ILLINOIS NATURAL AREAS INVENTORY

SUMMARY REPORT

ILLINOIS NATURAL AREAS INVENTORY

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The Illinois Natural Areas Inventory was a 3-year project to find and describe natural areas for the Illinois Department of Conservation. The results of the inventory will be used to develop and implement a state natural area plan, to protect the diversity of natural features in Illinois.

Methods for finding natural areas consisted of compiling available information, examining maps and aerial photos, aerial surveys, and on-site inspections. As many as 90 items of information were compiled for the significant sites. A computer-based system was developed to store, retrieve, and analyze the information.

The 1,089 sites identified as natural areas have a total of 1,730 significant features. Six hundred and ten natural areas were identified because of their high quality, relatively undisturbed communities of plants and animals. There are 269 areas with endangered species, 160 outstanding geologic areas, and 17 outstanding aquatic areas. Two hundred and fifty-one areas are nature preserves or school natural areas.

The approximate acreages of high quality, relatively undisturbed areas of land and water identified by the Inventory are as follows: 13,500 acres of forests, 2,300 acres of prairies, 1,300 acres of savannas, 6,000 acres of wetlands, 2,000 acres of lakes and ponds, and 600 acres of rocky glades and similar communities. These relatively undisturbed areas include seven-hundredths of 1% of Illinois' total land and water area.

The natural areas represent a wide diversity of natural features. Most geologic formations, major soil associations, and topographic features occur in at least one site listed by the project. Natural areas were found in all but three counties, but they are concentrated in hilly regions, along rivers, and near cities.

About one-third of the natural areas are receiving some degree of protection, but only one-fifth of the significant natural features can be considered permanently protected. Half of the areas are threatened with destruction from changes in the use of the land.

In this day of tremendous technological advancement, there can be no question of the value of basic scientific research. Natural areas are resource materials from which new knowledge can be derived. As scientists learn more about the world of nature, they are increasingly aware of the tremendous loss that will be suffered with the impending annihilation of natural communities all over the world. The loss in real wealth from the extinction of living forms is beyond comprehension. Natural areas can serve as check areas in studies relating to air, water, and soil pollution. Gaining a greater knowledge of wild communities and populations can lead to a better understanding of the growing problems of human society, urban environment, and population control, and serve valuable functions in research in many aspects of land management.

Natural areas serve as outdoor classrooms for students of all levels, from grade school through college. They provide a teaching resource to fill the need of contact with the world of nature.

Plants and animals have evolved into a bewildering diversity of forms, varying in infinite detail with their adaptation to varying climates, soils, and living conditions. Researchers find that the wild relatives of domesticated species are valuable sources of new genetic material. The plants and animals man uses are only a tiny fraction of the wild things that inhabit the earth. The potential usefulness of the others is unknown but doubtless enormous. We are constantly discovering new uses and products from wild plants and animals previously unexploited.

Many forms of life will perish from the earth if we do not spare bits of their native habitats as havens from the flood of civilization. Simply to keep on earth the awe-inspiring myriad array of living things is our obligation to future generations. We should also recognize that these creatures have a right to a place on earth.

Natural areas are sources of beauty and inspiration, both as scenery, and in the more intimate sense of the form and color of individual groups of living things.

Natural areas also serve as living museums – examples of the rich and diverse natural world from which the pioneers built this country. They are historic memorials that serve as living links with the primitive past in such a way as to enhance our understanding and perception of the world we live in.

— From the Illinois Nature Preserves Commission's
Two-year Report, 1971-72.

Introduction

Purpose of the Illinois Natural Areas Inventory

The Illinois Natural Areas Inventory was a systematic effort to find, evaluate, describe, and classify natural areas for the Illinois Department of Conservation. The purpose was to provide accurate and detailed information about the location and characteristics of natural areas of statewide significance.

This report summarizes the methods and findings of the project. Detailed information is provided in separate technical reports. The Illinois Department of Conservation and Illinois Nature Preserves Commission are using information compiled by the Inventory to develop and implement a plan that will identify the needs and means for preserving natural areas in the state.

Need for a Comprehensive Natural Areas Inventory

The Department of Conservation protects natural areas by acquiring and managing certain areas, by analyzing proposals for development projects, and by distributing money to local governments for land acquisition. The Illinois Nature Preserves Commission and the Department of Conservation are responsible for the Illinois Nature Preserves System, which provides for dedication and protection of natural areas under State law. Accurate and detailed information about natural areas is needed to fulfill these protection goals.

Private citizens, businesses, and public bodies own, manage, and use areas with outstanding natural values. The areas are assured better protection if concerned individuals and groups are aware of their location and significance. More natural areas are destroyed through ignorance than are lost because people are aware of them and abuse them.

Since limited resources are available for preserving natural areas, time and money should be spent on the most important areas, which are not always obvious. Sixty-one percent of the 610 sites with high quality natural communities that were identified by the Inventory were previously unknown to the Department of Conservation and the Nature Preserves Commission. These tracts include some large, diverse areas with many significant features. In terms of acreage, the newly discovered areas include 42% of the high quality natural communities identified by the Inventory. Although it costs money to inventory a natural area, it costs even more money to negotiate preservation or to acquire an area, and costs for managing areas continue indefinitely. Dedicating an area to preservation as its highest and best use is a big commitment to the future, and public agencies have an obligation to make correct decisions about which areas should be preserved.

An inventory brings information together into one system, so that areas can be readily compared and evaluated. Requests for information from planning agencies and for environmental impact analyses can be answered with less effort. Unnecessary conflicts with developers are avoided by planning ahead. Less time is spent responding to enquiries and emergencies, and time that is saved can be used to protect areas. A comprehensive inventory provides information needed to determine which areas are most significant and which are needed to complete a nature preserves system. A plan based on a solid background of information is more likely to be accepted by the people of Illinois and by the owners and managers of natural areas.

The Illinois Natural Areas Inventory will continue to be updated. However, as much information as possible was collected in an initial effort instead of relying on gradual accumulation of information as it becomes available. Otherwise, doubt would continue about the relative value of areas because more significant sites might have been overlooked. In the meantime, natural areas would continue to be destroyed. Threats of destruction were identified for half of the natural areas, and certainly more are threatened with disturbances unknown to the Inventory.

Concepts and Terms

Definitions and Guidelines

Natural area categories

A natural area was defined as a tract of land or water that (1) has a natural configuration or sufficient buffer land to insure its potential for protection and proper management, and (2) meets one or more of the criteria in the following seven categories:

Category I: Ecological areas. — These areas have terrestrial or wetland natural communities that are relatively undisturbed, so that they reflect as nearly as possible the natural condition at the time of settlement in the early 1800's.

Category II: Endangered species habitats. — These sites have animals or plants that are in danger of extirpation from Illinois.

Category III: Relict species habitats. — Sites with outstanding assemblages of plants that have persisted from a past climatic period were listed as relict species habitats.

Category IV: Geologic areas. — Localities that are outstanding representatives of the state's geologic diversity were listed in this category.

Category V: Natural study areas. — Lands that are managed and used as natural areas for teaching and research or as nature preserves were included as natural study areas.

Category VI: Unique natural areas. — A few significant natural areas did not fit into any of the above categories. These are sites of unique natural features, which are often small areas with unusual biological features, such as a cave with an unusual assemblage of invertebrate animals.

Category VII: Aquatic areas. — Some streams and lakes were listed as natural areas because they are relatively natural habitats for native aquatic life.

Acreage

Areas with high quality natural communities were usually required to be 20 acres or larger. This standard did not apply to natural communities that are not normally as large as 20 acres, and it did not apply if all the high quality remnants of a certain type were smaller than 20 acres. Prairie remnants as small as one-quarter acre were inventoried. Geologic areas, aquatic areas, habitats with endangered or relict species, and natural study areas could be any size that was adequate to represent the significant feature and provide potential for protection of the area.

Degree of disturbance

Outstanding representatives of natural communities were selected on the basis of relative lack of disturbance, but disturbed areas qualified in the other natural area categories. Although the term *natural area* was applied to any site listed by the Inventory, many are not undisturbed sites.

Ownership and preservation status

All of Illinois was surveyed, and areas were inventoried without regard to the kind of ownership or whether an area was preserved. Information was collected about all natural areas to provide a complete base of information.

Natural Area Boundaries and Features

Guidelines for determining boundaries of natural areas are stated briefly as follows: (1) Boundaries should be conservative, but adequate to include the significant features and to provide potential for protection of the area. (2) Natural area boundaries should follow the boundaries of natural features if possible. (3) Acquisition factors such as access and monetary value of the land should not be considered. (4) Boundaries should not be drawn arbitrarily.

A classification of land condition classes and features was developed to insure uniform procedures for mapping and describing areas:

Land condition classes
- Natural land
- Buffer land

Features
- Significant features
- Exceptional features
- Notable features
- Artificial disturbance features
- Natural disturbance features

The part of a natural area that is relatively undisturbed is termed *natural land.* Disturbed land included in a natural area to insure protection of the significant features is termed *buffer land.*

A red squirrel along the Kankakee River. This species, also known as the pine squirrel, was thought to have been eliminated from the state shortly after 1900. Investigations by the Inventory staff revealed that the red squirrel inhabits at least four northern Illinois counties.

A *significant feature* is a feature that allows a site to qualify as a natural area of statewide significance. A natural area must have at least one significant feature. The significant features are classified according to the seven natural area categories as follows:

I. High quality terrestrial or wetland natural communities
II. Habitats with endangered species
III. Habitats with relict species
IV. Outstanding geologic features
V. Lands that are managed and used for natural science studies
VI. Unique natural features
VII. Outstanding aquatic features

An *exceptional feature* is a feature that increases the preservation value of a natural area but is not important enough to be the reason for identifying a natural area. Examples of exceptional features include archeological sites, habitats with species that are rare but not endangered, and most bedrock outcrops.

A *notable feature* is any feature in a natural area that is less important than an exceptional feature or a significant feature. Notable features were recorded at the option of the fieldworker.

Artificial disturbance features are cultural features such as roads and buildings. *Natural disturbance features* are the result of processes such as windstorms and fires.

Natural Community Classification

The communities of plants and animals in Illinois were classified into 93 types of natural communities. These were distinguished on the basis of important natural features such as soil moisture, topographic position, and vegetation. The following are examples of natural communities: wet floodplain forest, limestone glade, and calcareous seep. The communities were grouped into nine classes:

Forest
Prairie
Savanna
Wetland
Lake and Pond
Stream
Primary
Cave
Cultural

The classification was used with the *Natural Divisions of Illinois*, which recognizes different regions of the state on the basis of differences in the topography, bedrock, soil, glacial history, and distribution of native plants and animals. One of the goals of the Inventory was to identify the least disturbed examples of every natural community in each of the 34 Natural Divisions and Sections in Illinois. The natural community classification was applied to every natural area, regardless of whether or not the area had been disturbed.

Natural Quality Classification

The Inventory developed a classification of *natural quality*, which is defined as a measure of evidence of disturbance to a natural community. Letter grades were used to describe the amount of successional instability or change in a community's natural diversity, species composition, and structure due to disturbance. The grades are summarized as follows:

Grade A: Relatively stable or undisturbed communities. Example: Old growth, ungrazed forest.

Grade B: Late successional or lightly disturbed communities. Example: Old growth forest that was selectively logged 5 years ago.

Grade C: Mid-successional or moderately to heavily disturbed communities. Example: Young to mature second growth forest.

Grade D: Early successional or severely disturbed communities. Example: Severely grazed, old growth forest.

Grade E: Very early successional or very severely disturbed communities. Example: Cropland.

The grading system was applied to all natural areas to describe the degree of disturbance. Factors such as acreage and the presence of endangered species were not considered when determining natural quality, but were treated as separate factors when determining the overall preservation value of a natural area.

Basic Organization

The project consisted of two parts: (1) surveys to find and to collect information about natural areas, and (2) development of an information system to store, retrieve, and analyze the data. The information system consists of maps, files, and a computer system.

Offices, Staff, and Schedule

The main office was at the University of Illinois in Urbana. The state was divided into five districts, with one or two natural area ecologists responsible for work in each district. Field assistants were employed during the summers. Staff in the main office supported and directed the fieldworkers and compiled and computerized the data.

Pilot studies began in March 1975. Ecologists were hired and began a three-month training session in July. More training sessions and pilot studies were conducted as new parts of the project were started. About half of the counties were surveyed by October 1976, and collection of the rest of the information was completed by the following October.

Surveys

As specified by the Department of Conservation, the various kinds of natural areas were surveyed in different manners. Information was gathered from field surveys for areas with relatively undisturbed terrestrial and wetland natural communities and with relict species. The inventory of endangered species relied on existing records, but species were checked in the field when necessary and practical. The inventory of geologic areas was based on information compiled by the Illinois State Geological Survey. The inventory of lakes and streams relied on recommendations from the Illinois Natural History Survey. The survey of school natural areas was conducted by a mailed questionnaire and a review of publications.

Each survey was a process of selecting potential natural areas, then determining which ones were significant. Each successive stage examined the remaining candidates in greater detail. The survey stages were as follows:

Compiling available information
- Gathering background material
- Contacting people and agencies
- Reviewing literature

Examining maps and aerial photos
Aerial survey
Initial ground survey
Final field survey

The inventories of geologic areas, aquatic areas, and school natural areas relied on compiling available information, so the last four survey stages usually were not conducted for these areas.

Basic Principles

To the greatest extent possible within the limitations of time and money and within the guidelines set by the Department of Conservation, the Inventory conducted a thorough survey of Illinois' natural areas. Emphasis was placed on making sure that areas were not overlooked as well as describing and evaluating the significant sites.

This project differed from many natural area surveys because the staff devoted much effort to searches for relatively undisturbed natural communities. Many techniques were developed for finding and evaluating high quality natural communities, and most areas were found by examining maps and aerial photos and by field surveys. However, a wealth of information was compiled from the work of others, including over 1,400 published references to biologically significant areas. Although the degree of disturbance was the criterion for identifying one category of natural area, 60% of the natural areas have significant features other than lack of disturbance.

The Inventory emphasized systematic searches and fieldwork to find new natural areas and to evaluate previously known sites. If it had only compiled information that was already available about natural areas, 57% of the areas with outstanding natural communities probably would have been overlooked. For the other 43% of the areas, about one-third would not have been documented well enough to determine whether they qualified as natural areas. If the project had relied solely on secondary sources, the information that could have been uniformly collected for all areas would have been very limited, and areas would have been mistakenly included that should not qualify as significant natural areas by the Inventory's definition. The project had a trained and coordinated staff to collect and evaluate information, rather than relying solely on sources such as publications that might be out-of-date.

Instead of choosing natural areas and then deciding why they were important, the Inventory developed a list of significant features and then found occurrences of these features. A further step was taken by drawing natural area boundaries around the significant features to include the natural diversity of the site and to provide potential for protection of the features. If one significant feature occurred with another, then both were included in the same natural area, but each significant feature kept its separate identity and remained an independent reason for recognizing the site.

A bald cypress along the Cache River. A few dozen of these ancient trees survive in the swamps of extreme southern Illinois.

Methods

Compiling Available Information

Information was gathered from sources such as publications to (1) identify natural areas, (2) compile resources that would aid the search for areas, and (3) collect information to help describe and evaluate areas.

Gathering background information

This involved gathering soil reports, maps, unpublished reports, and similar materials. Much of the information was from the Illinois Nature Preserves Commission, Department of Conservation, Natural History Survey, universities, and museums.

Contacting knowledgeable people and agencies

Professionals such as the District Forester and the District Soil Conservationist in each county were asked for information about natural areas. Enquiries often led to other citizens who knew about the natural areas in a county. Other people with known interests in natural areas were contacted, especially faculty members at colleges and universities.

General publicity

Information about natural areas was solicited through five taped interviews distributed to about 80 radio stations, two live radio programs, a television presentation, four statewide news releases, and several articles in newsletters and local newspapers. The staff presented 27 talks throughout the state, attended by an estimated total of 2,000 people.

Examining Maps and Aerial Photographs

Purpose

Maps and aerial photos of each county were systematically examined to (1) select potential natural areas, (2) determine what land had no significant potential for natural areas, and (3) map, describe, classify, and evaluate the identified natural areas.

Map resources

Topographic maps were the most valuable map resource for finding and investigating natural areas. The staff also made extensive use of soil maps, geologic maps, county highway maps, and a presettlement vegetation atlas of Illinois.

Aerial photographs

The Inventory relied on black and white aerial photos from the Agricultural Stabilization and Conservation Service (ASCS). Examining the photos was effective because vegetation and cultural features are usually easy to recognize, and resolution is adequate. For example, the faint pattern of lines in a field plowed several years ago is often visible, and the crown of a solitary tree is easily distinguishable.

Many other kinds of photos are available for parts of Illinois, including low-altitude infrared color photos, as well as photos from high-altitude military aircraft and spacecraft. However, only ASCS aerial photos were used by the Inventory, mainly because the resolution of other photos was not fine enough or they were not widely available.

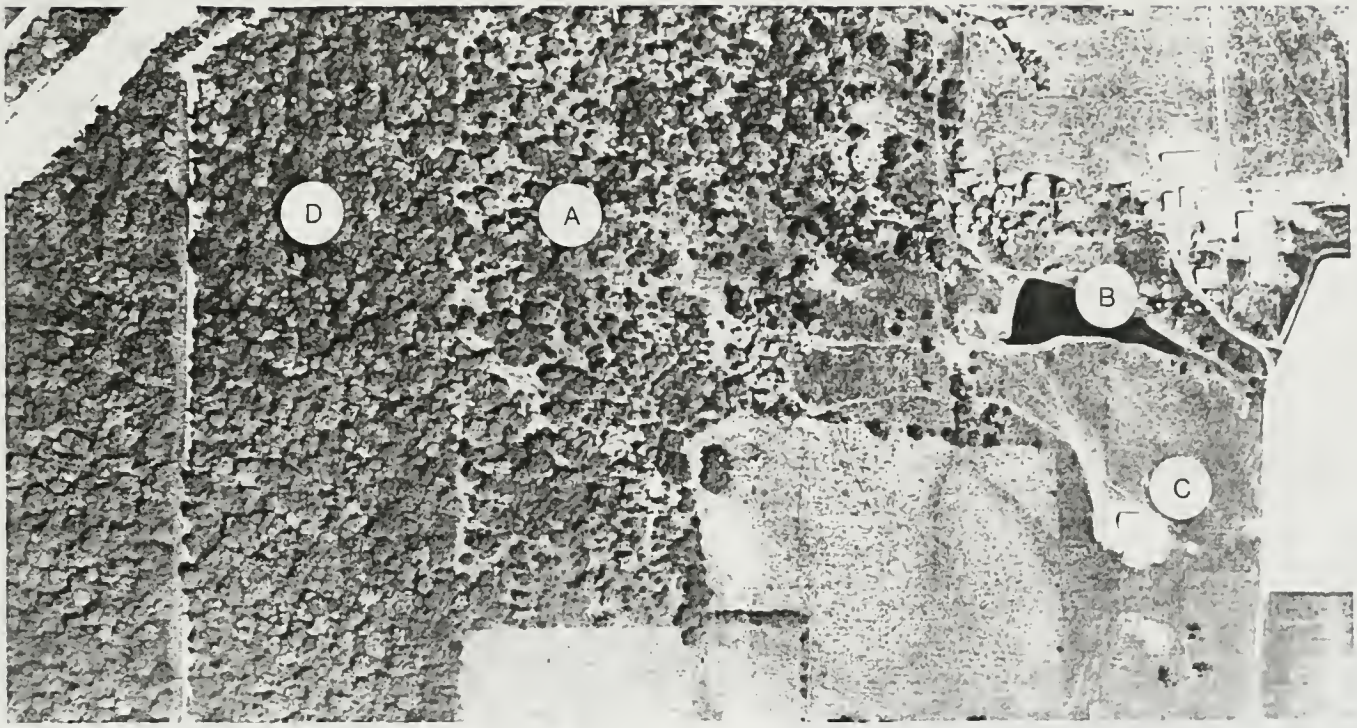
Satellite images

The usefulness of Landsat satellite images for inventorying natural areas is limited by their comparatively poor resolution. Under ideal conditions, the ground resolution of the processed images is usually about 600 to 800 feet. By comparison, the Inventory workers needed to see thin livestock trails and the gaps in the forest canopy caused by removal of single trees. Landsat images are useful for regional surveys, broad classifications, and small-scale maps, but they cannot replace topographic maps and large-scale aerial photos for finding and describing natural areas.

Examination procedure

The procedures for detecting natural areas and disturbances from maps and aerial photos are discussed in the Inventory's technical report. Areas that appeared to have potential as significant natural areas were outlined and numbered on topographic maps. Brief notes about the potential natural areas as well as the disturbed areas were recorded on maps and forms. The potential areas were also examined on older photos (as early as 1938) to detect past disturbances.

The map and aerial photo examination required 3 to 5 days for a typical county, and usually 20 to 40



An example of an aerial photo used to select potential natural areas. The tract labeled *A* shows evidence of grazing damage: the trees are widely scattered, and whitish livestock trails extend into the trees from a stock pond (*B*) and a barn (*C*). The timber stand labeled *D* has a dense, even canopy of large-crowned trees, indicating an old, undisturbed forest.

potential natural areas were found. In some counties the procedure required less than a day, and no areas were found. A few counties with many wetlands required 2 or 3 weeks of study and resulted in over 100 sites to be checked.

Aerial Survey

Purpose

The aerial survey was a means of (1) screening potential areas, (2) finding new areas, and (3) determining boundaries and characteristics of natural areas.

The aerial survey was an extension of the map and aerial photo examination stage. It provided a closer and more recent view than possible with maps and photos, and it allowed fieldworkers to reject many nonqualifying areas quickly, without completing the time-consuming initial ground survey. New areas were found and areas were studied in a detailed manner not possible with maps and photos. The aerial survey allowed a quick comparison and overview of many areas in a short time.

General techniques

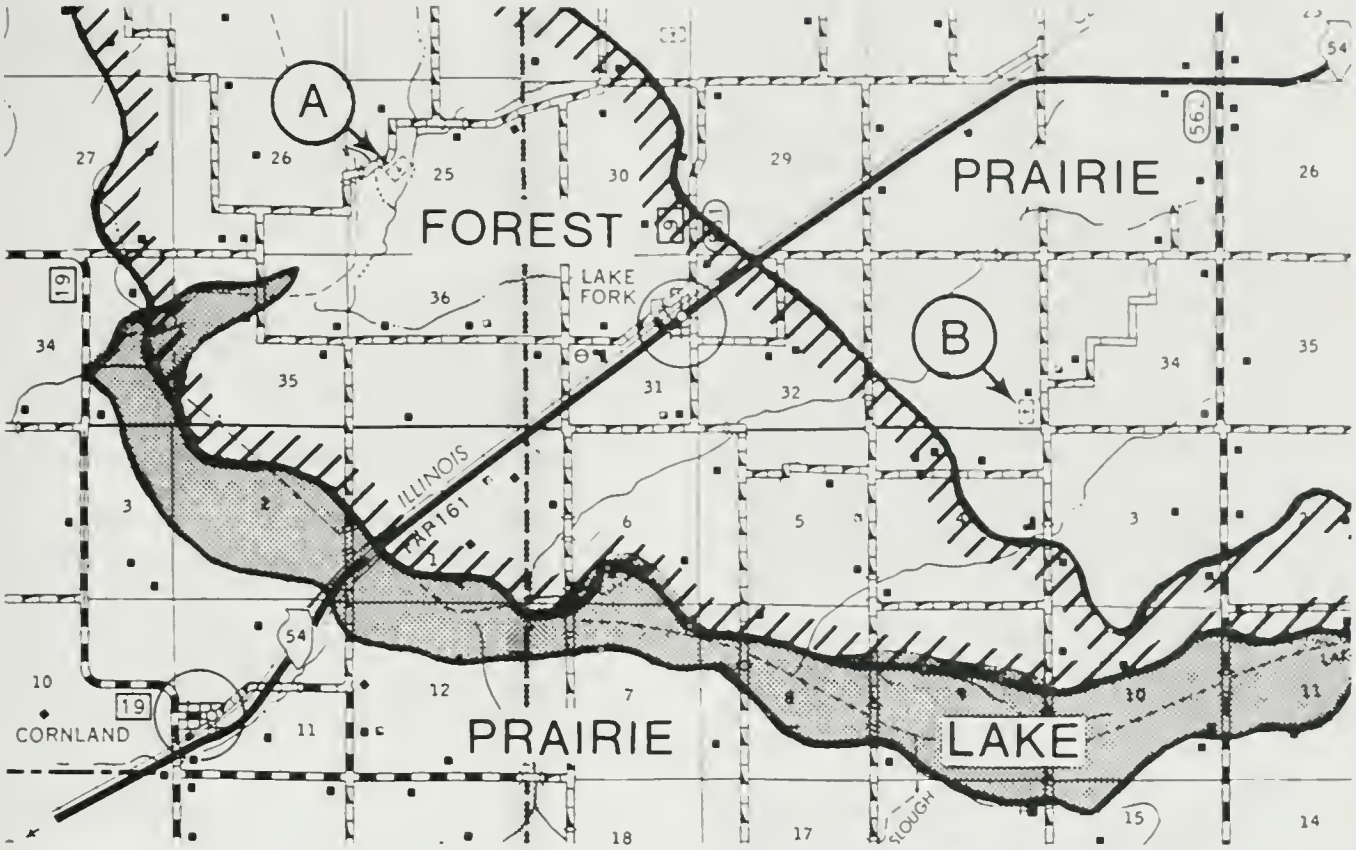
Cessna 172 aircraft were used, which are single-engine, high-wing airplanes. Areas were generally viewed by flying as slowly as practical and safe (80 to 90 miles per hour), at 500 to 800 feet above the ground. Before each flight, maps and forms were assembled and a flight plan was drawn. The tracts usually were observed while circling each site from one to four times.

Examples of techniques

Aerial survey techniques are detailed in the Inventory's technical report, but the following are examples of how an airplane was used.

An airplane can be useful for determining the boundaries of a natural area, which may differ from preliminary boundaries from aerial photos. The photos may not show some disturbances clearly, or the disturbances may have happened since the area was photographed. For instance, by circling 2,000 feet above a 1,000-acre swamp, fieldworkers were able to accurately and precisely map the extent of recent clearing and logging. In 14 minutes a task was accomplished that could not have been done as well on the ground, even with 2 days work by a two-person team.

Although most forested natural areas were found by examining aerial photos, sometimes the aerial survey was helpful for determining the exact boundaries of the highest quality stands of timber in large tracts of mature forest. The exact boundary of the oldest stands of trees cannot always be de-



A section of the *Presettlement Vegetation Atlas of Illinois*. The vegetation maps were used to select cemeteries to survey for prairie remnants. For example, the cemetery at *A* is more than a mile inside the forest, and has no potential for prairie vegetation. The cemetery labeled *B* is on prairie soil, one-half mile beyond the limits of the forest. The rear of this cemetery has a remnant of native prairie vegetation.

limited with precision from aerial photos if the forest in general is mature and has a natural structure, as is the case with the many square miles of forest along the lower Kaskaskia River. The most promising tracts along the Kaskaskia were outlined from aerial photos, but the extent of some of the tracts was uncertain because the largest-crowned trees seemed to intergrade with younger stands. Tracts of old growth bottomland timber in the region characteristically have large bur oaks. The task was to select stands with large bur oaks, which are easy to sight from an airplane in the winter because they have thick, grayish limbs and twigs.

Hill prairies occur along major river valleys on dry, exposed slopes, and they are highly visible from an airplane. Although hill prairies can be found by studying maps and aerial photos, it was not necessary to find every potential prairie before the aerial survey. Instead, the ecologists decided which sections of river valleys had potential for prairies, and flew along the bluffs marking the location of every hill prairie. It was possible to determine which prairies had signs of grazing damage, and often half were rejected during an aerial survey.

Natural seep communities occur along major rivers, so the aerial survey of these communities shared some techniques with the search for hill prairies. In the winter, seeps appear as prominent blackish patches, especially if the surrounding land is snow covered. The seeps sometimes are dark green because of horsetail colonies or emerald green because of water cress. Fieldworkers were able to find seeps along the 200-mile length of the middle Illinois River and lower Sangamon River in less than 5 hours.

Effectiveness

An average of 10 to 12 sites could be viewed in an hour from an airplane, which is the number that could be visited in 2 to 4 long working days on the ground. The potential areas in most counties could be surveyed from the air in 1 to 3 hours, but some counties required as many as 8 hours. Between 50% and 90% of the areas in an average county were eliminated during the aerial survey.

Initial Ground Survey

Purpose

The purpose of the initial ground survey was to prepare for the final field survey by evaluating the sites selected during prior inventory stages. The initial ground survey also served to check the accuracy of the map and aerial photo examination and the aerial survey, and it was used to develop techniques for the final field survey.

Procedure

The initial ground surveys were completed during the fall, winter, and spring so that the summer could be reserved for final field surveys. Initial surveys were not made of endangered and relict species sites, because these were usually small areas that required searching habitats during spring and summer months.

If an area was determined to not be significant, it was investigated only enough to record the reasons why it did not qualify. Significant areas were surveyed in more detail, to define the boundaries and locate features so that the final field survey could be planned. About two-thirds of the potential areas were rejected during the initial ground survey in a typical county.

Final Field Survey

Purpose

Final evaluation, description, and classification of each natural area were completed during the final field survey. The information was recorded as described in the following paragraphs.

Main Data Form

This form included standard entries about the area's significance, location, natural characteristics, and use. The most important of these items are listed in the next section.

Maps and aerial photographs

The boundaries of the natural area were drawn on a copy of a topographic map. Natural communities, natural quality, land condition classes, and other features were mapped with overlays on aerial photos. For some kinds of natural areas, sketch maps were used instead of aerial photos.

Vegetation sampling

The vegetation of relatively undisturbed natural communities was measured with ecological sampling techniques to help determine the dominant species and to help assess the natural quality of the communities.

Species lists

Checklists were completed for amphibians, reptiles, birds, mammals, ferns, trees, and shrubs. In addition to ecological sampling of herbaceous communities, the plants in prairies, glades, and wetlands were listed. Communities such as cliffs that could not be sampled with standard techniques were described with detailed plant lists.

Information Collected about the Natural Areas

As many as 90 items of information were collected for the areas. Not every kind of information was appropriate to every area, and less detailed information was collected for areas that were not visited. The most important items are as follows:

Basic information
- Name of area
- Significant feature. — The reason why a natural area was identified
- Exceptional feature. — A feature that adds to the preservation value of a natural area
- Topographic map with boundaries of natural area
- Aerial photo with overlays showing the location and boundaries of features within the natural area

Location
- County
- Township and Range
- Section and subdivisions of the section, to the nearest quarter-quarter section
- Topographic map

Natural characteristics
- Altitude. — Minimum and maximum
- Topography. — Physiographic unit, major topographic feature, and individual topographic feature
- Geologic formation
- Soil association
- Natural community classification
- Natural quality. — Acreage of each natural community in each natural quality grade; description of natural quality
- Acreage of natural area
- Plant community. — For each natural community

Legal status and use
- Ownership
- Use of natural area and surrounding land
- Mangement needs
- Actual or potential management facility
- Preservation status
- Threat of destruction

Discussion of preservation values

Supplemental materials
- Species lists
- Vegetation sampling data
- Literature citations

Surveys

Category I Survey
High Quality Natural Communities

Summary

This search for the least-disturbed examples of each natural community was the largest effort of the project, with 610 sites identified. The Category I survey is not detailed at this point because the standard techniques of compiling available information, examining maps and aerial photos, aerial surveys, and ground surveys have already been explained. Surveying railroads and cemeteries to find prairie and savanna remnants involved special procedures, so these surveys are discussed in some detail in the following paragraphs.

Railroad prairies

Prairie remnants may be found on railroad rights-of-way because many railroads were built before the prairies were cultivated. Prairies have persisted in occasional remnants where they have escaped heavy disturbance during construction and maintenance of the tracks.

About 7,000 of the 11,000 miles of railroad in Illinois were selected to be surveyed. The remainder were not checked because maps and photos showed no significant potential for prairies. The railroads were surveyed from an airplane in the fall, when prairie grasses are brightly colored and highly visible. About 670 potential prairies were selected, and these were checked on the ground in the late fall. The least disturbed sites were revisited in the summer for final evaluations and descriptions.

Sixty prairie remnants were found, with a total of 123 acres of high to very high quality prairie. The railroad prairies are in 29 counties, and they are the only natural black-soil prairie remnants in 12 counties.

Cemetery prairies and savannas

Settlers of the Illinois prairie established cemeteries on land that had never been plowed or intensively grazed. Some of these early graveyards support prairie vegetation in parts that have not been mowed frequently. Other cemeteries have savanna vegetation because they have been mowed or burned often enough to suppress young trees and shrubs but have not been so closely manicured that the native herbs have been replaced by other species.

A survey of cemeteries was conducted from August to October 1976. Before the fieldwork, the *Presettlement Vegetation Atlas of Illinois*, topographic maps, soil maps, and county highway maps were studied to find cemeteries with potential for prairie or savanna remnants. Volunteers did most of the initial screening by visiting each cemetery and making a list of the prairie plants. Dr. Robert F. Betz contributed his knowledge gained from previously surveying over 800 cemeteries in northern Illinois. The staff visited the most promising cemeteries to make the final descriptions and evaluations.

Information was compiled for 3,923 cemeteries. Twenty-four sites were listed as natural areas, and 111 others have potential for recovery under proper management. The natural areas include 41.4 acres of high or very high quality communities. The cemeteries contain the only black-soil prairie remnants in seven counties and the only natural savanna remnants on well drained silt loam soils in Illinois.

Category II Survey
Habitats with Endangered Species

People and organizations involved with endangered species in Illinois

Among the State agencies concerned with endangered plants and animals are the Department of Conservation, Endangered Species Protection Board, Nature Preserves Commission, Natural History Survey, State Museum, and Department of Transportation. Many other people have conducted research and contributed knowledge about endangered species as individuals or as members of various organizations and academic institutions.

In 1977 the Natural Land Institute received a grant to conduct a year-long Endangered Species Project. The Inventory and the Endangered Species Project shared the tasks of compiling information from museum and herbarium searches, reviewing research files and literature, field surveying, and interviewing biologists. The Inventory identified and described specific sites, and the Endangered Species Project determined the population status and management needs of species.

The Middle Fork of the Vermilion River. This stream was listed as an outstanding aquatic area. It is the only known habitat for the bluebreast darter in Illinois. Four other natural areas were identified along this central Illinois stream.

Determining the status of species

A series of workshops was conducted in which specialists were invited to discuss fishes, amphibians, reptiles, birds, mammals, and vascular plants. When the Inventory began its survey for endangered species, a final list based on sound and comprehensive information was not available. The Inventory did not attempt to make a final determination of each species' status, but used the concept of *significant features* and *exceptional features* instead of the terms *endangered* and *threatened*. Significant feature status was limited to species so rare in Illinois that they merit special preservation efforts. If a species was given significant feature status, then every known occurrence of the species in Illinois was identified as a natural area.

A plant species was considered a significant feature if currently known from three or fewer sites in Illinois. A plant would qualify as a significant feature if known from five or fewer places on a vulnerable site such as a wetland. Exceptional feature status was given to any plant species that was too common to qualify as a significant feature, but was rare enough to add exceptional value to an area. Animals were treated in a manner similar to plants, but most animals are mobile or secretive, so their numbers and distribution were not determined as readily.

Inventory procedures for animals

Other people and agencies were the main sources of information about habitats with endangered vertebrates. The Illinois Natural History Survey contributed the records for fishes. The Survey also

compiled most of the information about amphibians and reptiles from past collections and contributions of new knowledge from herpetologists. Information about birds came from the Natural History Survey, Department of Conservation, professional ornithologists, amateur birders, and the literature. For mammals, information from published sources and museum collections was used, but most knowledge about current populations came from fur trappers, wildlife biologists, and mammalogists at universities.

Although special surveys to find new populations of endangered vertebrates were not a part of the Inventory project, the staff did some fieldwork to verify reports of endangered animals and searched for these species during the regular field surveys. Volunteers checked specific sites and searched for certain species.

Inventory procedures for plants

The main sources of plant locations were herbaria, literature, personal knowledge of botanists, and files of various agencies. Fieldworkers checked sites with recent and precise enough locality data that there was some promise that the plant could be relocated. Between five and 20 sites were visited in a typical day. Sites were not visited if enough current information about the species' population, location, and habitat was available.

Results

The numbers of significant feature (SF) and exceptional feature (EF) occurrences in natural areas are as follows:

	SF's	EF's
Fishes	7	44
Amphibians and reptiles	18	67
Birds	23	145
Mammals	11	25
Vascular plants	462	629

Endangered animals and plants occur in a wide variety of habitats throughout the state, but the greatest numbers are in wetlands in extreme northeastern and southern Illinois. Fifty-six percent of the endangered plant habitats and 13% of the endangered animal sites are high or very high quality natural communities.

Three aquatic plants were discovered for the first time in Illinois. Other plants that had not been seen in Illinois in many decades were relocated, and some species thought to be endangered were found in so many localities that they were deleted from the tentative endangered species list.

Prior to the inventory, the red squirrel was thought to have been extirpated from Illinois by the early 1900's. The red squirrel is a small animal of northern forests, unlike its larger, reddish relative, the fox squirrel, which is common throughout the state. Although the red squirrel had not been listed as part of the current Illinois fauna, the staff found red squirrels in four northern Illinois counties in 1977.

Category III Survey
Habitats with Relict Species

Definition and guidelines

A relict species is one that occurs in a small, disjunct population that is a survivor of a formerly more widespread population. The range of the relict species has disintegrated or retreated because of climatic changes, and the species remains in a local, specialized habitat that provides a suitable microclimate and allows it to survive competition from other species. The guidelines for recognizing relict habitats required that assemblages of more than one species be disjunct from their normal ranges by at least 100 miles. Although animals, especially invertebrates, are sometimes part of relict associations, analysis was limited to plants.

Procedure

The relict species survey used the same techniques as the survey of ecological areas. It was a search for habitats rather than individual species, so sites with unusual soil and topography were surveyed.

Results

Thirty-nine sites were listed with a total of 45 relict habitats. Twenty-five sites are cliff habitats, six are on bluffs or in associated ravines, five are seeps, and three are in sand prairie or barren communities.

Category IV Survey
Geologic Areas

Definition and procedure

Category IV significant features are outstanding representatives of the state's geologic diversity. Geologic features differ from biological features in that they are often large, numerous, and not vulnerable to destruction. Human disturbances such as roadcuts and mines are often important advantages to geologists because the disturbances provide fresh rock exposures for study.

Unlike ecological areas, where the goal was to list every significant feature, only representative sites were chosen for geologic areas. Areas were selected to form a system that represents the geologic diversity of the state. The inventory of geologic areas was compiled by Dr. H. B. Willman of the Illinois State Geological Survey. Because there were often several

outstanding examples of the same feature, preference was given to natural exposures, sites with a variety of features, sites where preservation might be practical, and sites with published scientific studies.

Results

One hundred and sixty geologic areas were identified. The sites have outstanding examples of stratigraphy and sedimentation, igneous rocks, geologic structures, topographic features, and fossil localities.

Category V Survey
Natural Study Areas

Definition

Natural study areas are sites managed and used as nature preserves or as natural areas for teaching and research. A site qualified if managed and used for natural science studies, even though it might have been disturbed and lacked any other significant feature.

Procedure

A total of 4,860 schools were surveyed with a mailed questionnaire. The schools included all private secondary schools, public elementary and secondary schools, colleges, and universities. Enquiries were often followed by further mail, telephone, and personal contacts. Forest preserve districts, conservation districts, park districts, and private preservation groups were also canvassed. Information was solicited through several news releases and articles in newsletters. Most nature preserves were found through lists in publications.

Results

Two hundred and sixty-six Category V significant features in 251 areas were found, including 66 Illinois Nature Preserves, 16 Federal Research Natural Areas, and nine Registered Natural Landmarks.

Category VI Survey
Unique Natural Areas

Summary

Some natural areas have features worthy of preservation efforts that do not fit well under the other natural area categories defined by the Department of Conservation. For example, several caves were recognized because of their outstanding assemblages of invertebrate animals. Thirty Category VI significant features were found in 29 areas. All but five occurred with other kinds of significant features.

Category VII Survey
Aquatic Areas

Summary

Aquatic areas include streams and lakes, which were not evaluated as part of the Category I survey. Vegetated ponds and natural wetlands were evaluated by the Inventory staff and were listed as ecological areas, but streams and lakes were inventoried as aquatic areas. Dr. Philip W. Smith and Dr. Lawrence M. Page of the Illinois Natural History Survey provided recommendations for outstanding aquatic areas. The 17 aquatic natural areas include five lakes and segments of 12 streams.

Literature Survey

Purpose

A literature review was conducted to (1) find articles useful for developing survey procedures and classification systems, (2) learn about natural areas that were not previously known, and (3) compile a bibliography pertaining to natural areas.

Procedure

The most efficient way to find articles was to scan the table of contents of pertinent journals. Publications were also found by using a computer search service, by acquiring lists of graduate theses, and by reviewing published bibliographies.

Results

The bibliography of Illinois natural areas covers 1,484 titles. This includes 1,413 references to biology and ecology and 71 references to geology. About half of the natural areas have published references, and 10 areas have more than 40 references each. Few geologic references were listed because the information is readily available in an index and bibliography of Illinois geology published by the Illinois State Geological Survey. In addition to citations about specific natural areas, approximately 3,500 other references about field biology, ecology, and inventory techniques were compiled.

The literature review revealed 16 articles about natural areas published in the 1800's and articles published in every year since 1901. The number of pertinent publications has roughly doubled every 20 years, coinciding with the development of the science of ecology. Over 200 articles that refer to Illinois Nature Preserves have been published since the first Nature Preserve was dedicated in 1964.

Summary of Natural Area Characteristics

Number and Distribution of Natural Areas

Number and distribution by county

A total of 1,089 sites were identified by the Inventory. Figure 1 shows the number of significant features that occur in natural areas in each county. Sites were recognized in all but three of the 102 counties. Areas with high quality communities were found in all but eight counties. Sixty-one counties have endangered species sites, 15 counties have relict species sites, and 56 counties have geologic areas. There are nature preserve and school natural areas in 76 counties, unique natural areas in 20 counties, and outstanding aquatic areas in 17 counties. The average county has 10 or 11 natural areas. Eight counties have over 30 areas.

In general, the natural areas are clustered, and large parts of the state are nearly devoid of natural land. The sites often occur in lines, such as prairie remnants along the same railroad or a series of hill prairies along a river valley. Natural areas of all kinds are clustered around cities, where public parks and preserves have protected and restored the natural landscape. On the broadest scale, natural areas are absent from the flat prairie farmland. Over half of the natural areas occur within 15 miles of the boundaries of the state, mainly because many sites are on the rugged bluffs and undrained bottomlands along the rivers that form the western and southern boundaries of Illinois.

Distribution in relation to human population

Natural areas are concentrated in counties with population extremes. The four most populous counties in Illinois (Cook, DuPage, Lake, and Will) rank first, twenty-seventh, second, and fourth, respectively, in the number of areas. The least populated county (Pope) ranks third. Nearly one-third of the sites are in or near major population centers. One hundred and seventy-one natural areas are in cities, towns, or villages.

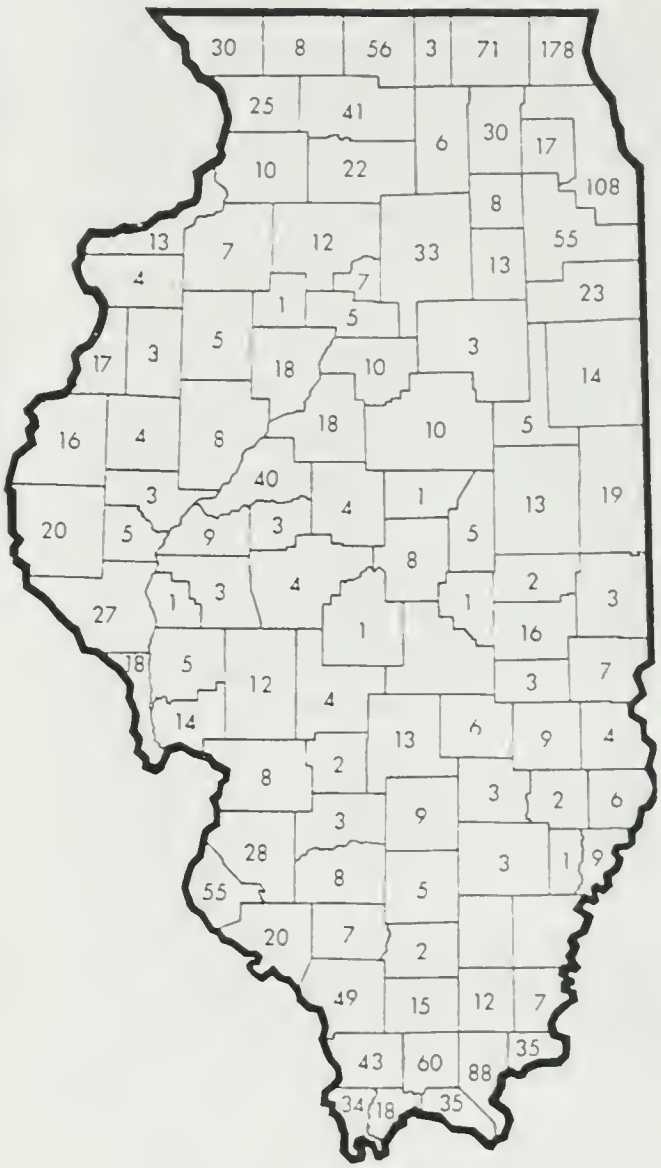


Figure 1. Number of significant features that occur in natural areas in each county.

Fraction of county, expressed in millionths

- less than 1.0
- 1.0 to 9
- 10 to 99
- 100 to 999
- 1,000 to 9,999
- 10,000 to 15,000

Figure 2. Relative acreage of land and water in each county that is undisturbed or nearly undisturbed.

Natural Characteristics

Acreage

Natural areas average 184 acres and range from less than 0.1 acre to 13,100 acres. The smallest are sites with endangered or relict species, and the largest encompass cave systems and habitats of river otters and prairie chickens. Natural areas are distributed about equally among four size classes: 0.1 to 5.0 acres, 5.1 to 25 acres, 26 to 80 acres, and 81 to 13,100 acres.

Topography, geology, and soils

Natural areas were recognized in all 16 physiographic divisions of Illinois. Almost all of the specific types of topographic features in the state occur in natural areas. Eighty-nine percent of the 143 geologic formations in Illinois occur in sites listed by the Inventory. Natural areas were found with 25 of the 26 major soil associations in Illinois. Prairie soils have the fewest natural areas.

Natural communities

The Inventory developed a classification of 85 types of natural communities in Illinois, excluding cultural communities. Each type is a distinct natural community where it occurs in a different Section of the Natural Divisions of Illinois. There were at least 900 natural communities in presettlement Illinois. There may have been over 1200 communities, but our knowledge is too scant to make a firm estimate of the original number of communities. The Inventory was able to find high quality examples of about 380 natural communities, and the natural areas included disturbed examples of about 160 other kinds of communities.

Vegetation

The plants most often dominant in natural areas are white oak, little bluestem grass, red oak, black oak, sugar maple, Indian grass, big bluestem grass, post oak, and silver maple.

Natural quality

Natural quality is a measure of the degree of disturbance. Grade A communities show very little or no effects of disturbance, and Grade B communities show slight disturbance. The acreage of Grade A and B land and water listed by the Inventory is as follows:

Forests	13,484 acres
Prairies	2,352
Savannas	1,296
Wetlands	6,029
Lakes and ponds	1,960
Glades and similar communities	602
TOTAL	25,723 acres

The total is seven-hundredths of 1% of Illinois' area. About 118 acres of natural prairie remain for each million acres of the estimated presettlement extent of the prairie in Illinois. The presettlement acreage of forest in Illinois is uncertain, but probably less than 1 acre of forest out of every 280 that remains is of high to very high natural quality. Figure 2 shows the fraction of each county that remains relatively undisturbed.

Ownership, Use, Management, and Protection

Ownership and use

Considering all 1,089 natural areas, 69% are wholly or partly in private ownership and 38% are wholly or partly in public ownership. Over half (63%) of the areas are in only one ownership, but 10% have five or more ownerships. The most common uses in natural areas are low-intensity recreation (34%) and visits for research and education (23%). Nearly one-third of the areas have no apparent use.

Management

Management problems were identified in 76% of the areas. The two largest kinds of management needs, each accounting for about 27% of the problems, are (1) management of vegetation and exotic species, and (2) control of overuse and abuse by people. Because of the time and expenses involved, most active management work on natural areas is done by public agencies or private organizations that own or lease the tracts. Two hundred and eighteen natural areas are known to be protected and managed (at least in part) by public agencies. There are 276 areas for which park districts, conservation districts, and similar organizations are potential managers: the tracts are within the jurisdiction of these agencies but are not owned or managed by them. The Illinois Department of Conservation is the largest owner of natural areas, with 100 areas. Colleges and universities own or manage 41 natural areas. Sites can be protected through zoning and land use planning. About half the counties in Illinois have zoning laws, as do about one-third of the municipalities. Eighty-nine percent of the natural areas are in county or multi-county planning regions.

Preservation status and threats

Most sites (52%) include private land, not protected by the owner or lessee. The next largest category (with 15% of the areas) includes public land, not protected by the owner or lessee. Threats were identified in about half of the natural areas. Geologic areas are least likely to be threatened. The fieldworkers thought that no threat was likely for 40% of the ecological areas. Public lands are about half as likely to be threatened as private lands.

Effectiveness of the Survey Methods

Comparison of the Survey Stages

Compiling available information

This stage had one of the highest rates of return (38%) in terms of the number of natural areas identified for the number of areas considered. A high percentage of the areas identified from existing information consisted of Illinois Nature Preserves and other well-known natural areas. Available information was often too incomplete to determine whether a site qualified as a natural area as defined by this project.

Examining maps and aerial photographs

Study of maps and aerial photos revealed most of the ecological areas but relatively few endangered species sites. Examining maps and photos assured that the search for high quality natural communities was thorough, and it provided a large number of potential areas at a low cost. About 73% of the potential ecological areas were identified in this manner.

Aerial survey

Most of the areas were screened with an aerial survey. The aerial survey cost less than one-twentieth of the survey budget, and screening sites without an airplane would have taken 7 to 10 times as much time and money. Significant natural areas would have been overlooked without the aerial survey.

Ground surveys

Less than 1% of the natural areas were found by ground surveys unsupported by preparatory work such as examining aerial photos. It was necessary to visit about one-third of all of the potential areas on the ground.

Adequacy of Available Information

Information available from other sources is often too incomplete for a comprehensive inventory. If the Inventory had relied solely on available information, it would have found 29% of the ecological areas and 83% of the occurrences of endangered or relict species. Of the sites that could have been found through available information, 32% of the ecological areas and 14% of the endangered or relict species habitats would have required fieldwork to determine whether the reported sites were actually significant.

Information from publications and from the files of researchers and agencies cannot be expected to be suitable for incorporation into a natural areas inventory without critical examination. About half of a sample of 500 possible natural areas from the files of naturalists and nature preserve organizations did not qualify as significant sites by the Inventory's definition. Three studies of natural areas in Illinois were examined to analyze the effectiveness of relying on published information. These reports relied on information from others and limited fieldwork, and they listed a total of 71 sites, 48 of which did not qualify for inclusion by the Inventory's definition of a natural area. A total of 152 additional sites were listed by the Inventory from the regions covered by these reports. Published information about natural areas may be misleading because the information is out-of-date or inaccurate, or because criteria differ. Without further investigation it would not always have been possible to determine which sites in publications or unpublished files would have qualified.

Aside from overlooking areas and mistakenly including areas that are not significant, an inventory that omits field surveys is limited by the uneven amount of information available for different areas. A bare minimum of information can be considered uniformly complete for all areas as a basis for making comparisons.

Completeness of the Inventory

Ecological areas

All of Illinois was studied with maps and aerial photos. Every site found with significant potential for undisturbed natural communities was examined in the field. For example, all river valleys were checked for hill prairies and seeps. All railroads and all cemeteries that could be found in prairie regions were checked for prairie remnants. Every tract of timber of 20 acres or larger that had a natural-appearing structure on aerial photos was checked in the field. All wetlands were studied on maps and photos, from an airplane, or on the ground.

The relatively large number of potential natural areas (88%) that were eliminated during the screening process indicates that preliminary standards were low enough that few significant sites were over-

A canyon in Starved Rock State Park. This area on the Illinois River qualified as a natural area under five categories. It has high quality natural communities, habitats with endangered and threatened species, and assemblages of relict species. The park contains outstanding bedrock outcrops, and portions are dedicated as an Illinois Nature Preserve.

looked. If the previous knowledge accumulated over the years had been ignored by the Inventory, less than 6% of the sites (excepting caves) would have been overlooked. Most likely the remaining undiscovered areas are small, and probably most will remain unknown. In terms of acreage of high quality natural communities, the inventory probably is close to complete.

Endangered species sites

Even with 1,431 occurrences of the species considered by the Inventory in the endangered species survey, there were no natural areas identified for 18% of the animals listed by the Endangered Species Protection Board and 26% of the plants listed by the Endangered Species Project. The Inventory was required only to compile available information about endangered species, but field surveys were conducted when possible. In some cases, the Inventory could do little more than help identify gaps in knowledge about the state's flora and fauna.

Relict species sites

The inventory of relict species habitats probably was thorough. The significant ones were almost always obvious, but many other sites with less potential were surveyed. This assured that the initial selection standards were liberal enough to avoid overlooking sites.

Other natural area categories

These inventories relied mainly on information from available sources. More sites could be added if future investigations are made. For example, depending on the emphasis given to the different kinds of geologic features (rock outcrops, landforms, etc.), other sites could have been listed as geologic areas.

Destruction and Preservation of Natural Areas

Past Destruction of Natural Land and Water

Two hundred years ago, there was only one natural area in Illinois. Now we call over one thousand sites "natural areas."

Plant communities

The sites now called natural areas are among the few places on the landscape where vegetation has not been completely removed at one time or another. Most natural areas have been disturbed to some extent, but the diversity of natural species has not been lost and the areas have been able to recover.

Fauna

The loss of Illinois' native fauna is in some ways greater than of the flora. Many natural areas have a rich diversity of plants, but they are too small to support natural animal populations. The Illinois Natural History Survey is cooperating with the Endangered Species Project in preparing a publication which will describe the current status of endangered vertebrates. Relatively little knowledge has been accumulated about most invertebrates in Illinois, but studies indicate that the insects that pollinate some native prairie plants may be almost gone from Illinois.

Aquatic ecosystems

Abuse and deterioration of Illinois' ecosystems has not stopped at the riverbanks and lakeshores, but most people are unaware of the drastic changes that have taken place beneath the water's surface. Scientists have documented the damaging uses that our waters have received, particularly the Illinois River. In 1900, the Chicago Sanitary and Ship Canal began pouring sewage into the Illinois River. R. E. Richardson documented the virtual extermination of the natural fauna that lived on the bottom of the Illinois River. The changes were drastic, immediate, and permanent. Rafts of dead snails floated down the river and piled up 1 to 2 feet deep at Peoria. Thirty-one sludge worms were counted per square meter on the bottom of Upper Peoria Lake in 1915, and 20,400 per square meter in 1922. Pollution has declined, but one researcher reported that sludge worms still provided 30% of the diet for carp in the upper Illinois River during the 1960's. Introduction of carp has severely damaged the water quality, native fish fauna, aquatic vegetation, and waterfowl populations that depend on Illinois' waters. Dredging, damming, and barge traffic have brought further changes. The backwater lakes in the Illinois River bottomland were once sand-bottomed and clear. Researchers from the Illinois Natural History Survey have estimated that half of the original 400,000 acres of backwaters along the Illinois River have been drained. Most of the remaining ones are rapidly filling by mud topped with a layer of flocculent ooze.

Illinois' smaller streams have also been damaged. Dr. Philip W. Smith of the Natural History Survey listed the causes of extirpation and decimation of native Illinois fishes, in order of importance: (1) siltation, (2) drainage of wetlands, (3) stream desiccation due to lowered water tables, (4) competition and hybridization due to habitat changes and introduction of exotic species, (5) pollution, (6) dams and impoundments, (7) raising of water temperatures due to removal of streamside vegetation, and (8) unknown causes.

Present Destruction of Natural Areas

The following experiences show how natural areas are being affected by detrimental uses.

During the railroad prairie survey in late 1975, the fieldworkers saw three stands of prairie grass being bulldozed as they flew over them. Another 3-mile stretch appeared to have high potential for prairie, but 2 weeks later it had been plowed. A fifth site, visited the day after it was sighted from the air, was being bulldozed. Yet another was plowed the day after it was sighted. It is not likely that all these areas were high quality prairies, but they were being disturbed for railroad maintenance or plowed faster than the Inventory could check them.

In Hamilton County there was a 20 square mile tract of timber in 1952, without any road. By 1971 the timber had been reduced to a few hundred acres. The staff examined 1971 aerial photos, chose two woodlots, and checked them in 1975. One had been cleared. The other had not, probably because about two dozen oil wells were in it. After the oil wells are taken out, the remaining timber may be removed until none remains out of 20 square miles that persisted until 25 years ago. No undisturbed areas were found in this county, and none to the east in White County. In Wayne County, to the north, 20,000 acres of timber have been cleared in the past 20 years. A staff ecologist found a 32-acre wetland in Gallatin County, the next county to the south. This was the only sizeable natural pond in this part of the state, but it has been drained and cleared since the fieldworkers completed the survey of the area.

A recently completed barge canal removed one-third of the forest along the lower Kaskaskia River in St. Clair County — the largest continuous block of bottomland timber remaining in Illinois. Some of the finest upland forests in Illinois have been maintained by farmers in St. Clair County, and large stands of bottomland timber had been carefully preserved by hunting and fishing clubs. They are among the very few forests in Illinois that probably were never logged or grazed, but the barge canal removed much of the timber. The canal promises accelerated development of the upland natural areas. When a staff member went to the county agricultural office for aerial photos of three woodlots, developers were asking for photos of the same three forests.

In Brown and Schuyler counties, fieldworkers flew from woodlot to woodlot, looking for natural areas. Timber in 15 out of 42 potential areas had been harvested recently. In Madison County, 34 out of 54 areas had been logged. In Edwards County, a staff ecologist chose 19 forests and wetlands by examining maps and aerial photos. The aerial survey revealed that all had been recently cleared or disturbed by logging, clearing, or draining. The aerial survey was often a discouraging exercise, but it proved that the aerial photo interpretation techniques were sound because the areas chosen for mature, well-structured forest were the same ones chosen by loggers.

Northeastern Illinois has the highest concentration of natural areas and the greatest pressure from development. An Inventory ecologist chose about 150 potential wetland natural areas in McHenry County by examining 1970 aerial photos. When he finished, 1974 aerial photos became available, so he rechecked the areas. Thirty-one of the 150 wetlands had been altered in the 4-year interval, mostly by filling for construction.

One of the greatest discoveries was a 60-acre tract on the Lake-Cook county line north of Chicago with prairie and sedge meadow. The area had been disturbed in the past, but there was a total of 14 acres of high to very high quality prairie, with massasauga rattlesnakes and hundreds of white lady's slipper orchids. One of the finest black-soil prairies in the state, it was previously unknown to naturalists. Negotiations were underway to preserve the prairie when the prairie sod was stripped away by a bulldozer on Labor Day weekend 1976.

Since 1971, at least 500 acres of natural prairie and marsh have been developed for housing at the south edge of Chicago. Some of the prairies have been destroyed so recently that they are included in this report's summaries and statistics as if they still exist.

Reasons Why Natural Areas Still Exist

Introduction

The factors that have allowed tracts to remain undisturbed or to recover from disturbance are to some extent the same factors that will continue to conserve natural areas. One factor that has increased greatly in the last decade is deliberate protection of natural areas. Changes in economics and land use that work against preservation of natural areas have also increased, and many areas that survived undisturbed until the 1960's and 70's would have been destroyed by now if they had not been intentionally protected.

Natural areas exist for several reasons. Some have been deliberately protected. Many cannot be eco-

Apple River Canyon. The stream was listed as an outstanding aquatic area, and the canyon has many endangered and northern relict plants

nomically exploited. Some have survived despite disturbances. Many have escaped development through accidents of land use patterns. Survival of a natural area often depends on the economics and motivation of the landowner. About one-third of the natural areas are protected, at least informally. It is good that so many areas are protected, but this may indicate that the chances of a natural area surviving without protection are not high.

Forests

Although a few forests are natural areas because the sites are so steep or rocky that the timber has not been harvested, most undisturbed forests have been deliberately protected, often by the same family for generations. The settlers on the Illinois prairie regarded their forests as a valuable resource. As a result, a higher percentage of forest remains undisturbed in the Grand Prairie counties than in counties that had no prairie.

Several large forested tracts have been acquired by park districts and forest preserve districts around large cities. Most had been disturbed, but some have been protected for so long that they now qualify as natural areas. Many forests are being given the protection needed to mature and recover from past disturbances in state parks.

Prairies

Most prairie remnants are on soil that is too sandy, rocky, wet, or steep to cultivate or graze economically. The prairies that formed the deep, fertile soils are almost entirely farmed, but a few small remnants persist on odd tracts of land that have escaped use for some reason.

Many prairie remnants, especially the ones on soil that could be cultivated, are accidents of economics and land use patterns. Sixty-two prairie remnants are on railroad rights-of-way or still persist after the tracks have been removed, and 17 are in the abandoned or unused parts of cemeteries. Seven prairies are on parts of public lands that are not intensively used, such as land at a former arsenal, at an airport, and along a canal.

Some of the largest natural prairies are in the Chicago metropolitan area, on land that was subdivided in the 1920's. Lots were sold, but the economic depression of the 1930's prevented the land from being developed. In some cases sidewalks were built, but no sewer lines were laid — in part because of the sandy, wet, unstable soil. Cities grew around the prairies, and local ordinances prevented people from building on the small lots. Some of these prairies are being acquired for preservation.

The Inventory found five prairies in Illinois that were deliberately protected in private ownership. All had suffered some disturbance, usually grazing, but the high quality acreage totals 32.3 acres. Four of the five prairies are now owned or are in the process of being transferred to agencies that will protect and manage them.

Savannas

Natural savanna remnants persist in Illinois for the same reasons as prairies, although the savannas are fewer and consequently have less factors responsible for their existence. The Inventory found several hundreds of acres of natural savanna on land that is too sandy to farm intensively, but only 12.3 acres of high quality savanna were found on deep, fertile, fine-textured soils.

Wetlands

Most of the remaining wetlands have survived despite past efforts to drain them. Almost all have been altered by attempts to exploit them. In some cases, a wetland probably has survived because the several owners cannot agree to drain the area, or the key landowner does not want to drain it. Many wetlands are not yet worth the effort to drain or fill, and some have been protected for hunting, fishing, and trapping.

Primary communities

Most of these communities are relatively undisturbed because they are glades, bluffs, and cliffs that are too rocky or steep to exploit, but there are a few exceptions. For example, five of the seven limestone glade natural areas in Hardin County — the largest concentration in Illinois — are near quarries, and several others have already been removed by mining.

A cave in southern Illinois. Over one thousand gray bats, an endangered species, use this room in the cave as a nursery in the summer. The cave has a beetle and a millipede known from no other locality in the world.

Caves

The two greatest disturbances to caves are vandalism and pollution of the cave's water. A cave's features and its ecosystem are easily damaged, and they recover slowly, if at all. Vandalism is in direct proportion to the amount of visitation, so most caves in recreation areas are essentially ruined. Caves have been intersected by limestone mines, but quarry operators avoid caves as much as possible.

Habitats with endangered species

Nearly three-quarters of the habitats with endangered plants are on land that is too steep, dry, rocky, gravelly, sandy, or wet to develop easily, and about 40% of the total are wet areas. About one out of eight endangered plant habitats exists because the land has been preserved. Most endangered animals require prairie habitats, or large tracts of wetland or forest, or clean water. Some animals and plants are considered endangered in Illinois only because their natural ranges barely extend into the state.

Habitats with relict species

Relict sites have survived because of unusual topographic or soil characteristics that have prevented the land from being developed. The relict sites are either steep bluffs and ravines, cliffs, sandy areas, or seeps.

Geologic areas

Although specific sites may be destroyed, and some unusual outcrops, landforms, and fossil beds may become endangered, in general the geologic features of Illinois are not threatened. Many of the sites chosen for the Inventory are artificial exposures.

School natural areas and nature preserves

About 10% of the areas protected as nature preserves or school natural areas were donated for that purpose. Of the remaining ones, about half were purchased, leased, or dedicated specifically for nature preservation. The other half were not acquired specifically for nature preservation, but were subsequently designated as natural areas.

Unique natural areas

Most unique natural features are in caves, wetlands, or habitats that support endangered or relict species, so the above comments about these kinds of areas are pertinent here.

Outstanding lakes and streams

The lakes and streams listed by the Inventory were recommended by the Illinois Natural History Survey, mainly on the basis of the native fauna, which depends largely on the quality and diversity of habitats. Most of the high quality lakes are glacial lakes that have not been heavily affected by dredging, filling, surrounding residential development, or recreation activities. It has been estimated that there are 480 permanent streams in Illinois, totaling 11,912 miles, excluding the Mississippi, Ohio, and Wabash rivers, but not many streams can be considered outstanding. Twelve stream segments were listed in the inventory, totaling about 210 miles.

Future Trends

Many of the most outstanding natural areas in Illinois are already protected. Within the next few years, many decisions will be made about whether a vulnerable natural area will be protected. If preservation actions are deferred, the area will be used for some other purpose. Some areas have survived until recently because they have been protected by the owners. In some instances, the persons who had protected the natural areas have died, and the sites are in jeopardy.

Areas that had been safe until recently are being exploited because of changing economics. Limestone glades were formerly among the least vulnerable of natural communities, but some are now being removed by quarries. Hill prairies are being used for homesites. Prairies along railroads that have not been touched since the tracks were laid 120 years ago are threatened by modern maintenance methods that involve herbicides and heavy machinery. Farmers, caught between low grain prices and high prices for land and equipment, farm land that was never previously cultivated.

Future Needs

Adequacy of the Present System of Preserved Areas

A plan for expanding the nature preserves system in Illinois is beyond the scope of this report, but a summary in Table 1 shows how much the currently preserved areas protect Illinois' natural features. Cooperation from all kinds of landowners will be necessary to assure protection of the state's natural diversity.

One hundred and twenty-four areas may be considered preserves with active protection and an adequate assurance of permanence. These include 66 Illinois Nature Preserves, 16 Federal Research Natural Areas, nine Registered Natural Landmarks, and one U. S. Forest Service Ecological Area. Forty other tracts are considered to be preserved because the titles to the land (or easements) were acquired by the Department of Conservation, universities, or private organizations specifically to preserve the areas.

Table 1 lists some of the significant natural features and shows how many are in at least one preserved area. Protection of half to three-quarters of the features might seem sufficient from some points of view; but to protect the diversity of Illinois' natural heritage, each feature should be in at least one protected area. Every endangered species is important, and so little is left of the original natural communities that every remnant is significant. For instance, the 253 sites with natural prairie, totaling 2,352 acres, represent about one-hundredth of 1% of the prairie existing when the Prairie State was admitted to the Union.

Prairie plants surrounding a gravestone. One of the last remnants of the Grand Prairie of central Illinois is protected in this pioneer cemetery.

Table 1. Degree with which natural features are represented in preserved areas. The left column gives the number of certain important features in Illinois. The middle column gives the number (and percent) of these features that occur in dedicated Illinois Nature Preserves. The right column gives the same kind of information for all preserved areas, including Illinois Nature Preserves.

Natural Feature	*Entire State*	*Illinois Nature Preserves*	*All Preserved Areas*
Occurrences of significant features			
High quality natural communities	689	57 (8%)	86 (12%)
Habitats with endangered animals	59	6 (10%)	12 (20%)
Habitats with endangered plants	462	151 (33%)	172 (37%)
Habitats with relict species	45	5 (11%)	9 (20%)
Outstanding geologic features	160	2 (1%)	8 (5%)
Unique natural features	30	1 (3%)	2 (7%)
Outstanding aquatic features	17	2 (12%)	2 (12%)
Relatively undisturbed natural communities (acres)			
Forests	13,484	1,026 (8%)	2,589 (19%)
Prairies	2,352	637 (27%)	737 (31%)
Savannas	1,296	147 (11%)	148 (11%)
Wetlands	6,029	1,105 (18%)	2,366 (39%)
Lakes and ponds	1,960	68 (3%)	141 (7%)
Glades and similar communities	602	187 (31%)	187 (31%)
Major topographic features	21	15 (71%)	16 (76%)
Geologic formations	143	51 (36%)	61 (43%)
Major soil associations	26	20 (77%)	22 (87%)

There is much potential for contributions by the Federal Research Natural Area program. All Research Natural Areas in Illinois are on land managed by the Fish and Wildlife Service, and 14 of the 16 sites are in a single national wildlife refuge. There are at least 160 significant natural features on 96 other tracts of Federally owned land in Illinois, and many of these tracts might qualify as Research Natural Areas.

Updating the Inventory

Areas must be checked periodically for threats to their integrity. They can be monitored at several levels of exactness. Aside from preserving each area with a manager responsible for each tract, on-site inspections can be the most complete way of monitoring areas. The landowner is often the best steward of a natural area, and local residents might volunteer to watch and protect some areas. An aerial survey is much quicker, more effective, and less expensive than a ground survey for detecting disturbances. Features can be studied from an airplane with adequate detail, particularly if the observer is familiar with the area. The least expensive and quickest survey would use satellite images, but even under ideal conditions, features narrower than 600 to 800 feet cannot usually be detected. One advantage is that construction activities or clearing of vegetation appear as bright, contrasting scars on the satellite images.

A continuing effort will be needed to investigate new information about possible natural areas. The Inventory's information system is designed to accept additions, deletions, and corrections. It will need to be continually updated to be the most effective tool for preservation.

Preserving All of Our Natural Heritage

The Department of Conservation requested that the Inventory focus most efforts on sites with high quality terrestrial or wetland natural communities, habitats with relict species, and habitats with endangered species. Less emphasis was given to geologic features and aquatic features. The results should meet the immediate needs for developing a system of preserved natural areas, but it is recommended that increased emphasis be placed on protecting the kinds of ecological features that were not studied in detail. These include invertebrate animals, nonvascular plants, and aquatic ecosystems.

As a first step, we need to understand how well protection of nonvascular plants and invertebrates could be achieved in natural areas identified for other reasons. The volumes of information about invertebrates compiled by the Illinois Natural History Survey could be used as a basis for understanding the size of the task and the approaches needed to protect these animals. Similarly, the biological and water quality information compiled by agencies in the Illinois Institute of Natural Resources could be used to address the needs of protecting natural lakes and streams. Special efforts to identify and protect these important features need to be supported and encouraged.

A calcareous seep with prairie dock in flower. There are 15 acres of this unusual natural community in Illinois.

The Inventory selected relatively small, specific sites that merit special efforts for immediate protection, but preserving these sites alone will not assure that natural diversity is protected. Large tracts of forest, wetland, and grassland need to be maintained. These areas do not necessarily need to be removed from use by people. They can sometimes have uses such as timber production, flood control, and recreation. Many animals rely on such large areas for feeding, breeding, and resting. Not all native plants can maintain their populations indefinitely in small, isolated sanctuaries without the benefit of corridors of natural land so that plant migrations can balance local extinctions.

All aspects of our natural environment need to be protected. Unless erosion, air and water pollution, and transformation of wildland into farmland and urban areas are controlled, native animals and plants will become further endangered, and preserved areas will become little more than museum pieces.

Preservation of the sites identified by the Inventory is an important part of conservation of natural resources. These natural areas are the best remaining examples of our natural heritage, and they are irreplaceable refuges for an abundance and diversity of natural features. They are valuable historical resources, and they are models and sources from which other areas can be restored. Preservation of these areas will be a key to successfully maintaining a healthy and productive environment.

Information System

One feature of the Illinois Natural Areas Inventory was the development of a computer-based information system for the storage, retrieval, processing, and analysis of the Inventory data. Contractual requirements included computerizing as much of the data as possible, evaluating existing information systems for possible use, and ensuring easy access to the system through the Department of Conservation.

A series of workshops was held in which potential users and beneficiaries of the final system were consulted about components and requirements of the computer system. The most important requirements developed by the workshop participants were an interactive and conversational system, easy to use and requiring minimal programmer support; the ability to manipulate textual data and provide report-like printed output; the ability to perform conditional searching for values by natural area; the ability to prioritize natural areas based on weighted values; the ability to perform a minimum of simple statistics on the data; and, finally, reliability of hardware.

Several information systems were examined in detail and evaluated for possible use for the project: the IRIS system and the MONICA system, both created by the Center for Advanced Computation of the University of Illinois, written in ALGOL and operational on a Burroughs B6700 computer; the Consistent System and JANUS, created by the Cambridge Project at Cambridge, Massachusetts, written in PL/1 and operational on a Honeywell 6180 computer; the SELGEM system created by the Smithsonian Institution, written in COBOL and operational on a variety of computers; and the Natural Area Information System (NAIS), created by The Nature Conservancy of Arlington, Virginia, written in PL/I and FORTRAN and operational on an IBM OS-360-65 computer. Two possible alternatives to such existing systems were also examined: creation of an information system using the existing facilities and resources of the State of Illinois in Springfield, or purchase of a minicomputer to be programmed and used in-house.

Purchase of a minicomputer was selected as most appropriate for the inventory. That decision was based on several considerations: the initial expense of the hardware and software programming would be followed by virtually no continuing cost; the system could be tailored to the user's data; the user would be independent of someone else's schedule of operations; and the user would not need to be concerned about the system being replaced or upgraded, with the need for reprogramming. Finally, it was felt that having an in-house computer would tend to promote use of the system beyond simple responses to a problem or a request for data: the user would be encouraged to experiment with the system and its data in creative and innovative ways, expanding the usefulness of the inventory.

The programs produced on the minicomputer allow interactive data entry, text editing, and data retrieval to either a viewing screen or a hard copy printer. The data retrieval package permits conditional searching of the data base, prioritization of natural areas based on specific data elements, and formatted report-like output of statistical analyses or a tabulation of the data.

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