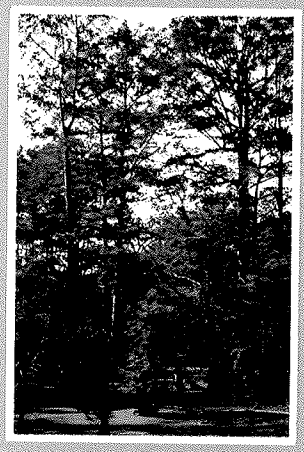
Natural Areas For Oklahoma



Oklahoma Natural Heritage Program

NATURAL AREAS FOR OKLAHOMA

Important Areas of Natural Significance in Oklahoma

Thomas A. Zanoni
Paul G. Risser
and
Ian H. Butler

Oklahoma Natural Heritage Program
University of Oklahoma
770 Van Vleet Oval
Norman, Oklahoma 73019

August 1, 1979

Bald cypress *Taxodium distichum* in southeastern Oklahoma

This report, *Natural Areas for Oklahoma*, is a summary of the results that have been achieved by the Oklahoma Natural Heritage Program after two and a half years of intensive information gathering and analysis. It is submitted to the Oklahoma Department of Tourism and Recreation in partial fulfillment of tasks described by the Program in the Oklahoma Natural Heritage Program Contract Phase II (Extension) 1978.

The report describes an element occurrence classification system designed to incorporate the diverse natural features of the State of Oklahoma. The report also discusses criteria for establishing priorities in the selection and evaluation of natural areas, and presents an initial directory of 148 high quality, potential natural areas within the framework of the classification.

In addition, a brief consideration of current and future capabilities of the Heritage Program is presented.

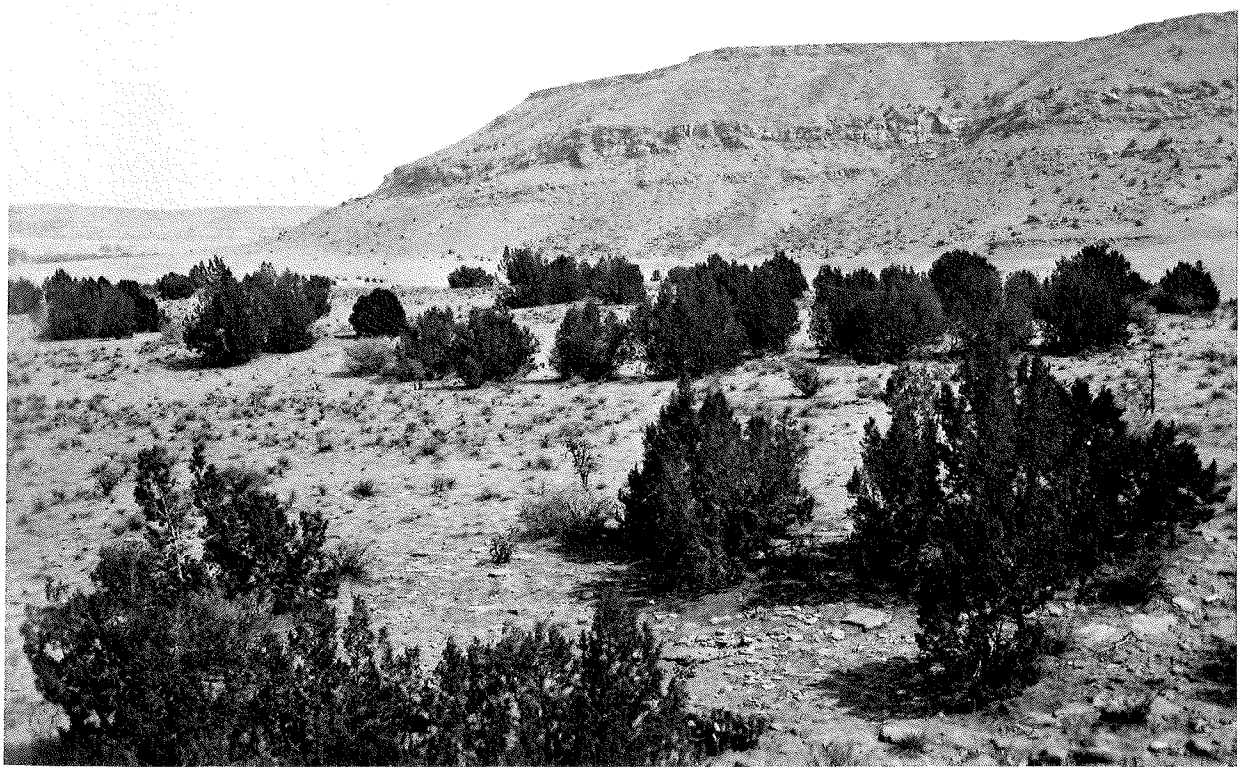
ACKNOWLEDGEMENTS

The Oklahoma Natural Heritage Program has depended upon the knowledge and cooperation of hundreds of Oklahomans. These individuals have shared information, made suggestions and encouraged the authors. In the future all of us in Oklahoma will profit from the past and future contributions and cooperative endeavors of these people.

Over the past two and one-half years, a number of individuals have served directly on the staff of the Natural Heritage Program. They have acted as consulting scientists, graduate research assistants, student assistants, technical assistants, and secretaries. This report and the effort to date would not have been possible without their expert assistance. The authors are sincerely grateful for contributions made by the following: H.P. Barnes, B. Branam, G.D. Clark, S.L. Collins, F. Forcella, D. Gettinger, M.G. Johnson, K.S. Kliewer, G.C. Kohlbacher, B.E. Leuck, M. Mason, S. Nelson, E.K. Niles, R.D. Owen, K.E. Parish, G.B. Richey, C.T. Schaefer, L.M. Smith, and J.A. Swift of The University of Oklahoma; E.I. Collin, M.E. Hirst, and R.L. Kline of Oklahoma State University; S.M. Lofton of Claremore Junior College; D.J. Huddleston and P.F. Nighswonger of Northwestern Oklahoma State University; S.A. Norris, C.E. Taylor, and B.R. Wright of Southeastern Oklahoma State University; and M.N. Fisher of the Nature Conservancy.

The Oklahoma Natural Heritage Program Advisory Council, appointed by the Governor of Oklahoma, has served as a review and advisory board of the activities for the Oklahoma Natural Heritage Program. Council members were selected from conservation, educational, state, and federal agencies in Oklahoma. The assistance and cooperation of these Council members are gratefully acknowledged: M.W. Baker, Jr., University of Oklahoma; H.G. Barclay, University of Tulsa; C. Bynum, Oklahoma Wildlife Federation; J.H. Carroll, U.S. Army, Corps of Engineers; L. Curtis, Oklahoma City Zoo; R. Gomez, Oklahoma Department of Wildlife Conservation; H.L. Harrell, Williams Brothers Engineering Company; R.D. Hecock, Oklahoma State University; W. Howard, Oklahoma Wildlife Federation; R.M. Laval, U.S. Forest Service; J.E. Lovell, Southwestern Oklahoma State University; J.L. Moleski, Williams Brothers Engineering Company; J.D. Monfore, Weyerhaeuser Company; R.R. Murphy; P.F. Nighswonger, Northwestern Oklahoma State

University; L.E. Orth, Kerr-McGee Corporation; R.W. Seibert, Southwestern Oklahoma State University; J.W. Sanford, Forestry Division, Oklahoma Department of Agriculture; L.A. Solomon, Oklahoma Conservation Commission; P.A. Vohs, Jr., Oklahoma Wildlife Cooperative Research Unit; F. Wade, Southeastern Oklahoma State University; J. Wilhm, Oklahoma State University; S.H. Wilkirson, U.S. Fish & Wildlife Service; P.R. Wilson, Oklahoma Water Resources Board; G.B. Wint, Oklahoma Department of Wildlife Conservation.



One-seed juniper, Juniperus monosperma at Black Mesa

Prickly pear cactus, Opuntia polycantha, from western Oklahoma

CONTENTS

Photographs provided by Dr. George Goodman

Partridgeberry, Mitchella repens,
growing in Southeastern Oklahoma

INTRODUCTION

The natural environment of Oklahoma is a dynamic mosaic of interacting plant and animal aggregations on the landscape, interdependent upon one another for food, shelter, and living space. Close integration of these biological elements has, over thousands of years, steadily influenced diverse adaptations of life cycles, structures and physiological responses into a wonderful array of natural features which today inhabit the thin rim of our earth (29)*.

Because of its central geographic position in relation to the broad biological zones of our continent, the State of Oklahoma has representatives of many of these fascinating and different biological features.

Prior to the arrival of man these myriad features remained unaltered except for disburbances by events such as drought, tornadoes, floods, lightning, fires, and native pestilences. But alteration of the landscape has always been a part of man's occupation of the State. Native American residents used wildlife and plants in their daily existence, as did the early settlers of Oklahoma. With increased population densities, landscape modification accelerated. Native grasslands were converted to cultivated farmland and pasture for livestock; the forests of eastern Oklahoma were cut for timber and subsequently planted to cropland and pasture. Alteration of streams and rivers for recreation, flood control, agriculture and domestic water storage also became widespread. With the increased demand on these natural resources, changes in the vegetation and wildlife were inevitable.

Today, we are living in this modified environment and we continue to alter it, directly or indirectly, by our requirements for existence and by our recreational pursuits. The habitats of our plants and animals have

*Numbers in parentheses refer to literature cited in the bibliography.

been changed in many parts of the State.

In contemplating the future of our State, it is neither possible nor desirable to attempt a reversion of Oklahoma's landscape to a primeval state. However, because of the widespread alteration of natural habitats, preservation of representative examples of these biological features is an important obligation to those of us entrusted with the stewardship of Oklahoma.

Beginning in January, 1977, the Oklahoma Natural Heritage Program became a planning activity of the office of the Division of Planning and Development of the Oklahoma Tourism and Recreation Department under the direction of Mr. Abe L. Hesser. As such, the Oklahoma Natural Heritage Program began an inventory of the natural features of the state, principally plant and animal species, and terrestrial and aquatic habitats. In addition, work was started which continues today, to identify and evaluate these features as areas of ecological significance for the purpose of discerning representative or outstanding or unusual natural areas. To accomplish these tasks it was necessary to develop a classification system of natural features which characterized the State's natural diversity. This classification system is an important tool that provides a rational scheme with which to direct the acquisition and use of data, including the resultant selection and designation of bio-reserves. Today, the information and methods developed by the Heritage Program can begin to guide the State of Oklahoma in determining which areas are most worthy of recognition and protection.

Outstanding examples of biological or physical features which are protected from disturbance or destruction through binding and formal agreement with the people of Oklahoma are termed natural area preserves. A natural area:

> *aims to maintain in perpetuity an essential heritage of biota and physical features, valued in their own right, and as a resource which mankind can draw upon for economic and material purposes, and for aesthetic and intellectual gain.* (27)

These areas constitute a potent resource for the future of Oklahoma, and should be valued and sustained comparable to the State's mineral and agricultural reserves, for in the long run, they can yield comparable economic and cultural benefits to all Oklahomans.

Natural areas have three major functions: to serve as facilities for environmental research and monitoring, as reserves for the conservation of genetic diversity in plants and animals, and for recreational educational purposes.

Environmental Research and Monitoring

"Man masters nature not by force but by understanding" (5). There is little doubt but that this is one of the hardest lessons mankind has had to learn over the centuries. In order to "master nature" we need to more completely comprehend "the immense complexities of the ecosystem and the interrelationship of plants and animals and their environments" (16). The study of these natural systems is best accomplished in undisturbed places where their workings are not masked nor altered by human influence, and where the truths of the matter may be discerned.

Research is an appropriate activity for many natural areas, always providing that no deleterious effects to the natural area result

from research projects. Information gained from both basic and applied research in undisturbed natural areas can be invaluable for land use planning; it can minimize costly errors and may reveal unsuspected opportunities for a wide variety of interest.

Knowledge of the functions and interrelations of species in ecosystems is important for monitoring environmental quality. Unspoiled areas serve as sensitive, full-time warning systems, or "miners' canaries" (15), and "provide convenient monitors of all pollutants including their synergistic effects" (33). In agriculture and forestry there is a growing concern for systems management, acknowledging "that every component of a naturally functioning ecosystem serves a purpose and that each component benefits the system in some way" (19). Discovery of the functions of these components through the study of representative natural areas could be instrumental in lessening our present dependency on expensive energy-intensive agricultural and silvicultural techniques.

Genetic Diversity in Plants and Animals (25)

Genetic diversity in populations is the result of slow evolutionary processes over long periods of time. This diversity is quickly reduced in the face of outright destruction of many sensitive populations or because of drastic habitat alterations which do not permit these populations to thrive. Today, rapid habitat destruction by expanding human populations is reducing our genetic resources very quickly. These genetic resources have economic and societal values which are often overlooked. Our wild and weedy species potentially have many direct applications in medicine, such as those species showing anti-cancer activities, or drug properties; in industry, as sources of fuels, timber, fibers or oils; in the direct enhancement of agricultural productivity, such as improved forage grasses, or species useful for land reclamation and erosion protection.

The protection of designated natural areas as reservoirs of genetic diversity ensures that a rich variety of life will be preserved for the use of coming generations.

All areas designated specifically as genetic reservoirs exclude human activities, with the exception of minimal maintenance requirements.

Recreation and Education

Many natural areas are suited for human use. In fact, public awareness of the purposes and uses of natural areas is necessary for continuing the Natural Areas Program. Increased public awareness is best accomplished through direct public participation in natural areas, and hopefully will contribute to the enhancement of public attitudes toward wildlife and to a better understanding of the natural world.

Public attitude will depend upon the success of various activities that are compatible with the maintenance of nature preserves. These activities include:

Nature-oriented recreation:
Photography; sketching; hiking, observing plants, animals and scenic areas.

Nature-oriented education:
Use of nature trails; identifying various plants and animals; study of ecological processes; informal nature studies by individuals, school groups, and science teachers.

The success of a publicly used natural areas has several social benefits. The presence of a high quality natural area in a community can be a source of local community pride, and may tend to attract others to live or work in the community. Also, it has been

documented that public appreciation for a natural area often results in a general increase of respect for public and private property, with an attendant decline in vandalism (21). Finally, a working natural area retains its role as an oasis for the public from encroaching residential or industrial development and from the pressures of daily life.

This report is grouped into four major sections:

Section I THE NATURAL DIVERSITY OF OKLAHOMA discusses the State's natural diversity, relating the terrestrial, aquatic, floral and faunal features, their distributions, and the factors influencing climate.

Section II NATURAL AREA INVENTORY: METHODS AND RESULTS presents the methods used by the Program to characterize the State's natural diversity, as well as the processes used to select and evaluate potential natural areas. Also, an analytical profile of the top 148 recommended areas is shown.

Section III MANAGEMENT RECOMMENDATIONS outlines approaches to the problems of natural area management policies, and discusses an overall management policy for a system of natural areas in Oklahoma.

Section IV TODAY AND TOMORROW summarizes the Heritage Program's work to date, its goals for the future, and describes some major services now offered to the people of the State.

SECTION I

THE NATURAL DIVERSITY OF OKLAHOMA

THE NATURAL DIVERSITY OF OKLAHOMA

Oklahoma is blessed with a wide variety of natural features which represent our natural heritage. As noted previously, the purpose of the Oklahoma Natural Heritage Program is to identify top quality representative areas which collectively ensure that a complete array of examples is eventually preserved for future generations. Much of the State's pre-settlement plant and animal life has been displaced or destroyed by agriculture, industry, or urban development. It continues to dwindle today to the extent that many people have yet to see lands or rivers which have not been manipulated by the hand of man.

The following section describes the aboriginal natural features of Oklahoma, many of which, with the exception of geologic and topographic features, exist today only as remnants of their former distributions. These features formed both the basis of the Heritage program classification, and the standards by which the quality of natural areas are to be judged.

Geologic and Topographic Features (8, 11)

The surface of Oklahoma is marked by distinctive geomorphic provinces which are readily apparent in their geologic and topographic characteristics (Fig. 1). The major mountain provinces are the Ozark Plateau, Boston Mountains, Ouachita Mountains, Arbuckle Mountains and Wichita Mountains.

In northeastern Oklahoma the Ozark Plateau is a deeply dissected plateau of limestones and cherts; the adjacent Boston Mountains are formed from a deeply dissected plateau with a sandstone cap.

The Arkansas Hill and Valley Belt is an area of gently rolling plains capped by sandstone.

The Ouachita Mountain Province of southeastern Oklahoma includes three sections of folded and faulted rock structures: The

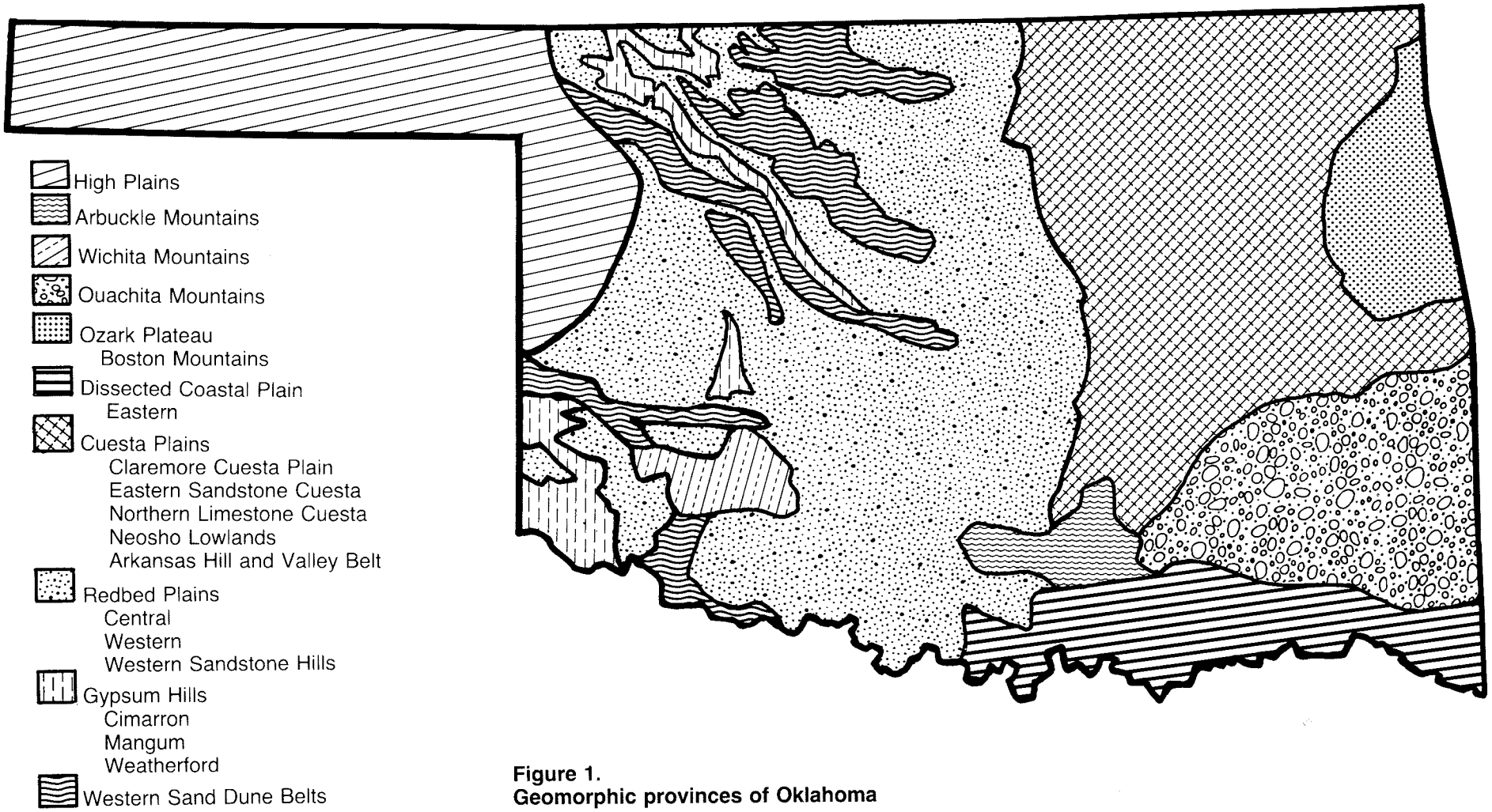


Figure 1.
Geomorphic provinces of Oklahoma

Beavers Bend Hills, moderate to high elevation hills and ridges of sedimentary rock; the Ridge and Valley Belt, long and sinuous mountain ridges of sandstone above shale valleys; and the Hogback Frontal Belt, thrust blocks in hogback ridges of sandstone and limestones.

In southcentral Oklahoma the Arbuckle Mountain Province consists of the Arbuckle Hills, a series of low to moderate elevation limestone hills, and the Arbuckle Plains, gently rolling hills and plains developed on granite and on gently dipping limestone.

The Ardmore Basin, a lowland of shales and sandstone, is between the Arbuckle Mountain Province and the Dissected Coastal Plain Province.

The Wichita Mountain Province includes the Wichita Mountains and the Quartz Mountains of southwestern Oklahoma. This province consists mainly of peaks of granite and other igneous rock with a region of low to moderate elevation hills of limestone.

The Dissected Coastal Plain is a region of sands, gravels, and clays on the old Gulf Coastal Plain in southeastern Oklahoma, chiefly along the Red River.

Several portions of the State have nearly level to rolling terrain. In northeastern Oklahoma these plain regions include the Neosho Lowland, gently rolling shale lowlands with a few, limestone-capped escarpments and buttes; the Claremore Cuesta Plains, resistant sandstones and limestone gently dipping westward forming cuestas between broad shale plains; and the Eastern Sandstone Cuesta Plains, west-dipping sandstone cuestas with broad shale plains. The plains region of central Oklahoma includes the Northern Limestone Cuesta Plains, west-dipping cuestas of limestone with broad shale valleys in between; and the Central Redbed Plains, gently rolling hills and broad, flat plains of shales and sandstone.

The western region of the State has a nearly level to gently rolling terrain, with hills in several provinces. The Western Sand Dune Belts are stabilized sand dunes of alluvium blown mainly onto the north sides of the rivers. Hilly provinces include the Cimarron Gypsum Hills, escarpments and badlands of interbedded gypsum and sandstone; the Western Sandstone Hills, of soft, flat, red sandstones forming gently rolling hills dissected by steep-walled canyons; the Western Redbed Plains, gently rolling hills of flat red sandstones and shales; the Weatherford Gypsum Hills, gently rolling hills in massive gypsum; and the Mangum Gypsum Hills, gently rolling hills to steep bluffs and badlands developed on interbedded gypsum and shale.

In the northwestern region and the Panhandle are the High Plains, an area of nearly flat to gently rolling surface derived from alluvial sands and deeply cut by water-courses. The northwestern tip of the Panhandle is the location of the flat-topped Black Mesa (Mesa de Maya), an erosional remnant of a basaltic lava flow from Colorado that has the highest elevation in Oklahoma.

Vegetation (3, 9, 10)

The native vegetation of Oklahoma is varied, ranging from the dense forests of the eastern mountainous areas to the grasslands of central, western, and Panhandle regions. For convenience, the vegetation is discussed as broadly defined units, even though a unit may be quite complex and include several phases and successional stages. The game types (Fig. 2) of Duck and Fletcher (1943) are used as the basis for this discussion. The vegetation types are actual units; however, the map presents them as "potential vegetation." This implies that in the areas indicated on the map, the vegetation would be the type designated if the native vegetation were present and if

disburbances were minimal, allowing for development of the climax vegetation.

The Bottomland Forest type occurs along streams and rivers throughout the State, but actual species composition is quite variable. Cottonwood and willow are often the only woody species in the Panhandle and western Oklahoma. Many species compose the bottomlands of central and eastern Oklahoma: American elm, chinquapin oak, hackberries, chittamwood, oaks, sycamore, pecan, bitternut hickory, and black walnut. Sweet gum, black gum, water oak, and willow oak occur in far eastern and southeastern bottomlands. The Cypress Bottom Forest type is similar to the other southeastern Bottomland Forests, but includes the bald cypress. The Cypress Bottom Forest occurs along streams and rivers, but is more fully developed along ox-bow lakes and small streams with reduced flow.

The Oak-Hickory Forest type is located primarily in the northeastern Ozarks Highlands and also in some areas of the Ouachita Mountains. This type occurs on mountainous terrain, often on limestone. Tree species are more numerous than in other forested types in Oklahoma. The common oaks include blackjack oak, post oak, red oak, pin oak, black oak, and white oak. Other common trees are black hickory, pignut hickory, shellbark hickory, and winged elm. The understory includes many different species of shrubs and herbs.

The Oak-Pine Forest type occupies most of the Ouachita Mountains and small parts of the Ozark Mountains. In these mountainous areas the soils are derived from sandstone and shales or limestones. The vegetation type is marked by the presence of shortleaf pine in a mixture of oaks and hickories. Slope, exposure, soil type and soil moisture determine the composition of the vegetation. Common trees are shortleaf pine, white oak, blackjack oak, post oak, Shumard oak, black locust, black history, American basswood, and sugar maple. The shrub layer is often well developed and may include huckleberry, hoary mock orange, azaleas, gooseberry, and spicebush.

The Loblolly Pine Forest type in extreme southeastern Oklahoma is part of the extensive loblolly pine forests of the Gulf Coastal Plain. Loblolly pine occurs in nearly pure stands or mixed with oaks and hickories on sandy soils.

The Post Oak-Blackjack Forest type covers parts of the eastern two-thirds of the State. Post-oak, blackjack oak, and black hickory are the principal tree species, while little bluestem and big bluestem grasses may occur in open woodlands. This vegetative type occurs on rolling to rough terrain in soils derived from sandstone and shale, and on wind-blown sand in the western parts of its distribution.

The Tallgrass Prairie type occupies the central two-thirds of the State on flat to gently rolling terrain where soils are developed from shales and clays in the central region and from limestone, sandstone and shales in the northeastern region. Big bluestem, little bluestem, indiangrass, and switchgrass are the principal tallgrasses. Blue grama, sideoats grama, and buffalo grass occur more often to the western parts of the Tallgrass Prairie.

The Mixedgrass Eroded Plains type occurs in the western third of Oklahoma. A mixture of tallgrasses and shortgrasses characterize this type on rolling to deeply cut ravine and canyon terrain on soils derived from sandstones, shale and clay. Erosion is often severe in certain areas and gypsum may be exposed. Principal grass species are little bluestem, buffalo grass, blue grama and sideoats grama; many forbs are also present.

The Stabilized Dune type occurs along the larger rivers in the northwestern part of the State, especially on the north side of the Cimarron and North Canadian Rivers. This

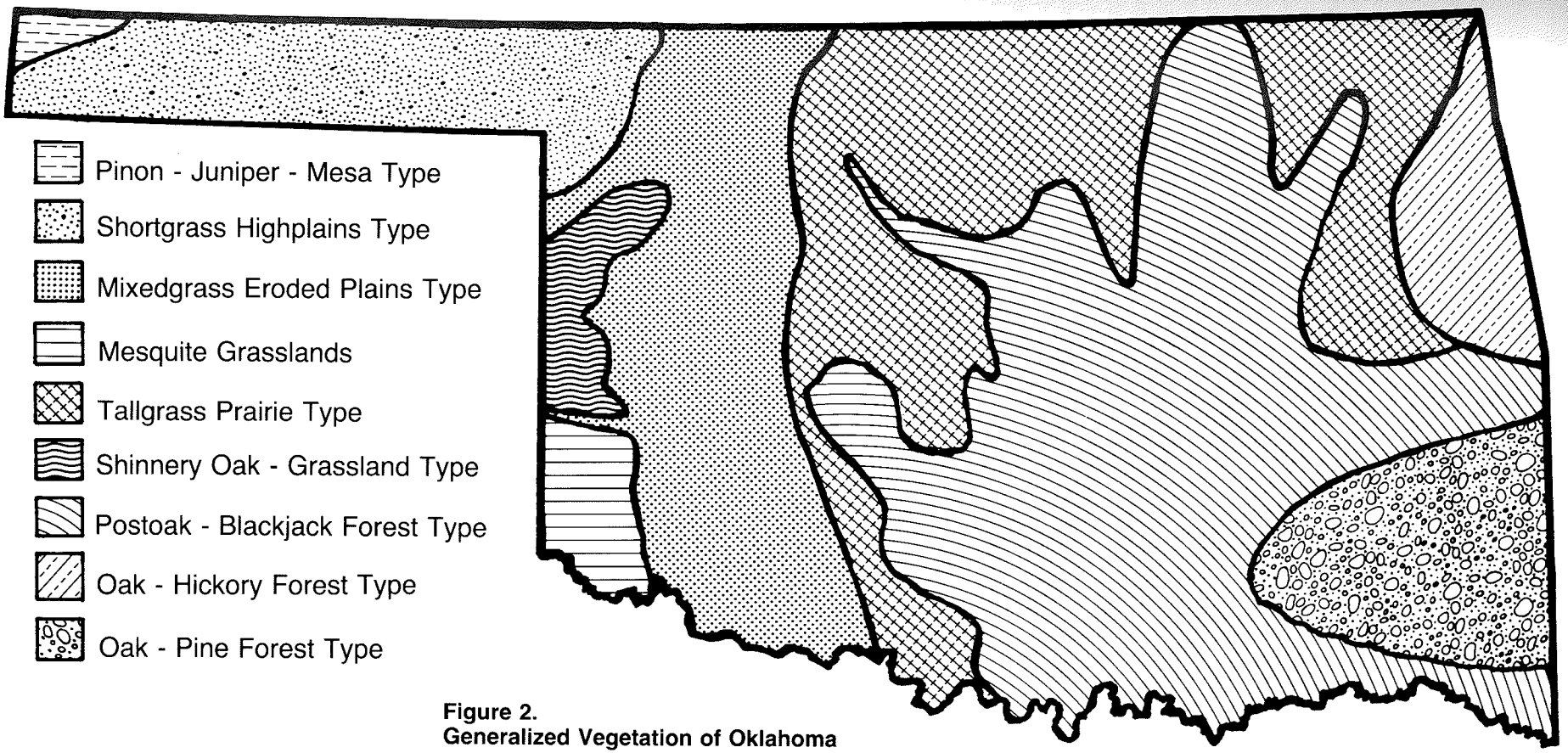


Figure 2.
Generalized Vegetation of Oklahoma

area consists of vegetated, stabilized dunes and a few shifting dunes. Woody plants on the dunes are American elm, hackberry, chittamwood, post oak, blackjack oak, grapes, sand plum, roughleaf dogwood, and aromatic sumac. Big sandreed, sand bluestem, little bluestem, other grasses, and forbs also occur on the dunes.

The Shinnery-Oak-Grassland type occurs along the western edge of Oklahoma on low, rolling terrain of deep, sandy soils. This type occurs as a shrub to short savanna usually with Havard oak (shin oak), hackberry, sand plums, aromatic sumac, grapes and other woody species. Little bluestem, sideoats grama, blue grama, and buffalo grass are frequently present.

The Sand-Sage-Grassland type occurs in scattered areas in western Oklahoma, mainly in the northwestern part and the Panhandle. The terrain is rolling and dune-like with sandy soil. Sand sagebrush, sand plum, aromatic sumac, and hackberries are the major woody species. Little bluestem, sand bluestem, indiangrass, and various shortgrasses are often present.

The Shortgrass-Highplains type of the Panhandle and extreme northwestern part of the State is on an extensive plain of outwash materials from the Rocky Mountains. Buffalo grass, blue grama, sideoats grama and three-awn grass are the predominant grasses. Prickly pear cactus and yucca are common on areas of sparse grass cover.

The Pinon-Juniper-Mesa type occurs on the mesa topography of the northwestern corner of the Panhandle. This vegetation is of Rocky Mountain foothills origin and is more common to the west in Colorado and New Mexico. Pinon pine, oneseed juniper, netleaf hackberry, cholla cactus, and wavy leaf oak are common woody plants. Buffalo grass, blue grama, and hairy grama are common grasses. Ponderosa pine and Rocky Mountain juniper, common to the west in New Mexico and Colorado, are known from only very small areas in Oklahoma.

There are about 2,700 species and varieties of ferns, conifers, and flowering plants in Oklahoma (35). Roughly 227 plant species are considered to have either rare, threatened or endangered status. This is approximately 8% of the State's flora.

Twelve species of plants are Federally recognized Proposed Endangered or Nominated Threatened Species. These species, occurring in the eastern third of the State, include Ozark chinquapin, seaside alder, pipeworth, golden gladecress, hairy podvetch and false dragonhead.

A number of plant species have been recognized as rare in the State though the species may be abundant elsewhere (26). These include bald cypress (Southeast), blue ash (East) and pinyon pine (Northwest), and 51 other tree species. In addition there are 18 State recognized rare vines and other woody plants, and about 155 rare herbaceous plants. As always, there are many plant species about which so little is currently known as to prevent any determination of rarity for the present.

Wildlife

The distribution patterns of wildlife are similar to that of the vegetation. There are relatively few endemic species of amphibians, reptiles, birds, fish, and mammals, but many species of wildlife (and plants) in Oklahoma are at the periphery of their distribution.

Approximately 100 species of mammals (2, 10, 24) are known from Oklahoma. Only four large mammals: whitetailed deer, pronghorn antelope, Rocky Mountain mule deer, and black bear are now native. The bison and American elk were once common but now both exist only as reintroduced and managed species.

Furbearing mammals taken for the commercial pelt trade are badger, beaver, bobcat, red fox, gray fox, swift fox, mink, muskrat, oppossum, river otter, raccoon, spotted skunk (civet), striped skunk, and weasel. At various times in the past the coyote, Texas red wolf, and gray wolf pelts have also been sold but the latter two are now every uncommon.

The Rare and Endangered Species of Oklahoma Committee (26) lists six mammal species as endangered in Oklahoma: two species of bats, the gray and Indiana myotis; river otter; cougar; and the black-footed ferret, which is also a Federally endangered mammal. Seventeen other species of mammals, including the desert shrew, ringtail, swift fox, mule deer and Texas kangaroo rat, complete a list of scarce or vulnerable mammal species in the State.

The bird fauna of Oklahoma includes 394 species (28, 31, 32). Distribution of the birds only loosely fits the vegetation types, since the mobility of birds increases the chances of finding a species in several habitats. Migratory birds are common, especially since the increase in lakes and wetlands formed by construction of reservoirs throughout the State. Habitat alteration and loss has caused a decrease in certain species such as the greater and lesser prairie chickens. Game management for increasing population sizes has been effective for some species, such as the wild turkey.

Game birds include bobwhite, quail, scaled quail, greater prairie chicken, lesser prairie chicken, ring-necked pheasant, turkey, mourning dove, king rail, gallinule, common (Wilson's) snipe, and American woodcock. Common waterfowl include species of ducks, geese, mergansers, and teals.

As of 1975 there were four bird species on the Federal list of Threatened Birds: prairie falcon, peregrine falcon, southern bald eagle, and the redcockaded woodpecker. Two other Oklahoma endangered species are the swallow-tailed kite and the anhinga. Twenty-three other rare bird species found in Oklahoma include the golden eagle, mountain plover, sandhill crane, and purple gallinule.

Reptiles (36) are represented by about 95 species and subspecies of turtles, lizards, and snakes. Distribution of the species is generally associated with specific vegetation types. General zones recognized are the Coastal Plain, Interior Highlands (Ozark and Ouachita Mountain Regions), oak-woodland, grasslands, High Plains, and Mesa de Maya. About 60 species and subspecies of frogs, toads, and salamanders are known for Oklahoma (4).

The American alligator, the only endangered reptile to occur in the State, is found in the Southeastern Coastal Plain. Thirteen other reptiles, including the southern painted turtle and the checkered whiptail, are considered to be rare in Oklahoma.

There are approximately 165 species of fish reported for Oklahoma (20). The distribution of the fish is directly influenced by the watercourses and impoundments which often transect several physiographic, geologic, and biotic zones; however, small regional assemblages do seem to occur in broader geologic provinces and major watersheds. None of the fish in Oklahoma are endemic. Several species have been introduced for game fishing.

Thirty-four species of Oklahoma fish, or 20% of all State species, are considered State rare or endangered. Six species, including the shovelnose sturgeon and the leopard and Kansas darters are endangered. Twenty-eight other species are rare, and found only in a few eastern Oklahoma streams. None have Federal rare or endangered status to date (34).

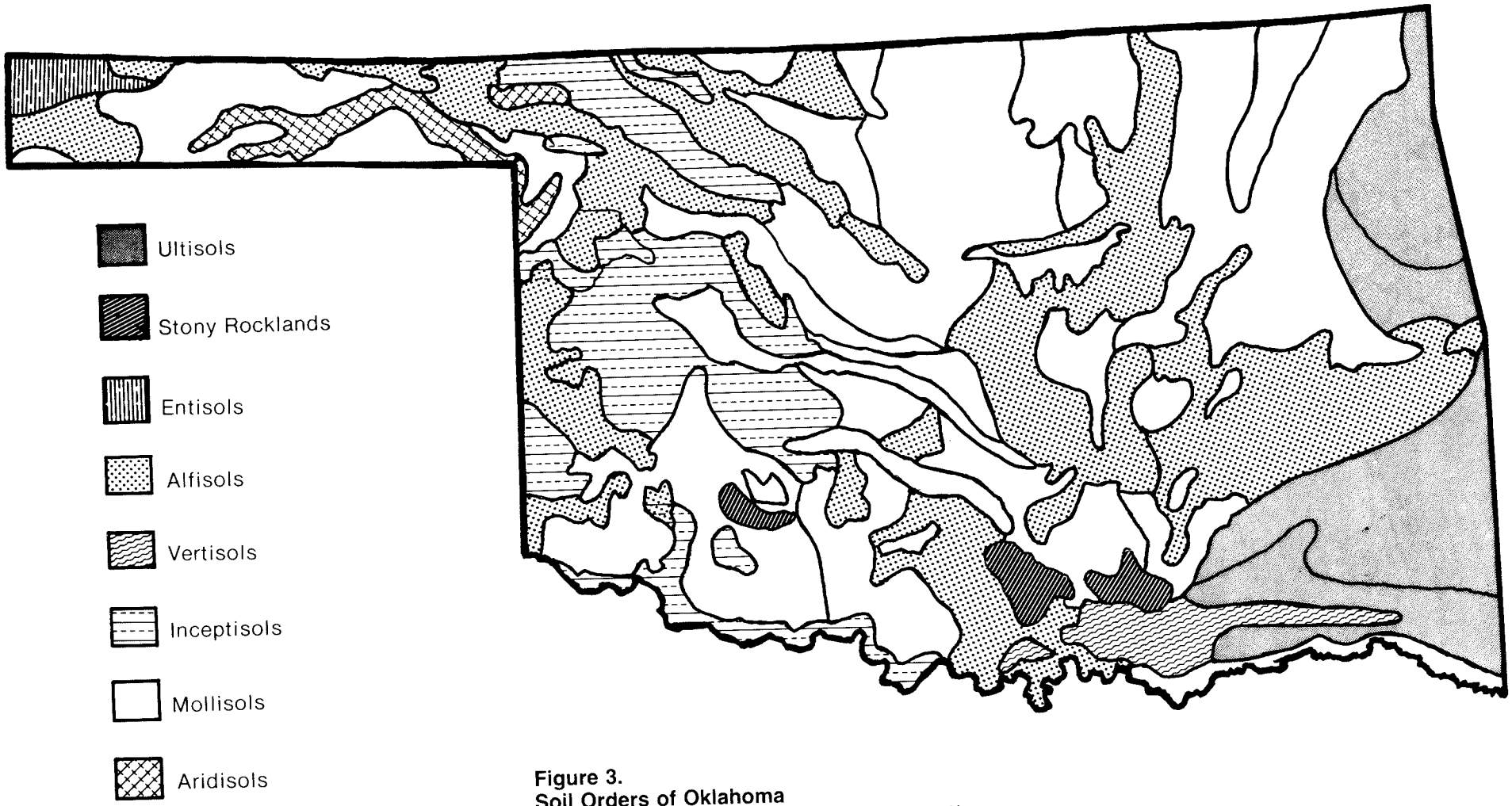


Figure 3.
Soil Orders of Oklahoma
(Redrawn from Gray and Roozitalab, 1976)

Soils

Climatic, geologic, and biotic factors influence the development of the soil from parent materials, and trends in soil formation follow closely the patterns of these factors. The present soil classification organizes the locally named soil series into orders. Soil orders (12, 13) occurring in Oklahoma (Fig. 3) from east to west are Ultisols, Mollisols, Alfisols, Vertisols, Aridisols, and Entisols. Stoney Rocklands (not a soil order) also occur in Oklahoma.

The Ultisol soils occur only in eastern Oklahoma where the native vegetation consists mainly of forests. Precipitation usually exceeds evapo-transpiration for at least part of the year, and the warm humid climate has seasonal deficiencies of rainfall. Water movement through the soil results in leaching and translocation of clay and various nutrients.

The Mollisol soils, very dark-colored, base-rich soils, belong to the most extensively distributed soil order in Oklahoma. They are developed mainly in northeastern and central Oklahoma, but also are in the western part and the Panhandle. These soils are naturally covered by native grasslands, although some forested areas are also present.

The Alfisol soils occur in regions where water evapo-transportation from plants exceeds precipitation in eastern, central, and western Oklahoma. The water movement through the soil causes removal of free carbonates from the topsoil, but a substantial part of the exchangeable bases remain. Native vegetation is grasslands, shrub savannas or forests.

The Vertisol soils occur mostly in southeastern Oklahoma, an area of high precipitation and high humidity. The clayey soils may develop deep, wide cracks during the dry parts of the year. These cracks fill with rain water and rewet the soil from above and below. Shrinking and swelling is characteristic of these mostly clay soils. The limy clay "Blackland Prairie" soils are derived from limestone parent materials and are dark colored.

The Stony Rocklands occur in the Arbuckle Hills, Arbuckle Basin, and Ardmore Basin on limestone parent materials.

The Inceptisol soils are formed predominantly in the western half of Oklahoma where the soil is leached in most years. This order of young soils does not have pronounced diagnostic features. Grasslands occur on upland areas and riparian woodlands occur along stream courses where these soils form.

The Aridisols soils occur in the central and eastern parts of the Panhandle in association with the Mollisols. Aridisols are light colored soils of dry areas which are not leached and usually have calcium carbonate or salt accumulations. The soils occur in water-and wind-deposited sediments under scattered shrubs.

The Entisol soils occur mostly on floodplains and steep slopes throughout the State. Little or no evidence of active soil formation is apparent because the soil is too young or because the mineral parent material is more resistant to weathering and breakdown. Entisols are found as recently deposited sediments on floodplains which eventually become forested; sandy soils under grasses or shrub savannas; recently formed soils on steep slopes in the western Panhandle; and as wet clayey alluvial bottomland in eastern Oklahoma.

Water Resources (17, 22)

Major rivers of Oklahoma head in the Rocky Mountains to the west and drain to the east and southeast into the Mississippi River. The two largest rivers include the Arkansas River system in the northern two-thirds of the State and the Red River system in the southern third.

The main tributaries of the Arkansas River include the Salt Ford of the Arkansas River, the Cimarron (Beaver) River, the Verdigris River, the Grand (Neosho) River, the Illinois River and the Poteau River. Where the Arkansas River enters Oklahoma from Kansas, its salt concentration is so high that it is classified as saline. Other western tributaries contribute somewhat saline and mineralized

water. Eastern tributaries provide a large influx of non-saline and low-mineral content water, improving the overall water quality in the eastern Oklahoma part of the Arkansas River system.

The Red River system enters in Oklahoma from headwaters in Texas and the main stream constitutes the southern boundary of Oklahoma. Tributaries in southwestern Oklahoma provide a small portion to the downstream flow of the Red River. The southwestern tributary water quality is markedly saline and mineralized, especially with gypsum. The Washita River is the major tributary in western Oklahoma. In eastern Oklahoma the principal tributaries are the Blue River, the Muddy Boggy River, the Kiamichi River, and the Little River (including Glover Creek and the Mountain Fork River).

Numerous ponds and lakes have been formed by impounding streams and rivers. There are approximately 1800 lakes (10 acres or more surface area) and countless upstream, small impoundments and ponds (less than 10 surface acres). No natural lakes occur in Oklahoma.

Climate (7, 30)

The location of Oklahoma in the Central Great Plains of the interior of North America is responsible for the prevailing continental climate. Yet, warm, moist air coming from the Gulf exerts much influence, particularly in the southern and eastern areas of the State. As a result, these areas receive greater humidities, cloudiness, and precipitation than do areas in the northern and western portions of the State. Summers are long and occasionally very hot. Winters are short with infrequent extended periods of extreme cold.

Mean annual temperature ranges from 64°F on the southeastern border to about 60°F along the northcentral border. The temperatures decrease westward through the Panhandle to about 57°F in western Cimarron County. Temperatures at 90°F or higher occur about 85 days per year, on the average, in the western Panhandle and in northeastern Oklahoma. These high temperatures occur about 120 days, on the average, in the southwest, and 95 to 100 days in the southeast. Temperatures of 100°F or higher are common from May to September, especially in the southwest, where an average of 20 to 25 days per year reach these temperatures.

Low humidity and southerly breezes often accompany the high summer temperatures. Occasional strong, hot winds accompany the high daytime temperatures; when persisting for a long period of time this condition leads to drought. Periods of prolonged drought occurred during the 1890's, 1910's, 1930's and 1950's.

Temperature extremes range from the low of -27°F to the high of 120°F. Days with a temperature of 32°F or less occur on an average of 55 to 65 days per year in the southern counties and 90 to 100 days per year in the counties along the northcentral and northeastern border with Kansas. The Panhandle may average 125 to 145 days per year with a temperature of 32°F or less.

The average length of the growing season or frost-free period ranges from 168 days in the Panhandle to about 225 days along the Red River in the southcentral and the southeastern part of the State.

Rainfall, the major part of precipitation in Oklahoma, decreases sharply from east to west. The average annual precipitation ranges from about 56 inches in the southeastern corner to about 15 inches in the western tip of the Panhandle. Annual precipitation is quite variable. Spring and early summer rains are more abundant than late summer and early autumn rains. Periods of heaviest rainfall and of most frequent occurrence are May to July and September and October.

The annual distribution of snowfall is usually the reverse of the annual distribution of rainfall. Southeastern Oklahoma averages two inches; the western Panhandle averages 20 inches. Snow persists on the ground only a few days at most, but blizzard-like conditions occasionally occur.

SECTION II

NATURAL AREA INVENTORY: METHODS AND RESULTS

NATURAL AREA INVENTORY: METHODS AND RESULTS

Classification Of Natural Features

From the review of the climate, geologic and topographic features, soils, and water resources, it is clear that physical characteristics are quite varied across the State and as a consequence, support a large diversity of animal and plant species and habitats. The variability is inherently interesting, but challenging because of the array of the natural diversity which is included in the State. To capture the spectrum of natural diversity, a conceptual framework or classification of natural features with identifiable units is desirable. The classification of features presented here is based on previous classifications of the environment, such as Duck and Fletcher's Game Type Map of Oklahoma (1943), examination of previously published and unpublished studies and data, and numerous field studies concerning vegetation, wildlife, and aquatic habitats.

The basic concepts adopted for this classification are: 1) the classification units are spaces on the landscape that are habitats for animals and plants; 2) in addition to habitat types, classification units for species of animals and plants of special concern should be recognized; 3) that units for abiotic elements such as land forms or geologic features should be included; 4) the classification units must exist in Oklahoma; 5) the classification units should be recognizable on the landscape, that is, the characteristics of the unit should be apparent; 6) the structure of the classification is to be such that classification units of similar nature should be adjacent to each other; 7) it should be possible to aggregate similar features into more broadly defined units; and 8) a hierarchical arrangement based on the aggregation of similar units is desirable.

With these criteria as goals, the natural features of Oklahoma were organized into the following broad categories:

Natural Features	Unit Numbers
Terrestrial Habitats	
Upland Forests	1.0 - 5.0
Bottomland Forests	6.0 - 9.0
Grasslands	10.0 - 13.0
Wetland Habitats	14.0 - 17.0
Lotic and Lentic Habitats	18.0 - 43.0
Other Habitats	44.0 - 45.0
Man-Altered Habitats	46.0 - 49.0
Special Species	100.0
Disjunct Habitats	101.0

The Upland Forests of the Terrestrial Habitats are distinguished primarily by the species composition of the vegetation cover. The names of the forested habitats indicate the predominant species, the first named tree being the most common in the habitat.

Bottomland Forests are considerly more variable than the Upland Forests. Regional division is chosen for the differentiation of the habitats, rather than by species dominants. The major Bottomland Forest regions are eastern, south-central, north-central, and western with variants recognized.

The major units of the Grasslands are distinguished by the dominant grass species. The units are the Eastern Prairies or Tallgrass Prairies, the Mixedgrass Grasslands, the Mixedgrass Grassland Savannas, and the Shortgrass Grasslands.

Wetland Habitats are defined either as having standing water for a part of the year or for the entire year. Variants are marked by the duration and depth of water and the kind of vegetation (herbaceous, shrubby, or arborescent). For example, an area that has inundated soil for part of the year and includes trees would be a Swamp with Trees, Unit 16.2.

Aquatic Habitats are categorized as two basic types: The flowing water or Lotic Habitats, and the standing water or Lentic Habitats. The habitats of these two types are first distinguished by geologic regions (Fig. 4), based on water quality characteristics which influence aquatic animals and plants. Lotic Habitats in each province are divided into streams or rivers while Lentic Habitats in each province are divided into ponds (of less than 10 acres surface area) and lakes (of 10 acres or larger surface area). For example, the classification unit numbers are assigned thusly:

	Lotic Habitats		Lentic Habitats	
Province	Stream	River	Pond	Lake
Ozark Plateau	18.1	18.2	31.1	31.2
Eastern	19.1	19.2	32.1	32.2
Ouachita	20.1	20.2	33.1	33.3

Habitats of plants and animals that are not marked by pronounced or obvious vegetation cover are included under "Other Habitats". Caves, rock shelters, talus caves, and geologic features are included as "Other Habitats".

Man-altered Habitats do occur in Oklahoma. These types provide habitats for many of our wildlife species and include significant acreage in many parts of the State. These types, having been altered by man in varying degrees, include high-management grasslands, croplands, managed forests and rights-of-way.

The Special Species units are generally used in conjunction with habitat types to mark the presence of special or unique animal or plant species at an area.

Figure 4.
Aquatic habitat regions based on geologic regions (Kingsbury, 1968)

Disjunct Habitat is a designation used with a specific habitat to denote that the habitat occurrence is of particular interest because it is geographically separated from the main distribution of the habitat type.

The detailed classification of habitat types, special species and disjunct habitats is built open a hierarchical numbering scheme, that is, a general category which may have variants or refinements of that category. An example of the hierarchical arrangement can be shown in the case of the Blackjack Oak Forest:

Terrestrial Habitats

Upland Forests
3.0 Oak-Hickory Forests
3.1 Post Oak-Blackjack Oak Forests
3.11 Post Oak-Blackjack Oak Forests
3.12 Post Oak Forest
3.13 Blackjack Oak Forest
3.14 Post Oak-Blackjack Oak-Black Hickory-Black Oak Forest
3.15 Post Oak-Blackjack Oak-Juniper Forest

The Blackjack Oak Forest (classification unit 3.13) is one of the five variants of the unit 3.1 or Post Oak-Blackjack Oak Forests, which is a varient of the unit 3.0, Oak-Hickory Forests, which includes all forests in Oklahoma that are composed of oak and hickory trees that are Upland Forests.

This hierarchical arrangement, besides showing the similarities among the classification units, also allows for classification of habitats even if an analysis by species composition is not available. If it is known that a particular tract has a forest cover that includes oak and hickory trees, but the specific leading dominant species are not known, the more general classification unit 3.2, Mixed Oak-Hickory Forest, can be assigned, indicating that the exact species composition was not known at the time the data was recorded, but that an Oak-Hickory Forest of some species composition is present.

The utility of the classification is also demonstrated in describing a tract of land which has several natural features. For example:

> A tract of 500 acres in Cleveland County, Oklahoma, includes a pond (surface area of 5 acres) with a stream, occurring in a woodland composed of 90% post oak and 10% blackjack oak trees.

This tract includes the following classification units:

> Post Oak Forest 3.12
>
> Central Stream 23.1
>
> Central Pond 36.1

By aggregating the classification units, it is clearly possible to compose a general description of the locality.

Identification And Inventory Of Natural Areas

The classification system is perhaps at the heart of the Heritage Program. It has provided the necessary framework for searching and organizing information, and, as a result, quantities of information on the broadest array of the State's diverse natural features have been successfully and efficiently managed to identify and inventory an initial group of potential natural areas.

Three approaches were used to find potential natural areas, because together they enabled a rapid and comprehensive method. Classification features were separated into three categories: habitat types, abiotic features and special species. Information was then gathered concerning 1) locations of representative habitats, 2) locations of uncommon or unique habitats and abiotic features, and 3) locations of rare or uncommon species.

The importance of finding locations of uncommon or rare species is based on the realization that uncommon or rare species may occur together, and that the habitat in which the species occur is likely to be special because of characteristics of the habitat or because of unusual distribution patterns of the species. Locations of uncommon or rare species then act as leads to the recognition of the habitat types in which they occur.

Lists of special species of animals and plants were developed from several publications that evaluated the animals and plants of Oklahoma on the bases of being uncommon or rare in the State, the region and the nation. References for the development of the special species list include: the report "Rare and Endangered Vertebrates of Oklahoma" (26) which includes amphibians, birds, fish, mammals, reptiles, and vascular plants; the report "Endangered and Threatened Plants of the United States" (38), only vascular plants; various lists of proposed and nominated threatened or endangered animals and plants published by the Office of Endangered Species, Fish and Wildlife Service, U.S. Department of the Interior; and also, additional species not listed in the previous three references, but considered to be important. The list of special species includes 245 plant, 21 amphibian, 18 reptile, 29 fish, 30 bird, 24 mammal and 9 mollusc and arthropod species.

Information or data sources for species and habitat occurrences included museum collections, literature reports, and personal contacts.

Museum collections provide information concerning the localities at which the special species have been collected. Collections at the following institutions were examined: Oklahoma State University, University of Oklahoma, University of Oklahoma Biological Station, Northeastern Oklahoma State University, Northwestern Oklahoma State University, Southeastern Oklahoma State University, Southwestern Oklahoma State University, Phillips University, East Central University and Eastern Oklahoma State College. The plant collections at Missouri Botanical Garden, New York Botanical Garden, Southern Methodist University, University of Arkansas, University of Missouri and the University of Texas, were also searched for selected plant species.

Numerous publications were searched for information which might identify potential natural areas by species or habitat information and location. These publications include the Proceedings of the Oklahoma Academy of Science, the Scissortail, the Bulletin of the Oklahoma Ornithological Society, Bulletin of the Oklahoma Herpetological Society, Oklahoma Underground, Tulsa Grotto, National Speleogical Society News, Oklahoma Wildlife Cooperative Research Unit Biannual Reports, and Oklahoma Geology Notes. Other journals that include articles about natural features of Oklahoma, but not completely devoted to Oklahoma, were examined. Biological monographs of selected species were reviews for leads to the locations of potentially important habitats inhabited by those species.

Internal publications of several organizations, such as the Oklahoma Department of Wildlife Conservation and the U.S. Army, Corps of Engineers, were also examined. Unpublished theses and dissertations and prepublication manuscripts were obtained for examination.

Personal contacts with knowledgeable individuals were made in several ways. A brochure describing the Oklahoma Natural Heritage Program was mailed to about 1500 people in Oklahoma and to others who were known to have some particular association with the State.

The Staff of the Program visited over 200 knowledgeable people throughout Oklahoma during the summer of 1977. The purpose of these visits was to acquaint the people with the Program and to solicit information concerning locations of species of special interests and of habitats that were representative, uncommon, or unique. These personal contacts often provided information that was not uncovered by examination of the museum or the literature sources.

Additional contacts were made as the museum and literature sources were examined. Further elaborations and clarifications were sought from previously collected information, as well as information leading to the identification of other areas not previously brought to the attention of the Oklahoma Natural Heritage Program.

Two thousand records of occurrence of special species were obtained and entered into the data system. Additional species occurrences are on hand, but limited time to process the information or insufficient data from the original sources to find localities on maps has so far prevented entry of the information into the data system.

Five hundred ninety-four records of occurrences of possible natural areas were entered into the data files. This number is not a direct indication of the quantity of natural features in the data system. An area may include 1) a single natural feature as defined by the habitat classification, or 2) several examples of the same natural feature, or 3) several different natural features. Additional leads to 335 localities or habitat types were obtained. This information was retained in the data files, but was not entered into the analyses of potential natural areas because of one or more reasons: 1) the area no longer existed as described by the information sources, 2) insufficient information was available to determine the natural significance, 3) information provided by the source was of a general nature and specified no particular place on the landscape, and 4) the area was primarily of historical importance.

Information concerning the occurrences of habitats and special species was obtained or reproduced for use in the office of the Oklahoma Natural Heritage Program. This information was organized and stored several ways to facilitate access and cross-referencing. Reference files are maintained in file cabinets, on maps, and in a computer data storage and retrieval system.

Data obtained for determining locations of possible natural areas was recorded in a standard format on data sheets. Information from the original sources and references was supplemented with information obtained from maps and special reports that would provide a more complete description of the reported occurrences of habitats and special species. The data recorded are listed in Table 1. Completed data sheets were carefully edited before entering the data into the data storage and retrieval computer file. These summary data from the computer file on occurrences of habitats (Fig. 5) and special species (Fig. 6) were prepared in multiple copies for distribution into four manual files: 1) habitat type or name of species, 2) county, 3) general vegetation (Duck and Fletcher), and 4) topographic map location. These manual files, kept in the Program office, serve as reference for the features plotted on the topographic maps and for answering questions concerning habitats, species, or localities that do not require a complex sorting of information, which is more easily accomplished through the computer.

Selected locations of habitat and special species occurrences were field-investigated to verify the locations and existence of the reports; also, occurrences of other special

species or habitats were recorded for the same locations.

Table 1. Data recorded for occurrences of special species and habitats.

Special Species Occurrences
family of plant or animal
genus and species
collector's name and number
museum location
author of literature reference
literature reference
date of collection
county and site of collection
topographic map of location
habitat
phenology
name of managed area
number of owners of managed area
principal owners' names
county council of governments
watershed
geomorphic province
geologic substrate
soils
vegetation, general
habitat, generalized
other notes

Habitat Occurrences
habitat types (classification units)
name of habitat
informant and date
author of literature reference
literature reference
county and site of habitat
topographic maps of location
habitats
presence of endangered or threatened species
acreage
name of managed area
number of owners of habitat
principal owners
county council of governments
watershed
geomorphic province
geologic substrate
soils
vegetation, general
habitat, generalized
other notes

0000014
NAME: ELDORADO BLUFFS
HABITAT: GYPSUM BLUFF, MESQUITE VEGETATION ALONG RIVER
HABITAT TYPE: 12.3
NATURAL AREA CODE: JACKSON 03
QUAD MAPS: 3409945
SITE:4.5 MI. E. & 3 MI. S OF ELDORADO
ACREAGE OF HABITAT: 160
INFORMANT: R. OWEN, B. LEUCK **DATE:** 1977 07 27

WATERSHED (OK-WRB): 1-17 **COUNCIL OF GOVERNMENTS:** SWODA
GEOLOGIC PROVINCE: MANGUM GYPSUM HILLS
GEOLOGIC SUBSTRATE: PB
SOILS (USDA-SCS): 185, 459, 550, 575
VEGETATION (DUCK & FLETCHER): MESQUITE GRASSLANDS
HABITAT, GENERAL: UPLAND FOREST
OTHER: R.23W., T.2S., SECT. 2
DIRECTIONS: D **BOUNDARY:** B **SURVEY:** E
VERIFIED: V **LOCATED:** C

Figure 5. Example of an occurrence record of the possible natural area, El Dorado Bluffs, Jackson County, Oklahoma.

001526
BRAYULINEA DENSA **CODE:** SPJR.405.003
FAMILY: AMARANTHACEAE **ORGANISM:** ANGIOSPERM
COLLECTOR: OUN-HERB
DATE: 1948 06 10 **CAPTIVE:** NO
COUNTY: CIMARRON CO. OKLA COUNTY
CODE: 84 **QUAD MAP:** 3610288
SITE: 2 MI. E OF KENTON
HABITAT: BENEATH PROSOPIS
PHENOLOGICAL STAGE: FL
LATITUDE, LONGITUDE: 365405N1025530W
COUNCIL OF GOVERNMENTS: OEDA
WATERSHED (OK-WRB): 2-9
GEOLOGIC PROVINCE: HIGH PLAINS
GEOLOGIC SUBSTRATE: JTR, MORRISON FORMATION, EXETER SANDSTONE, DOCKUM FORMATION
SOILS (USDA-SCS): BC, BERTHOUD LOAM
VEGETATION (DUCK & FLETCHER): PINION-JUNIPER-MESA
HABITAT, GENERAL: GRASSLAND, UPLAND
OTHER: R.1E., T.5N., SECT. 14
DIRECTIONS: D
VERIFIED: V **LOCATED:** U

Figure 6.
Example of the occurrence record of the special species, the plant Brayulina densa (Amaranthaceae)

Selection and Evaluation of Natural Areas

The selection and evaluation of potential natural areas must be based upon merit through the use of rational decisions. Decisions made as objectively as possible contribute to the credibility of the natural areas as a high quality preserve, facilitate the early elimination of inferior potential areas from further evaluation, and aid in the concentration of both time and money on those areas worthy of preservation. The Oklahoma Natural Heritage Program developed this approach, which is similar to those used successfully by other state heritage programs around the country.

The following discussion describes a two-phase method that selects and evaluates potential natural areas for inclusion into a series of recommended areas. This method provided the basis for choosing the 148 recommended natural areas presented in this report, and it will continue to be used in designating all future natural areas.

Nominated natural areas are subjected first to the selection phase (Fig. 7) which is designed to narrow the number of potential areas to those that can be considered truly representative of units in the natural features classification. These selected natural area sites are then evaluated (Fig. 8) by rating them for management potential through the comparison of similar features in similar areas. Management potential refers specifically to a reasoned estimate of the long term ability of an area to maintain the features in an overall high quality.

All areas receive one of three possible ratings: high, medium or low. Only high rated areas are given recommended status. Those areas given medium or low ratings, although not recommended as prime natural areas, are retained to provide depth to the "high" selections, and to act as alternate areas which may have appropriate uses in the future.

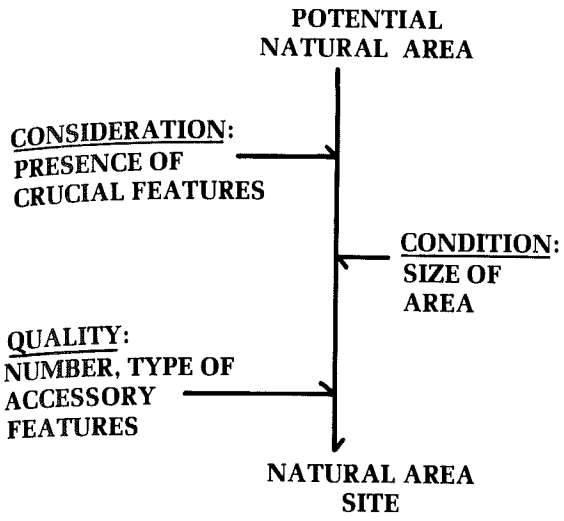


Figure 7.
Selection process in designation of natural areas.

SELECTION OF NATURAL AREAS

Areas under CONSIDERATION (Fig. 7) for inclusion in the natural areas system for Oklahoma must have at least one crucial feature. Crucial features are those natural features for which an area may be designated (37). No plot of land can gain natural area status without either one or a combination of crucial features. All crucial features correspond to units of the classification, but it should be understood that not all of these units are automatically crucial features.

Six categories of crucial features are described below:

1. Undisturbed habitat types; plant communities, or terrestrial habitats remaining unaltered by technological man.
2. Federally listed threatened, rare, and endanered species; plants and animals listed by the Office of Endangered Species, USFWS.
3. Habitats with relict species; remnant species assemblages that have survived broad climatic changes.
4. Unique or striking high quality geologic features; e.g. mesas, box canyons, or natural arches.
5. Outstanding aquatic features, e.g. unique lakes, ponds, rivers and streams.
6. Those areas having unique features not easily categorized; e.g. bat caves, select man-altered habitats.

Potential areas considered for inclusion, in addition to processing crucial natural features, must also meet the requirement of CONDITION. A natural area must be of a sufficient size that will allow the continued health and maintenance of its crucial features. Biological features require ecological considerations to determine the amount of area that will adequately maintain their viability. The actual acreage chosen will depend upon what is to be preserved; not all features will require large amounts of space, but the boundaries drawn must be natural ones, and not arbitrarily designated.

There are factors which contribute to the QUALITY of a natural area that are not in themselves sufficient reason for selecting an area, but which should not be ignored. These accessory factors include:

1. The presence of State rare and endangered species, or State endemnic species.
2. The geographical distribution of the features represented in the natural area.
3. Recorded history of the area, that is, information from any previous scientific studies adds value to an area.
4. Other features that may be regionally significant within the State, for example, unusual soil types.

The three requirements of selection, CONSIDERATION, CONDITION, and QUALITY, must be met before any nominated potential natural area can become a selected natural area site. Not all areas will score high in all three requirements, but all will have satisfied a minimum acceptable level.

Evaluation of Natural Areas

Figure 8 is a diagram showing the processes used in the evaluation of potential natural areas. As mentioned previously, this second phase is used to determine the potential of a selected area for management. Evaluation of a potential area is based upon several criteria:

1. Diversity of crucial and accessory features. Areas having more crucial, or accessory, features will be valued over those having fewer. There are significant exceptions to this guideline, especially in regard to unique areas. Also, areas having boundaries, or parts of their boundaries, contiguous with other selected areas increases their value, regardless of diversity.
2. The presence of adequate buffer land (37). All natural areas, to some degree, require a buffering zone surrounding the area, which, while itself not necessarily of high natural quality, serves to protect the integrity and vigor of the natural area. Sensitive areas that lack available buffer land are generally more difficult to manage for preservation than areas with buffer land, and consequently, receive a lower evaluation rating for this criterion.
3. Accessibility. Many vulnerable natural areas, which may be biologically sensitive, should not be too accessible to the public or to other groups of users. By the same token, some areas, considered primarily for their educational potential, assume added value if they are located near roads or urban centers.
4. Threats to the Area. Natural area sites faced with significant alteration or probable destruction are valued higher than those areas less vulnerable or less endangered.

A fifth criterion is Availability. This requirement has not been systematically applied to the Program's initial recommended areas, since no mechanism, either public or private, now exists in the State which can seriously consider this problem.

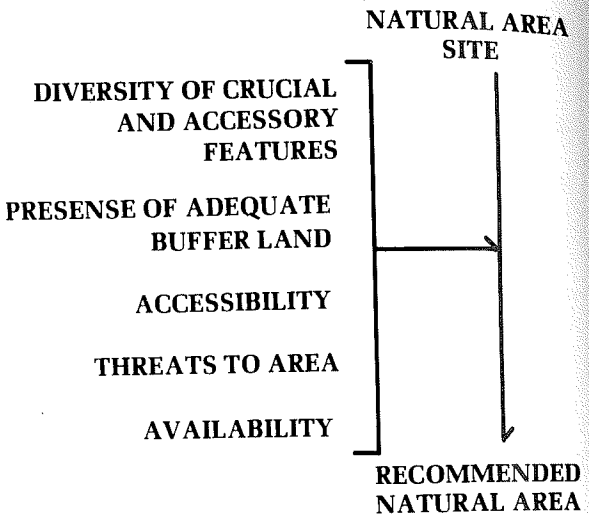


Figure 8.
Evaluation process in designation of natural areas.

Availability is perhaps the ultimate concern for the evaluation of natural areas. It refers to the willingness of landowners to recognize the value of the crucial features occurring on their land and their willingness to explore ways of preserving these features. Numerous options for preservation exist, but if the land is not available, little can be accomplished. Those lands which are available will

have precedence over those that are not.

Using these evaluation criteria, each natural area site was rated comparatively with similar areas having similar features. For example, all selected areas for the habitat type 1.1, Shortleaf Pine-Oak-Hickory, were compared to other areas of the same unit habitat type. No comparisons were made between different units.

The following analysis of the occurrences of the natural features and the selections for recommended natural areas (Table 2) is structured around the classification units of physical features of habitat types and special species. Note that any area may appear under several units if it was chosen for representation of different features. For instance, Greer County 019 area* was rated "high" for the Mesquite Savanna (unit 12.3), Shortgrass Grassland (unit 13.0), and Gypsum Caves (unit 44.1). Other natural features at area Greer County 019 which were not rated as "high" include a Western Gypsum Pond (unit 40.3). (See Appendix 2, Area 019, for a summary of this information.)

Table 2. The natural features classification. One hundred and forty eight recommended natural areas are presented in the context of classification units.

1.0 SHORT LEAF PINE-OAK-HICKORY FORESTS

Forests marked by presence of shortleaf pine with oaks and hickories, in the Dissected Coastal Plain, Ouachita Mountain, and Ozark Plateau geomorphic provinces.

The variants reflect the predominating species of these forests in the eastern quarter of the state.

1.0 Shortleaf Pine Forest
Dominant species not determined.
Areas: Leflore County 585*, 584

1.1 Shortleaf Pine-Oak-Hickory Forest
Shortleaf pine predominant; white oak, Shumard oak, black oak, blackjack oak, southern red oak, black hickory, mockernut hickory also present.
Areas: Latimer County 257
McCurtain County 337
Pushmataha County 375, 378

1.2 Post Oak-Blackjack Oak-Shortleaf Pine Forest
Post oak and blackjack oak predominant; shortleaf pine also common; mockernut hickory, white oak, black oak, Shumard oak, red oak, blackgum, winged elm.
Areas: Atoka County 250
McCurtain County 336

1.3 Oak-Shortleaf Pine-Hickory Forest
Various oaks predominant, especially white oak, black oak, Shumard oak, and post oak; shortleaf pine and mockernut hickory common; also red maple and blackgum.
Areas: Latimer County 165
Pushmatha County 374

*In this report all natural area sites are designated by county name and identification number. More specific information about location has been excluded in the interest of protecting private landowners.

*Numbers following county names refer to natural area numbers as listed in appendix 1 and map.

2.0 LOBLOLLY PINE FORESTS

2.1 Loblolly Pine-Mixed Hardwood Forests
Loblolly pine with southern red oak, black hickory, post oak, and other hardwood tree species, on the Dissected Coastal Plain of McCurtain County.
Areas: McCurtain County 239

3.0 OAK-HICKORY FORESTS

3.1 Post Oak-Blackjack Oak Forests
Post Oak-Blackjack Oak Forests are predominantly postoak and blackjack oak; in the eastern two-thirds of Oklahoma.

3.10 Post Oak-Blackjack Forests
Dominant species not determined
Areas: Comanche County 586
Murray County 282
Seminole County 543

3.11 Post Oak-Blackjack Forest
Post Oak and Blackjack Oak predominant; occasionally other oaks, winged elm, hackberry, and chittamwood present; in central and eastern Oklahoma.
Areas: Caddo County 122
Cleveland and Oklahoma Counties 114
Dewey County 140

3.12 Post Oak Forest
Post oak is the main constituent; blackjack oak and other hardwood species are in very low occurrence; in the eastern and central thirds of the State.
Areas: Jefferson County 129
Major County 206

3.13 Blackjack Oak Forest
Blackjack Oak is the main constituent; post oak and other hardwood species are in very low occurrence; in the eastern and central thirds of the state.
Areas: Cleveland County 120
Garfield County 088
Major County 205

3.14 Post Oak-Blackjack Oak-Black Hickory-Black Oak Forest
Post oak, blackjack oak predominate; with black hickory in the central and eastern quarters of state; also with black oak in the eastern quarter of the State.
Areas: Coal County 092
Latimer County 151
Lincoln County 218
Love County 216
Muskogee County 307
Osage County 358
Ottawa County 356
Pittsburg County 313, 327, 559
Tulsa County 383

3.15 Post Oak-Blackjack Oak-Juniper Forests
Post oak, blackjack oak, and juniper woodlands; the predominating species varying among these three components.

3.151 Post Oak-Blackjack Oak-Eastern Redcedar
Eastern redcedar present with post oak and/or blackjack oak.
Areas: Canadian County 177
Major County 492

3.152 Post Oak-Blackjack Oak-Ashe Juniper Forest
Ashe juniper with postoak and/or blackjack oak.
Areas: Murray County 278

3.2 Mixed Oak-Hickory Forests
Various species of oak with hickory; in the eastern half of Oklahoma.

3.20 Mixed Oak-Hickory Forests
Oak and hickory predominant, species not determined.
Areas: Adair County 310, 524
Cherokee County 084, 656
Delaware County 103 (including 104, 105, 106, 107, 134, 135, 138, 145)
Johnston County 443
LeFlore County 584, 585
Osage County 360
Ottawa County 531
Rogers County 561

3.21 Black Oak-Blackjack Oak-Post Oak-Black Hickory Forest
Black Oak-predominant; often with blackjack oak, post oak, and black hickory; scattered localities in the eastern half of Oklahoma.
Areas: None designated

3.22 White Oak-Oaks-Hickory Forest
White oak predominant; often with Shumard oak, black oak, post oak, mockernut hickory, and occasionally blackgum; in eastern quarter of State in the Ozark Plateau and the Ouachita Mountains.
Areas: Adair County 260
LeFlore County 222

3.23 Winged Elm-Post Oak-Blackjack Oak-Hickory Forest
Winged elm is dominant; often with post oak, blackjack oak, mockernut hickory, and black hickory; in the eastern third of Oklahoma, often occurs after disturbance or removal of native forest cover.
Areas: None designated

3.24 Black Hickory-Post Oak-Black Oak-Blackjack Oak Forest
Black hickory predominant; often with post oak, black oak, blackjack oak; also mockernut hickory, Shumard oak, American elm, and black locust may be present; in eastern half, but mostly eastern third of the State.
Areas: Mayes County 210

3.25 Chinquapin Oak-Sugar Maple-Post Oak-Shumard Oak Forest
Chinquapin oak more common; often with sugar maple, post oak, Shumard Oak; composition variable; mainly in the Ozark Plateau of northeastern Oklahoma.
Areas: Muskogee County 306

3.26 Sugar Maple-Hardwood Forest
Sugar maple with other hardwood tree species; composition variable; in the Ozark Plateau and Ouachita Mountains of the eastern third of Oklahoma.
Areas: Rogers County 487

3.27 Mixed Oaks Forest
Various oak species, none of which is much more common than the other species; in eastern third of Oklahoma.
Areas: Murray County 311

3.28 Post Oak-Hardwood Forest
Post oak is more common; various other hardwood species present; eastern third of the State.
Areas: Adair and Cherokee Counties 342
Choctaw County 170
Sequoyah County 316

4.0 PINYON-JUNIPER WOODLANDS

Woodland is a part of the pinyon-juniper woodland of the Rocky Mountain Foothills region.

4.1 Pinyon-Juniper Woodland
Pinyon pine and one-seed juniper dominant woody species; Ponderosa pine, Rocky Mountain juniper, and wavy-leaf oak may be present; in the northeastern corner of the Oklahoma Panhandle.
Areas: Cimarron County 002

5.0 OTHER UPLAND FORESTS

Other upland forests that are much more restricted in distribution or not fitting the forest types listed previously.

5.0 Other Upland Forests
Specific types not recognized in classification.
Areas: Woods County 261 (sand dune woodland)

5.1 Live Oak Forest
Live oak predominant; in Quartz Mountains.
Areas: None designated

5.2 Forests Radically Altered by Man
Areas: None designated

5.3 Beech-Hardwood Forest
Beech present in few numbers or as predominant species; in Ouachita Mountains.
Areas: McCurtain County 243

6.0 EASTERN OKLAHOMA BOTTOMLAND FORESTS

Tree species diversity is high and forest composition is variable; in eastern third of State.

6.1 Northeastern Oklahoma Bottomland Forest
Red maple, silver maple, river birch, black willow, pecan, cottonwood, hackberry, black walnut, blackgum, sycamore, and American elm often present; in northern half of eastern third of State.
Areas: Cherokee County 565
Mayes County 564
Osage County 360
Ottawa County 491
Rogers County 486

6.2 Southeastern Oklahoma Bottomland Forests
In the southern half of the eastern third of the State.

6.21 Southeastern Bottomland Forest
Water oak, willow oak, sweetgum, red maple, silver maple, green ash, sycamore, river birch, hackberry, water elm, black willow, and southern red oak present.
Areas: Bryan and Choctaw Counties 388
McCurtain County 241, 272, 336, 337, 343, 555, 572, 575
Pittsburg County 559

6.22 Cypress Southeastern Bottomland Forest
Similar to the Southeastern Bottomland Forest (6.21), but with bald cypress; mainly in the Little River basin of McCurtain County.
Areas: McCurtain County 299

7.0 SOUTHCENTRAL OKLAHOMA BOTTOMLAND FORESTS

In the southern half of the central third of Oklahoma; species composition highly variable.

7.1 Southcentral Bottomland Forest
Sugarberry, American elm, pecan, black walnut, black willow, cottonwood, sycamore, green ash, water oak, and bur oak present; salt cedar may be present.
Areas: Cleveland County 093
Johnston County 127
Johnston and Marshall Counties 553
Murray County 282

8.0 NORTHCENTRAL OKLAHOMA BOTTOMLAND FORESTS

In the northern half of the central third of Oklahoma; species composition highly variable.

8.1 Northcentral Bottomland Forest
American elm, green ash, hackberry, pecan, black willow, cottonwood, sycamore, black walnut, bur oak; also may include pin oak, silver maple, soapberry, and occasionally salt cedar.
Areas: Canadian County 177, 496, 574
Logan County 517
Osage County 357
Pawnee and Osage Counties 346

9.0 WESTERN OKLAHOMA BOTTOMLAND FOREST

Tree species composition less diverse than in the eastern part of the State; in the western third and the Oklahoma Panhandle.

9.0 Western Bottomland Forest
Tree species not determined, may be similar to the Western Mixed Bottomland Forest (9.1).
Areas: Comanche County 110
Harper and Woodward Counties 255
Major County 208
Roger Mills County 593

9.1 Western Mixed Bottomland Forest
Cottonwood, black willow, American elm, slippery elm, green ash, soapberry; also occasionally western walnut and bur oak; species composition variable.
Areas: Comanche County 586
Custer County 583
Jackson and Tillman Counties 509
Roger Mills County 558

9.2 Cottonwood-Willow Western Bottomland Forest
Cottonwood and black willow with other shrub willows, black willow lacking in the western Oklahoma Panhandle; in the western third and the Oklahoma Panhandle.
Areas: Cimarron County 002
Texas County 587
Woodward County 550

10.0 EASTERN PRAIRIES

Tallgrass prairies of little bluestem, big bluestem, switchgrass, and indiangrass; in the eastern half of the State.

10.0 Eastern Prairies
Specific type of Eastern Prairie not determined; condition and species composition dependent upon usage.
Areas: Comanche County 586
Craig County 235
Haskell County 256
Jefferson County 131
Marshall County 212
McCurtain County 268
Muskogee County 308
Osage County 357
Pontotoc County 320

10.1 Eastern Prairie Climax
Little bluestem, big bluestem, switchgrass, indiangrass, leadplant, scurfpea, and wildindigo; occasionally eastern gamagrass; in the eastern half of Oklahoma, mostly northeastern on deep, well drained soils.
Areas: Alfalfa County 252
Osage County 276
Tulsa County 394

10.2 Eastern Prairie Claypan
Little bluestem, big bluestem, switchgrass, indiangrass, leadplant, scurfpea, and wildindigo; in the eastern half of the State, on clay soils.
Areas: None designated

10.3 Eastern Prairie Limy
Little bluestem, big bluestem, switchgrass, indiangrass, leadplant, scurfpea, and occasionally eastern gamagrass; in the Dissected Coastal Plain and Arbuckle Mountains in deep calcareous soils; "blackland prairie."
Areas: Bryan and Johnston Counties 504

10.4 Eastern Prairie Eroded
Little bluestem, indiangrass, purpletop, purple lovegrass, jointtail grass, splitbeard bluestem, silver bluestem, windmill grass, Japanese brome, fall switchgrass, annual three-awn, and western ragweed.
Areas: None designated

10.5 Other Eastern Prairies
Areas: None designated

11.0 MIXEDGRASS GRASSLANDS

Best condition Mixed Prairies are dominated by little bluestem, sideoats grama, blue grama; in the western half of the State and the Oklahoma Panhandle.

11.0 Mixedgrass Grassland
Species composition not determined; condition and usage determine composition.
Areas: Grady County 020
Jefferson County 133
McClain County 592
Murray County 311

11.1 Mixedgrass Grassland Climax
Little bluestem, sand bluestem, western wheatgrass, sideoats grama, blue grama, buffalograss, sand dropseed, switchgrass, and indiangrass; in the western half of the State, on deep loamy soils.
Areas: Tillman 362

11.2 Mixedgrass Grassland Claypan
Species similar to Mixed Prairie Climax, with mixedgrasses and short grasses more prominent; in the western half of the State, on clay soils.
Areas: None designated

11.3 Mixed Grassland Osage Hills
Mixedgrass Grassland Climax species with tallgrasses dominant; in northeastern quarter of Oklahoma on shallow soils over limestones, limy clays, and sandstones.
Areas: None designated

11.4 Mixedgrass Grassland Eroded
Little bluestem, indiangrass, purpletop, purple lovegrass, jointtail grass, splitbeard bluestem, silver bluestem, windmill grass, Japanese brome, fall switchgrass, annual three-awn and western ragweed; surface soil nearly completely removed, subsoil exposed.
Areas: Custer County 583
Roger Mills County 558
Woodward County 550

11.5 Mixedgrass Grassland Slickspot
Alkali sacaton, white tridens, blue grama, tall dropseed, switchgrass with numerous weedy grasses; in the western half of the State; in loamy soils with white alkali hard crust in small patches or depressions.
Areas: None designated

11.6 Mixedgrass Grassland Gypsum
Sideoats grama, little bluestem, sand bluestem; with hairy tridens, buffalograss, sand dropseed; in western third of State on shallow loams, gypsum exposed; present in small areas with other mixedgrass grasslands.
Areas: Custer and Washita Counties 418, 419
Major County 208
Woods County 411
Woodward County 406

11.7 Other Mixedgrass Grasslands
Areas: None designated

12.0 MIXEDGRASS GRASSLANDS SAVANNAS

Woody plants present with grasses and forbs from the Mixed Prairie.

12.1 Sagebrush Sands Savanna
Sand sagebrush, little bluestem, sand bluestem, switchgrass, indiangrass, and blue grama; with sand lovegrass, sand paspalum, sand dropseed, sideoats grama, yucca, skunkbush and sandplum; in the northwestern quarter of Oklahoma, on deep sandy soils.
Areas: Beaver County 230
Harmon County 015
Harper and Woodward Counties 255
Roger Mills County 369
Woods County 261

12.2 Shinnery Oak Savanna
Shinnery oak, hackberry, and Mixed Prairie species of grasses and forbs; in the western third of Oklahoma on deep sands.
Areas: Harmon County 015
Roger Mills County 226, 558

12.3 Mesquite Savanna
Mesquite, blue grama, silver bluestem, buffalograss, and sideoats grama; mainly in the southwestern quarter of the State; on clayey soils.
Areas: Comanche County 586
Greer County 019
Harmon County 016

Other Mixedgrass Grassland Savannas
Areas: None designated

13.0 SHORTGRASS GRASSLANDS

Blue grama, sideoats grama, and buffalograss predominate; in northwestern Oklahoma and the Oklahoma Panhandle.

13.0 Shortgrass Grassland
Species composition not determined; actual condition and composition dependent upon usage.
Areas: Beaver County 230
Greer County 019
Greer and Harmon Counties 018
Texas County 554

13.1 Shortgrass Grassland Climax
Blue grama, western wheatgrass and buffalograss; also with sand dropseed and sideoats grama; yucca may occur; on deep loamy soils.
Areas: None designated

13.2 Shortgrass Grassland Hardpan
Species composition of Shortgrass Climax (13.1); in shallow soils over a hard chalky zone.
Areas: Cimarron County 001, 002, 003

13.3 Other Shortgrass Grasslands
Areas: Roger Mills County 369

14.0 MEADOWS

Vegetation characterized by graminoid plants, sedges, and rushes. The water table is near the soil surface, but usually there is no standing water.
Areas: None designated

15.0 MARSHES

Herbaceous vegetation with few or no woody plants; soil is waterlogged, standing water is often present.

15.0 Marshes
Depth of standing water not determined, or varies greatly in area.
Areas: Alfalfa County 274

15.1 Shallow Marsh
Cattails, arrowheads, burreeds, sedges, and rushes; waterlogged soils to shallow standing water to six inches deep in growing season.
Areas: Bryan County 175
Johnston and Marshall Counties 553

15.2 Deep Marsh
Spatterdock, waterlily, duckweed, pondweeds, elodea, naiads, watermilfoil, and coontail; standing water six inches to three feet in growing season, including shallow ponds and sloughs.
Areas: Comanche County 586
Johnston and Marshall Counties 553

16.0 SWAMPS

Wetlands with woody plants (shrubs or trees); water table at or near the surface of the soil, flooded to about six to twelve inches during part of the year.

16.0 Swamps
Both shrubs and trees may be present.
Areas: Alfalfa County 274
Pushmataha County 510

16.1 Swamps with Shrubs
Vegetation may include willow, alder, buttonbush, dogwood, viburnum, and swamp privet, but no trees.
Areas: Johnston and Marshall Counties 553
McCurtain County 299

16.2 Swamps with Trees
Swamps with trees; may integrade with bottomland forests at some localities.
Areas: Johnston and Marshall Counties 553

17.0 SALINE AREAS

Soil and water are salty and sometimes alkaline; includes salt flats and salt plains.

Areas: Alfalfa County 263, 274
Beckham County 294
Blaine County 328

18.0 OZARK PLATEAU STREAMS AND RIVERS

18.1 Ozark Plateau Streams
Areas: Cherokee County 565
Delaware County 103
(includes 14, 107, 134, 138)
Ottawa County 312

18.2 Ozark Plateau Rivers
Areas: None designated

19.0 EASTERN STREAMS AND RIVERS

19.1 Eastern Streams
Areas: Cherokee County 078
Osage County 276
Osage and Pawnee Counties 346

19.2 Eastern Rivers
Areas: None designated

20.0 OUACHITA STREAMS & RIVERS

20.1 Ouachita Streams
Areas: McCurtain County 245, 272, 334, 575
Pittsburg County 559

20.2 Ouachita Rivers
Areas: LeFlore County 585
McCurtain County 331, 572, 575
Pushmataha County 555

21.0 COASTAL PLAIN STREAMS & RIVERS

21.1 Coastal Plain Streams, Limestone
Areas: Bryan and Choctaw County 388

21.2 Coastal Plain Rivers, Limestone
Areas: None designated

21.3 Coastal Plain Streams, Sandstone and Shale
Areas: None designated

21.4 Coastal Plain Rivers, Sandstone and Shale
Areas: McCurtain County 241

22.0 ARBUCKLE STREAMS & RIVERS

22.1 Arbuckle Streams
Areas: Johnston County 124, 443
Johnston and Marshall Counties 553
Murray County 284
(includes 282)

22.2 Arbuckle Rivers
Areas: None designated

23.0 CENTRAL STREAMS & RIVERS

23.1 Central Streams
Areas: Canadian County 177, 496
Osage County 357

23.2 Central Rivers
Areas: None designated

24.0 ALLUVIUM STREAMS & RIVERS

24.1 Alluvium Streams, Non-gypsum
Areas: Harper and Woodward Counties 255
Roger Mills County 558, 593

24.2 Alluvium Rivers, Non-gypsum
Areas: Alfalfa and Grant Counties 253
Harper and Woodward Counties 255
Roger Mills County 593

24.3 Alluvium Streams, Gypsum
Areas: None designated

24.4 Alluvium Rivers, Gypsum
Areas: None designated

25.0 MIDWESTERN STREAMS & RIVERS

25.1 Midwestern Streams, Non-gypsum
Areas: None designated

25.2 Midwestern Rivers, Non-gypsum
Areas: None designated

25.3 Midwestern Streams, Gypsum
Areas: None designated

25.4 Midwestern Rivers, Gypsum
Areas: None designated

26.0 BLAINE GYPSUM STREAMS & RIVERS

26.1 Blaine Gypsum Streams
Areas: Blaine County 328
Major County 208

26.2 Blaine Gypsum Rivers
Areas: None designated

27.0 WESTERN STREAMS & RIVERS

27.1 Western Streams, Non-gypsum
Areas: Beckham County 294
Greer and Harmon Counties 018
Roger Mills County 226

27.2 Western Rivers, Non-gypsum
Areas: Texas County 587

27.3 Western Streams, Gypsum
Areas: Custer and Washita Counties 418 and 419

27.4 Western Rivers, Gypsum
Areas: None designated

28.0 WICHITA STREAMS & RIVERS

28.1 Wichita Streams
Areas: Comanche County 586 (includes 111)

28.2 Wichita Rivers
Areas: None designated

29.0 MESA DE MAYA STREAMS & RIVERS

29.1 Mesa de Maya Streams
Areas: None designated

29.2 Mesa de Maya Rivers
Areas: None designated

30.0 OTHER LOTIC SYSTEMS

30.1 Freshwater Springs
Areas: Johnston County 128
Murray County 503
Rogers County 561

30.2 Sulphur Springs
Areas: Mayes County 209

30.3 Waterfalls
Areas: Murray County 284

30.4 Salt Springs
Areas: Beckham County 294

31.0 OZARK PLATEAU PONDS & LAKES

31.1 Ozark Plateau Ponds
Areas: None selected

31.2 Ozark Plateau Lakes
Areas: Delaware County 103

32.0 EASTERN PONDS & LAKES

32.1 Eastern Ponds
Areas: None selected

32.2 Eastern Lakes
Areas: None selected

33.0 OUACHITA PONDS & LAKES

33.1 Ouachita Ponds
Areas: Pushmataha County 510

33.2 Ouachita Lakes
Areas: None selected

34.0 COASTAL PLAIN PONDS & LAKES

34.1 Coastal Plain Ponds, Limestone
Areas: None designated

34.2 Coastal Plain Lakes, Limestone
Areas: Johnston and Marshall Counties 555 (539)

34.3 Coastal Plain Ponds, Sandstone and Shale
Areas: None designated

34.4 Coastal Plain Lakes, Sandstone and Shale
Areas: None designated

35.0 ARBUCKLE PONDS & LAKES

35.1 Arbucke Ponds
Areas: None designated

35.2 Arbuckle Lakes
Areas: None designated

36.0 CENTRAL PONDS & LAKES

36.1 Central Ponds
Areas: None designated

36.2 Central Lakes
Areas: None designated

37.0 ALLUVIUM PONDS & LAKES

37.1 Alluvium Ponds, Non-gypsum
Areas: None designated

37.2 Alluvium Lakes, Non-gypsum
Areas: Alfalfa County 274
Custer County 583

37.3 Alluvium Ponds, Gypsum
Areas: None designated

37.4 Alluvium Lakes, Gypsum
Areas: None designated

38.0 MIDWESTERN PONDS & LAKES

38.1 Midwestern Ponds, Non-gypsum
Areas: None designated

38.2 Midwestern Lakes, Non-gypsum
Areas: None designated

38.3 Midwestern Ponds, Gypsum
Areas: None designated

38.4 Midwestern Lakes, Gypsum
Areas: Non designated

39.0 BLAINE GYPSUM PONDS & LAKES

39.1 Blaine Gypsum Ponds
Areas: None designated

39.2 Blaine Gypsum Lakes
Areas: None designated

40.0 WESTERN PONDS & LAKES

40.1 Western Ponds, Non-gypsum
Areas: None designated

40.2 Western Lakes, Non-gypsum
Areas: None designated

40.3 Western Ponds, Gypsum
Areas: None designated

40.4 Western Lakes, Gypsum
Areas: None designated

41.0 WICHITA PONDS & LAKES

41.1 Wichita Ponds
Areas: Comanche County 586

41.2 Wichita Lakes
Areas: None designated

42.0 MESA DE MAYA PONDS & LAKES

42.1 Mesa de Maya Ponds
Areas: None designated

42.2 Mesa de Maya Lakes
Areas: None designated

43.0 OTHER LENTIC SYSTEMS

43.1 Playas
Playas are dry lake beds, found in the Panhandle which occur as shallow depressions containing water only in seasons and years of substantial rainfall.
Areas: Cimarron County 546
Texas County 544, 554

43.2 Oxbow Lakes and Ponds
Areas: McCurtain County 299
Rogers County 486

44.0 CAVES, ROCK SHELTERS & TALUS CAVES

44.1 Gypsum Caves
Caves formed by solution of gypsum beds of the western third of Oklahoma.

Areas: Greer County 019
Greer and Harmon Counties 018
Major County 208, 215
Woods County 411
Woodward County 406, 409

44.2 Limestone Caves
Caves formed in limestone and dolomite beds; in Ozark Mountains, Boston Mountains, Arbuckle Mountains, and Wichita Mountains geomorphic provinces.
Areas: Adair County 310, 524
Delaware County 103 (includes 104, 105, 106, 134, 135, 138, 145)
Murray County 304

44.3 Sandstone Caves
Caves formed in sandstone and shale; in the Ouachita Mountain, McAlester Marginal Hills Belt, Eastern Cuesta Plains, Central Redbed Plains, and High Plains geomorphic provinces.
Areas: Cimarron County 003
LeFlore County 225

44.4 Rock Shelters and Talus Caves
Caves that are cavities in the interstices of jumbled boulders or in talus accumulations.
Areas: None designated

44.5 Granite Caves
Caves in Granite.
Areas: Kiowa County 193

45.0 GEOLOGIC FEATURES

Habitats that have little vegetation cover and are not aquatic.

45.1 Rock Outcrops
Areas: Kiowa County 192

45.2 Mesas
Areas: Major County 492
Roger Mills County 369

45.3 Natural Bridges
Areas: Pittsburg County 327

45.4 Fossils
Areas: Murray County 382

45.5 Canyons
Areas: None designated

46.0 HIGH-MANAGEMENT GRASSLANDS

46.1 High-Management Grassland
Areas: Cotton County 089 (Bermuda grass)

47.0 CROPLANDS

Areas: None designated

48.0 MANAGED FORESTS

48.4 Shelterbelts and Fence Post Lots
Areas: Greer 096 (shelterbelt)

49.0 ROADS & RAILROADS (Rights-of-way)

Areas: None designated

100.0 SPECIAL SPECIES

Species of plants or animals of special concern or unique status; these classification units are usually used in combination with ones designating habitat types.

100.1 "Big Trees" or "Champion Trees"
Areas: Grant County 005

100.2 Other Plants
Areas: Johnston County 127

100.3 Mammals
Areas: Adair County 310, 524
Comanche County 475
Delaware County 104, 134
Greer, Harmon County 018
Jackson County 013
Kiowa County 196
Major County 208, 215
Pittsburg County 559
Texas County 465

Woods County 411, 472
Woodward County 406, 409

100.4 Birds
Areas: Alfalfa County 263 (includes 275)
Alfalfa and Grant Counties 253
Beaver County 230
Cleveland County 093
Creek County 566
Custer County 583
Harper and Woodward Counties 255
Haskell County 401, 403
Johnston and Marshall Counties 539 (includes 553)
Logan County 577
McCurtain County 336 (includes 337)
Muskogee County 226, 540, 581
Osage County 276, 357, 360
Pittsburg County 513
Roger Mills County 226
Rogers County 389
Sequoyah County 402, 552
Texas County 455
Washington County 563

100.5 Amphibians and Reptiles
Areas: None designated

100.6 Fish
Areas: McCurtain County 572, 575
Pushmataha County 555, 562

100.7 Other Animals
Areas: None designated

101.0 DISJUNCT HABITATS

Designation used in conjunction with a habitat type to denote unusual geographic segregate of the habitat type; this classification unit is used as an information category.

ANALYSIS OF NATURAL AREA DATA

It is appropriate to look at the data from a more analytical perspective to see how completely the spectrum of crucial features in the classification have been represented in the initial proposal of 148 natural areas.

There are a total of 157 features in the Heritage Program classification at present. Major classes of these features are as follows:

Terrestrial and Wetland	66 units
Lotic and Lentic	70 units
Other Habitats (Geologic)	9 units
Special Species	6 units

The frequency of occurrence of crucial Terrestrial/Wetland, and crucial Lotic/Lentic features on the 148 proposed natural areas is shown in Figures 9 and 10.

It is apparent from inspection of Figure 9, that of the total 66 terrestrial and wetland features nearly 50% were represented between 2 and 5 times in the initial selection of 148 areas. Of greater concern however, is that nearly 50% of the total number of features were represented only once or not at all in the proposed areas. About 25% of all terrestrial and wetland features remain unrepresented by any known potential natural area.

By comparison, occurrences of Lotic and Lentic features are more skewed than those of terrestrial and wetland occurrences. Of 70 units, about one-third were included in the initial areas between 1 and 3 times. Over 60% of all Lotic and Lentic features were unrepresented by any proposed area.

These two graphs indicate that while much work has been accomplished to date, much more needs to be done before a wide spectrum of the State's natural diversity can be said to have been designated for preservation.

In particular, a continued emphasis on selection and evaluation will be required on those aquatic features which have not yet been included in the natural areas. This effort will involve the difficult task of refining the aquatic classification to increase its utility and accuracy in the selection of aquatic areas.

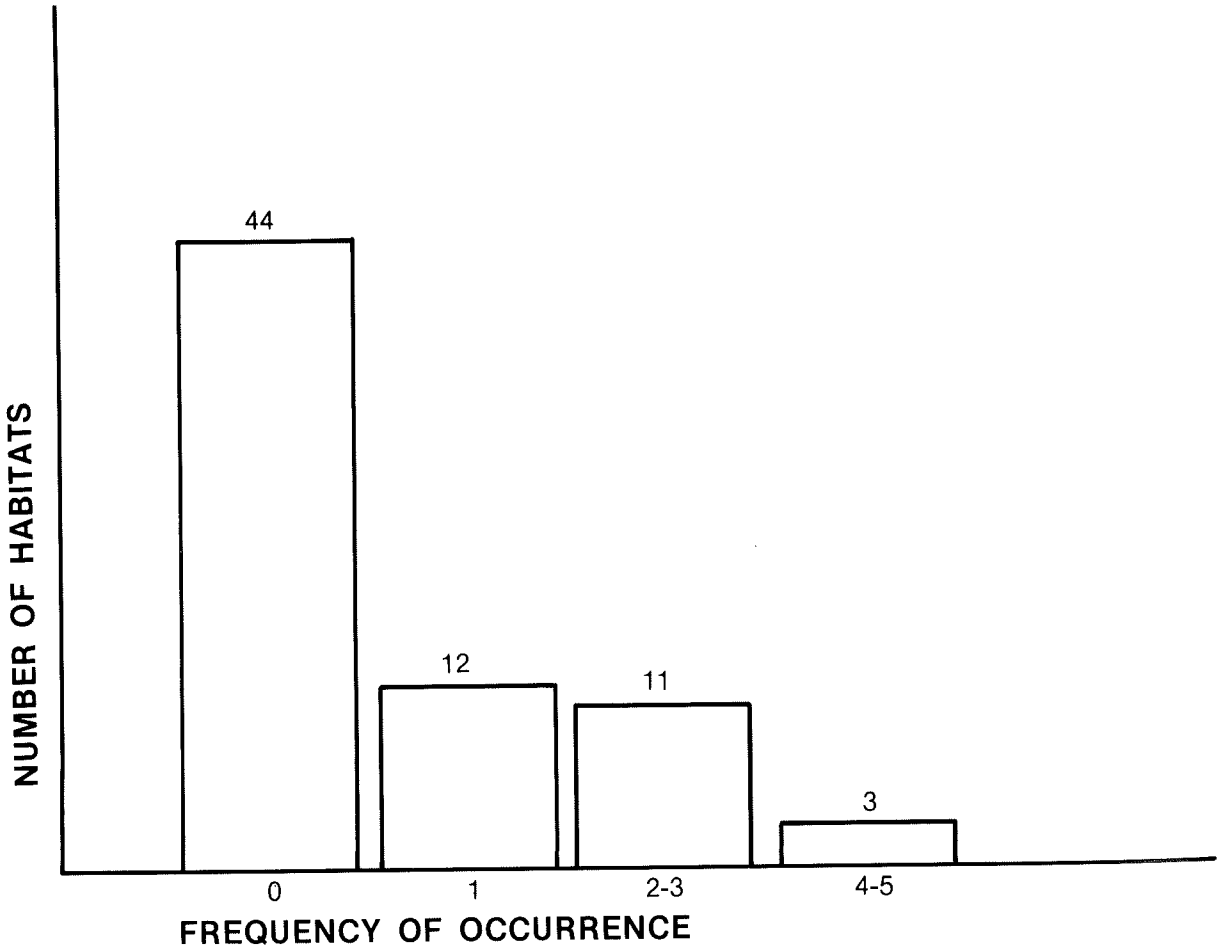


Figure 9.
Frequency of Lotic and Lentic Habitats in Highly Rated Natural Areas.

NUMBER OF HABITATS

Also, although terrestrial and wetland features are better represented in the initial natural areas, many remain unaccounted for or under-represented. It is significant to note that such a large percentage of our prime terrestrial and wetland features should be so uncommon as to remain unselected for natural area status after two years of data gathering. It is indicative of just how scarce some natural features have become in the State of Oklahoma 150 years after settlement.

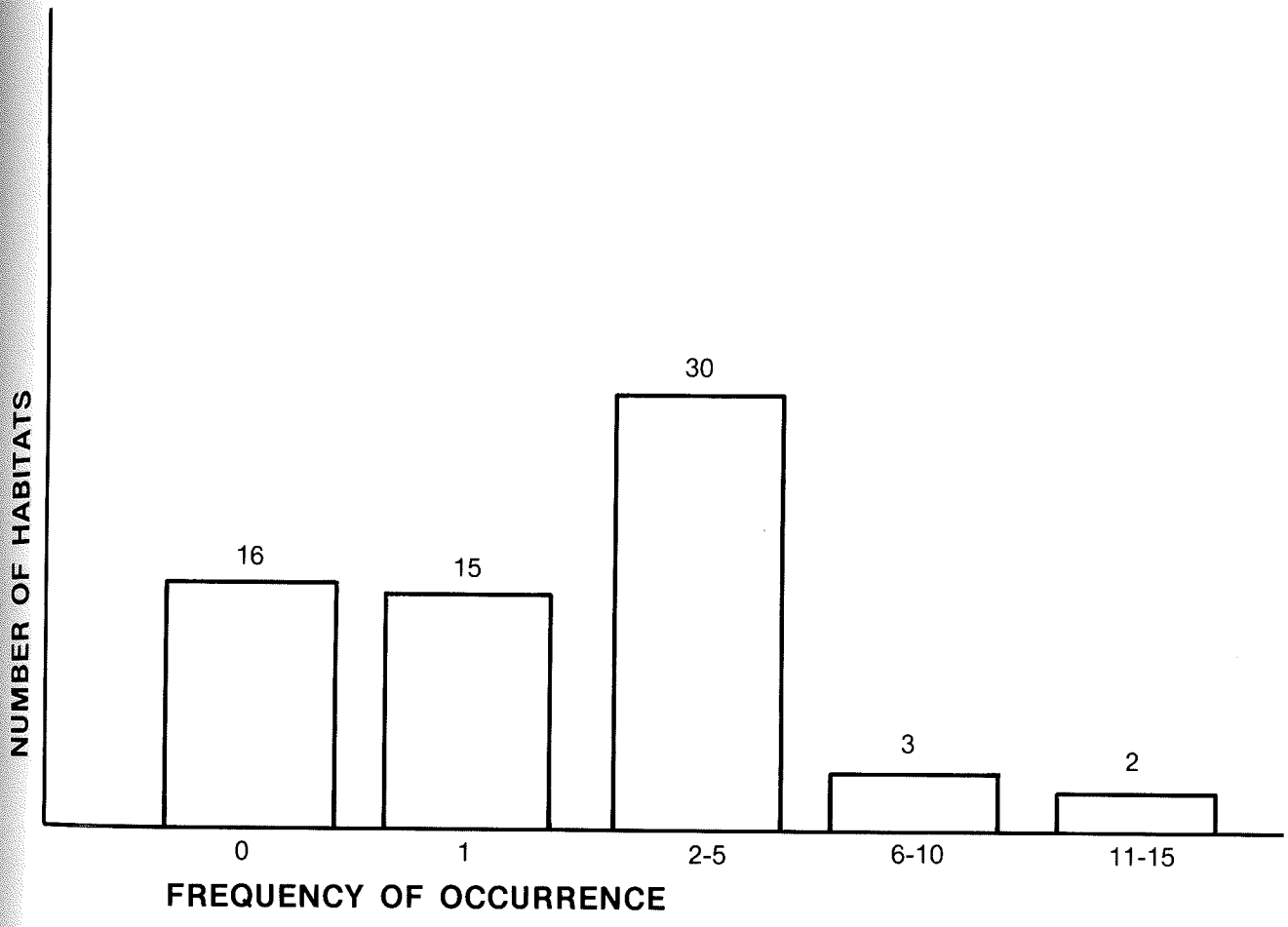


Figure 10.
Frequency of Terrestrial and Wetland Habitats in Highly Rated Natural Areas

Figure 11 shows a distribution map of occurrences of crucial features as they appeared in the recommended natural areas. The companion map, Figure 12, shows the distribution of the number of recommended natural areas by county and the percent of county area to be occupied by the natural areas in a given county.

Taken together, these maps reveal that overall coverage of crucial features by natural areas statewide has been relatively comprehensive in the eastern, western, and Panhandle counties, but not in the more central counties. Most importantly, 16 counties are not represented by any crucial features and a majority of counties are probably underrepresented with 1-3 natural features per county. Clearly, much of the Oklahoma landscape has yet to be fully explored for occurrences of those crucial features which have become increasingly difficult to find. Most, if not all, of the easier choices have been made. Further gains in accumulating examples of the State's natural diversity will come more slowly in the future, so it is important that this inventory process continue.

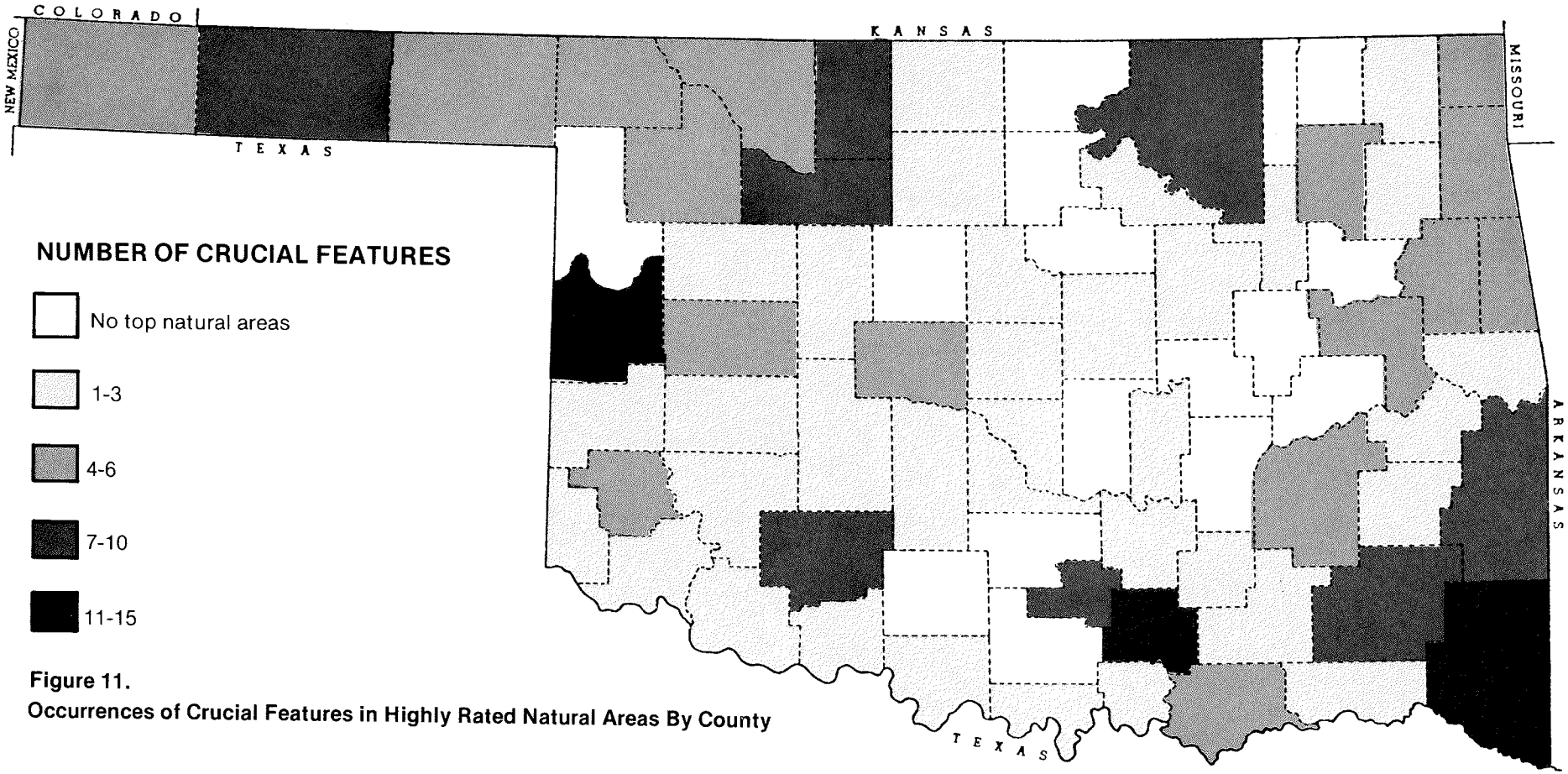


Figure 11.
Occurrences of Crucial Features in Highly Rated Natural Areas By County

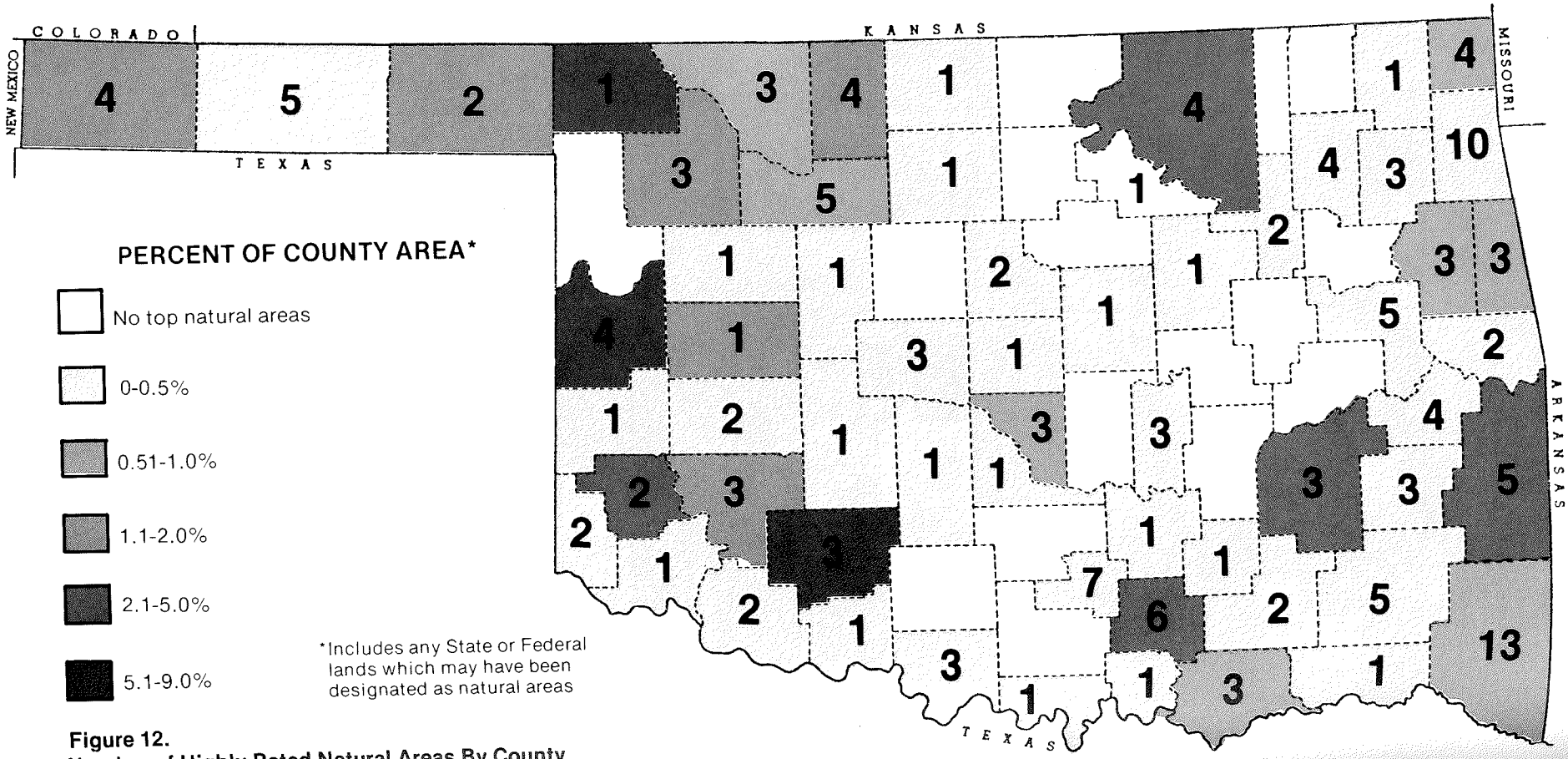


Figure 12.
Number of Highly Rated Natural Areas By County

SECTION III

MANAGEMENT RECOMMEN-DATIONS

MANAGEMENT RECOMMENDATIONS

MANAGEMENT OF OKLAHOMA'S NATURAL AREAS

Attitudes, management plans, and policies determine the level of protection given to natural areas. Poor management, planning and practice will prove expensive, resulting in the eventual deterioration of valuable natural areas, and in further depletion of natural resources in the State. Sound policies and intelligent planning for the protection of natural areas, however, will yield results beneficial to the present and future maintenance of these areas.

The successful management of natural areas demands both the consistent use of overall objectives for area management, and the application of these objections in a framework for the development of individual natural area plans.

Management objectives of Oklahoman's natural areas will derive from two imperatives (1):

1. The primary imperati ve will be to protect and preserve natural areas for this and future generations.
2. The secondary imperative will be to manage these areas for educational, scientific, and recreational uses, compatable with the primary imperative such that no activity will impair the natural areas.

To accomplish these goals the Oklahoma Natural Heritage Program recommends that the following general guidelines be used in reference to the management of all natural areas in Oklahoma:

1. Each area should be managed according to a plan which recognizes the attributes of the area and needs of the users.
2. If choices must be made, management should emphasize resource preservation over resource use.

3. Natural areas should be managed only to the extent necessary to preserve and appreciate the natural features for which they were established, and to seek the least possible degradation of their unique characteristics, including naturalness, solitude, and absence of permanent visible disturbance.
4. Management practices should seek natural distributions, numbers, and interactions of indigenous species; allow natural processes to control the represented ecosystems to the greatest extent possible; and whenever appropriate, to favor the preservation of rare, threatened and endangered species dependent on the represented natural conditions.
5. Educational, scientific, and recreational activities should be permitted where such activities are biologically sound, legal and conducted in the spirit of the natural areas.

Managed under these guidelines the network of natural areas in Oklahoma will have a standard, coherent policy from which can be derived specific management plans to enhance the perpetuate individual areas.

Formulation of Specific Management Plans

Each selected natural area will represent special natural features. Therefore, the management plan for that area must be designed to specifically preserve those features. At the same time, the management plan must recognize the needs of the potential users and the general objectives of the natural areas program.

A number of elaborate procedures (e.g. Figure 13) have been envisioned for management planning in parks, wilderness areas, and natural areas. Such a plan may incorporate various steps and information flows, but it is important that any well-developed management plan include the following characteristics:

1. General objectives and priorities are established and alternatives considered.
2. Resources are inventoried and data is assimulated in a meaningful manner.
3. The user community is well defined.
4. Cognizance is made of legal and external planning constraints.
5. Responses to management are monitored and feedback provisions are made to alter management strategies where appropriate.

Accordingly, the general policy for developing individual management plans for Oklahoma's natural areas will follow the scheme outlined in Figure 14.

The following paragraphs briefly present the components of the scheme as they will be in the process of area plan development.

Natural Area Attributes

As stated in the management objective, the Area Attributes ultimately determine the kind of area plan that will satisfy the two imperative goals of the Program. The attributes of a natural area are those crucial and accessory features (described in SECTION II of this report) for which the area was selected.

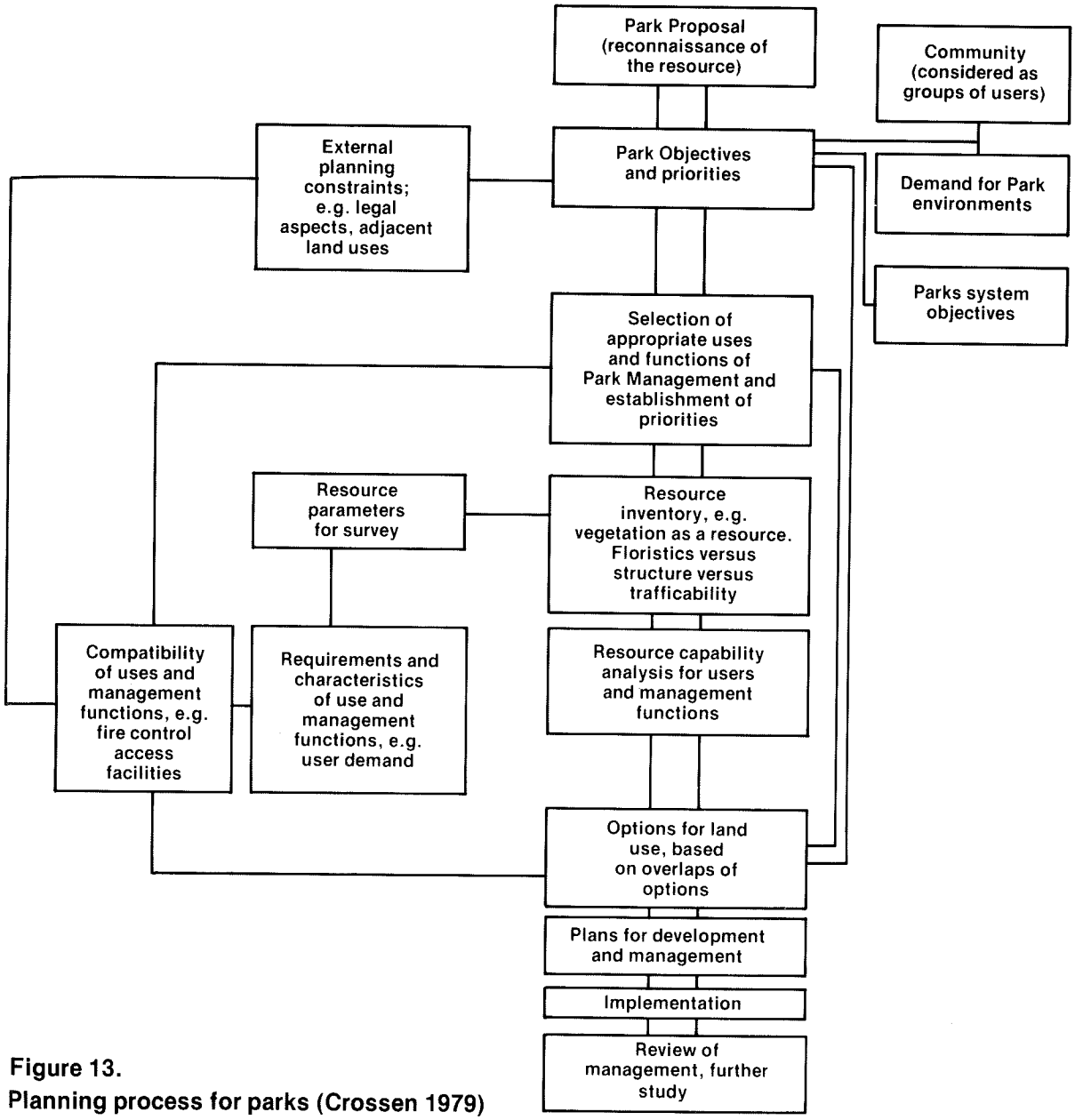


Figure 13.
Planning process for parks (Crossen 1979)

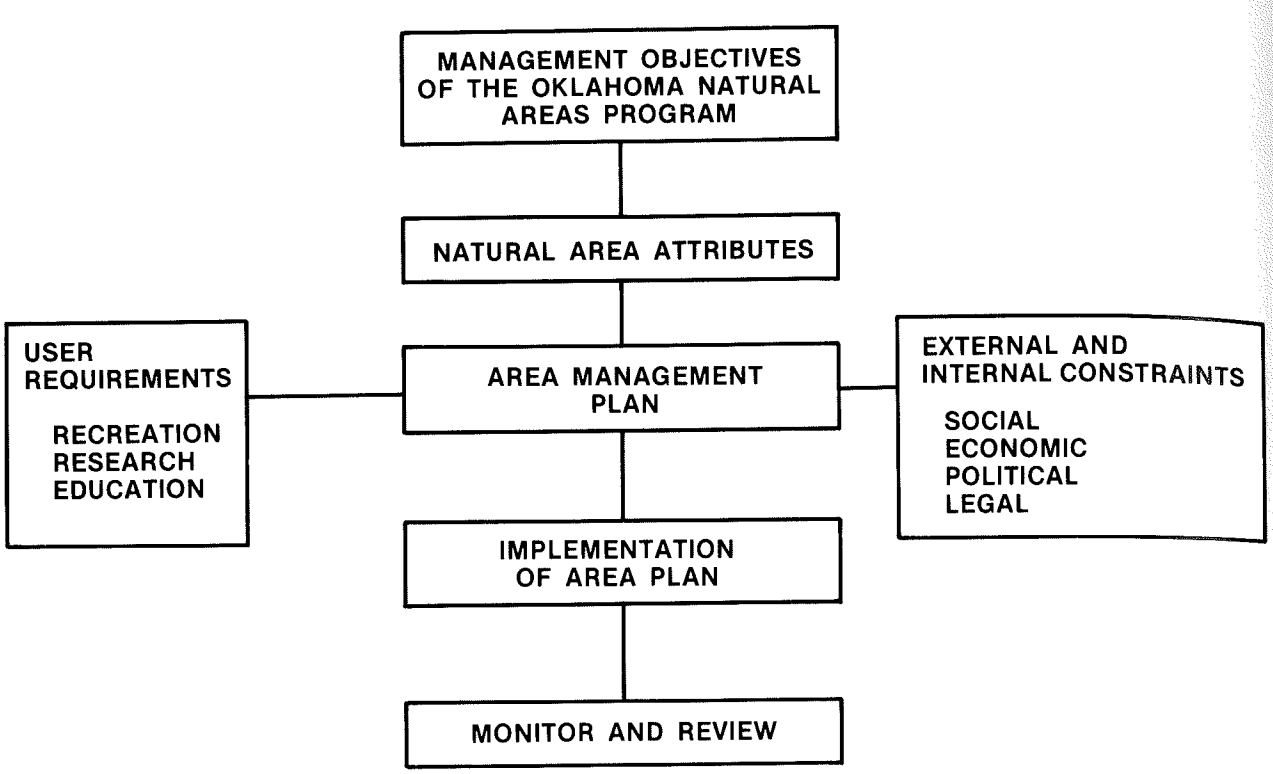


Figure 14.
Area plan development process for each Oklahoma natural area.

Area Management Plan

Area plans must be developed from a sound understanding of ecological processes and wildlife habitats. Among the characteristics to be considered in developing the area plan are:

- effects of grazing on plants, herbivores and carnivores
- successional sequences
- conditions which promote species diversity
- consequences of altering food chains
- habitat requirements of wildlife species
- theoretical and practical aspects of maintaining genetic diversity
- effects of fires, fertilizers and water on persistence of habitat types
- required size of area for maintenance of species, and community integrity
- potential wildlife management techniques

The resources of each area will be mapped according to the existing classification system. Then a plan for management of each unit will be completed, taking into account as far as possible both user requirements, and external and internal constraints.

External and Internal Constraints

All internal constraints will be established by the management plan and by any possible conditions established at the time of acquisition. External constraints are those imposed by adjacent zoning for land-use restrictions.

User Requirements

Users of the natural areas fit into two broad categories: Recreational and Scientific/Educational.

Recreational users should be encouraged to an enlightened appreciation of the State's natural diversity, with an emphasis on the interrelations between all living things. The intensity of recreational use in an area will depend upon the AREA ATTRIBUTES, but should include a range of nature-oriented activities involving both direct and indirect participation by recreationists. Direct participation covers such activities as painting, photography, walking, observing flora or fauna, and meditation. Indirect participation may include the use of such nature exhibits as may be provided, or attending supervised programs conducted by naturalist interpreters.

Scientific/Educational users require examples of representative habitats for the purposes of observing and recording attributes about these natural resources. These attributes may be particular ecological processes at the individual, population, community or ecosystem levels. In general, research describing the biological and physical resources of the area will be of use for ensuring that optimum management procedures are being utilized.

Permits to use natural areas will be issued by a subcommittee of the Oklahoma Natural Heritage. This subcommittee will consist of a representative from the Tourism and Recreation Department, Wildlife Conservation Department, and two representatives of the Scientific/Educational sector; the Director of the Natural Heritage Program will serve as a non-voting chairman of the subcommittee. This subcommittee may request specific information from potential users prior to approval or disapproval of each specific request.

Implementation, Monitoring and Review

Once the management plan is completed, efforts will be made to be certain the plan is implemented.

In addition, the status of each area will be monitored periodically. Some of the monitoring may be conducted by remote sensing techniques, but other sources of information will be field surveys and the results of Scientific/Educational activities. At intervals, no more infrequently than three years, the management plan for each natural area will be reviewed and revisions considered by the subcommittee at the Heritage Council.

SECTION IV

TODAY AND TOMORROW

TODAY AND TOMORROW

NATURAL AREAS AND THE OKLAHOMA NATURAL HERITAGE PROGRAM

The Oklahoma Natural Heritage Program, since its inception in January, 1977, has conducted an inventory of the natural features of Oklahoma for the purpose of selection and recognition of significant areas for a natural areas system. The Program functions as an information gathering and analysis project of the Division of Planning of the Oklahoma Tourism and Recreation Department.

The systematic approach to the task involved the development of the classification of habitats and special species. Identification and inventory of possible natural areas included the examination of museum collections, the literature, and by personal contacts with several hundred people knowledgeable about Oklahoma. Over 2000 records of special species occurrences were recorded and entered into the Program's data system. Information concerning over 900 possible natural areas was examined, and of these areas, 594 were entered into the data system. Approximatley 200 localities were visited by the Program staff for the purpose of field investigation.

Evaluation of the 594 possible natural areas proceeded in an orderly pattern. Comparison of areas possessing the same natural features was made by examination of the available information for the inherent characteristics of consideration, condition, and quality. Additional accessory factors were also considered.

From the systematic approach to data collection, analysis, and evaluation, it was possible to choose 148 areas for the natural areas system of Oklahoma. Appendix 2 presents a summary of the number of natural areas rated "high" and chosen to represent each of the classification units. The work is not completed. There are gaps in the representation of natural areas described by the classification. Continued search and

evaluation of terrestrial, wetland, and aquatic habits are needed to ensure that prime areas are not left undiscovered.

The pressure to develop many excellent areas continues unabated, and therefore it cannot be assumed that a minimum number of representative areas will suffice for the future (27). As many prime areas as can be recognized will need to be considered for natural area status so that a system of natural areas may have an opportunity to become reasonably complete.

The Program's initial phase of identification, inventory, evaluation, and recommendation will continue as new information concerning our natural features become available. Expansion into the realm of geologic features and land forms is desirable so that all natural features will come under the scope of the Oklahoma Natural Heritage Program.

Interest at the national level in the recognition and designation of natural areas has rapidly increased in the last few years. The Heritage Conservation and Recreation Service, U.S. Department of the Interior, now directs national activities relating to natural areas. Technical and financial support are available to the State for continued planning, development, and acquisition.

The future efforts of the Heritage Program will be directed to more than developing a natural areas system. The first two years of the Program have seen the growth of a large, well-organized data base specifically concerning the natural diversity of biological systems in Oklahoma. It is probably the most complete source of natural heritage information in the State. This information can now be used to provide assistance for planning, environmental assessment, research projects, or other legitimate uses. The proper use of land has never been so imperative as it is today, and it is a goal of the Oklahoma Natural Heritage Program to provide such information to promote wise and rational use of our land and water resources.

Information to be made available to data users may include the status and location of special plants and animals in the State, plant communities, special habitats, and unique or interesting geological features. In addition, current information on select wildlife populations and special features lacking legal protection may be provided.

The release of any and all information by the Oklahoma Natural Heritage program will not exceed the level of the users' requirements, and an agreement of confidentiality will be made between the Heritage Program and the data user, since unauthorized public distribution of the locations of vulnerable species and habitats may contribute to their destruction.

Other future activities of the Heritage Program will include the following: detailed investigations of those natural areas selected for protection by the State of Oklahoma; an increased emphasis on management; recommendations for threatened species and habitats whenever the Program shall be invited to assist in these areas by State agencies, or private interest; and a strong effort to make the public aware of the Program's work and of the necessity for their interest and active support in the preservation of the State's natural features.

The importance of a Natural Heritage Program to the State of Oklahoma should not be undervalued. There are numerous conservation and wildlife preservation groups in the State; each of them is valuable and should be encouraged. In many cases these talented and vitally interested people have contributed significantly to the Oklahoma Natural Heritage Program. However, individually none of them is capable of

attempting to systematically inventory the State's natural diversity, or to try to capture that diversity within a system of natural areas. Two things make the Heritage Program unique among wildlife agencies and private groups alike: The comprehensive scope of the Program, and the vigorously objective approach built into the Program for the designation of only the best examples of our natural diversity.

Perhaps we should reiterate here that preservation is not our only business; what the Oklahoma Natural Heritage Program advocates is not the preservation of everything for all time, but rather the wise use of what we now have. To achieve this wisdom, we need to expand the human mind and foster the growth of the human spirit.

We begin by seeking a few trees or birds; to get them we must build a new relationship between men and land.

—Aldo Leopold

LITERATURE CITED

1. Arkansas, State - 1974. Arkansas Natural Area Plan. Arkansas Dept. of Planning, Little Rock.
2. Blair, W. F. 1939. Faunal relationships and geographic distribution of mammals in Oklahoma. Amer. Midl. Natur. 22:85-133.
3. Blair, W. F. and Hubbell, T. H. 1938. The biotic districts of Oklahoma. Amer. Midl. Natur. 20:425-454.
4. Bragg, A.N. 1950. The identification of Salientia in Oklahoma, pp. 9-29 in A. N. Bragg, et al. (eds.), Researches on the Amphibia of Okla., Norman, Okla.: University of Oklahoma Press.
5. Bronowski, J. 1965. Science and Human values. Harper and Row, New York.
6. Crossen, T. I. 1979. A New Concept in Park Design and Management. Biol. Conserv. 15:105-125.
7. Curry, B. R. 1970. Climate of Oklahoma. U.S. Dept. of Commerce, Environmental Science Service Admin., Climatography U.S. 60-34 (rev.).
8. Curtis, N. M., Jr., and W. E. Ham. 1972. Geomorphic provinces of Oklahoma, p. 3 in K. S. Johnson, et al. (eds.), Geology and earth resources of Oklahoma, an atlas of maps and cross sections. Oklahoma Geol. Surv. Educ. Pub. 1.
9. Duck, L. G. and Fletcher, J. B. 1943. A game type map of Oklahoma. Oklahoma Game and Fish Department, Division of Wildlife Restoration.
10. Duck, L. G. and J. B. Fletcher. 1945. A survey of the game furbearing animals of Oklahoma. Oklahoma Game and Fish Commission, Division of Wildlife Restoration and Research, Pittman-Robertson Ser. 11, State Bull. 3.

11. Goodman, J. M. 1977. Physical environment of Oklahoma, pp. 9-24 in J.W. Morris (ed.), Geography of Oklahoma, Oklahoma City, Okla.: Oklahoma Historical Society.
12. Gray, F. and H. M. Galloway. 1969. Soils of Oklahoma. Oklahoma State University, Agric. Exp. Sta., Misc. Publ. MP-56 (rev.).
13. Gray, F. and M. H. Roozitalab. 1976. Benchmark and key soils of Oklahoma, a modern classification system. Oklahoma State University, Agric. Exp. Sta., Misc. Publ. MP-97.
14. Hendee, J. C. and Schoenfield, C. A. 1978. Wilderness Management for Wildlife: Philosophy, Objectives, Guidelines. Transaction 43rd North American Wildlife and Nat. Resources Conf. 1978. Wildlife Management Institute, Washington, D.C.
15. Hinds, T. W. 1979. The Cesspool Hypothesis vs. Natural Areas for Research in the United States. Environmental Conservation 6:13-20.
16. Iltis, H. 1959. We Need Many More Scientific Areas. Wisconsin Preservation Bull. 24:3-8.
17. Irwin, J. H. 1977. Water resources of Oklahoma, pp. 25-39 in J. W. Morris (ed.), Geography of Oklahoma. Oklahoma City, Oklahoma: Oklahoma Historical Society.
18. Kingsbury, P. J. 1968. Plankton production and species distribution in the limnological provinces of Oklahoma. Ph.D. dissertation, University of Oklahoma, Norman.
19. Maser, C., Trappe, J. M., and Ure, D. C. 1978. Implications of Small Mammal Mycophagy to Management of Western Coniferous Forests. Transactions 43rd North American Wildlife and Natural Resources Conf. Wildlife Management Inst., Pub.
20. Miller, R. J. and H. W. Robison. 1973. The Fishes of Oklahoma. Stillwater, Oklahoma: Okla. State University Press (Oklahoma State University Museum of Natural and Cultural History, Natural History Series 1).
21. National Audubon Society. 1975. Mohawk Park Nature Center. A Site Survey and comprehensive Plan. Nature Center Planning Division, National Audubon Soc., New York.
22. Oklahoma Water Resources Board. 1976. Oklahoma's Water Atlas, 1976. Oklahoma City, Oklahoma: Oklahoma Water Resources Board.
23. Oklahoma Department of Wildlife Conservation. 1978. 1978-1979 Oklahoma Hunting Regulations (except waterfowls). Oklahoma City: Oklahoma Department of Wildlife Conservation.
24. Oklahoma Department of Wildlife Conservation. (no date). Oklahoma Mammals. Oklahoma: Oklahoma Dept. of Wildlife Conservation.
25. Oldfield, M. L. 1979. The Value of the Conservation of Genetic Resources, Part I: Uses of Genetic Diversity. Texas System of Natural Laboratories, Inc., Austin, Tex.
26. Rare and Endangered Species of Oklahoma Committee. 1975. Rare and Endangered Vertebrates and Plants of Oklahoma. Stillwater, Oklahoma: Soil Conservation Service.
27. Ratcliffe, D. (ed.) 1977. A Nature Conservation Review. Vol. I. Cambridge University Press, Cambridge.
28. Schnell, G. D. 1978. Check-list of Birds of Oklahoma. Norman, Oklahoma: Stovall Museum of Science and History, University of Oklahoma.

29. Shelford, V. E. 1963. The Ecology of North America. Chicago, Ill.: University of Illinois Press.
30. Sutherland, S. M. 1977. Climate of Oklahoma. pp. 40-53 in J. W. Morris (ed.), Geography of Oklahoma. Oklahoma City, Okla.: Oklahoma Historical Society.
31. Sutton, G. M. 1967. Oklahoma birds, their ecology and distribution, with comments on the avifauna of the southern Great Plains. Norman, Oklahoma: University of Oklahoma Press.
32. Sutton, G. M. 1974. A check-list of Oklahoma birds. Norman, Okla.: Stovall Museum of Science and History, University of Oklahoma.
33. Thomas, W. A. 1972. Indicators of Environmental Quality: An Overview. In: Indicators of Environmental Quality. W. A. Thomas, (ed.) Plenum Press, New York.
34. University of Kansas. 1979. Index to Federal Wildlife Regulations, Appendix E. Association of Systematics Collections, Museum of Natural History, Lawrence, Kansas.
35. Waterfall, U. T. 1972. Keys to the Flora of Oklahoma. Fifth ed. Stillwater, Oklahoma: Published by the author.
36. Webb, R. G. 1970. Reptiles of Oklahoma. Norman, Oklahoma: University of Oklahoma Press. (Stovall Museum Publication).
37. White, John. 1978. Illinois Natural Areas Inventory Technical Report Vol. I. Survey Methods and Results. Illinois Natural Areas Inventory, Urbana.
38. Zanoni, T. A., Gentry, J. L., Jr., Tyrl, R. J. and Risser, P. G. 1979. Endangered and threatened plants of Oklahoma. Norman, Oklahoma: Department of Botany and Microbiology, and Stillwater, Oklahoma: Department of General and Evolutionary Biology.

APPENDICES

APPENDIX 1. Natural areas for Oklahoma. (Fig. 15). See Table 2 for list of numbers and names of classiciation units.

County	Area	Top Features	Other Features	Acreage	Ownership
Adair	260	3.20	18.1, 100.2	500	Private
Adair	524	3.20, 44.2, 100.3		160	Private
Adair, Cherokee	342	3.28		190	State
Adair	310	3.20, 44.2	18.1, 31.1	2,500	Private, Conservation, Group
Alfalfa	252	10.1		50	Private
Alfalfa, Grant	253	24.2, 100.4	9.2	7,000	Private
Alfalfa	263, 274	15.0, 16.0 17.0, 34.2, 100.4	24.1	32,000	Federal
Atoka	250	1.2		890	Private
Atoka	512	16.0	15.0, 34.4	60	Private
Beaver	230	12.1, 13.0, 100.4	9.2, 27.1, 47.1, 100.4	14,720	Private
Beaver	368	40.4	13.0	630	Private
Beckham	294	17.0, 27.1, 30.4		40	Private
Blaine	328	17.0, 26.1		328	Private
Bryan	175	15.1	21.3	40	Private
Bryan, Choctaw	388	6.21, 21.1		1,685	Private
Bryan, Johnston	504	10.3	3.14, 7.1, 21.1	1,860	Private
Caddo	122	3.11		240	Private
Canadian	177	3.151, 8.1, 23.1, 101.0	11.0	1,360	Private
Canadian	496	8.1, 23.1, 101.0		400	Private
Canadian	574	8.1		110	Private
Cherokee	078	19.1	3.2, 6.1, 44.2, 100.3	1,680	Private
Cherokee	084	3.2	100.2	140	Private
Cherokee	565	3.20, 6.1, 18.1		1,600	Private
Choctaw	170	3.28		120	Private
Cimarron	001	1.32	4.0, 45.2	2,578	Private, State, Federal
Cimarron	002 003	4.1, 9.2, 13.2		17,903	Private
Cimarron	546	43.1	13.0	440	Private
Cleveland	093	7.1	100.4	45	Private
Cleveland, Oklahoma	114	3.11	35.2	4,230	City
Cleveland	120	3.13	11.0	not determined	State
Coal	092	3.41		1,400	Private
Comanche	475	100.3	11.0, 28,1, 41.1	1,000	Federal

County	Area	Top Features	Other Features	Acreage	Ownership
Comanche	586, 110	3.10, 9.0, 9.1, 10.0, 12.3, 15.2 28.1, 41.2	3.151, 100.3, 100.4, 101.0	59,020	Federal
Cotton	089	46.1	48.4	50	Private
Craig	235	10.0	6.1, 19.1	960	Private
Creek	566	100.4		4	Private
Custer, Washita	418, 419	11.6, 27.3	9.1, 44.1, 100.3	840	Private
Custer	583	9.1, 11.4 37.2, 100.4		8,084	Federal
Delaware	103, 104, 105, 106 107, 134, 135, 138, 145	3.20, 18.1, 31.2, 44.2, 100.3		34,900	Private, City, State
Dewey	140	3.11	9.0, 27.1	560	Private
Garfield	088	3.13		90	Private
Grady	020	11.0	7.1, 25.1, 38.1	1,120	Private
Grant	005	100.1		1	Private
Greer, Harmon	018	13.0, 27.1, 44.1, 100.3	11.6, 13.0	5,120	Private
Greer	019	12.3, 13.0, 44.1	27.3, 40.3	4,800	Private
Greer	096	48.4	47.1	20	Private
Harmon	015	12.1, 12.2	12.3, 40.1	30	State
Harmon	016	12.3	100.3	160	Private
Harper, Woodward	255	9.0, 12.1, 24.1, 24.2, 100.4	12.2	33,615	Private, Federal
Haskell	256	10.0	19.1, 32.1	540	Private
Haskell	401	100.4	3.2, 6.21, 32.1	160	Federal
Haskell	403	100.4	6.2, 32.2	160	Federal
Jackson	013	100.3	13.0	480	Private
Jackson, Tillman	509	9.0	100.4	500	Private
Jefferson	129	3.12		100	Private
Jefferson	131	10.0	7.1	530	Private
Jefferson	133	11.0		560	Private
Johnston	124	22.1	3.10, 7.1, 100.2	45	Private
Johnston	127	7.1, 100.2	22.1	220	Private
Johnston	128	30.1	7.1, 22.1, 100.2	55	Private
Johnston	443	3.20, 22.1		1,000	Private
Johnston, Marshall	539 553	7.1, 15.1 15.2, 16.1, 16.2, 22.1, 34.2, 100.4	3.2, 22.2, 34.1, 47.1	16,600	Federal
Kiowa	192	45.1	9.3, 12.3, 41.1	7,892	State, Private
Kiowa	193	44.5	11.0	1,860	Private
Kiowa	196	100.3	11.0	90	Private
Latimer	151	3.14	20.1	640	Private
Latimer	165, 257	1.1, 1.3		820	Federal
LeFlore	225	44.3	1.0	160	Federal
LeFlore	584, 228	1.0, 3.20		13,600	Federal

County	Area	Top Features	Other Features	Acreage	Ownership
LeFlore	585, 222	1.0, 3.20, 3.22, 6.21, 20.2		11,100	Federal
Lincoln	218	3.14		120	Private
Logan	517	8.1	23.2	470	Private
Logan	577	100.4	3.10	8	Private
Love	216	3.14	22.1	240	Private
Marshall	212	10.0	34.1	240	Private
Major	205	3.13		140	Private
Major	206	3.12		270	Private
Major	208	9.0, 11.6, 26.1, 44.1, 100.3	39.1	1,000	Private
Major	215	44.1, 100.3	9.0, 26.1, 100.3	240	Private
Major	492	3.151, 45.2	26.1	3,200	Private, State
Mayes	209	30.2		10	Private
Mayes	210	3.24	19.1	480	Private
Mayes	564	6.1	100.4	100	Private
McClain	592	11.0	7.1, 25.1, 38.1	1,760	Private
McCurtain	239	2.1	21.3	240	Federal
McCurtain	241	6.21, 21.4		1,280	Private
McCurtain	243	5.3	1.0	320	Private
McCurtain	268	10.0		320	Private
McCurtain	299	6.22, 16.1, 43.2	21.4, 100.6	810	Private
McCurtain	331	20.2	1.0, 100.2	720	State
McCurtain	336, 337	1.1, 1.2, 100.4	6.2, 20.1, 20.2	14,087	State
McCurtain	572	6.21, 20.2, 100.6		22 river miles	Private
McCurtain 245, 272, 334	575,	6.21, 20.1, 20.2, 100.6		53 river miles	Private
Murray 284, 278	282,	3.10, 3.152, 7.1, 22.1, 30.3		700	Private, City
Murray	304	44.2	11.0	560	Private
Murray	311	3.27, 11.0		150	Private
Murray	382	45.4		40	Private
Murray	503	30.1	7.1, 35.1	20	Private
Muskogee	266	100.4		4	City
Muskogee	306	3.25	3.14	100	Private
Muskogee	307	3.14		320	Private
Muskogee	308	10.0	19.1, 32.1	1,280	Private
Muskogee	540	100.4	48.4	8	Private
Oklahoma	581	100.4		20	Private
Osage	276	10.1, 19.1, 100.4	8.1, 32.1	8,320	Private
Osage, Pawnee	346	8.1, 19.1	19.2, 100.4	2,500	Private, Federal
Osage	357	8.1, 10.0, 23.1, 100.4	36.1	26,240	Private
Osage	358	3.14		200	Private
Osage	360	3.20, 6.1, 100.4	32.2	550	Private, Conservation, Group, Federal
Ottawa	356	3.14		920	Private
Ottawa	312	18.1	6.1, 44.2, 100.6	160	Private

County	Area	Top Features	Other Features	Acreage	Ownership
Ottawa	491	6.1	43.2	35	Private
Ottawa	531	3.20	6.1, 31.2, 100.4	1,095	Private, State
Pittsburg	313	3.14	20.1	1,960	Private
Pittsburg	327	3.14, 45.3	20.1	60	Private
Pittsburg	559	3.14, 6.21, 20.1, 100.3	10.0, 33.1, 33.2, 100.4	not determined	Private
Pontotoc	320	10.0	7.1, 22.1, 35.1	1,920	Private
Pushmataha	374	1.3		370	Private
Pushmataha	375	1.1	20.1	550	Private
Pushmataha	378	1.1		140	Private
Pushmataha	510	16.0, 33.1		5	Private
Pushmataha	55	6.21, 20.2, 100.6		38 river miles	
Roger Mills	226	12.2, 27.1, 100.4	47.1	10,880	Private
Roger Mills	369	12.1, 13.1, 45.2	12.2	880	Private
Roger Mills	558	9.0, 11.4, 12.2, 24.1	37.1, 37.2, 48.2	25,280	Private, Federal
Roger Mills	593	9.0, 24.1, 24.2		850	Private, Federal
Rogers	389	100.4	10.0, 19.1	5	Private
Rogers	486	6.1, 43.2		640	Private
Rogers	487	3.26		50	Private
Rogers	561	3.20, 30.1	32.1	85	Conservation
Seminole	543	3.10		320	Private
Sequoyah	316	3.28	3.14	110	Private
Sequoyah	402	100.4	32.2	160	Federal
Sequoyah	552	100.4	6.1, 19.1	1	Private
Texas	455	100.4	9.2, 27.2	10	Private
Texas	465	100.3	13.0	220	Private
Texas	544	43.1	13.0	760	Private
Texas	554	13.0, 43.1		800	Private
Texas	587	9.2, 27.2	100.4	2,870	Private
Tillman	362	11.1	49.2	890	Private
Tulsa	383	3.14	45.1	660	Private
Tulsa	394	10.1	19.1	160	Private
Woods	261	5.0, 12.1, 100.3		5,470	Private
Woods	472	100.3	11.0	120	Private
Woodward	406	11.6, 44.1, 100.3		640	Private
Woodward	409	44.1, 100.3	9.0, 26.1, 45.3	200	Private
Woodward	550	9.2, 11.4	12.1, 24.1, 37.1	8,800	Private

APPENDIX 2. Summary of the numbers of natural areas featuring each classification unit and rated "high" for inclusion in the natural areas system. Total number of natural areas system. Total number of natural areas is 148.

Classification Unit	Areas Rated High
TERRESTRIAL HABITATS	
Upland Forests	
1.0 Shortleaf Pine - Oak-Hickory Forests	
1.0 Shortleaf Pine Forest	2
1.1 Shortleaf Pine-Oak-Hickory Forest	4
1.2 Post Oak-Blackjack Oak-Shortleaf Pine Forest	2
1.3 Oak-Shortleaf Pine-Hickory Forest	2
2.0 Loblolly Pine Forests	
2.1 Loblolly Pine-Mixed Hardwood	1
3.0 Oak-Hickory Forests	
3.10 Post Oak-Blackjack Oak Forests	3
3.11 Post Oak-Blackjack Oak Forest	3
3.12 Post Oak Forest	2
3.13 Blackjack Oak Forest	3
3.14 Post Oak-Blackjack Oak-Black Hickory-Black Oak Forest	11
3.15 Post Oak-Blackjack Oak-Juniper Forest	-
3.151 Post Oak-Blackjack Oak-Eastern Red Cedar Forest	2
3.152 Post Oak-Blackjack Oak-Ashe Juniper Forest	1
3.20 Mixed Oak-Hickory Forests	11
3.21 Black Oak-Blackjack Oak-Post Oak-Black Hickory Forest	-
3.22 White Oak-Oaks-Hickory Forest	2
3.23 Winged Elm-Post Oak-Blackjack Oak-Hickory Forest	-
3.24 Black Hickory-Post Oak-Black Oak-Blackjack Oak Forest	1
3.25 Chinquapin Oak-Sugar Maple-Post Oak-Shumard Oak Forest	1
3.26 Sugar Maple-Hardwood Forest	1
3.27 Mixed Oak Forest	1
3.28 Post Oak-Hardwood Forest	3
4.0 Pinyon-Juniper Woodlands	
4.1 Pinyon-Juniper Woodland	1
5.0 Other Upland Forests	
5.0 Other Upland Forests	1
5.1 Lie Oak Forests	-
5.2 Forests Radically Altered by Man	-
5.3 Beech-Hardwood Forest	1
Bottomland Forests	
6.0 Eastern Oklahoma Bottomland Forests	
6.1 Northeastern Oklahoma Bottomland Forest	5
6.2 Southeastern Oklahoma Bottomland Forest	-
6.21 Southeastern Bottomland Forest	10
6.22 Cypress Southeastern Bottomland Forest	1
7.0 Southcentral Bottomland Forests	4
7.1 Southcentral Bottomland Forest	4
8.0 Northcentral Oklahoma Bottomland Forests	
8.1 Northcentral Oklahoma Bottomland Forest	6

Classification Unit		Areas Rated High
9.0	Western Oklahoma Bottomland Forests	
	9.0 Western Oklahoma Bottomland Forest	4
	9.1 Western Mixed Bottomland Forest	4
	9.2 Cottonwood-Willow Western Bottomland Forest	3
Grasslands		
10.0	Eastern Tallgrass Prairies	
	10.0 Eastern Prairies (Tallgrass Prairies)	9
	10.1 Eastern Prairie Climax	3
	10.2 Eastern Prairie Claypan	-
	10.3 Eastern Prairie Limy, "Blackland Prairie"	1
	10.4 Eastern Prairie Eroded	-
	10.5 Other Eastern Prairies	-
11.0	Mixedgrass Grasslands	
	11.0 Mixedgrass Grassland	4
	11.1 Mixedgrass Grassland Climax	1
	11.2 Mixedgrass Grassland Claypan	-
	11.3 Mixedgrass Grassland Osage Hills	-
	11.4 Mixedgrass Grassland Eroded	3
	11.5 Mixedgrass Grassland Slickspot	-
	11.6 Mixedgrass Grassland Gypsum	5
	11.7 Other Mixedgrass Grasslands	-
12.0	Mixedgrass Grassland Savannas	
	12.1 Sagebrush Sands Savanna	5
	12.2 Shinnery Oak Savannas	3
	12.3 Mesquite Savanna	3
	12.9 Other Mixedgrass Grassland Savannas	-
13.0	Shortgrass Grassland	
	13.0 Shortgrass Grassland	4
	13.1 Shortgrass Grassland Climax	-
	13.2 Shortgrass Grassland Hardpan	3
	13.3 Other Shortgrass Grasslands	1
WETLAND HABITATS		
15.0	Marshes	
	15.0 Marshes	1
	15.1 Shallow Marsh	2
	15.2 Deep Marsh	2
16.0	Swamps	
	16.0 Swamps	2
	16.1 Swamps with Shrubs	2
	16.2 Swamps with Trees	1
17.0	Saline Areas	
	17.0 Saline Areas	3
LOTIC AND LENTIC HABITATS		
LOTIC HABITATS (FLOWING WATER)		
18.0	Ozark Plateau Streams & Rivers	
	18.1 Ozark Plateau Streams	3
	18.2 Ozark Plateau Rivers	-

Classification Unit		Areas Rated High
19.0	Eastern Streams & Rivers	
19.1	Eastern Streams	3
19.2	Eastern Rivers	-
20.0	Ouachita Streams & Rivers	
20.1	Ouachita Streams	5
20.2	Ouachita Rivers	5
21.0	Coastal Plain Streams & Rivers	
21.1	Coastal Plain Streams, Limestone	1
21.2	Coastal Plain Rivers, Limestone	-
21.3	Coastal Plain Streams, Sandstone & Shale	-
21.4	Coastal Plain Rivers, Sandstone & Shale	1
22.0	Arbuckle Streams & Rivers	
22.1	Arbuckle Streams	4
22.2	Arbuckle Rivers	-
23.0	Central Streams & Rivers	
23.1	Central Streams	3
23.2	Central Rivers	-
24.0	Alluvium Streams & Rivers	
24.1	Alluvium Streams, Non-gypsum	3
24.2	Alluvium Rivers, Non-gypsum	3
24.3	Alluvium Streams, Gypsum	-
24.4	Rivers, Gypsum	-
25.0	Midwestern Streams & Rivers	
25.1	Midwestern Streams, Non-gypsum	-
25.2	Midwestern Rivers, Non-gypsum	-
25.3	Midwestern Streams, Gypsum	-
25.4	Midwestern Rivers, Gypsum	-
26.0	Blaine Gypsum Streams & Rivers	
26.1	Blaine Streams	2
26.2	Blaine Rivers	-
27.0	Western Streams & Rivers	
27.1	Western Streams, Non-gypsum	3
27.2	Western Rivers, Non-gypsum	1
27.3	Western Streams, Gypsum	1
27.4	Western Rivers, Gypsum	-
28.0	Wichita Streams & Rivers	
28.1	Wichita Streams	1
28.2	Wichita Rivers	-
29.0	Mesa de Maya Streams & Rivers	
29.1	Mesa de Maya Streams	-
29.2	Mesa de Maya Rivers	-
30.0	Other Lotic Systems	
30.1	Freshwater Springs	3
30.2	Sulphur Springs	1

Classification Unit	Areas Rated High
30.3 Waterfalls	1
30.4 Salt Springs	1
LENTIC HABITATS (STANDING WATER)	
31.0 Ozark Plateau Ponds & Lakes	
31.1 Ozark Plateau Ponds	-
31.2 Ozark Plateau Lakes	1
32.0 Eastern Ponds & Lakes	
32.1 Eastern Ponds	-
32.2 Eastern Lakes	-
33.0 Ouachita Ponds & Lakes	
33.1 Ouachita Ponds	1
33.2 Ouachita Lakes	-
34.0 Coastal Plain Ponds & Lakes	
34.1 Coastal Plain Ponds, Limestone	-
34.2 Coastal Plain Lakes, Limestone	1
34.3 Coastal Plain Ponds, Sandstone & Shale	-
34.4 Coastal Plain Lakes, Sandstone & Shale	-
35.0 Arbuckle Ponds & Lakes	
35.1 Arbuckle Ponds	-
35.2 Arbuckle Lakes	-
36.0 Central Ponds & Lakes	
36.1 Central Ponds	-
36.2 Central Lakes	-
37.0 Alluvium Ponds & Lakes	
37.1 Alluvium Ponds, Non-gypsum	-
37.2 Alluvium Lakes, Non-gypsum	2
37.3 Alluvium Ponds, Gypsum	-
37.4 Alluvium Lakes, Gypsum	-
38.0 Midwestern Ponds & Lakes	
38.1 Midwestern Ponds, Non-gypsum	-
38.2 Midwestern Lakes, Non-gypsum	-
38.3 Midwestern Ponds, Gypsum	-
38.4 Midwestern Lakes, Gypsum	-
39.0 Blaine Gypsum Ponds & Lakes	
39.1 Blaine Gypsum Ponds	-
39.2 Blaine Gypsum Lakes	-
40.0 Western Ponds & Lakes	
40.1 Western Ponds, Non-gypsum	-
40.2 Western Lakes, Non-gypsum	-
40.3 Western Ponds, Gypsum	-
40.4 Western Lakes, Gypsum	-
41.0 Wichita Ponds & Lakes	
41.1 Wichita Ponds	1
41.2 Wichita Ponds	-

Classification Unit	Areas Rated High
42.0 Mesa de Maya Ponds & Lakes	
42.1 Mesa de Maya Ponds	-
42.2 Mesa de Maya Lakes	-
43.0 Other Lentic Systems	
43.1 Playas	3
43.2 Oxbows Ponds & Lakes	2
OTHER HABITATS	
44.0 Caves, Rock Shelters, Talus Caves	
44.1 Gypsum Caves	7
44.2 Limestone Caves	4
44.3 Sandstone Caves	2
44.4 Rock Shelters & Talus Caves	-
44.5 Granite Caves	1
45.0 Geologic Features	
45.1 Rock Outcrops	1
45.2 Mesas	2
45.3 Natural Bridges	1
45.4 Fossils	1
45.5 Canyons	-
MAN-ALTERED HABITATS	
46.0 High-Management Grassland	
46.1 High-Management Grassland	1
47.0 Croplands	
48.0 Managed Forests	
48.4 Shelter Belts & Fence Post Lots	1
49.0 Roads & Railroads Rights-of-Way	
SPECIAL SPECIES	
100.0 SPECIAL SPECIES	
100.1 "Big Tree" or "Champion Tree"	1
100.2 Other Plants	1
100.3 Mammals	16
100.4 Birds	25
100.5 Amphibians and Reptiles	-
100.6 Fish	4
100.7 Other Animals	-
DISJUNCT HABITATS	
101.0 Disjunct Habitats	

FIGURES

TABLES

This publication, printed by University Printing Services, is issued by the University of Oklahoma and authorized by the Chairman of the Natural Heritage Program. 100 copies have been prepared and distributed at a cost of $900 to the taxpayers of the State of Oklahoma.