SURVEY REPORT

and

EDUCATIONAL-USE PLAN

NATURE CENTER

SHAKER LAKES PARK

Shaker Heights, Ohio



NATIONAL AUDUBON SOCIETY
Nature Centers Division
1130 Fifth Avenue, New York, N. Y. 10028

Canoe club?

Survey Report

and

Educational-Use Plan

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Shaker Heights, Ohio

Prepared for

Shaker Lakes Garden Club

(14-66-71)

NATIONAL AUDUBON SOCIETY
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Preface

This survey and nature center plan for the Shaker Lakes Park is a four-part presentation. Part I contains some essential background information and objectives of an outdoor interpretive program. Part II covers a survey report of the park, including such information as location, character of the land, a review of the natural resources, an evaluation of the area for nature study and conservation education, and brief recommendations for maintenance.

Part III represents an overall plan for the development of a nature center in three steps. Costs and other data are submitted for each step. Part IV presents a summary of major recommendations.

In considering these findings and suggestions it should be kept in mind that certain standards of development, maintenance and programming are desirable if the nature center is to serve a useful community purpose. The proposal set forth herein represents the minimum standards that should be sought in program and facilities.

NATIONAL AUDUBON SOCIETY
Nature Centers Division
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Associate Director

June 10, 1966

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PART I

BACKGROUND INFORMATION

PERSPECTIVE

The idea of using land to teach nature appreciation and conservation is a growing concept in America. Increasingly more emphasis is being placed on conservation education and interpretive programs through the use of parks, school lands and other natural areas as outdoor laboratories, particularly in and around our cities and suburbs where the need is greatest. More and more the idea of community nature centers as gateways to the natural world is gaining favor.

A community nature center also provides opportunities for the pursuit of nature recreation, that is, esthetic enjoyment and spiritual refreshment. "Everyone," said John Muir, "needs beauty as well as bread, places to play in and pray in, where nature may heal and cheer, and give strength to body and soul." Without this kind of outlet today, the urban dweller is finding that living in an artificial environment is becoming increasingly more difficult as time passes.

Today, as outdoor recreational demands grow, many people who take to the outdoors are seeking something more than mere

ball fields, benches, fireplaces and picnic tables. A great many are seeking solitude and natural beauty. They are seeking greater personal satisfactions in leisure. In short, they are searching for higher quality in outdoor enjoyment. This suggests, then, that those who are interested in community development should plan for the use of land to provide education and esthetic enjoyment; moreover, programs and facilities should be promulgated which will help people to enjoy fuller and richer lives.

The modern age has brought to urban America an era of mass leisure. Accelerated advances in science and technology have given us new dimensions in power, including power to move and change vast areas of our natural environment. Moreover, automation, improved transportation and communications, and higher wages are creating a socio-economic revolution the like of which our nation has never known before.

America's affluent society, including its high standard of living, has not come without difficulties. Today, as we sacrifice country life for city life, we are faced with serious problems: a lack of appreciation by people, generally, for the land and our natural environment, the pollution of water and air, the loss of open space, blemished landscapes and squalid surroundings.

In growth and development we must recognize the importance of a life-giving environment, or watch our urbanization go down the road to shapeless sprawl, decaying and unhealthy neighborhoods, exploited resources, noise and general ugliness. These are dilemmas which all social-minded leaders, including educators, planners, engineers, developers, economists and ministers, must ponder.

SPECIAL SIGNIFICANCE OF A COORDINATED NATURE CENTER PROGRAM

The nature center program is designed to bring land and people together. All who participate in the program will have a better opportunity to interpret the natural world about them and to develop the kind of personal conscience they need in order to live as better citizens.

People will not safeguard that which they do not understand. They will not protect and treat kindly that which they do not appreciate. A nature center program is designed to help everyone become better stewards of open space, of undeveloped land, and of natural resources in general. Mr. Walter A. Tucker, director-secretary, Columbus Metropolitan Park System, Columbus, Ohio, has commented on the values of nature education in parks as follows:

The success of the nature interpretive program in our parks is reflected by increased public participation. The benefits are evident in the improved public behavior as shown by the orderliness of visitors, the absence of litter, and freedom from willful destruction of property.

We believe that natural history programs more than justify the expense involved. We are convinced that our park nature program more than pays its way on a dollars and cents basis.

Objectives of a Nature Education Program

The nature center program provides firsthand, direct experiences to groups and individuals. It is particularly suited to studies in social science, natural science, and conservation as well as health and physical education.

The primary educational objectives which seem important here are:

- To develop an awareness of the importance of conserving our natural resources, especially those which provide food, clothing and shelter, by emphasizing the broad concepts of conservation.

- To develop the ability to read the record of past and present resource use from the landscape.

- To grasp scientific understanding by seeing applications of natural principles and laws in their outdoor settings

instead of just reading textbook descriptions

·To develop an awareness that all things in nature change constantly

·To promote an understanding of the interdependence of the various facets of nature, with particular emphasis on ecological relationships

·To give students an opportunity to share knowledge and experiences with classmates

·To practice decision-making through democratic action

·To encourage good health practices

·To develop self-reliance as well as a cooperative attitude

·To help students think creatively

For the visitors to parks, school grounds and other areas of open space, the following general objectives seem worthwhile:

·To teach proper outdoor manners and good conduct, and thus help curb vandalism

·To develop a sense of respect for all living things

·To promote better citizenship by stressing the need for responsible individual action, since the maintenance of a healthful environment in a community is the cumulative result of many decisions made by residents, financiers, developers, school districts, park departments and other government agencies

·To make leisure time more productive and satisfying

·To provide a place for creative types of outdoor pursuits (nature study, hikes, painting, sketching, photography, writing)

·To help increase knowledge and understanding of the natural world and man's place in it

·To develop sensitivity, awareness and appreciation toward land and natural resources

·To help develop a desire and thus a will to protect the living and non-living resources in all parks and other open lands

PROBLEM OF TEACHING CONSERVATION

A persistent problem in teaching conservation in American

schools and colleges is how to reach young people so as to influence the way they treat natural resources and the environment in which they live. What students do today and how they live are patterns that will be seen in resource use and environmental control in the future.

To create conservation-mindedness in the individual it is necessary to stress personal experiences, to develop perception through use of the senses, so that the world of nature will have full meaning. The essential element, life, is absent from a tray of mounted butterflies. Even a fish in an aquarium, a bird in a cage, is no teaching substitute for a wild fish in a pond or a thrush in a native wood lot.

Where can the urban resident (child or adult) go today to study nature? Where can the teacher take a class to study interrelationships in the outdoors? What methods should a teacher use to make outdoor experiences meaningful?

Nature center lands are currently available for outdoor learning experiences in many parks and school grounds. The main problem seems to be one of holding on to what is available, adding land, and of developing additional programs.

A corollary to providing and retaining "lands for learning" is the training of teachers who can teach comfortably and

competently in the outdoors. Perhaps a basic change is needed in viewpoint, especially on how to approach the outdoors where children are concerned. The late Rachel Carson, in a recent magazine article (in Woman's Home Companion) entitled "Help Your Child to Wonder," had some advice for parents which teachers may want to ponder. She wrote:

> "How can I possibly teach my child about nature--why I don't even know one bird from another." I hear parents say.
>
> I sincerely believe that for the child, and for the parent seeking to guide him, it is not half so important to know as to feel. Once the emotions have been aroused--a sense of the beautiful, the excitement of the new and the unknown, a feeling of sympathy, pity, admiration, or love--then we wish for knowledge. It is more important to pave the way for the child to want to know than to put him on a diet of facts he is not ready to assimilate.

PART II

SITE SURVEY AND APPRAISAL

This part of the report contains information and data relative to a land area between the cities of Shaker Heights and Cleveland Heights, Ohio, known as Shaker Lakes Park, now owned by the City of Cleveland (under the jurisdiction of the Department of Parks). Pertinent information will be given on the location of the park, accessibility, size and shape, terrain and general characteristics of the land, a review of the natural and other resources of the area, important local human factors, and values of the park as open space. Brief recommendations for each section of the park will conclude this part of the report.

LOCATION

The Shaker Lakes Park is located generally in the eastcentral portion of Cleveland and specifically between the cities of Shaker Heights and Cleveland Heights. The area included in the survey is bounded by Coventry Road, North Park Boulevard, Park Drive, South Park Boulevard, Woodland Road, West Park Boulevard, and another portion of South Park Boulevard. The park,

as shown on Map #1 on the next page, is completely surrounded by residential and school development.

ACCESSIBILITY

The park site has excellent accessibility by car on many wide streets and by rapid transit on the Shaker Boulevard line.

SIZE AND SHAPE

The area being considered for the proposed nature center is approximately 275 acres and assumes the shape of a distorted letter "Y." The width of the plot is generally narrow in view of its length of about two miles. The present acreage is considered very adequate for a nature center. The shape of the area, however, poses some problems of control and use.

TERRAIN AND GENERAL CHARACTERISTICS OF THE LAND

Varied terrain is a desirable characteristic of land intended for use as an outdoor laboratory. Diversified topography affords more opportunities to teach natural history related to local geological features than does nearly flat country. In this regard Shaker Lakes Park is a good site.

In general the terrain has a rolling topography with steep



LOCATION MAP

Map No. 1.

slopes leading to the lakes or to the flood plains of Doan Brook. The range of elevation is from 890 to 1000 feet above sea level, making a difference of 110 feet between the lowest and the highest points on the site.

SOIL AND GEOLOGIC RESOURCES

The park is within the Ellsworth soil area where the soils have developed from an unassorted mixture of clay, sand, gravel and boulders left by the glacial ice of Pleistocene times. The surface soil is usually a grayish-brown, friable silt loam 6 to 12 inches thick. The subsoil is mottled yellow, gray and brown silty clay to clay, 12 to 28 inches thick. It is plastic when wet and hard when dry. The fine-textured subsoils and substrata result in the slow movement of air and water, and shallow root penetration. These factors combine to make the soils moderately low in productivity.

The area included in this study has at least three geologic features on the surface. They are: (1) results of the most recent glacier, (2) action of Doan Brook as a geologic force, and (3) small exposures of Orangeville shale in the banks of both branches of Doan Brook before they come together at the lily pond.

The deep gorge below the area studied where Doan Brook has

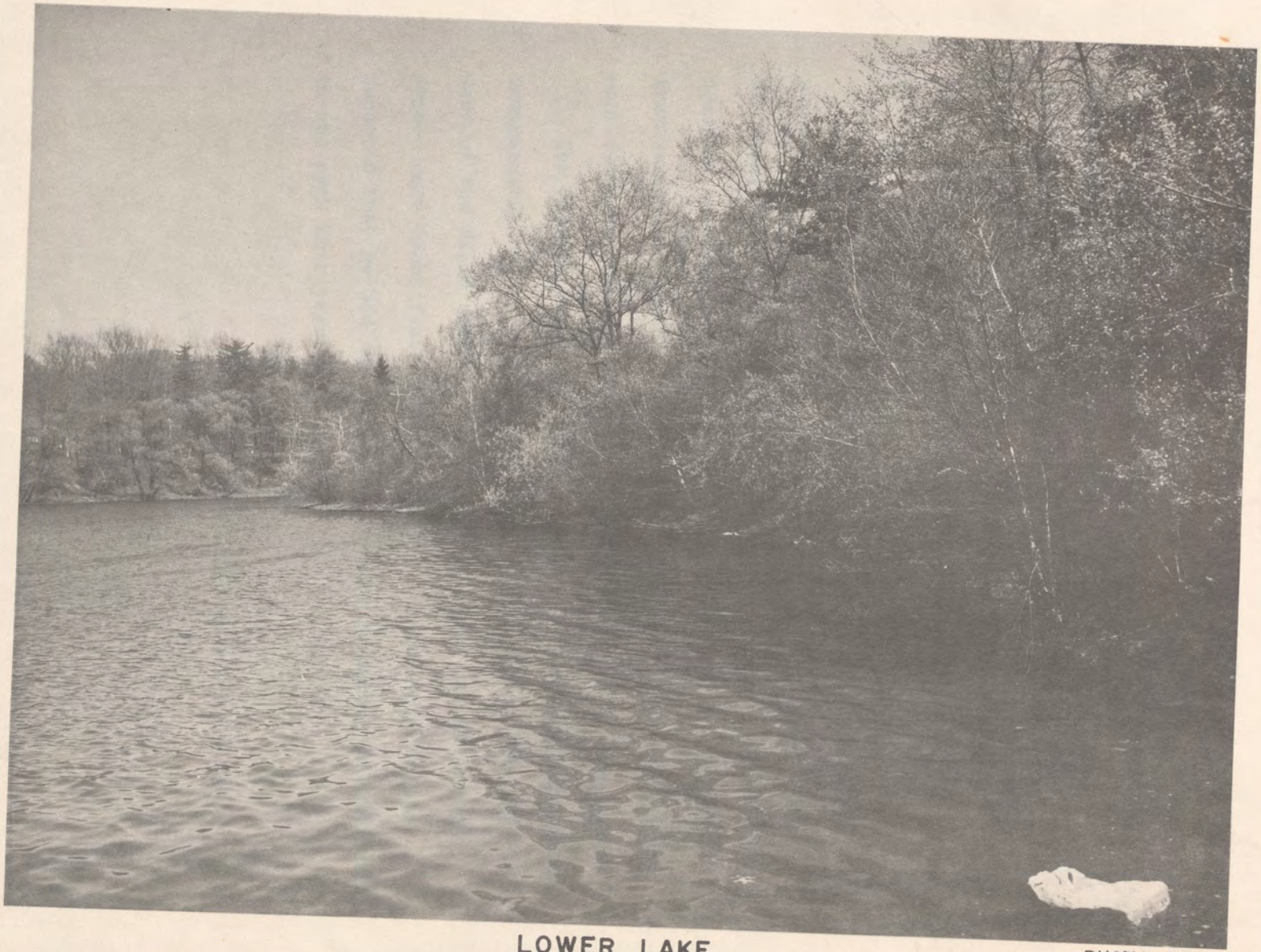
cut through the Portage escarpment is a spectacular geologic laboratory. Berea sandstone, Bedford shale, Euclid bluestone, Cleveland shale and Chagrin shale are all found as prominent layers in a giant "slice-of-time" display in the gorge.

WATER RESOURCES

The park includes the two branches of Doan Brook, a marshy area and pond where they meet, and two lakes created by the Shakers when they built dams on the brook in 1837 and in 1854. The falling and splashing water at the two dams is responsible for attracting as many as 35 to 50 additional birds, particularly warblers, as compared to an area without the sound of falling water. The broad expanses of the lake surfaces (see Photo #1, next page) attract several species of waterfowl, the kingfisher, a number of swallows, as well as several mammals. The marsh and small pond are equally attractive to other species of wildlife.

FOREST AND OTHER GROUND COVER RESOURCES

The park was once covered with a dense forest dominated largely by beech and sugar maple interspersed with tulip, white ash, cucumber and tupelo. Where the land was relatively level



LOWER LAKE

PHOTO NO. 1

and poorly drained, swampy places developed in which American elm, black ash and red maple were present in large numbers. On the flood plains established by the brook as it meandered from side to side in its narrow valley, giant sycamores grew up as sentinels to mark the course of the stream. Red oaks and white oaks were found on the edges of most ravines.

Although all of the area has been lumbered and much of the underbrush has been removed from the park, the remaining trees are remarkable in representing the original forest. The predominant beech-maple combination still persists. In walking from section to section of the park, one cannot help but notice many different stands, each with trees of about the same age.

The diverse character of plant cover in the park contributes immeasurably to its value as an outdoor laboratory. During the week of the field study 35 different trees and six different shrubs were identified (see Table #1). A naturalist friend reported that he had identified 60 species of spring wildflowers in the park last year.

(Table #1 on following page)

Table 1

Native Trees and Shrubs

Shaker Lakes Park

Trees

Ash--white	Hickory--bitternut	Oak--swamp white
Basswood	Hickory--shagbark	Oak--white
Beech	Hornbeam--American	Pine--white
Birch--black	Hornbeam--hop	Sassafras
Birch--yellow	Maple--red	Sycamore
Butternut	Maple--silver	Tulip
Cherry--choke	Maple--sugar	Tupelo
Cherry--black	Oak--bur	Walnut--black
Cottonwood	Oak--pin	Willow--black
Cucumber	Oak--red	Willow--heart-leaved
Elm--American	Oak--chestnut	Willow--shining
Hemlock	Oak--scarlet	

Shrubs

Dogwood	Pawpaw	Sumac--staghorn
Hawthorn	Serviceberry	Vibernum--maple-leaf

WILDLIFE RESOURCES

The Cleveland Audubon Society reports that the Shaker Lakes Park is the best birding area in Ohio. For this reason the society has helped to sponsor an annual series of late winter and spring bird walks for 33 consecutive years. A reliable observer has listed 158 different species of birds that he has identified in the park. The area is an outstanding observation site during

the migrations of waterfowl and warblers.

The park is a refuge for winter birds, and many of the trees make attractive nesting sites. The varied habitats in the form of lakes, streams, marshy areas, deep woods, open grassy areas, and thick patches of underbrush provide food and cover for migratory and permanent-resident populations. Photo #2 on the next page shows the lily pond and marsh area in Section C. This is considered as the best bird observing spot in the park.

Because the park is in the midst of a densely populated area, mammals are not very numerous. Six different species were seen or identified by their tracks during the survey. A grey squirrel, chipmunk, field mouse, raccoon, muskrat and rabbit were listed.

HUMAN FACTORS

The cities around the Shaker Lakes Park have felt the full impact of urbanization and have reached a fairly stable population level under present zoning regulations.

The following statistical information was furnished by the Real Property Inventory of Metropolitan Cleveland:

(Table 2 on page 19)



LILY POND AND MARSH

PHOTO NO. 2

Table 2

Human Factors

	Shaker Heights	Cleveland Heights
POPULATION:		
1950	28,222	59,141
1960	36,460	61,813
1970 (est.)	39,098	61,830
SCHOOL ENROLLMENT (public):	1965	1965*
Elementary	4,109	6,785
Junior high	1,915	3,068
High school	1,907	3,234
	7,931	13,087
(parochial-estimate):		
Elementary	585	970*
Junior high	273	438
High school	272	462
	1,130	1,870
COLLEGE ENROLLMENT:		
John Carroll University	4,370	

*includes University Heights because of combined school district

Because the park is located in the midst of a heavily populated residential area, the land is readily available for nature recreation and serious study. There are 27 schools within a radius of less than two miles. All of the schools of Shaker

Heights, Cleveland Heights and University Heights, and many of those of the City of Cleveland are within a convenient distance. John Carroll University, Western Reserve University and Case School of Applied Technology are nearby.

VALUE OF PARK AS OPEN SPACE AND FOR SCIENTIFIC STUDY

> For over three centuries the beauty of America has sustained our spirit and enlarged our vision. We must act now to protect this heritage. In a fruitful new partnership with the states and cities the next decade should be a conservation milestone. We must make a massive effort to save the countryside.

Thus spoke our President on behalf of saving precious open space. In the message on natural beauty he stated further concerning highways:

> I hope that, at all levels of government, our planners and builders will remember that...roads themselves must reflect, in location and design, increased respect for the natural and social integrity and unity of the landscape and communities through which they pass.

There is great concern in Shaker Heights and Cleveland Heights over losing Shaker Lakes Park to construction through zoning changes that will permit a highway or high-rise apartments to take this "green island." The Shaker Lakes Park is the largest remaining tract of open space in the Shaker Heights-Cleveland Heights community. As an expression of local interest

in the park, the Federation of Realty Interests of Greater Cleveland adopted the following resolution on May 12, 1966:

> In the opinion of the...Federation...the Shaker Lakes ...Park section is one of the outstanding residential ...areas in the country. Certainly, nothing now existing in Cleveland can compare in such variation of outdoor beauty. We believe it of utmost importance that this area, available to all citizens of Metropolitan Cleveland, be preserved against the ever-increasing consumption of land by a continually growing urban population. To consume an easily available and beautiful conservation area would be to deny these advantages to succeeding generations and bring up those generations in a partial vacuum.
>
> For the benefit of our future citizens this should be avoided at all costs and this area be preserved for their use, pleasure and education.

For the study of conservation and nature in an outdoor laboratory, there is no comparable area to the park within the limits of Greater Cleveland. The open water, the brook and the many other habitats found within the park provide an unusual number of different kinds of trees, wildflowers and birds close to the heart of a great city.

The area is of historic interest, too. The stone dams stand as mute witnesses to the skills and resourcefulness of the Shakers who used waterpower to operate a woolenmill, gristmill and sawmill.

RECOMMENDATIONS ON SEVEN SECTIONS OF PARK

As a matter of convenience the park was divided into seven sections for study purposes. These sections were designated by the letters A through G, as shown on Map #2 on the next page.

In order to increase the nature recreation and educational uses of the park and at the same time to protect the land from deterioration, the following brief comments and suggestions are made:

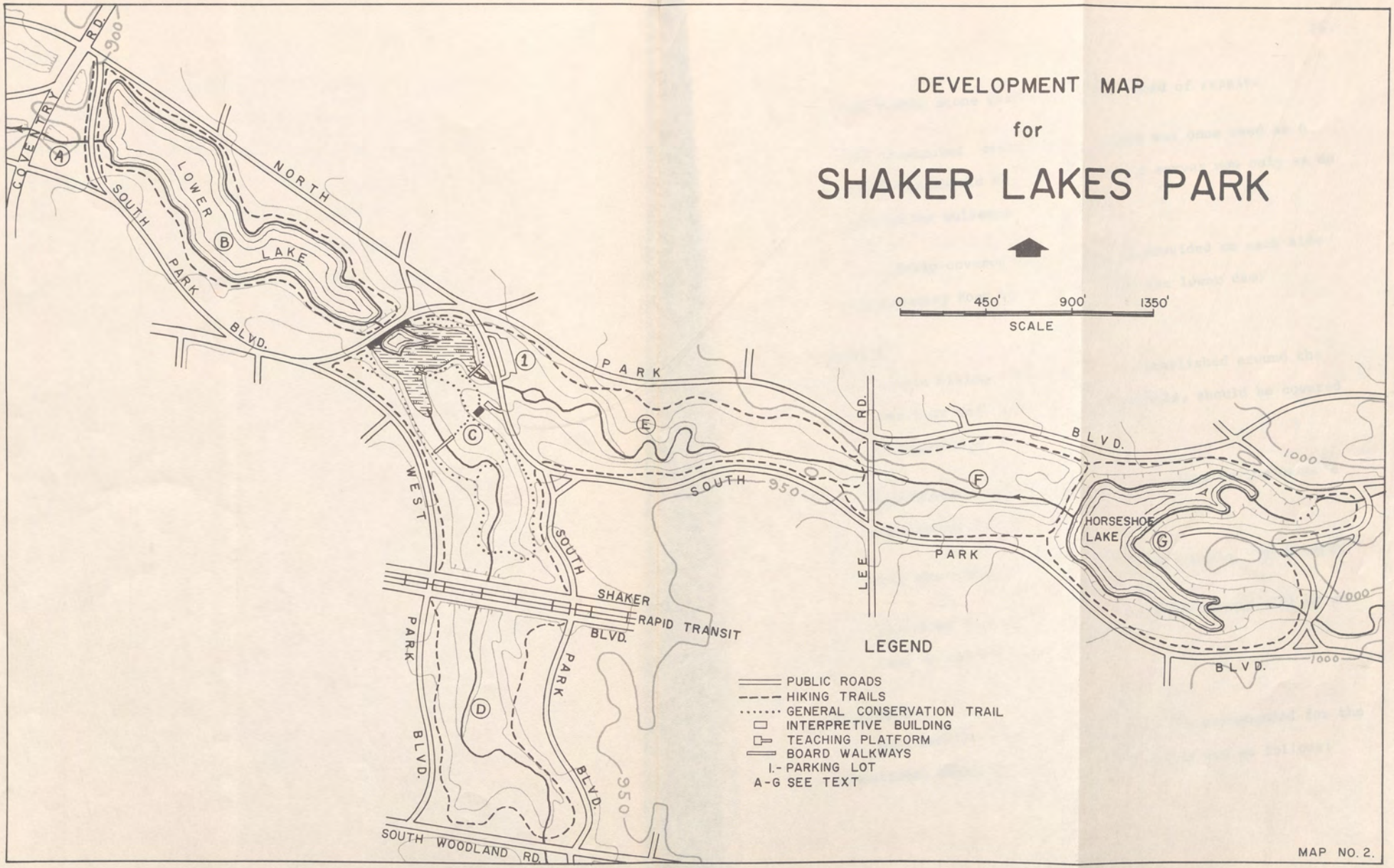
Section A

- Keep most of the present trail layout except the parts nearest the brook where excessive erosion is taking place.
- Top-dress all desired trails with woodchips to mark the route to be followed and to prevent erosion.
- Close and obliterate all but two or three entrances to the section.
- Erosion control is needed at places on the steep banks along the lines set forth by Duane E. Bosworth, Soil Conservationist (Soil Conservation Service, 14400 Pearl Road, Strongville, Ohio), in his letter of December 13, 1965, to the Shaker Lakes Garden Club.

DEVELOPMENT MAP

for

SHAKER LAKES PARK



MAP NO. 2.

- The rustic stone footbridge is in need of repair.

- The ransacked stone building that was once used as a toolhouse should be torn down as it serves now only as an attractive nuisance.

- A woodchip-covered walk should be provided on each side of Coventry Road where it crosses the lower dam.

Section B

- A single hiking trail should be established around the Lower Lake and, like all other trails, should be covered with woodchips.

- Many branch trails and loop trails close to the water's edge should be obliterated.

- Stop the fishing. The signs state clearly, "NO FISHING."

- Institute tree planting so that replacements will be on hand as old trees die.

Section C

This section is the area that will be recommended for the educational building. Some brief comments are as follows:

·The dam that creates the lily pond is eroding rapidly and should be repaired.

·Dredging is recommended to a depth of two or three feet in the pond area to increase the amount of open water. The spoil could be put on the nearby reclaimed area. If dredging is not done, the silt, which is now caught in the pond, will begin filling the Lower Lake.

·Fencing will be required when the educational building is constructed.

·A trail system can be developed on the drier parts of the site. Note Photo #3 on the next page of a beech-maple stand.

Section D

·A hiking trail should be established along the sides of this section where the open grassy area meets the trees. The same idea should be applied to Sections E and F.

·Tree planting should be considered in order to have replacements for the American elm trees which dominate the scene.



BEECH-MAPLE FOREST

SECTION C

NORTH OF SHAKER BOULEVARD

PHOTO NO.3

Section E

This section supports a good stand of trees and can serve just as it is as an outdoor laboratory. The stand is another remnant of the beech-maple-oak combination that has persisted in the section for many years. The flood plain is effective for the spreading and slowing of flood waters during periods of rapid run-off.

·No further clearing of underbrush should be done on the flood plain. The present ground cover helps to prevent soil erosion during floods. Photo #4 (on next page) shows Doan Brook and the flood plain at the western end of the section.

Section F

The forest cover is a mixed-age stand of beech-maple-elm with a scattering of sycamore.

·There should be no further clearing of the underbrush.

Section G

The higher land of Section G has been developed as a picnic area. The trees represent more of the beech-maple climax with huge oaks and tulip trees present.

·Low land on both sides of the picnic area might be de-



PHOTO NO. 4

DOAN BROOK AND FLOOD PLAIN

SECTION E

veloped for waterfowl. The south side probably has the better terrain for dredging to make a circular or oval pond with a nesting island in the center.

PART III

NATURE CENTER PLAN FOR SHAKER LAKES PARK

WHAT IS MEANT BY A NATURE CENTER

A nature center in simple terms is a gateway to the great world of nature. It is a special outdoor area where the people of a community can see and enjoy nature readily and easily. At such a center everyone can learn something about the interrelationships of plants and animals, as well as non-living features, and develop insights on how man can maintain a life-supporting environment. A dynamic nature center provides innumerable recreational, educational, scientific and cultural values to the people of an urbanized community.

SUGGESTED COMPATIBLE AND NON-COMPATIBLE USES

No area of land can be everything to everybody. The Society's Nature Centers Division has found that certain uses are compatible to a nature center; others are not. If the Shaker Lakes Park is to become a nature center, then the following compatible and non-compatible uses should be noted:

Compatible Uses

Land and water conservation practices

Nature and ecological studies
Organized, naturalist-led walks
Self-guided walks
Bird study forays
Organized (group) outdoor education tours
Indoor and outdoor lectures
Nature painting, photography, sketching, writing
Conservation meetings, forums, workshops, programs, exhibits
Educational day camping sessions for school, college and recreation groups

Non-Compatible Uses

Trailer camping, overnight tent camping
Hunting and fishing
Field sports-ball sports
Rifle marksmanship
Horseback riding
Motor scooter use
Animal zoo (caged mammals and birds)
Indiscriminate lounging and romping throughout the area (walking permitted only on established walks and trails)
Bicycling on hiking trails

NATURE CENTER RECOMMENDED

The Nature Centers Division of the National Audubon Society recommends that the Shaker Lakes Garden Club cooperate with the public agencies concerned to establish a nature center at the Shaker Lakes Park. In addition to offering people of the Shaker Heights-Cleveland Heights area educational and esthetic experiences, the center would afford a measure of isolation, a bit of wilderness. By providing a buffer strip of open land between

housing and other developments, the center would perform a valuable function in open space. In addition a nature center furnishes a place and opportunities where people can perform "do-it-yourself" activities. This stimulates group and individual initiative, pride, self-reliance and responsibility, and an appreciation for work.

THREE STEPS SUGGESTED FOR NATURE CENTER DEVELOPMENT

It is recommended that a full-scale nature center at the Shaker Lakes Park be developed in three steps. Emphasis should be placed on the extent and quality of the program rather than on land development and facilities.

Step I. A Summer Program for the First Year

This step should be the kick-off for establishing a nature center in the Shaker Lakes Park. The essential ingredient is an interested and well-qualified naturalist who can guide both children and adults in nature education and recreation by helping them to interpret and understand their living environment. The usual crafts, camping, swimming and other purely recreational pursuits should be left to other programs in the community.

A minimum of facilities is suggested for this first step. An arrangement might be made to use one of the school buildings

in the park area as the focal point of the activity. The cost figures cited in the following table are for minimum programming for the first summer.

Table 3

Step I. First-Year Costs

Naturalist (for six-week period)	$1,000
Social security and insurance.	100
Teaching materials	100
Total.	$1,200

It is probably better to cooperate in the beginning with existing recreational and camping programs in the area rather than to attempt the operation of a strictly independent program. This would result in groups coming to the park from playgrounds and day camps for nature education on a scheduled basis.

Step II. A Two-Year Full-Time Program

Proper educational programming requires advance planning so that when the center is open all visiting groups will be properly handled. Also, each person who comes to the center should feel that the visit is both pleasant and rewarding. Inasmuch as a great portion of the director's time in the initial stages will

be spent on program planning and on center development, it would be a mistake to start a major educational program at this time.

A center is like a highway or any other development. It must be reasonably finished before being put to use. Nothing is more disconcerting and discouraging than to visit a half-completed facility where adequate provisions do not exist to accommodate visitors and constant apologies must be made for unsatisfactory conditions. It is recommended, therefore, that the formal opening of the center at the Shaker Lakes Park be delayed until the physical area and the interpretive building are ready for the public. This does not mean that an initial educational program, such as is herein suggested, cannot be undertaken immediately.

If such action is desired, then a director-naturalist should be employed after completion of the first summer program. The director would begin working with teachers to acquaint them with the park and the proposed nature center program. As a result of working with schools and others interested in natural resources, a limited number of scheduled groups would be given interpretive tours of the park to demonstrate the values of a nature center to the community. The director should be provided with a small van-type vehicle to visit schools and for transportation of small groups to the park. Under this arrangement the director would

spend about half of his time teaching and guiding and the other half planning center programs and facility development.

Such an initial two-year program could probably be carried out on a total budget of $22,750. A breakdown of the budget follows:

Table 4

Step II. Two-Year Program Costs

	First Year	Second Year
Vehicle (new panel van)	$ 2,500	$ -
Director-naturalist	8,000	8,500
Social security and insurance	800	850
Vehicle operation	500	600
Educational materials	500	500
Totals	$12,300	$10,450

Step III. A Full-Scale Nature Center

A final step for establishing a full-scale nature center at the Shaker Lakes Park involves the employment of a director and other personnel, provision of certain improvements, and implementation of a complete nature education program.

Suggested Improvements. Certain land and water improvements and features, including educational facilities, are basic

to a successful nature center. However, only the more important of these are recommended in this report. A number of these features are shown on the intensive-use area and building site map (Map #3) on the next page. Each is described briefly and accompanied by a priority rating to effect a suggested order in development. Priorities are symbolized as follows:

First priority: PR-1 (immediate development)

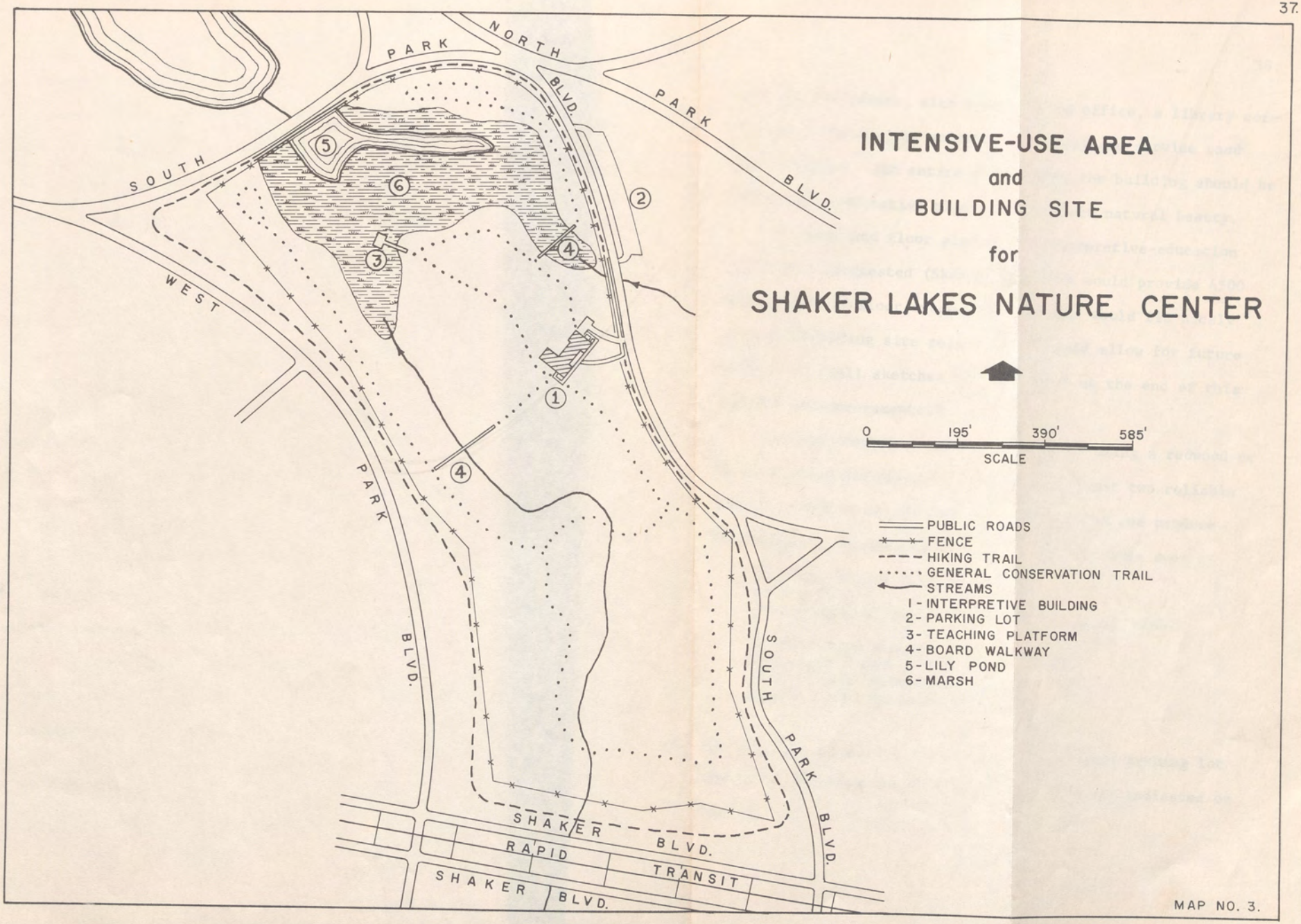
Second priority: PR-2 (secondary stage development)

Third priority: PR-3 (long-term development)

1. Fencing (PR-1). An adequate chained-link fence around the entire intensive-use area is essential to the development of the nature center (see Map #3).

2. Interpretive-education building (PR-1). This structure would serve as a communications focal point for the Shaker Lakes Nature Center. It would function as a visitors gathering and recording point where information and orientation services would be available and where indoor exhibits and seasonal displays would be arranged. It would contain, among other things, rooms for school and other groups during orientation or inclement weather, and for special meetings and conferences.

   The building would also serve as the official headquar-


PARK
NORTH
BLVD.
PARK
BLVD.
SOUTH
WEST
PARK
BLVD.
SOUTH
PARK
BLVD.
SHAKER
BLVD.
RAPID
TRANSIT
SHAKER
BLVD.
1
2
3
4
4
5
6
INTENSIVE-USE AREA
and
BUILDING SITE
for
SHAKER LAKES NATURE CENTER
0
195'
390'
585'
SCALE
PUBLIC ROADS
FENCE
HIKING TRAIL
GENERAL CONSERVATION TRAIL
STREAMS
1 - INTERPRETIVE BUILDING
2 - PARKING LOT
3 - TEACHING PLATFORM
4 - BOARD WALKWAY
5 - LILY POND
6 - MARSH

MAP NO. 3.

ters for the center, with space for an office, a library corner and workshop. An attractive walkway and service road are essential. The entire area around the building should be landscaped with native plants and reflect natural beauty.

A sketch and floor plan of an interpretive-education building is suggested (Sketch #1) which would provide 4500 square feet of floor space. This design would fit nicely into the building site selected and would allow for future expansion. (All sketches are presented at the end of this section on improvements.)

Certain economies can be effected by using a redwood or western red cedar pre-cut building. At least two reliable companies are in the pre-cut lumber business and produce buildings for nature centers. The two companies are:

Heritage Timber Building, Inc.
56 Dee Road
Park Ridge, Illinois (plant at Dowagiac, Mich.)

Timber-Lodge Division
Pritchard Products Corp.
4625 Roanoke Parkway
Kansas City, Missouri 64112

3. Parking lot (PR-1). A graded and black-topped parking lot should be provided for 20 cars at the location indicated on Map #3.

4. General conservation trail (PR-1). This trail starts at and returns to the interpretive building, and tells the story of conservation of soil, water, forests, wildlife and minerals in one, easy, 60-minute walk. It is equipped with simple trailside teaching signs and displays and resource stations, and leads to a teaching platform over the pond and to other points of interest.

From this main conservation trail a series of other short loop trails can be developed to cover specific resource areas. These can be located after the director is on the job, and should include:

Soil trail. Designed chiefly to illustrate the various phenomena in the formation of soil. It also shows the effects of weathering on soil, and how lichens, mosses and ferns, grasses, shrubs and trees and animals affect the soil and are related to it.

Water resources trail. Leads to the brook and lily pond and to other trailside features which tell the story and importance of water and explain the hydrological cycle.

Forest resources trail. Off-shoot trail leads through a wooded area. Stations along the trail provide stops where forest community principles can be explained.

Wildlife trail. Short trail just off the main conservation trail where wildlife improvements and conservation principles and features are stressed.

Geology trail. Short loop points out the importance of rocks and minerals.

Trail for the blind. This can be a short version of the general trail, equipped with feeling, touching, smelling and hearing devices geared to teach conservation and natural history to the visually handicapped.

Trail for wheelchair patients. This could be another separate, short trail with special features adapted for non-ambulatory visitors.

5. Hiking trail system (PR-1). A major hiking trail system is suggested outside the educational area, and is shown on Map #2 (page 23). These non-labeled trails should be surfaced with woodchips and provide for esthetic walks, photography, painting, sketching, creative writing, and nature study activities. Other trails, as they now exist, should be discontinued and obliterated.

6. Emergency fire tool box (PR-1). This is a wooden display box containing forest fire fighting tools set on four treated

posts and placed along the forest resources trail loop where the story of forest fire prevention and control can be stressed. The tools can also be used for emergency purposes, and should include an Indian back-pack pump, 4 council fire rakes, long-handled shovel, regular rake, rattan broom, swatter and Swedish bow saw.

7. Super bird feeder (PR-2). This is a large bird-feeding station with a bird bath and dripping water. It should be located near the interpretive building, screened with shrubs in semi-circular fashion, yet visible from a window of the building and a nearby observation blind.

8. Council ring (PR-2). This is a trailside facility for orientation before a group begins a trail tour, or a place to hold critiques at mid-point or after a field trip has been completed. Several possible designs can be used: one (Sketch #2) is a small, modest ring seating 50 people; the other (Sketch #3) is a larger, semi-circular version holding up to 100 people. The council ring is an excellent place to hold campfire ceremonies or evening fellowship programs.

9. Weather station (PR-2). This is a small but officially approved U.S. Weather Bureau field station, equipped with a

rain gauge, psychrometer, thermometer, aerometer and directional wind vane, and located near the interpretive building. Daily readings are sent to the U.S. Weather Bureau.

10. Soil profile and soil box (PR-3). A special display or a pit along the soil trail loop can show a typical soil profile or soil layers in the area. It should be accompanied by a box containing compartments with different soil materials ranging from litter and duff to parent material.

11. Herb garden (PR-3). This could be a small plot of herbs common in the locality. A school group or garden club might be willing to provide and maintain such a project.

12. Bee tree (PR-3). A bee tree is a fascinating trailside feature. If a wild bee tree cannot be found in a convenient location, a swarm of bees can be placed in a crevice of a hollow tree. The director should secure the technical assistance of a professional beekeeper for this feature and for establishing a live bee hive in the interpretive building.

13. Photographic and observation blind (PR-3). One or more blinds can be constructed of plant materials or woven redwood panels and be located in different habitats for wild-

life study and photography. Locations should be selected by the director.

14. Tree stump and log display (PR-3). Where convenient along the trail, a tree stump with sloping cut can be made into a smoothed and waterproofed display. The annual growth rings can be matched with local events which occurred during the life of the tree. A log can be split or cut at several angles, sanded and varnished to show rays, grain and wood texture.

15. Geology and fossil wall (PR-3). This is a short, low, stone wall along the geology trail loop exhibiting in cemented fashion a number (10 or 12) of the more important rocks, fossils and minerals of the area. It should be accompanied by a panel showing the origin, location and name of each specimen imbedded in the wall.

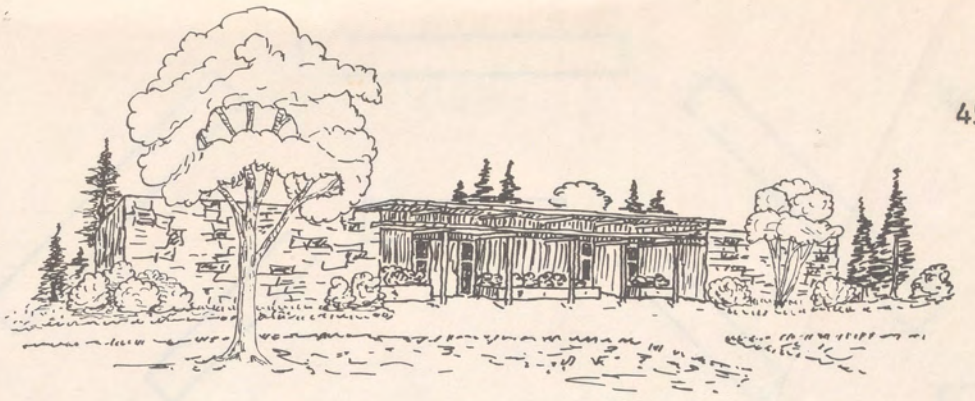
16. Concentrated plant plots (PR-3). These are small (4'x10'), carefully planted and tended plots near the interpretive building which enable visitors to identify wild plants by means of labels. The design should utilize rocks or other natural features associated with plants. It has been found to be educationally worthwhile to transplant and con-

centrate in small areas the following common native plant groups: (1) lichens, fungi and algae; (2) mosses, club mosses and horsetails; (3) ferns; and (4) wildflowers.

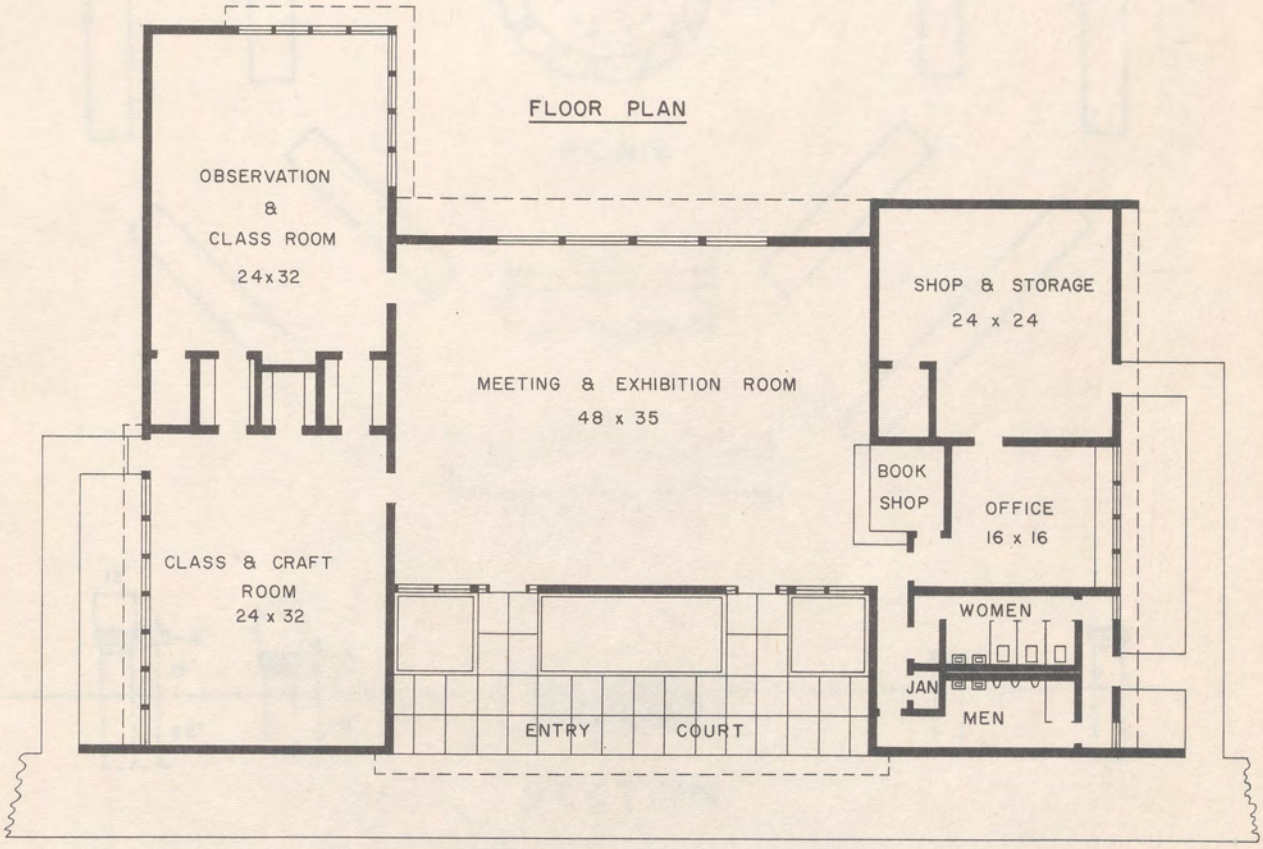
17. Teaching station (PR-3). This is a low, elevated walkway and platform constructed on treated poles extending over a portion of the marsh. The design can be of simple construction to permit observers a better view of the water and wet areas without disturbing the plant growth (see Map #3). A possible design is shown in Sketch #4.

18. Wildlife habitat improvements (PR-3). It has long been an axiom in conservation circles that wildlife is a product of the land, especially the edges, that is, the hedgerows, brushpiles, wetland coves and woodland borders. When abundant food, cover and water are properly distributed, one in relationship to the other, an area can approach its full wildlife potential.

A list of practices that will increase wildlife, along with directions for applying the improvements, has been compiled by the Nature Centers Division. These recommendations are given in Appendix C.



FLOOR PLAN



SUGGESTED DESIGN

for an

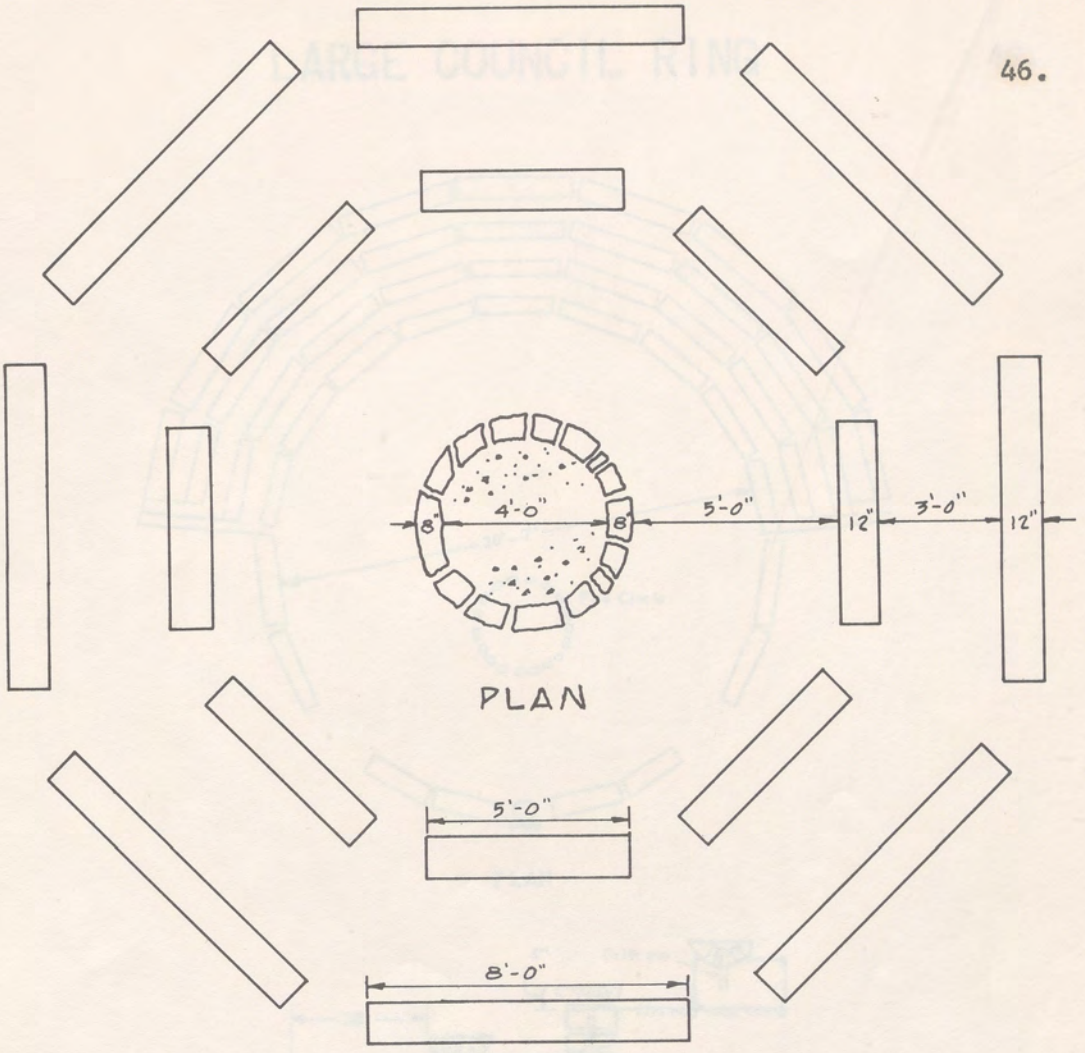
EDUCATION BUILDING

Approximate Area 4500 sq.ft.

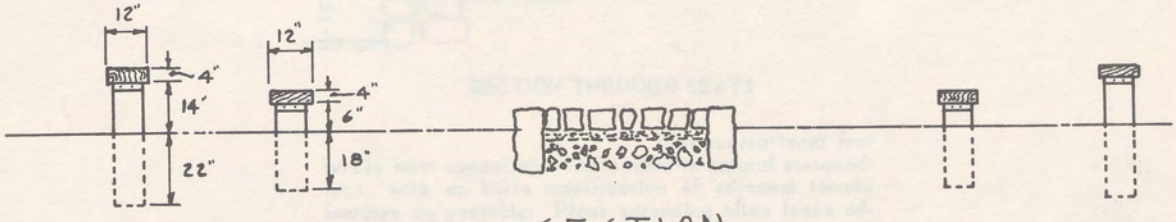
0 3 6 9 12

NATURE CENTERS DIVISION
NATIONAL AUDUBON SOCIETY

Sketch #1



PLAN



SECTION

COUNCIL RING

DESIGNED BY: U.S. FOREST SERVICE

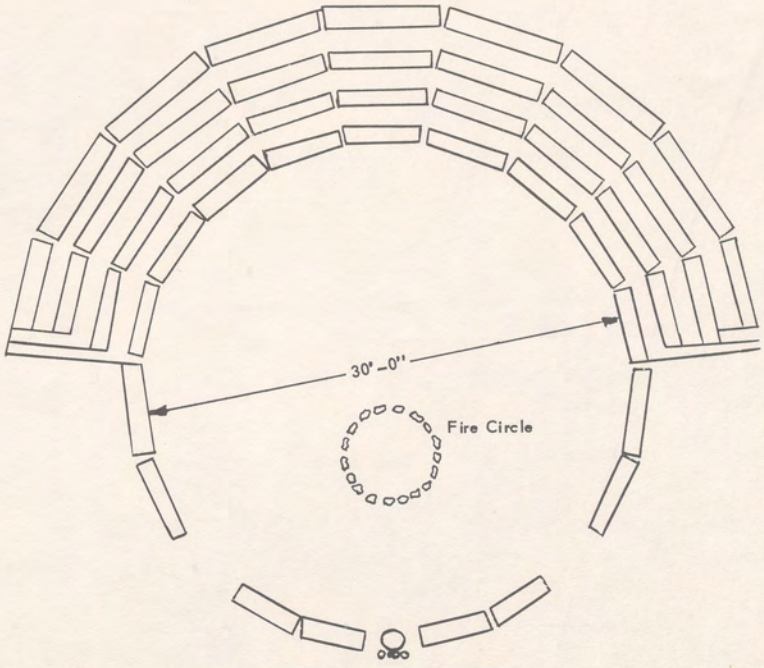
DISTRIBUTED BY: NATURE CENTERS DIVISION

NATIONAL AUDUBON SOCIETY

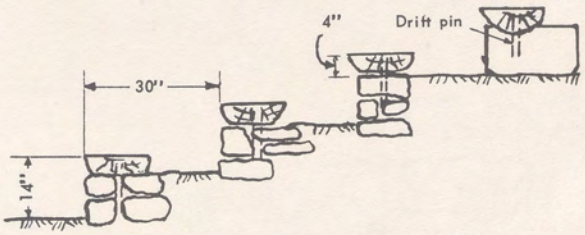
Sketch #2

SCALE 1/4" = 1 FT.

LARGE COUNCIL RING



PLAN



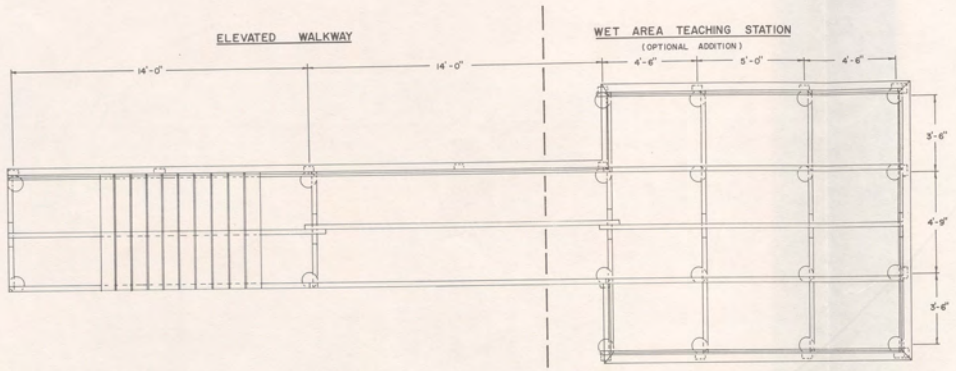
SECTION THROUGH SEATS

This recreational feature is most appealing when located in natural surroundings, with as little modification of adjacent terrain features as possible. Plant screening often lends additional effect.

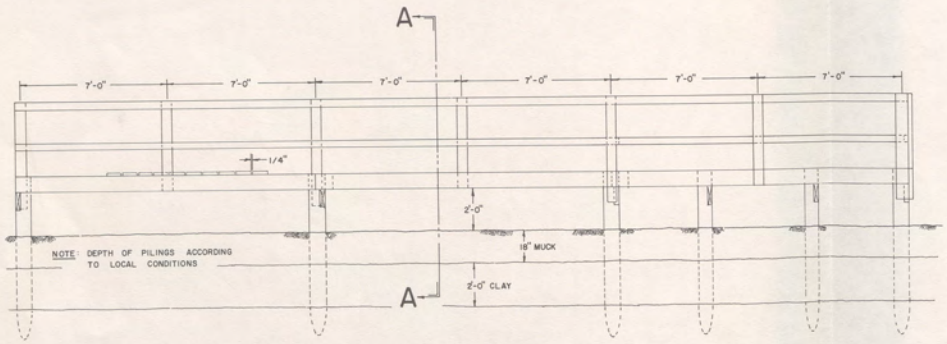
Simplicity is the keynote in this design; seating arrangement in successively elevated tiers. The natural earth floor of the ring should be well drained, even to the extent of using catchments and subterranian drains when necessary.

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NATURE CENTERS DIVISION
NATIONAL AUDUBON SOCIETY

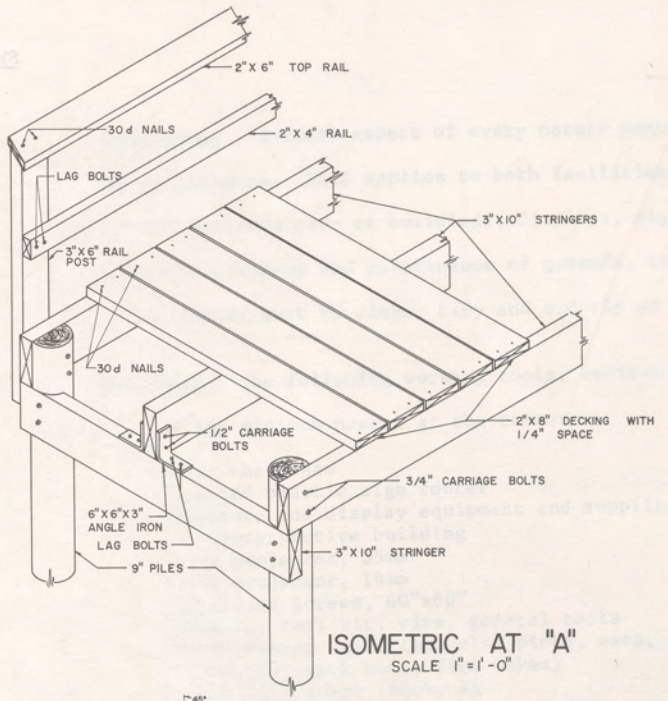
Sketch #3



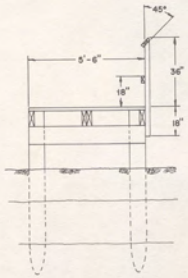
PLAN
SCALE 3/8"=1'-0"



ELEVATION
SCALE 3/8"=1'-0"



ISOMETRIC AT "A"
SCALE 1"=1'-0"



SECTION A-A
SCALE 3/8"=1'-0"

LUMBER SCHEDULE			
USE	SIZE	FINISH	WOOD SPECIFICATION AND TREATMENT
PILES	9" DIA.	ROUGH SAWN	LUMBER SHALL BE DENSE-STRUCTURE, SOUND YELLOW PINE OR CONSTRUCTION GRADE FIR TREATED TO A NET RETENTION OF 12 POUNDS PER CUBIC FOOT OF LUMBER WITH 5% WATER REPELLANT PENTACHLORO-PHENAL SOLUTION FOR PILES AND 8 POUNDS PER CUBIC FOOT OF LUMBER WITH 5% WATER REPELLANT PENTACHLOROPHENAL SOLUTION FOR ALL OTHER USES.
STRINGERS	3" X 10"	ROUGH SAWN	
DECKING	2" X 8"	ROUGH SAWN	
TOP RAIL	2" X 6"	DRESSED	
MID. RAIL	2" X 4"	DRESSED	
POSTS	3" X 6"	DRESSED	

SUGGESTED PLAN

WET AREA WALKWAY AND TEACHING STATION

DESIGNED AND DISTRIBUTED BY THE
NATURE CENTERS DIVISION
NATIONAL AUDUBON SOCIETY

Maintenance. A vital aspect of every nature center is adequate maintenance. This applies to both facilities and grounds, and includes care of buildings, displays, signs, and the continuous clean-up and maintenance of grounds, trails and roads. The center must be clean, tidy and orderly at all times.

Equipment. The following working tools, equipment and supplies are the minimum needed at the center:

Power chain saw
Wood and plastic sign router
Furniture and display equipment and supplies for the interpretive building
Slide projector, 35mm
Movie projector, 16mm
Projection screen, 60"x60"
Carpenter tool kit, vise, general tools
Field working tools (shovels, picks, axes, brush hooks, grub hoes, fire rakes)
Indian fire pumps (back, 4)
Fire tool box
Band power saw
Mitre saw (bench)
Carpenter's work bench
Aquaria (indoor type, 3 with filters and air pumps)

Administrative Guidelines. Any facility which seeks to serve the public interest--and the proposed nature center would qualify as such an institution--must operate efficiently and effectively; otherwise, complications will arise. The following guidelines should prove helpful:

·Inaugurate an efficient system of record keeping and cost

accounting for the center; also, begin keeping a center history journal, and record minutes of all administrative and committee meetings.

·Exercise close supervision and control over public use of the area. Rules and regulations should be drawn up, approved, posted and then enforced.

·The director should keep an accurate check on attendance and program scheduling. He should also maintain a running inventory of the man-made and natural resources of the area.

·The director should maintain close liaison with the local mass media, such as radio, TV and the newspapers. Local citizens, particularly school and youth groups, should be kept well informed as to what is going on at the center, what services are being offered, and how the center is serving the community.

Personnel. Technical and non-technical permanent staff personnel will be needed at the nature center. The director should be hired as soon as a permanent organizational structure is worked out and funds for development and initial operations

are assured. A minimum operating staff for the nature center should include:

1. Director. This is the key position at the center. Much of the success or failure of the project will rest with this man. The minimum qualifications should call for a person of college background with a major in biology, zoology or natural resources conservation, and with at least two years of professional, practical experience in outdoor interpretation, land management and natural history education. A person with an aptitude for meeting people and with competence in administration, outdoor teaching, public speaking, guiding, and sound land management should be sought.

   A salary range of from $9,000 to $10,000 per year might have to be paid to secure such a director. The salary would depend, however, on what benefits and other remunerations are involved.

2. Clerk-typist. This position could be filled by a responsible woman who would serve as an office manager, sales clerk, typist, and general administrative assistant to the director.

3. Caretaker. This is a non-technical job calling for the

services of a responsible custodian, warden and grounds man.

4. Janitor. This would be a parttime position.

Program Offering. The crux of a nature center facility lies in its outdoor education program. Unless a center makes use of its total outdoor natural environment for learning, it is falling short of exploiting its greatest asset.

To achieve a favorable and enjoyable outdoor learning atmosphere, the director of the center must be a good administrator and teacher. He must also have skill as an artist, showman and public relations expert. This suggests that the program offering must change with the seasons, be interesting and imaginative, and closely coordinated with curricula of the local school system.

1. What to Teach. Space does not permit a detailed discussion of what to teach in the outdoors. It must suffice to say that a policy of teaching natural history concepts and conservation principles in personalized fashion in the field is a safe and sound practice to follow. A program which stresses ecological concepts and places an emphasis on the building of personal attitudes toward maintaining a life-giving environment is operating on solid ground. Appendix A, "Teach-

ing in the Outdoors," gives a variety of ideas on what can be taught in the outdoors.

It can be said that attitudes stem from knowledge, and that knowledge begets understanding, which in turn generates interest. When knowledge, understanding and interest develop, then sound conservation attitudes follow--respect and reverence and love toward things natural. When such attitudes develop in people, there emerges a sense of responsibility toward resources, including an appreciation of property and the landscape in general.

It is in the area of character building that the nature center makes its greatest contribution to a community. Therefore, an effective center at the Shaker Lakes Park should upgrade to a considerable degree conservation understanding and conservation education.

2. Educational Programming. The following points on programming should be considered in operating the center:

   - Organize displays and exhibits in an orderly fashion in the interpretive building, e.g., proceed from general conservation to soil resources, water resources, forest resources, wildlife, minerals, and interrelationships in a natural environment.

- School and other groups should visit the center by appointment. Naturalist-guided tours should be arranged well in advance. Each school group should be provided with some introductory material before the visit so that when the class arrives, it will be prepared for the outdoor experience.

- Provide each visiting teacher or group leader with a set of follow-up materials for subsequent classroom work.

- Acquaint visitors with the rules of the center, and ask everyone to stay on established trails. Indiscriminate wandering over the center should not be permitted. All employees must help enforce this rule.

- The staff should set an example for visitors, e.g., follow the six L's philosophy in outdoor teaching--look, listen, learn, love, let alone, and litter not.

- Limit outdoor tours to 75 or 90 minutes for each group.

- Organize teenage work groups to help with simple maintenance and the building of displays. The center

should be able to stimulate the interest of many young people in science, natural history and conservation.

- Concentrate on interesting, inexpensive displays rather than heavy, permanent dioramas. Change displays frequently.

- Have staff keep abreast of new and effective teaching techniques by occasionally visiting other centers and by attending conferences on outdoor interpretation.

The location of John Carroll University, Western Reserve University and Case School of Applied Technology within easy commuting distance of the proposed nature center is of special interest to the project. Appendix B, "College-Level Utilization of the Outdoors in Education," gives values, desirable outcomes, and some subject areas that should benefit from the use of the nature center.

Dealing with Vandalism. A continuing educational program aimed at wise use is a positive approach toward preventing vandalism at a nature center. A number of park administrators support educational programs because, in their words, "without the interpretive programs which teach people how to use our

parks and to appreciate what the land offers, the areas will be destroyed and the open space lost to development."

In addition to the educational program, the following brief suggestions are made:

- Design, plan and construct areas, facilities, buildings and equipment upon proven principles of sound use based on practices found to be effective in discouraging or preventing vandalism.

- Carry out a program of preventive maintenance, accompanied by immediate repair or replacement.

- Involve patrons in planning processes.

- Establish sound regulatory rules based on a good understanding of human nature.

- Patrol areas on a reasonable schedule.

- Select leadership carefully to avoid conflict situations, and make adjustments as needed.

- Provide adequate lighting of all areas, facilities and buildings.

- Institute a dynamic, well-balanced program that meets the

needs of the constituents.

•Work closely with other community agencies.

If vandalism does occur or persists in spite of these measures, the vandals must be apprehended and restitution made either in work or money by the vandals or financially by the parents.

Costs. The development and operation of a center involves two types of expenditures--capital outlay and annual operating costs. In submitting the following suggestive cost figures, it should be made clear that the capital expenditures do not include cost of the land and existing improvements. While any facility can operate below par standards, such an approach is not recommended. A facility that aspires to show the best that the city has to offer in this field should strive to meet at least minimum standards.

The cost figure cited are based on current and known operating facilities in the United States. Table 5 presents the initial capital outlay costs, and Table 6 the annual operating costs for the proposed center.

(tables on next page)

Table 5

Step III. Initial Capital Outlay Costs

Interpretive-education building	$ 90,000
Service road, parking lot, landscaping	3,000
Utility development (electricity, water, sewage)	4,500
Trail development, board walkway and teaching station	5,000
Furniture, display materials, equipment for interpretive building	4,500
Power equipment and tools	1,500
Miscellaneous and contingencies	2,000
Total	$110,500*

*does not include an estimated $10,000-$15,000 for proposed fencing.

Table 6

Step III. Annual Operating Costs

Personnel services:	
Director	$ 9,000
Clerk-typist	4,000
Caretaker-warden	4,800
Janitor (parttime)	2,000
Social security and other personnel benefits	2,000
Utilities, fuels, mileage on vehicles	1,500
Maintenance and repairs	500
Telephone	600
Office and educational supplies	2,000
Insurance	600
Staff travel and expenses	600
Miscellaneous and contingencies	1,000
Total	$28,600

Financing. No detailed attempt can be made here to cover the complex matter of financing. A few guidelines on fiscal operations, however, should prove helpful. The point needs to be made that an effective nature center costs money. A well-run center, not unlike a well-run community park, museum, school or college, requires adequate and assured financing. A center cannot be relegated to operating on a shoestring and expect to be a credit to the organization or agency it represents or to the community it serves.

An effective way to raise private funds is for a tax-exempt local body to undertake a special campaign for funds. Such a campaign can be directed at private citizens, philanthropic groups, local organizations and businesses.

One of the most effective methods of augmenting annual operating funds is to establish an endowment fund. A fund with a principal of $1 million, when invested, can be expected to yield a safe annual return of nearly $40,000 a year, which would be a substantial sum toward meeting annual operating costs. Even a partial endowment of $500,000, however, would go a long way toward alleviating the burdensome problem of conducting yearly fund drives, although occasional drives might be needed.

Sometimes partial, local financing can be obtained from

school districts. Often school officials are willing to approve payment of a small per-capita fee to have school groups use nature center facilities and services which they themselves cannot provide. An annual $1 charge per child is not an unreasonable figure to consider in such cases. It is possible, too, for a school district to operate a nature center as part of the school system.

A modest income can also be realized by developing a small sales store in the interpretive building featuring natural history materials and a rental program of teaching materials, as well as making a charge for special services such as workshops for teachers and youth leaders.

PART IV

SUMMARY OF MAJOR RECOMMENDATIONS

The Nature Centers Division of the National Audubon Society makes the following major recommendations regarding the proposed nature center in Shaker Lakes Park:

1. The Shaker Lakes Garden Club should extend the leadership needed to establish a dynamic nature center at Shaker Lakes Park.

2. The nature center should evolve through three steps:
   a. A first-year summer program
   b. A two-year, full-time program
   c. A full-fledged nature center, complete with an interpretive-education building.

3. Such a center should be a total community effort. Close cooperation should be sought with colleges, schools, public agencies and service clubs in Cleveland.

PART V

APPENDICES

A. Teaching in the Outdoors

B. College-Level Utilization of the Outdoors in Education

C. Habitat Improvements for Wildlife

APPENDIX A

TEACHING IN THE OUTDOORS

HOW TO TEACH IN THE OUTDOORS

Capitalize on Natural Curiosity of Children

Establish purpose
Pre-plan
Time each experience carefully
Plan for proper pupil behavior
Make observations
Evaluate

Patterns of Pupil Experiences

Primary grades: Direct observation to find out what is happening at a particular moment in the outdoors and to maintain a sense of wonder

Middle grades: Observation, with critical comparison and simple measurement

Upper grades: Comparative measurement, sustained experiments, calculation of results, and statistical evaluation

WHAT CAN BE TAUGHT OUTDOORS

Outdoor experiences should be part of many meaningful units of study. Such experiences can be used to initiate a unit of study, raise questions for research, or to test theories derived from reading. The outdoors can contribute to the curriculum in many other ways, e.g., for collecting data and specimens, observing natural phenomena, inspiring creative work, or helping to explain some concept introduced in the classroom. Each topic which follows is accompanied by a list of educational objectives:

Work Done by Solar Energy

To measure solar energy received as heat and light
To measure differences in solar energy absorbed by different colors
To concentrate solar energy into a high temperature source
To use solar energy to perform water distillation
To use solar energy to produce electricity

The Nature of Seasonal Change

To identify seasonal changes in trees, shrubs and flowers
To distinguish between annual and perennial plants
To distinguish between evergreens and deciduous trees

Deciduous Plants

To identify deciduous trees and shrubs when leaves are present
To identify deciduous trees and shrubs after leaves fall

Evergreen Plants

To compare evergreen trees and deciduous trees
To compare needles and cones of various coniferous trees
To locate and identify evergreens in a community

Flowers and Their Work

To identify the parts of a flower
To learn the value of flowers
To recognise similarities and differences between flowers
To relate the shape of flower parts to the method of fertilization

Seed Dispersal

To identify ways by which plants disperse their seeds
To relate the pattern of seed dispersal with the places where seedlings sprout
To find out why all seeds do not successfully produce plants

How Plants Multiply

To find how plants multiply other than by seeds
To describe how spreading plants are used to advantage in certain situations

Survival Needs of Invertebrates

To relate activities of insects to their basic biological needs for food, protection and reproduction
To identify some common insects and spiders
To locate various insect homes

To describe how man manages the environment to encourage some insects and spiders and to discourage others

Birds

To recognize common birds of area
To describe differences in behavior of various birds
To provide winter feeding station
To identify birds that are residents and seasonal visitors
To improve habitat conditions for birds

Interrelationships Within Little Environments

To find changes in the environment caused by weather
To find changes caused by plants and animals
To discover how one form of life affects another

Soil Erosion and Deposition

To be able to point out evidence of soil erosion and deposition
To identify the factors that accelerate erosion and those that slow it down
To correct a soil erosion problem in the community

The Nature of the Physical Environment

To measure climatic factors of temperature, rainfall, wind, relative humidity and sunshine
To identify microclimates within a larger climate zone and be able to identify the factors that produce these microclimates
To recognize major cloud formations and relate them to weather, air movements and the influence of the sun

The Earth in the Solar System and the Universe

To locate apparent direction by sun's movement caused by rotation of the earth
To relate observed changes in the position of the sun and stars to the movements of the earth
To demonstrate size and distance relationship in the solar system
To be able to point out the North Star

To recognize some star constellations
To locate planet and first magnitude stars

CURRICULUM CONTENT BASED ON OUTDOORS

Energy of Sun is Necessary for All Life and Activity on Earth

Sun's energy affects climate
Plants use sun's energy
Growth patterns of plants and animals
Man's dependence on sun's energy

Movements of Earth in Space Produce Day and Night, and Seasonal Changes

Day and night caused by rotation of earth on axis
Seasonal changes result from movement of the earth around the sun and the $23\frac{1}{2}^{o}$ tilt of the earth's axis

Night Sky Shows Vastness of Universe

Solar system
Seasonal change in position of stars
Constellations
Direction and location determined from stars

Geological Structure of Earth's Crust Influences Topography and Determines the Distribution of Minerals

Geological structure affects man
Geological structure creates watershed
Geological structure is found in stream beds and road cuts
Geological structure provides parent material of soil

Natural Forces and Man Cause Changes In Earth's Surface

Farming activities
Stream action, wind erosion
Decomposition
Earthquakes
Volcanoes
Folding and faulting of earth's surface
Rising and sinking of surface

Climatic Conditions are Affected by Interrelated Conditions

Latitude
Altitude
Sunlight
Location of mountain systems
Movement of air
Shape and distribution of land and water surfaces
Ocean currents
Humidity
Surface vegetation

Climatic Conditions Affect Plant and Animal Life

Vegetation at different altitudes
Seasonal influence on plant growth patterns and reproduction
Seasonal influence on animal habits
Plants, animals and man adapt to climatic conditions

Certain Natural Processes, Occurring as Cycles, Influence the Interrelations and Interdependencies of all Living Organisms and have Significant Effects on the Physical World

Photosynthesis and respiration
Water cycle
Nitrogen cycle
Food chain
Reproduction cycles

The World, When Undisturbed by Man, Tends to Maintain A State of Interdependence, but not a True Balance

All living organisms have a place and a function
Change and modification are a continual process
Specific habitats show a state of interdependence

Man is a Great Factor Responsible for Upsetting Interdependencies in the Living Environment

Radioactivity
Air pollution
Water pollution
Misuse of natural environment
Urbanization

SCIENCE INVOLVEMENT IN TEACHING OUTDOORS

Minerals of Economic Importance

Methods used to identify
Formation of certain minerals
Comparative amounts of various minerals
Uses by man and natural life
Amounts of deposits necessary for economical use
Rate of consumption
How various minerals are extracted
Types of topography where a certain mineral is most often found
The part these minerals have played in the history and geography of the area
What man does to conserve minerals
Esthetic values
Recreational values

Rocks and Soil

Identification of rocks
How certain rocks were formed
Minerals common to various rocks
Relation of rock type to topography
How to read the rocks to determine the geological history of the area
Natural forces that cause rocks to break and wear away
How the formation of soil depends on the decomposition of rocks
What happens to rock particles that are worn away, other than those which make soil
How the natural forces aid in making soil
The various forms of plant and animal life that contribute to soil building
How soil fertility and types depend on various climatic and environmental factors
Amount of time needed to make good topsoil
The dependence of all life on soil
The identification and characteristics of soil types
The identification and characteristics of soil layers
What man can do to conserve and build up the soil in the community
How to test soil for its properties
Factors, both natural and man-made, which contribute to the depletion and destruction of soil

Constructive and destructive effects of erosion
Rate of time to destroy good topsoil
Various types of erosion
Nature's way of retarding erosion
Methods used to retard soil erosion in the community
Esthetic values
Recreational values

Water

Forms of water
The water cycle
Cloud formations and their meaning
Various forms of precipitation
Comparative effects, both destructive and constructive, of different types of precipitation
Water's contribution to soil building
The uses of water by plants and animals
The watershed, its importance and implications
Identification of the watershed in which school is located
The influence that precipitation has in determining the types of plant and animal communities that inhabit the area
How water contributes to erosion
The results of either an overabundance or deficiency of precipitation during a year or a span of years
How precipitation affects climate
How man strives to conserve water and use it wisely
Water's effect on the locality
How a community can "save" water
Esthetic values
Recreational values

Plants

Differentiation and methods of identification
The various segments of the plant kingdom
The parts of plants and their purposes
Life cycles of the various types of plants in area
Explanation of pollination, its value and various methods by which it is accomplished
How seeds are formed and methods of dispersal; the value of seed dispersal
The basic necessities of all plant life are air, food, water, and sun:

How green plants obtain necessities
How parasitic plants obtain necessities
How varying amounts and types of these necessities influence the character of the plant community
Adaptations of plants to fit in with their environment
How plants adapt themselves to secure necessities
The struggle for survival among plants
How plants depend on animals and animals on plants (food chain)
The dependence of plants on water
The role of plants in the water cycle
How plants contribute to the storage of water
How plants depend on soil and how various types of soil affect plants
How plants help in building soil
How different plant parts protect the soil
The dependence of plants on minerals
The nitrogen cycle
The oxygen cycle
The effect of fire on various plant communities
The natural defenses of certain plants against fire
The recovery of plant communities after fire
Man's utilization and dependence upon plants including new uses and discoveries
The conservation of plants by man
Plants' role in the history of the community
Reading the history of a community through a knowledge of plants

Animals

Methods of identification
The various segments of the animal kingdom
The parts of animals and their functions
The life cycles of various types of animals
The basic necessities of animals--air, food, water, shelter, space to live
The adaptations of various types of animals
How food chains contribute to interdependence
How animals depend on plants
The dependence of animals on soil
How animals contribute to soil building
The dependence of animals on minerals
Animals' role in the water cycle

The effect that climate has in determining the type of animal community
Animals' contribution to the nitrogen cycle
Struggle for survival among animals
Reading animals' characteristics by study of their tracks and droppings
The conservation of animals by man
How man has affected interdependence among wildlife
Animals' role in the history of a locality
The effect of fire on various animals
Esthetic value
Recreational value

Air and Weather

The components of air and their uses
Weather (high pressure, low pressure, precipitation, temperature, winds); their causes and effects
Various cloud formations; their origin and meaning
The water cycle
The understanding of humidity
The effects of dry and wet cycles
The oxygen cycle
The dependence of all living things on air
The effects of various types of weather on rock, minerals, soil
Air currents and their effect upon the local climate
The effects of various types of topography upon the weather and their resultant effects on climate
Man's use of the various properties of the air other than for breathing
The effect of weather on the history of the locality
Esthetic values
Recreational values

Physical Forces

The dependence of all life on the sun's energy
The effect of various types of weather on the earth's surface
The meaning and effect of weather cycles
The effect of glaciers on topography

The cause and effect of various types of geological phenomena--volcanoes, faults, landslides, earthquakes
The importance of the stars, planets and the moon to our earth
The composition of the earth
Esthetic values
Recreational values

APPENDIX B

COLLEGE-LEVEL UTILIZATION OF THE OUTDOORS IN EDUCATION

Many values accrue from education in the outdoors. For example, increased powers of observation, keener sense and appreciation of nature and the need for conservation, an expanded lifespace, a better understanding of group relations, and a more perceptive approach to discovery, exploration and research. Teachers and students alike have the opportunity to extend themselves--physically, sociologically and psychologically. All in all, the quality of education is upgraded in the outdoors. As Dr. Willar Zahn has said:

> Outdoor education improves the quality of student interests, provides sources of motivation for developing new interests as well as for extending the old, and increases the availability of desirable interests in the total environment. Cause and effect relationships become more direct and obvious, emphasis on meaning is thereby enhanced, and the ensuing delight in learning is thus deepened and made more intimate and personal. The element that is important here is that the quality of experiencing is greatly improved.

Dr. E. V. Pullias wrote:

> In deep sincerity, I believe outdoor education is a ray of light, a crack in a thick, dark wall which could bring a desperately needed new dimension to man's attempt to educate himself.

DESIRABLE OUTCOMES

The development of an awareness of the outdoor environment
The participation in outdoor learning activities that will enrich classroom teaching
The development of the ability to use a multi-sensory approach to teaching and learning
The ability to use more exploratory learning in teaching
The ability to understand and use teacher-pupil planning
The recognition of the values derived from an informal group experience

The following is a partial list of subject areas that can benefit through using the outdoors:

SOCIAL SCIENCE

A study of the history of the local area; its land, its people, and its customs
An investigation of historical sites: Indian sites, old canals, mine and furnace sites

PHYSICAL AND NATURAL SCIENCE

A study of forests, forest life and reforestation
Field experiences in botany, zoology, geology, astronomy and meteorology
Investigation of conservation problems with respect to watersheds, rivers and lakes, fish and game, trees and forests

HEALTH, PHYSICAL EDUCATION AND RECREATION

Education in various outdoor skills: fishing, camping, swimming, boating
Investigation of health problems in connection with operating an outdoor school (camp)
Administration and organization of an activity program for an outdoor school

MATHEMATICS

Field problems in land measurement and map making
Estimation of distances and sizes: land areas, elevation, tree heights, lumber footage and tree ages
Keeping the accounts and financial records for an outdoor school operation

FINE ARTS

Developing a varied music and dramatics program for an outdoor school: informal sings, pageants, plays

An opportunity for creative drawing and sketching, pottery making and working with other native materials

INDUSTRIAL ARTS

Developing designs and plans for outdoor school buildings
Organizing an educationally sound arts and crafts program for an outdoor school

HOME ECONOMICS

Planning and preparing foods for regular menus and cook-outs
Investigating problems of an outdoor school food service operation

LANGUAGE ARTS

Opportunities for creative writing: plays, poems, and prose based upon outdoor experiences
An investigation of literature relating to the local area and local natural resources

PSYCHOLOGY AND TEACHER EDUCATION

Developing insights into child development, principles of learning and group dynamics
Investigation of the potentialities of the outdoors in curriculum development

APPENDIX C

HABITAT IMPROVEMENTS FOR WILDLIFE

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PART 1. THE ABC'S OF WILDLIFE MANAGEMENT

Production of wildlife is governed by natural laws, as distinguished from the man-made laws. Natural laws are fixed and unchangeable, enforced by such basic facts as birth and death and the need of living things for food, water and shelter. We cannot re-make natural laws to suit ourselves; all we can do is to understand them and work with them. To work against them brings certain failure.

Understanding the laws of nature requires study and thinking. To outdoor enthusiasts and others interested in wild creatures, however, it is an easy and pleasant study, as simple and logical as everyday arithmetic. As in arithmetic we can start with something we know and go on from there.

One of the first simple things we know is that there is wildlife almost everywhere. It is present naturally. We did not "produce" or make it. The next fact is that wildlife, like all life, must eat, drink and find shelter in order to live. It must find a place to raise young. Wherever you find any species of wildlife, you know it is finding the kind of food, water and home that it needs. Otherwise, it wouldn't be there.

Only the wild creatures that find enough of the right kind of food, cover and water will live. The rest must either starve because they cannot eat, be killed because they cannot hide, or they will die because they cannot raise enough young to replace their losses. In a sense, these are expressions of natural laws.

These natural laws are the basis for one of the important principles of wildlife management. This principle is called carrying capacity. Carrying capacity is the number of quail, rabbits or other wildlife which any piece of land will support or "carry" at one time. The amount and quality of the food, cover and water which determine carrying capacity are, in turn, determined by (1) the kind of soil and its fertility and (2) the way the land is used.

Fertility is the richness of the soil--the kinds and amounts of food elements, like iron and calcium and nitrogen, contained in the soil in forms that can be used, first by plants and in turn by animals. If there isn't enough lime or phosphorus in the soil to grow bones and teeth and to make good blood, the wild

animals that live there will be few and unhealthy. The same is true of domestic animals. If there aren't enough nutrients forthcoming from the soil, the animals will be diseased and will fail to bear enough healthy young.

The best land use is that which produces the greatest benefit for people while conserving soil, water, minerals, and native plant and animal life. Some land may be used chiefly for grain while other land, which cannot be cultivated without erosion, must be kept in pasture or meadow. Still other land, unsuited either for cultivation or grazing, will grow valuable timber. In many parts of the country the pattern of land use must be greatly varied: a tract here in cultivation, a strip there in grass, a hillside or waterway in trees. Wildlife is a valuable by-product. We Americans have made many mistakes in land use. We have overcropped our fields, overgrazed our pasture, overcut our timber, wasted our soil, silted our streams, destroyed the homes of wildlife.

Fortunately, soil fertility can be built up or conserved, and land use can be changed for a better balance with nature. Doing this is profitable to the farmer and beneficial to his domestic stock, and it helps wildlife by increasing the carrying capacity of the land for it. Therefore, carrying capacity for wildlife can be increased by the same methods which help the farmer improve his land and crops. Good wildlife management is just good farming. The same principles apply on small parcels of land--the back "forty," a small woodlot, a limited natural area, a piece of unspoiled land, or even a suburban lot.

The fact that carrying capacity can be increased wouldn't mean much if it weren't for another natural law. This law is the power of wild creatures to produce young in numbers far greater than needed to keep up the population level, if all of them lived. One quail hen will lay an average of 14 eggs. If all should hatch and the young should live and reproduce at the same rate for five years, the total number of quail resulting from this one bird would be 65,536!

To increase the number of young reared successfully to maturity, the landowner must improve the carrying capacity of the range during the nesting and rearing season. Specifically, this means increasing the amounts and quality of food, cover and water which, according to the natural laws, determine how many young quail live and how many will die.

The wildlife conservation lesson in all this is plain. People cannot produce wildlife; only nature can do that. We can help, however, by understanding and working with nature and her laws. We can increase wildlife by helping nature increase the carrying capacity: by restoring soil fertility and by wise farming and forestry practices which will provide more and better food, cover and water for wildlife, and at the same time provide better living conditions for people.

The National Audubon Society, in cooperation with local, state and federal wildlife agencies and private organizations, clubs and individuals, encourages all landowners to help wildlife by providing mammals and birds with additional supplies of natural wildlife food plants, by planting wildlife borders and sowing food patches. It is only through such a program that permanent improvements can be made in wildlife habitat. More food, more water, more cover means more wildlife for Americans to enjoy. Nature, through her amazing power of reproduction, will stock the new wildlife areas as fast as we can provide them.

In summary, the most basic of modern wildlife management practices--and the one that comes nearest to being a "cure-all" for dwindling numbers of wild birds and mammals--is habitat maintenance and improvement. Wildlife habitat is a combination of water, food, cover and living space. Improvement in quality is the principal means by which wildlife habitat can be increased in any area.

Habitat improvements are not only important educationally for people who come to a managed area to study or work with natural resources. For students there is the opportunity for direct, firsthand experience by working with habitat improvement measures. Also, through such activities as making a census of mammals or birds in an area, studying the variety of food and cover present, checking for available water supplies, analyzing tree growth and making soil tests, students discover some of the problems of the living world. Significantly, too, some solutions to problems are sometimes uncovered.

It is evident that any practice which benefits one species of wildlife will usually benefit a few other forms. Or to put the matter in another way, no single form of wildlife stands alone in the natural world.

PART 2. SONGBIRDS AND NON-GAME BIRDS

Management Practices

1. Protect marshes, swamps, woodlands and streambanks from fire.
2. Save, establish and maintain shrubby fencerows, hedgerows and thickets.
3. Construct small ponds and other wet areas.
4. Make clearings in mature forests.
5. Provide food patches.
6. Allow some dead trees to stand.

Hedgerows

The low, woody vegetation of hedgerows is the desired habitat of many songbirds. Bush honeysuckle, wild plum, autumn olive, highbush cranberry or any of several other shrubs make effective hedgerows along field borders, gullies or ponds. These plants attract the catbird, cardinal, mockingbird, cedar waxwing, brown thrasher, indigo bunting and others.

Probably the most popular hedge or living fence is the closely-spaced plantings of the multiflora rose. It provides travel lanes for many kinds of wildlife and is used as homesites by birds, small mammals and predaceous insects that help control insect pests. Mockingbirds, cardinals, towhees and indigo buntings utilize the rose fences. Such plantings are an excellent means of encouraging the insectivorous praying mantis, the egg cases of which are a common sight in rose hedges.

Hedgerows can be established by planting seedlings of desirable wildlife plants by hand or with a tree planter. An alternate way is by use of the "plow-perch" method. That is, in summer or early fall, plow a 10-foot strip where a hedgerow is desired. Set fence posts in a straight or staggered line at about 20-foot intervals down the center of the plowed strip. String

wire or binder twine between them for perches. Fruit-eating birds will plant their choice foods, such as wild cherries, blackberries, dogwood, raspberries, elderberries and mulberries. These "plow-perch" plantings grow almost as fast as those produced from rooted stock.

Fencerows

When allowed to develop, fencerows grow into shrubby borders and can be maintained as such by cutting down tall trees as they appear. The idea is to have a thick, bushy row of small trees and shrubs. Shrub borders harbor many beneficial insects, such as the ladybird beetle and praying mantis, and small mammals. Shrubby fencerows are used by such birds as the thrasher, cardinal, goldfinch, red-eyed vireo, mockingbird and chipping sparrow.

Roadsides and streambanks are much used by the birds listed for hedgerows. Ground nesters use them if they are in grass, whereas the tree and shrub nesters occupy them if woody cover is dominant. Mowing is one way to control unwanted plants which may grow along fencerows.

Mature Woodlands

Tall trees are nesting places for the great horned owl, red-tailed hawk, Baltimore oriole, scarlet tanager and others. Dead trees with hollow trunks invite flickers, redheaded woodpeckers, sapsuckers, bluebirds, house wrens and screech owls. To provide for these species, leave dead trees standing in the woodland or kill two or three tall, unwanted trees per acre. Killing is best done by "ringing" or girdling the trunk, that is, cutting through the bark in a strip two or three inches wide around the tree at breast height and one to two inches deep into the sapwood. Grasses and shrubs will appear in an area formerly shaded by a tree and will attract birds other than the kinds noted above.

Woodland Clearings

Dense mature woodlands seldom harbor many small birds. To encourage more use by wildlife, it is necessary to make openings in established timber stands to provide a greater variety of food and cover plants, better nesting sites and better feeding places for young broods.

One method to open a forest is to clear-cut the timber from one-half to two-acre plots. Open areas can be of any shape, but open strips 30 to 60 feet wide and generally running east and west are best. Clear-cutting is not necessary in timber stands open enough to permit the growth of blackberries, blueberries, grasses and similar plants. When plants of this kind are shaded out of previously made openings, it is time to cut new openings.

Another method to provide openings in a timber stand is to select trees, such as apple trees (gone wild or in an old orchard), wild cherry, hackberry, oak or hickory, and apply the orchardist's plan for producing more fruit. Measure the diameter of the tree in inches at 4½ feet above ground, multiply the diameter by 3, substitute feet for inches. This gives the length of each side of a square from which all trees are to be removed except the fruit tree to be favored. Example: the selected tree is 10 inches in diameter at 4½ feet above ground. Multiply 10x3 = 30 inches. Substitute feet for inches. This makes the length of each side of the square 30 feet. Center the tree in this square and remove all other trees. A surprising number of shrubs, grasses and new birds will appear.

Volunteer Food Patches

A small field can be managed to attract such seed-eating birds as snow buntings, redpolls, goldfinches, tree sparrows, mourning doves and juncos. No planting is necessary. Lay the field out in five strips. Width is not too important but probably each strip should not be less than 10 or greater than 30 feet wide. Each year plow a single strip in sequence, such as 1-3-5-2-4 or 2-4-1-3-5. By repeating the sequence after the fifth year, shrub invasions are halted and strips of mixed vegetation are continually available to the birds. Favorite bird foods are annuals such as bristlegrass, barnyard grass, panic grasses, lambsquarter and ragweed that spring up the first year. A mixture of perennial grasses, oxeye daisies, asters, goldenrods, blackeyed susans and others cover the plowed areas by the third year.

Planted Food Patches

Food patches planted for songbirds will attract many seed-eaters. The size may range from 100 to 2,000 square feet or

more. Pure stands of corn, wheat, sorghum, millet or sunflowers produce the most food, but a mixture of these attracts a greater variety of birds. The bristlegrasses and ragweeds which accompany tilling of land are nutritious bird foods. All cultivation should be done on the contour when needed to avoid soil erosion. Long patches are preferred to square ones. There should be maximum sunlight and the soil well prepared and fertilized. Check the planting guide and the suggested food patch mixtures near the end of this appendix.

Wetlands

Many kinds of birds, from geese to tiny marsh wrens, are attracted to wetlands. The kinds and numbers drawn to the site depend on the size and location of the wet area, its degree of wetness and the plant and other animal life present. There are several kinds of wetlands:

1. Ponds. A dam constructed across a drainageway offers the best means of creating a wetland habitat. Ponds so created attract redwings, mourning doves, snipes, killdeers, herons and a number of other birds.

2. Water holes. These are constructed by digging pits to provide at least 200 square feet of surface area in land having a high water table (one foot or less below the ground surface) or in relatively flat drainageways where runoff will keep the pits filled with water. The holes should be four to six feet deep.

3. Marshes. Marshes support a myriad of plant and animal life. A marsh can be built on an open area of fairly flat land where soils are tight enough to hold water or the water supply is sufficient to compensate for limited seepage. The construction of a dam or dike is usually necessary. In the simple marsh, water will range in depth from one inch to two feet or more. A more elaborate marsh will have a larger water area and may have a depth of several feet at one end with most of the remainder covered by one or more inches of water.

   Vegetation may grow so dense as to eliminate all open water in a shallow marsh. It is important to have

some open-water areas scattered over a marsh. These can be created during the early construction stage by digging pits to provide minimum-sized water areas of 200 square feet from four to six feet deep. One or more such areas per acre of marsh are desirable. The spoil should be piled where there is no chance of its sliding back into the excavation.

Native marsh plants will quickly invade a new wet area; thus, planting is unnecessary. Circling the marsh with a row or clumps of selected shrubs adds to its beauty and usefulness. The plants should be set at least 50 feet from the water's edge.

A greater degree of management is possible if a water-level control device is installed in the dam. By fluctuating the water level an owner can reduce unwanted vegetation and encourage more desirable plants.

Tree and Shrub Plantings

Trees and shrubs provide cover, nesting sites and food for many birds. The pine family rates high in food and cover value with songbirds throughout the country. The dogwoods and viburnums are of great value to birds since about 90 different species eat their berries. If you can plant but one tree for the birds, make it a mulberry. The birds relish its berries, preferring them to such soft fruits as domestic cherries.

PART 3. COTTONTAIL RABBIT

Management Practices

1. Establish or maintain woody cover in hedgerows and fencerows. "Living brushpiles," small thicket-like plantings of multiflora rose, are ideal.

2. Pile brush in woodland borders.

3. Maintain cattail-covered marshes and sloughs for winter cover.

4. Establish and maintain grass or grass-legume stands on roadbanks and field borders. White clover with a suitable grass makes choice rabbit food.

Brushpiles

Locate brushpiles near the edge of a woods, field or marsh. Make them six feet high and 25 to 30 feet across so that a dog cannot burrow through or a person kick them over. Crisscross a few large logs or limbs for a foundation, or pile them over a stump to keep the cuttings from rotting down too quickly. Lay on slash generously and put some heavy pieces over the top so that wind will not blow the brushpile apart. Several animals, including rabbits, will use brushpiles for cover. By the time a brushpile rots, it will be replaced by a tangle of vines, shrubs and brambles--"a living brushpile."

Grass

Grass is a basic food provider for many species of wildlife, including rabbits, but it requires sunlight for growth. With this in mind it is necessary to carry out selective cutting and thinning of trees along roads, wood edges and field edges so that grass can take hold. Special attention should be given to seeding areas with grasses that thrive in partial or nearly complete shade. Red fescue, redtop, orchard grass, bluegrass and bristlegrass are some good and widely-used examples.

Special Food Patch

A plot of oats seeded with one of the following mixtures makes a good food and cover area for rabbits:

(Tables on next page)

Mixture #1 for one acre	lbs.
Orchard grass	2
Redtop	2
Red clover	2
Timothy	4
Alsike clover	1
Total.....	11

Mixture #2 for one acre	lbs.
Sweet clover (yellow or white)	1
Timothy	4
Alsike clover	2
Orchard grass	2
Redtop	2
Red clover	2
Total.....	13

Plow in early spring when the soil is workable and not too wet; lime, if needed; harrow and seed one bushel of oats per acre with one of the above mixtures, using sufficient fertilizer. If it is necessary to plow in the late summer or fall, winter wheat may be planted. Then seed the following spring to the proper grass-clover mixture or to clover.

The oats or wheat should be left standing in the field, thus providing food for all forms of wildlife that eat seeds. The seeding of clovers and grass will not only furnish food but also nesting cover.

It is recommended that a strip at least 15 feet wide be mowed along the edges of these clover-grass strips each year. Mow after the nesting season is over to produce succulent green growth.

Hairy vetch planted in the fall at the rate of 30 pounds per acre with one bushel of rye provides food that will attract cottontail rabbits from a considerable distance. Small plantings of turnip, mustard, kale and collards also make excellent winter "green patches" for rabbits.

PART 4. GRAY SQUIRREL AND RELATED SPECIES

Management Practices

1. Control fire in woods.

2. Manage forests according to accepted forest management principles; practice selective cutting; leave 2-3 good den trees per acre.

3. Favor choice, high-yielding, food-producing trees.

Nests

Squirrel nests are of two types: den tree nests and leaf nests. Den tree nests are the more important, affording the best protection throughout the year. There are two types of dens: those used for reproduction, shelter or escape, and those used for escape only. The latter consists of tree cavities that are too deep or shallow, or have entrances that are too large or damp. A depth of 2-3 feet from the den entrance is preferred. Ideally a den entrance should not be over 3½ inches in diameter. The following are general recommendations for selecting squirrel den trees that are to be saved from a timber cutting operation:

1. Select trees that provide food and have durable heartwood, e.g., white oak, black walnut, hickory, chestnut oak, red gum, black gum, maple or basswood.

2. Select a live tree at least 15 inches in diameter and with the den entrance at least 20 feet from the ground.

3. Select trees that are being used by squirrels.

4. Select den trees that are well distributed throughout the area. Good den trees are not always abundant in the more extensive forests. Where den trees are not found, nesting boxes should be provided.

Leaf nests are built in almost any species or size of tree and no special management measures are needed.

Food and Cover

Staple diet consists mostly of nuts and acorns and (in the case of fox squirrel) corn. Favored foods are hickory nuts, acorns, walnuts, butternuts, beechnuts, pine seeds, maple seeds and hazelnuts. Squirrels generally prefer hickory nuts over acorns. Seeds and buds of maple, tulip poplar and osageorange are also utilized.

Trees in the woodland border or around woodland openings are generally better food producers because they receive more sunlight and moisture. In summer and fall, fruits such as blueberry, black gum, blackberry, dogwood apple, wild grape and wild cherry aid in supplying food for squirrels.

PART 5. DUCKS, GEESE AND SWAN

Management Practices

1. Maintain, improve and increase wetland areas.
2. Control depth of water in pond areas.
3. Provide nesting sites.
4. Keep water areas open in winter.
5. Control excess vegetation in and around ponds.
6. Provide grazing areas for geese.
7. Provide loafing and nesting islands.
8. Control snapping turtles.
9. Increase size of sanctuary by agreement or lease from adjacent land owners.

Wetland Areas

Maintain and improve existing wetland areas and establish new ones. Reclaim former pond areas where periodic receding of water levels have encouraged overgrowth of shrub and emergent plant life. Restoration of these areas consists of removing surface sod and brush accumulation. Usually this material can be used to build island areas or "loafing sites" around remaining tree or shrub growth.

Additional peat, clay or gravel accumulation can be removed from the site. Shallow flooding of these areas provides much productive acreage. The removal of the sod alone may release good stands of duck potato and other excellent duck and wildfowl seeds and tubers that have been lying dormant.

Water-Level Control Devices

Build water control structures at outlets of marshes and low areas which have reliable water supplies. Regulate water levels to enhance the production of natural food plants and to encourage a desired ratio of cover to open water.

Construct "stone fords" in creeks and small streams to impede flow of water and thus create small impounded areas. This helps to stabilize water levels, especially during the nesting period. Gradual flooding of areas during late summer, when food plants are completing their growth, provides additional shallow feeding areas.

Used culverts from county road systems can be used very effectively to control small water-holding areas. A cement seep collar helps prevent washing-out and also doubles as a water-level control structure.

Draw down pond water level during mid- to late June, and allow shoal areas to dry for a few days. Disc or rototill exposed edges adjacent to grazing areas. Broadcast a seed mixture of smartweed, millet and buckwheat. As soon as shoots start to form seeds, allow water to rise slowly behind the growth to provide support for the fruiting heads. Such planted areas supplement the natural food production.

Fall and spring runoff ponds created by low dikes in hay fields and newly-seeded grain fields are used in several parts of the country. These areas attract wildfowl and shorebirds during fall and spring migrations. The addition of smartweed at planting time makes them even more attractive as waterfowl feeding areas.

Nesting Sites

In areas where intensive duck nesting is desired, hedges of nesting cover radiating from ponds are planted to multiply the number of territories available for nesting ducks and geese. Low-spreading shrubs and vines, such as multiflora rose, autumn olive, pfitzer juniper and honeysuckle are the most effective species to use.

Open Water in Wintertime

High-pressure water jets are often used to keep a portion of a pond ice-free during the winter. A small pump attached to a domestic well bringing the warmer water from below the earth's surface can also be used. Water holes for winter use do not have to be large, as waterfowl use the water mainly to drink and to warm their feet. Mechanical aquatherms, siphon jet pumps and compressed air are common automatic units used to keep water areas open during the wintertime.

Control Excess Vegetation on Wetlands

The control of excess vegetation on wetlands is beneficial to waterfowl, especially during the late summer months. Mechanical controls include (1) rotary mowing of strips or areas adjacent to ponds or pond edges during low water-level periods, (2) killing low shrub growth the season before they are to be removed by mechanical means, thus reducing the tendency to sprout, and (3) shearing off excess shrub growth projecting through the ice right after the first freezing weather occurs.

Biological methods of plant control include (1) using plant growth inhibitors to provide openings in rank growths, such as water lilies and cattails, and (2) physically "rolling" or drag-

ging down "emergent" vegetation in shallow ponds, providing open water areas and bringing seed heads down where ducks can feed on them and thus reducing the next season's plant potential.

Grazing Areas

Mow strips on land taken out of cultivation to encourage grass for waterfowl grazing. Mowed idle fields near regular feeding areas attract geese since they seek green forage for grazing. Odd strips of buckwheat adjacent to the feeding areas are also utilized.

Loafing and Nesting Islands

Loafing islands and nesting platforms should be provided in and around semi-remote water areas. Protection from land and air predators is essential. Islands and old muskrat houses are ideal. Platform nesting spots can be placed some distance from the shore on stumps circled with metal flashings or coon guards and completed with umbrellas made out of fencing, tree branches or vegetative cover.

Floating "islands" can be anchored in shallow water ponds. Metal barrels are sometimes attached underneath to adjust the height of flotation. The "islands" can be constructed from green logs with rough mitred corners made by a chain saw and held together with lag screws. Each "island" should be landscaped with a mat of reed canary grass, a willow shrub, a clump of birch, or a pfitzer juniper planting to provide shade and protection from predators.

Control Snapping Turtles

Snapping turtles sometimes become serious predators in waterfowl refuges. A good person to contact for advice about any turtle control that should be exercised is the local representative of the state game and fish department.

Extending Effect of Sanctuary

Like the Canada geese, mallards, black ducks, pintails and

other ducks have a tendency to feed in newly-harvested fields. Leasing or encouraging privately-sponsored refuge areas near feeding areas will be helpful in restoring waterfowl numbers.

PART 6. WHITE-TAILED DEER

Management Practices

1. Protect woodlands from uncontrolled fires.

2. Clear-cut small areas in larger woodlands for "clearings" and encourage sprout growth, especially soft maple.

Range

Contrary to common belief, white-tailed deer do not travel far. Studies indicate that the annual range (movement from winter to summer areas) is 1.5 miles or less for 43% of the herd. Almost 4/5 of all deer studied travel less than 6 miles. This means that deer may starve to death within what seems to be easy walking distance of available food.

Food and Cover

Deer live essentially on browse which consists of the tender sprout growth, shoots and twigs of shrubs and trees. A deer weighing 150 pounds needs at least 10-12 pounds of good browse daily to satisfy growth requirements, 8-10 pounds for maintenance.

Food preferences vary with the season. Some foods are mountain maple, hemlock, white cedar, dogwood, red maple, mountain ash, willow, viburnums, wintergreen, sweetfern, poplar, greenbrier, grass, clovers, acorns and beechnuts. Variety is essential for proper nutrition. Some plants are eaten heavily by deer, but out of necessity instead of choice. Foods such as

oaks, cherries, balsam fir, alder, spruce, pines, tamarack, rhododendron and laurel, when eaten alone and for a long duration, lead to starvation.

In overpopulated areas choice foods are often browsed out of reach of does and fawns. (Any browse over your head is generally out of reach for deer.) Special practices, such as cutting red maple, birches and hard maple in November through March to induce sprout growth, should be done where a shortage of food exists. Cut trees less than 10" in diameter because they sprout the best.

Special Food Patches

Deer will make heavy use of herbaceous forage in food strips planted on fields near woodlands. A fall or winter grain or clover field are choice foods at these locations.

Plow during late summer; apply lime, if needed; apply sufficient fertilizer (see seeding guide, Part 11); harrow and drill in 4-6 pecks of winter wheat per acre. Each of the following mixtures will plant one acre, and should be seeded on the wheat early the following spring:

Mixture #1--northern Pennsylvania and north	lbs.	Mixture #2--southern Pennsylvania and south	lbs.
Birdsfoot trefoil	4	Alfalfa	4
Alfalfa	3	Red clover	2
Alsike clover	1	White clover	4
White clover	2		
Total.....	10	Total.....	10

Pure stands of clover may be seeded instead of the suggested mixture. White clover provides excellent food for wildlife. It may be seeded alone at the rate of 2-3 pounds per acre. For other mixtures consult your local seedman, county agricultural agent or Soil Conservation Service technician.

PART 7. BOBWHITE

Management Practices

1. Plant various legumes such as vetch and certain lespedezas.

2. Provide a variety of cover in the form of wild plum thickets, tangles of grapevines over fallen trees, and brushpiles in woodland edges and fencerows.

Lespedeza

Bobwhites like the seeds of several lespedezas and find cover in some of them, both from the weather and from their enemies. The seeds of the annual lespedezas (Korean, common and Kobe) are eaten as one of several choice foods. Sericea lespedeza makes good cover for bobwhite and its seeds are occasionally eaten. The shrub or bush lespedeza is reliable bobwhite food.

Generally speaking, ordinary bicolor lespedeza is limited to areas where there is no frost before late October. Natob, another strain of bicolor, can be grown farther north because the seeds ripen earlier. Its range is roughly the western part of Virginia, West Virginia, Pennsylvania, New Jersey, southern New York to northern Massachusetts.

Japonica lespedeza fills the gap in the range between ordinary bicolor and Natob since its seeds ripen by September 25. Its range covers roughly the area between northern North Carolina to southern Pennsylvania and west to the Mississippi River.

Planting Shrub Lespedeza

Size. Approximately 1/8 to 1/4 acre in each strip.

Shape. 300-400' long, 15-20' wide, 4-6 rows. Rows should follow contour of land to prevent erosion.

Amount. One strip to each 20-25 acres.

Material. Each strip requires 1,000-2,000 plants or 2 pounds of scarified seed. Small amounts of seed can usually be obtained free of charge from soil conservation districts or the state game department. Seeds and plants are available from most commercial seed firms.

Site preparation. Plan and harrow the area the same as for any field crop. Test soil for acidity and apply lime if needed.

Setting plants. Space plants 18-24" apart in rows 3-4' apart. Set plants anytime from late fall to early spring in the south and the earlier the better. In northern states plant a suitable strain as soon as possible after frost is out of the ground.

Seeding. Use scarified seed on a well-prepared seedbed. Plant in rows (20-30 seeds per foot) or broadcast at the rate of 16 pounds per acre. Seed only when soil moisture is good and soon after the danger of killing frost is past.

Fertilizing. A liberal amount of fertilizer assures good growth and abundant seed production. The amount needed will depend on the fertility of the soil.

PART 8. RUFFED GROUSE

Management Practices

1. Protect woodlands from uncontrolled fires.

2. Create and maintain openings in woods and seed clovers in them.

3. Establish shrub borders around woodlands either by plantings or by cutting trees from edges of woods.

4. When establishing conifer plantations, leave a strip 60' wide unplanted between each strip of evergreens.

Range

Good ruffed grouse range contains three kinds of plants: (1) shrubs and low-growing ground cover for rearing broods and for summer and fall foods, (2) hardwoods for nesting and for fall, winter and spring foods, and (3) conifers or brush tangles for winter cover. All three kinds should occur within an area of 40 acres so as to be available in the daily travel limits of the birds. Under a well-planned system of rotated cuttings and forest use, all grouse requirements may well be fulfilled without extra effort.

Food

The diet of young grouse consists almost entirely of insects for the first couple of weeks. As the summer progresses they eat foods such as strawberries, raspberries and dewberries. By late summer young grouse eat the same food as adults, which consists of a great variety of buds, blossoms and fruits from wildflowers, weeds, vines, shrubs and trees.

PART 9. WILD TURKEY

Management Practices

1. Control fire in both woodlands and fields.
2. Practice selective cutting in forests to leave poorer timber sites in relatively open stands and an ample supply of food trees.
3. Mow grassy areas in late July or August.
4. Establish fruit and nut-bearing trees and shrubs along roads and around woods openings.
5. Provide an adequate water supply through development of springs, water holes and ponds.

6. Grow clover or other green winter forage in turkey range.

Cover

In good range, coniferous and hardwood forests should both be available within each 10,000 acres, which is about the smallest unit that should be considered for managing wild turkeys. Clearings should be of two types: (1) sodded areas that provide grasses and (2) openings created by clear-cut lumbering operations to provide succulent fruits and berries. Good habitat should have a clearing of 1-2 acres in every 100 acres.

Food

Acorns of almost any type often make up one-half to two-thirds of the turkey's diet. Flowering dogwood berries, beechnuts, hickory nuts, and seeds of ash and pines are also choice foods. In some localities seeds from maple, elm and birch are used in considerable quantity. Bluegrass and clover are used extensively as forage.

PART 10. MOURNING DOVE

Management Practices

1. Establish windbreaks and Christmas tree plantations for nesting sites.

2. Develop water supplies through springs, water holes and ponds.

3. Establish or maintain hedgerows.

4. Establish or maintain borders and clumps of coniferous trees.

5. Develop small sand and gravel beds where none exist.

Food

Seeds compose 99% of the mourning dove's diet. Agricultural crops in the form of waste grains and weed seeds compose the major source of food. Some of the species of plant seeds used by doves are as follows:

Crotons	Pine	Bristlegrasses
Corn	Sweetgum	Soybeans
Crabgrass	Wheat	Pokeberry
Buckwheat	Ragweed	Peanuts

Grit

Proper grit is very important in the diet of many birds and its presence can often assure the success of mourning doves. Very small, natural gravel scattered along roads and fire lanes will provide this necessity. Crushed stone and broken gravel cannot be used by doves.

PART 11. SELECTED INFORMATION

Topics

1. Seeding guide for wildlife plantings.
2. Food patch mixtures for planting in spring.
3. Where to get assistance.

(Seeding guide on next page)

Seeding Guide For Wildlife Plantings

Seed	Rate of seed per acre	Lime	Fertilizer	Size of patch	Planting time
Food patch mix #1, 2, and 3	20 lbs. per acre	according to lime requirement test for 6-6.5 pH	300-400 lbs. per acre 5-10-10	¼-1 acre	spring
Rye	3-4 pecks per acre	same	same	same	early fall
Wheat	1-1½ bu. per acre	same	same	same	same
Soybeans	1½-2 bu. per acre	same	same	up to 5 acres	late spring
Corn	10 lbs.; 40" between rows	same	400-500 lbs. per acre 5-10-10	up to 5 acres	late spring
Japanese millet	25 lbs.	same		¼-1 acre	late spring
Buckwheat	1-1½ bu.	same	300 lbs. per acre. 5-10-10	¼-1 acre	early summer
Birdsfoot trefoil with grass	6 lbs.; with orchardgrass 3 lbs.	same	at seeding 300 lbs. per acre 5-10-10. Annual top dressing 300 lbs. 0-14-14	¼-1 acre	early spring or late summer
Sericea lespedeza	15 lbs.	maintain pH 5.8	same	long strips	spring
Bicolor lespedeza	16 lbs.	maintain pH 5.8	same	long strips	spring

Food Patch Mixtures For Planting In Spring

		lbs.
Mixture #1 for five acres:	Buckwheat	10
	Grain sorghum	9
	Foxtail millet	15
	Proso millet	15
	Kaffir	9
	Sudangrass	5
	Soybeans	15
	Cowpeas	13
	Vetch	9
		100
Mixture #2 for five acres:	Buckwheat	15
	Foxtail millet	15
	Sudangrass	15
	Soybeans	25
	Cowpeas	30
		100
Mixture #3 for ten acres:	Proso millet	35
	Grain sorghum	50
	Sunflower	15
		100

Where To Get Assistance

There are sources of information and help available to every landowner who would like to know more about the nature of soil on his property, planting dates, amount of lime and fertilizer needed for wildlife food plantings, and sources of plants and seeds that he may need.

County Agricultural Extension Service. The county extension agent's office is located in every county seat and in some cities and offers services to every landowner. The county extension agent can arrange to have soil tested to determine its fertility and its need for lime. He is a source of information on the local soil conservation districts and the state agencies (game and fish, forestry, geology, surface water control) that are available to assist a landowner. The extension agent will have the names of agencies and dealers that supply plants and seeds.

Soil Conservation District. The owner of an outdoor education area may want a soil survey and assistance in selecting, planting and managing food plots. There may be a need, too, for engineering data on dam and other water-control structures and for various fish and wildlife practices. The best and easiest way to get these services is to apply to the local soil conservation district in the county in which the area is located. These districts are local subdivisions of state government and are managed by boards of local landowners. Soil conservation districts in turn get technical help from many agencies and organizations, especially the U.S. Soil Conservation Service.

United States Government.

a. Topographic maps. These maps which show contours, elevations, waterways, roads and other information may be purchased from the U.S. Geological Survey, Washington 25, D.C. Write the agency for free index maps on which will be shown the quadrangle in which the area of concern is located. Order map by name of quadrangle and in the largest scale available. Topographic maps are also sold by some of the larger local stationery stores.

b. Aerial photographs. Prints and enlargements of most areas of the United States may be purchased. Write

for Photo Index Sheet and order form CSS-441 to the Performance and Aerial Photography Division, Commodity Stabilization Service, U.S. Department of Agriculture, Washington 25, D.C. These photos are also on file in offices of the Agricultural Stabilization and Conservation and the Soil Conservation Service in the local county seat.