors affecting this species are usually localized.
  - 1) Population imbalances caused by improper stocking or poor length limit enforcement.
  - 2) Poor water quality.
    - (a) Reduced water visibility makes feeding difficult.
    - (b) Gills become clogged with silt.
    - (c) Silt covers eggs and prevents them from hatching.
    - (d) Turbidity reduces prey populations.

#### F. Other activities

1. Take the students to a pond and fish for largemouth bass. Point out the pond's watershed and discuss features of the pond which make it favorable for supporting a bass population.
2. Bring several legally harvested bass to the classroom and have the students analyze stomach contents.
3. Collect eggs from a legally harvested female bass and place them in a jar for student observation.
4. Use a hand lens or microscope to show the students the annual rings occurring on a bass scale.
5. Set up a display of different bass lures and describe how, when and where each lure should be used.

#### G. Conclusion

The largemouth bass is a very popular sport fish which has been stocked in ponds and reservoirs throughout the U.S. It is a highly adaptable species living in many different types of aquatic habitats. With good management, the majority of Missouri ponds and lakes can support largemouth bass populations and provide fishing enjoyment for many years.

#### H. Competency

Outline the life history of the largemouth bass.

#### I. Answers to Evaluation

1. c
2. b
3. a
4. c
5. b
6. d
7. a
8. d
9. a
10. e

Name \_\_\_\_\_

Date \_\_\_\_\_

UNIT IV - ANIMAL LIFE HISTORIES

Lesson 3: Largemouth Bass (Aquatic Habitat)

EVALUATION

Complete the following statements by circling the letter of the best answer.

1. The average life span of a largemouth bass is \_\_\_\_\_.
  - a. six months
  - b. one year
  - c. five years
  - d. ten years
  - e. twenty years
  
2. The world record largemouth bass weighed \_\_\_\_\_.
  - a. 10 pounds 4 ounces
  - b. 22 pounds 4 ounces
  - c. 54 pounds 11 ounces
  - d. 91 pounds 2 ounces
  - e. none of the above
  
3. Bass can sense vibrations in the water through their \_\_\_\_\_.
  - a. lateral lines
  - b. gills
  - c. mouth
  - d. scales
  - e. all of the above
  
4. Bass feed primarily by \_\_\_\_\_.
  - a. smell
  - b. hearing
  - c. sight
  - d. touch
  - e. none of the above
  
5. The largemouth bass is a \_\_\_\_\_ species.
  - a. rare
  - b. highly adaptable
  - c. threatened
  - d. endangered
  - e. none of the above

6. Bass may eat \_\_\_\_\_ their summer diet during the winter.
- a. more than two times
  - b. more than ten times
  - c. less than one-half of
  - d. less than one-tenth of
  - e. none of the above
7. \_\_\_\_\_ are not eaten by bass.
- a. Aquatic plants
  - b. Mice
  - c. Snakes
  - d. Frogs
  - e. all of the above
8. Male bass build their nests in \_\_\_\_\_.
- a. hollow logs
  - b. underwater brush piles
  - c. at least 20 feet of water
  - d. one foot to 15 feet of water
  - e. September and October
9. \_\_\_\_\_ are the most effective predators of bass eggs.
- a. Bluegills
  - b. Crayfish
  - c. Carp
  - d. Insect larvae
  - e. Bullheads
10. Turbid water adversely affects the largemouth bass by \_\_\_\_\_.
- a. clogging their gills with silt
  - b. suffocating their eggs
  - c. lowering water visibility
  - d. reducing the number of animals they prey on
  - e. all of the above



## UNIT IV - ANIMAL LIFE HISTORIES

### Lesson 4: Bald Eagle (Wetland Habitat)

Objective: The student will outline the life history of the bald eagle.

#### Study Questions

1. What are physical characteristics of the bald eagle?
2. How widely distributed and abundant is the bald eagle?
3. What type of habitats do bald eagles require?
4. What kind of behavioral habits do bald eagles have?
5. What foods do bald eagles eat?
6. What are characteristics of the bald eagle's reproductive cycle?
7. How have adverse factors influenced bald eagle populations?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.

## UNIT IV - ANIMAL LIFE HISTORIES

### Lesson 4: Bald Eagle (Wetland Habitat)

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson.

##### B. Motivation

Ask the students if they have had the opportunity to see a bald eagle in the wild. If they have, ask the students to describe how the eagle looked and acted. Guide the discussion to capture the excitement associated with seeing a bald eagle in the wild. Point out that even though the bald eagle is an endangered species, Missouri residents have a good chance to see one during the winter.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Follow-up on the motivation discussion by asking the students to describe specific details of the eagle's appearance.

**What are physical characteristics of the bald eagle?**

- a) Size and sex criteria
  - 1) Bald eagle is one of the largest birds of prey in the world.
    - (a) Mature adult has a wingspan of 6 1/2 to 8-feet.
    - (b) Weighs 8 to 15 pounds.
  - 2) Male and female are nearly the same size.
  - 3) Has a large hooked beak suited for tearing flesh.
  - 4) Feet are as large as a human hand and have sharp talons two inches long.
- b) Coloration, age criteria and longevity
  - 1) Adult bald eagle coloration
    - (a) White head, neck and tail
    - (b) Brownish black body plumage
    - (c) Yellow eye irises and feet
    - (d) Yellow feet
  - 2) Bald eagles do not take on this appearance until they are four years old. Younger individuals vary from solid dark brown to a mottled brown and white plumage.

- 3) Average life span of the bald eagle is 30 years in the wild, but some individuals have lived up to 50 years in captivity.
  - c) Vision
    - 1) Possesses eyesight five to six times more acute than a human.
    - 2) Prominent brow shades the eye for keener vision.
  - d) Voice
    - 1) High, thin note which can be heard over short distances.
    - 2) Creaky yelp sounding like a puppy.
    - 3) Do not have a piercing scream.
  - e) Physical mobility
    - 1) Normal flying speed of 20 to 40 miles per hour.
    - 2) Can dive at speeds up to 100 miles per hour.
    - 3) Can fly for long periods without rest.
    4. Highly maneuverable.
2. Ask the students to describe the range of the bald eagle. Point out that this species has a large range partially due to its migratory habits, but is not abundant within its range.

**How widely distributed and abundant is the bald eagle?**

- a) The bald eagle had about 20,000 nesting pairs in what is now the U.S. when it was chosen as our national emblem in 1782.
  - 1) Number of bald eagles has greatly declined since then due to:
    - (a) Human enroachment
    - (b) Habitat destruction
    - (c) Environmental contamination
    - (d) Open persecution
  - 2) Breeding range was reduced to Alaska, Canada, the Great Lakes states and the Pacific Northwest by the late 1800s.
  - 3) Today, there are only 1,400 pairs nesting in the lower 48 states.
- b) Missouri is one of the leading states for wintering bald eagles.
  - 1) Missouri has the second highest concentration of wintering bald eagles. Washington is first.
  - 2) Nearly 400 bald eagles were counted at Squaw Creek National Wildlife Refuge in northwest Missouri, one of the highest winter concentrations anywhere.

3. Ask the students to describe bald eagle habitat. Guide the discussion to reveal how bald eagles require large expanses of breeding areas and a ready source of food on their wintering grounds. Emphasize that an individual eagle must have adequate habitat thousands of miles apart. Compare bald eagle habitat management to more sedentary species such as the cottontail rabbit or bobwhite quail.

**What type of habitats do bald eagles require?**

- a) Bald eagles nest along lakes and streams in the remote, coniferous forests of Alaska, Canada, the Great Lakes states and Pacific Northwest.
  - b) Migrate each spring and fall.
  - c) Wintering areas
    - (a) Most bald eagles to states west of the Mississippi River in the fall.
    - (b) Tend to become concentrated in areas with open water such as large reservoirs and the tailraces of dams along major rivers.
    - (c) Bald eagles are more tolerant of humans and each other during the winter months.
4. Ask the students to describe bald eagle habits they are familiar with. Point out that some of the facts they may have heard are not true. For instance, the long-standing myth of eagles carrying off young children to their nests is false. Bald eagles very rarely attack humans unless provoked and are not capable of carrying away objects over ten pounds.

**What kind of behavioral habits do bald eagles have?**

- a) Sociability
  - 1) Bald eagles are independent birds which have little use for each other's company except when concentrated on their wintering grounds.
  - 2) Family groups are rare because young eagles must fend for themselves soon after leaving the nest.
  - 3) Communal roosts are a characteristic of the bald eagle on its wintering grounds.
    - (a) Birds will crowd together in one tree.
    - (b) Harass each other for the best positions.
- b) Migration schedule
  - 1) Majority of bald eagles will arrive in Missouri during December.
  - 2) Begin moving north again in late February, and it is rare to see a bald eagle in Missouri after April 1.

- c) Nesting habits
  - 1) Bald eagle mate for life.
  - 2) Male and female share the task of incubating the eggs and caring for the eaglets after they are hatched.
    - (a) Male captures prey and brings it to the nest.
    - (b) Female feeds the eaglets.
  - 3) Eagle nest is called an aerie.
    - (a) It is usually in the top of a giant tree and may be used by the same pair for 20 years.
    - (b) Bald eagles will return to their nest in March after a four- to six-week migration.
    - (c) 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.

5. Point out that bald eagles have definite food preferences, but are always meat-eaters.

**What foods do bald eagles eat?**

- a) Fish compose 60 to 90 percent of the bald eagle diet.
  - 1) Bald eagles capture fish by diving at the water surface and grasp fish near the top with their talons.
  - 2) Usually carry the fish away to a nearby perch for eating.
  - 3) Prey items weigh from three to five pounds.
- b) Bald eagles prefer fish, but will eat other animals.
  - 1) Follow waterfowl migrations and prey on ducks and geese as a secondary source of food.
  - 2) Will capture and eat rodents and other birds.
  - 3) Will consume carrion especially during winter when food is scarce.
- c) Bald eagles rob ospreys of fish they have captured.
- d) Bald eagles congregate near dams during the winter for the constant source of dead and stunned fish which have passed through the dam gates or hydroelectric turbines.

6. Ask the students to estimate how long it would take for a pair of bobwhite quail to produce 12 offspring in favorable habitat. How long would it take a pair of bald eagles to produce the same amount? Point out that bald eagles have a comparatively low reproductive rate even in optimum conditions.

**What are characteristics of the bald eagle's reproductive cycle?**

- a) Bald eagles have a low reproductive rate which characterizes species with relatively long life spans.
  - b) Egg-laying and incubation
    - 1) Female lays two white eggs (rarely three) in late March or early April at three to four day intervals.
    - 2) Eggs are hatched at the end of April or early May after a 35-day incubation period.
    - 3) Incubation begins immediately after the first egg is laid.
      - (a) This causes the first egg laid to be hatched first.
      - (b) First hatched eaglet has an advantage over its sibling when fighting for food in the nest due to its larger size.
      - (c) Eaglets sometimes kill their siblings in the nest.
  - c) Eaglet development
    - 1) Eaglets increase in size from three inches to three feet in 90 days.
    - 2) Eaglets leave the nest in 11 to 12 weeks.
      - (a) Parents force the eaglets to leave the nest by refusing to feed them.
      - (b) The eagle "family" does not stay together after the eaglets have left the nest.
  - d) Territorialism
    - 1) Bald eagles will attack nearly anything approaching their nest, including humans.
    - 2) 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.
7. Point out that the bald eagle has been the victim of many human activities--both intentional and unintentional.
- a) Federal government has passed laws to protect the bald and golden eagles from humans.
    - 1) The Eagle Protection Act of 1975 makes it a felony to shoot an eagle.
      - (a) Persons convicted of killing an eagle are subject to a fine of up to \$5,000, imprisonment of up to one year, or both.
      - (b) The same penalty applies for the possession of eagle parts or products without a permit.
    - 2) The federal government declared the bald eagle an endangered species in 1978 in 43 states, including Missouri.
      - (a) It is "threatened" in Minnesota, Wisconsin, Michigan, Oregon and Washington.
      - (b) The bald eagle is not considered threatened or endangered in Alaska which has a breeding population of 10,000 birds.

- b) Chlorinated hydrocarbon 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.
- 1) These pesticides do not break down and may persist in the soil and water as toxic compounds for many years.
  - 2) Indiscriminate application of these chemicals directly killed millions of non-target birds, mammals and invertebrates.
  - 3) 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) Being at the top of the food chain, bald eagles and other birds of prey accumulated these compounds in their body fat.
    - (b) Pesticide interfered with the production of egg shells inside the female's body.
    - (c) Thin egg shells caused the eggs to break during incubation resulting in poor reproductive success.
    - (d) Federal government banned DDT in 1972 and placed restriction on many other pesticides. Instances of pesticide poisoning have declined since then.

#### F. Other activities

1. If you are teaching this lesson in December or January, you may want to take your students to Eagle Days. This is an annual event sponsored by the Missouri Department of Conservation for the Missouri citizens to have an opportunity to see bald eagles in the wild. In past years the event has been scheduled at Clarksville, Squaw Creek National Wildlife Refuge, Mingo National Wildlife Refuge and Schell-Osage Wildlife Area. For current dates and locations consult the November or December issue of the Missouri Conservationist.
2. Have the students write an essay on why or why not the bald eagle is a respectable national emblem.
3. Take a field trip to a local zoo to give the students an opportunity to view a bald eagle in captivity.

#### G. Conclusion

The bald eagle is one of the most well-known wildlife species in the U.S. As our national emblem, it inspires confidence in ourselves and our country. However, comparatively few people are acquainted with the details of its life history and habits.

It will require a coordinated effort by resource agencies and the general public to maintain and hopefully expand bald eagle populations. If the bald eagle should someday slip away into extinction, we would lose a treasured species as well as a part of ourselves.

H. Competency

Outline the life history of the bald eagle.

I. Answers to Evaluation

1. c
2. c
3. c
4. d
5. a
6. b
7. d
8. b
9. e
10. a



Name \_\_\_\_\_

Date \_\_\_\_\_

UNIT IV - ANIMAL LIFE HISTORIES

Lesson 4: Bald Eagle (Wetland Habitat)

EVALUATION

Complete the following statements by circling the letter of the best answer.

1. The bald eagle has a wingspan of \_\_\_\_\_.
  - a. Two feet
  - b. Four to five feet
  - c. Six to eight feet
  - d. Ten to twelve feet
  - e. at least 15 feet
  
2. Bald eagles do not have a white head, neck and tail until they are \_\_\_\_\_ years old.
  - a. two
  - b. three
  - c. four
  - d. eight
  - e. ten
  
3. The average life span of a bald eagle in the wild is \_\_\_\_\_ years.
  - a. 10
  - b. 15
  - c. 30
  - d. 40
  - e. 50
  
4. There are only \_\_\_\_\_ nesting pairs of bald eagles remaining in the lower 48 states.
  - a. 100
  - b. 575
  - c. 1,000
  - d. 1,400
  - e. 12,000

5. Bald eagles do not nest in \_\_\_\_\_.
- Missouri
  - Alaska
  - Minnesota
  - Washington
  - all of the above
6. Bald eagles migrate to Missouri to \_\_\_\_\_.
- breed
  - spend the winter
  - select a mate
  - prey on abundant white-tailed deer
  - none of the above
7. Fish compose \_\_\_\_\_ percent of the bald eagle diet.
- 5 to 10
  - 15 to 25
  - 30 to 40
  - 60 to 90
  - 100
8. Bald eagles build their nests \_\_\_\_\_.
- on the ground
  - in the top of large trees near a river or lake
  - in abandoned buildings
  - in tree cavities
  - none of the above
9. The bald eagle is endangered in \_\_\_\_\_ states.
- 10
  - 25
  - 30
  - 50
  - none of the above
10. Chlorinated hydrocarbons become more and more concentrated in animals higher on the food chain through a process called \_\_\_\_\_.
- biological magnification
  - accelerated necropsy
  - hyperactive assimilation
  - asymmetrical osmosis
  - none of the above

## UNIT V - FISH AND WILDLIFE PROTECTION

### Lesson 1: Introduction to Fish and Wildlife Protection

Objective: The student will relate the reasons for fish and wildlife regulations and describe how they are made and enforced in Missouri.

#### Study Questions

1. What are the three basic objectives of fish and wildlife regulations?
2. What authority does the Missouri Conservation Commission have in making and enforcing fish and wildlife regulations?
3. How are state fish and wildlife regulations made?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1989.
2. A Summary of Missouri Hunting and Trapping Regulations, Missouri Department of Conservation, current year.
3. A Summary of Missouri Fishing Regulations, Missouri Department of Conservation, current year.

## UNIT V - FISH AND WILDLIFE PROTECTION

### Lesson 1: Introduction to Fish and Wildlife Protection

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson and briefly review Lesson 2 of Unit I.

##### B. Motivation

Ask the students if they are familiar with specific regulations. Ask them to speculate on why some of the specific regulations are enforced.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students to give three reasons why fish and wildlife regulations are passed and enforced.

**What are the three basic objectives of fish and wildlife regulations?**

- a) Enforcement of laws regulating the harvest of wild animals was the first tool of fish and wildlife management.
- b) History has proven that unregulated hunting, fishing and trapping can seriously damage fish and wildlife populations.
- c) Basic objectives of regulations
  - 1) Protect the fish and wildlife resource
    - (a) Harvest seasons
    - (b) Closed seasons over entire year
  - 2) Distribute the harvest equally
    - (a) Bag limits
    - (b) Possession limits
    - (c) Exemptions from permit requirements
    - (d) Special regulations for handicapped individuals
  - 3) Encourage ethical sportsmanship. These are regulations used to promote safety and to prohibit the use of certain types of harvesting methods and equipment. Examples are:
    - (a) Fluorescent orange clothing required of deer hunters.

- (b) Safety sticker on the guns of turkey hunters.
  - (c) Muzzleloading guns used to hunt deer must be a .40 caliber or larger.
  - (d) No person shall pursue or shoot wildlife from a motor driven land vehicle or aircraft at any time.
  - (e) 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 possession of any firearm, bow or other implement capable of harvesting game.
2. Ask the students what government agency has the authority to make fish and wildlife regulations. Where does the authority come from?

**What authority does the Missouri Conservation Commission have in making and enforcing fish and wildlife regulations?**

- a) Prior to the creation of the Missouri Conservation Commission, all fish and wildlife statutes and regulations were made by the State Legislature.
- b) The Missouri Conservation Commission was created and given authority to make and enforce regulations in 1937 by constitutional amendment.
  - 1) The Missouri Conservation Commission is the only state agency with the authority to recommend, pass and enforce fish and wildlife regulations.
  - 2) Only the State Legislature has the authority to assign penalties for violations.
  - 3) Wildlife Code of Missouri is a small booklet which describes regulations.
- c) The Missouri Conservation Commission is responsible for the enforcement of regulations.
  - 1) Enforcement is accomplished through the activities of approximately 175 conservation agents stationed at various locations throughout the state (usually one per county).
  - 2) Other Missouri Department of Conservation employees have enforcement authority, but it is not their main responsibility.
  - 3) Limits to authority
    - (a) Cannot arrest anyone for trespassing on private land without a signed land-owner complaint
    - (b) Cannot arrest anyone on private land for violating all-terrain vehicle laws passed by the State Legislature

- 4) Missouri Department of Conservation has full police power on land it owns, manages, operates or leases.
3. Ask the students how a Missouri citizen may submit a regulation recommendation for the Commission to consider.

**How are state fish and wildlife regulations made?**

- a) Regulation Committee of the Missouri Department of Conservation.
  - 1) Meets once a month to review suggested changes in the Wildlife Code.
  - 2) Committee is composed of MDC's top managers and administrators.
  - 3) Committee reviews recommendations for changes in the Wildlife Code from a variety of sources.
    - (a) MDC administrators and lower-level employees
    - (b) Individual Missouri citizens
    - (c) Special interest groups
    - (d) Missouri courts
  - 4) Committee bases its decisions on biological information with due regard for public opinion. Public hearings are sometimes held.
  - 5) Committee's first priority is the proper management of fish and wildlife populations.
- b) Missouri Conservation Commission
  - 1) Has final authority on recommendations made by the regulation committee.
  - 2) After approval by the Commission, the new and/or amended regulations are filed with the Secretary of State and become effective not less than ten days after being filed.
  - 3) Commission must adhere to federal guidelines from the U.S. Fish and Wildlife Service when setting migratory bird regulations (mourning dove, ducks, geese, etc.).
    - (a) Federal government has jurisdiction over migratory birds.
    - (b) The Commission has the option to be more restrictive than federal guidelines, but cannot pass more liberal regulations.

**F. Other activities**

1. Ask the local conservation agent to give a presentation to the class about fish and wildlife regulations.

2. Anyone born on or after January 1, 1967 must present proof of hunter safety training in order to purchase any type of Missouri hunting permit. Encourage the students to take the hunter education course offered by the Missouri Department of Conservation. Contact the local conservation agent for details.
3. Give each student a copy of the Wildlife Code of Missouri and have them list at least ten regulations in their own words.

#### G. Conclusion

Law enforcement is the foundation of fish and wildlife management. The tremendous population growth of Missouri white-tailed deer, turkey and other species during the past 50 years is largely due to the enforcement of regulations made by the Missouri Conservation Commission.

Missouri citizens can help conservation agents do their job by reporting poaching activities through the Operation Game Thief program. If you see a possible poaching violation in progress, call the local conservation agent or dial 1-800-392-1111. The identity of people reporting poaching activities remains anonymous. Rewards are available for information leading to the arrest and conviction of game-law violators.

#### H. Competency

Relate the reasons for fish and wildlife regulations and describe how they are made and enforced in Missouri.

#### I. Answers to Evaluation

1. c
2. a
3. b
4. d
5. a

Name \_\_\_\_\_

Date \_\_\_\_\_

**UNIT V - FISH AND WILDLIFE PROTECTION**

**Lesson 1: Introduction to Fish and Wildlife Protection**

**EVALUATION**

**Complete the following statements by circling the letter of the best answer.**

1. \_\_\_\_\_ was the first tool of fish and wildlife management.
  - a. Artificial stocking
  - b. Habitat management
  - c. Law enforcement
  - d. Creating wildlife preserves
  
2. \_\_\_\_\_ is one of the three basic objectives of fish and wildlife regulations.
  - a. Distributing the harvest equally
  - b. Raising funds for the U.S. Fish and Wildlife Service
  - c. Discouraging people from hunting, fishing and trapping
  - d. Aggravating sportsmen
  
3. The \_\_\_\_\_ passes and enforces Missouri fish and wildlife regulations.
  - a. U.S. Fish and Wildlife Service
  - b. Missouri Conservation Commission
  - c. Missouri Department of Natural Resources
  - d. Missouri State Legislature
  - e. none of the above
  
4. The \_\_\_\_\_ assigns penalties for violations of fish and wildlife regulations.
  - a. U.S. Fish and Wildlife Service
  - b. Missouri Conservation Commission
  - c. Missouri Department of Natural Resources
  - d. Missouri State Legislature
  - e. none of the above



5. The \_\_\_\_\_ and \_\_\_\_\_ cooperatively set migratory bird seasons and bag limits.
- a. U.S. Fish and Wildlife Service and Missouri Conservation Commission
  - b. Missouri Conservation Commission and the Governor
  - c. Soil Conservation Service and Dept. of Natural Resources
  - d. Conservation agents and other MDC employees
  - e. none of the above

## UNIT V - FISH AND WILDLIFE PROTECTION

### Lesson 2: Legal Process

Objective: The student will describe the legal process associated with fish and wildlife violations.

#### Study Questions

1. What is the legal process associated with fish and wildlife violations?
2. How can an individual receive a wildlife donation from a conservation agent?

#### References

1. Fish and Wildlife Management (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1988.
2. Wildlife Code of Missouri. Missouri Department of Conservation, current year.

## UNIT V - FISH AND WILDLIFE MANAGEMENT

### Lesson 2: Legal Process

#### TEACHING PROCEDURES

##### A. Introduction

Introduce the lesson.

##### B. Motivation

Ask the students what happens when someone is caught breaking the law. Point out that penalties in the form of fines or imprisonment vary with different types of violations. Most violations of the Wildlife Code carry a maximum fine of \$500 and/or a jail term not to exceed 90 days. However, such penalties are not assessed arbitrarily - due legal process must always be followed.

##### C. Assignment

##### D. Supervised study

##### E. Discussion

1. Ask the students what happens to a violator when he/she is caught by a conservation agent. Point out that there is a predictable legal process.

**What is the legal process associated with fish and wildlife violations?**

- a) Arrest and court appearance
  - 1) Conservation agent has the authority to arrest or issue the violator a "courtesy summons to appear in court."
  - 2) Violator must do one of the following depending on the seriousness of the violation or policy of the court having jurisdiction where the violation occurred.
    - (a) Appear in court
    - (b) Provide a written waiver pleading guilty
    - (c) Arrange for his/her attorney to appear in court

- 3) If violator does not do one of the preceding, the judge may issue a warrant for his/her arrest.
    - (a) Conservation agent or other local law enforcement officer will arrest the violator and take him/her to the sheriff's office or police station.
    - (b) Violator will be required to post a "bond."
  - 4) The violator (defendant) will appear in court on a specified date and has the right to plead guilty or not guilty.
    - (a) If plea is guilty, the judge will assess a penalty.
    - (b) If the defendant pleads not guilty, he/she has the choice of appearing before the judge or a jury.
- b) Penalties
- 1) Four legal categories of violations in the Wildlife Code.
    - (a) Infraction
    - (b) Class A misdemeanor
    - (c) Class B misdemeanor
    - (d) Class D felony
  - 2) Class A misdemeanor has a maximum penalty of \$250 with no jail term or court record (example: 2nd degree trespass).
  - 3) Majority of violations are class B misdemeanors.
    - (a) Maximum penalty of \$500 and/or a jail term not to exceed 90 days.
    - (b) Examples are: refusing inspection of a license or permit by a conservation agent; causing fish kills by polluting streams; using a shotgun with more than a three-shot capacity; harvesting more than the bag limit in one day; or spotlighting deer.
  - 4) Most serious violation of the Wildlife Code is a class D felony.
    - (a) Penalty carries a fine between \$200 and \$1000 and/or up to two years imprisonment in the state penitentiary.
- c) Use of collected fines
- 1) Conservation agents do not receive any of the money from fines collected for violations of the Wildlife Code.
  - 2) Public schools within the court's jurisdiction receive all fine proceeds.
  - 3) 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)

2. Ask the students if they have heard of anyone receiving road-killed deer from a conservation agent.

**How can an individual receive a wildlife donation from the conservation agent?**

- a) 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.
- b) Road-killed deer
  - 1) Should be reported to the local conservation agent or law enforcement agency immediately.
  - 2) Conservation agent may release the deer into the driver's custody by completing a wildlife disposition form.
  - 3) If the driver does not want the deer carcass the conservation agent may give it away to individuals and families who will make use of it.
  - 4) Unsalvageable deer are often disposed of by highway maintenance crews.
- c) Conservation agents may sometimes have wildlife carcasses or pelts seized as evidence of illegal activities. After the evidence has been shown in court, it is usually disposed of, or possibly given away for non-commercial use.
- d) People who want to receive wildlife donations should contact their local conservation agent and express their interest.
- e) 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.

#### F. Other activities

1. Ask the local conservation agent to give a presentation to the class about the legal process associated with people who violate the Wildlife Code.
2. Solicit wildlife donations from the local conservation agent as a class exercise. Have activities prepared to use the animal appropriately (game processing, hide tanning, etc.).
3. Have the students make a list of migratory birds which have complete protection under the law.

## G. Conclusion

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.

## H. Competency

Describe the legal process associated with fish and wildlife violations.

## I. Answers to Evaluation

1. c
2. a
3. a
4. c

Name \_\_\_\_\_

Date \_\_\_\_\_

UNIT V - FISH AND WILDLIFE PROTECTION

Lesson 2: Legal Process

EVALUATION

Complete the following statements by circling the letter of the best answer.

1. The majority of violations of the Wildlife Code are \_\_\_\_\_.
  - a. infractions
  - b. class A misdemeanors
  - c. class B misdemeanors
  - d. for trespassing on private land
  - e. class D felonies
  
2. \_\_\_\_\_ is an example a class D felony.
  - a. Using explosives to kill fish
  - b. Using a shotgun with more than a three shot capacity
  - c. Shooting ducks on the water
  - d. Hunting without a license or permit
  - e. Spotlighting deer
  
3. Money from fines collected for violations of the Wildlife Code go to the \_\_\_\_\_.
  - a. public schools within the court's jurisdiction
  - b. county prosecutor's office
  - c. sheriff's department
  - d. operation of the court
  - e. conservation agent
  
4. A road-killed deer should be \_\_\_\_\_.
  - a. buried
  - b. taken home immediately
  - c. reported to a conservation agent immediately
  - d. pulled off the road and left
  - e. hauled away and reported to a conservation agent within a week