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REPORT

# PLANT COMMUNITIES OF OHIO:

## A PRELIMINARY CLASSIFICATION AND DESCRIPTION

Dennis M. Anderson

Division of Natural Areas and Preserves
Ohio Department of Natural Resources
Columbus, Ohio 43224

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# PREFACE

Plant Communities of Ohio consists primarily of a classification and description of the existing natural, more stable plant community types in Ohio, and an outline of methods for surveying these communities. These materials were developed for use by the Division of Natural Areas and Preserves, Ohio Department of Natural Resources, in the inventory, cataloging and analysis of communities for protection planning purposes. Except for certain methodology, however, they are general enough to be used by other interested parties.

This document is preliminary in all aspects. Time and resource constraints have not permitted as complete and balanced a research treatment as the complexity of plant community study warrants. The classification system and community descriptions are subject to alteration and expansion as new data and additional research opportunities become available. Comments and questions concerning this document are appreciated and encouraged.

The philosophy behind this work assumes an appreciation for the complexity of natural systems. It assumes that no classification can be, at one time, both simple enough for easy comprehension and complex enough to represent these systems with much thoroughness. It assumes the reader is one who is open rather than dogmatic, who appreciates the gray as much as the black and white, and who seeks the order of things but doesn't demand simplicity. Within this realm, this publication is intended as a practical, useable document compatible with the research capabilities and needs of preservation organizations.

The concepts presented here represent an additional step in the first stage of scientific inquiry, the descriptive or naturalist stage. Future workers hopefully will transcend this level to quantitative ones which more adequately describe Ohio's vegetation patterns. Future research will involve investigations of the state's various vegetational continuums, correlations between vegetational and environmental gradients, and vegetation dynamics. Eventually more synthetic stages of inquiry will explain the systems of this vegetation, its mineral and energy flows and its complex species interactions. Then will knowledge of Ohio's plant communities be truly useful as baseline data for comparison with man's altered systems. It is hoped that this document will help encourage additional research in this direction.

Research for this document was initiated in 1976 by the Ohio Natural Heritage Program under the direction of The Nature Conservancy. A draft plant community classification was published in 1977 as part of the Ohio Natural Heritage Program Technical Report. In the past five years since that report, the classification system has been revised substantially, and the community descriptions and survey methodology have been developed under the direction of the Division of Natural Areas and Preserves.

The author wishes to acknowledge the contributions of Division staff members, especially Barbara Andreas, Allison Cusick, Guy Denny, Anne Filbert, Patricia Jones, Susan Laverty, Robert McCance, Richard Moseley, Reed Noss, Daniel Rice, Mary Ann Silagy, and David Spooner. Encouragement was provided by Debra Walton of the Ohio Natural Heritage Program; Richard Armstrong, Steve Buttrick, and David Younkman of The Nature Conservancy staff; and Tom Cooperrider of Kent State University. Much of the groundwork was provided by the previous work of other ecologists.

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Part 1

GENERAL COMMUNITY CLASSIFICATION

## 1.1 CLASSIFICATION AND PRESERVATION PURPOSES

PURPOSES

The primary reason for the construction of the current classification is to provide a framework by which natural plant communities in Ohio may be inventoried, cataloged and analyzed for preservation purposes. As "civilization" has continued to expand throughout Ohio, the need to identify and protect the decreasing numbers of quality community types has grown. Too, it has become increasingly evident that a more systematic effort is needed to adequately protect the full spectrum of community types rather than just a selected or fortuitous group. An ideal goal is to protect each major community type in each physiographic region of the state, to the extent that the different types occur in each region. The first step in working toward this goal is identifying what these communities are. Hence, the current classification was created. The classification was compiled at a level believed specific enough to cover the state's major vegetational variations, yet general enough to offer a realistic preservation goal.

Whereas the above discussion assumes that community preservation is a worthwhile endeavor, the value of this effort is dubious to some parties and has various meanings to all parties. The preservation of representative plant communities is important for several reasons, including the following:

1. Research. Studies of communities provide knowledge of ecological systems and processes, how materials and energy flow through these systems, and how different groupings of animals and plants coexist in seemingly integrated patterns. Communities represent complex biological systems which have and continue to evolve toward relatively stable equilibriums with their physical environments. As such, they contrast with and contain much potentially useful information for man and his comparatively unstable communities. Moreover, the natural communities serve as valuable controls or benchmarks to man's disturbed and changing communities.

2. Species Richness. Whereas preservation of specific endangered or threatened plants and animals represents a "fine filter" approach to species richness protection, preservation of plant communities provides a "coarse filter" approach. Community preservation protects not only known genetic richness, but also much diversity not yet recognized, including that of many "lower" forms. Too, community preservation captures many yet unknown relationships and processes which exist between species, both rare and common, and between species and their physical and chemical environments. All of these species aspects represent resources and information of possible future benefit to man.

3. Education and Inspiration. The preservation of plant communities provides many and diverse opportunities for people of all ages, interests and backgrounds. It allows people to visualize the wilderness which their forefathers once confronted. It allows them to enjoy and learn about those aspects of nature no longer available to them in their cities or on their farms. To some, it is primarily an aesthetic experience. To a few, it is a deep personal experience which allows rediscovery of themselves and their places in the universe.

The values, both tangible and intangible, of natural plant community preservation in Ohio are many. These values are all greatly increased when that preservation includes a full and balanced range of representative examples of all major community types. The values are further increased when these examples are spread across all regions of the state. Such breadth will help ensure the preservation of the broadest possible range of natural diversity, information and opportunity still available in the state. Such a goal may not be possible, but any movement towards it will represent a valuable gain. To seek the goal, a careful but comprehensive community definition and survey program must be conducted.

## PRIORITIES

The priorities or strategy of plant community surveys by preservation organizations, including the Division of Natural Areas and Preserves, necessarily involves a balancing of efforts between short-term (next decade) and long-term objectives. The major short-term goals are as follows.

1. Endangered Communities. Given the continued rapid destruction rate of natural communities in Ohio, it is imperative that immediate attempts be made to identify and preserve the best examples of the most endangered community types. This is especially important given the additional restriction of limited funds. Most obvious in this category are the boreal and prairie remnants. Non-climatic remnants include additional wetland types. The Endangered Community category also includes especially high quality stands of either rare or common community types. Some little disturbed forest tracts, for example, would fall into this group. There are now few opportunities to protect historically little disturbed stands of any type.

2. Preserved Communities. To determine what communities need to be preserved, it is first necessary to accurately know what has already been preserved. Too, it is not enough to know simply that a "bog", for example, has been preserved. It is necessary to know what type or types of bog it is, and what the dominant species are. All people have amazing capacities for remembering a few interesting species in a community while forgetting or never seeing the dominant components. Systematic inventory and documentation is necessary to correct these deficiencies. Hence, a basic housekeeping

chore is to complete general surveys of all public and private preserves or natural areas in Ohio.

3. Community Definition. To insure that a proper balance of different community types is surveyed and preserved, it is essential that the community classification system and community definitions are reviewed regularly and, if necessary, revised in light of new data. Community definition requires care that some community complexes are not finely divided into several types while other groups of similar complexity are treated as single units. Community definition is required so that a broad and balanced array of different community types and genetic diversities over all regions of the state are represented in the preservation plan of the state. More complete clarification of community definition must be continued in the long-term.

4. Opportunistic Community Studies. Equally rare as certain plant communities are capable people and funds to study the communities. No opportunities should be lost to promote high quality short-term studies when expertise or monies are available.

The major long-term goals are as follows:

1. Community Definition. Whereas qualitative community definition may be adequate for the short-term, high quality quantitative definition is a requisite for the long-term. Quantitative definition is time consuming, but only it can provide the objective data necessary for accurate comparisons between communities. Such comparisons are needed to insure that the proper preservation spread is achieved. The data are also needed to monitor the successional status of preserved communities, both for preservation purposes and for land use benchmark purposes.

2. Community Research. In addition to community definition and monitoring research, many other types of community research should be promoted over the long-term. Much of this research would necessarily be initiated and accomplished by personnel and funds unavailable in preservation organizations. The major benefit of this work would be knowledge of the processes functioning in natural communities, and subsequent application of this knowledge, where possible, to man's communities. Man is just beginning to understand ecological processes and the ways he must adjust to them for continued prosperity.

The skilled staff, time and money necessary to locate, classify, evaluate and rank examples of each plant community type will require priority placement among preservation activities, including those at the Division of Natural Areas and Preserves, if satisfactory progress is to be made on the preservation of Ohio plant communities. The work is, in many ways, more complex and time-consuming than surveys for rare species or other natural features. Resource constraints will require that preservation organizations seek and encourage outside support of this work in addition to allocating their own resources to the effort.

## 1.2 COMMUNITY CONCEPTS

### COMMUNITY DEFINITIONS

A specific plant community or plant community stand is a concrete group of plants occurring together at a certain place and time. Such stands may be defined narrowly or broadly but, as defined here, they are fairly homogeneous groups of species, as versus genera or physiognomic forms, delimited usually to areas of several hectares or less. Some occupy only small fractions of hectares. In contrast, an abstract plant community or plant community type is a mental concept of reoccurring stands having similar compositions. It too may be narrowly or broadly defined. In the present classification an abstract plant community is more specifically considered a group of a few cover dominant species which reoccur together rather commonly in Ohio, or which reoccur infrequently but are markedly characteristic (e.g. bogs, prairies, etc.).

### HOLISM VERSUS INDIVIDUALISM

Two schools concerning the classification of plant communities have developed during the twentieth century. At their extremes, the holistic school says communities are distinct and repetitive enough that they can be classified, while the individualistic school argues that each community stand on the earth is unique and that classifications exist only in the imagination. Moreover, the holistic school considers community stands to consist of highly integrated species groups and patterns evolved over time. The other camp considers stands to consist of constantly changing populations of species, each species acting relatively independently of the others. As with many complex concepts, the truth probably lies in the less simplistic gray area between these extreme positions. Too, truth between the two poles probably varies per community type and community stand, and it probably changes over time. In any case, the extreme positions help simplify and clarify the ingredients which comprise the middle ground.

The position taken with the current classification is that each vegetation stand is "unique" to a greater or lesser degree, but that many fairly similar stand types reoccur predictably in similar environments. Said another way, given a limited number of dominant species in Ohio, only certain combinations usually occur, or not all combinations are probable. The reoccurring species combinations of a specific community type are not envisioned as discrete, homogeneous units, but as limited areas where many of the species characteristic of that community type are concentrated, these concentrations usually grading gradually into other adjacent species concentrations comprising other community types.

Understory vegetation is believed to have similar patterns and to be closely to loosely correlated with the overstory types. Each overstory type may have more than one understory type, and certain understory types occur under more than one overstory type. Too, the understory of each stand varies per specific microsite and changes over time due to canopy alterations and other factors. Nevertheless, only certain groups of understory species normally occur under each overstory type. Over- and understory correlations are not random. Understory communities in the eastern deciduous forest region of North America are complex, but it is assumed that further study will clarify their patterns.

## GRADIENTS

A classification of such communities as described above is accurate to the extent it identifies and incorporates the major vegetational segments along the various environmental gradients. It must be understood to be artificial in the number of vegetation segments it identifies and where it draws lines between them. It would be similar to taking a color spectrum and dividing it into just light and dark colors, the eight prime colors, or the eight colors plus the infinite number of intermediate mixtures. In vegetational classification it should be recognized that, often, certain arbitrary units must be emphasized at the cost of transitional segments between these units even though the transitions may have as much validity as the units (i.e. blue and red may be considered units rather than bluish-red). Such artificiality must be accepted as a necessary evil. In terms of community protection it isn't a critical point if the transitions are recognized and included in the concepts of and planning for one or both of the "official" communities between which the transitional types occur.

## SUCCESSION AND EQUILIBRIUM

Questions concerning the validity of succession concepts in plant communities need not be correlated with the discussion of whether or not they are classifiable. Nevertheless, certain classical concepts of succession arose with the school which viewed communities as distinct nameable units. The idea was that most sites had a potential climax vegetation towards which succession would normally proceed in predictable steps. More recent theory includes several alternative and sometimes conflicting hypotheses and many of these dismiss or deemphasize the role of succession. In concert with the individualistic school, these do not view community dynamics as consistent groups of species replacing others by succession, but as individual species with specific "strategies" competing with each other.

Similarly, the classical concept of climax is now commonly deemphasized. The main argument here is that communities are perpetually changing in response to environmental and internal fluctuations so that equilibrium "climax" states are seldom achieved. Debate between pro- and con-climax schools is hindered by the semantic question of how much change may occur within a stand which is still considered to be in equilibrium. Some theories are less critical of a climax or relative equilibrium concept than they are of that which assumes orderly successional patterns are necessary to reach climax. Because, however, the succession and climax concepts have been so closely associated in the past, both terms are often eschewed now, even when there is argument against only one.

The position taken in the current classification system is again one between the poles. It is believed that most community stands in Ohio would mature, if not disturbed by man, to states of relative compositional stability, at least for a few centuries. Specific areas would be disturbed by blowdowns, fire and other natural events, but these normally would not strongly affect the major proportions of most community types in any one period. Exceptions would include certain wetland systems subject to significant water level changes, or certain relict communities, such as prairies, which are dependent on "disturbance". Even the exceptions, however, could be considered examples of dynamic equilibriums. Succession in the current classification is simply considered as a replacement, usually gradually, of one community with another. Primary succession in Ohio today is considered largely a process resulting from substrate moisture alterations following natural physiographic dissection or filling, or of climatic changes. Man, of course, confuses these patterns in various ways. Natural changes of certain community types to others are not considered to represent legitimate succession any more than changes which may occur in the opposite directions. Succession is considered to include changes of few to many species involving simple to complex interactions; the process may but is not assumed to involve complex and highly integrated interactions.

## 1.3 CLASSIFICATION ALTERNATIVES

When creating the present Ohio community classification, a choice had to be made whether to use some pre-existing classification, to modify one or more of these systems, or to create a new system. Pre-existing classifications included those wholly or partially constructed for Ohio, and those constructed for other areas but useable in Ohio. A review of the major alternatives, and rationale for the classification chosen are given below.

### OHIO-RELATED CLASSIFICATIONS

Ohio has a long history in vegetation research and classification. Valuable vegetation descriptions of portions of the state go back as far as those of Atwater (1818) and others. Sears (1925, 1926), Sampson (1927), Transeau and Sampson (1938) and Chapman (1944) provided the first comprehensive classifications and maps of the original (i.e. pre-European settlement) vegetation. Their works were based primarily on combinations of original field data and analyses of the earliest land survey data. Many of their students compiled specific data on individual counties, and several other workers conducted high quality studies of specific areas. Beatley's (1959) study of Jackson and Vinton counties represents a fine work of a specific area. Of different scope and purpose, Cannon et al. (undated) developed a classification for surveying wildlife habitats in Ohio.

Gordon (1966, 1969) produced the most comprehensive original vegetation map and description available for Ohio to date. His data were derived from the original land surveys, publications and dissertations, and broad-scale reconnaissance. Good general introductions to the vegetation of Ohio may be found in these two works of Gordon, the introduction in Braun (1961), and Lafferty (1979).

In addition to classifications specific to Ohio, many regional, national and continental studies have included the state. Broadest in scope are the biotic region classifications, Bailey's (1980) ecoregion delineation being a recent example. More specific are the Society of American Foresters' descriptions of North American forest cover types, editions appearing from 1932 to 1980. The latest edition (Eyre 1980) contains a map, from the National Atlas, of current United States forest types. Braun (1950) concentrated on the forests of eastern North America, and Kuchler (1964, 1975) described all potential natural community types across the United States. Cowardin et al. (1979) provided a recent wetland classification for the country.

Analysis of the existing Ohio-related classifications determined that none were fully acceptable for use in the current system. Several reasons existed. First, most of the systems were too general in scope to allow identification of communities to a level of specificity deemed necessary for adequate preservation purposes. Examples include the classifications of Braun (1950) and Kuchler (1964, 1975). Indeed, some people will argue that even the current classification is too general. Nevertheless, it is more specific than most previous systems. A second problem was that some systems, such as those of the SAF (Eyre 1980) and Cowardin (1979), addressed only certain vegetation types, such as forest or wetlands. This alone would not have prevented their being used for part of the desired classification. These classifications, however, were also national systems which frequently did not adapt well to many Ohio situations. Too, the type of classification used in Cowardin was tailored to wetland systems and would be hard to expand conceptually to terrestrial communities. Of the pre-existing Ohio-related classifications, Gordon's (1966, 1969) appeared to have the greatest potential for at least partial adoption. This is not surprising as it was the most specific yet comprehensive work on the state. In many ways Gordon's classification, and that of his predecessors, was adopted with expansion and modification.

## OTHER CLASSIFICATIONS

### Ordination

Of the systems being used outside Ohio, one major alternative was ordination similar to that created by Curtis (1959) for Wisconsin. In that type of a system each community stand is placed in its measured mathematical position relative to all other measured stands based on one or more community factors having continuous, rather than discrete, distributions. Classifications can then be constructed by slicing the resulting continuum of stands into arbitrary groups. Curtis's system, or a modification of it, has scientific merit and it apparently works well in Wisconsin. Ordination, however, was not chosen for use in Ohio because considerably more data would have to be compiled and analyzed before an accurate ordination(s) for the state could be developed, and because such an ordination would likely consist of abstract categories beyond the comprehension of most people, at least as units easily recognized in the field.

A counter argument is that use of a term such as "beech-maple forest" implies too much classical rigidity of community concept. Modern usage of such a term, however, does not suggest it is a homogeneous, well-defined "climax" type but, simply, a gradient type in which beech and sugar maple emerge as the most consistent dominant species. If a future attempt is made to "classify" Ohio's communities by ordination, at least three major gradient correlations will have to be considered. These include substrate wetness, substrate type (e.g. glaciated, calcareous western Ohio contrasting with unglaciated, noncalcareous southeastern Ohio), and climate (e.g. the hemlock-white pine-northern hardwood affinities in northeastern Ohio, and the prairie affinities in western Ohio).

### Releve' Synthesis

In contrast to ordination is the releve' method of classifying communities, a method widely used in Europe and other areas outside of North America (Mueller-Dombois and Ellenberg 1974). The method consists of carefully locating quadrats in stands homogeneous in all layers, then making complete species lists, or releve's, and species cover estimates. The lists of similar stands are then compared in a matrix, or releve' synthesis table, and reordered so the most similar stands are classified together. This method was used in the present Ohio classification only to the extent that the dominant and more common species of different stands were subjectively compared and reordered using a matrix. The Ohio classification differs from releve' classification mainly by utilizing only cover dominants, rather than all species, in the separation of community types. Thus, the Ohio classification has broader community units. The releve' method was not used in Ohio largely because it would have resulted in more splitting of overstory-understory combination types than what is desired at this time. Too, very little all-layer Ohio vegetation data have been compiled with the degree of specificity required by the releve' method. These limitations, however, do not mean the method should not be considered for future use.

Classification by Hierarchy

Another classification type being used widely in other areas is one divided hierarchically from general to specific levels based largely on physiognomy at the highest levels, cover dominants at the intermediate levels, and subdominants at the lowest levels (e.g. Brown et al. 1980, Buttrick 1981, Driscoll et al. 1978, Radford et al. 1981, United Nations Educational, Scientific and Cultural Organization 1973). This system may be used in coordination with the releve' or other classification methods. The hierarchical arrangement allows convenient taxonomic ordering of communities similar to that used for species. It is more standardized on a world level, facilitating classification and comparison among community types from different areas. It is ideally suited for electronic data storage and mapping at different levels of specificity.

In many ways the classification adopted for use in Ohio is of this type. It differs primarily in two ways. It groups certain communities by natural ecological units rather than by physiognomic units (e.g. tamarack bogs are placed under bogs rather than under evergreen forests). Secondly it, at this stage, divides the hierarchy only to a level of broadly defined, subjectively determined generic groups of cover dominants. Unlike some classifications, a new formal classification unit is not automatically established each time a new combination of cover dominants, let alone subdominants, is encountered. This is done primarily to simplify the system for conceptualization, communication, cataloging and protection planning. It allows the system to function more in a classifying capacity than in just a detailed inventorying role. It also allows more natural groupings of communities differing for relatively minor causes, including successional and historical factors and minor topographic variations. If necessary, the Ohio system could be reordered or divided into more specific levels in the future. In any case, field data should be gathered so stands are described by what they actually are, not by what they should be according to the current or some other artificial classification system. Hence, these data are fairly absolute and could be reordered as desired.

CONCLUSION

As no one existing classification appeared to fit all needs for the type desired at this time, an eclectic approach was taken whereby the best elements of several classifications were utilized, and these were modified by current field observations. Gordon's (1966, 1969) and other systems were altered primarily by adding specificity to previously designated community types, adding comprehensiveness by including additional general community categories, utilizing existing rather than original vegetation (e.g. dedesignating chestnut as an existing dominant), and defining the community types with more specific (albeit sometimes arbitrary) pragmatic guidelines for inventory and cataloging purposes. For the most part a hierarchical classification was employed with the larger categories based on natural physiognomic-ecologic units, and the subcategories based on combinations of characteristic dominant genera, the appropriate species of which are limited by individual community definition. Breakdown of the classification to only this level allows a simplicity which is readily grasped for preservation planning. The categories are not represented by abstract ordination-type units, but still are believed to represent recognizable, repeatable community gradient types. The nominal genera representing each category are understood to not always, by their names alone, accurately represent specific stands. Understanding of the variations of each community type as represented in the community descriptions, however, minimizes this problem. Field data for each community stand are collected independently of the classification system. Thus these data retain their accuracy and may be reclassified or declassified in the future as necessary. The current Ohio classification was created to represent, hopefully, a simple, natural, useable and flexible system.

Part 2

# OHIO COMMUNITY CLASSIFICATION AND DESCRIPTIONS

## 2.1 CLASSIFICATION

### ARRANGEMENT

The community classification proposed in this work is shown in the accompanying outline. It was formulated subjectively from existing data and field observations. The classification is arranged by major ecologic-physiognomic groups containing major species groups. Although certain species are specified (in the community descriptions) for each group, the groups are usually named only to a generic level in the classification outline. The classification could be taken to more specific levels if so desired. The ecologic groups are generally arranged from open to closed communities and, within these, "wet" to "dry" communities. The classification does not break down all communities to an equal level of refinement, several of the herbaceous communities being defined only to a physiognomic level (e.g. submergent marsh, calcareous cliff community, etc.). The classification is not finalized and alterations will be made as more data are obtained and new concepts evolve.

The community names must be interpreted with appropriate flexibility. No classification which divides the vegetation landscape to only the level in the present system can cover all situations with nomenclatural preciseness. Corrective alternatives would be to utilize considerably finer classification levels or to use terms having greater vagueness. Each choice has its merits and liabilities. Each unit name in the present system is meant to represent a moderately broad community level expressed by the names of the cover dominant genera (identified to species in the community descriptions) which are its most consistently important components. Restriction of each unit name to one or a few species does not imply that all of those species are dominant or even present in each representative stand, or that other species may not occur as codominants. In extreme cases, all of the nominal species may be rare or absent in a stand, and species usually of lesser importance predominate. Such extremes are not separated out as additional "official" community types because they are identifiable as segregates of existing "official" communities, they are transitions between two "official" communities, and/or they are relatively infrequent. More generally, they are excluded to control classification inflation.

### EXCLUSIONS

The title Plant Communities of Ohio is obviously arrogant as the classification fairly ignores non-vascular species, man-made plant communities, and unstable communities undergoing secondary succession following man-made disturbance. The non-vascular species would be a legitimate component in the system but are excluded only because of lack of information and expertise on them.

Certain communities prized by some people are undoubtedly absent,

# PLANT COMMUNITIES OF OHIO

| Code number (W = Wetland) | |
|---|---|
| 10.000-W | Marsh Communities |
| 11.000-W | Marshes |
| .110-W | Submergent Marsh |
| .210-W | Floating-leaved Marsh |
| .310-W | Mixed Emergent Marsh |
| .320-W | Cattail Marsh |
| .330-W | Sedge-Grass Meadow |
| 12.000-W | Herbaceous Riverine Communities |
| .110-W | Submergent Riverine Community |
| .210-W | Floating-leaved Riverine Community |
| .310-W | Mixed Emergent Riverine Community |
| .320-W | Water-willow Riverine Community |
| 13.000-W | Shrub Swamps |
| .110-W | Mixed Shrub Swamp |
| .120-W | Buttonbush Shrub Swamp |
| .130-W | Alder Shrub Swamp |
| 20.000-W | Bog-Fen Communities |
| 21.000-W | Bogs |
| .110-W | Sphagnum Bog |
| .120-W | Leatherleaf Bog |
| .130-W | Tall Shrub Bog |
| .140-W | Tamarack-Hardwood Bog |
| 22.000-W | Fens |
| .110-W | Cinquefoil-Sedge Fen |
| .120-W | Tamarack Fen |
| .130-W | Arbor Vitae Fen |
| 30.000 | Prairie Communities |
| 31.000 | Prairies |
| .110-W | Slough Grass-Bluejoint Prairie |
| .120 | Big Bluestem Prairie |
| .130 | Little Bluestem Prairie |
| .140 | Post Oak Opening |
| .150 | Sand Barren |
| 32.000 | Savannas |
| .110 | Oak Savanna |

| | |
|---|---|
| 40.000 | <u>Beach and Cliff Communities</u> |
| 41.000 | Beach Communities |
| .110 | Beach-Dune Community |
| 42.000 | Cliff Communities |
| .110 | Calcareous Cliff Community |
| .120 | Non-calcareous Cliff Community |
| 50.000-W | <u>Forest Communities</u> |
| 51.000-W | Swamps |
| .110-W | Maple-Ash Swamp |
| .120-W | Oak-Maple Swamp |
| .130-W | Hemlock-White Pine-Hardwood Swamp |
| .140-W | Mixed Swamp |
| 52.000-W | Floodplain Forests |
| .110-W | Maple-Cottonwood-Sycamore Floodplain Forest |
| .120-W | River Birch-Maple Floodplain Forest |
| .130-W | Mixed Floodplain Forest |
| 53.000 | Upland Forests |
| .110 | Beach-Oak-Red Maple Forest |
| .120 | Beech-Sugar Maple Forest |
| .210 | Hemlock-White Pine-Hardwood Forest |
| .220 | Arbor Vitae-Mixedwood Forest |
| .310 | Mixed Mesophytic Forest |
| .410 | Oak-Maple Forest |
| .420 | Oak-Maple Tuliptree Forest |
| .510 | Oak-Hickory Forest |
| .520 | Appalachian Oak Forest |
| .530 | Oak-Pine Forest |

at least by familiar names, from the classification. In a few cases this may occur because these types are unknown or too poorly known by the author. In most cases, however, such communities are probably lumped under broader community concepts and are not readily apparent in the outline. Except as noted above for certain herbaceous communities, an attempt was made to keep all communities on a fairly equal conceptual basis. For instance, pure stands of single species often have emotional appeal for community status, but they usually can be recognized as segments of more broadly interpreted community types more appropriate to the classification level used in the outline.

Sometimes the question is asked, "Is so-and-so a community type?" The answer is always yes. The bacteria on the head of a pin represent a stand of some community type. More accurately the question should be "Is so-and-so significant enough to be segregated as a separate classification type on a level equal with the other community types in the classification?" With the type of classification system employed here, such questions never have absolute answers. The main alternative for alleviating this problem is to give equal rating to every encountered stand type. Then, however, the classification system is reduced largely to an inventory system.

A few recognizable community types, such as seeps and gravel beaches, are knowingly omitted from the classification system due largely to their infrequency, small aerial extent and/or lack of known compositional consistency. This becomes a problem of "where to draw the line" on less significant communities. Any of these, however, can be added to the classification if they are found to be important enough.

## 2.2 DESCRIPTIONS

### CONTENTS

The accompanying plant community descriptions contain five parts: description, distribution, status, inventory guidelines and selected references. A few have sections on management. In each description section an attempt is usually made to define the community in question, compare it with similar community types, and describe its major variations. At this time the description section for many types is cursory, with only the most essential descriptive elements being given. At the end of each description section is a statement on the amount of research known to have been conducted on the community type in Ohio. It is obvious in this section that many communities have received little study, and very few have received quantitative study.

The distribution sections in the community descriptions attempt to provide general statements on the known geographical and environmental locations of communities in and beyond Ohio. Accurate statements concerning the distributions of communities beyond Ohio are very difficult to make as most communities vary proportionally with their distance from the state. In these situations, vegetational gradients appear on a regional level and simple comparisons based on presence or absence are invalid. The best comparisons are ones of degree, such as may be derived through similarity indices. Even with indices the compared data must often be obtained from sources which used different survey methods or levels of control, limiting the value of the comparisons. In any case, time did not allow the use of such analyses for the Ohio communities, at least not at this juncture.

Also included in the distribution sections are the names of specific stands representing the described community types. These are generally limited to stands on public property or sites owned by The Nature Conservancy. There is no implication that the named stands represent the highest quality or most characteristic examples in the state. The locations of additional examples of many community types may be found in Herrick (1974), Cusick and Troutman (1978), Melvin (1974), ODNR Division of Natural Areas and Preserves (1979), and The Nature Conservancy (1974).

The status section in the community descriptions attempts to summarize the known existing quality, quantity and protectedness of each community type. This statement varies considerably in specificity depending on the extent of knowledge of each type. It is meant to be useful for preservation planning.

The inventory guidelines section in the descriptions attempts to give a general idea of how much inventory effort should be given to each community type. It is included especially for use by or for the Division of Natural Areas and Preserves and other preservation groups. It too is meant to be helpful for preservation planning.

The sections on selected references include those works considered most basic to and necessary for understanding each community type as it occurs in Ohio. Where possible, listings were limited to published documents because of their greater accessibility. Some communities have very few documented descriptions, and these descriptions often are but small sections of more comprehensive works. Other, more popular communities have considerable documentation, only some of which are included in the selected listings. Although frequently not identified to specific community type, many additional Ohio vegetation works are listed by Gordon (1964), Elfner, Stuckey and Melvin (1973), and Roberts and Stuckey (1974).

The scientific nomenclature in the community descriptions is conservative and follows Fernald (1950) except for certain fairly well accepted alterations. The common names are also basically those of Fernald except where other names are believed to have broader use. Peterson and McKenny (1968) were consulted for alternative common names of many herbaceous species.

Various references are available for the identification of vascular plants in Ohio. Basic regional manuals including Ohio are those of Fernald (1950), Gleason (1952), and Gleason and Cronquist (1963). Manuals specific to Ohio include those of Weishaupt (1971) on vascular species, Braun (1961) on woody species, and Braun (1967) on monocots. Useful manuals on pteridophytes include those of Wherry (1961) and Cranfill (1980). Valuable checklists are those of Schaffner (1932) and Cusick and Silberhorn (1977).

The community code numbers on the classification outline and community descriptions are those employed by the Division of Natural Areas and Preserves for processing community inventory data. The Division maintains comprehensive manual and computerized files on these data. The Division's data system is part of that developed by The Nature Conservancy for use in its various state Natural Heritage Programs. Public access to these data for scientific, educational or environmental impact review purposes may be obtained through the Division.

DESCRIPTIONS

Submergent Marsh 11.110

DESCRIPTION: Submersed herbaceous plants dominate part of a lacustrine system. Predominant flowering species inlcude:

| | |
|---|---|
| Pondweeds, Potamogeton spp. | Coontail, Ceratophyllum demersum |
| Horned Pondweed, Zanichellia palustris | Water-milfoil, Myriophyllum exalbescens |
| Naiads, Najus spp. | Water-milfoil, M. spicatum (an exotic) |
| Waterweed, Elodea canadensis | Bladderworts, Utricularia spp. |
| Waterweed, Elodea nuttallii | |
| Eelgrass, Vallisneria americana | |

Other flowering species, aquatic mosses and the liverwort, Riccia fluitans, occur infrequently. Several algal species are commonly present, with Chara spp. especially conspicuous in certain alkaline environments. The community type is distinct physiognomically from other marsh community types. It may occur beneath a floating-leaved marsh or among the bases of plants of an emergent marsh or other wetland community, but is should be inventoried separately.

Submergent marshes commonly grade into open, deeper water or, in shallower water, are bounded by emersed plants or shores. The emersed plants usually represent other marsh community types, shrub swamps or bogs. These types often replace submergent marshes following long-term sediment filling of the marsh areas. Reverse successions, however, may occur in the short-term, with submergent marshes being replaced by open water. As a result of these hydrological fluctuations, submergent marshes may be dynamic, varying in composition and coverage on an annual basis.

Ecological data on floating-leaved marshes in Ohio are limited to primarily qualitative studies of selected areas. A few studies (e.g. Judd and Taub 1973; Lowden 1969; Moore 1976; Stuckey 1971, 1978) have evaluated floristic changes which have occurred in specific Ohio marshes during the last few decades.

DISTRIBUTION: Submergent marsh communities of different compositions occur throughout the world where physical conditions permit. In proximity to Ohio, they occur in all regions but are especially common to the north, in Michigan, Ontario and New York. Their species compositions vary in relation to their distances from Ohio. The occur in all regions of the state but are more prevalent in the glaciated sections, especially adjaent to western Lake Erie. Inland they occur as natural stands in kettle lakes and other ponded uplands on glacial till, and occasionally in ponds on terraces of existing or preglacial streams. Some of these water bodies are created or augmented by beavers.

Examples of natural submergent marshes include those at Carp Pond and Sheldon's Marsh (Erie Co.), Pickerington Marsh (Franklin Co.) and Stages Pond (Pickaway Co.). Many altered or artificial stands occur at public reservoirs and, especially along western Lake Erie, public and private wildlife areas.

STATUS: Natural submergent marshes in Ohio have declined in quality and quantity since the advent of European settlement. Many have been drained or flooded, and most are affected by pollution. Carp and motor boats have affected some stands. Stuckey (1971, 1978) indicated that in Put-In-Bay harbor, species with wide ecological amplitudes and characteristic of turbid, warm, poorly oxygenated waters (e.g. Potamogeton pectinatus, Vallisneria americana, Heteranthera dubia, Ceratophyllum demersum and Myriophyllum exalbescens) have survived much better than those with narrow ecological amplitudes and characteristic of clear, cool, well oxygenated waters, such as the following:

| | |
|---|---|
| Potamogeton amplifolius | P. praelongus |
| P. filiformis | P. richardsonii |
| P. friesii | P. zosteriformis |
| P. gramineus | Najus flexilis |
| P. natans | Megalondonta beckii |
| P. perfoliatus | |

Good quality natural submergent marshes in Ohio are becoming rare.

INVENTORY GUIDELINES: All relatively natural stands of submergent marsh in Ohio should be inventoried. These may be recognized generally by their higher water qualities and their compositions of species dependent upon these qualities. Rare species are often present and "weedy" species, such as Potamogeton crispus, Ceratophyllum demersum, Myriophyllum spicatum and others, are not overly dominant.

SELECTED REFERENCES:

Core, E.L. 1948. The flora of the Erie Islands. Ohio State Univ. Franz Theodore Stone Lab. Contr. No. 9. 106 p. (See p. 11-15.)

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p. (See p. 393-401.)

Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Geol. Surv. Bull. 16. 424 p. (See p. 223-227.)

Detmers, F. 1912. An ecological study of Buckeye Lake. Proc. Ohio State Acad. Sci. 5(10): 1-138. Spec. Pap. No. 19. (See esp. p. 22-23, 37-41, 76-78, 84.)

Jennings, O.E. 1908. An ecological classification of Cedar Point. Ohio Nat. 8: 291-340. (See p. 304-308, 332-336.)

Judd, J.B. and S.H. Taub. 1973. The effects of ecological changes on Buckeye Lake, Ohio, with emphasis on largemouth bass and aquatic vascular plants. Ohio Biol. Surv. Biol. Notes No. 6. 51 p. (See p. 7-17.)

Lowden, R.M. 1969. A vascular flora of Winous Point, Ottawa and Sandusky counties, Ohio. Ohio J. Sci. 69: 257-284.

Moore, D.L. 1976. Changes in the marsh and aquatic vascular flora of

11.110

East Harbor State Park, Ottawa County, Ohio, since 1895. Ohio J. Sci. 76: 78-86.

Stuckey, R.L. 1971. Changes of vascular aquatic flowering plants during 70 years in Put-in-Bay Harbor, Lake Erie, Ohio. Ohio J. Sci. 71: 321-342.

____________. 1978. The decline of lake plants. Nat. Hist. 8: 66-69.

____________, J.R. Wehrmeister and R.J. Bartolotta. 1978. Submersed aquatic vascular plants in ice-covered ponds of central Ohio. Rhodora 80: 575-580.

## Floating-leaved Marsh 11.210

DESCRIPTION: Herbaceous plants with floating leaves dominate part of a lacustrine system. The predominant flowering species include:

| | | | |
|---|---|---|---|
| Pondweeds, | Potamogeton spp. | Smartweeds, | Polygonum amphibium |
| Duckweeds, | Lemna minor | | P. coccineum |
| | L. trisulca | Water-lilies, | Nymphaea odorata |
| | Spirodela polyrhiza | | N. tuberosa |
| Water-meals, | Wolffia columbiana | | |
| | W. punctata | | |

Other flowering species (e.g. Brasenia schreberi, Callitriche spp.) may occasionally be present. Lotus (Nelumbo lutea) may also occur as a floating-leaved species, though it often becomes emersed. Non-flowering plants, such as water-fern (Azolla caroliniana) and the purple-fringed riccia (Ricciocarpus natans), may be present in some places. The community type is distinct physiognomically from other marsh community types. It may occur over a submergent marsh or intermixed with an emergent marsh or other wetland community, but it should be inventoried separately.

Floating-leaved marshes generally have distinct boundaries set by deeper open water and other communities in shallower water, including other marsh types, shrub swamps and bogs. Long-term natural succession of floating-leaved marshes usually results in their gradual replacement by emergent communities as their waters become shallower from deposition. Short-term succession, however, may parallel either rising or falling water levels resulting from local hydrological conditions. The extent and diversity of floating-leaved marshes may vary annually depending on prevailing water levels.

Ecological data on floating-leaved marshes in Ohio are limited to primarily qualitative studies of selected water bodies. A few studies (e.g. Judd and Taub 1973; Lowden 1969; Moore 1976; Stuckey 1971, 1978) have evaluated floristic changes which have occurred in specific Ohio marshes during the last few decades.

DISTRIBUTION: Floating-leaved marsh communities of different species occur throughout the world where physical conditions permit. In proximity to Ohio, they occur in all regions but are especially common to the north, in Michigan, Ontario and New York. Their species compositions vary in relation to their distances from Ohio. Floating-leaved marsh stands occur in all regions of the state but are more prevalent in the glaciated sections, especially adjacent to western Lake Erie. Inland they occur as natural stands in kettle lakes and other ponded uplands on glacial till, and occasionally in ponds on terraces of existing or preglacial streams. Some of these water bodies are created or augmented by beavers.

Examples of natural floating-leaved marshes include those at Carp Pond and Sheldon's Marsh (Erie Co.), Pickerington Marsh (Franklin Co.) and Stages Pond (Pickaway Co.). Many altered or artificial stands occur at public reservoirs and, especially along western Lake Erie, public and private wildlife areas.

11.210

STATUS: Natural floating-leaved marshes in Ohio have declined in quality and quantity since the advent of European settlement. Many have been drained or flooded, and most are affected by pollution. Motor boats have affected some stands. Good quality natural examples are becoming rare.

INVENTORY GUIDELINES: All relatively natural stands of floating-leaved marsh in Ohio should be inventoried. Stands including the less common species of duckweeds and pondweeds are especially important, whereas stands restricted to common species, like Lemna minor, should be inventoried only when significant for additional reasons. Efforts on stands in reservoirs should receive low priority.

SELECTED REFERENCES:


Core, E.L. 1948. The flora of the Erie Islands. Ohio State Univ. Franz Theodore Stone Lab. Contr. No. 9. 106 p. (See p. 11-15.)

Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Geol. Surv. Bull. 16. 424 p. (See p. 227-230.)

Detmers, F. 1912. An ecological study of Buckeye Lake. Proc. Ohio State Acad. Sci. 5(10): 1-138. Spec. Pap. No. 19. (See esp. p. 23, 37-43, 77-78.)

Jennings, O.E. 1908. An ecological classification of Cedar Point. Ohio Nat. 8: 291-340. (See p. 307-309, 332-337.)

Judd, J.B. and S.H. Taub. 1973. The effects of ecological changes on Buckeye Lake, Ohio, with emphasis on largemouth bass and aquatic vascular plants. Ohio Biol. Surv. Biol. Notes No. 6. 51 p. (See p. 7-17.)

Lowden, R.M. 1969. A vascular flora of Winous Point, Ottawa and Sandusky counties, Ohio. Ohio J. Sci. 69: 257-284.

Moore, D.L. 1976. Changes in the marsh and aquatic vascular flora at East Harbor State Park, Ottawa County, Ohio, since 1895. Ohio J. Sci. 76: 78-86.

Stuckey, R.L. 1971. Changes of vascular aquatic flowering plants during 70 years in Put-in-Bay Harbor, Lake Erie, Ohio. Ohio J. Sci. 71: 321-342.

____________. 1978. The decline of lake plants. Nat. Hist. 8: 66-69.

## Mixed Emergent Marsh 11.310

DESCRIPTION: Emersed herbaceous plants (or plants commonly emersed) dominate part of a lacustrine community. The community may be simple to complex per stand, but is highly variable in total composition across Ohio. Predominant species include:

Bluejoint, Calamagrostis canadensis
Manna Grass, Glyceria spp.
Rice Cutgrass, Leersia oryzoides
Reed Canary Grass, Phalaris arundinacea
Reed Grass, Phragmites communis
Cordgrass, Spartina pectinata
Sedges, Carex spp.
Umbrella-sedges, Cyperus spp.
Spike-rushes, Eleocharis spp.
Bulrushes, Scirpus spp.
Marsh Fern, Thelypteris palustris
Narrow-leaved Cattail, Typha angustifolia
Broad-leaved Cattail, T. latifolia
Bur-reeds, Sparganium spp.
Water-plantain, Alisma subcordatum
Arrowheads, Sagittaria spp.
Sweetflag, Acorus calamus
Arrow Arum, Peltandra virginica
Pickerelweed, Pontederia cordata
Rushes, Juncus spp.
Iris, Iris versicolor
Iris, I. virginica
Smartweeds, Polygonum spp.
Docks, Rumex spp.
Lotus, Nelumbo lutea
Yellow Pond-lily, Nuphar advena
Rose-mallows, Hibiscus spp.
Swamp Loosestrife, Decodon verticillatus
Loosestrife, Lythrum alatum
Purple Loosestrife, L. salicaria (an exotic)
Mermaid-weed, Proserpinaca palustris
Swamp Milkweed, Asclepias incarnata
Vervains, Verbena spp.
Beggar-ticks, Bidens spp.

The community includes not only plants emerging from water but also those growing on adjacent, wet sand or mud bars, flats and banks. It often occurs in close association with floating-leaved and submergent marsh communities but should be inventoried separately from these. Emergent marsh communities with over half their covers in cattails are classified as cattail marshes, while those with over half their covers in sedge family species, marsh grasses and/or rushes (Juncus spp.) are classified as sedge-grass meadows. Emergent marshes differ from bogs, fens and wet prairies simply in lacking or having low quantities of the indicator species limited primarily to those communities. Emergent marshes, however, do grade into all of these communities and arbitrary judgments must sometimes be made as to which type dominates a given site. As many species may be common in either emergent marshes or these other communities, one often must rely more on indicator species than dominant cover species.

A great complexity of community subsets may exist in a single marsh (see Lowden, 1969, for a good example of this), and emergent marshes vary in composition in different regions and water regimes. If possible, a subclassification of emergent marshes in Ohio should be created. Emergent marshes are commonly bounded towards deep water by floating-leaved or submergent marshes, or open water. Towards drier or other sites, mixed emergent marshes often are bounded by or grade into other emergent marsh types, shrub swamps, bogs or fens. In long-term succession, emergent marshes theoretically become drier due to organic and mineral deposition, and are eventually replaced by shrub swamps and swamp forests. In short-term succession, however, emergent marshes may proceed towards either drier or wetter conditions depending on local physical conditions.

Ecological research on emergent marshes in Ohio has been limited to primarily qualitative studies. Some studies (e.g. Judd and Taub 1973; Lowden 1969; Moore 1976; Stuckey 1971, 1978; Trautman 1981) have documented floristic changes which have occurred in specific Ohio marshes in the last few decades.

DISTRIBUTION: Emergent marsh communities of different species occur throughout the world where physical conditions permit. In proximity to Ohio, they occur in all regions but are especially common to the north, in Michigan, Ontario and New York. Their species compositions vary in relation to their distances from Ohio. They occur in all regions of the state but are more prevalent in the glaciated sections, especially adjacent to western Lake Erie. Inland they occur as natural stands in kettle lakes and other ponded uplands on glacial till, and occasionally in ponds on terraces of existing or preglacial streams. Some of these water bodies are created or augmented by beavers.

Examples of natural emergent marshes include those at Carp Pond and Sheldon's Marsh (Erie Co.), Pickerington Marsh (Franklin Co.) and Stages Pond (Pickaway Co.). Many altered or artificial stands occur at public reservoirs and, especially along western Lake Erie, public and private wildlife areas.

STATUS: Natural emergent marshes in Ohio have declined in quality and quantity since the advent of European settlement. Many have been drained, some have been flooded, and most are affected by pollution. Stuckey (1971, 1978) found that in Put-in-Bay harbor, species with wide ecological amplitudes and characteristic of turbid, warm, poorly oxygenated waters (e.g. *Sparganium eurycarpum*, *Sagittaria latifolia*, *Scirpus atrovirens* and *Asclepias incarnata*) have survived much better than those with narrow ecological amplitudes and characteristic of clear, cool, well-oxygenated waters (e.g. *Sagittaria rigida* and *Scirpus acutus*). Similarly, the spread of the exotic purple loosestrife, crowding out native species, has become a problem in some Ohio marshes since about 1960 (Stuckey 1980). Good quality natural examples are becoming rare.

INVENTORY GUIDELINES: All relatively natural stands of emergent marsh in Ohio should be inventoried when they are of significant size or composition relative to the region in which they occur. Throughout Ohio, small and fairly insignificant stands of emergent marsh occur as small patches or zones of other communities. These usually do not warrant documentation. Marshes with little significance in northern Ohio may be significant in southern Ohio because of the rarity of marshes in the latter area.

SELECTED REFERENCES:

Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402.

Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Geol. Surv. Bull. 16. 424 p. (See p. 227-237.)

Detmers, F. 1912. An ecological study of Buckeye Lake. Proc. Ohio State Acad. Sci. 5(10): 1-138. Spec. Pap. No. 19. (See esp. p. 22-23, 41-43, 76-79, 83-86.)

Jennings, O.E. 1908. An ecological classification of Cedar Point, Ohio Nat. 8: 291-340. (See p. 303-210, 328-330, 332-338.)

Judd, J.B. and S.H. Taub. 1973. The effects of ecological changes on Buckeye Lake, Ohio with emphasis on largemouth bass and aquatic vascular plants. Ohio Biol. Surv. Biol. Notes No. 6. 51 p. (See p. 7-17.)

Lowden, R.M. 1969. A vascular flora of Winous Point, Ottawa and Sandusky counties, Ohio. Ohio J. Sci. 69: 257-284.

Marshall, J. and R. L. Stuckey. 1974. Aquatic vascular plants and their distribution in the Old Woman Creek Estuary, Erie County, Ohio. Center for Lake Erie Area Res., Ohio State Univ., Columbus. 53 p.

Moore, D.L. 1976. Changes in the marsh and aquatic vascular flora at East Harbor State Park, Ottawa County, Ohio, since 1895. Ohio J. Sci. 76: 78-86.

Stuckey, R.L. 1971. Changes of vascular aquatic flowering plants during 70 years in Put-in-Bay Harbor, Lake Erie, Ohio. Ohio J. Sci. 71: 321-342.

_______. 1975. A floristic analysis of the vascular plants of a marsh at Perry's Victory Monument, Lake Erie. Mich. Bot. 14: 144-166.

_______. 1978. The decline of lake plants. Nat. Hist. 8: 66-69.

_______. 1980. Distributional history of Lythrum salicaria (purple loosestrife) in North America. Bartonia 47: 3-20.

Trautman, M.B. 1981. The fishes of Ohio, rev. ed. Ohio State Univ. Press, Columbus. 782 p. (See p. 15-17, 26-27.)

Cattail Marsh 11.320

DESCRIPTION: Cattails (narrow-leaved cattail, Typha angustifolia; broad-leaved cattail, T. latifolia; and/or their intermediates) comprise over half the cover of an emergent marsh community. Associated species may be few to many, including all of those found in mixed emergent marshes. More common associates, variable per stand and region of the state, include:

| | |
|---|---|
| Marsh Fern, Thelypteris palustris | Duckweed, Lemna minor |
| Bur-reed, Sparganium eurycarpum | Pickerelweed, Pontederia cordata |
| Arrowhead, Sagittaria latifolia | False Nettle, Boehmeria cylindrica |
| Bluejoint, Calamagrostis canadensis | Swamp Rose-mallow, Hibiscus moscheutos |
| Rice Cutgrass, Leersia oryzoides | Swamp Rose-mallow, H. palustris |
| Reed Grass, Phragmites communis | Swamp Loosestrife, Decodon verticillatus |
| Sedges, Carex spp. | Bittersweet Nightshade, Solanum dulcamara (an exotic) |
| Three-square, Scirpus americanus | |
| Soft-stem Bulrush, S. validus | Beggar-ticks, Bidens spp. |

Cattail marshes often are nearly pure stands of either cattail species, or of both species segregated into patches or zones. Cattails colonize areas to the exclusion of other species by extensive vegetative reproduction of their rhizomes. They frequently colonize areas recently denuded or exposed by either natural or artificial causes. Associated species which do occur in cattail communities often are restricted to the community margins. Associated species are seldom consistent per stand, as demonstrated in a detailed study by Segadas-Vianna (1951).

Cattail marshes grade into or are bordered by all other herbaceous wetland community types, including other marsh types, shrub swamps, bogs and fens. Long-term succession results in accumulated deposition of their own and other matter, and a subsequent drying of their substrate. They are then usually replaced by sedge or grass meadows, shrub swamps, or swamp forests. Short-term successions may result in reversals towards wetter communities. Isard (1966) described a recent reversal from maple-elm-ash swamp forest to cattail marsh at Mentor Marsh.

Ecological data on Ohio cattail marshes are limited to qualitative species lists and successional schemes. An extensive quantitative study of cattail stands in Oakland County, Michigan was published by Segadas-Vianna (1951).

DISTRIBUTION: Cattails occur in temperate and tropical regions throughout the world. Broad-leaved and narrow-leaved cattails both occur throughout much of North America. Cattail marshes similar to those in Ohio are in all adjacent states and Ontario. Some authorities have referred to broad-leaved cattail as the common inland species, whereas narrow-leaved cattail is more common on the Atlantic coast. Stuckey (1975) and others, however, have reported narrow-leaved cattail to have increased in abundance, relative to broad-leaved cattail, in western Lake Erie in the past few decades.

Cattail marshes occur throughout Ohio, though more frequently in glaciated areas and most abundantly in northern Ohio. They may occur in any wet areas, from lakes to drainage ditches. Several authorities have indicated broad-leaved cattail has a wide tolerance range for pH, while narrow-leaved cattail occurs more frequently in association with basic or saline waters.

Segadas-Vianna (1951), however, found little or no correlation between these species, their associates, and various substrate characteristics.

Examples of cattail marshes in Ohio occur at Mentor Marsh (Lake Co.) and, largely as a secondary community, Springville Marsh (Seneca Co.).

STATUS: Cattail marshes are relatively common in Ohio and not known to be endangered in any specific region or in any specific compositional form. Many of them, however, are secondary communities associated with disturbed areas or newly created ponds or reservoirs. Large natural stands are not common.

INVENTORY GUIDELINES: Inventory efforts should concentrate on larger natural stands exhibiting greater successional stability. Attempts should be made to survey stands of different compositions and different relationships with associated communities. Secondary communities generally should receive little attention, as should minor zonations of cattails in more complex vegetational patterns (although the sum of the parts of these patterns may be significant).

SELECTED REFERENCES:
Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402.

Braun, E.L. 1967. The Monocotyledoneae [of Ohio]: cat-tails to orchids. 464 p. (See p. 17-20.)

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p. (See p. 391-392.)

Detmers, F. 1912. An ecological study of Buckeye Lake. Proc. Ohio State Acad. Sci. 5(10): 1-138. Spec. Pap. No. 19. (See p. 24, 77-79.)

Isard, L.G. [1966.] The vegetation of Mentor Marsh, a preliminary survey. [Cleveland Mus. Nat. Hist., Cleveland.] 27 p. + figs. (See p. 18-25.)

Jennings, O.E. 1908. An ecological classification of the vegetation of Cedar Point. Ohio Nat. 8: 291-340. (See p. 305-306, 329-330, 336-338.)

Lowden, R.M. 1969. A vascular flora of Winous Point, Ottawa and Sandusky counties, Ohio. Ohio J. Sci. 69: 257-284.

Segadas-Vianna, F. 1951. A phytosociological and ecological study of cattail stands in Oakland County, Michigan. J. Ecol. 39: 316-329.

Stuckey, R.L. 1975. A floristic analysis of the vascular plants of a marsh at Perry's Victory Monument, Lake Erie. Mich. Bot. 14: 144-166. (See p. 163.)

Sedge-Grass Meadow 11.330

DESCRIPTION: Sedge family members, characteristic grasses, rushes (i.e. *Juncus* spp.), and /or bur-reeds (i.e. *Sparganium* spp.) comprise over half the cover of an emergent marsh or wet meadow. Predominant species include:

- Marsh Fern, *Thelypteris palustris*
- Narrow-leaved Cattail, *Typha angustifolia*
- Broad-leaved Cattail, *T. latifolia*
- Bur-reed, *Sparganium americanum*
- Bur-reed, *S. eurycarpum*
- Bluejoint, *Calamagrostis canadensis*
- Fowl Manna Grass, *Glyceria striata*
- Rice Cutgrass, *Leersia oryzoides*
- Reed Canary Grass, *Phalaris arundinacea*
- Sedge, *Carex comosa*
- Sedge, *C. crinita*
- Sedge, *C. frankii*
- Sedge, *C. granularis*
- Sedge, *C. grayii*
- Sedge, *C. hystricina*
- Sedge, *C. lanuginosa*
- Sedge, *C. lupulina*
- Sedge, *C. scoparia*
- Sedge, *C. squarrosa*
- Sedge, *C. stipata*
- Sedge, *C. stricta*
- Sedge, *C. tribuloides*
- Sedge, *C. vulpinoidea*
- Twig-rush, *Cladium mariscoides*
- Umbrella-sedges, *Cyperus* spp.
- Three-way Sedge, *Dulichium arundinaceum*
- Spike-rush, *Eleocharis acicularis*
- Spike-rush, *E. calva*
- Spike-rush, *E. obtusa*
- Spike-rush, *E. smallii*
- Fimbristylis, *Fimbristylis autumnalis*
- Beak-rushes, *Rhynchospora* spp.
- Three-square, *Scirpus americana*
- Bulrush, *S. atrovirens*
- Wool-grass, *S. cyperinus*
- River Bulrush, *S. fluviatilis*
- Bulrush, *S. lineatus*
- Soft-stem Bulrush, *S. validus*
- Rush, *Juncus acuminatus*
- Rush, *J. dudleyi*
- Rush, *J. effusus*
- Rush, *J. tenuis*
- Rush, *J. torreyi*

Various forbs may also be present, but they characteristically occur in relatively low abundances. Sedge-grass meadows are similar to and often grade into mixed emergent marshes, fens and wet or wet-mesic prairies, but they lack the species, especially forbs, which characterize these communities. In some stands, however, it is more appropriate to consider sedge-grass meadows as simpler variations or extensions of these communities.

The community varies in composition per region and site. A more commonly encountered combination is that dominated by just sedges (i.e. *Carex* spp.) and/or bluejoint. Some sedges and bluejoint form nearly pure stands by prolific reproduction through their rhizomes and the formation of tussocks or "tussock meadows." A good review of such meadows was given by Curtis (1959, p. 369-372). Some sedge meadows in the sandy swales of the Oak Openings in northwestern Ohio are dominated by spike rushes, twig-rush, beak-rush (*R. capitellata*) and, in small local areas, fimbristylis. Aldrich (1941) described the "*Juncus-Scirpus* Associes," usually dominated by *Juncus effusus*, wool-grass, and sometimes rice cutgrass, as a major secondary community in northeastern Ohio.

Sedge-grass meadows are associated and form continuums with nearly all wetland community types, including swamp forests. They commonly succeed to shrub swamps. Many, if not most, of these meadows are secondary in origin following cutting and grazing of swamp forests, and grazing, draining and burning of marshes and wet prairies. Succession in these secondary stands proceeds more rapidly than in the primary, more stable stands.

Ecological research on sedge-grass meadows in Ohio has been limited to abbreviated floristic surveys of selected areas.

DISTRIBUTION: Sedge-grass meadows are distributed worldwide in temperate and boreal regions. In North America, they are most common in the glaciated regions. Close to Ohio, they are common in Michigan, Wisconsin and Ontario.

The meadows occur on wet or seasonally wet soils throughout Ohio. They are most common on poorly drained uplands and around lakes in the Glaciated Plateau of northeastern Ohio and Till Plains of western Ohio. They were probably once common in the Lake Plains but most have been plowed under. They are still common in the interdunal swales of the Oak Openings. In the Unglaciated Plateau, they are restricted mostly to cleared floodplains and terraces. They basically occur on mineral soils but may develop over peat, much of which is derived from the deposition of their own organic matter. The soils are all usually wet in the spring, but some may become quite droughty by late summer.

Few, good, knowingly primary stands of sedge-grass meadows exist in Ohio. One good but less typical example is the major community at Irwin Prairie (Lucas Co.). Partially secondary examples occur at Springville Marsh (Seneca Co.) and Kiser Lake Wetlands (Champaign Co.).

STATUS: Whereas secondary stands of sedge-grass meadows are relatively common in patches, often small, throughout the state, sizeable probable primary stands are few. Some primary stands have undoubtedly been destroyed by draining and farming. Drainage, followed by either human destruction or increased succession rates, is the major threat to those remaining primary stands.

INVENTORY GUIDELINES: All primary sedge-grass stands of significant size or composition should be inventoried. Narrow zones around lakes should not be ignored but will often be included in an inventory as part of a mixed emergent marsh stand. Secondary stands are not usually important for inventory, but occasionally may warrant attention if they have attained relative successional stability or are unusual in composition.

SELECTED REFERENCES:

Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402.

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p. (See p. 365-377.)

Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Geol. Surv. Bull. 16. 424 p. (See p. 232-235.)

Gordon, R.B. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113. (See p. 54, 47, 66.)

Jennings, O.E. 1908. An ecological classification of the vegetation of Cedar Point, Ohio Nat. 8: 291-340. (See p. 305, 328-329, 338-339.)

Tryon, C.A. and N.W. Easterly. 1975. Plant communities of the Irwin Prairie and adjacent wooded areas. Castanea 40: 201-213.

## Submergent Riverine Community 12.110

DESCRIPTION: Submersed herbaceous plants dominate part of a riverine system. Predominant flowering species include:

| | |
|---|---|
| Pondweeds, Potamogeton spp. | Eelgrass, Vallisneria americana |
| Waterweed, Elodea canadensis | Coontail, Ceratophyllum demersum |
| Waterweed, E. nuttallii | Water-milfoil, Myriophyllum spicatum (an exotic) |

Other flowering species, aquatic mosses and the liverwort Riccia fluitans occur infrequently. Several filamentous algae species are commonly present. The community type often occurs intermixed with or adjacent to floating-leaved or emergent riverine communities, but should be inventoried separately from these. The type includes stands in water which flows either all or part (e.g. oxbows) of a year, usually every year. The type excludes headwater marshes which normally display very slow flowage and are not subjected to large annual sediment movements. The distinction between a marsh and river system, however, is not always clear.

Submergent riverine communities usually are bounded by open water on the channel sides of deeper streams, and by emergent communities or stream banks on the shallower sides. Orderly successional patterns are generally disrupted by the annual movements of sediments and the subsequent reformations of the channel. Successions are based more on physiographic than autogenic developments.

Ecological data on submergent riverine communities in Ohio are nearly nonexistent. A few species lists have been compiled.

DISTRIBUTION: Submergent riverine communities occur throughout the world. They occur in all regions around Ohio and generally differ in their species compositions in direct relationship to their distance from the state. The communities occur in stream channels and floodplain ponds and oxbows throughout Ohio.

STATUS: Submergent riverine stands are common in Ohio but most consist of algae and, locally, a few flowering plant species highly tolerant of pollutants, turbidity and warmer water. Trautman (1981) explained that early 19th century Ohio streams contained abundant vegetation in quiet, unshaded water. Less aquatic vegetation grew in areas shaded by trees, which then were larger and denser. Since that period, dredging, pollution, sedimentation and turbidity have eliminated the large and more diverse beds of submersed vegetation. The introduction of carp has probably augmented these problems significantly. Many oxbows or floodplain ponds have been filled for farming. Stuckey (1976) found submersed vascular species generally absent form the Sandusky River system today as a result of turbidity and silted bottoms.

These degraded conditions probably persist in most streams of the state. Sewage and industrial pollution is better controlled in many areas, but short-term pollution slugs probably offset most advances in biotic life. Runoff of sediments, fertilizers and, possibly, herbicides remains a major problem in, especially, the agricultural areas of western and northern Ohio. Reforestation has helped reduce agricultural sedimentation in southeastern Ohio streams during the past few decades, but much of this has been offset by increased sedimentation and acid drainage from coal mines. As a result of all of these factors, high quality submergent riverine communities in Ohio are now very rare.

INVENTORY GUIDELINES: All substantial submergent riverine stands in relatively unpolluted water, containing rare native species, or containing a high diversity of species should be inventoried. Stands consisting primarily of algae should be inventoried only when known to be significant.

SELECTED REFERENCES:

Stuckey, R.L. 1976. Aquatic vascular plants of the Sandusky River Basin. Pages 295-333 in D.B. Baker, W.B. Jackson and B.L. Prater, eds. Sandusky River Basin Symposium, May 2-3, 1975, Tiffin, Ohio. U.S. Gov. Printing Office, Washington, D.C.

Trautman, M.B. 1981. The fishes of Ohio, rev. ed. Ohio State Univ. Press, Columbus. 782 p. (See p. 15-27.)

Floating-leaved Riverine Community 12.210

DESCRIPTION: Herbaceous plants with floating leaves dominate part of a riverine system. Predominant flowering species include:

Pondweeds, Potamogeton spp.
Duckweed, Spirodela polyrhiza
Duckweed, Lemna minor

Other flowering species (e.g. Polygonum amphibium, Nymphaea sp., Callitriche sp.) and, rarely, non-flowering species may be present. The community type often occurs intermixed with or adjacent to submergent or emergent riverine communities, but should be inventoried separately from these. The type includes stands in water which flows either all or part (e.g. oxbows) of a year, usually every year. The type excludes headwater marshes which normally display very slow flowage and are not subjected to large annual sediment movements. The distinction between a marsh and riverine system is not always clear.

Floating-leaved riverine communities may occur over the entire breadth of slow streams, or may be restricted to the slower waters in shallower or more protected areas. They may cover the middle surfaces of oxbows or floodplain ponds. They are commonly bordered by deeper or more rapidly moving open water, and by emergent vegetation on river banks in shallower areas. Flooding, usually annually, shifts their substrates and prevents predictable succession patterns. On a very general, long-term scale, base leveling results in larger, slower streams more suitable to many floating-leaved species.

Little ecological data on Ohio floating-leaved riverine communities exist. The rarity, low diversities and disturbed natures of these communities reduce interest in them.

DISTRIBUTION: Floating-leaved riverine communities occur in most river systems of the world, and in most major systems in states adjacent to Ohio. In Ohio, they are most prevalent in the larger rivers, those with slower currents and more abundant oxbows and floodplain ponds.

STATUS: Duckweed communities are common in Ohio, being usual features over the slower currents of stream margins in the low water periods of late summer. They commonly cover the surfaces of floodplain ponds and oxbows not otherwise dominated by emersed species. Fertilizer runoff possibly stimulates their growth. The rarer duckweed species are not common and have probably declined. The smaller rooted floating-leaved species, such as pondweeds and smartweeds, are not as common in the state, and often consist of the more disturbance-tolerant species. In some streams, they are more frequent in more protected backwater areas. It is difficult to say how common the rooted species were prior to European settlement, but it is probable they were more common and diverse than today. They have undoubtedly been affected by stream dredging, brush clearing and deforestation which have stream-lined channels and altered stream flows; by increased sedimentation of their substrates; and by increased levels of fertilizers, herbicides, organics, metals, mine acids and temperatures.

Water-lilies probably were never common in Ohio rivers and today are almost absent from them. They require slow currents and are generally restricted to lower, more mature stream gradients.

INVENTORY GUIDELINES: Duckweed stands in Ohio rivers are common and only the largest usually warrant inventory efforts, unless they include uncommon duckweed or other floating-leaved species. Substantial stands of non-duckweed species are not common and usually should be inventoried. Stands containing water-lilies should always be documented.

quadrat data for stands along the Scioto, Hocking and Muskingum rivers, and Stuckey and Wentz (1969) studied the effects of pollution in a section of the Ottawa River.

DISTRIBUTION: Emergent riverine communities occur in most river systems of the world, and in all regions adjacent to Ohio. Those in the eastern deciduous forest region have generic compositions similar to those in the state. Emergent communities exist in all Ohio streams not recently dredged or channelized.

The communities exist wherever seed or propagule stock colonizes an environment periodically or always innundated by flowing water. The communities vary in composition depending on stream gradients, frequencies and durations of floods, water and substrate chemistries, current and historical human impacts, and other factors.

One good example of a mixed emergent riverine community occurs at Dupont Marsh on the Huron River, Erie County.

STATUS: Small bands of mixed emergent riverine communities are common along the margins of streams throughout Ohio, but large stands (excluding water-willow stands) are uncommon. Although large stands may never have been common in the state, those which did occur have been heavily impacted by man. Trautman (1981) related historical descriptions of streams with large stands of wild rice (Zizania aquatica, now a threatened species in Ohio) and other aquatic vegetation. Channelization; dredging; dams; and agricultural, urban, industrial and mine pollution have undoubtedly affected the qualities and quantities of most stands. Stuckey and Wentz (1969) for example, found in the Ottawa River that many southern, ecologically narrow species had been replaced by more tolerant, widespread species, largely as a result of industrial pollution. They listed the following as southern, less tolerant species:

Carex frankii
Scirpus americanus
Saururus cernuus
Rumex verticillatus
Amaranthus tuberculatus
Strophostyles helvola
Hibiscus militaris
Samolus parviflorus
Lippia lanceolata
Lycopus rubellus
Physostegia virginiana
Justicia americana
Eclipta alba
Helenium autumnale

They listed the following as widespread, tolerant speices:

Sagittaria latifolia
Polygonum coccineum
P. hydropiper
P. lapathifolium
P. pensylvanicum
P. persicaria
P. punctatum

Koryak (1978) noted that greater control of water level fluctuations in dam pools of the Monongahela River, Pennsylvania has possibly inhibited emergent vegetation growth.

INVENTORY GUIDELINES: All sizeable emergent riverine communities in Ohio should be inventoried, especially those with higher diversities of less common, less tolerant species. Narrow marginal stream bands usually

Mixed Emergent Riverine Community 12.310

DESCRIPTION: Emersed herbaceous plants (or plants commonly emersed) dominate part of a riverine system. Predominant flowering species include:

Broad-leaved Cattail, Typha latifolia
Bur-reed, Sparganium americanum
Bur-reed, S. eurycarpum
Water-plantain, Alisma subcordatum
Arrowheads, Sagittaria spp.
Rice Cutgrass, Leersia oryzoides
Sedges, Carex spp.
Umbrella-sedges, Cyperus spp.
Spike-rushes, Eleocharis spp.
Bulrush, Scirpus atrovirens
Soft-stem Bulrush, S. validus
Rushes, Juncus spp.
Lizard's-tail, Saururus cernuus
Smartweeds, Polygonum spp.
Docks, Rumex spp.
Yellow Pondlily, Nuphar advena
Halberd-leaved Rose-mallow, Hibiscus militaris
Swamp Milkweed, Asclepias incarnata
Fog-fruit, Lippia lanceolata
Monkey-flower, Mimulus ringens
Water-willow, Justicia americana
Beggar-ticks, Bidens spp.

The community type often occurs adjacent to floating-leaved or submergent riverine communities, but should be inventoried separately from these. Stands with covers more than half in water-willow are classified separately. The type includes not only emersed plants but also herbaceous plants on adjacent wet bars or banks of mud, sand or rocks. It includes stands along the main channels of streams, and those in ponds and oxbows of floodplains which are usually flooded annually. It excludes headwater marshes which usually have very slow currents and are not affected by large annual sediment movements. Marshes and riverine communities, however, are indistinguishable in some areas.

Emergent riverine communities commonly occur in the margins and shallows of streams and are bordered on their channel sides by open water, submergent riverine communities or, less frequently, floating-leaved communities. On the shoreward sides they are bordered by various communities on wet to dry substrates. These are most commonly floodplain forests, often only in narrow bands between the streams and farm fields. Shrubs, such as sandbar willow (Salix interior) and buttonbush (Cephalanthus occidentalis), frequently characterize the streamside borders of these forests. Small, seasonally xerophytic herbaceous communities sometimes occur on sand or gravel bars or banks adjacent to the emergent stands. These are rapidly changing communities consisting largely of "weedy" annuals or first-year perennials which colonize newly exposed deposits after flood waters have subsided.

The substrate and water environment of emergent riverine stands is often too dynamic to allow predictable successional patterns. In some situations, however, flood-tolerant shrubs and trees may become established in emergent communities, leading to the development of floodplain forests. The developing root and rhizome systems of the emergents and woody species help stabilize the substrate, while the stems of woody species slow the currents of floods, allowing sediment deposition and further community development.

Ecological data on emergent riverine communities in Ohio are limited mostly to species lists (see Selected References). Lewis (1975) compiled should not be inventoried unless they have significantly diverse or unusual compositions. Only the largest or more diverse natural oxbows and floodplain ponds should be documented.

SELECTED REFERENCES:

Braun, E.L. 1916. The physiographic ecology of the Cincinnati region. Ohio Biol. Surv. 2: 113-211. Bull. No. 7 (See p. 194-197.)

Koryak, M. 1978. Emergent aquatic plants in the upper Ohio River and major navigable tributaries, West Virginia and Pennsylvania. Castanea 43: 228-237.

Lewis, K.P. 1975. Community analysis and the dynamics of establishment of Acer saccharinum on flood plains of the Unglaciated Appalachian Plateau. Ph.D. diss., Ohio University, Athens. 111 p. + appendices. (See p. 47-59.)

Lindsey, A.A., R.O. Petty, D.K. Sterling and W. VanAsdall. 1961. Vegetation and environment along the Wabash and Tippecanoe rivers. Ecol. Mon. 31: 105-156. (See p. 111, 114-122, 147-153.)

Stuckey, R.L. 1976. Aquatic vascular plants of the Sandusky River Basin. Pages 295- 333 in D.B. Baker, W.B. Jackson and B.L. Prater, eds. Sandusky River Basin Symposium, May 2-3, 1975, Tiffin, Ohio. U.S. Gov. Printing Office, Washington, D.C.

_______, and W.A. Wentz. 1969. Effect of industrial pollution on the aquatic and shore angiosperm flora in the Ottawa River, Allen and Putnam counties, Ohio. Ohio J. Sci. 69: 226-242.

Trautman, M.B. 1981. The fishes of Ohio, rev. ed. Ohio State Univ. Press, Columbus. 782 p. (See p. 15-17, 26-27.)

Water-willow Riverine Community 12.320

DESCRIPTION: Water-willow (Justicia americana) comprises over half the cover of an emergent riverine community. It usually grows in nearly pure stands, or in patches mostly segregated from patches of other species. Hence, there possibly are no species which may be termed true, strong associates. Examples of the types of species which may occur in limited association with water-willow include:

Lizard's-tail, Saururus cernuus
Sandbar Willow, Salix interior
Smartweeds, Polygonum spp.
Docks, Rumex spp.
Dodder, Cuscuta gronovii
Monkey-flower, Mimulus ringens
Beggar-ticks, Bidens spp.

Many other species occur at least locally or as scattered individuals. Lizard's-tail is the most prominent associate in several streams in central and southwestern Ohio. Here patches or zones of water-willow alternate with patches of lizard's-tail. Dodder, a parasite, forms conspicuous orange-yellow entanglements in many water-willow stands in late summer.

Vegetational succession in riverine water-willow stands is unpredictable. Stands in some situations probably undergo few changes before their habitats are obliterated by subsequent channeling of the river. Many of these flood-prone habitats are apparently harsh enough that few species can compete effectively with the water-willow. It persists largely through its prolific and somewhat protected rhizome system. The rhizomes are sheltered not only from rushing water and sediments but also from the cutting actions of debris and ice. Colonies do promote sediment deposition which occasionally may help willow (Salix spp.) stands get started, promoting further deposition. Through time, water-willow stands probably migrate across and along river valleys in response to the migration of river channels, occupying new habitats and relinquishing old ones.

Penfound (1940) and Lewis (1975, 1980) reported various aspects concerning the biology of water-willow. The species produces nearly 21 linear feet of rhizomes per square foot of substrate, and averages about 15 erect stems per square foot. The species forcibly ejects seeds which can germinate immediately, and which, when they are not destroyed by floods, may be important in colonizing new areas. However, vegetative reproduction, by means of rhizome growth or transport of pieces of aerial stems or rhizomes, is the main propagation method. Fragmentation by flooding probably aids the process.

Lewis (1975) also conducted quadrat studies on water-willow communities in southern Ohio, but encountered only water-willow in these samples. Besides the studies of Lewis (1975, 1980), no work specifically on Ohio water-willow communities is known to have been done.

DISTRIBUTION: Water-willow occurs throughout most of eastern United States east of the Mississippi, and southeastern Canada (Penfound 1940). The species forms sizeable stands in suitable habitats throughout most of this range. It occurs throughout Ohio, generally in rocky riffles or margins of streams. The stands studied by Lewis (1980) were over substrates of mostly gravel and sand with p.H.'s of usually 7.0-7.8. Most of his stands were 10-30 cm above river level in the summer.

Good examples of water-willow communities occur on the Maumee River near Grand Rapids, and on the Olentangy River between Delaware and Columbus.

STATUS: Water-willow communities are common in Ohio and not known to be endangered. Stuckey and Wentz (1969), however, termed water-willow a southern, ecologically narrow species which possibly has been eliminated by industrial pollution in part of the Ottawa River. It is possible that water-willow communities in Ohio are being affected by industrial and other types of pollution but not in obvious amounts or rates. Controlled experiments similar to those conducted by Lewis (1975, 1980) could yield significant results.

INVENTORY GUIDELINES: Because of their current commonness in Ohio, only the more significant water-willow stands should be inventoried. Significance may be based on size, relationships with other species, local rarity, or other factors.

SELECTED REFERENCES:

Lewis, K.P. 1975. Community analysis and the dynamics of establishment of Acer saccharinum on flood plains of the Unglaciated Appalachian Plateau. Ph.D. diss., Ohio Univ., Athens. 111 p. + appendices. (See p. 36, 55, 73, 95.)

_______. 1980. Vegetative reproduction in populations of Justicia americana in Ohio and Alabama. Ohio J. Sci. 80: 134-137.

Penfound, W.T. 1940. The biology of Dianthera americana L. Am. Midl. Nst. 24: 242-247.

Stuckey, R.L. and W.A. Wentz. 1969. Effect of industrial pollution on the aquatic and shore angiosperm flora in the Ottawa River, Allen and Putnam counties, Ohio. Ohio J. Sci. 69: 226-242.

## Mixed Shrub Swamp 13.110

DESCRIPTION: Characteristic shrub species, singly or in combination, comprise over half the cover of a wetland. Predominant species include:

Peach-leaved Willow, Salix amygdaloides
Heart-leaved Willow, S. cordata
Pussy Willow, S. discolor
Shining Willow, S. lucida
Black Willow, S. nigra
Silky Willow, S. sericea
Speckled Alder, Alnus rugosa
Common Alder, A. serrulata
Black Chokeberry, Pyrus melanocarpa
Swamp Rose, Rosa palustris
Meadow-sweet, Spiraea alba
Winterberry, Ilex verticillata
Dogwood, Cornus amomum
Silky Dogwood, C. obliqua
Gray Dogwood, C. racemosa
Red Osier, C. stolonifera
Highbush Blueberry, Vaccinium corymbosum
Bittersweet Nightshade, Solanum dulcamara
Buttonbush, Cephalanthus occidentalis
Common Elder, Sambucus canadensis
Arrow-wood, Viburnum recognitum

Shrub swamps with over half their covers dominated by alders or buttonbush are classified separately. General mixed shrub swamps are not always easily differentiated from stands or zones of tall shrub bogs, and the two may occasionally grade into each other in certain habitats. Tall shrub bogs are dominated by characteristic shrubs (highbush blueberry, alder, black chokeberry, poison sumac, winterberry, mountain holly, and leatherleaf), are accompanied by characteristic bog herbs, and are underlain by carpets of sphagnum over thick peat. General shrub swamps may also have sphagnum, but it does not occur in thick continuous mats, and there has not been a thick accumulation of peat. Shrub swamps often represent successional stages intermediate between various wet open communities and swamp forests. Hence, their herbaceous compositions may consist of elements from both of these extremes, but they gradually change toward a dominance by forest species as succession proceeds. Generally, however, emersed marsh-meadow herbs typify most primary and more stable shrub swamps, although the abundance and diversity of these herbs is characteristically reduced as the shrubs expand to form dense, dark, impenetrable thickets. In many situations, shrubs and associated herbs will invade a marsh or meadow by first colonizing the hummocks which extend above water. At first, the depressions between the hummocks will remain wet and occupied by aquatic species, but gradually they are filled to the point that the shrubs extend across them. The shrubs develop rapidly then, usually forming a well defined boundary with the marsh. Secondary shrub swamps may have more forest herbs and more weedy species.

Mixed shrub swamps vary in composition in different regions of Ohio, largely in response to substrate and physiographic differences. Shrubs swamps over the calcareous substrates of western Ohio usually are composed of combinations of dogwoods, willows, buttonbush and swamp rose. Those with alders are restricted mostly to eastern Ohio. Those with northern, often bog-related, species are more prevalent in the kame and kettle deposits and colder climate of northeastern Ohio. Alder shrub swamps and buttonbush shrub swamps are classified as separate entities because of the relative commonness with which those species occur in nearly pure stands. They, however, are not significantly different from many mixed shrub swamps, and may more accurately be considered as simple variations of mixed communities rather than as exclusive types. Mixed shrub swmaps also vary in composition as a result of their origin. Aldrich (1941), for example, considered buttonbush-alder as a major primary community in northeastern Ohio, and dogwood-rose-meadow sweet a major secondary community.

Primary shrub swamps characteristically occur in zones between marshes, wet meadows or fens and swamp forests. This placement illustrates their successional position. Primary stands are quite stable and may last for decades, especially with fluctuating water levels which retard forest development. Secondary stands are less stable, largely due to the pre-existence of drier, more developed soils suitable for forests. Curtis (1959), however, indicated that tree invasion of the dense secondary "shrub-carrs" of Wisconsin is slow, requiring over 50 years in the larger stands.

Ecological data on shrub swamps in Ohio are limited to species lists and subjective determinations of dominants on selected areas.

DISTRIBUTION: Mixed shrub swamps with species typical in Ohio occur throughout the eastern deciduous and boreal forest regions of North America. They are most common in the glaciated regions north of Ohio. They occur throughout Ohio in variable compositions as noted under Description above. In the glaciated region, primary stands occur mostly as zones around natural lakes or fens. Secondary communities may occur where any former wetland communities have been altered. In unglaciated Ohio, they are more restricted, usually associated with wet areas on floodplains and terraces. Many existing stands in southeastern Ohio are secondary, having developed since the cutting of floodplain forests.

Examples of mixed shrub swamps exist at Irwin Prairie (Lucas Co.), Mentor Marsh (Lake Co.), Portage Wetlands (Summit Co.), Springville Marsh (Seneca Co.) and Kiser Lake Wetlands (Champaign Co.). All of these, however, have been affected by altered drainages or other impacts.

STATUS: Large stands of mixed shrub swamps probably never did occur in Ohio, and many of the largest stands today are secondary stands resulting from the cutting of swamp forests and the draining of herbaceous wetlands. Many of the secondary stands were subsequently grazed before they succeeded to shrub swamps. Narrow zones of shrub swamps around natural lakes were and continue to be fairly common in the state. Many of these, however, have also been affected by draining, flooding, burning, grazing, etc. Sizeable, relatively stable, natural mixed shrub swamps in Ohio are rare.

INVENTORY GUIDELINES: All larger primary mixed shrub swamps in Ohio should be inventoried. Because of the rarity of these primary stands, the larger and more stable, if any, secondary stands should also be documented. Most small stands need not be recorded unless they display unusual compositional, successional or other significant relationships.

SELECTED REFERENCES:

Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402. (See p. 379-380, 383-393.)

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p. (See p. 352-355.)

Jennings, O.E. 1908. An ecological classification of the vegetation of Cedar Point. Ohio Nat. 8: 291-340. (See p. 309, 330-331, 339.)

Buttonbush Shrub Swamp 13.120

DESCRIPTION: Buttonbush (*Cephalanthus occidentalis*) comprises over half the cover of a shrub swamp. Associates shrubs commonly include:

Peach-leaved Willow, *Salix amygdaloides*
Heart-leaved Willow, *S. cordata*
Pussy Willow, *S. discolor*
Shining Willow, *S. lucida*
Black Willow, *S. nigra*
Silky Willow, *S. sericea*
Common Alder, *Alnus serrulata*
Swamp Rose, *Rosa palustris*
Winterberry, *Ilex verticillata*
Dogwood, *Cornus amomum*
Silky Dogwood, *C. obliqua*
Red Osier, *C. stolonifera*
Highbush Blueberry, *Vaccinium corymbosum*
Common Elder, *Sambucus canadensis*
Arrow-wood, *Viburnum recognitum*

Very often, however, buttonbush is the only shrub present. It frequently occurs in water several decimeters deep and/or in shaded woodland ponds, both conditions of which may restrict the growth of other shrubs. In less extreme situations, buttonbush does exist in association with varying numbers and kinds of other shrubs. The 50% or more cover definition of buttonbush swamps is arbitrary, and these communities in some situations form continuums with mixed shrub swamps. Less frequently buttonbush swamps may grade into alder swamps, and buttonbush seldomly occurs in tall shrub bogs.

The herbs associated with buttonbush swamps are usually those of marsh or wet meadow communities, determined largely by the amount of standing water present. Those in woodland ponds are limited by shade. Buttonbush swamps vary from dense stands with little room or light for understory herbs, to broken stands with considerable space for herbs. Typical herbs associated with buttonbush swamps include manna grasses (*Glyceria* spp.), rice cutgrass (*Leersia oryzoides*), sedges (*Carex* spp.), spike-rushes (*Eleocharis* spp.), smartweeds (*Polygonum* spp.) and swamp loosestrife (*Decodon verticillatus*). Sphagnum may occur locally and provide microhabitats for certain herbs.

Buttonbush swamps characteristically occupy habitats intermediate between marshes and swamp forests. While they may form mosaic patterns with marsh vegetation, they usually have relatively distinct boundaries with the forests, based on water levels. Stands in permanent ponds probably still have considerable stabilities, while those in seasonal ponds or over wet soils are threatened with succesison by swamp forests.

Ecological data on buttonbush swamps in Ohio are limited to primarily species lists of selected areas.

DISTRIBUTION: Buttonbush occurs throughout southeastern Canada and eastern United States, extending south into Mexico. Buttonbush swamps occur in all regions of the state. In glaciated Ohio, they commonly develop on margins of natural lakes or in woodland ponds. In unglaciated Ohio they occur in floodplain or terrace ponds, and in backwaters of the Ohio River.

Good examples of buttonbush swamps in woodland ponds occur at Fowler Woods (Richland Co.) and Blacklick Woods (Franklin Co.).

STATUS: Although many Ohio buttonbush swamps have undoubtedly been drained and cleared, they are frequent in the state and not known to be endangered in any of its regions.

INVENTORY GUIDELINES: All sizeable, natural buttonbush swamps in Ohio should be inventoried. Those comprising narrow zones around ponds, however, will not normally warrant inventory efforts. Secondary buttonbush swamps occasionally develop which, due to their sheer size, are significant enough for documentation.

SELECTED REFERENCES:

Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402. (See p. 379-380, 383-393.)

Andreas, B.K. 1980. The flora of Portage, Stark, Summit and Wayne counties, Ohio. Ph.D. diss., Kent State Univ., Kent. 2 vols. (See p. 60-62.)

Alder Shrub Swamp 13.130

DESCRIPTION: Common alder (Alnus serrulata) or speckled alder (Alnus rugosa) comprise over half the cover of a shrub swamp. Associated shrubs commonly include:

- Peach-leaved Willow, Salix amygdaloides
- Pussy Willow, S. discolor
- Black Willow, S. nigra
- Swamp Rose, Rosa palustris
- Meadow-sweet, Spiraea alba
- Poison Sumac, Rhus vernix
- Winterberry, Ilex verticillata
- Red Osier, Cornus stolonifera
- Highbush Blueberry, Vaccinium corymbosum
- Bittersweet Nightshade, Solanum dulcamara
- Buttonbush, Cephalanthus occidentalis
- Common Elder, Sambucus canadensis
- Arrow-wood, Viburnum recognitum

Alder swamps enriched by other shrub species may be similar and grade into mixed shrub swamps. A designation of a specific stand to one of these types, based on whether it is half or more alder, will sometimes be arbitrary. Alder swmaps also resemble tall shrub bogs. Again, the differentiation may not always be clear, but alder swamps generally lack the massive sphagnum growths and significant populations of bog indicator species associated with tall shrub bogs.

Alder swamps often consist of nearly pure stands of just one of the two alder species, with associated shrubs restricted to the margins. In other situations the alders, both of which may grow several meters tall, form canopies over lower layers of other shrub species. Where alders do occur with other shrub species, the compositions of the stands differ in different regions of Ohio. Common alder is nearly restricted to eastern Ohio, speckled alder is mostly restricted to northern Ohio and, hence, their occurrence in combination is restricted to northeastern Ohio. Several shrubs (e.g., peach-leaved willow, meadow-sweet, poison sumac, winterberry, highbush blueberry and arrow-wood) seldom occur in alder swamps except in northeastern Ohio. Southeastern Ohio alder swamps are generally less diverse than those in northeastern Ohio.

Few data exist on the herbaceous flora associated with Ohio alder swamps. Curtis (1957) indicated that the understory of the community in Wisconsin has a high degree of homogeneity. He noted that reclining plants with weak stems, especially bedstraws (Galium spp.), are numerous. Representative species in primary stands in Ohio include:

- Osmunda cinnamomea
- O. regalis
- Onoclea sensibilis
- Thelypteris palustris
- Typha latifolia
- Carex spp.
- Symplocarpus foetidus
- Polygonum saggitatum
- Caltha palustris
- Impatiens capensis
- Decodon verticillatus
- Galium asprellum
- Bidens spp.

Secondary, often drier stands have more weedy understories, including Panicum spp., Aster spp., Solidago canadensis, etc.

Alder stands in natural situations generally occur in zones or patches between herbaceous or shrubby wetland vegetation and swamp forests bordering streams or lakes. The density and nearly complete crown closure of many stands probably retard succession toward forest. Nevertheless, long-term succession in most stands is toward swamp forest, variable in composition in different regions.

Ecological data on alder swamps in Ohio are limited to species lists of selected areas.

DISTRIBUTION: Common alder occurs throughout most of eastern United States and southeastern Canada, while speckled alder occurs in northeastern and north-central United States and southeastern and south-central Canada. Communities in which alders dominate probably exist through much of those regions. In Ohio, common alder is mostly restricted to the eastern and south-central counties, while speckled alder is mostly restricted to the northern counties, especially those in the northeast. The usual habitats are stream or lake borders, or seeps. The soil is generally a soft humus, quite wet at least part of the year. Curtis (1957) described the water of Wisconsin speckled alder stands to be non-stagnant, nutrient rich, and with a pH of 7.1 to 7.7, though sometimes as low as 4.8. In Ohio, speckled alder is commonly associated with calcareous fen margins as well as acid bogs. Common alder is possibly more common on slightly acid soils.

Alders are unusual in being non-legumes having the capacity to fix nitrogen. As such, they have a competitive advantage in certain nitrogen-deficient environments, possibly including many of the wet mucky soils in which they occur in Ohio.

Curtis (1959) noted that some associated species of alders in Wisconsin were ones believed to have high nitrogen requirements. He also noted that a relationship could exist between the relatively high number of modal species (those with their highest presence percentages in a specific community type) for alder swamps and the soil characteristics produced or influenced by the alder.

STATUS: Alder swamps are frequent in eastern Ohio as small patches or zones, probably similar to their general occurrence there prior to European settlement. Many of these, however, are secondary stands, especially in southeastern Ohio. The probable primary stands appear to have good successional stability, and secondary stands, even if less stable, will probably continue having good opportunities to develop on various disturbed nitrogen-deficient sites.

INVENTORY GUIDELINES: All sizeable, seemingly primary alder swamps in Ohio should be documented. Patches too small to inventory on their own merits should be noted when included in inventories as parts of other vegetational units. Secondary stands should not be recorded unless they are particularly large and stable or significant for other reasons.

SELECTED REFERENCES:

Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402. (See p. 379, 383-393.)

Curtis, J.W. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p. (See p. 355-357.)

Sphagnum Bog 21.110

DESCRIPTION: Sphagnum moss (Sphagnum spp.) and characteristic herbaceous species comprise over half the cover of a community established over peat. The community is commonly called a bog mat or bog meadow. Characteristic herbs include:

Marsh Fern, Thelypteris palustris
Sedges, Carex spp.
Tawny Cotton-grass, Eriophorum virginicum
Beak-rush, Rhynchospora alba
Rushes, Juncus spp.
Pitcher-plant, Sarracenia purpurea
Round-leaved Sundew, Drosera rotundifolia
Marsh St. John's-wort, Hypericum virginicum
Swamp Loosestrife, Decodon verticillatus
Vaccinium macrocarpon, Large cranberry

Other moss genera and many other, often less common herbs may be present, including several endangered species (e.g. Pogonia ophioglossoides, Vaccinium oxycoccos, Menyanthes trifoliata). Scattered individuals or patches of shrubs or trees may be present, including poison sumac (Rhus vernix), mountain-holly (Nemopanthus mucronata), leatherleaf (Chamaedaphne calyculata), highbush blueberry (Vaccinium corymbosum), larch (Larix laricina) and red maple (Acer rubrum). The woody plants frequently are stunted in their growth due to the harsh habitat conditions.

Although the different community zones of a given bog are highly interrelated, they are, for classification and inventory purposes, treated here as separate units. Hence, the sphagnum-mixed herb community or zone shares similarities with and usually adjoins or grades into leatherleaf or tall shrub bog communities or zones. It is differentiated from these communities based on its relative low cover percentages of woody species. The sphagnum community also resembles (and, through time, may alternate with) fen communities having substantial sphagnum development. The fen communities, however, are distinguished by species characteristic of alkaline habitats, in addition to the species which may grow on the acidic sphagnum. As sphagnum is limited neither to bogs or fens, small open patches of miscellaneous herbaceous species over sphagnum may occasionally be confused with bogs. Such patches usually lack deep peat substrates and characteristic bog species. Differentiation between such patches and bogs, however, may be somewhat arbitrary.

Bog mat communities characteristically develop or previously developed next to and over an open lake, although this situation is no longer common in Ohio. The open water may contain various aquatic species and be classified as different types of marsh. The water, however, usually is brown, oxygen-deficient and dystrophic from the accumulation of peat substances and chemicals and it is thusly not representative of that in the average marsh. In many bogs north of Ohio, the outer margin and much of the body of the bog mat consists of sedges. Good sedge mats do not occur in Ohio. Here, the common margin species is swamp loosestrife which extends a mat over water by the growth of entangled arching and floating branches. Sphagnum develops around and over the loosestrife stems, followed, eventually, by bog herbs and shrubs.

A bog mat remains more successionally stable as long as it continues to sink at a rate equal to that of its development. As the mat becomes grounded and firmer, woody plants become more competitive. The classic example depicts the bog mat eventually migrating to the center of the lake, peat deposition eventually filling the lake, and bog shrubs and trees finally succeeding the bog mat. Curtis (1959) noted that estimates of the time required to form a foot of peat in the Great Lakes region range from 100 to 800 years. Hence, the stability of a mat can be determined partly by the depth of water and uncompressed peat beneath it. In Ohio today, most mats have already disappeared through succession, or have been restricted to small patches surrounded, usually, by bog shrubs. Without regressive succession resulting from increased water levels or other disturbances, most remaining bog mats in Ohio will succeed to shrub bog or treed bog communities.

Ecological data on Ohio bogs consist mostly of floristic lists and general process descriptions. Selected references, including the classic work by Dachnowski (1912), are listed below. Limited quantitative data were collected by Mossman (1972) on Camden Lake, Lorain County.

DISTRIBUTION: Bog mat communities with herbaceous species or genera similar to those in Ohio occur through most of southern Canada and northern United States, south in the Appalachians to the Carolinas. Most are north of Ohio, and most in Ohio are in the northeast quarter. A very few herbaceous bog remnants occur in northwestern and north-central Ohio. In northeastern Ohio, the major remnants occur in complex moraine-kame-esker deposits in Geauga, Portage, Summit, and Stark counties. There many are associated with a buried pre-glacial valley of the Teays River system (Andreas 1980).

Bogs in general develop in areas with impeded drainages constantly supplied with water having limited quantities of minerals and nutrients. Most critical are the existence of conditions conducive to the growth and maintenance of sphagnum. Various studies have indicated that sphagnum cannot tolerate immersion by waters rich in minerals, but that it has a competitive advantage in quiet, acid, sterile water. Sphagnum and peat, once established, augment these conditions by releasing additional acids and other substances into the water, and by efficiently absorbing most available minerals. If these sterile water conditions remain relatively stable, the sphagnum can flourish. Once it is established, other characteristic bog plants are provided with a suitable habitat, preexisting marsh species are inhibited by the extreme conditions, and a true bog community develops. The xerophytic forms of some of the mat species reflect the harsh habitat, including the reduced availability of water due to its chemistry and to the high evaporation rates at the mat surface.

Although atypical in its history and its successional and gradient relationships, one of the best sphagnum-mixed herb stands in Ohio is that on Cranberry Island, Buckeye Lake, Licking County.

STATUS: Dachnowski (1912, see his map facing p. 27) described the numerous peat deposits which have formed in Ohio since Pleistocene time. He noted one estimate of 155,047 acres for the state, although only part of this would have been contributed by bog mat communities. These communities and deposits have been radically reduced since European settlement by flooding, draining, burning, and mining.

Bog mat communities, possibly once frequent in northern Ohio, are now rare. The largest natural stand is on Cranberry Island, and this whole island, at the present rate, will be destroyed by erosion in a few decades. All other natural stands are small and threatened with succession, trampling, plant collecting, and elimination for "development." Nearly all are on private land. Some secondary stands do exist, including one large example which has developed in the bottom of a private quarry. The sphagnum, or bog mat, community is one of the most endangered vegetation types in the state.

MANAGEMENT: Sphagnum bogs require protection from human traffic and plant collecting, fires, changes in water qualities, and, if desired, succession. Manipulation of water levels could help control succession, but in some circumstances this might be accomplished only at the expense of other valuable bog zones. Preservation priorities would have to be established in advance of such efforts.

INVENTORY GUIDELINES: Essentially all primary and secondary sphagnum communities in Ohio should be inventoried. A major exception would be small, non-diverse stands or zones of swamp loosestrife or other mat-foundation species followed closely by larger, more significant zones of bog shrubs or trees.

SELECTED REFERENCES:

Andreas, B.K. 1980. The flora of Portage, Stark, Summit and Wayne counties, Ohio. Ph.D. diss., Kent State Univ., Kent. 2 vols. (See p. 62-64 + Description of Selected Areas.)

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Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Geol. Surv. Bull. 16. 424 p. (See esp. p. 237-244.)

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Detmers, F. 1912. An ecological study of Buckeye Lake. Proc. Ohio Acad. Sci. 5(10): 1-138. Spec. Pap. No. 19. (See p. 48-57.)

Gordon, R.B. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113. (See p. 67-70.)

Jones, C.H. 1941. Studies in Ohio floristics, I: Vegetation of Ohio bogs. Am. Midl. Nat. 26: 674-689.

Mossman, R.E. 1972. A floristic and ecological evaluation of Camden (Bog) Lake, Lorain County, Ohio. M.S. thesis, Ohio State Univ., Columbus. 175 p. (See esp. p. 51-52, 62-63.)

Stoutamire, W.P. 1967. Sphagnum. Cranbrook Inst. Sci. News Letter 36: 98-104.

Leatherleaf Bog 21.120

DESCRIPTION: Leatherleaf (Chamaedaphne calyculata) comprises over half the cover of a community established over peat. The community is the usual bog heath or low shrub bog type found in Ohio. Except for a sublayer of sphagnum (Sphagnum spp.), the leatherleaf usually forms nearly pure zones or patches, largely through vegetative reproduction by epicormic shoots and adventitious roots (Swan and Gill 1970). Associated species generally are neither abundant nor consistent. Herbaceous species occuring on margins or in small openings between the shrubs include sedges (e.g. Carex scoparia), cotton-grass (Eriophorum virginicum), swamp loosestrife (Decodon verticillatus) and many other species. In each microhabitat they vary in presence and abundance because of various light, water, and historical conditions. Huckleberry (Gaylussacia baccata), another relatively low shrub, is common on drier margins but generally does not form sizeable stands. Other low heath shrubs common in more northern bogs are nearly non-existant in Ohio, including bog-rosemary (Andromeda glaucophylla, extirpated from Ohio) and Labrador-tea (Ledum groenlandicum, endangered in Ohio). Common marginal or invading tall shrubs and trees include winterberry (Ilex verticillata), highbush blueberry (Vaccinium corymbosum), tamarack (Larix laricina) and red maple (Acer rubrum). Buttonbush (Cephalanthus occidentalis) is the major associate in at least one bog. Although leatherleaf may occur in zones in close association with other bog zones, they are treated separately for inventory purposes.

In the classic example and in many Ohio bogs, leatherleaf occurs as a patch or zone between open water or an herbaceous zone (often of swamp loosestrife) and a tall shrub or tree zone. As succession and peat deposition occur, these zones migrate towards the bog center, the outer ones replacing the inner. The leatherleaf provides a growing surface for the sphagnum, which subsequently provides more rooting medium and mat buoyancy for the leatherleaf. As established portions of the stand gradually sink, the leatherleaf and sphagnum maintain their relative positions by continued vegetative growth. Most remaining herbaceous species are eliminated by the shading and other competitive advantages of the dense leatherleaf. Within time, however, the substrate beneath the outer portion of the leatherleaf zone becomes firm enough that tall shrubs and trees invade and eventually replace the leatherleaf. Although this or a similar progressive succession will usually occur in the long term, shorter-term regressive successions, induced by raised water levels, fires, etc., may occasionally occur. At those times, the leatherleaf and/or the bog mat zones or patches may resume previous dominance levels.

In a very few Ohio bogs, leatherleaf forms nearly complete covers across the entire bogs except on the outer margins. The margins consist of tall shrubs ringed on the outside by moats. Such aspects are more common in bogs north of Ohio. The reason for the extreme dominance of leatherleaf in these situations is not clear. Some may occur in shallower, flatter basins which would support more homogeneous environments and communities. Some may partially result from disturbances to previous communities. Segadas-Vianna (1955) noted that leatherleaf is relatively tolerant of drainage and fire, and that it can rapidly establish nearly pure stands by means of its high vegetative reproduction capacity. Gates (1942) reported leatherleaf stands widespread in a part of northern lower Michigan where fires previously destroyed tree associations. He stated that periodic fire is favorable to the maintenance of leatherleaf. Schwintzer (1979) described a Michigan bog in which a leatherleaf-sphagnum stand, present in 1917, succeeded to trees, but largely recovered following tree mortality because of an increased water level. Leatherleaf may also increase following forest cutting.

Ecological data on leatherleaf stands in Ohio are limited to a few species lists.

DISTRIBUTION: Leatherleaf occurs from Greenland to Alaska, south to northeastern and north-central United States. Segadas-Vianna (1955) called the leatherleaf community one of the most widespread and characteristic American bog associations. Leatherleaf in Ohio is restricted to northeastern Ohio and Cranberry Island, Licking County. Braun (1961) noted the Cranberry Island location probably resulted from human introduction. The species also formerly occurred in northwestern Ohio (Defiance and Williams counties). In habitat, it is limited in the state mostly to bogs. These bogs occur in kettle lakes and other glacial deposits with impeded drainages, mostly in Geauga, Portage, Stark and Summit counties.

STATUS: Leatherleaf communities were probably never common in Ohio in the past two centuries. Today they are limited to northeastern Ohio, and there they are often limited to narrow zones or patches among other bog communities. Frequently, the species is common in a bog but does not form the dominant overstory species. Sizeable leatherleaf stands in Ohio are now rare.

MANAGEMENT: The successional relationships of leatherleaf in Ohio is described above under Description. The requirements of the species here are not well known, but studies in Canada and Michigan have indicated its success may be enhanced in certain situations by elimination of competing trees and tall shrubs, by fire and by altered water levels. Any management applied to a leatherleaf community, however, must be done with caution. Priorities would have to be preestablished as any gain in a leatherleaf zone would take place only at the expense of another zone.

INVENTORY GUIDELINES: All sizeable primary or secondary leatherleaf stands or zones in Ohio should be inventoried.

SELECTED REFERENCES:

Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402. (See p. 371, 383-393.)

Braun, E.L. 1961, 1974 facs. ed. The woody plants of Ohio. Hafner Press, New York. 362 p. (See p. 293.)

Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Geol. Surv. Bull. 16. 424 p. (See esp. p. 245-246.)

Gates, F.C. 1942. The bogs of northern lower Michigan. Ecol. Mon. 12: 213-254. (See p. 238-240.)

Schwintzer, C.R. 1979. Vegetation changes following a water level rise and tree mortality in a Michigan bog. Mich. Bot. 18: 91-98.

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Segadas-Vianna, F. 1955. Ecological study of the peat bogs of eastern North America, II: The Chamaedaphne calyculata community in Quebec and Ontario. Can. J. Bot. 33: 647-684.

Swan, J.M.A. and A.M. Gill. 1970. The origins, spread, and consolidation of a floating bog in Harvard Pond, Petersham, Massachusetts. Ecology 51: 829-840.

Tall Shrub Bog 21.130

DESCRIPTION: Characteristic tall shrub species, singly or in combination, comprise over half the cover of a community established over peat. Characteristic shrubs include:

Speckled Alder, Alnus rugosa
Common Alder, A. serrulata
Purple Chokeberry, Pyrus floribunda
Black Chokeberry, P. melanocarpa
Poison Sumac, Rhus vernix
Winterberry, Ilex verticillata
Mountain-holly, Nemopanthus mucronata
Red Osier, Cornus stolonifera
Highbush Blueberry, Vaccinium corymbosum
Witherod, Viburnum cassinoides
Arrow-wood, V. recognitum

Other tall shrub species may occur locally. The composition of shrubs varies per site, and some bogs have two or more compositionally different tall shrub zones. Dachnowski (1912) maintained that different shrub species successfully coexist partially by having root systems on different vertical levels. Tall shrub bogs are similar to and may grade into alder or mixed shrub swamps. These shrub swamps may have sphagnum in their understories but they lack the massive, continuous sphagnum carpets characteristic in tall shrub bogs, they do not occur over well developed peat (unless they are secondary communities over previous bog sites), and they lack most characteristic bog herbs. Tall shrub bog stands often occur in zones between other bog community zones. Though these zones are all part of single bog systems, they are treated separately for inventory purposes.

The associated herbaceous species of tall shrub bogs are also variable per site, depending on the proximity of a bog mat, the density of shading of the shrubs, the water level, the history of the area, and other factors. A representative list requires further study. Lower shrubs, such as leatherleaf (Chamaedaphne calyculata) and huckleberry (Gaylussacia baccata), may be common, especially in more open stands or along margins. Scattered or marginal trees frequently include tamarack (Larix laricina), yellow birch (Betula alleghaniensis) and red maple (Acer rubrum).

In textbook examples, tall shrub bog zones occur between low shrub zones (leatherleaf in Ohio) toward the bog centers and bog forest zones toward the bog margins. As long-term peat deposition and mat grounding proceeds, all the zones migrate toward the bog centers. Thusly, the tall shrubs replace the low shrubs, and trees replace the tall shrubs. Shading by taller invading strata also contributes to the demise of the earlier, lower strata. The textbook pattern appears to occur in a few Ohio bogs. In a few other bogs, the leatherleaf is bordered by a combination of tall shrubs and trees, and this is bordered by an outer zone of just tall shrubs. In seemingly older and, sometimes, more disturbed bogs, nearly the entire bog area is occupied by tall shrubs. It is also possible that these more homogeneous stands occur in flatter basins resulting in more uniform successional conditions. A few Ohio bogs have small bog mat remnants surrounded directly by tall shrub or tall shrub and tree zones. Moats, narrow channels with just water and herbaceous species which encircle bogs, often separate tall shrub communities where they meet upland communities. Moats are possibly maintained by both ice movement and runoff of water with higher mineral contents. With progressive succession, different variations of the vegetation changes outlined above occur, but generally tall shrub bogs eventually replace low shrub and herbaceous bog stands, and bog and other forests eventually replace tall shrub stands. Regressive successions, however, brought on by raised water levels, fire, etc., may result in changes in opposite directions. Ecological data on Ohio tall shrub bog communities are nearly limited to species lists. Mossman (1972) presented transect data of a winterberry-arrow wood community at Camden Lake, Lorain County.

DISTRIBUTION: Tall shrub bog communities with the same dominant species as those in Ohio occur throughout southeastern Canada and northeastern and north-central United States. Most are north of Ohio. In Ohio, they are mostly limited to the northeast quarter, although several previously occurred in north central and northwestern Ohio. They are generally associated with kettle lakes and other glacial deposits with impeded drainages, especially in Geauga, Portage, Stark and Summit counties.

STATUS: Tall shrub bogs are the most common type of bog communities in Ohio. They probably have attained this status due both to the natural successional age of many Ohio bogs, and to their relatively higher resilience to some human impacts than other bog communities. Nevertheless, most tall shrub bogs in the state have been destroyed or altered. Draining, burning, grazing, nutrient runoff, mining, and filling have been the main impacts. Some stands are doubtlessly secondary in origin, having developed where bog mats were drained and burned, or where bog forests were cut, burned, or flooded. It is not easy to distinguish between primary and secondary tall shrub stands, but the secondary ones may have unusual compositions, drier substrates and lower stabilities. An unusual community mosaic may occur where there have been various degrees of peat destruction on one area. Natural tall shrub bog stands in Ohio are infrequent, most are on private land, and all are located in the most populated and "developing" section of the state.

MANAGEMENT: The qualities of existing tall shrub bogs can be maintained largely by retaining appropriate water levels and guarding against fires and nutrient or other detrimental runoff. Forest succession on older or disturbed stands would need to be controlled, if so desired, with cutting or raised water levels.

INVENTORY GUIDELINES: Generally, all primary and secondary tall shrub bog zones, patches or stands in Ohio should be inventoried, excepting only those of very small size.

SELECTED REFERENCES:

Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402. (See p. 371-372, 383-393.)

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Jones, C.H. 1941. Studies on Ohio floristics, I: Vegetation of Ohio bogs. Am. Midl. Nat. 26: 674-689.

Mossman, R.E. 1972. A floristic and ecological evaluation of Camden (Bog) Lake, Lorain County, Ohio. M.S. thesis, Ohio State Univ., Columbus. 175 p. (See esp. p. 52-53, 60-62.)

Tamarack-Hardwood Bog 21.140

DESCRIPTION: Tamarack (Larix laricina) and/or characteristic hardwood species comprise over half the cover of a community established over peat and over a characteristic bog understory. The community is commonly called a bog forest. Characteristic hardwood species include yellow birch (Betula alleghaniensis), red maple (Acer rubrum) and, less frequently, quaking aspen (Populus tremuloides), blackgum (Nyssa sylvatica) and black ash (Fraxinus nigra). American elm (Ulmus americana) was a former dominant, and white pine (Pinus strobus) and hemlock (Tsuga canadensis) were former local constituents. Other hardwood species are occasionally present.

The community is most similar to a swamp forest, into which it grades in space and succeeds in time. No firm distinction can be drawn between the two community types, especially when tamarack is absent. Generally, however, the bog forests have nearly complete sphagnum carpets over peat which is still undergoing compaction, include more herbs and shrubs characteristic of bogs, and often occur with other bog community types. These characters are usually absent or much reduced in swamp forests. Tamarack bogs are also similar to tamarack fens, both of which may occur on sphagnum mats. They are similar enough that under proper conditions, one may succeed the other. Tamarack fens are distinctive in having water sources relatively high in calcareous solutes, and having a much different understory flora as a result of that water. Bog forests often occur as zones with other bog community types, but are treated separately for inventory purposes.

The density and diversity of understory species depends largely on the density and shading of the overstory, and the diversity of microhabitats, including levels of the substrate above water. Over time the extent of soil mineralization is important. Stands with much tamarack are usually more open and can support a wide diversity of sun and shade-tolerant species. Stands with hardwoods eventually become quite shaded if succession is progressive. This causes many former open bog species to disappear. Characteristic shrubs include:

Speckled Alder, Alnus rugosa
Black Chokeberry, Pyrus melanocarpa
Poison Sumac, Rhus vernix
Winterberry, Ilex verticillata
Mountain-holly, Nemopanthus mucronata
Leatherleaf, Chamaedaphne calyculata
Huckleberry, Gaylussacia baccata
Highbush Blueberry, Vaccinium corymbosum
Arrow-wood, Viburnum recognitum

Characteristic herbaceous species include or previously included:

Cinnamon Fern, Osmunda cinnamomea
Royal Fern, O. regalis
Spinulose Wood Fern, Dryopteris spinulosa
Sensitive Fern, Onoclea sensibilis
Marsh Fern, Thelypteris palustris
Skunk-cabbage, Symplocarpus foetidus
Wild Lily-of-the-valley, Maianthemum canadense
Indian Cucumber-root, Medeola virginiana
False Nettle, Boehmeria cylindrica
Marsh-marigold, Caltha palustris
Goldthread, Coptis groenlandica
Pitcher-plant, Sarracenia purpurea
Round-leaved Sundew, Drosera rotundifolia
Bramble, Rubus hispidus
Poison Ivy, Rhus radicans
Spotted Touch-me-not, Impatiens capensis
Northern White Violet, Viola pallens
Wild Sarsaparilla, Aralia nudicaulis
Bunchberry, Cornus canadensis
Large Cranberry, Vaccinium macrocarpon
Star-flower, Trientalis borealis

The herbs occur in various combinations per stand. Some are relatively rare.

Tamarack in Ohio bogs usually grows in nearly pure stands or zones. The species is highly shade-intolerant and does not compete effectively with hardwoods. Seedlings usually must become established on open bog mats or among bog shrub stands of limited density. Once this understory or a tamarack overstory becomes too dense, the seedlings do not survive. Hence, the longevity of some tamarack stands may be quite limited if active succession is occurring.. Some stands probably are or were maintained by natural disturbances, such as windthrow of the shallow-rooted overstory trees. Gates (1942) reported that windthrow reduced the age of the oldest tamaracks in northern lower Michigan to 130 years. Tamaracks may also be maintained by vegetative reproduction through root shoots, even in conditions unfavorable to seedlings (Curtis 1959).

In some bog zonations, a relatively narrow ring of tamarack occurs between an inner mat or leatherleaf zone and an outer tall shrub zone. In these situations the tamarack seedlings are possibly invading the more open inner zone but are unable to become established in the dense outer shrub zone. In other situations, tamarack stands are bordered on the outside by hardwood bog stands. Here, tamarack may have become established in a tall shrub zone that was less dense or that had been opened by burning or other factors. In any case, if not disturbed by regressive impacts, tamarack bogs normally succeed to hardwood bogs or tall shrub bogs followed by hardwood bogs. The hardwood bogs, in turn, eventually succeed to stands which more resemble swamps. This succession follows the continued compaction of the underlying peat. With the increase of hardwoods, leaf litter becomes a greater constituent of the peat. The peat level continues to rise, and aeration and disintegration rates of the upper portion increases. In time, the rate of disintegration nearly equals that of deposition, true soil profiles begin to develop, and a bog forest ceases to exist.

Ecological data on tamarack-hardwood bogs in Ohio are limited to general descriptions and species lists.

DISTRIBUTION: Tamarack occurs from Newfoundland to Alaska, south to Minnesota and West Virginia. It is a major community component throughout this range, often occurring with more northern species such as white spruce (Picea glauca), black spruce (P. mariana), balsam fir (Abies balsamea) and arbor vitae (Thuja occidentalis). In Ohio, tamarack is confined to the northeast quarter and to a site in Williams County in the northwest corner. It formerly also occurred in Defiance County, the county south of Williams County. While some of its present stations represent tamarack fens, most are tamarack bogs. Tamarack in Ohio is nearly limited to kettle lakes and other glacial deposits with poor drainages promoting peat deposition. It rarely occurs on upland sites in the state. Tamarack bogs generally occur in areas having water sources low in calcareous solutes, although this may not always be necessary.

STATUS: Tamarack bogs of considerable frequency and some of fair size occurred in Ohio at the beginning of European settlement. Dachnowski (1912) reported several stands which no longer exist, including one three miles long and one-half mile wide in Williams County. He noted that in 1912 most of that site was under cultivation except one area of about 300 acres with "an impassable tamarack bog." The stand has since been completely destroyed. Aldrich (1942) reported a Trumbull County tamarack stand one and one-half square miles in size at settlement time. By 1942 he noted that only a "few" tamarack remained on the site.

Tamarack bogs have decreased in Ohio because of several factors. The trees are sensitive to flooding, and stands have been destroyed by water level changes caused by both humans and beaver. In contrast, Van Dersal (1933) reported a great tamarack loss in Pymatuning Swamp (previously in both Ashtabula County, Ohio and Crawford County, Pennsylvania) in the 1920's due to drought. He explained that though tamarack can grow in dry areas, those located in wet soils cannot survive if quickly exposed to drought conditions. The shallow-rooted, thin-barked trees are easily killed by fire and thrown by wind, though Gates (1942) observed that burned or otherwise disturbed boggy areas in Michigan are often invaded by dense stands of tamarack seedlings. Aldrich (1941) reported that tamarack in northeastern Ohio declined primarily because of its commercial value and the larch sawfly. Tamarack, because of its decay-resistent properties, was used for railroad ties, telegraph poles, and ship parts. Fowells (1965) explained that larch sawfly periodically defoliates stands over large areas for several successive years. In some situations, the trees whose tops are killed by sawflies or floods may produce adventitious shoots.

Tamarack stands destroyed by one of these factors may be succeeded by a number of different communities, ranging from sedge meadows to hardwood forests, depending on the nature and severity of the disturbance. Hardwood bogs lacking tamarack have undoubtedly declined because of similar factors. Today, few tamarack stands of more than a few trees exist in Ohio. Most of these stands are small, on private land, and have very uncertain successional stabilities.

MANAGEMENT: As noted above, tamarack is sensitive to several environmental factors, all of which should be monitored in managed stands. The major requirements are stable water levels, fire control, disease control (if possible), and presence of areas open enough for seedling survival.

INVENTORY GUIDELINES: Any group of tamarack trees in Ohio large enough to be called a stand should be inventoried.

SELECTED REFERENCES:

Aldrich, J.W. 1941. Biological survey of the bogs and swamps in northeastern Ohio. Am. Midl. Nat. 30: 346-402. (See p. 372-374, 383-393.)

Andreas, B.K. 1980. The flora of Portage, Stark, Summit and Wayne counties, Ohio. Ph.D. diss., Kent State Univ., Kent. 2 vols. (See Description of Selected Areas.)

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p. (See p. 225-227.)

Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Geol. Surv. Bull. 16, 424 p. (See esp. p. 251-253.)

21.140

Fowells, H.A. 1965. Silvics of forest trees of the United States. U.S. Dep. Agric., For. Serv., Agric. Handb. No. 271. 762 p. (See p. 227-234.)

Gates, F.C. 1942. The bogs of northern lower Michigan. Ecol. Mon. 12: 213-254. (See p. 241-242.)

Shanks, R.E. 1942. The vegetation of Trumbull County, Ohio. Ohio J. Sci. 42: 220-236. (See p. 232.)

Van Dersal, W.R. 1933. An ecological study of Pymatuning Swamp. Ph.D. diss., Univ. Pittsburgh. 138 p. (See p. 68-74.)

Cinquefoil-Sedge Fen 22.110

DESCRIPTION: Characteristic herbs and/or shrubs comprise over half the cover of an open wetland community, usually over marl. The most consistently dominant shrub in Ohio stands is shrubby cinquefoil (Potentilla fruticosa). Other characteristic shrubs include:

Pussy Willow, Salix discolor
Silky Willow, S. sericea
Speckled Alder, Alnus rugosa
Ninebark, Physocarpus opulifolius
Black Chokeberry, Pyrus melanocarpa
Swamp Rose, Rosa palustris
Poison Sumac, Rhus vernix
Alder-leaved Buckthorn, Rhamnus alnifolia
Silky Dogwood, Cornus obliqua

Usually the tall shrubs are not dominants but occur as scattered individuals or patches, or along margins. Other shrubs may be present locally, including rarer species such as hoary willow (Salix candida), autumn willow (S. serissima), bayberry (Myrica pensylvanica) and swamp birch (Betula pumila). Herbs include many species in the sedge and sunflower familiies. Open marl areas commonly have spikerush (Eleocharis rostellata), beak-rush (Rhynchospora capillacea), rush (Juncus brachycephalus), Kalm's lobelia (Lobelia kalmii), and several rarer species locally. The greatest portions of most areas, however, have dense covers. These are most commonly dominated by sedges (Carex spp.) often in combination with shrubby cinquefoil. Characteristic species in these areas include:

Marsh Fern, Thelypteris palustris
Grass, Muhlenbergia glomerata
Sedge, Carex buxbaumii
Sedge, C. hystricina
Sedge, C. incomperta
Sedge, C. interior
Sedge, C. leptalea
Sedge, C. sterilis
Sedge, C. stricta
Sedge, C. suberecta
Sedge, C. spp.
Soft-stem Bulrush, Scirpus validus
Queen-of-the-prairie, Filipendula rubra
Mountain-mint, Pycnanthemum virginianum
Aster, Aster puniceus
Joe-pye-weed, Eupatorium maculatum
Ohio Goldenrod, Solidago ohioensis
Rough-leaved Goldenrod, S. patula

Many other herbaceous species, including many rarities, may be relatively common at specific sites. Sphagnum (Sphagnum spp.) occurs locally and produces an acid microhabitat suitable to the establishment of certain additional species (e.g. Drosera rotundifolia). In alkaline stream waters in or near fens, muskgrass (Chara spp.) and watercress (Nasturtium officinale (an exotic) often occur.

Although the dominant species of cinquefoil fens are relatively consistent throughout Ohio, the total compositions of these communities are variable in different regions. Stuckey and Denny (1981) found that, based on total compositions, fens in Ohio fall in two basic groups, prairie fens and bog fens, plus intermediates. The prairie fens contain, in addition to the usual dominants, species characteristic of prairies, including big bluestem (Andropogon gerardi), Indian grass (Sorghastrum nutans), prairie dock (Silphium terebinthinaceum) and whorled rosinweed (Silphium trifoliatum). The bog fens contain supplemental species more characteristic of bogs, including speckled alder (Alnus rugosa), round-leaved sundew (Drosera rotundifolia) and black chokeberry (Pyrus melanocarpa). Stuckey and Denny indicated that the "prairie" species in Ohio fens generally have southeastern geographical affinities, while the general and "bog" species generally have northern affinities. The prairie fens are mostly in west-central Ohio, and the bog fens mostly in northeastern Ohio. These two fen types are here considered as subsets of cinquefoil fens.

Cinquefoil fens are most similar to treed fens, sedge-grass meadows, wet-mesic prairies, shrub swamps, and bogs. All of them grade into cinquefoil fens so that simple distinctions cannot always be made. The tamarack and arbor vitae fens primarily differ visually in having tree overstories. Each of the other similar communities has several characteristic species in common with the characteristic species of fens. Differentiation requires examination of their total floras and the relative percentage covers of their dominants. Knowledge that fens, but not the other communities, require constant supplies of calcareous waters (with resultant marl) is often helpful, but this character is not always obvious in the field. As continuums between the community types occur, "either-or" categorizing of some stands will be arbitrary.

Most Ohio cinquefoil fens are bordered at least partially by tall shrub zones. Which of these zones are integral parts of the fens is also somewhat arbitrary, depending on their substrate conditions, their extents and, especially, their understory compositions. In some situations the tall shrubs have and may continue to invade and succeed portions of the low shrub-herbaceous fen communities. Curtis (1959) noted that such succession is common in Wisconsin fens protected from periodic burning. The extent to which the process is occurring in Ohio is not well known. Those fens with more active and constant spring sources are possibly more stable. Whatever the case, when succession in Ohio fens does occur, it probably most often does so towards shrub swamps, followed eventually by forests.

Few quantitative vegetation data exist for cinquefoil fens in Ohio, but other information has been compiled. Stuckey and Denny (1981) conducted a phytogeographic analysis of several fens, and Foos (1971) performed a similar study on Resthaven Wildlife Area, Erie County. Several works have considered the physical, floristic and faunal aspects of Cedar Bog, Champaign County (e.g. Forsyth 1974, Frederick 1974, King and Frederick 1974). Brodberg (1976) studied the water chemistry and flora of Mud Lake, Williams County. Andreas (1980), Dachnowski (1912) and others have compiled species lists.

DISTRIBUTION: Communities resembling cinquefoil fens probably occur in previously glaciated temperate and boreal regions with calcareous substrates throughout the northern hemisphere. Ones similar to those in Ohio occur in the northeastern and upper midwestern United States, and southeastern and south-central Canada. Fens in Ohio are limited almost entirely to the Till Plains of western Ohio and Glaciated Plateau of northeastern Ohio. Most are in regions of significant relief on and around end moraines, kames and eskers. Some (e.g. Cedar Bog) also are in filled pre-glacial river valleys. Concentrations occur in the regions of Logan, Champaign and Clark counties, and Portage, Summit and Stark counties. Ohio fens are limited to sites receiving constant, cold, calcareous, oxygen-deficient underground water supplies. These sites most frequently occur as springs at the bases of porous glacial deposits. The minerals in these waters precipitate to form marl, a whitish-gray deposit frequently with additions of snail shells, conspicuous near the mouths of the springs. Limited amounts of peat may occur over or mixed with the marl. Multiple peat and marl layers occur at some sites.

Examples of cinquefoil fens in Ohio include Cedar Bog, Champaign County and portions at Resthaven Wildlife Area, Erie County.

STATUS: Dachnowski (1912) described several fens in Ohio which have disappeared since his writing, and several others doubtlessly disappeared in the nineteenth century before his study. Most were destroyed by combinations of draining, burning, grazing, mowing, and cultivation. Bonser (1903) gave a detailed description of the various effects of these factors on Big Spring Prairie, Wyandot County, a large area once containing significant fen units. The fen portions of Resthaven Wildlife Area were greatly altered by the mining of calcium deposits, and other fens have fallen to the mining of peat. Some fens have been destroyed by flooding by humans and beaver.

The past effects of fire on Ohio fens is not clear. Bonser theorized that, at Big Spring Prairie, light burns helped maintain some fen-like communities by retarding tree growth, while, at other sites, severe fires destroyed the organic soils enough that the original communities were replaced by other communities. Dachnowski (1912) notes a burned area in or near Cedar Bog (then called Dallas Arbor Vitae Bog) that had reverted to a dense cover of shrubby cinquefoil. It is possible that some existing fens in the state are or will become threatened by shrub succession which once was controlled by fire.

There are less than thirty fair to good quality cinquefoil fens left in Ohio. Most of those are partially disturbed, many are small, and most are on private land. It is a threatened community in the state.

MANAGEMENT: Possibly the major current threat to Ohio fens is alteration of their water sources, primarily in terms of quantity but also in terms of quality. Where possible, land uses affecting the ground and surface waters near fens should be controlled, and beaver activity should be monitored. Succession rates of tall shrubs into fens should be measured, and control measures considered where necessary.

INVENTORY GUIDELINES: All cinquefoil fens in Ohio should be inventoried.

SELECTED REFERENCES:

Andreas, B.K. 1980. The flora of Portage, Stark, Summit and Wayne counties, Ohio. Ph.D. diss., Kent State Univ., Kent. 2 vols. (See Description of Selected Areas.)

Bonser, T.A. 1903. Ecological study of Big Spring Prairie, Wyandot County, Ohio. Ohio State Acad. Sci., Spec. Pap. No. 7. 96 p. + map. (See esp. p. 46-64.)

22.110

Brodberg, R.K. 1976. Vascular macrophytes of Mud Lake, Williams County, Ohio. M.S. thesis, Bowling Green State Univ., Bowling Green. 68 p.

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p. (See p. 361-365.)

Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Biol. Surv. Bull. 16. 424 p. (See esp. p. 246).

Denny, G.L. 1979. Bogs. Pages 141-150 in M.B. Lafferty, ed. Ohio's natural heritage. Ohio Acad. Sci., Columbus. (See p. 146-150.)

Foos, K.A. 1971. A floristic and phytogeographic analysis of the fen element at the Resthaven Wildlife Area (Castalia Prairie), Erie County, Ohio. M.S. thesis, Ohio State Univ., Columbus. 81 p.

Forsyth, J.L. 1974. Geologic conditions essential for the perpetuation of Cedar Bog, Champaign County, Ohio. Ohio J. Sci. 74: 116-125.

Frederick, C.M. 1974. A natural history study of the vascular flora at Cedar Bog, Champaign County, Ohio. Ohio J. Sci. 74: 65-116. (See p. 75-80.)

Gordon, R.M. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113. (See p. 65-66.)

King, C.C. and C.M. Frederick, eds. 1974. Cedar Bog Symposium, Urbana College, November 3, 1973. Ohio Biol. Surv. Inf. Circ. No. 4. 71 p.

Stuckey, R.L. and G.L. Denny. 1980. Prairie fens and bog fens in Ohio: floristic similarities, differences, and geographical affinities. Pages 1-33 in R.C. Romans, ed. Geobotany II. Plenum Press, New York.

Tamarack Fen 22.120

DESCRIPTION: Tamarack with an understory largely of characteristic cinquefoil-sedge fen species dominates a wetland community. These species include:

Tamarack, Larix laricina
Marsh Fern, Thelypteris palustris
Sedges, Carex spp.
Skunk-cabbage, Symplocarpus foetidus
Bayberry, Myrica pensylvanica
Shrubby Cinquefoil, Potentilla fruticosa
Red Raspberry, Rubus idaeus
Poison Sumac, Rhus vernix
Red Maple, Rhamnus alnifolia
Alder-leaved Buckthorn, Rhamnus alnifolia
Gray Dogwood, Cornus racemosa
Highbush Blueberry, Vaccinium corymbosum

Additional species may be present.

The community in Ohio can be confused only with the tamarack bog community. They are distinguished by their understories, the bog having only acid-substrate species while the fen has both acid and alkaline-substrate species. Species common to both include sphagnum, tamarack poison sumac, highbush blueberry and others. Species specific to tamarack fens include shrubby cinquefoil, alder-leaved buckthorn and others. As the tamarack and some of the other species are boreal in distribution, tamarack fens fall into Stuckey and Denny's (1981) category of boreal, as versus prairie, fens. Tamarack fens are probably not much different from boreal cinquefoil-sedge fens except for the presence of tamarack.

Evidence shows that bogs and fens may alternately occupy the same site over time. Some initial post-glacial calcareous sites, for example may first have supported fens. With enough sphagnum growth, these could have changed to acid bogs, at least in terms of the vascular plant growth over the sphagnum. With altered water supply conditions, the acid conditions could then have been diluted and a shift back towards fen conditions affected.

The tamarack fens in Ohio are bordered by combinations of marsh, shrub swamp, swamp and upland forest communities.

Data on tamarack fens in Ohio are contained in the works of Dachnowski (1912), Brodberg (1976), Tandy (1976), Andreas (1980), and Stuckey and Denny (1981).

DISTRIBUTION: Tamarack fens occur from Ohio north into Ontario where they acquire considerably different characteristics in terms of species compositions. Only one good example, Frame Lake in Portage County, remains in Ohio. A tamarack community in Williams County has a sedge understory and now resembles a fen more than a bog. This community, however, has been disturbed by raised water levels, and evidence shows it may previously have had additional bog characteristics. Scattered tamarack trees also occur in a few additional fens but not with enough abundance to term them tamarack fens. The former extent of the community in Ohio is not well known.

STATUS: Tamarack fens in Ohio are endangered. There is only one good remaining example and it has recently been hurt by water levels raised by beaver.

INVENTORY GUIDELINES: Any additional tamarack fens, if they exist, should be thoroughly inventoried.

SELECTED REFERENCES:

Andreas, B.K. 1980. The flora of Portage, Stark, Summit and Wayne counties, Ohio. Ph.D. diss., Kent State Univ., Kent. 2 vols.

Brodberg, R.K. 1976. Vascular macrophytes of Mud Lake, Williams County, Ohio. M.S. thesis, Bowling Green State Univ., Bowling Green. 68 p.

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Stuckey, R.L. and G.L. Denny. 1981. Prairie fens and bog fens in Ohio: floristic similarities, differences, and geographical affinities. Pages 1-33 _in_ R.C. Romans, ed. Geobotany II. Plenum Press, New York.

Tandy, L.W. 1976. Vascular plants of four natural areas of northeastern Ohio. M.S. thesis, Kent State Univ., Kent. 140 p.

Arbor Vitae Fen 22.130

DESCRIPTION: Arbor vitae and associated hardwood species dominate the single stand (Cedar Bog) of this community in Ohio. These species include:

| | |
|---|---|
| Arbor Vitae, Thuja occidentalis | Red Maple, Acer rubrum |
| Tuliptree, Liriodendron tulipifera | Black Ash, Fraxinus nigra |

Additional tree species occur infrequently. Much of the arbor vitae occurs in pure or nearly pure groups with the hardwoods confined to openings or margins.

The community is unlike any other in Ohio. The arbor vitae-mixedwood community, the only other type with arbor vitae in Ohio, is restricted strictly to relatively dry cliff faces and margins. Its associates are upland oaks, maples, etc.

The arbor vitae fen community at Cedar Bog is, as most fens, located on wet marl produced by artesian springs. A cinquefoil-sedge fen community encircled by arbor vitae occupies the area where the springs arise. The arbor vitae closes in next to the spring stream where it becomes a concentrated channel south of the fen meadow. Outside of the arbor vitae on the east side is mostly old-field. Outside of the arbor vitae on the west side is mostly swamp forest consisting largely of black ash, tuliptree, red maple and other species. American elm was a former major component.

The Environmental Control Corporation (1973) and others have theorized that the arbor vitae stand is threatened with succession by the hardwood species. A major concern is that past downstream ditching has accelerated upstream erosion, giving the hardwoods an advantage. Collins et al. (1979), however, contested the successional speculations, concluding that arbor vitae will remain the dominant species in the foreseeable future.

Cedar Bog is one of the better studied areas in Ohio. Significant works include those of Dachnowski (1910), Environmental Control Corporation (1973), Forsyth (1974), Frederick (1974), King and Frederick (1974), and Collins et al. (1979).

DISTRIBUTION: Arbor vitae occurs in wet communities, many of which could be called fens, from Ohio north in Canada to James Bay, and east from Nova Scotia to Manitoba. North of Ohio the arbor vitae-containing communities become more boreal in composition, including species such as spruce, fir and tamarack (Braun 1950, Eyre 1980). The arbor vitae fen in Ohio occurs only at Cedar Bog in Champaign County.

STATUS: The stability of the Cedar Bog arbor vitae stand in the near future is probably mostly dependent on the maintenance of stable water levels. There is some concern that accelerated downstream drainage may affect the community, or that the source water could be affected in various ways (Forsyth 1974). A good monitoring program with permanent markers should be established.

INVENTORY GUIDELINES: It is doubtful that any other arbor vitae fens exist in Ohio.

SELECTED REFERENCES:

Braun, E.L. 1950 (1967 facs. ed.). Deciduous forests of eastern North America. Hafner Pub. Co., New York. 596 p. + map.

Collins, S.L., J.L. Vankat and J.V. Perino. 1979. Potential tree species dynamics in the arbor vitae association of Cedar Bog, a west-central Ohio fen. Bull. Torrey Bot. Club 106: 290-298.

Dacknowski, A. 1910. A cedar bog in central Ohio. Ohio Nat. 11: 193-199.

Environmental Control Corporation. 1973. Man and Cedar Bog: Projected effects of routing a highway near a boreal relict bog in central Ohio. Environ. Control Corp., Painesville. 14 sections.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

Forsyth, J.L. 1974. Geologic conditions essential for the perpetuation of Cedar Bog, Champaign County, Ohio. Ohio J. Sci. 74: 116-125.

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King, C.C. and C.M. Frederick, eds. 1974. Cedar Bog Symposium, Urbana College, November 3, 1973. Ohio Biol. Surv. Inf. Circ. No. 4. 71 p.

Slough Grass-Bluejoint Prairie 31.110

DESCRIPTION: Slough grass (Spartina pectinata), bluejoint (Calamagrostis canadensis) and/or other characteristic herbaceous species comprise over half the cover of an open community. Big bluestem (Andropogon gerardi) may be a major component, and reed grass (Phragmites communis) was formerly important. The community is commonly called "wet prairie" and, as used here, includes the wetter examples of what could be called "wet-mesic prairie." Few examples of sufficient size or natural integrity remain by which to compile an accurate list of original characteristic associated species. Moreover, species characteristic of just wet prairies are difficult to determine from earlier works, most of which usually considered both wet and mesic prairies together in the category wet prairie. An abbreviated list includes the following species:

Marsh Fern, Thelypteris palustris
Sedges, Carex spp.
Bulrushes, Scirpus spp.
Rushes, Juncus spp.
Purple Meadow-rue, Thalictrum dasycarpum
Loosestrife, Lythrum alatum
Water-hemlock, Cicuta maculata
Closed Gentian, Gentiana andrewsii
Swamp Milkweed, Asclepias incarnata
Mountain-mint, Pycnanthemum virginianum
New England Aster, Aster novae-angliae
Saw-toothed Sunflower, Helianthus grosseserratus

All of the associated species, however, occur in other community types and cannot be used as strict indicators of wet prairies. The dominant grasses all have the ability, through vegetative reproduction, to form dense stands in which associated species are limited. Sizeable stands of this type no longer occur in the state.

Slough grass-bluejoint wet prairies in Ohio are similar to and grade or formerly graded into mesic prairies, savannas, sedge-grass meadows, and fens. Mesic prairies usually are dominated by big bluestem and Indian grass (Sorghastrum nutans), with slough grass, bluejoint and reed grass having little importance. Wet and mesic prairies occur in intergrading mosaics on individual sites having various moisture levels. The transitional areas may be termed wet-mesic prairies (as did Curtis (1959) in Wisconsin) but these are not separated here in a formal category because of their now limited extent and lack of definitional clarity in the state. Certain wet prairies also formerly graded into savannas having wet prairie understories. Today both wet prairies and savannas with intact understories are rare enough in Ohio that their occurrence together is improbable.

Slough grass-bluejoint prairies also cannot be clearly distinguished from sedge-grass meadows, and the distinctions are further obscured by the disturbed and isolated natures of both communities. Some sedge meadows, in fact, are probably remnants of grazed wet prairies. Communities containing significant quantities of slough grass, big bluestem and/or characteristic prairie forbs are considered prairies. Bluejoint stands with few additional prairie indicators usually are considered sedge-grass meadows, and reed grass stands with few prairie indicators are considered emergent marshes.

Many wet and mesic prairie species in Ohio also occur in open fens. Such fens have been designated as "prairie fens," in contrast to bog fens which are characterized by a more boreal composition. Fens are differentiated from wet prairies by the presence of fen indicators, such as shrubby cinquefoil (Potentilla fruticosa), and by their occurrence over marl at artesian springs.

Slough grass-bluejoint prairies in Ohio probably varied in composition and aspect more because of different local physiographic conditions than because of geographical positions. Few early accounts are specific enough to identify slough grass and bluejoint, though a number appear to single out reed grass, possibly because of its relative conspicuousness. Reed grass evidently was truly common, however, in certain areas, including Castalia Prairie (Resthaven Wildlife Area) in Erie County and Big Spring Prairie in Wyandot County (Bonser 1903), Killdeer Plains in Wyandot County and Scioto Marsh in Hardin County (Dobbins 1937) and Madison County (Sears 1926). The wet prairies which did not grade into mesic prairies, sedge-grass meadows and marshes were commonly bordered by swamp on floodplain forests. Some undoubtedly supported trees in the form of savannas during at least part of their occupancy. The trees probably consisted of bur oaks, white oaks, and others more tolerant of environmental extremes.

Few opportunities remain to study succession, primary or secondary, on the slough grass-bluejoint wet prairie remnants remaining in Ohio. Some workers (e.g. Dobbins 1937) indicated the occurrence of a classical successional pattern, wet prairies succeeding to mesic prairies and mesic prairies to swamp forests. Such may have been the pattern on sites where soil moisture was a major controlling factor, trees being poorly suited to the radical change from innundated soils in winter to droughty soils in summer. Where trees could survive the moisture regime, however, swamp forests probably directly succeeded wet prairies unless controlled at frequent enough intervals by fire.

Secondary stands of slough grass, bluejoint and reed grass developed in various suitable habitats, aided by the vegetative reproduction capacities of these species. Dobbins (1937), for instance, noted stands in west-central Ohio where swamp forests near primary prairies had been cut. Compared to primary prairies, such stands probably had simpler compositions consisting of mixtures between the original floras of the sites and the invading prairie floras.

Ecological data on slough grass-bluejoint prairies in Ohio are limited to species lists of small remnants. Some of these lists lump wet and mesic prairies. Cusick and Troutman (1978) conducted a comprehensive survey of Ohio prairies, some of which are wet prairies. Hurst (1971) studied the phytogeography of the prairie element, including wet prairie and other species, at Resthaven Wildlife Area, Erie County. Most true wet prairies in Ohio were destroyed before enough capable students were available to study them.

DISTRIBUTION: Slough grass-bluejoint prairies similar to those in Ohio occur or occurred throughout the glaciated portions of the Prairie Peninsula as mapped by Transeau (1935) west to the Missouri River region. In Ohio they were limited to the Tillplains and Lake Plains of the western and north-central portions of the state. Gordon (1966) mapped general prairie areas in Ohio, some of which included wet prairies. They were especially prominent at sites of former post-glacial lakes, but also occurred on level, poorly drained uplands and bottomlands. The water at some sites was augmented by springs. Wet prairies typically occurred over heavy soils which were flooded in winter and spring, but which could become quite dry by late summer. In spring they were wet enough to serve as spawning grounds for certain fish, and by fall they were usually dry enough to burn. Curtis (1959) explained that wet prairies in Wisconsin lowlands receive cold air drainage at night, the humidity of which, combined with that from the soils, approximates "tropical conditions" in the day. The cold air drainage also brings early frosts but does not appear to hurt the late developing, frost-resistant prairie species.

Examples of patches of wet prairies in Ohio today exist at Resthaven Wildlife Area, Erie County, and Killdeer Plains Wildlife Area, Wyandot County.

STATUS: Early historians and scientists indicate that sizeable wet prairie stands previously existed in different areas of western and north-central Ohio. The same observers noted that most of these tracts were destroyed before the twentieth century. Most fell to drainage, farming and grazing. The wet prairie soils, once spurned because of their drainage problems, became highly sought for their natural fertility. Many were converted to farms reserved for specialty crops. Wet prairies which were not eliminated by use were indirectly degraded by drainage of adjacent lands. Too, the lush prairie foliage provided ideal pasturage. Curtis (1959) reported that wet prairies in Wisconsin were so sensitive to grazing that under its influence, exotic grasses replaced the original flora in only two to three years. Gordon (1969) reported that grazed Ohio prairies developed into sedge meadows. Wet prairies in Ohio have been selectively eliminated. Today, no sizeable, intact stands remain in the state.

MANAGEMENT: A sizeable literature has developed on the management of prairies throughout the prairie states. This literature should be consulted for specific management techniques. Fire is now regarded as a major tool necessary for retarding succession by woody species and, at least in some community types, maintaining species richness. The main management challenge for primary or secondary wet prairies in Ohio probably is providing and maintaining appropriate soil moistures. Lowered water tables caused by universal drainage efforts may restrict successful manangement attempts to special, less typical sites.

INVENTORY GUIDELINES: All primary or secondary slough grass-bluejoint prairie in Ohio large enough to be called stands should be inventoried.

SELECTED REFERENCES:

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Big Bluestem Prairie 31.120

DESCRIPTION: Big bluestem (Andropogon gerardi), Indian grass (Sorghastrum nutans) and/or other characteristic herbaceous species comprise over half the cover of an open community. Indian grass (Sorghastrum nutans) is a codominant in some areas. Big bluestem prairies and slough grass-bluejoint prairies are both sometimes called tallgrass prairies. Big bluestem prairies are also commonly called "mesic prairies" and, as used here, they include the more mesic examples of what could be called "wet-mesic" or "dry-mesic prairies." The term "big bluestem prairie" is used here for consistency of nomenclatural form in the classification system. Wet-mesic and dry-mesic prairies are not formally recognized because of the scarcity of intact stands in Ohio allowing accurate delimitation to this level. Characteristic associated species of big bluestem prairies include:

Little Bluestem, Andropogon scoparius
Switchgrass, Panicum virgatum
Tick-trefoil, Desmodium canadense
Sullivant's Milkweed, Asclepias sullivantii
Wild Bergamot, Monarda fistulosa
Virginia Mountain-mint, Pycnanthemum virginianum
New England Aster, Aster novae-angliae
Giant Sunflower, Helianthus giganteus
Saw-toothed Sunflower, H. grosseserratus
Prairie Coneflower, Ratibida pinnata
Black-eyed Susan, Rudbeckia hirta
Prairie Dock, Silphium terebinthinaceum

Many other herbaceous species may be present, at least locally. Big bluestem is the common dominant, but other species may dominate on specific sites. Members of the grass and sunflower families are especially important. Many species previously characteristic of prairies are now widespread weeds, including evening-primrose (Oenothera biennis), Indian hemp (Apocynum cannabinum), common milkweed (Asclepias syriaca), ragweeds(Ambrosia spp.), horseweed (Conyza canadensis) and other species listed by Gordon (1969).

Weaver and Fitzpatrick (1934) attribute the dominance of big bluestem to its rapid development, dense sod-forming habit, great stature, and the shade tolerance of its seedlings. Its dominance along certain railroad tracks and other areas has possibly also been augmented by selective herbicides. Big bluestem and Indian grass are both southern, warm-season grasses which develop late in the growing season. Many small ephemeral herbs in mesic prairies flower and fruit early, before the dense shade of the tall grasses develops. The tall grasses and taller forbs remaining into the autumn are typically frost resistent (Curtis 1959).

Various additional factors affect the compositional patterns in big bluestem prairies. Curtis (1959), for example, found that species with active vegetative reproduction by rhizomes and those with known or suspected allelopathic chemicals displayed the most aggregation or clumping. Weaver (1954) emphasized the interrelations of roots and rhizomes, noting that these organs in successfully associating species usually develop on different layers.

Big bluestem mesic prairies in Ohio are most similar to and grade or formerly graded into wet prairies, dry prairies, oak savannas, and open fens. Distinctions between these community types are largely arbitrary. Wet prairies, in contrast to mesic prairies, usually include slough grass (Spartina pectinata) and/or bluejoint (Calamagrostis canadensis) among their dominants. Big bluestem may or may not be present. Dry prairies usually include little bluestem and, sometimes, side-oats grama (Bouteloua curtipendula) as dominants, though big bluestem and Indian grass are also commonly present. The latter tall grasses form dense sods on mesic prairies but are more restricted to bunch forms on dry prairies. Guidelines by which to separate big bluestem prairies and savannas in Ohio today are mostly academic. Most prairie remnants are now too small to support tree growths identifiable as savannas, and most mesic savannas have understories of bluegrass resulting from grazing. Some fens have been characterized as "prairie fens" because of the large number of prairie species they contain. They differ from prairies by their inclusion of many typical fen species, such as shrubby cinquefoil (Potentilla fruticosa), and by their occurrence over marl near artesian springs.

Big bluestem prairies in different regions of Ohio generally are relatively similar in composition. This results in part from the commonly strong influence of the dominant species. The prairies in the Till Plains are fairly homogeneous. Those on sandy soils in the Lake Plains of northwestern Ohio display some floristic differences, as do those in the unglaciated Bluegrass Region in southwestern Ohio. Although most prairies in the Bluegrass Region are dry, Braun (1928b) described big bluestem-prairie dock mesic prairies occurring on and restricted to sites over Monroe Dolomite. She indicated that although the primary nature of those prairies is questionable, they were probably at least enlargements of smaller natural patches. Braun (1928a) believed these prairies in unglaciated Ohio originated before Wisconsin glaciation. Others (e.g. Transeau 1935) have disagreed.

Many prairie-like patches in Ohio are undoubtedly secondary in origin, though proof of this on any given site is hard to obtain. Some evidence may be gleaned from original land surveys and early historical accounts. This evidence can be confused, however, where essentially secondary prairies occur on former primary prairie sites. Presence of "conservative" species, those which do not frequently spread from original prairie sites, provides additional evidence, though some argument exists as to which species these are. Gordon (1969, p. 58-59) gives one list of conservative species, and Curtis (1959, p. 293-294) gives another. Other prairie species are weedy. Sears (1926), for example, cited another's early observation that Rudbeckia sp. appeared where hogs rooted in prairie, Dobbins (1937) noted the spread of saw-toothed sunflower onto abandoned farmland, and Weaver (1954) noted the propensity of Indian grass to invade disturbed areas. Curtis (1959) listed a few species "whose present range bore little relation to the original prairies" of Wisconsin, including big bluestem and switchgrass.

Former big bluestem prairies in Ohio which did not grade into other prairie types or savannas usually were bordered fairly abruptly by forests. Shrub zones between the forests and prairies were frequently mentioned by early historians, though details are few and intact patterns are missing today.

Named shrubs often include hazelnut (Corylus americana), wild plum (Prunus americana) and rose (doubtlessly including prairie rose, Rosa setigera). The forests were of different types, depending on soil moisture levels and other factors. Ohio prairies generally occurred in regions of oak-hickory forests, the oak species varying per site.

The successional relationships between forests and prairies in and beyond Ohio have been the subject of a classic debate. Many theories have been proposed as to why what occurs where. Most current authorities believe that climate, substrate conditions, and fire have all had significant roles in at least certain times and places. In the Ohio portion of the Prairie Peninsula, it appears probably that all three factors played major roles in the origin of big bluestem prairies, while substrate, fire and, to a lesser extent, grazing animals have been the major factors in their maintenance to recent times. Prairies in general may be viewed as special groups of fire and drought-selected species. No in-depth historical observations exist concerning successional relations in Ohio prairies, and the physical natures of many existing prairies are too altered to allow very legitimate contemporary studies of supposed prehistorical conditions. Whatever past conditions existed, most remnants today appear plagued by forest succession resulting from fire control and lowered water tables.

Ecological data on Ohio big bluestem prairies consist mostly of floristic lists, plus origin and maintenance theory (e.g. Sears 1926, Transeau 1935). Braun (1928b) provided quantitative data for the Bluegrass Section prairies, and Braun (1928a) provided theory as to their origin. Hurst (1971) studied the phytogeography of selected Ohio prairie species, interestingly finding that only 13.3% had distributions nearly coinciding with the eastern extent of the Prairie Peninsula. Cusick and Troutman (1978) conducted a comprehensive survey of prairie remnants. Sears (1926), Jones (1944), Gordon (1969), and Troutman (1979) provided descriptive overviews of Ohio prairies. Stuckey and Reese (1981) included various works.

DISTRIBUTION: Mesic prairie remnants dominated by big bluestem occur throughout the Prairie Peninsula (Transeau 1935) and westward to the Mississippi and Missouri River region. In Ohio they are restricted primarily to the Till Plains in the western counties and the Lake Plains in the northwest. A few occur in the unglaciated Bluegrass Region in Adams County, and a few remnants approach mesic prairie conditions in the Glaciated Plateau in northeastern Ohio. Gordon (1966) mapped the pre-European settlement Ohio prairies, many of which were mesic in character. Sears (1926) reported that Ohio prairies occurred in five major regions: (1) the sandy region of Fulton, Lucas, and Wood counties (including the Oak Openings), (2) the thin-soiled limestone region of Sandusky, Erie, Seneca, and Huron counties, (3) the sandy oak openings region of Wayne and Stark counties, (4) the Wyandot and Sandusky Plains of Wyandot, Marion, and Crawford counties, and (5) the Darby Plains of Union, Madison and adjacent counties (including the Pickaway Plains).

Big bluestem prairies generally occurred on flat to rolling divides, headwaters, and terraces in the Till Plains, and on the more mesic sand deposits in the Lake Plains. They occurred both on and between end moraines where moisture conditions permitted. Sears (1926) postulated a close relation between the distribution of Ohio prairies and preglacial topography. Such a correlation, however, appears true only to a limited extent. Mesic prairies produced and occurred over rich black soil, generally moist but prone to droughtiness in late summer.

Claridon Prairie, Marion County, is a good example of a big bluestem prairie remnant with gradations into both wet and prairie aspects. Bigelow Cemetery State Nature Preserve, Madison County, is a micro-example of mesic prairie preserved only because of a sacred limited use.

STATUS: Sears (1926) estimated there were approximately 1,500 square miles, or nearly 4 percent of Ohio, of treeless areas in the state at the beginning of European settlement. Troutman (1979) reported that about 1,000 square miles of these were in prairie. Gordon (1969) estimated that at least 300 prairie areas existed then in Ohio, ranging in size up to several townships. Many of these included big bluestem prairie stands. Nearly all of these prairies have been destroyed.

Most big bluestem prairies were eliminated in the nineteenth century by combinations of plowing and grazing. Weaver (1954) found big bluestem to have the highest grazing preference of all prairie grasses, Indian grass to also rate highly, and that both species decreased when grazed. Many people have observed the increase of Kentucky bluegrass (Poa pratensis) in grazed or otherwise disturbed prairie. Weaver explained that bluegrass is eliminated by shade and fire on natural prairies, but becomes more competitive when these factors are reduced. Curtis (1959) explained that bluegrass and other species have low-growing rhizome tips compared to the easily grazed upright tips of the native grasses. He found that grazing on Wisconsin prairies resulted in complete replacement by bluegrass and other exotics in less than ten years.

Big bluestem prairies in Ohio today consist only of tiny fragments in railroad and utility rights-of-way, roadside ditches, small forgotten cemeteries, and other small tracts set aside only because they were less useable than others. Most of these remnants are disturbed and some are secondary. Because of their small sizes, many are probably depauperate in original floristic compositions due to random species elimination. Most of the original physical relationships between mesic prairies and other natural, adjacent communities have also been lost. The surviving remnants, because of their small sizes and, frequently, proximities to intensive human activities, are under constant threat of further alteration and elimination.

MANAGEMENT: Many papers have recently appeared concerning the management of prairies. These works should be consulted for specific recommendations concerning the management of big bluestem prairies. A general consensus has developed that periodic burning is required to suppress succession by woody species, at least in the eastern reaches of the Prairie Peninsula. Mowing and cutting also suppress woody species, much as natural grazing did, but they may lack other "normal" or beneficial effects of fire. These effects include the maintenance of species richness by reduction of accumulated cover, and the maintenance of growth vigor which results from mineral release and warmer soil surfaces. Fire could also affect accumulated allelopathic chemicals. Experimentation (including good quantitative data) and care should be taken on the frequency and timing of burning or other manipulation.

Some midwestern sites with long grazing histories have been found to support suppressed prairie vegetation which will develop when grazing is stopped. Release experiments should be conducted on any sites suspected of possibly supporting such vegetation.

Much interest has recently developed concerning the creation of artificial prairies. Moeller (1973), for instance, described the methods used in the development of a mesic prairie at Aullwood Audubon Center in Montgomery County. Creation of such prairies or refurbishment of degraded natural prairies should involve usage of only local genotypes, thus preserving the genetic integrities of existing or local populations.

INVENTORY GUIDELINES: All primary or secondary groups of big bluestem prairie species large enough to be considered stands should be inventoried. No firm guidelines defining this limit can be set. Scattered plants along a weedy roadside normally would not be included, while a fractional acre of relatively undisturbed prairie generally would be included.

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Little Bluestem Prairie 31.130

DESCRIPTION: Little bluestem (Andropogon scoparius) and/or characteristic associated herbaceous species comprise over half the cover of an open community. Infrequently little bluestem is absent. Side-oats grama (Bouteloua curtipendula) is a codominant in some areas, and infrequently occurs without little bluestem. The tall grasses big bluestem (Andropogon gerardi) and Indian grass (Sorghastrum nutans) are commonly present but generally comprise less than half the cover. Here, they usually occur in relatively scattered bunches (as versus sods) between which the lower grasses and forbes dominate. The community is commonly called "dry prairie" and, as used here, includes the drier examples of what could be called "dry-mesic prairie." Characteristic forbs are numerous and quite different per region, substrate characteristics, and site disturbance history. Species generally common throughout the state include:

Nodding Wild Onion, Allium cernuum
Bastard-toadflax, Comandra umbellata
Strawberry, Fragaria virginiana
Partridge-pea, Cassia fusciculata
Bush-clover, Lespedeza capitata
Flowering Spurge, Euphorbia corollata
New Jersey Tea, Ceanothus americanus
Butterfly-weed, Asclepias tuberosa
Whorled Milkweed, A. verticillata
Hoary Puccoon, Lithospermum canescens
Aster, Aster ericoides
Aster, A. laevis
Tall Coreopsis, Coreopsis tripteris
Blazing-star, Liatris scariosa
Prairie Dock, Silphium terebinthinaceum
Whorled Rosinweed, S. trifoliatum
Gray Goldenrod, Solidago nemoralis
Stiff Goldenrod, S. rigida

Many other species occur on specific sites, and various combinations of grasses and forbs may dominate. Species of the grass and sunflower families are particularly important. The dominant grasses are all considered warm season grasses which do not attain full development until late summer and fall. The taller forbs are also late bloomers. Mosses and lichens (Cladonia spp.) are important constituents in some prairies, and the alga Nostoc sp. is an interesting component of the Bluegrass Region prairies.

Little bluestem prairies in Ohio are most similar to big bluestem prairies, oak savannas, post oak openings and sand barrens. Many species which occur in little bluestem prairies also occur in big bluestem prairies, and vice versa. The main difference lies in the relative quantities of each species in each prairie type. Classic big bluestem prairies are most often dominated by dense, tall covers of big bluestem and Indian grass. Except in small, often drier areas, little bluestem is clearly subordinate to the tall grasses, and the forbs are more mesic in character. In little bluestem prairies, the tall grasses are absent or restricted to discontinuous patches, usually with combined covers of less than 50 percent. They also are commonly shorter in height than they are on more mesic sites. Little bluestem usually is a major dominant, and the forbs are more characteristic of dry soils. Classification of transitional communities between little anb big bluestem prairies is arbitrary.

Little bluestem prairie vegetation occurring as understory beneath open overstories of oaks represent dry oak savannas. Discreet prairie openings within oak forests are considered prairies, not savannas. Though once frequent in the prairie areas of the state, oak savannas, due to disturbance and succession, are now rare. Separation of little bluestem prairies from dry savannas previously would once have entailed artificial guidelines, but that problem is largely academic today.

Post oak openings in Ohio are confined to the Bluegrass Region (Adams County) where they are not always clearly separable from little bluestem prairies. Both communities commonly contain red cedars (Juniperus virginiana), and the distinction is further confused by the presence of hybrid secondary communities. Generally, the prairies include one or more of the prairie grasses as dominants, they occur over various substrates, and their vegetation cover is nearly complete. The post oak openings are dominated by a diverse array of characteristic species, the prairie grasses being absent or low in abundance (usually less than 50 percent of the cover). The openings are apparently restricted to sites over Crab Orchard Shale, and vegetation cover is generally sparse over the barren, eroded substrate surface.

Little bluestem prairies are also similar to and grade into sand barrens in northwestern Ohio. Here too the distinction is confused by the occurrence of mongrel secondary communities. Both little bluestem prairies and sand barrens in that region occur over dry sand deposits, and many sand barren stands probably have resulted from disturbance of prairies. Generally, the prairie dominants include at least one prairie grass, whereas sand barrens are dominated by a diverse array of characteristic herbs with the common prairie grasses usually having lower importance. A general artificial guideline for little bluestem prairies, in contrast to sand barrens, is that the prairie grasses (little bluestem, big bluestem and Indian grass) comprise over half the vegetation cover, and that typical dry prairie species, as versus species generally restricted to sand barrens, comprise over half the species richness.

Little bluestem prairies display considerable floristic variation in different regions and sites in Ohio. This results primarily from the large number of species which may comprise the community, the occurrence of the community on various substrate types, and the various types and degrees of disturbance which have occurred in different stands. In addition to characteristic prairie species, stands usually include additional xeric species more general in habitat but common to the region in which the stands occur. Slightly different species groups occur over the different Ohio substrates, including both alkaline and acidic types in glaciated and unglaciated regions. The communities on the various substrates appear to represent different subtypes which warrant further quantitative study and comparison. Major differences, however, should not be assumed. Curtis (1959 p. 272), for example, found that dry "sand prairies" in Wisconsin do not differ significantly in composition from dry prairies on heavier soils.

One of the most intensive studies of a substrate-related prairie is that by Braun (1928b) on the dry prairies of the unglaciated Bluegrass Region in Adams County. Here the prairies are restricted to droughty slopes and promontories of Peebles (Cedarville) Dolomite. Little bluestem and sideoats grama are common dominants, and Indian grass and big bluestem are usually present. These prairies differ from the rest of those in the state by their inclusion of southern and southwestern xerophytes, including limestone adder's-tongue (Ophioglossum engelmannii), American aloe (Agave virginica), and milk-pea (Galactia volubilis). The aloe is locally common enough that Braun referred to one community as the Andropogon-Bouteloua-Agave association. The presence of these southern species and other factors led Braun (1928a) to believe these prairies are pre-Illinoian glaciation in age. (In a 1955 work she referred to them as "pre-Wisconsin or even earlier.") This theory has been challenged by other workers (e.g. Transeau 1935) who generally believe these prairies developed during a post-Wisconsin xerothermic period, as did those in glaciated areas.

Other substrate-related prairie-like communities which may be considered as broadly defined little bluestem prairies are open slump communities with prairie species. The prairie aspects of these stands are maintained by the frequent slumping of their unstable steep soils, usually caused by erosion of nearby streams. Little bluestem and other prairie species often dominate these sites, although various other non-prairie, open species are commonly present and are dominants in certain areas or subareas. The communities have general appearances of dry prairies, but their soils range from dry to wet, dependent on amounts of seepage. This extreme moisture variation often occurs in a mosaic over a given site. The habitat and floristic characteristics of the slump communities are different enough from more typical dry prairies that assignment to a separate classification, albeit a heterogeneous and uncommon one, might be more appropriate.

In addition to the natural floristic variations between Ohio little bluestem prairies, other differences have been imposed by human disturbance. No stands have escaped this impact, with beneficial disturbances promoting maintenance of the original compositions, and detrimental disturbances resulting in the partial or complete vegetation replacements, often by more weedy native and exotic species. Disturbance has also created artificial, secondary prairies or prairie-like communities. This has often occurred where combinations of more "weedy" prairie and non-prairie species have successfully invaded soils too eroded for quick establishment of trees. Some prairie species have even invaded quarries. Braun (1928b) and Jones (1944) described secondary successions involving prairie species in the Unglaciated Plateau. Little bluestem and poverty oat grass (Danthonia spicata) are prominent constituents. Braun also described a little bluestem-nut rush (Scleria triglomerata) community which she considered as possibly primary but non-prairie in total composition. Cusick (1981) believed that few prairies existed in the Bluegrass Region before European settlement, that most which exist there now are secondary in origin.

Some prairie species spread to non-prairie sites more commonly than other prairie species. Curtis (1959), for example, found big bluestem distribution in Wisconsin shows little relation to former prairies, whereas side-oats grama, prairie dock and other species appear confined to them. Moreover, little bluestem, big bluestem and Indian grass all have general distributions throughout Ohio and the eastern United States, often occurring in non-prairie sites. Hence, except where histories or signs of past land uses remain, primary prairies frequently are indistinguishable from secondary prairies. Species composition alone will not provide the answer, as many believed primary stands are very weedy, and some believed secondary stands have few weeds and appear quite natural.

Most little bluestem prairies in Ohio previously graded into big bluestem prairies or oak savannas, or were bordered by oak-dominated woodlands. Shrubs were commonly present in patches or on borders. "Thorn" (probably Crataegus spp.), grape (Vitis spp.), hazelnut (Corylus americana), rose (probably Rosa carolina and R. setigera) and wild plum (probably Prunus americana) were described as common in the Sandusky Plains (Sears 1926). Most such borders have been eliminated. Blueberries or deerberry (Vaccinium spp.) and huckleberry (Gaylussacia baccata) are more common on the borders of prairies over sandy soils. Carolina buckthorn (Rhamnus caroliniana) was, and is, a common border shrub in the Bluegrass Region prairies. The woodlands surrounding the dry prairies were generally dry oak-hickory types. Dominants included black oak (Quercus velutina), white oak (Q. alba), shagbark hickory (Carya ovata), and other species. In the Bluegrass Region red cedar (Juniperus virginiana) is an additional border dominant and arbor vitae (Thuja occidentalis) was an interesting former, local component (Braun 1928b).

Most little bluestem prairies in Ohio are believed to have originated as a result of various combinations of past climatic conditions, substrate conditions and/or fire. Substrate conditions and fire are the major factors that have maintained these communities to the present. The degree of importance of each factor has been different per site. Some communities on extremely exposed and droughty substrates have been maintained by this factor alone. Others have depended more on fire, and as fire has been increasingly controlled by human intervention since European settlement, many of these have succeeded to oak forests.

Ecological data on little bluestem prairies in Ohio consist mostly of species lists. Sears (1926), Braun (1928b), Transeau (1935) and others offered theoretical speculation on the origin of these prairies. Quantitative data are largely limited to the works of Braun (1928b) on the Bluegrass Region prairies, Irwin (1929) on Cedar Cliffs Prairie Opening in Clermont County, and Wistendahl (1975) on Buffalo Beats in Athens County. Recent work has also been conducted on Lynx Prairie, Adams County. Hurst (1971) studied the phytogeography of various prairie species, some of which occur in dry prairies. Cusick and Troutman (1978) conducted a comprehensive survey of Ohio prairies. Stuckey and Reese (1981) included various prairie works.

DISTRIBUTION: Little bluestem prairie or prairie-like remnants with dominants similar to those in Ohio occur throughout the Prairie Peninsula (as mapped by Transeau (1935)), westward into eastern portions of mixed prairie, and at isolated sites in various locations east of Ohio. In Ohio they occur or occurred on calcareous bedrock outcrops, and on post-glacial beach ridges and other sand deposits in the Lake Plains of northwestern and north-central Ohio; on calcareous bedrock outcrops and on Wisconsin moraine and outwash deposits in the Till Plains of western Ohio; on calcareous bedrock in the unglaciated Bluegrass Region in southwestern Ohio; one example in Illinoian till in southwestern Ohio; a few prairie-like examples on various glacial deposits in the Glaciated Plateau of northeastern Ohio; and several prairie to prairie-like remnants in the Unglaciated Plateau of southeastern Ohio. Gordon (1969) mapped the pre-European settlement prairies in Ohio, some of which were dry prairies. Slump prairies occur at scattered locations throughout the state. In all cases the Ohio prairies occur on substrates subject to drought, with high exposure and wind being important dessicating factors at some sites. As with Wisconsin dry prairies (Curtis 1959), it is probable that some Ohio stands are partly supported by water from atmospheric condensation.

Buffalo Beats, a tiny prairie in the Unglaciated Plateau, shows a strong correlation with a restricted lens of calcareous clay in a region otherwise characterized by non-calcareous substrates (Wistendahl 1975). Buffalo Beats is an example of a relatively dry prairie lacking little bluestem. Other workers have also indicated a correlation of remnants in the Unglaciated Plateau with local clay deposits. Similarly, compass plant (Silphium laciniatum), though more of a mesic prairie species, occurs in its eastern-most continental and only Ohio station on calcareous silty clay loam in the Unglaciated Plateau. Other prairie-like remnants in the Plateau, however, occur over other substrate types.

Some of the best examples of little bluestem prairie in Ohio today exist at Lynx Prairie, Adams County.

STATUS: Little bluestem prairies in Ohio never were large in extent and today they consist of bits and pieces, some primary and some secondary, all with at least minimal disturbance. In the agricultural regions they are restricted to non-tillable rights-of-way and other less useable areas. These remnants have lost many of their previous natural relationships with big bluestem prairies, savannas, etc. In the non-agricultural regions little bluestem prairies are largely restricted to small openings, most of which are threatened by forest succession. Most of the remnants have decreased natural floristic richness because of their small sizes, and increased alien richness because of past impacts.

The major impacts have been plowing, grazing and forest succession. Light grazing, like that which may have occurred in pre-European settlement time, has affected the prairies but not eliminated them. Heavy grazing has eliminated them. Weaver (1954) reported that little bluestem, big bluestem and Indian grass all decrease under grazing pressure, while side-oats grama slowly increases. Curtis (1959), reviewing data on Wisconsin dry prairies, indicated that side-oats grama increases under light grazing and decreases moderately under heavy grazing. Although bluegrass (Poa pratensis), redtop (Agrostis alba) and other weedy native and exotic species increase in grazed dry prairies, they are less successful there than in wetter prairies. This results from the weeds having relatively high moisture demands compared to the native species, and the side-oats grama and certain other dry prairie species remaining competitive under grazing pressure (Curtis 1959).

Most of the little bluestem prairie remnants which have not been destroyed by man have disappeared or been reduced by forest succession. Most of this has occurred in the prairies which were partially maintained by fire. Accidental and purposeful burning of natural habitats remained common through the nineteenth and early twentieth centuries. Since then, fire control has been practiced in most areas. Most little bluestem prairies in wooded regions show evidence of woody invasion, and some remain only as understories beneath recently developed forest cover.

While many secondary communities are less stable than their primary equivalents, secondary little bluestem prairies may have higher stabilities because of the eroded substrates over which many of them occur. Jones (1944), however, indicated this was not true of most secondary stands in the Unglaciated Plateau, and described a fairly rapid successional sequence from abandoned fields to prairie to forest. Cusick (in press) described the rapid changes from abandoned farmland to prairies, taking only a few decades, and on to woodland in the Bluegrass Region prairies. Curtis (1959) reviewed Wisconsin studies which document succession from abandoned agricultural fields to dry prairie in 10 to 20 years, and, in the absence of fire, these further succeeding to forest cover at 35 years.

MANAGEMENT: Many papers have recently appeared concerning both the maintenance of prairies and the creation of man-made prairies. These works should be consulted for ideas on little bluestem prairie management. Prairies which have survived primarily because of extreme substrate conditions should require less manipulation as long as these conditions are maintained. Slow invasion by woody species should be monitored and retarded as necessary. Woody invasion is a greater problem on the dry prairies with less extreme substrate conditions. Most of these stands were probably partially maintained by fire, and this should be continued in their management. Experimentation on sample plots should be conducted before using any proposed, questionable management techniques. All management techniques should be quantitatively monitored, when possible, not only for their effects on woody invasion but also their effects on species richness, species vigor, erosion, and other site-specific factors.

INVENTORY GUIDELINES: Inventories should be conducted on all little bluestem prairie remnants in Ohio believed to be possibly primary, to be large enough to qualify as stands rather than just clusters of plants, and to be comprised more of prairie species than of weeds. This guideline is admittedly vague, but much flexibility is required, especially given the variations of dry prairies across the state. For instance, a 5 x 5 m prairie in Adams County, where such stands are not uncommon, would have less significance than it would in many other parts of the state. In some situations, it is more meaningful to inventory a group of small, close openings as a single unit rather than separately. Known secondary prairies with qualities approaching those of the better primary prairies should also be inventoried.

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31.130

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Post Oak Opening 31.140

DESCRIPTION: Characteristic herbaceous species in various combinations comprise over half the vegetation cover of an open community. The community is known to exist only over Crab Orchard Shale in the Bluegrass Region in Adams County. Characteristic herbs include:

Little Bluestem, Andropogon scoparius
Triple-awned Grass, Aristida longespica
Panic Grass, Panicum flexile
Poverty Grass, Sporobolus vaginiflorus
Nodding Wild Onion, Allium cernum
White Sweet Clover, Melilotus alba
Flowering Spurge, Euphorbia corollata
Wild Carrot, Daucus carota (an exotic)
Mountain-mint, Pycnanthemum tenuifolium
Houstonia, Houstonia sp.
Pale-spike Lobelia, Lobelia spicata
Sunflower, Helianthus hirsutus
Blazing-star, Liatris cylindracea
Blazing-star, L. squarrosa
Black-eyed Susan, Rudbeckia hirta
Prairie Dock, Silphium terebinthinaceum
Whorled Rosinweed, S. trifoliatum
Gray Goldenrod, Solidago nemoralis

Other herbaceous species, lichens (Cladonia spp.) and mosses are common locally or temporally. Prairie dock is a conspicuous dominant in some areas but is absent from others. Dominant species are various per site and subsite, probably partly determined by local soil depths. Substantial portions of the highly eroded soil are often free of vegetation. Shrubby St. John's-wort (Hypericum spathulatum) is common locally along borders. Red cedar (Juniperus virginiana) occurs scattered within the openings or along borders. Various oaks occur sometimes as scattered individuals or groups in the openings, but always along the borders and in the surrounding oak woodlands. These include white oak (Quercus alba), shingle oak (Q. imbricaria), blackjack oak (Q. marilandica), post oak (Q. stellata) and black oak (Q. velutina). Post oak is especially common in certain areas.

John Locke (1838) gave what is believed to be an early description of this community type. He wrote:

> When it [the "great Marl stratum," now called the Crab Orchard Shale] is left in conical mound-like outliers, the marl is often almost barren of trees, and produces some peculiar prairie like plants, as the prarie [sic] dock, wild sunflowers, scabish [blazing-stars], rudbeckias, &c. These places are called "bald hills," and "buffalo beats." Several occur within a mile of West Union, in a northerly direction, and would be quite a paradise for the botanist.

Locke gave no impression that the community is secondary in origin. Braun (1928b), in The Vegetation of the Mineral Springs Region of Adams County, Ohio, described the plant communities of the region according to the bedrock types on which they occur. In the Crab Orchard Shale section under the subsection "white oak forest," she included the above quote from Locke. The only accompanying statement she included was: "These have been so cleared or grazed, that almost nothing remains." Although disturbance of the sites has continued, it is of interest that the species noted by Locke are still conspicuous components today, if similar communities are being compared.

Braun gave little or no direct, published mention of the community again. In 1961, however, describing the Bluegrass Region, she wrote: "In local spots, post oak and blackjack oak are codominant and form an open stand--a woodland aspect not seen elsewhere...," and "The xeric prairies and post oak woodlands of Adams County, if originating during an interglacial age, expanded again in the recent Xerothermic Internal, and are now being slowly curtailed in extent." Similarly, Herrick (1964) included a brief notice by Braun of "Post Oak Openings" north of West Union. This term also appeared on some of her herbarium records from that region (Allison Cusick, pers. comm.). Braun did not mention post oaks with her quote of Locke, but her post oak openings and Locke's communities both occur north of West Union on Crab Orchard Shale. Too, communities similar to those described by Locke exist today in that region, and these usually contain post oak as a common border constituent. Hence, it appears that the communities described by Locke, Braun, and this text are the same, and that the name "post oak openings" may be applied to all three. This history also indicates that the community is either primary or partly primary in origin, or it is a relatively stable, early established secondary type.

Following Locke's lead, Braun described a second environment occurring on Crab Orchard Shale which she entitled "ravine slopes." It differs from the post oak openings by having steeper slopes and, according to Locke, having originally been covered with sugar maple (Acer saccharum). The environment is most common east of West Union on the slopes of Ohio Brush Creek. Although more definitely secondary in nature than the post oak openings, its eroded soils support many cf the same species. The conspicuousness of red cedar in the community has given rise to the name "cedar barren" (Braun). Several species of the openings (e.g. prairie dock), however, are rare or absent on the "barrens." Nevertheless, the two community types are not clearly separable. Additionally, some badly eroded areas on overlying dolomites support similar communities, at least superficially. The distinctions among these communities are further obscured by the homogenizing effects of disturbance. In these situations judgments of when the term "post oak openings" still applies will sometimes be arbitrary.

In comparison to primary communities, post oak openings are most similar to little bluestem prairies, especially as such prairies exist in the Bluegrass Region of Adams County. The prairies differ primarily in being dominated by prairie grasses (mostly little bluestem and side-oats grama, Bouteloua curtipendula), in having nearly complete vegetation covers over thin but not obviously eroding soils, and in occurring usually over dolomites rather than Crab Orchard Shale. Braun (1928a) believed the Bluegrass Region prairies, unlike the Till Plains and Lake Plains prairies, developed prior to Wisconsin glaciation. If this theory is true and if the post oak openings are primary communities, they too probably developed at least partially in pre-Wisconsin time. The openings also have some resemblance to the cedar glades of Kentucky and Tennessee (e.g. Baskin and Baskin 1978). Although the two community types have similar aspects of scattered cedars in openings with thin soils and sparse vegetation, their total floristic compositions are considerably different and the cedar glades occur over limestone or dolomite. Similarly, the compositions of post oak openings and the cedar glades described by Curtis (1959) for Wisconsin are quite different.

Given the probable continuous existence of post oak openings since they were described by Locke in 1838, at least certain stands of the community type appear to have good successional stability. This stability probably results mostly from the poor suitability of the thin, eroding soils for invasion by woody species. Such invasion appears most active where soils are deeper. Grazing has probably also affected succession, beneficially by retarding certain woody species and by possibly increasing erosion, and detrimentally by selectively eliminating some species and allowing the increase of weeds. Fire may have been a retardant on some sites, though the sparse vegetation could not have supported very hot fires. With enough time and protection from these impacts, however, there is little doubt that the openings would succeed to oak woodlands.

No substantive ecological data exist for the community. Cusick and Troutman (1978) provided abbreviated species lists of the major known remnants.

DISTRIBUTION: No communities very similar to the post oak openings are known to exist outside Ohio, though similar environmental potentials for such communities probably occur in states to the south. In Ohio, the openings are restricted to the Crab Orchard Shale in the unglaciated Bluegrass Region, north of West Union in Adams County. The shale is calcareous and weathers to a light brown to yellowish, heavy silt loam containing scattered pieces of dolomite. On slopes, deep erosion gullies are usually present. The shale occurs over Brassfield Limestone and beneath Bisher Dolomite, all of which outcrop along Ohio Brush Creek east of West Union. The openings usually occur on slight slopes or, as Locke described, "conical moundlike outliers." "Cedar barrens," similar to post oak openings and described above, occur on steeper slopes, more commonly along Ohio Brush Creek.

A fairly good example of a post oak opening is the "prairie" of Adams Lake State Nature Preserve.

STATUS: Post oak openings in Ohio never were common. Their restriction to a small area of Ohio has limited their extent while increasing their vulnerability to similar impacts. Less than half a dozen good examples are currently known to exist. The community has been exposed to a variety of past impacts of which some, such as grazing and marginal fires, may have helped retard woody succession. These factors, however, may also have selectively affected local compositions. A previous owner of one area indicated the Civilian Conservation Corps in the 1930's had planted it with pines (Pinus sp.) and black locust (Robinia pseudoacacia) and had built erosion check-dams. The dams have disappeared and the trees, when present, are now restricted to the borders. It is probable that some stands were previously seeded with sweet clover (Melilotus spp.) or other species. Although the community in the long-term would be threatened by woody succession, its major threat now is human development. One of the best stands is just outside a town, another stand is partially used as a campground, and another of the best stands is under utility wires. Some of the sites could support houses, a number of which are now being built in the area. The community type is endangered in Ohio.

MANAGEMENT: Little management is probably necessary on the sites or site portions with the thinnest, least fertile soils. Control of woody species may be necessary over time on sites with deeper soils. Erosion control should probably not be practiced, or should be practiced only within limits. Manual control of weeds may be necessary in local areas. Fire is probably not necessary but could be tested on experimental plots.

INVENTORY GUIDELINES: All stands which fit the definition of post oak openings over Crab Orchard Shale should be inventoried. Similar stands, if any, over other bedrock strata should be viewed critically before being included in this category.

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## Sand Barren 31.150

DESCRIPTION: Characteristic shrubby and herbaceous species in various combinations comprise over half the vegetation cover of an open community over moist to dry inland sand deposits. Most stands occur in or near the Oak Openings region of northwestern Ohio. Characteristic herbaceous species include:

Bracken, Pteridium aquilinum
Little Bluestem, Andropogon scoparius
Fall Witch Grass, Leptoloma cognatum
Panic Grass, Panicum lanuginosum
Panic Grass, P. oligosanthes
Canada Bluegrass, Poa compressa (an exotic)
Sedge, Carex pensylvanica
Umbrella-sedge, Cyperus filiculmis
Rush, Juncus greenei
Colicroot, Aletris farinosa
Bastard-toadflax, Comandra umbellata
Sheep Sorrel, Rumex acetosella (an exotic)
Thimbleweed, Anemone virginiana
Strawberry, Fragaria virginiana
Cinquefoil, Potentilla simplex
Tick-trefoil, Desmodium spp.
Bush-clover, Lespedeza capitata
Lupine, Lupinus perennis
Milkwort, Polygala sanguinea
Flowering Spurge, Euphorbia corollata
Frostweed, Helianthemum bicknellii
Frostweed, H. canadense
Pinweed, Lechea leggettii
Arrow-leaved Violet, Viola sagittata
Purple Gerardia, Gerardia purpurea
Pussy-toes, Antennaria plantaginifolia
Aster, Aster pilosus
Cudweed, Gnaphalium obtusifloium
Dwarf Dandelion, Krigia biflora
Blazing-star, Liatris aspera
Black-eyed Susan, Rudbeckia hirta
Early Goldenrod, Solidago juncea
Gray Goldenrod, S. nemoralis
Goldenrod, S. rugosa

Many other herbaceous species occur more locally. Sizeable open sand areas with little or no vegetation frequently also occur. Lichens (Cladonia spp.) and mosses (Polytrichum spp., etc.) sometimes form conspicuous patches in these areas, and earthstars (Geastrum sp.) may be common. Characteristic shrubs include:

Pussy Willow, Salix discolor
Willow, S. hymilis
Sweet-fern, Comptonia peregrina
Carolina Rose, Rosa carolina
Northern Dewberry, Rubus flagellaris
Shining Sumac, Rhus copallina

Individual stands of the community type vary considerably in dominant species and total floras, often resulting from different soil moisture levels and former uses. Some individual sites have different zones or patches of dominants largely defined by soil moisture differences. Some species, like fall witch grass and the frostweeds, usually occur only as infrequent individuals. Others, like umbrella-sedge (Cyperus filiculmis) and bush-clover (Lespedeza capitata), are common and occur as groups of individuals. A few, like bracken and northern dewberry, form dense patches. Some dominance patterns probably result partly from allelopathic interactions.

The name "sand barrens" is derived from that used by Curtis (1959) for similar communities in Wisconsin. There they occur on sand dunes on river terraces. Curtis believed these are secondary communities following disturbance of dry-mesic or dry prairies and subsequent wind movement of the sandy substrates. Of the 33 "prevalent species of sand barrens" listed by Curtis for Wisconsin (See his Table XV-1) at least 25, or 76 percent, occur or occurred in or very near the sand barrens of Ohio. The Ohio community also has some similarities to the "bracken-grassland" community of Curtis, especially in the importance of bracken. The grasses most significant in Wisconsin, however, are not so significant in Ohio, and the Ohio stands are not associated with pine communities like those in Wisconsin.

Sand barrens in the Oak Openings region of northwestern Ohio occur among a mosaic of different plant communities developed over post-glacial sand deposits. Dominance of the different community types also is dependent primarily on different substrate moisture levels and historic impacts. The moisture levels range from dry in the sands well above the water table to wet in those near or below the water table. The different communities have similarities and gradations on soils with similar moisture regimes and similar use or non-use histories. Sand barrens in the region are most similar to little bluestem prairies and dry oak savannas. Sand barren and prairie communities here display gradual intergradations, making classification of the transitional communities arbitrary. Generally, sand barrens, in contrast to prairies, have less than half their vegetation covers in prairie grasses (especially little bluestem), and more than half their species in types more characteristic of barrens than prairies. The more definite sand barren stands usually occur on the higher, more xeric sand deposits.

The openings of the Oak Openings consist mostly of sedge-grass meadows, prairies, and sand barrens among, primarily, black oak (Quercus velutina) and white oak (Q. alba) woodlands. Gradations occasionally occur between the barrens (or prairies) and the woodlands. Originally such gradations were probably common, constituting dry oak savannas. Historic use patterns, however, have mostly either eliminated the trees or allowed them to develop into closed woodland with subsequent loss of the sand barren flora.

On slopes where dry and wet soils meet, sand barrens (and little bluestem prairies) form transitions, usually fairly abrupt, with sedge-grass meadows. The meadows commonly consist of various sedge family members (Carex, Cladium, Eleocharis, Fimbristylis, and Rhynchospora), bluejoint (Calamagrostis canadensis) and, locally, small interesting patches of less conspicuous species, such as St. John's-wort (Hypericum gentianoides), sundews (Drosera spp.) and others.

The nature of the sand barrens prior to European settlement is open to question concerning composition and extent. Curtis (1959) believed the sand barrens of Wisconsin represented secondary communities following the historical disturbance of dry or dry-mesic prairies. Such is probably also true of many Ohio sand barrens. Plowing and over-grazing of little bluestem prairies, and extreme cutting and grazing of dry oak woodlands probably opened up the sandy soils to increased dessication and wind movement. Lowered water tables augmented these effects. Such disturbances created rigorous conditions conducive to the support of only selected species, including those typical of sand barrens. Sand barrens probably did exist in the Oak Openings prior to European settlement, but they were likely restricted to the highest, most consistently dry sand deposits.

Today they also occur as secondary stands on lower, previously less xeric soils. Some of these rapidly succeed to woodland if left undisturbed, while others are more stable because of the more natural dryness of or greater disturbance to their soils.

Prairies and, to a lesser degree, sand barrens in the Oak Openings region probably were partially maintained by fire. The original borders of these communities were commonly oak woodlands, the densities and boundaries of which probably fluctuated in response to burning. Savannas with prairie or barren understories existed, at least temporarily, in the more open stands. Succession to forest, at least temporarily, probably quickly occurred on the soils with greater moisture levels. Today, few savanna-like situations remain, most having been destroyed or, with fire control, allowed to develop into closed woodland. Fire control and lowered water tables have also allowed the invasion of dense stands of quaking aspen (Populus tremuloides) into some barrens and prairies.

Except for miscellaneous species lists, few ecological data on sand barrens in Ohio have been obtained.

DISTRIBUTION: Sand barren-like communities are known to occur north and west of Ohio to Wisconsin and Nebraska. In Ohio they are nearly restricted to sites within the Oak Openings region in the northwestern quarter of the state, including parts of Lucas, Fulton, Henry, and Wood counties. This region was mapped by Gordon (1966). At least one stand, and probably remnants of others, occur on sand deposits in other counties along the south side of Lake Erie. The communities occur on sands deposited by post-Wisconsin glacial lakes (e.g. Lakes Warren and Maumee which were higher than and preceded Lake Erie) and subsequently reformed into dunes and other formations by wind. The barrens are generally limited to the higher, more droughty deposits, though secondary stands occur elsewhere.

The sands of the barrens are fine and appear moist to wet in winter and spring or following rain, but after a rainless period in summer those much above the water table become very dry. Curtis (1959) explained that the microhabitat conditions of the community are extreme, especially regarding high summer temperatures and evaporation rates, and low soil moistures and nutrients. He indicated that many species characteristic of sand barrens have various morphological or life history adaptations related to these desert-like conditions. Dwarf dandelion (Krigia virginica) and others are ephemeral spring annuals, milkwort (Polygala polygama) and others have water storage organs, cudweed and others have hairy leaf coatings, and other species have deep root systems. Some species, however, have no obvious modifications of these types. Nitrogen-fixing species, such as the legumes, sweet-fern and possible other species, have obvious nutritional advantages in the sterile, sandy environment.

Some of the best examples of sand barren stands in Ohio occur in Oak Openings Preserve Metropark of the Toledo Metroparks system. A few specific sites are listed by Cusick and Troutman (1978).

STATUS: Sand barren stands in Ohio were never common, and those which remain are small and vulnerable to quick and easy elimination. Some of the best stands are under the relatively protective management of the Toledo Metroparks. Others occur in the Maumee State Forest. Those outside of the park and forest systems are subject primarily to development of the Oak Openings region west of Toledo, mainly by housing and commercial interests. No stands outside of Lucas County are known to be protected. Some stands are threatened by forest succession, which has been increased locally by reforestation projects. A few stands are threatened by off-the-road vehicles. In summary, a few good stands in a limited area are protected, and the rest are endangered.

INVENTORY: All sand barren stands in Ohio should be inventoried. Emphasis should be placed on those suspected of being primary or more stable.

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Oak Savanna 32.110

DESCRIPTION: Oaks (Quercus spp.), with or without other tree species, comprise a prominent yet partial overstory above, or originally above, a prairie understory. Tree cover may range from as low as 10 to nearly 100 percent of ground area. The trees may be large or brushy in size, and scattered or clumped in distribution. They occur within existing or former prairie boundaries rather than just as borders around prairie openings. Tree species vary or varied per site, as described below. Because of the scarcity of oak savannas remaining in Ohio, the community concept expediently includes a broad range of former types, including dry to wet savannas and oak barrens.

Oak savannas and prairies originally comprised a single, dynamic, interrelated group of communities which graded into each other in both space and time. Differentiation of the two was, and is, arbitrary. Curtis (1959) defined the savannas of Wisconsin as having at least one tree per acre but less than 50 percent canopy coverage. Such criteria may once have worked in Ohio but today they are difficult to apply to the small, disturbed remnants. In the present system, communities in Ohio will be considered prairies unless, based on subjective judgment, the trees represent a major visible and functional component.

Specific community types excluded from the oak savanna category include the Bluegrass Region prairies and post oak openings containing red cedars (Juniperus virginiana). It is believed that recognition of separate savanna and treeless communities here would result in too much artificial splitting of these restricted community types. Too, the Oak Openings region of northwestern Ohio, though possibly representing a regional savanna system, is not considered a savanna on the community stand level. Instead, each specific site within the Openings is classified by its individual characteristics as sedge meadow, prairie, sand barren, woodland, etc. Similarly an opening and an adjacent woodland in the Openings are not considered as a savanna unit, but as separate community types. If, however, a prairie or sand barren stand in the Oak Openings does contain a substantial tree component within its boundaries, it is considered a savanna.

Oak savannas in Ohio had different species compositions and aspects depending largely on the floristic regions in which they occurred and the moisture conditions and fire patterns of their specific sites. One of the more common, more stable and more vivid types was the classic bur oak (Q. macrocarpa) savanna on the Wisconsin till plains of west-central Ohio. Dobbins (1937) described its characteristics in that region, noting that bur oak occurred "as an individual or in small groves in and around the prairie..." Associated trees in the more level, moist prairies included shingle oak (Q. imbricaria), swamp white oak (Q. bicolor), red oak (Q. rubra), shellbark hickory (Carya laciniosa), American elm (Ulmus americana) and other species. Dobbins described the wet prairies at Killdeer Plains, Wyandot and Marion counties, as "essentially treeless except for a few widely scattered elms, cottonwoods, willows and bur oaks." He mentioned that "bur oak land", including bur oak forests, was used as an indicator of the high value of the lower, more fertile soils on which it commonly occurred. Sears (1926) quoted a report from Madison County where "The prairies consisted of level stretches of country covered with sedge-grass, and dotted here and there with patches of scrubby burr-oak growing upon the highest points of land... The growth of the burr-oaks on the prairies was impeded by these periodical fires..."

Oak savanna of different composition occurred on drier sites. Dobbins described this type in west-central Ohio as located on over-drained gravel moraines and gravel-filled glacial outwash valleys. Although bur oak also grew on these sites, dominant species usually were white oak (Q. alba), black oak (Q. velutina), shagbark hickory (Carya ovata) and, towards southwestern Ohio, post oak (Q. stellata). Dobbins reported the trees here were characteristically dwarfed and stunted, and the prairie understory included scrubby growths of blackberry (Rubus allegheniensis), hazelnut (Corylus americana) and wild plum (Prunus americana). The understory was generally little bluestem prairie.

Similar white oak-black oak savannas occurred, and still occur as small remnants, in the Oak Openings on the Lake Plains of northwestern Ohio. As noted before, the savanna concept used in the Oak Openings is of two types: the regional concept used for the gross relationship of the openings and the woodlands; and the specific concept, as used here for the characteristics of specific sites. The understory compositions of the Oak Openings savannas differed from those in west-central Ohio savannas because of the Openings' occurrence on sand, rather than gravel deposits. The understories were generally little bluestem prairies with high incidences of sand-tolerant species, though occasionally sand barren types of understories may have been included. Hehr (1970) found the presettlement vegetation of the Oak Openings formed continuums correlated primarily with different soil types.

Stands with dry oak savanna aspects undoubtedly were also present in the Bluegrass Region prairies of unglaciated southwestern Ohio, though few records remain. Most prairies there today are characterized more as small openings (with red cedars) than as savannas dotted with oaks.

An unusual dry oak savanna-like community was reported by Beatley (1959) to have occurred on lacustrine deposits associated with the preglacial Teays River valleys in Jackson County in the Unglaciated Plateau. White oak and, locally, shagbark hickory dominated the overstory, while dry prairie species comprised part of the understory. Shrubs and understory trees mentioned in historical statements quoted by Beatley include "Cherry, Aspen, plum, alder, hazel, etc.," "Hurle bush," "Crabapple and Thornbrush" and "briars, etc." Savanna aspects included "Land very thin soil, with barren prairies, timber B. oak, w. Oak grubs, interspersed with Hazel," "Timbered with a few scrubby Oak and Hickory trees...," and "Some glades of open land, grassy without any timber." Beatley explained that the heavy silt-loams on these sites may have been wet in some seasons but subject to drought in late summer.

Sears (1926) called oak savannas "oak openings," which he defined as:

> Essentially oak savannah, the oak forming thin groves, or being present as scattered clumps or individuals, with the (generally

> lower) ground between occupied by grasses and other herbaceous vegetation.

In contrast, he defined "barren" as:

> An habitat in which tree growth is scrubby, defective, or even absent; used alike in cases of deficient and excessive soil mositure.

It is clear that some of the communities described above would represent barrens by Sears' terminology. Especially on dry sites, good distinctions between oak openings and barrens could not always be made. More certain examples of barrens occurred in certain areas of the Unglaciated Plateau in northeastern Ohio, as reported by Sears (1926) and Gordon (1969) from early land survey records. Gordon indicated that no adequate descriptions of the floras of these sites exist, but that the herbaceous understory was presumed to be that of white oak-black oak-chestnut (Castanea dentata), chestnut oak (Q. prinus) or oak-blueberry (Vaccinium spp.) communities. Gordon felt those barrens were temporary communities created by Indian fires. In addition to barrens, Sears also reported more typical savannas ("oak openings") in the Glaciated and Unglaciated Plateaus of northeastern Ohio.

Lengthy debates have and continue to occur over the reasons for the origin and maintenance of prairies and savannas in the Prairie Peninsula. Savannas play a critical role in that discussion as they represent a major type of transition from prairie to non-prairie, or forest. Several factors undoubtedly affected prairie-savanna creation and survival, including climate, substrate conditions, natural and aboriginal fires, natural grazing and plant migration. Whereas climate was very important during the theorized post-glacial xerothermic period, its influence in Ohio has subsequently diminished in prairie maintenance. Here, prairies and savannas at the time of European settlement were largely confined to sites of substrate extremes and/or the influence of fires. Although few records remain of Indians actually starting fires in Ohio, evidence of such activities in other prairie states indicates that the practice was probably also common here. On some extremely exposed sites, prairies were maintained by substrate and microclimate conditions alone. On more mesic sites, some prairies and savannas (especially barrens) were probably maintained almost entirely by fire. Most prairies and savannas, however, were probably maintained by a combination of substrate and fire. The two factors reinforced each other, the seasonally dry substrate supporting a more burnable vegetation, and the fire producing a more open, drought-prone substrate.

Given fire control and continuation of a mesophytic climate, most savannas in Ohio would probably have succeeded to forest in several decades. The different rates, depending on the severity of substrate conditions to trees, and the competitiveness of trees in the different prairie communities. Curtis (1959) proposed the interesting theory that Wisconsin has both "brush prairies" and "true prairies", both of which appear similar when maintained by fire. True prairies, however, contain no trees, while brush prairies contain low "grub" trees which readily sprout in the absence of fire. He further speculated the true prairies originated from the burning and complete tree elimination of climax, non-oak forests, while brush prairies originated from the burning and imcomplete tree removal from successional oak-containing forests. The oaks were not eliminated because of their fire resistance, including grub formation. Because of the apparent commonness of trees reported to have occurred in Ohio prairies, most prairies here would probably have qualified as brush prairies. The dominance of bur oak in some Ohio savannas has been reported a result of rapid taproot development by its seedlings and subsequent growth and invasion of the species into prairies. Curtis, however, concluded that bur oak savannas in Wisconsin originated from degradation of pre-existing forests rather than invasion by the oaks. Reports indicated that these Wisconsin savannas developed into dense oak stands within 30 years following cessation of fire. Bur oak, where present, was more common than other species because of the greater fire resistance of its bark. Curtis indicated that sprouts from bur oak grubs may attain fire-resistant size in 12 to 15 years of protection from fire, while trees of the black oak group never attain a safe size. He also suspected that local populations of white oak may have acquired additional fire resistance by introgression with bur oaks.

In summary, little is known about succession of savannas in Ohio based on studies in this state. If, however, the evidence from Wisconsin can be applied here, changes from prairies to savannas to woodlands, or vice versa, often involved succession less than it did mere shifts in growth forms of preexisting species. True successions of understory species may have occurred in response to these shifts, and true successions of woody species into some prairies probably did occur, though more by restricting the margins in successive steps than producing transitional savannas.

Most oak savannas in Ohio were destroyed before they could be studied. Almost no ecological data exist on them.

DISTRIBUTION: Oak savannas similar to those in Ohio previously occurred throughout the Prairie Peninsula to South Dakota and Oklahoma. Barrens like those described by Sears (1926) and Gordon (1969) undoubtedly occurred in additional areas outside the Peninsula. Savannas in Ohio occurred, as described above, on sand deposits in the Oak Openings region of the Lake Plains in northwestern Ohio, on outwash and morainal deposits or till in the Till Plains of west-central Ohio and the Glaciated Plateau of northeastern Ohio, on dolomite in the Bluegrass Region of southwestern Ohio, on sandstone in the Unglaciated Plateau of eastern Ohio, and on pre-glacial lacustrine deposits in the Unglaciated Plateau in, at least, Jackson County. The savannas varied considerably in composition and aspect in these different regions.

STATUS: Most true savannas in Ohio have been destroyed or have succeeded to woodland following control of fires and, in some areas, possibly also following drainage. Curtis (1959) reported that the rarest plant community in Wisconsin is an oak savanna with an intact ground layer. The same may be true for Ohio. Most bur oak savannas have been replaced by corn and beans, or the trees remain with an understory of bluegrass and cows. Only one bur oak savanna stand with a fairly complete prairie understory is currently known. Most black oak-white oak or other dry oak savannas have been destroyed for development or have long ago succeeded to woodland.

Small areas of open dry oak communities over prairie understories are occasionally found, though today these usually represent marginal successions into prairies rather than remnant savannas. Oak savannas in Ohio are on their way out.

MANAGEMENT: Management of oak savanna remnants in Ohio represents a major challenge. Those few which retain savanna aspects have largely been maintained during the past few decades by grazing. Continuation of the practice will eventually result in loss of the trees by attrition, with little or no replacement by the same species or by former processes. More natural management would probably require the use of fire on most areas. This would entail establishing a balanced burning program which would allow the maintenance of the appropriate intermediate numbers of trees representing a savanna. Such a program might have to be augmented by selective cutting, though this would considerably reduce the naturalness of the techniques employed. Understory species would probably have to be restocked in overgrazed savannas. Opportunities for release of suppressed prairie species should first be allowed on areas recently grazed. Regardless of which techniques are used, previously wetter savannas may never regain their former conditions because of regional drainage impacts.

INVENTORY GUIDELINES: All Ohio savanna remnants, with or without natural understories, should be inventoried. Stands marginal between prairie and savanna generally should be classified as prairie, while previous savannas with closed or nearly closed overstories generally should be classified as savanna.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv., new ser. 1(1): 1-182. (See. p. 91-95.)

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p. (See p. 298-305, 325-351.)

Dobbins, R.A. 1937. Vegetation of the northern "Virginia Military Lands" of Ohio. Ph.D. diss., Ohio State Univ., Columbus. 161 p. (See p. 57-72, 117-120.)

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_____. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113 (See p. 61-64.)

Hehr, D.W. 1970. A comparative study of the composition of the presettlement vegetation and the characteristic geologic substrate of the Oak Openings and surrounding area in northwestern Ohio. M.A. thesis, Bowling Green State Univ., Bowling Green. 90 p.

Moseley, E.L. 1928. Flora of the Oak Openings. Proc. Ohio Acad. Sci. 8: 79-134 + map. Spec. Pap. No. 20.

Sears, P.B. 1926. The natural vegetation of Ohio, II: the prairies. Ohio J. Sci. 26: 128-146

Beach-Dune Community 41.110

DESCRIPTION: Characteristic species dominate a sand beach or dune formed by an existing lake. Dominant and associated species include:

| | |
|---|---|
| Beachgrass, Ammophila breviligulata | Sea-rocket, Cakile edentula var. lacustris |
| Canada Wild-rye, Elymus canadensis | Silverweed, Potentilla anserina |
| Switchgrass, Panicum virgatum | Beach-pea, Lathyrus japonicus |
| Winged Pigweed, Cycloloma atriplicifolium | Wild Bean, Strophostyles helvola |
| Russian Thistle, Salsola kali (an exotic) | Seaside Spurge, Euphorbia polygonifolia |
| Four-o'clock, Mirabilis nyctaginea (an exotic) | Evening-primrose, Oenothera biennis |
| Clammyweed, Polanisia graveolens | Wormwood, Artemisia caudata |
| | Cocklebur, Xanthium strumarium |

Many additional more generalized or less frequent species occur. Several of the most characteristic species are endangered or threatened in Ohio.

The species composition of the community is unlike any other in Ohio. The community concept excludes ancient beaches, mostly in the form of post-glacial beach ridges, which now have entirely different compositions. The community occurs in Ohio only along Lake Erie.

The Ohio beaches are surprisingly consistent in compositions and patterns of species. The first plant zone begins just below the storm level drift line of wood and beer cans. Scattered annuals occur here, usually dominated by sea-rocket. Additional species occur above this zone. They may or may not appear in additional zones, depending on the slope and other characteristics of the beach and its storm history. Generally, the further the beach zone from the water, the less severe the conditions and the more species, including annuals and perennials, that occur. Seldom, however, do these zones form complete covers over the sand.

On only two beaches in Ohio is the beach followed by open (i.e. non-wooded) sand accumulations large enough to be called dunes. And only here are there significant stands of dune grass. Behind the dunes are rear beaches with greater climatic and substrate stabilities and greater numbers of species.

Behind the open beaches are usually wooded areas, often of cottonwoods. A tangle of grape vines and shrubs frequently occupies the understory. The trees may or may not occur on a stabilized dune. Those wooded areas today are usually strips narrowed by human development just behind them. It would be possible to classify the tree zones as a separate beach type, but this was considered not useful as the strips which remain are small and they can just as easily and possibly more accurately be viewed as integral parts of the whole beach system.

Beaches are dynamic environments with continual movement of substrates and communities. Changes are most dramatic on the front beaches and dunes, but the species occurring there are more adapted to these fluctuations. Tree succession onto the more stable rear beach or dune is a natural process.

Descriptions of beaches in Ohio are included in the works of Jennings (1908), Core (1948) and Marshall (1955).

DISTRIBUTION: Beaches with species compositions similar to those in Ohio occur in local areas throughout the Great Lakes. Beaches in Ohio are limited to the shores of Lake Erie, mainly in the flatter terrain west of Cleveland. Non-wooded sizeable dunes exist at only two sites, interestingly both east of Cleveland.

Sheldon's Marsh in Erie County has a good beach community, and Headlands Dunes in Lake County has a good beach-dune community.

STATUS: The beach community in Ohio is endangered. Many of its species are endangered in Ohio, and the community as a whole consists of isolated pieces, most of which are specifically sought and impacted by humans. Most of the beaches have been diminished by the long-term rise of Lake Erie. Sheldon's Marsh beach, one of the finest in Ohio, will likely be lost by the natural migration of its sand base. One of the two dune stands is private and threatened by trail bikes and other human use. The other dune stand is a preserve but receives heavy foot traffic from an adjacent park.

INVENTORY GUIDELINES: All beach pieces large enough to be called stands should be inventoried. For preservation purposes, all larger beaches should be regularly monitored for floristic composition changes.

SELECTED REFERENCES:

Core, E.L. 1948. The flora of the Erie Islands. Ohio State Univ., Franz Theodore Stone Lab. Contr. No. 9. 106 p.

Cowles, H.C. 1899. The ecological relations of the vegetation on the sand dunes of Lake Michigan. Bot. Gaz. 27: 95-117, 167-202, 281-308, 361-391.

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p.

Jennings, O.E. 1908. An ecological classification of the vegetation of Cedar Point. Ohio Nat. 8: 291-340.

Marshall, H.G. 1955. Succession in a dune community at Mentor Headlands, Ohio. Ohio J. Sci. 55: 90-94.

Calcareous Cliff Community 42.110

DESCRIPTION: Lichens, mosses, herbs and shrubs dominate an open calcareous cliff community. Characteristic vascular species include:

Walking Fern, Asplenium rhizophyllum
Wall-rue, A. ruta-muraria
Bulblet Fern, Cystopteris bulbifera
Purple Cliff-brake, Pellaea atropurpurea
Polypody, Polypodium virginianum
Sedge, Carex eburnea
Columbine, Aquilegia canadensis
Alumroot, Heuchera americana
Hydrangea, Hydrangea arborescens
Sullivantia, Sullivantia sullivantii

Many other species occur, most of them much more locally than those above.

The community is similar only to the non-calcareous cliff community type. Many of the same species occur on both. Curtis (1959) studied cliff communities in Wisconsin and found that greater species similarities were obtained when the cliffs were classified as being "shaded" or "exposed" rather than being classified by their substrate types. This was considered for the Ohio classification but was not done for two main reasons. First, good comparative data are not available to make the comparisons that Curtis did. Second, field determination of relative shading is considerably more difficult than that of substrate. Some cliffs are always shaded, some partially, and others are wholly or partly shaded for different amounts of time each day. Too, the physiological effects of exposure are mediated to different degrees by the amounts of water in or on the substrate. Lastly, given a single cliff, it was considered simpler to speak of it as one community with different gradient types than as different communities. Nevertheless, the classification should be reevaluated as more data are obtained.

Calcareous cliffs are commonly bounded on the bottom by either water or some mesic forest. They are usually bordered on the top by a dry or dry-mesic forest, usually oak-maple or oak-hickory.

Descriptive accounts of calcareous cliffs in Ohio include the works of Braun (1917, 1928, 1969), Core (1948) and Anliot (1973).

DISTRIBUTION. The nominal category of calcareous cliffs applies worldwide wherever calcareous substrates are exposed. Cliffs with species similar to those in Ohio, however, are limited to eastern North America. Calcareous cliffs in Ohio occur throughout the state but are common only in local areas. Few exist in the mostly non-calcareous region of eastern Ohio. In western Ohio most of the calcareous materials are buried by till. The cliffs are most prominent in the Lake Erie islands and Catawba Peninsula, along rivers that have dissected through the till, and in the unglaciated Bluegrass Region in Adams County. The substrate is usually dolomite or limestone.

Good examples of the community exist at Clifton Gorge in Greene County, and in the Edge of Appalachia preserves in Adams County.

STATUS: Although some of the communities have been destroyed by reservoirs and other human disturbances, most appear to remain intact. Rock climbers pose local threats, and acid rain may pose an insidious general threat. The community needs more study to assure that its major variants are preserved, including those expressed by non-vascular species.

INVENTORY GUIDELINES: All sizeable calcareous cliffs should be inventoried, especially in regions where they are not common. Good notes should be taken on the environmental characteristics of the site, including substrate type and wetness, and exposure.

SELECTED REFERENCES:
Anliot, S.F. 1973. The vascular flora of Glen Helen, Clifton Gorge, and John Bryan State Park. Ohio Biol. Surv., Biol. Notes No. 5. 162 p.

Braun, E.L. 1917. The vegetation of conglomerate rocks of the Cincinnati region. Plant World 20: 380-392.

_______. 1928. The vegetation of the Mineral Springs region of Adams County, Ohio. Ohio Biol. Surv. 3: 305-517. Bull. No. 15.

_______. 1969. An ecological survey of the vegetation of Fort Hill State Memorial, Highland County, Ohio. Bull. Ohio Biol. Surv. new ser. 3 (3): 1-134.

Core, E.L. 1948. The flora of the Erie Islands. Ohio State Univ., Franz Theodore Stone Lab. Contr. No. 9. 106 p.

Curtis, J.T. 1959. The vegetation of Wisconsin. Univ. Wisconsin Press, Madison. 657 p.

Non-calcareous Cliff Community 42.120

DESCRIPTION: Lichens, mosses, herbs and shrubs dominate an open non-calcareous cliff community. Characteristic vascular species include:

- Mountain Spleenwort, _Asplenium montanum_
- Pinnatifid Spleenwort, _A. pinnatifidum_
- Hay-scented Fern, _Dennstaedtia punctilobula_
- Intermediate Wood Fern, _Dryopteris intermedia_
- Marginal Shield Fern, _D. marginalis_
- Polypody, _Polypodium virginianum_
- Blunt-lobed Woodsia, _Woodsia obtusa_
- Bentgrass, _Agrostis perennans_
- Columbine, _Aquilegia canadensis_
- Stonecrop, _Sedum ternatum_
- Hydrangea, _Hydrangea arborescens_

Many additional species exist lcoally, usually less frequently than those above. Several endangered or threatened species occur in the community.

The community is similar only to the calcareous cliff community, the two being distinguished more by substrate types than by species compositions. The two communities do have many species in common.

Non-calcareous cliff communities vary in composition mostly in correlation with exposure intensity and substrate moisture. The cliff environment ranges from dry, shaded grottoes to wet or moist shaded lower cliffs or colluvium, to exposed cliffs on moist substrates or shaded cliffs on dry substrates, to very dry exposed upper cliffs and cliff tops. A gradient of vegetation follows these changes. Most species require at least slight ledges or crevasses for rooting, with the areas having the greatest soil accumulations generally supporting the greatest diversities of species. Cliff communities may be classified in different ways according to these different environmental factors or to species similarities. See a further discussion of this in the description of calcareous cliff communities.

Non-calcareous cliffs in Ohio generally are bordered on the bottom by streams or mesic to dry-mesic forests, and on the top by dry forests of, usually, oak-pine or Appalachian oak.

Works on the non-calcareous cliff community in Ohio are scarce, but include those in Griggs (1914) and Noblick (1972).

DISTRIBUTION: Non-calcareous cliff connunities exist throughout much of the world, with those having species compositions similar to Ohio communities occurring through much of eastern North America. In Ohio they are limited to eastern Ohio where the substrates are usually sandstones, conglomerates or shales. Most are in the Unglaciated Plateau though some are in the Glaciated Plateau where erosion has exposed and dissected the bedrock.

Examples of the community exist at Nelson-Kennedy Ledges in Portage County, the Hocking Hills State Parks in Hocking County, and Lake Katharine in Jackson County.

STATUS: The community is fairly common in the Unglaciated Plateau but fairly rare in the Unglaciated Plateau. The community has received too little systematic study to accurately identify the status of different exposure or regional subtypes. The community stands generally appear stable. In some areas they have suffered from quarry operations, and the level portions at several parks have been severely hurt by human traffic.

INVENTORY GUIDELINES: Inventories in areas where the cliffs are common must be selective, seeking the larger and more diverse stands with wider variations of environmental conditions. Inventories in the Glaciated Plateau or other areas where the community is uncommon should document most of the more sizeable stands.

SELECTED REFERENCES:

Griggs, R.F. 1914. A botanical survey of the Sugar Grove region. Ohio Biol. Surv. 1: 244-340. Bull. No. 3.

Noblick, L.R. 1972. The plant communities and vascular flora of Conkle's Hollow State Park, Hocking County, Ohio. M.S. thesis, Ohio State Univ., Columbus. 163 p.

Maple-Ash Swamp 51.110

DESCRIPTION: Soft maples, ashes and/or associated species dominate over substrates at least seasonally wet with non-flowing (i.e. non-riverine) water. Dominant species include:

Red Maple, Acer rubrum
Silver Maple, A. saccharinum
Black Ash, Fraxinus nigra
White Ash, F. americana

Associated or locally codominant species include:

Cottonwood, Populus occidentalis
Quaking Aspen, P. tremuloides
Black Willow, Salix nigra
Yellow Birch, Betula alleghaniensis
American Elm. Ulmus americana
Sweetgum, Liquidambar styraciflua
Sycamore, Platanus occidentalis
Boxelder, Acer negundo
Blackgum, Nyssa sylvatica
Green Ash, Fraxinus pennsylvanica

Additional species may be important locally. American elm was once the major dominant before succumbing to the Dutch elm disease, introduced into Ohio in 1930. The elm is still an important understory component. Black ash is more confined to central and northern Ohio. Sweetgum is restricted to southern Ohio.

Maple-ash swamps differ from oak-maple swamps in having few oaks (under ca. 20% of the number of canopy trees), and from mixed swamps in having few of the more mesic species (e.g. American basswood, tuliptree, etc.; under ca. 20% of the number of canopy trees). They differ from beech-oak-red maple stands in having little (under ca. 20%) beech.

Maple-ash swamps grade into open wetlands, primarily marshes and shrub swamps. Here the less shade-tolerant species such as cottonwood and black willow are commonly more prevalent. Either the swamps or the open wetlands may replace the other with changed water levels. Maple-ash swamps also grade into oak-maple swamps and mixed swamps, the division between these sometimes being quite arbitrary.

The major work on maple-ash swamps in Ohio is that of Sampson (1930). Many other, mostly qualitative works exist. Braun (1936) produced limited quantitative data on maple-elm-sweetgum communities on the Illinoian Till in southwestern Ohio.

DISTRIBUTION: Three of the main dominants of the community occur throughout most of the eastern United States and southeastern Canada. Black ash occurs in the northeastern U.S. and southeastern Canada. Communities with some resemblances to those in Ohio occur throughout much of this range. Kuchler's (1964) elm-ash forest (no. 101) is limited to Michigan, Indiana and Ohio. The SAF black ash-American elm-red maple type (no. 39) is limited primarily to southeastern Canada and the Lake States (Eyre 1980).

The maple-ash community in Ohio is located primarily in the Lake Plain, Till Plains, Glaciated Plateau and locally in the Unglaciated Plateau. It occurs over poorly drained substrates in both upland and lowland areas. It and other swamp forest types are included as elm-ash swamp on Gordon's (1966) map.

Young second-growth examples in Ohio occur in portions of Goll Woods in Williams County and Fowler Woods in Richland County.

STATUS: No mature stands are known to exist. Most remaining stands have been disturbed with repeated cutting, and all are threatened by regional drainage.

INVENTORY GUIDELINES: Inventory all older and larger stands. Inventory younger or smaller stands that are compositionally or regionally unusual.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1936. Forests of the Illinoian Till Plain of southwestern Ohio. Ecol. Monogr. 6: 89-149.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. Foresters, Washington. 148 p. + map.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States: manual to accompany the map. Am. Georg. Soc. Spec. Pub. No. 36. 39 + 116 p.

Sampson, A.W. 1930. Succession in the swamp forest formation in northern Ohio. Ohio J. Sci. 30: 340-357.

Oak-Maple Swamp 51.120

DESCRIPTION: Oaks, soft maples, ashes and/or associated "hydric species" dominate over substrates at least seasonally wet with non-flowing (i.e. non-riverine) water. Dominant species include:

Pin Oak, _Quercus palustris_
Swamp White Oak, _Q. bicolor_
Bur Oak, _Q. macrocarpa_
Red Maple, _Acer rubrum_
Silver Maple, _A. saccharinum_
Black Ash, _Fraxinus nigra_
White Ash, _F. americana_

Associated or locally codominant species include:

Cottonwood, _Populus occidentalis_
Quaking Aspen, _P. tremuloides_
Black Willow, _Salix nigra_
Bitternut, _Carya cordiformis_
Shellbark, _C. laciniosa_
Shagbark, _C. ovata_
River Birch, _Betula nigra_
White Oak, _Quercus alba_
Yellow Oak, _Q. muehlenbergii_
Red Oak, _Q. rubra_
American Elm, _Ulmus americana_
Sweetgum, _Liquidambar styraciflua_
Blackgum, _Nyssa sylvatica_

Additional species may be important locally. American elm was a major component prior to its demise caused by Dutch elm disease. Black ash is restricted mostly to northern and central Ohio, while river birch and sweetgum are restricted to southern Ohio.

Oak-maple swamps differ from maple-ash swamps in having a significant oak component (over ca. 20% of the number of canopy trees), and differ from mixed swamps in having low numbers of the more mesic species (e.g. American basswood, tuliptree, etc.; under ca. 20% of the trees). They differ from beech-oak, red maple ("wet beech") stands in having little (under ca. 20%) beech.

On wetter ground, oak-maple swamps commonly grade into marshes and shrub swamps. On slightly drier ground they commonly grade into mixed swamps or beech-oak-red maple ("wet beech") communities. Succession between oak-maple swamps and these other communities may occur in either direction following water level or other environmental changes.

Few quantitative data have been gathered on oak-maple swamps in Ohio. Sampson (1930), Braun (1936) and Beatley (1959) conducted substantial works, mostly qualitative in scope.

DISTRIBUTION: Oak-maple swamps similar to those in Ohio are restricted largely to or near the midwestern states.

The southern aspect of this community is included in the SAF pin oak-sweetgum cover type (no. 65, Eyre 1980).

The community in Ohio occurs chiefly in the Lake Plain, Till Plains, Glaciated Plateau and locally in the Unglaciated Plateau. Those with bur oak are mostly limited to the Lake plain and Wisconsin Till Plain, while those with pin oak and swamp white oak occur in all regions. The community occurs on upland or lowland depressions, usually over till or lacustrine deposits. Gordon's (1966) ash-elm swamp category included this and other swamp types.

Second-growth examples exist at Irwin Prairie in Lucas County and Culberson Woods in Clinton County. Goll Woods in Williams County contains many large bur oaks, but it also has many mesic trees in portions of the understory.

STATUS: No old-growth stands are known to exist and most of the secondary stands are threatened with cutting and regional drainage. Pin oak and swamp white oak stands have generally expanded with the cutting of other swamp types, but they too are probably declining now.

INVENTORY GUIDELINES: Inventory all larger and older growth stands. Inventory younger and smaller stands that are compositionally or regionally unusual.

SELECTED REFERENCES:
Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1936. Forests of the Illinoian Till Plain of southwestern Ohio. Ecol. Monogr. 6: 89-149.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Sampson, H.C. 1930. Succession in the swamp forest formation in northern Ohio. Ohio J. Sci. 30: 340-357.

Hemlock-White Pine-Hardwood Swamp 51.130

DESCRIPTION: White pine, formerly hemlock, and/or hardwoods dominate over substrates at least seasonally wet with non-flowing (i.e. non-riverine) water. Previous characteristic dominant species include:

Hemlock, Tsuga canadensis
White Pine, Pinus strobus
Yellow Birch, Betula alleghaniensis
Red maple, Acer rubrum

Previous associated or locally codominant species include:

Tamarack, Larix laricina
American Elm, Ulmus americana
Black Ash, Fraxinus nigra

Other species may have been important locally.

Whereas several stands of this community once existed in northeastern Ohio, only one good stand is known to remain. Previously the stands apparently contained various mixtures of the three conifers and hardwoods listed above. The one remaining stand, White Pine Bog Forest in Geauga County, is dominated by white pine, red maple and yellow birch. It contains no hemlock, and only a few tamarack exist on the more open margin.

There are a few fairly level hemlock stands on the Lake Plain and Glaciated Plateau in Ashtabula County which may be easily mistaken for this community. In these, however, the hemlock consistently occurs on slight but fairly well drained rises above the surrounding pools of water or pockets of wet soil. These stands have many of the same understory species as upland hemlock stands and cannot accurately be termed swamps.

The community previously graded into various mixtures of bogs, shrub swamps and marshes on gradients toward wetter substrates. On drier ground they commonly graded into, and probably were succeeded by, hardwood swamps. On steeper gradients they graded into various upland stands. White Pine Bog Forest grades upward into a stand of white pine, sugar maple, beech, etc.

Stein (1974) conducted a general survey of White Pine Bog Forest. Dachnowski (1912), Hicks (1933) and Van Dersal (1933) provided qualitative descriptions of stands now destroyed. No quantitative data are known to exist.

DISTRIBUTION: Stands with similarities to those which existed in Ohio occur in Indiana, Michigan, Pennsylvania, New York, New England and Ontario. This range corresponds in part with Braun's (1950) hemlock-white pine-northern hardwoods region, Kuchler's (1964) northern hardwoods (type no. 106), and SAF's white pine-hemlock type (no. 22, Eyre 1980). The one good Ohio stand is the White Pine Bog Forest in Geauga County. Additional stands previously existed in Ashtabula, Geauga, Portage, Trumbull and possibly additional northeastern Ohio counties. Most occurred in kettles or other glacially derived depressions.

STATUS: White Pine Bog Forest appears successionally stable, though quantitative measurements with permanent plots should be made to monitor this. The Forest is publically owned but is not formally protected.

INVENTORY GUIDELINES: Any additional, newly discovered stands, large or small, primary or secondary, should be inventoried.

SELECTED REFERENCES:

Braun, E.L. 1950 (1967 fasc. ed.). Deciduous forests of eastern North America. Hafner Pub. Co., New York. 596 p. + map.

Dachnowski, A. 1912. Peat deposits of Ohio. Ohio Geol. Surv. Bull. 16. 424 p.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Wahsington. 148 p. + map.

Hicks, L.E. 1933. The original forest vegetation and the vascular flora of Ashtabula County, Ohio. Ph.D. diss., Ohio State Univ., Columbus. 211 p.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States: manual to accompany the map. Am. Geogr. Soc. Spec. Pub. No. 36. 39 + 116 p.

Stein, C.B. 1974. Evaluation of White Pine Bog Forest, Ohio, as a National Natural Landmark. U.S. Dep. Int., Natl. Park Serv. 6 + p.

Van Dersal, W.R. 1933. An ecological study of Pymatuning Swamp. Ph.D. diss., Univ. Pittsburgh. 138 p.

 

Mixed Swamp 51.140

DESCRIPTION: A mixture of typical wet swamp trees and one or more species of more mesic nature dominate over substrates at least seasonally wet with non-flowing (i.e. non-riverine) water. The typical wet swamp species include:

Pin Oak, _Quercus palustris_
Swamp White Oak, _Q. bicolor_
Bur Oak, _Q. macrocarpa_
Yellow Birch, _Betula alleghaniensis_
American Elm, _Ulmus americana_
Red Maple, _Acer rubrum_
Silver Maple, _A. saccharinum_
Black Ash, _Fraxinus nigra_
White Ash, _F. americana_

Typical more mesic species include:

Hickories, _Carya_ spp.
Black Walnut, _Juglans nigra_
Red Oak, _Q. rubra_
White Oak, _Q. alba_
Tuliptree, _Liriodendron tulipifera_
Black Cherry, _Prunus serotina_
American Basswood, _Tilia americana_

Many other wet and more mesic species may occur as associates or as local codominants.

Mixed swamp differs from both maple-ash and oak-maple swamps by its inclusion of a substantial amount (over ca. 20% of the number of canopy trees) of one or more of the more mesic species. Mixed swamps in general are just more complex communities in terms of species richness, including species of both wet and wet-mesic situations. They can be viewed as transitional types, though this implies an unwarranted lesser secondary status. Mixed swamps differ from beech-oak-red maple ("wet beech") by lacking significant amounts (under 20% of the trees) of beech.

Mixed swamps characteristically grade into maple-ash or oak-maple swamps on wetter ground, and beech-oak-red maple and other upland types on drier ground. Classical succession theory would suggest gradual alteration from the wetter to the more mesic of these, though the dynamics in many situations is probably more complex than this.

Little qualitative or quantitative data exist on mixed swamps in Ohio. Sampson (1930) provided some valuable description, his red oak-basswood phase of the elm-ash-swamp forest corresponding to the treatment of mixed swamp given here.

DISTRIBUTION: Swamps with mixtures of some of these species occur through much of eastern North America, though those with greatest similarity to Ohio's are limited primarily to the Great Lakes states and Ontario.

Mixed swamps may occur anywhere in Ohio but are most prevalent in the Lake Plain, the Wisconsin Till Plain and the Glaciated Plateau. They exist over substrates generally wet-mesic in moisture. These may flood seasonally but for only limited periods. Mixed swamps on Gordon's (1966) map would represent a portion of his elm-ash swamp category.

STATUS: No old-growth stands are known and most existing secondary stands are threatened with regional drainage and continued cutting. Some of the current stands probably represent invasions of more mesic species into previously wet swamps following drainage. In parallel, mixed swamps have probably been invaded by additional more mesic species following drainage. The current status of the community in Ohio is not well known.

INVENTORY GUIDELINES: All older growth and sizeable stands should be inventoried. Care must be taken to find stands with relative successional stability as mixed compositions in many stands simply denote past disturbance and immaturity.

SELECTED REFERENCES:

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys, Ohio Biol. Surv., Columbus. Map.

Sampson, A.W. 1930. Succession in the swamp forest formation in northern Ohio. Ohio J. Sci. 30: 340-357.

Maple-Cottonwood-Sycamore Floodplain Forest 52.110

DESCRIPTION: Soft maple, cottonwood, sycamore and associated species dominate on sites flooded seasonally with flowing water. Characteristic dominant species include:

| | |
|---|---|
| Cottonwood, Populus deltoides | Honeylocust, Gleditsia triacanthos |
| Sandbar Willow, Salix interior | Boxelder, Acer negundo |
| Black Willow, S. nigra | Silver Maple, A. saccharinum |
| Hackberry, Celtis occidentalis | Ohio Buckeye, Aesculus glabra |
| American Elm, Ulmus americana | White Ash, Fraxinus americana |
| Sycamore, Platanus occidentalis | Green Ash, F. pennsylvanica |

Other species may be locally associated or codominant. Although many variations occur, the soft maples, cottonwood and sycamore are fairly consistently present as dominants. American elm too is consistent but is relegated to mostly an understory position since its decimation by the Dutch elm disease. Sandbar willow is usually present on newly formed sand or gravel bars and black willow is common on the open riverside margins of the forests. Hackberry, honeylocust and Ohio buckeye are more common in calcareous areas.

The maple-cottonwood-sycamore floodplain community differs from the river birch-maple floodplain in having small amounts (under ca. 20% of the number of canopy trees) of river birch, and it differs from mixed floodplain forests in having small amounts (under ca. 20% of the canopy trees) of more mesic species (e.g. sugar maple, beech, red oak, white oak, etc.).

Maple-cottonwood-sycamore floodplains are usually fairly distinct communities, commonly separated on one side by the river channel and on the other by a drier forest on a terrace or a slope. Today, however, the terrace community is usually corn. The most typical examples are those which flood annually. Those with less frequent flooding or with floods of shorter durations usually have more mesic species and approach the mixed floodplain community composition.

The community is dynamic, annually receiving silt loads in some portions and losing soil and vegetation in other portions. It typically has different vegetation zones developed on alluvial deposits of different ages. Replacement of one zone by another involves simply short-term stepwise maturation more than it does any complex successional pattern. The vegetation both affects and is subject to the continual meandering of the stream channel.

Significant studies on components of the maple-cottonwood-sycamore floodplain community in or near Ohio incude those of Hood (1967), Lee (1945), Lewis (1975) and Lindsey et al. (1961). More general statements include those in Braun (1916), Braun (1928), Beatley (1959) and Gordon (1969).

DISTRIBUTION: Floodplains with species compositions similar to those in the maple-cottonwood-sycamore community in Ohio occur primarily in or near glaciated areas in the midwestern and Great Lakes states and southern Ontario. The community corresponds in part to the SAF silver maple-

American elm type (no. 62; Eyre 1980). In Ohio it is the major floodplain type along most all larger river channels except those with substantial river birch populations in southeastern Ohio. The community corresponds only partly with Gordon's (1966) bottomland hardwoods type.

STATUS: The community is relatively common in the state though very few are old growth and the width of many has been diminished by agriculture, flood control structures, etc.

INVENTORY GUIDELINES: Inventory efforts should concentrate on the larger and more mature stands. Perspective must be maintained on the dynamic nature of the community, realizing that what is inventoried or preserved today could be considerably changed tomorrow.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio. Biol. Surv. new ser. 1(1): 1-182 p. + map.

Braun, E.L. 1916. The physiographic ecology of the Cincinnati region. Ohio Biol. Surv. 2: 113-211. Bull. No. 7.

_______. 1928. The vegetation of the Mineral Springs region of Adams County, Ohio. Ohio Biol. Surv. 3: 375-517. Bull. No. 15.

Eyre, F.H. ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Hood, J.D. 1967. Patterns of vegetation and distribution of Populus deltoides Marsh. within the Hocking River flood plain. M.S. thesis, Ohio Univ., Athens. 143 p.

Lee, M.B. 1945. An ecological study of the floodplain forest along the White River system of Indiana. Butler Univ. Bot. Stud. 7: 1-21.

Lewis, K.P. 1975. Community analysis and the dynamics of establishment of Acer saccharinum on flood plains of the Unglaciated Appalachian Plateau. Ph.D. diss., Ohio Univ., Athens. 111 p. + appendices.

Lindsey, A.A., R.O. Petty, D.K. Sterling and W. Van Asdall. 1961. Vegetation and environment along the Wabash and Tippecanoe rivers. Ecol. Monogr. 31: 105-156.

River Birch-Maple Floodplain Forest 52.120

DESCRIPTION: River birch, soft maple, sycamore, American elm (at least formerly), and associated species dominate on sites flooded seasonally with flowing water. Characteristic dominant species include:

| | |
|---|---|
| Black Willow, _Salix nigra_ | Boxelder, _Acer negundo_ |
| River Birch, _Betula nigra_ | Red Maple, _A. rubrum_ |
| American Elm, _Ulmus americana_ | Silver Maple, _A. saccharinum_ |
| Tuliptree, _Liriodendron tulipifera_ | Yellow Buckeye, _Aesculus octandra_ |
| Sycamore, _Platanus occidentalis_ | White Ash, _Fraxinus americana_ |
| Black Cherry, _Prunus serotina_ | |

Other species may be present locally as associates or codominants. River birch, the key indicator species, varies in abundance from nearly pure stands to representing but small portions of more complex stands. By arbitrary definition, however, the birch should comprise over approximately 20% of a stand's canopy trees to be classified as the birch type. This differentiates river birch-maple floodplain stands from those in either the maple-cottonwood-sycamore or mixed floodplain community types.

This classification will sometimes appear quite artificial where the birch types grade slowly into the other types, or where a community appears similar in all respects to a birch type except for the possibly fortuitous absence of the birch at given sites. Otherwise, the birch community type is usually fairly distinct from most other community types. It normally is much different from the more upland terrace or slope communities commonly existing along its landward margins. One area where the birch community does become confused with other communities is on lacustrine deposits of the preglacial Teays River drainage system. Here, river birch enters communities of pin oak, red maple, sweetgum, etc. in swamp, as versus floodplain, communities. Beatley (1959) described this situation in Jackson and Vinton counties.

McClelland and Ungar (1970) found that river birch stands in southeastern Ohio are frequently overwhelmingly dominated by the birch. They attributed much of this dominance to that species' apparently high tolerance to the acid mine drainage prevalent in that region. Cribben and Ungar (1974) confirmed these results and indicated the soils of river birch stands are characterized by high aluminum concnetrations and low calcium and magnesium concentrations.

The best quantitative data on river birch communities in Ohio are those of Cribben and Ungar. Beatley (1959) and others have provided good descriptive accounts, including analyses of the earliest land surveys.

DISTRIBUTION. The river birch-maple floodplain forest of Ohio corresponds to the SAF river birch-sycamore type (no. 61, Wistendahl _in_ Eyre 1980). The range of the latter is given as southern New England west to southern Illinois and south to Florida and Texas. In Ohio the community is restricted to the southern portion of the Unglaciated Plateau, especially in areas with coal mine operations. As noted above, it is apparently related to acid mine drainage.

STATUS: There is evidence the type has considerably expanded in the state since the advent of white man. Today it is common along many streams in its range. It may expand further depending on how well acid drainage is controlled in the state. Valuable studies could be conducted on areas not having birch now but where it could be expected to grow in the future.

INVENTORY GUIDELINES: To some extent the community can be considered a "weedy" type which does not warrant much inventory effort. Nevertheless, the larger, more mature and/or the possibly more natural stands should be documented.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Cribben, L.D. and I.A. Ungar. 1974. River birch (Betula nigra L.) communities of southeastern Ohio. Ohio Biol. Surv., Biol. Notes. No. 8. 37 p.

Eyre, F.H. ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

McClelland, M.K. and I.A. Ungar. 1970. The influence of edaphic factors on Betula nigra L. distribution in southeastern Ohio. Castanea 35: 99-117.

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Mixed Floodplain Forest 52.130

DESCRIPTION: Various "wet" to "mesic" species, usually in mixed stands, dominate on sites flooded seasonally with flowing water. Characteristic "wetter" dominant and associated species include:

Hackberry, *Celtis occidentalis*
American Elm, *Ulmus americana*
Sycamore, *Platanus occidentalis*
Honeylocust, *Gleditsia triacanthos*
Boxelder, *Acer negundo*
Red Maple, *A. rubrum*
Silver Maple, *A. saccharinum*
Ohio Buckeye, *Aesculus glabra*
Yellow Buckeye, *A. octandra*
White Ash, *Fraxinus americana*
Green Ash, *F. pennsylvanica*

The term "wetter" here implies that these species appear better able to endure more strenuous flooding. It does not imply these species are restricted to the habitat. Yellow buckeye, for example, is more characteristic of mesic habitats.

Characteristic more mesic species include:

Hickories, *Carya* spp.
Black Walnut, *Juglans nigra*
Beech, *Fagus grandifolia*
White Oak, *Quercus alba*
Red Oak, *Q. rubra*
Tuliptree, *Liriodendron tulipifera*
Black Cherry, *Prunus serotina*
Sugar Maple, *Acer saccharum*
American Basswood, *Tilia americana*

Many additional species may occur locally. Cottonwood, black willow and sandbar willow usually occur along the more open forest margins or open deposits in the river channel. The "wetter" oaks, pin oak, swamp white oak and bur oak, are present in some areas, and several more mesic species may be present. The community differs from maple-cottonwood-sycamore floodplains in having substantial amounts (over ca. 20% of the number of canopy trees) of these more mesic species or "wet oaks". It differs from river birch-maple floodplains in having little (under ca. 20% of the trees) river birch.

The community is complex and highly variable in nature largely because it represents different transitional stages between those communities which flood regularly for extended periods and the upland communities which never flood. Thusly, it represents those communities which flood irregularly and usually for brief periods. Most of the more mesic species, in fact, cannot tolerate extended flooding. The community usually occurs on ground slightly higher than that occupied by maple-cottonwood-sycamore and river birch-maple communities, or it occurs on smaller streams which flood for shorter durations.

Floodplain stands with the "wetter" oaks are also included here even though they may not have less flooding than the wettest floodplain community types. This is done because of their relative infrequency compared to the wettest types and their often occurring as parts of more complex floodplains in which wet and more mesic communities occur in mosaics.

Admittedly, then, the mixed floodplain community is somewhat of a waste basket in which floodplain stands which don't fit into the maple-cottonwood-sycamore and river birch-maple types are put. Given this, the community represents a cluster of communities rather than a more predictable homogeneous type. Several workers have noted that the complexity of some floodplain stands in Ohio reaches that of mixed mesophytic stands. The main difference between the two is that one develops over alluvium and is sometimes flooded, and the other develops over residual soils and is never flooded.

In areas where flooding is infrequent and/or where the soil is a mixture of alluvium, colluvium or other deposits, the mixed floodplains may grade into other lowland or upland communities in which the lines of separation are not always clear. The lowlands are commonly swamp forests and the uplands may be various mesic types.

Descriptions of mixed floodplain communities in or near Ohio include those of Braun (1916), Beatley (1959), Lindsey et al. (1961) and Gordon (1969).

DISTRIBUTION: Mixed floodplains with varying degrees of similarities to those in Ohio occur throughout much of the eastern United States and southern Ontario. They occur throughout Ohio in the transitional areas described above. Only part of Gordon's (1966) bottomland hardwoods type refers to this community.

STATUS: As with all Ohio floodplain communities, mixed floodplains have been affected by cutting and flood control measures. They have been affected by permanent clearing more than the other types because, flooding less often, they are more useable. Too, they usually contain more valuable timber. A clear status statement is difficult to make, largely because of the community's complexity and the incompleteness of existing data.

INVENTORY GUIDELINES: All larger and more mature stands should be inventoried. Efforts should be made to document different types of stands in different physiographic regions.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1916. The physiographic ecology of the Cincinnati region. Ohio Biol. Surv. 2: 113-211. Bull. No. 9.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3 (2): 1-113.

Lindsey, A.A. R.O. Petty, D.K. Sterling and W. Van Asdall. 1961. Vegetation and environment along the Wabash and Tippecanoe rivers. Ecol. Monogr. 31: 105-156.

Beech-Oak-Red Maple Forest 53.110

DESCRIPTION: Beech, often with oaks and/or red maple, dominates a wet-mesic habitat. Common dominant and associated species include:

| | |
|---|---|
| Shellbark, *Carya laciniosa* | Red Oak, *Q. rubra* |
| Shagbark, *C. ovata* | American Elm, *Ulmus americana* |
| Beech, *Fagus americana* | Sweetgum, *Liquidambar styraciflua* |
| White Oak, *Quercus alba* | Red Maple, *A. rubrum* |
| Swamp White Oak, *Q. bicolor* | Silver Maple, *A. saccharinum* |
| Bur Oak, *Q. macrocarpa* | Blackgum, *Nyssa sylvatica* |
| Pin Oak, *Q. palustris* | White Ash, *Fraxinum alba* |

Additional species may occur locally as associates or codominants. Since it demise by Dutch elm disease, American elm seldom appears in the overstory but may be common in the understory. Sweetgum occurs only in southern Ohio.

The type varies from nearly pure beech to mixtures of it with the other species. The community name "Beech-oak-red maple" is somewhat cumbersome and does not by itself convey a good image of the community type. Gordon's (1969) "wet beech type" does this better but, unfortunately, it does not fit into the logic of the current classification system. The correct image is one of a nearly flat moist to wet landscape, not usually wet enough to be called a swamp yet too wet for the existence of much sugar maple, beech's most common compatriot. Thusly, the community differs from swamp forest types by its inclusion of significant amounts (over ca. 20% of the number of canopy trees) of beech, and it differs from beech-sugar maple in having low amounts (under ca. 20%) of sugar maple. Care must be taken to not confuse a wet beech forest with a beech-sugar maple forest in which most of the sugar maple has been selectively cut. Beech forests also lacking sugar maple also occur as variations of mixed mesophytic forests, but these usually occur on sloping, mesic or dry-mesic sites.

The major region for the wet beech community in Ohio is the Illinoian Till Plain in southwestern Ohio. Here, the community and young secondary segregates of it represent most of the woodlot types on the areas of least dissection. Braun (1936) conducted a major study on the community in this region. She theorized a successional scheme in which various combinations of pin oak, red maple, American elm and sweetgum succeeds to combinations of these with white oak and beech, followed by beech or beech and white oak, followed ultimately by beech, the physiographic climax. Though some ecologists may argue with the temporal aspects of this classically conceived pattern, the basic gradients between these types, as outlined by Braun, do occur.

Wet beech also occurs on the Wisconsin Till Plain, the Lake Plain and the Glaciated Plateau. Here the community varies somewhat from that in the Illinoian Till Plain. Sweetgum, for example, is not present, while both bur oak and silver maple may be prominent. Shanks (1953) interestingly found beech much more abundant than sugar maple in the original forests of Shelby County, attributing this to higher soil moisture levels. It is possible there was much less beech-sugar maple and more wet beech in the original forests of Ohio than is commonly known.

Wet beech forests commonly grade into swamp forests lacking beech on wetter substrates, and into beech-sugar maple forests on more mesic substrates. The gradation is commonly gradual or, sometimes, in mosaic, making an "either-or" categorization of a given stand difficult. The secondary stands may also be confusing because the numbers of species with higher lumber values than beech have been reduced through "high-grading", or because the numbers of beech have been reduced to "improve" the stand. Regional drainage has undoubtedly altered many former wet beech stands.

Major works addressing the wet beech community type in Ohio include those of Braun (1936), Shanks (1953), and Fritts and Holowaychuk (1959). Additional works are available on this community as it occurs in Indiana.

DISTRIBUTION: The community is not known to extend beyond Ohio and Indiana but probably occurs in at least Michigan and Pennsylvania. In Ohio it is most common in the Illinoian Till Plain in southwestern Ohio but occurs also in the Wisconsin Till Plain, the Lake Plain, the Glaciated Plateau and possibly local areas of the Unglaciated Plateau. It usually occurs on nearly flat terrain with only fair drainage. In the Illinoian Plain it occurs over soils that are quite acid (Braun 1936). Part of the area mapped by Gordon (1966) as "beech forests" was undoubtedly wet beech.

Examples of the community exist at Stonelick State Park in Clermont County and Blacklick Woods in Franklin County.

STATUS: The community is still frequent in the Illinoian Till Plain and is rare in most of the rest of the state. Nearly all of the known stands are at least partly secondary. Frequently nearly all species but the beech are secondary. The type is threatened with continued cutting and regional drainage.

INVENTORY GUIDELINES: All sizeable and more mature stands should be inventoried, especially those with stable water regimes. Care should be taken to include only true wet beech stands and not cutover beech-sugar maple stands.

SELECTED REFERENCES:

Braun, E.L. 1936. Forests of the Illinoian Till Plain of southwestern Ohio. Ecol. Monogr. 6: 89-149.

Fritts, H.C. and N. Holowaychuk. 1959. Some soil factors affecting the distribution of beech in a central Ohio forest. Ohio J. Sci. 59: 167-186.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Shanks, R.E. 1953. Forest composition and species association in the beech-maple forest region of western Ohio. Ecology 34: 456-466.

Beech-Sugar Maple Forest 53.120

DESCRIPTION: Beech, sugar maple and associated species dominate the community. Dominant and associated species include:

Shagbark Hickory, Carya ovata
Black Walnut, Juglans nigra
Beech, Fagus grandifolia
White Oak, Quercus alba
Red Oak, Q. rubra
American Elm, Ulmus americana
Slippery Elm, U. rubra
Tuliptree, Liriodendron tulipifera
Black Cherry, Prunus serotina
Red Maple, Acer rubrum
Sugar Maple, Acer saccharum
American Basswood, Tilia americana
White Ash, Fraxinus americana

Additional species occur less frequently. Black maple (Acer nigrum) is included as a part of sugar maple (A. saccharum), too much intergrading between these two occurring to allow clear separation in many stands.

The community is most frequently dominated by beech and/or sugar maple, but it often also contains a third or fourth species as a codominant. In only rare instances, as defined in the current classification, will beech or sugar maple be an insignificant member. The community is differentiated from beech-oak-red maple (i.e. wet beech) by its inclusion of significant amounts (over ca. 20% of the number of canopy trees) of sugar maple, and by its occurrence in mesic habitats with mesic associates rather than in wet-mesic habitats with wetter associates (including understory indicators). It is differentiated from oak-maple communities by its inclusion of considerable beech (over ca. 20% of the trees). Its differentiation from mixed mesophytic forests is more difficult, and the following arbitrary guidelines are used. In the Wisconsin Till Plain and Lake Plain regions most stands with significant amounts (over ca. 20% of the number of canopy trees) of both beech and sugar maple are classified as beech-sugar maple. Infrequent stands in these regions with greater mixtures of mesic trees qualify as mixed mesophytic. In the remainder of the state, including mostly the dissected regions in eastern and southern Ohio, mixed mesophytic stands are much more common. Because of the abundance of beech and/or sugar maple in many of these stands, the beech-sugar maple category south of the Wisconsin glacial border usually is applied only to stands with high (ca. 70%) combined proportions of those two species, each contributing over ca. 20%.

Beech-sugar maple forests occur throughout Ohio but are most common and best developed in the Wisconsin Till Plain, the Lake Plain and the Glaciated Plateau, this comprising the Ohio portion of the Beech-Maple Forest Region as mapped by Braun (1950). Here the community occurs usually on rolling or slightly sloping topography over substrates of medium moisture levels. Towards wetter sites it commonly grades into wet beech communities, while towards drier sites it usually grades into oak-maple or oak-hickory communities. Stands comprising transitional types between these combinations are frequent.

Beech-sugar maple stands in the Glaciated Plateau, Unglaciated Plateau and Bluegrass Region are generally more complex and less clear in definition than those in the Till Plains and Lake Plain. This is true largely because of the greater complexity of the topography and substrates in the former regions, resulting in more complex community relationships. Differentiation of beech-sugar maple and mixed mesophytic communities there is based largely on the relative degrees of complexities achieved.

in overstory species richness. Other consistent, simpler and more fundamental differences generally are lacking. Physiographic location may be important in some areas, Beatley (1959), for example, indicating that beech-maple stands in the Vinton and Jackson county region are restricted to alluvial and lacustrine deposits. The two communities form gradients in which, depending on the situation, the beech-maple may appear as a simplified phase of the mixed mesophytic, or the mixed mesophytic may appear as a complex phase of the beech-sugar maple. In most of these situations the two communities are similar enough that differentiation as to type is unimportant.

In addition to mixed mesophytic communities, beech-sugar maple forests in eastern and southern Ohio grade into various other forest types, including mixed floodplains on lowlands and oak-maple-tuliptree and Appalachian oak forests on uplands.

Data on beech-sugar maple forests in Ohio are much more extensive than those available for most other community types. Some of the more significant works include those of Williams (1936), Braun (1950), Shanks (1953), Beatley (1959), Gordon (1969), Vankat et al. (1975), Lindsey and Escobar (1976), Pell and Mack (1977), and Dunn (1978). Many additional useful studies have been conducted in adjacent states.

DISTRIBUTION: Braun (1950) showed her beech-maple region as including Ohio, Indiana, bits of Illinois and Wisconsin, Michigan, Ontario, New York and a bit of northwestern Pennsylvania. In addition, she spoke of beech-maple stands occurring in her mixed mesophytic and western emsophytic forest regions. Kuchler (1964, type no. 102) and the SAF (Eyre 1980, type no. 60) indicated similar distributions. In Ohio the type occurs on mesic sites in all regions of the state, as described above. Much of Gorgon's (1966) beech forest category had to have been beech-sugar maple.

Fine examples exist at Hueston Woods in Butler County and Fowler Woods in Richland County.

STATUS: Beech-sugar maple forests are relative common in Ohio, though few old-growth or sizeable stands remain. They have been affected primarily by cutting and grazing. But for selective cutting, there is no indication that sugarbush operations have significantly hurt them. Though they remain fairly common at this time, it would be terrible to lose good representative stands throughout the state during our haste to preserve rarer entities.

INVENTORY GUIDELINES: All older and larger stands should be inventoried. Efforts should be made to locate good stands over a good geographic spread.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1950 (1967 facs. ed.). Deciduous forests of eastern North America. Hafner Pub. Co., New York. 596 p. + map.

Dunn, C.P. 1978. An ecological analysis of the tree stratum of the beech-maple forest type. M.S. thesis, Indiana State Univ., Terre Haute. 149 p.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States: manual to accompany the map. Am. Geogr. Soc. Spec. Pub. No. 36. 39 + 116 p.

Lindsey, A.A. and L.K. Escobar. 1976. Eastern deciduous forest; Vol. 2: beech-maple region. U.S. Dep. Int., Natl. Park Serv., Nat. Hist. Theme Stud. No. 3. 238 p.

Pell, W.F. and R.N. Mack. 1977. The Fagus grandifolia - Acer saccharum - Podophyllum peltatum association in northeastern Ohio. Bot. Gaz. 138: 64-70.

Shanks, R.E. 1953. Forest composition and species association in the beech-maple forest region of western Ohio. Ecology 34: 455-466.

Vankat, J.L., W.H. Blackwell, Jr. and W.E. Hopkins. 1975. The dynamics of Hueston Woods and a review of the question of the successional status of the southern beech-maple forest. Castanea 40: 290-308.

Williams, A.B. 1936. The composition and dynamics of a beech-maple climax community. Ecol. Monogr. 6: 317-408.

Hemlock-White Pine-Hardwood Forest 53.210

DESCRIPTION: Hemlock and/or white pine and hardwood species dominate a community over upland (i.e. never flooded) substrates.

Dominant and associated species include:

| | |
|---|---|
| White Pine, Pinus strobus | Red Oak, Q. rubra |
| Hemlock, Tsuga canadensis | Tuliptree, Liriodendron tulipifera |
| Yellow Birch, Betula alleghaniensis | Black Cherry, Prunus serotina |
| Sweet Birch, B. lenta | Red Maple, Acer rubrum |
| Beech, Fagus grandifolia | Sugar Maple, A. saccharum |
| White Oak, Quercus alba | White Ash, Fraxinus americana |

Additional species occur more locally or less frequently. Chestnut (Castanea dentata) was a former component.

The community is differentiated from most other community types simply when a significant amount (over 20% of the number of canopy trees) of the conifer species is present.

The community generally occurs on either valley slopes and bottoms or, in extreme northeastern Ohio, on flat till or lacustrine deposits. The community in these two considerably different environments are considered subsets of the main community type. Though different in other aspects, the subsets generally share the same overstory and understory species. The subset occurring on the flats are frequently termed "swamps". These often occur in tight mosaics with ponded areas but the trees themselves occur on rises which are never flooded. Hence, both the "flat" and "valley" subsets are considered upland types. In contrast are the hemlock-white pine types which originally did occur in at least periodically flooded environments, often in association with tamarack. These are more accurately termed hemlock-white pine hardwood swamps. Only one good example (White Pine Bog Forest) of this type is known to remain in Ohio. It is probable in the original forests that the upland and lowland conifer communities frequently formed gradients into each other.

The upland hemlock-white pine hardwood forest is sometimes considered a segregate of the mixed mesophytic community. This is a legitimate concept and the two are separated here partly for convenience and because they are easy to separate, at least artificially.

In addition to the topographical variations, the community also varies in composition. Hemlock more frequently occurs without white pine than with it, and some white pine stands without hemlock appear more closely associated to oak communities than to hemlock-northern hardwood communities. In southwestern Ohio hemlock interestingly occurs with arbor vitae. Many other less apparent variations also occur. The community grades into various upland and lowland communities, further augmenting its diversity.

Black and Mack (1976) conducted the most rigorous study of the community in Ohio to date. Other accounts include those of Williams (1936), Braun (1950), Beatley (1959) and Gordon (1969). Several works relevant to Ohio exist for Pennsylvania stands.

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53.210

DISTRIBUTION: Braun's (1950) hemlock-white pine-northern hardwoods region extends from Nova Scotia west to Manitoba and south to Pennsylvania, Ohio (just barely), Michigan, Wisconsin and Minnesota. Kuchler (1964, no. 106) cites a similar region, and Eyre (1980) describes several related community types within this region plus an extension into the southern Appalachians.

Transeau (1950, in Gordon 1969) mapped forests with hemlock in Ohio. Generally these occur in or near the eastern portion of the Lake Plain and the Glaciated and Unglaciated Plateaus. An outlier occurs at Clifton Gorge in Greene County. The map displays interesting concentrations. White pine also occurs in the eastern Lake Plain and Glaciated Plateau but substantial stands in the Unglaciated Plateau do not occur south of Washington County.

A good hemlock-white pine stand exists in Mohican State Forest, and good hemlock stands exist at Mohican State Park and the Hocking Hills State Park.

STATUS: The status of hemlock stands in Ohio is fairly good. Many of the best stands are in preserves or parks. The understories of most of those in parks, however, are heavily disturbed with trampling. Hemlock borer or other diseases have apparently affected some stands. Deer have affected hemlock stands in the past, and the currently enlarging herds could repeat this. The status of white pine is not as strong, stands of it being rarer and few are preserved. Too, its survival in most upland communities is partly dependent on fire or other disturbance.

INVENTORY GUIDELINES: All clusters of hemlock or white pine large enough to be termed stands should be inventoried.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Black, R.A. and R.N. Mack. 1976. Tsuga canadensis in Ohio: synecological and phytogeographical relationships. Vegetatio 32: 11-19.

Braun, E.L. 1950 (1967 facs. ed.). Deciduous forests of eastern North America. Hafner Publ. Co., New York. 596 p. + map.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Wahsington. 148 p. + map.

Gordon, R.B. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Griggs, R.F. 1914. A botanical survey of the Sugar Grove region. Ohio Biol. Surv. 1: 244-340. Bull. No. 3.

Kuchler, A.W. 1964. Potential natural vegetation of the counterminous United States: manual to accompany the map. Am. Geogr. Soc. Spec. Pub. No. 36. 39 + 116 p.

Williams, A.B. 1936. The composition and dynamics of a beech-maple climax community. Ecol. Monogr. 6: 317-408.

Arbor Vitae-Mixedwood Forest 53.220

DESCRIPTION: Arbor vitae and other needle-leaved and hardwood species dominate the community. Dominant and associated species include:

| | |
|---|---|
| Red Cedar, *Juniperus virginiana* | Chestnut Oak, *Q. prinus* |
| Arbor Vitae, *Thuja occidentalis* | Red Oak, *Q. rubra* |
| Hemlock, *Tsuga canadensis* | Tuliptree, *Liriodendron tulipifera* |
| White Oak, *Quercus alba* | Sugar Maple, *Acer saccharum* |
| Scarlet Oak, *Q. coccinea* | American Basswood, *Tilia americana* |
| Yellow Oak, *Q. muehlenbergii* | White Ash, *Fraxinus alba* |

Additional species may occur locally.

The community is considered to exist simply where significant amounts (over ca. 20% of the number of canopy trees) of arbor vitae are present. The only other community which has some, but not much similarity is the arbor vitae fen, of which Cedar Bog is the only example. Too, no gradations between the arbor vitae upland and fen communities ever existed in Ohio.

At Clifton Gorge and Rocky Fork Gorge the arbor vitae tends to form pure, isolated patches on the steep calcareous cliffs. Hemlock and boreal understory species occur in the same vicinities but somewhat scattered and isolated from the arbor vitae. In the Adams County communities the same relationships sometimes occur but here the arbor vitae also forms more mixed stands with the other, mostly hardwood species. In general, the more extreme the exposure, the purer the arbor vitae stand. On the less extreme uplands above the cliffs, the mixed stands generally grade into oak or oak-maple stands in short distances from the outcrops. The arbor vitae appears competitively stable only on or near these exposures.

About the only works considering the Ohio arbor vitae upland community with any detail are those of Braun (1928), Anliot (1973) and Roberts and Younger (1973).

DISTRIBUTION: Upland arbor vitae stands occur in scattered locations from the southern Appalachians, southern Ohio and Great Lakes region north into Canada. Johnson (in Eyre 1980, SAF type no. 37) reported arbor vitae is most common in Ontario and Quebec where it occupies both lowlands and uplands, including old-fields. The community in Ohio is limited to Greene, Ross, Highland and Adams counties. The species also occurs, or occurred, as scattered individuals in a few additional counties. Some of these, especially those in Delaware and Franklin counties, probably once represented good stands.

Accessible examples of upland arbor vitae communities exist at Clifton Gorge in Greene County and the Wilderness in Adams County.

STATUS: The community is not currently under any direct threat, and it appears successionally stable. Nevertheless, too few of the limited number of stands which ever existed in Ohio are protected.

INVENTORY GUIDELINES: All clusters of arbor vitae large enough to be called

53.220

stands should be documented.

SELECTED REFERENCES:

Anliot, S.F. 1973. The vascular flora of Glen Helen, Clifton Gorge, and John Bryan State Park. Ohio Biol. Surv., Biol. Notes No. 5. 162 p.

Braun, E.L. 1928. The vegetation of the Mineral Springs region of Adams County, Ohio. Ohio Biol. Surv. 3: 375-517. Bull. No. 15.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

Roberts, M.L. and J. Younger. 1973. Aquatic and terrestrial plants of the Paint Creek Lake project area. Pages 148-193 and 466-516 in C.E. Herdendorf and D.H. Stansbery, eds. Final report, environmental analysis of the Paint Creek Lake Project, Ohio. U.S. Army, Huntington Dist., Corps of Engineers. 648 p.

Mixed Mesophytic Forest 53.310

DESCRIPTION: A mixture of hardwood species dominate the community, usually on mesic slopes or in mesic coves. Dominant and associated species include:

| | |
|---|---|
| Hickories, Carya spp. | Black Cherry, Prunus serotina |
| Black Walnut, Juglans nigra | Red Maple, Acer rubrum |
| Beech, Fagus grandifolia | Sugar Maple, A. saccharum |
| White Oak, Quercus alba | Yellow Buckeye, Aesculus octandra |
| Red Oak, Q. rubra | American Basswood, Tilia americana |
| Tuliptree, Liriodendron tulipifera | White Basswood, T. heterophylla |
| Cucumbertree, Magnolia acuminata | White Ash, Fraxinus americana |

Several other tree species occur in the community less frequently or more locally. Chestnut (Castanea dentata) was a former dominant. Braun (1950) considered white basswood and yellow buckeye as, possibly, the most characteristic canopy trees. In Ohio, however, these trees are restricted to the southern portion of the state.

Most mixed mesophytic communities in Ohio never were as diverse as those in the more southern Appalachians and most have been subsequently more simplified by cutting and other disturbances. Whereas the community as a whole is comprised of many species, any given stand may be considerably simpler. A good example would be a mesic cove with a pure stand of tuliptrees. Only one tree dominates but the stand is still a sample or a "segregate" of the mixed mesophytic community.

Mixed mesophytic communities in Ohio grade into every other type of wet-mesic to dry-mesic forest community in southern and eastern Ohio. Pigeonholing of stands or slope segments into classification types becomes quite arbitrary. The following general guidelines are used to distinguish mixed mesophytic stands in the current classification system.

Generally the stands in Ohio are dominated by combinations of beech, tuliptree, sugar maple, red maple, white oak, red oak and white ash. This basic group is supplemented to varying degrees by the local addition of other species. Beech and tuliptree are possibly the most important indicators in Ohio. Most well-drained, upland woods in southern and eastern Ohio with significant amounts (over 20% of the canopy trees) of beech can be considered mixed mesophytic, except those qualifying as beech-sugar maple (where each of these speices represents over ca. 20% of the canopy trees and together they represent over ca. 70%). Similarly, woods in that region with significant amounts (20%) of tuliptree on mesic sites (coves and lower slopes) are also considered mixed mesophytic. Tuliptree on dry-mesic sites (upper slopes and rounded hilltops), however, generally falls into the oak-maple-tuliptree category, this community and the mixed mesophytic community commonly forming continuums. Other stands lacking significant amounts of beech or tuliptree may also qualify as mixed mesophytic, depending on the mesic qualities of their sites and their indicator species. Stands on mesic sites with either yellow buckeye or white basswood, for instance, are usually of that community type. Many stands with significant amounts of hemlock could also logically be called mixed mesophytic but here, for arbitrary convenience, they are placed in the hemlock-white pine-hardwood type.

Mixed mesophytic stands in Ohio are restricted mostly to dissected terrain in eastern and southern Ohio outside the Wisconsin Till Plain and Lake Plain. Scattered stands with mixed mesophytic complexity, however, also occur in local dissected areas within these younger glaciated regions. Too, Sampson (1930) and Gordon (1969) indicated the community previously occurred locally on low sand ridges and other more level topography in northeastern Ohio. Sampson found it difficult to separate mixed mesophytic from mixed swamp communities on those sites, a problem which needs further investigation. As beech-sugar maple stands in the Wisconsin Till Plains and Lake Plains are defined more broadly (stands where each of these species comprise over ca. 20% of the canopy trees) than they are in the hill regions (where, combined they must comprise over ca. 70%), care must be taken to restrict usage of mixed mesophytic categorization where beech-maple is more appropriate. Too, stands with high compositional mixtures because of their short-term developmental nature should not be confused with more stable mixed mesophytic communities.

As stated above, mixed mesophytic stands, where they occur, intergrade with most upland forest types. In many ways they may be viewed simply as mixing grounds where suitable habitats exist for species of both drier and wetter habitats. Sampson (1930) considered the community in northeastern Ohio a transitional type between oak-chestnut and beech-maple communities. Mixed mesophytic stands generally occur on well drained but moist substrates and climatically mesic sites, such as north- and east-facing slopes and in coves. On upper slopes and west- or south-facing slopes they grade into the drier oak-maple-tuliptree, oak-maple, oak or oak-pine communities, frequently in that order. At the bottoms of slopes they commonly grade into or abruptly meet floodplain communities.

Most data on mixed mesophytic communities in Ohio are descriptive. Significant works include those of Braun (1928, 1950, 1969), Segelken (1929), Sampson (1930), Cobbe (1943), Beatley (1959), and Gordon (1966, 1969). Much more work has been conducted in states south of Ohio.

DISTRIBUTION: Braun's (1950) mixed mesophytic forest region extends along the Appalachian Mountains from Pennsylvania to Alabama, while her western mesophytic forest region, which consists of a mosaic of mixed mesophytic and other communities, extends from the southern portion of her mixed mesophytic region west to the Mississippi River. Kuchler (1964, type no. 103) designated the mixed mesophytic community's distribution as Pennsylvania, West Virginia, Ohio, Kentucky and Tennessee.

The community in Ohio extends from the eastern portion of the Lake Plain in northeastern Ohio south through or near the Glaciated Plateau, Unglaciated Plateau, Bluegrass Region and Ohio River Valley region in eastern and southern Ohio (Braun 1950, Gordon 1966).

One of the finest examples in Ohio is at California Woods in Hamilton County.

STATUS: Most all mixed mesophytic stands in Ohio have been cut, and the cut stands generally have altered relative quantities of dominant species compared to those in the original stands. Too, the loss of chestnut has diminished the community's complexity. As a result, typical stands of its more complex variations in Ohio are now rare.

INVENTORY GUIDELINES: All small pockets of old-growth stands and all more extensive stands should be inventoried. Emphasis should be given to those with greater, stable diversities and to those with different compositions in different regions of the state.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1928. The vegetation of the Mineral Springs region of Adams County, Ohio. Ohio Biol. Surv. 3: 375-517. Bull. No. 15.

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Cobbe, T.J. 1943. Variations on the Cabin Run Forest, a climax area in southwestern Ohio. Am. Midl. Nat. 29: 89-105.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Griggs, R.F. 1914. A botanical survey of the Sugar Grove region. Ohio Biol. Surv. 1: 244-340. Bull. No. 3.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States: manual to accompany the map. Am. Geogr. Soc. Spec. Pub. No. 36. 39 + 116 p.

Sampson, H.C. 1930. The mixed mesophytic forest community of northeastern Ohio. Ohio J. Sci. 30: 358-367.

Segelken, J.G. 1929. The plant ecology of the Hazelwood Botanical Preserve. Ohio Biol. Surv. 4: 219-269, Bull. No. 21.

Oak-Maple Forest 53.410

DESCRIPTION: Oak, sugar maple and characteristic associated species dominate the community. These include:

Bitternut, *Carya cordiformis*
Pignut, *C. glabra*
Shagbark, *C. ovata*
Black Walnut, *Juglans nigra*
White Oak, *Quercus alba*
Scarlet Oak. *Q. coccinea*
Yellow Oak, *Q. muehlenbergii*
Black Oak, *Q. velutina*
Chestnut Oak, *Q. prinus*
Red Oak, *Q. rubra*
Shumard Oak. *Q. shumardii*
Hackberry, *Celtis occidentalis*
Slippery Elm, *Ulmus rubra*
Red Maple, *Acer rubrum*
Sugar Maple, *A. saccharum*
Ohio Buckeye, *Aesculus glabra*
American Basswood, *Tilia americana*
White Ash, *Fraxinus americana*
Blue Ash, *F. quadrangulata*

Additional species occur less frequently. Black maple (*Acer nigrum*) is considered as part of sugar maple as a result of estensive intergradation between the two.

The community is differentiated from beech-sugar maple, mixed mesophytic and oak-maple-tulip communities by the absence of substantial amounts (over ca. 20% of the number of canopy trees) of beech, tuliptree or other more mesic species. It is differentiated from Appalachian oak and oak-hickory communities by the presence of significant amounts (over ca. 20% of the trees) of sugar maple.

The community has considerable variation over its range in Ohio. Over calcareous substrates the dominant oaks are white, yellow, red and, locally, Shumard oak. Characteristic codominants are sugar maple, white ash, blue ash, hackberry and American basswood. Black walnut is locally important and honeylocust, Kentucky coffeetree, slippery elm, Ohio buckeye and redbud are common second-growth or understory species. Near bedrock outcrops yellow oak becomes more prominent. On the Lake Erie islands the community is simplified to largely sugar maple-hackberry communities (Hamilton and Forsyth 1972).

Over non-calcareous substrates white, red, scarlet and chestnut oak dominate with the sugar maple. Here, species more characteristic of calcareous substrates (e.g. yellow oak, hackberry and others) are absent while species more characteristic of acid substrates (e.g. red maple, blackgum and, formerly, chestnut) are present.

Towards more mesic sites the community generally grades into beech-sugar maple or mixed mesophytic communities, while towards drier sites it grades into oak-hickory or Appalachian oak communiites.

Data on the community in Ohio include the works of Beatley (1959), Gordon (1966, 1969), Hamilton and Forsyth (1972), Anliot (1973), Antonio and Vankat (1977), and Vankat et al. (1977).

DISTRIBUTION: The full distribution of stands which could be called oak-maple is not well known. It extends at least into Ontario, Indiana and Kentucky, and it undoubtedly occurs in pockets east and southeast of Ohio. It occurs in scattered locations throughout Ohio, usually on dry-mesic slopes of various substrate types. Concentrations of the community in the original forests were mapped by Gordon (1966), though current field observations do not concur with his distribution of the type in northeastern Ohio.

Examples of oak-maple communities exist at Clifton Gorge and Caesar Creek State Nature Preserves.

STATUS: The community is fairly common in scattered locations throughout Ohio, though those in eastern and southeastern Ohio are not as well known. A few examples, mostly in western Ohio, are protected or are at least in public ownership. No old-growth stands are known.

INVENTORY GUIDELINES: All older and more extensive stands should be inventoried. Better examples are needed for eastern Ohio.

SELECTED REFERENCES:

Anliot, S.F. 1973. The vascular flora of Glen Helen, Clifton Gorge, and John Bryan State Park. Ohio Biol. Surv., Biol. Notes No. 5. 162 p.

Antonio, T.M. and J.L. Vankat. 1977. Gradiant analysis of secondary deciduous forest vegetation occurring on a slope of Fort Ancient, southwestern Ohio. Ohio J. Sci. 77: 68-71.

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1 (1): 1-182 + map.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Hamilton, E.S. and J.L. Forsyth. 1972. Forest communities of South Bass Island, Ohio. Ohio J. Sci. 72: 184-210.

Vankat, J.L., D.S. Anderson and J.A. Howell. 1977. Plant communities and distribution factors in Abner's Hollow, a south-central Ohio watershed. Castanea 42: 216-227.

Oak-Maple-Tuliptree Forest 53.420

DESCRIPTION: Oaks, tuliptrees, often maples, and associated species dominate the community. These species include:

Pignut, Carya glabra
Shagbark, C. ovata
Mockernut, C. tomentosa
White Oak, Quercus alba
Scarlet Oak, Q. coccinea
Chestnut Oak, Q. prinus
Red Oak, Q. rubra
Black Oak, Q. velutina
Tuliptree, Liriodendron tulipifera
Red Maple, Acer rubrum
Sugar Maple, A. saccharum

Additional species occur less frequently. Chestnut (Castanea dentata) was a previous component. Black maple (Acer nigrum) is lumped with sugar maple.

The community is differentiated from oak-maple, Appalachian oak and oak-hickory communities by the presence of significant amounts (over ca. 20% of the number of canopy trees) of tuliptree. It is differentiated from mixed mesophytic and beech-maple communities by its insignificant amounts (under ca. 20% of the trees) of beech and other more mesic species.

The community is more homogeneous than the oak-maple communities, being restricted primarily to the Unglaciated Plateau. The differentiation between those two communities is not great in that area. The nearly complete absence of tuliptree in the glaciated range of the oak-maple community, however, and its contrastingly strong presence in much of the unglaciated region prompts the separation of the two communities. A different split would be to lump the oak-maple and oak-maple-tuliptree communities of the unglaciated region and differentiate them from the oak-maple community of the glaciated region. A third method would be to lump all three. The apparent relationship of the oak-maple-tuliptree and mixed mesophytic communities, however, does not agree well with the third option. Additional field work is required to clarify the situation.

Many or most of the oak-tuliptree or oak-maple-tuliptree stands in Ohio today are secondary communities which have considerably expanded in area since the cutting of the original forests. The light, easily distributed seeds of the maples and tuliptrees, and the rapid growth of tuliptree are some of the reasons for this expansion. The community type is now prevalent on many areas once cleared and farmed. It is often indicative of areas where mixed mesophytic forests once grew, though it also grows on sites previously occupied by beech-maple and the more mesic oak communities.

Data on the community in Ohio are sparse, but include those of Braun (1950), Beatley (1959) and Vankat et al. (1977).

DISTRIBUTION: The community occurs as segregates or secondary expressions of the mixed mesophytic forest through much of its range, at least near Ohio. Braun (1950) mapped the mixed mesophytic forest in a region from Pennslyvania to Alabama. The SAF tuliptree (i.e. yellow-poplar, no. 57) and tuliptree-white oak-northern red oak (no. 59) types generally fall in or near the same region (Eyre 1980). In Ohio the community is limited mostly to the Unglaciated Plateau.

STATUS: Being somewhat of a "weedy" community, oak-maple-tuliptree in Ohio currently appears quite healthy. It is aided by the selective cutting of foresters trying to promote tuliptree. It has expanded in Ohio since the time of white settlement. Unfortunately, no old-growth stands are known to remain.

INVENTORY GUIDELINES: Documentation must necessarily be selective of the older and more extensive stands, especially those which may be protected from cutting and which appear successionally relatively stable.

SELECTED REFERENCES:


Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1950 (1967 facs. ed.). Deciduous forests of eastern North America. Hafner Publ. Co., New York. 596 p. + map.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

Vankat, J.L., D.S. Anderson and J.A. Howell. 1977. Plant communities and distribution factors in Abner's Hollow, a south-central Ohio watershed. Castanea 42: 216-227.

Oak-Hickory Forest 53.510

DESCRIPTION: Characteristic upland oaks and, often, hickories dominate the community. They include:

Pignut, *Carya glabra*
Shagbark, *C. ovata*
Mockernut, *C. tomentosa*
White Oak, *Quercus alba*
Red Oak, *Q. rubra*
Shumard Oak, *Q. shumardii*
Post Oak, *Q. stellata*
Black Oak, *Q. velutina*

Additional species, including ones other than oaks and hickories, appear less frequently.

The community is distinguished from the Appalachian oak community by its lack of significant quantities (under ca. 20% of the number of canopy trees) of scarlet oak, chestnut oak and, formerly, chestnut. It is distinguished from oak-maple and oak-maple-tuliptree communities by its lack of significant amounts of sugar maple or tuliptree. It is distinguished from oak-pine communities by its lack of much pine.

The major consistent dominants are white, red and black oak, and shagbark hickory. Post oak occurs in south-central Ohio, and Shumard oak occurs in western, especially southwestern, Ohio. Pignut and mockernut are concentrated more in southeastern Ohio. Many additional associates are correlated with sites over calcareous substrates in western Ohio, while another set of associates are associated with the non-calcareous substrates of eastern Ohio and the beach ridges of northern Ohio.

The community often grades into the Appalachian oak community in eastern Ohio. The two communities there are often similar enough that classification of stands to one or the other appears highly artificial. They have become more similar since the demise of chestnut. In their extremes, however, the communities are fairly different. The practice of dividing these two communities in eastern Ohio can be questioned. More data on this topic are needed.

The oak-hickory community also grades into oak-pine communities on more exposed or more disturbed sites. It usually grades into oak-maple, oak-maple-tuliptree or mixed mesophytic communities on more mesic sites.

Several descriptive accounts of oak-hickory communities in Ohio exist. More comprehensive accounts are contained in Braun (1950), Beatley (1959) and Gordon (1969).

DISTRIBUTION: The central portion of the oak-hickory community corresponds in general with Braun's (1950) western mesophytic and oak-hickory forest regions. This extends through much of the United States west and southwest of Ohio. Kuchler's (1964, no. 100) oak-hickory forest generally corresponds with this range. The type occurs throughout Ohio, being most prevalent on well drained moraines, beach ridges and dry bedrock slopes. Gordon's (1966) mixed oak distribution includes upland oak-hickory and other oak-related communities.

STATUS: The type is relatively common in Ohio, though no very old-growth stands are known. Proper preservation efforts have probably not been afforded the community because of its frequency and lack of exceptional scenic qualities and species diversity.

INVENTORY GUIDELINES: Documentation must be selective for the better stands. Efforts, however, should be made to locate the older, less disturbed stands. Representative stands in all regions of the state should be found.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1950 (1967 facs. ed.). Deciduous forests of eastern North America. Hafner Pub. Co., New York. 596 p. + map.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States: manual to accompany the map. Am. Geogr. Soc. Spec. Pub. No. 36. 39 + 116 p.

Appalachian Oak Forest 53.520

DESCRIPTION: Characteristic oaks, formerly chestnut, and associated species dominate the community. These include:

| | |
|---|---|
| Pignut, *Carya glabra* | Chesnut oak, *Q. prinus* |
| Shagbark, *C. ovata* | Red Oak, *Q. rubrum* |
| Mockernut, *C. tomentosa* | Black Oak, *Q. velutina* |
| Chestnut, *Castanea dentata* | Red Maple, *Acer rubrum* |
| White Oak, *Quercus alba* | Blackgum, *Nyssa sylvatica* |
| Scarlet Oak, *Q. coccinea* | Sourwood, *Oxydendrum arboreum* |

Additional species occur less frequently.

The community is differentiated from the oak-hickory community by having significant amounts (over ca. 20% of the number of canopy trees) of Appalachian elements, notably scarlet and chestnut oak and, formerly, chestnut. Today the chestnut is present only as stumps and less frequently as sprouts. The community differs from oak-maple and oak-maple-tuliptree communities in having insignificant amounts (under ca. 20%) of either sugar maple or tuliptree. It differs from oak-pine communities in having low amounts (under ca. 20%) of pines.

Appalachian oak forests are very similar to oak-hickory forests as they are expressed in southeastern Ohio. The two have become more similar following the decline of chestnut. The Appalachian oak tends to occur on drier sites. The two types, however, intergrade enough to cause highly artificial "either-or" categorization on many sites. More data are needed to indicate whether the two communities should be kept as separate entities.

Appalachian oak forests commonly grade into either oak-hickory or oak-pine forests on drier sites, and into oak-tuliptree, oak-maple-tuliptree or just tuliptree stands on more mesic sites. It is probable that tuliptree has probably usurped part of the area formerly occupied by chestnut, thusly diminishing the range of Appalachian oak forests in favor of tuliptree-related communities.

Accounts of the community in Ohio have been made by Braun (1928, 1969), Beatley (1959), Gordon (1969), Vankat et al. (1977), Anderson and Vankat (1978), and others.

DISTRIBUTION: Kuchler's (1964, type no. 104) Appalachian oak forest is indicated as occurring in the Appalachians west to Ohio. The community occurs throughout parts of Braun's (1950) mixed mesophytic and oak-chestnut forest regions. It corresponds with the range given by the SAF (Eyre 1980) for chestnut oak (no. 44) and at least portions of other oak cover types. In Ohio it is restricted to the Unglaciated Plateau and, to a lesser degree, the Glaciated Plateau. It generally occurs on over-drained ridges and upper slopes. Gordon's (1966) mixed oak depiction includes Appalachian oak and other oak types.

Examples of second-growth stands exist at Fort Hill in Highland County, Christmas Rocks in Fairfield County and Lake Katharine in Jackson County.

53.520

STATUS: Appalachian oak is one of the commonest communities in the state. Unfortunately, no uncut stands are known to remain. Greater effort should be extended to find especially good stands, if they exist, than to preserve only what "happens to come along."

INVENTORY GUIDELINES: Inventory efforts must be quite selective. Only the less disturbed, more extensive, or more unusual stands should be sought. Special efforts should be extended towards remnant old-growth stands.

SELECTED REFERENCES:

Anderson, D.S. and J.L. Vankat. 1978. Ordination studies in Abner's Hollow, a south-central Ohio deciduous forest. Bot. Gaz. 139: 241-248.

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1928. The vegetation of the Mineral Springs region of Adams County, Ohio. Ohio Biol. Surv. 3: 375-517. Bull. No. 15.

_______. 1950 (1967 facs. ed.). Deciduous forests of eastern North America. Hafner Pub. Co., New York. 596 p. + map.

_______. 1969. An ecological survey of the vegetation of Fort Hill State Memorial, Highland County, Ohio. Bull. Ohio Biol. Surv. new ser. 3(3): 1-134.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

Gordon, R.B. 1966. Natural vegetation map of Ohio at the time of the earliest land surveys. Ohio Biol. Surv., Columbus. Map.

_______. 1969. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. new ser. 3(2): 1-113.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States: manual to accompany the map. Am. Geogr. Soc. Spec. Pub. No. 36. 39 + 116 p.

Vankat, J.L., D.S. Anderson and J.A. Howell. 1977. Plant communities and distribution factors in Abner's Hollow, a south-central Ohio watershed. Castanea 42: 216-227.

Oak-Pine Forest 53.530

DESCRIPTION: Oaks, hard pines and associated species dominate the community. These include:

| | |
|---|---|
| Yellow Pine, Pinus echinata | Scarlet Oak, Q. coccinea |
| Pitch Pine, P. rigida | Chestnut Oak, Q. prinus |
| Virginia Pine, P. virginiana | Black Oak, Q. velutina |
| Pignut, Carya glabra | Red Maple, Acer rubrum |
| Mockernut, C. tomentosa | Blackgum, Nyssa sylvatica |
| White Oak, Quercus alba | Sourwood, Oxydendrum arboreum |

Other species occur less frequently. Chestnut (Castanea dentata) was a former component.

The community differs from all other Ohio communities by its inclusion of significant amounts (over ca. 20% of the number of canopy trees) of one or more of the hard pines (white pine is classified as a soft pine and is excluded here).

Natural, stable oak-pine communities in Ohio are restricted to very exposed, xeric upland sites where the pines can compete effectively with hardwoods (this term here meaning deciduous trees, not hard pines). A typical pine stand is bordered by an open non-calcareous cliff community on one side, and by an Appalachian oak community on the other. The pine grades into oak away from the cliff where the community is less exposed and the soil is deeper.

Natural pine stands in Ohio are not common but are restricted to patches on severe sites. Secondary weedy stands, especially of Virginia pine, are common. These generally occur on less severe sites where the pines, if left undisturbed, will succeed to hardwoods. Increase of pine has been promoted by the cutting of hardwoods, fire, conservation replantings with pine, and the Christmas tree industry. The light-seeded pines rapidly invade cleared land and can compete well on abandoned, eroded soils.

Data on oak-pine forests in Ohio include those in Beatley (1959) and several theses and dissertations.

DISTRIBUTION: In a strip along and beyond the Appalachians, pitch pine occurs as far north as Maine, and yellow pine occurs as far south as Florida and Texas. Hence, communities with similarities to the Ohio oak-pine community may occur within this range. Those of greatest similarity, however, are confined to the mid- and southern Appalachians. In Ohio they are confined to the Unglaciated Plateau.

STATUS: While second-growth pine stands in Ohio are fairly wide-spread, natural and more stable communities are restricted to local areas. Because of their adaptability to extreme sites, however, these natural stands are not as threatened by human disturbance as communities on more useable sites. A major problem in accessing the true status of the community is being able to distinguish the primary from the secondary stands.

INVENTORY GUIDELINES: Inventories should be restricted to stands which are believed to be natural, or which possibly are secondary but appear to be relatively stable.

SELECTED REFERENCES:

Beatley, J.C. 1959. The primeval forests of a periglacial area in the Allegheny Plateau. Bull. Ohio Biol. Surv. new ser. 1(1): 1-182 + map.

Braun, E.L. 1950 (1967 facs. ed.). Deciduous forests of eastern North America. Hafner Publ. Co., New York. 596 p. + map.

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Soc. Am. For., Washington. 148 p. + map.

# Part 3

# COMMUNITY SURVEY METHODS

## 3.1 METHODS IMPORTANCE

This section outlines specific methodology by which plant communities in Ohio may be surveyed. It is tailored specifically for use by or for the Division of Natural Areas and Preserves, but much of it is general enough to be used by other parties. The value of accurate and valid community field data cannot be overemphasized. While classifications and ordinations of vegetation come and go, good field data retain their value and, within limits, can be reworked into various classifications. Properly collected field data represent fairly objective information whereas classifications and ordinations represent abstractions in which, to make more generalized inferences, much specific information is purposely obscured.

Additionally, the value of quantitative, as versus qualitative, data should be recognized. Although fairly accurate subjective assessments of vegetation can be made by experienced ecologists, only quantitative figures provide a means by which people of different experience or interest levels may consistently make similar vegetation assessments. Too, it is not only more accurate but often simpler to compare different stands or to monitor one stand over time with numerical data. This is especially true where many stands are involved, and where data are collected by different people, possibly in different generations. Even very simple quantitative data are usually superior to only qualitative data. Of course all of this is dependent upon the degree to which quantitative data are valid (e.g. involving proper stand homogeneity, including enough sampling intensity, etc.).

Although the above pitch for quantitative surveys may sound good, too often the use of such methods is simply not feasible. The surveyor conducting rapid inventories for protectable natural areas frequently must work alone and cover a few new sites in a single day. His total survey of an area may be equivalent only to the typical reconnaissance trip made prior to quantitative sampling. Quantitative sampling at this pace would often produce invalid data, data implying more but having less accuracy than qualitative data. A knowledge of quantitative methods at that point, however, is still valuable for raising consciousness of the ideal methodology (and thereby possibly increasing the accuracy of even the qualitative survey), for emphasizing the real limits of the qualitative survey, and for encouraging better judgment of when a quantitative survey would be more appropriate.

# 3.2 BASIC SURVEY METHODS

This section outlines the basic methods to be employed for gathering plant community data by or for the Division of Natural Areas and Preserves. It includes light quantitative and qualitative methods which may be used by one person conducting rapid surveys. Selected, more intensive quantitative methods are presented in Appendix C. These may be used where more time or surveyors are available, and where more detailed studies using permenent plots are conducted on established nature preserves. Useful additional information on vegetation survey methods may be obtained from Lindsey et al. (1958), Mueller-Dombois and Ellenberg (1974), Ohmann (1973), and other manuals.

## STANDS TO SURVEY

Generally, survey only stands having high or moderately high statewide significance (significance classes 1 and 2; see Appendix A for definitions). Restrict surveys of locally significant and insignificant stands (significance classes 3 and 4) to preserves where complete vegetation cover surveys are sought, to well known natural areas lacking statewide significant stands, and to specific areas for which surveys have been requested by outside sources. It is understood that the significance level, and hence, the priority level for surveying, of many stands will not be known until after they are at least partially surveyed.

## INFORMATION TO OBTAIN

### Statewide and locally significant stands (significance classes 1, 2 and 3)

The following forms should be completed for each surveyed stand:

1. General Plant Community Data Form.

2. Photocopy of quad map portion (or a suitable substitute map or photo) showing location and boundaries of the stand(s).

3. Either a) a Basic Quantitative Plant Community Data Form, or b) a Qualitative Plant Community Data Form.

4. LCD Form. (This is the basic form used by TNC and ODNR for filing information in their data systems. See Appendix B for directions on completing a plant community LCD form.)

It must be remembered that a "community stand" is usually <u>not</u> synonymous with a "natural area", the latter often consisting of several stands. A separate LCD should be completed for each significant stand on a given area.

Although space is provided on the General Plant Community Data Form to give the location of a stand, a map is preferable for preciseness and indicating boundaries. When more than one stand is being reported at one area, all stands can be indicated on the same map and copies made to accompany the forms for each stand. On such "master maps" it often is informative to indicate communities or land uses adjacent to the stand(s) surveyed.

## Insignificant (significance class 4) and destroyed stands

When insignificant and destroyed stands are surveyed on areas also having statewide and locally significant stands, they generally need be recorded only on the maps and/or the General Plant Community Data Forms for the significant stands. When, often for historic documentation or outside request, a survey is conducted of insignificant or destroyed stands occurring independently, completion of just a General Plant Community Data Form usually will suffice for a record. For none of these situations should quantitative or much qualitative data be compiled, or LCD's completed. Records of these stands will be stored only in the manual files.

## SAMPLING METHODS

### Quantitative Sampling

When time permits quantitative sampling, collect data on the General Plant Community Data Form and the Basic Quantitative Plant Community Data Form (see accompanying examples). Data taken on the latter form allow the determination of species presence, constancy, absolute frequency and, for trees, relative density by estimated size class. These figures can then be used in similarity indices for both stand and community definition, comparison, classification and ordination. The methodology was chosen to provide maximum data with minimum work, especially by a single person conducting rapid surveys. It was chosen also to provide a good balance between data useful for individual stand analysis and data useful for stand comparison. One weakness, however, with it and all methods depending on one or few surveys per stand is the incompleteness of data obtained on seasonally absent or under- and over-mature herbaceous species. This problem is additional to the taxonomic difficulty of dealing with some species regardless of their seasonal condition. Data manipulation will have to be restricted accordingly, based on the extent to which the data are skewed by those effects.

1. Stand Delimitation. Determine the approximate boundaries of the vegetation type to be inventoried so the sampling points can be spread throughout the stand. If a reconnaissance trip cannot be made, estimate the possible extent of the stand based on physiography, ownership, etc. Limit sampling to relatively homogeneous vegetation units, based on cover dominants. If it is uncertain whether two contiguous areas have basically the same compositions or not, segregate (i.e. stratify) their data and decide later whether to lump them.

2. Sample Numbers. Take data from 20 samples spread throughout the stand. The same number of samples are taken from each stand to better equalize the probability of listing different species for each area, thusly allowing more valid comparisons. In stands too small for 20 samples, take as many samples as possible or make a complete survey.

3. Sample Placement. Determine the location of the first sample by some procedure assuring randomness. To the extent possible, determine the locations of the subsequent 19 points by following compass lines in a square or rectangular pattern through the stand. Pace the distance between samples using a measurement predetermined by the estimated stand size (see step 1). The samples should be spread through most of the stand, though edges and obviously atypical pockets should be avoided. The sampling pattern may have to be modified due to topography, stand shape or snapping dogs, and specific sample sites falling on atypical areas may have to be moved. Such alterations should maintain sample randomness.

4. Tree Data. Compile tree data by a partial quarter method. Determine the four quarter areas around each sample point based on the compass line being paced and a line perpendicular to the compass line. Record by species the nearest tree equal to or greater than 10 centimeters dbh (diameter at breast height) in each quarter. Record the trees by estimated size classes as indicated on the Basic Quantitative Plant Community Data Form (see accompanying example). If desired, basal area data also can be obtained from the same points using the Bitterlich method.

5. Herb, Shrub and Small Tree Data. Compile data for herbs, shrubs and small tree species (those with members usually under 10 cm dbh) from the same sampling points used to obtain tree data or, in treeless communities, from points established in the same way. At each point merely record all species present in a 1-meter radius circle around the point. Most species can be accurately judged to be within or without the plot without resorting to plot measurement. When it is not known whether a species represents a "small or large" tree species, include data for it both here and, if any individuals qualify, under "large" trees (step no. 4 above).

6. Species Outside Plots. Record all encountered tree, shrub and herbaceous species within the stand but not appearing in the point/plot data. Such listing will be logistically difficult as one cannot predict which species will appear in samples not yet obtained. One way is to list all less common species seen and to cross them off if they are encountered later in samples. Time often will not allow a complete species survey in each stand. This deficiency, however, is partially alleviated

by the structured sampling method enforcing equal levels of effort between stands for the more common species. Be careful to restrict listings of species outside plots to those occurring only within the relatively homogeneous stand type being sampled. Although it is tempting to include fringe species to assure the compilation of a more complete list, this confuses and devalues the list of more characteristic species obtained more within the stand. If species are listed but suspected of being marginal types, label them as such.

7. Data Summary. Determine the absolute frequency percentage of each species by dividing the number of points/plots at which it occurs by the total number of points/plots surveyed. More simply, if 20 point/plots are surveyed, multiply the number of point/plot occurrences of each species by 5. (If it later becomes desirable to convert absolute frequency data to relative data, treat the tree figures separately from the herb-shrub figures since they are derived by different methods.)

   Determine the relative density percentage of each tree species by dividing its total number of occurrences in all point quarter sections by the total number of occurrences of all species in all quarter sections. Alternatively, if 20 points (i.e. 80 trees) are surveyed, multiply the total number of quarter section occurrences of each species by 1.25.

Qualitative Sampling

When time does not permit quantitative sampling, collect qualitative data on the General Plant Community Data Form (as exemplified above) and the Qualitative Plant Community Data Form (see accompanying example). Relax to a qualitative level, however, only when necessary. Although qualitative data may provide fair descriptions of individual stands, they have very limited capabilities for comparing stands and allowing objective constructions of classifications and ordinations.

As with quantitative sampling, restrict qualitative samples to relatively homogeneous stand types. Survey the stands well enough that the dominant and more common species are recorded by their overall estimated abundances, using the following terms:

Dominant. One of the few (usually 3 or less) species with the highest estimated cover percentages (or canopy tree density percentages) in a stand. Applies separately to species in each major stand layer. Where possible, give actual estimated percentages.

Common. Non-dominant species occurring throughout a stand in large numbers (hundreds per 100 x 100 m area - remember to visualize 100 m as a little longer than a football field).

Frequent. Species occurring throughout a stand in low numbers (tens per 100 x 100 m area).

Infrequent. Species with few individuals (under ca. 10) known to be in a stand. More accurately, record the actual number seen (e.g. "6 seen").

Locally ______. A useful combination term for use with "dominant",

When using these terms it is helpful to remember that "dominant" and "infrequent" are fairly absolute, allowing most species to be judged dichotomously as either "common" or "frequent". Sometimes different subsets of dominants occur in different subareas of a single stand. It is often informative to include an outline of these subsets.

Except for small stands, time restrictions usually will not allow compilation of complete species lists. The main objective is to catalog the most common and characteristic species, those most influential in the functioning of the stand.

FICTICIOUS DATA

Ohio DNR, Natural Areas & Preserves
GENERAL PLANT COMMUNITY DATA FORM

Natural area AUSTIN SWAMP
Owner ODNR, DIV. WILDLIFE
County PICKAWAY
Community type MAPLE-ASH SWAMP
Stand number 2
Surveyor P.G. SMITH
Stand size (acres) ca. 9
Date 4/1/82
Location (if map not provided) (SEE ATTACHED MAP)

BIOLOGICAL FEATURES

Sampling method

Qualitative ____

Quantitative ✓ Attach methods sheet (except when Basic Methods used).

Sampling intensity for qualitative study

Time (hours) ____

Area (% of community covered) ____

Description (dominants, tree size ranges, canopy closure, understory development, compositional variations, transitions to adjacent communities) SECOND-GROWTH SWAMP DOMINATED BY RED MAPLE AND WHITE ASH, WITH SHELLBARK AND AM. ELM COMMON. SILVER MAPLE COMMON LOCALLY IN NE. CORNER. 3 SAMPLED TREES 50-70 CM DBH, ALL OTHERS <50 CM. SHRUB LAYER SPARCE, DOMINATED BY SPICEBUSH. HERB LAYER VARIABLE IN COVER + DIVERSITY DEPENDING ON SOIL MOISTURE LEVELS. 2 OPENINGS, CA. 10 + 15 M IN DIAMETER, WITH DEEPER WATER AND BUTTONBUSH. SWAMP BORDERED ON THE SOUTH BY A SEDGE-CATTAIL RING AND CARP LAKE. ON THE NORTH IT GRADES INTO A WET-MESIC BEECH-R. MAPLE STAND.

Stability (possible successional history and trend) THOUGH SECOND-GROWTH, PROBABLY RELATIVELY STABLE IN COMPOSITION. THE ELM WAS LIKELY A PREVIOUS DOMINANT AND MAY STILL BE DECREASING. SOME UNDERSTORY CHANGES MAY FOLLOW MATURATION AND INCREASED CANOPY CLOSURE. THE COTTONWOODS WILL LIKELY DISAPPEAR EXCEPT ON THE MARGINS.

PHYSICAL FEATURES

Geology (type, depth to bedrock) WISCONSIN TILL

Soils (topographic and soil variations, or water characteristics)
KOKOMO SILTY CLAY LOAM (KERR & CHRISTMAN 1980). SITE NEARLY FLAT EXCEPT FOR BUTTONBUSH DEPRESSIONS & SLIGHT RISE AT NORTH END INTO THE BEECH STAND.

Slope (inclination, bearing, vertical position)
—

Microclimate (unusual or extreme features)
NOTHING OBVIOUSLY UNUSUAL.

DISTURBANCE FEATURES (cutting, grazing, flooding, draining, burning, etc.)

Past disturbances SECOND-GROWTH, THOUGH NO CUTTING FOR 2-3 DECADES. FENCING INDICATIVE OF POSSIBLE FORMER GRAZING.

Current disturbances ONE FOOT TRAIL USED BY FISHERMEN ALONG WEST MARGIN.

Future threats NONE KNOWN.

SIGNIFICANCE EVALUATION (statewide or local significance)
SECOND-GROWTH AND SMALL, BUT ONE OF THE BEST OF ITS COMMUNITY TYPE IN S-C OHIO. RATED MODERATELY STATEWIDE SIGNIFICANT.

ADDITIONAL AND CONTINUED COMMENTS

FICTICIOUS DATA

Ohio DNR, Natural
Areas & Preserves

BASIC QUANTITATIVE PLANT
COMMUNITY DATA FORM

Tree, shrub & herb data
(Freq. & rel. tree den.)

Area AUSTIN SWAMP
County PICKAWAY
Stand no. or type 2

Surveyor P.G. SMITH
Date 4/1/82

Trees: At each point, tally the nearest tree ≥ 10 cm dbh in each quarter. Tally by estimated dbh class (a = 10-30 cm, b = 30-50, c = 50-70, d = >70).
Herbs, Shrubs & Small Tree Species: Tally by presence in each 1 m-radius circular plot. In forests, center the plots on the points for tree data.

| Species | Points/Plots 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Freq. Tot | Freq. % | Rel. Density a | b | c | d | Tot | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ACER RUB. | ab | b | a ab | aa | aa a | ab c | ab | aa b | aa | | b | | a bb | b | a aa | aa | | ab | a | aa | 17 | 85 | 24 | 11 | 1 | | 36 | 45 |
| FRAX. AM. | a | a | b | ab | | | b | | a | aa | ab | ab | b | a | | | ab | aa | aa | b | 15 | 75 | 14 | 8 | | | 22 | 28 |
| ULMUS AM. | a | a | | | | a | | | | | | | | a | a | | | | | | 5 | 25 | 5 | | | | 5 | 6 |
| CARYA LAC. | | a | | | | | a | b | | | | aa | | b | | b | | | | | 6 | 30 | 4 | 3 | | | 7 | 9 |
| NYSSA | | | | | b | | | | a | a | | | | | | | | | | | 3 | 15 | 2 | 1 | | | 3 | 4 |
| POPULUS DEL. | | | | | | | | | | b | | | | | | | | | | | 1 | 5 | | 1 | | | 1 | 1 |
| FAGUS | | | | | | | | | | | b | | | | | | a | | c | | 3 | 15 | 1 | 1 | 1 | | 3 | 4 |
| ACER SACCHARINUM | | | | | | | | | | | | | | | | a | | | | b | 2 | 10 | 1 | 1 | | | 2 | 3 |
| CARPINUS | | | | | | | | | | | | | | | | | a | | | | 1 | 5 | 1 | | | | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | 52 | 26 | 2 | | 80 | 101 |

Species outside plots (continue on back): QUERCUS PAL.
OSTRYA - 3 SEEN ON N. MARGIN

FICTICIOUS
DATA

Ohio DNR, Natural Areas & Preserves
QUALITATIVE PLANT COMMUNITY DATA FORM

Area AUSTIN SWAMP | Surveyor P.G. SMITH
County PICKAWAY | Date 4/1/82
Stand no. 2

Primary species
All species: Give estimated relative frequencies as follows: D - dominant, C - common, F - frequent, I - infrequent, L_ - locally ______. Where possible, also give est. rel. cover or density %'s of dominants.
Tree species: Give estimated cm dbh size ranges. Underline actual measured sizes.

| | |
|---|---|
| D { ACER RUB. — D, CA. 50% OF CANOPY STEMS. DBH = 67, 58, 59, MOSTLY < 50. | D LINDERA — D SHRUB |
| FRAX. AM. — D, SECOND TO ACER RUB. DBH = 61, 56, MOSTLY < 40 | CORNUS RAC. — C |
| CARYA LAC. — C, DBH MOSTLY < 40 | SAMBUCUS CAN. — F |
| NYSSA — F | PARTHENO. QUIN. — LC |
| ULMUS AM. — C, MOSTLY SUBCANOPY | RHUS RAD. — C |
| ACER SACCHARINUM — LC AT NE CORNER | CEPHALANTHUS — D IN 2 WET |
| POPULUS DEL. — I, NO SAPLINGS SEEN | OPENINGS CA. 10 + 15 M IN DIAM. |
| QUERCUS PAL. — I | |
| FAGUS — F ON N MARGIN, MORE | |
| C ON HIGHER GROUND TO N | OSMUNDA CINN. — LC<br>O. REG. — I |
| | DRYOPTERIS INTERM. — C<br>ONOCLEA — C |
| | IMPATIENS CAP. — LF<br>PILEA PUM. — LC ON DEAD LOGS |
| | LAPORTEA — F TOWARDS HIGHER GROUND |
| | ASTER SP. — I (SIMPLEX? VEGETATIVE) |
| CARPINUS — C | CAREX LUPULINA — F<br>C. CRISTATELLA — I |
| OSTRYA — 3 SEEN ON N. MARGIN | C. SPP. — LD (VEGETATIVE)<br>CINNA ARUND — C |
| | GLECHOMA — I<br>SANICULA MAR. — ONE SEEN |
| | LYSIMACHIA NUM — LC<br>LYCOPUS AM — I |
| | |
| | |
| | |

000155

APPENDICES

# Appendix A

## SIGNIFICANCE CLASSES OF NATURAL PLANT COMMUNITY STANDS

The Ohio Division of Natural Areas and Preserves inventories and promotes the preservation of stands of significant natural plant communities as part of its responsibility to protect natural areas in Ohio. The evaluation system explained below is used by the Division to give general significance ratings to different stands for protection planning purposes. Significance here refers to a stand's value for natural diversity preservation, research and education. The evaluation system applies only to individual plant community stands as opposed to natural areas which often are characterized by several stands in addition to endangered species, geologic features and other elements. In the following discussion, the term plant community stand refers to an individual physical example of a specific vegetation type, while plant community type refers to an abstract concept of the real or imagined characteristic composition of two or more similar stands.

The significance evaluation of plant community stands is as much an art as it is a science. It involves various parameters which are often difficult to compare, vary per comparison, and have subjective weights. It is a relative evaluation requiring a good knowledge of many communities and stands for making intelligent evaluations of individual stands. Moreover, since plant community classification represents a largely arbitrary categorization of natural continuums, it is often difficult to say whether an evaluation of two stands represents a comparison of their conceived qualities or just an enumeration of their natural differences. The complexities of plant community stands and human biases defy the use of any simple, mechanical evaluation processes. The evaluation system presented below carries no claim as an infallible system but is supposed to represent a pragmatic, supplementary evaluation tool.

In the assignment of plant community stands to the significance classes named below, each stand is evaluated only in relation to other stands of the same community type (as defined by the plant community classification system). Stands of different community types are not rated against each other, nor are adjacent stands representing more than one community lumped together in one rating. Additionally, only those factors are considered which apply to the community level. Factors such as scenic quality, ownership, availability, and individual stand threat are excluded from the evaluation. All of these factors are important for protection planning, but are considered independently of stand significance evaluation. Factors such as endangered species, species richness, and fauna may be included in stand evaluation when they are known to be reliable indicators of the qualities of the stands in which they occur. Their chance occurrence or unknown importance in a stand, however, is not considered to add any special value to that stand, in which case these elements are considered separately.

The significance of a plant community stand, as presented here, is based primarily on two factors:

1. Stand Naturalness. A stand's relative lack of human disturbance or lack of natural disturbance uncharacteristic of the community type it represents. It is indicated by various features, including lack of human artifacts, maturity (i.e., relative successional stability, a feature not present in all significant natural communities), integrity of different components, lack of uncharacteristic species (especially species alien to the area in question), presence of conservative species (non-aggressive, indigenous, sometimes endangered species), and the presence of a characteristic (not necessarily high) species richness level.

2. Community Type Rarity and/or Threat. Community type rarity and threat are determined on the community type level, then applied to each stand representing the community type and area in question. Community type rarity refers to the number of known occurrences of a community type on various geographic levels, including physiographic sections. Community type threat refers primarily to either community type rarity and/or the rapidity with which a community type is disappearing. Evaluation of community type rarity and threat requires a familiarity with the community type within the geographic area(s) under consideration.

The significance evaluation of a stand may be influenced by other factors having variable degrees of importance:

3. Stand Size. A stand's areal extent.

4. Stand Biological Distinctiveness. A stand's distinctiveness in relation to biological factors (non-dominant indicator species, understory dominants, seasonal dominants, etc.) not inherent in the general definition of the community it represents. Distinctiveness may be considered to have positive or negative subjective significance, depending on the distinctiveness factor and on the number and quality of seemingly more "average" stands of a given community in existence.

5. Stand Physical Distinctiveness. A stand's distinctiveness in relation to physical factors (topography, geology, pedology, hydrology, microclimate) not inherent in the general definition of the community it represents.

6. Stand Reestablishment Potential. A stand's potential to reestablish itself, with or without human aid, as an example of a specific community type. This factor is often difficult to assess accurately since it is usually hard to determine with much precision what a stand originally was or what it would become with reestablishment.

7. Stand Research History. The extent or importance of a stand's data base. The data are relevent to stand evaluation only to the extent they apply to stand levels as opposed to species or other levels.

Additional factors not specified above may occasionally influence the significance evaluation of a stand.

The application of these evaluation factors must necessarily vary per community type and area of the state. For instance, substantially disturbed stands may retain high significance levels if they represent rare community types. Unstable stands representing relict communities are often quite significant. Qualitatively similar stands of certain community types may be considered more significant in one part of the state than another due to their relative rarity in one part. These and many other situations require carefully weighted evaluations, none of which will escape a certain degree of subjective choice. The significance classes are as follow:

1. <u>Highly Statewide-significant Plant Community</u>. A natural stand with national or high statewide significance compared to other stands of its community type in all or a large part of the state. It is possibly one of the 10 most significant examples of its community type in the state. If not already protected, it warrants preservation consideration even though no other significant elements (endangered species, geologic feature, etc.) may be present and, if purchased, full market value for the property might have to be paid.

2. <u>Moderately Statewide-significant Plant Community</u>. A natural stand with considerable but not highest statewide significance compared to other stands of its community type in all or a large part of the state. Probably not one of the most significant examples of its community type in the state. If not already protected, however, it could warrant preservation consideration by a statewide agency or organization if other significant elements were present or, if purchased, less than full market value for the property would have to be paid.

3. <u>Locally Significant Plant Community</u>. A natural stand with notable significance compared to other stands of its community type in the local area. If not already protected, it warrants preservation consideration by a local agency or organization.

4. <u>Insignificant Plant Community</u>. A natural stand with little or no significance compared to other stands of its community type in the local area. A relatively poor quality stand which in itself probably does not warrant any special preservation consideration. A stand identified for reference purposes, often because it represents a significant component of a managed or well known unmanaged natural area or preserve.

# Appendix B

## PLANT COMMUNITY LCD FORMAT

An LCD is the basic form on which the Division of Natural Areas and Preserves stores natural diversity data. The following outline provides guidelines for completing LCD information specific to plant communities. Such information normally will represent only selected data taken from field and summary survey forms on which data originally were compiled. As available information for many communities will be voluminous, care must be taken with each LCD to enter those data which best represent the community being described. Perspective must be maintained so the different informational categories listed below are included in proportions appropriate to their importance for data users. A sample completed LCD is included with this outline.

LINE 1, NAME OF ELEMENT AND CODE

Using the plant community classification system, enter the standardized name and code number of the plant community type which best describes the community being inventoried. Many communities will not fit the classification system with precision. When a community is similar to two classification system types, enter the type to which it seems closest on Line 1, and enter the code of the second type on Line 9, Spaces 57-61. When a community does not appear to correspond to any classification system type, see the keeper of the classification system.

LINE 2, LATITUDE-LONGITUDE, ETC.

Enter the state (OH), county code and, when known, quad name. Write the county name below the county code.

LINE 3, SOURCE OF LEAD

Normally enter "ONHP SURVEY" followed by the community surveyor's last name, followed by his first and/or middle names or initials (e.g., "ONHP SURVEY, SMITH, P.G."). Space as shown.

LINE 4, DATE OF INFORMATION, NAME OF MANAGED AREAS

Enter the year, month and, after space 6 and within a circle, the day the community was surveyed.

Write the name of a managed area below the managed area blocks.

LINE 5, OWNERS, ETC.

If known, write the name(s) of the principal owner(s) below spaces 3-32.

FICTICIOUS DATA

P.G.S.

99 REINPUT

## LCD ELEMENT FORM

**CARD 1**

NAME OF ELEMENT: MAPLE-ASH SWAMP

INDEX CODE: (class, element, subclass, occurrence, quad code, destruction): PC51 110 •

R - reported
C - confirmed
T - threatened

**CARD 2**

LATITUDE & LONGITUDE: N W

STATE: OH

COUNTY CODE: 129 (Pickaway)

USGS QUAD NAME: BROWNSTOWN

**CARD 3**

SOURCE OF LEAD: OWNP SURVEY, SMITH, P.G.

**CARD 4**

DATE OF INFORMATION (year, mo): 19824 ①

NAME OF MANAGED AREA: Washington State Park

**CARD 5**

OWNERS:

NAME OF PRINCIPAL OWNER: Ohio DNR

PROTECTION STATUS:

SPECIAL STATUS:

SIZE (ACRES):

**CARD 6 - 8**

GENERAL DESCRIPTION:

AUSTIN SWAMP. PICKAWAY CO., TAYLOR TWP., SW.1/4 SEC.3, E. OF ST.RT.163, 0.3 MI.S.
OF U.S.RT.6. CA.9 ACRES AT N.END OF CARP L. R.MAPLE & W.ASH DOMINANT, SHELLBARK
COMMON. SECOND GROWTH, MOST TREES UNDER 50 CM DBH. 2 BUTTONBUSH OPENINGS. FLOODS

**CARD 9**

IN SPRING. GOOD QUALITY SWAMP FOR SC.OHIO. 511204/2

**CARD 10**

CONTENTS OF MANUAL FILE

| | DIRECTIONS | BOUNDARIES | PHOTOS | FIELD SURVEY | OWNER INFORMATION | REFERENCES | ELEMENT | COORDINATES |
|---|---|---|---|---|---|---|---|---|
| | | | | S | | | | |
| CODE | D | B | P/A/N | E/V/B/S | O | R | V/U | C/U/N |

VERIFICATION OF DATA: ELEMENT, COORDINATES

000161

The remainder of Line 5 will be completed by the data processing section.

LINES 6-9, GENERAL DESCRIPTION

The general description may be entered through Line 9, Space 45. When appropriate, available, and space allows, the following information should be entered in the following order:

1. Natural Area Name. Name of the unmanaged area or of a specific, named area within a managed area (e.g. Buffalo Beats in the Wayne National Forest) in which the community occurs.

2. General Location. County, township, section portion, and position relative to cultural or natural features in which the community occurs. The locational information should be entered from the general to the specific.

3. Specific Location. Brief statement on the location of the specific community stand within the natural area (e.g., "AT N.END OF CARP L.").

4. Community Size. Estimated acreage of the community. Note this usually is smaller than the size of the natural area or the managed area (thesize of which is reported on Line 5) in which the community occurs. Where helpful, use a topographic map transparent overlay grid to help determine size. The community size statement may often be combined logically with the specific location statement (e.g., "10 ACRES AT N.END OF CARP L.").

5. Community Description. The dominant species. Do not simply repeat Line 1; be more specific. When available, include quantitative statements, preferably dominance or importance values, for the dominants (e.g., "HEMLOCK-42% OF BASAL AREA, BEECH-26%). List important associated species and understory or indicator species as space allows. Use the common names of species when they are available and specific enough.

6. Physical Features. If space allows, briefly note any physical features (e.g., soil mositure, bedrock type, etc.) which obviously affect the nature of the community.

7. Community Significance. Provide a statement explaining the significance class assigned the community in Line 9, Space 63. It is understood that this will be a subjective decision based on the surveyor's relative knowledge at the time of evaluation. The assignment can be changed as new knowledge is acquired. Relate the assignment to a national, state, or local significance level. Examples might include: "ONE OF LEAST DISTURBED SWAMPS IN SC.OHIO" or "SECOND-GROWTH WOODLOT WITH GOOD DIVERSITY FOR LOCAL AREA".

Balance the use of abbreviations and punctuations in the general description to achieve both conciseness and, in the printout, readability.

LINES 9-10, CODED INFORMATION

Record the following coded information as appropriate per community reported:

1. Alternative Community Classification, Line 9, Spaces 57-61.

   When appropriate, enter the code number of an alternative plant community type, as versus that on Line 1, under which an inventoried stand could be listed.

2. Wetland Classification, Line 9, Space 62.

   W - Wetland (as designated in the plant community classification).

   \- Not a wetland.

3. Significance Classification, Line 9, Space 63.

   1 - Community with national or high statewide significance.
   2 - Community with considerable, but not highest, statewide significance.
   3 - Community with local significance.
   4 - Community with little or no local significance.

4. Field Survey Intensity, Line 10, Space 4.

   S - Superficial survey. Community has received only a qualitative survey.

   E - Extensive survey. Community has received a general quantitative survey, such as a Basic Survey (see text).

   I - Intensive survey. Community has received a thorough, accurate quantitative survey. Few communities will receive this rating.

5. Additional Coded Information, Line 10.

   The remainder of Line 10 will be completed by the data processing section.

# Appendix C

## SELECTED INTENSIVE PLANT COMMUNITY SAMPLING METHODS

### Some Alternatives

DEFINITIONS

Trees - Trees ≥ 10 cm dbh (bh = 1.4 m).
Saplings - Small trees < 10 cm dbh and ≥ 1 m tall.
Seedlings - Small trees < 1 m tall.

TREES

Plot Choices

Circles - 400 $m^2$ (11.28 m radius)
200 $m^2$ (7.98 m radius)
100 $m^2$ (5.64 m radius)

Rectangles - 200 $m^2$ (20 x 10 m)
100 $m^2$ (20 x 5 m)
[20 $m^2$ (10 x 2 m) - only for long transects.]

Rectangular plots may be arranged contiguously into transects.

Partial Sampling

Measure plots, where helpful, with rangefinders. Record numbers of each species. If desired, record by estimated size class. If basal area is desired, record prism counts using the Bitterlich method with points nested at the centers of circular plots.

Derive, as desired, basal area (dominance), density and/or frequency.

Full Sampling

Measure plots with tapes or rods. Record dbh's by species. Alternatively, use the quarter method, recording dbh's and tree distances by species.

Derive, as desired, basal area (dominance), density, and/or frequency.

SAPLINGS AND SHRUBS

Plot Choices

Circles - 25 $m^2$ (2.82 m radius) or 50 $m^2$ (3.99 m radius) plots nested, where applicable, in centers of tree plots.

Rectangles - 25 $m^2$ (5 x 5 m) plots nested, where applicable, at one or both ends, or one or more corners of the tree plots.

Partial Sampling

Omit, or record numbers of saplings and presence of shrubs by species.

Derive, as desired, density (for saplings) and/or frequency.

Full Sampling

Record numbers or dbh's of saplings by species, and presence, cover class or estimated cover of shrubs by species.

Derive, as desired, dominance, density and/or frequency of saplings, and dominance and/or frequency of shrubs.

SEEDLINGS (SHRUBS) AND HERBS

Shrubs may be sampled in the small plots described below if the intermediate size plots for saplings are not needed.

Plot Sizes

Circles - 1 $m^2$ (0.56 m radius) or 5 $m^2$ (1.26 m radius) plots nested, where applicable, at centers of plots for other strata, or on midpoints of each of four radii (at right angles) of plots for other strata.

Rectangles - 1 $m^2$ (1 x 1 m) or 5 $m^2$ (1 x 5 m) plots nested, where applicable, at one or both ends, or one or more corners of the tree plots.

Circular and rectangular plots may be located randomly or along transects in non-forest communities.

Partial Sampling

Omit, or record presence by species.

Derive, if desired, frequency.

Full Sampling

Record numbers of seedlings by species, and presence, cover class, or estimated cover of herbs by species.

Derive, as desired, density and/or frequency for seedlings, and dominance and/or frequency for herbs.

SAMPLING PARAMETERS

Each community has various parameters which could be measured. The goal is to measure those parameters in those ways which will yield the desired data and levels of accuracy for the least amount of effort. Measurements on plant communities are commonly taken on characters which will yield dominance, density, and frequency data. Per stand surveyed, different combinations of these parameters may be used and at different levels of specificity. The guidelines above give two levels of parameter sampling: partial and full. Additional choices are sometimes available within these two levels.

The level of parameter sampling chosen will depend primarily on the data desired and the time available. The partial sampling levels may be appropriate when several or many stands are to be surveyed with limited time, or when only general data are desired. The full sampling levels are appropriate when relatively complete data are desired on one or a few stands and time is not limiting. Permanent stakes should be used in plots receiving full sampling. Ground and/or aerial photography may also be useful.

PLOT SHAPES, SIZES AND NUMBERS

Choose the plot shape and size appropriate per community type, stand size, data desired, and time available. In general, circular plots may be established faster and may be used in coordination with the Bitterlich method. Alternatively, rectangular plots may provide more accurate data in some situations, and may be arranged contiguously in transects.

Plot size will depend largely on the types of strata to be sampled, the size or shape of the stand, and the time available. Choice of plot size should be coordinated with choice of plot number. A large number of small plots may yield more accurate data than a few large plots.

There is no simple method to determine the number of points/plots which will yield an adequate sampling of any given community. The number will depend primarily on the homogeneity of the community, and this will vary greatly per community type and stand. Additionally, time limitations will often require that sampling be reduced to suboptimum levels. The number will vary inversely with plot size.

Basically, enough samples should be taken that additional samples do not significantly alter the accumulated data. A sampling error under 10-15% is very good. A 10% area sampling is sometimes recommended as a general sampling goal, though on large areas this may be hard to achieve. A sampling range of 3 to 10 Bitterlich points per acre (7-25 points/hectare) has been recommended for some midwestern forest communities. The adequacy of sampling should be checked by determining the affect of additional samples on the total data set. This may be done quantitatively by comparing determinations of dominance, density and/or frequency. Quick determinations with the Bitterlich method can be made by comparing just basal area values. Qualitative judgments can be made by simply observing the level of data variation for dominant species from plot to plot. Consult manuals for statistical methods having greater validity concerning sampling adequacy.

If, because of time constraints, a community may be only partially sampled, it is usually advisable to sample fewer strata or parameters adequately than to sample all strata and parameters inadequately.

## PLOT LOCATIONS

Make a quick reconnaissance of the entire community to be surveyed to determine size and boundaries. Include only relatively homogeneous vegetation in each community survey. That is, do not lump data from substantially different community types. If there is a question whether two areas do or do not represent essentially the same community, sample them separately (i.e. stratify your sampling) and then determine if the data are similar enough to be lumped.

Locations of points/plots in each stand will depend on the type of community, the size and shape of the community, and the number of plots desired. Generally, determine the first plot randomly and subsequent plots at regular intervals in a frequency and pattern that will allow the entire community to be sampled to the desired sampling level and within the given time limits. In many communities, a simple square-shaped sampling pattern or plots along one or more parallel lines will suffice.

# PLANT COMMUNITY SAMPLING PARAMETERS

## DOMINANCE

### Dominance

Basal Area Data

$$\frac{\text{Basal area of a species in all plots}}{\text{Total number of sampling plots}} \times \text{Area conversion factor*}$$

Bitterlich Data

$$\frac{\text{Number of prism-counted stems of a species at all points}}{\text{Total number of sampling points}} \times \text{Prism basal area factor}$$

Cover Data

$$\frac{\text{Total of cover values of a species in all plots}}{\text{Total number of sampling plots}}$$

### Relative Dominance

Derived from Raw Data

Basal Area Data

$$\frac{\text{Basal area of a species in all plots}}{\text{Basal area of all species in all plots}} \times 100$$

Bitterlich Data

$$\frac{\text{Number of stems of a species at all points}}{\text{Number of stems of all species at all points}} \times 100$$

Cover Data

$$\frac{\text{Total of cover values of a species in all plots}}{\text{Total of cover values of all species in all plots}} \times 100$$

Derived from Dominance

Bitterlich, dbh, and Cover Data

$$\frac{\text{Dominance of a species}}{\text{Total dominance of all species}} \times 100$$

## DENSITY

### Density

$$\frac{\text{Number of stems of a species in all plots}}{\text{Total number of sampling plots}} \times \text{Area conversion factor*}$$

Relative Density

Derived from Raw Data

$$\frac{\text{Number of stems of a species in all plots}}{\text{Number of stems of all species in all plots}} \times 100$$

Derived from Density

$$\frac{\text{Density of a species}}{\text{Total density of all species}} \times 100$$

FREQUENCY

Frequency

$$\frac{\text{Number of plots in which a species occurs}}{\text{Total number of sampling plots}}$$

Relative Frequency

Derived from Raw Data

$$\frac{\text{Number of plots in which a species occurs}}{\text{Total of number of plots of occurrence for all species}} \times 100$$

Derived from Frequency

$$\frac{\text{Frequency of a species}}{\text{Total of frequency values of all species}} \times 100$$

IMPORTANCE VALUE AND PERCENTAGE

Importance Value

Relative dominance + relative density + relative frequency of a species [or any two of these parameters may be added]

Importance Percentage

$$\frac{\text{Importance value of a species}}{\text{2 or 3 [depending on whether 2 or 3 parameters were used to determine importance value]}}$$

or

$$\frac{\text{Importance value of a species}}{\text{Total of importance values of all species}} \times 100$$

*Area conversion factor - This factor converts data from an average plot basis to hectare (or other size area) basis. Representative factors for conversions to a hectare basis include:

25 for 400 $m^2$ plots
($25 \times 400 = 10{,}000\ m^2 = 1$ ha)

50 for 200 $m^2$ plots

100 for 100 $m^2$ plots

200 for 50 $m^2$ plots

400 for 25 $m^2$ plots

500 for 20 $m^2$ plots

2,000 for 5 $m^2$ plots

10,000 for 1 $m^2$ plots

Ohio DNR, Natural Areas & Preserves
SAMPLING METHOD DATA FORM

General

Plot shape __________

Plot size(s) __________

No(s). of plots/points __________

Plot nesting relationships __________

__________

__________

__________

__________

Plot/Point location method

_____ Arbitrary

_____ Systematic. First Plot random? ______

_____ Random. Stratified? ______

Placement of plots/points relative to each other __________

__________

__________

__________

__________

Tree definitions. Trees __________

Saplings __________

Seedlings __________

Estimated sampling adequacy __________

__________

__________

__________

__________

Possible sampling misrepresentations __________

__________

__________

__________

__________

Permanent marker locations __________

__________

__________

__________

__________

__________

Ohio DNR, Nat.Areas & Preserves

TREE & SAPLING DATA

(Density & Basal Area by tape. Data by size classes.)

Area ______________

County ______________

Stand no. ______ Plot no. ______

Stratum ______________

Surveyor ______________

Date ______________

Height and Diameter Classes (specify)

| Species | | | | | | | | | | | | | | | | | | | | |
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Species outside plots:

Ohio DNR, Natural Areas & Preserves
TREE & SAPLING DATA
(Density & Basal Area by tape. Data by individual trees.)

Area ______________ Surveyor ______________
County ______________ Date ______________
Stand no. ________ Plot no. ________
Stratum ________

| Species | ____ | | ____ | | ____ | | ____ | | ____ | | ____ | | ____ | | ____ | | ____ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (cm & $cm^2$) → | dbh | BA | dbh | BA | dbh | BA | dbh | BA | dbh | BA | dbh | BA | dbh | BA | dbh | BA | dbh | BA |
| 1 | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
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| 5 | | | | | | | | | | | | | | | | | | |
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| 19 | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | |
| Total | no. | BA | no. | BA | no. | BA | no. | BA | no. | BA | no. | BA | no. | BA | no. | BA | no. | BA |
| | | | | | | | | | | | | | | | | | | |

Species outside plots:

Ohio DNR, Natural Areas & Preserves
TREE DATA
(Basal area by prism)

Area ______________________ Surveyor ______________________
County ______________________ Date ______________________
Stand no. ______________________ Prism metric BAF ______________________

Points - Tally by prism count.

| Species | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | tot | no/pt | BA/ha | %BA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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Species not counted:

Ohio DNR, Nat. Areas & Preserves

SAPLING, SEEDLING, SHRUB, HERB DATA

Area ____________________ Surveyor ____________________

County ____________________ Date ____________________

Stand no. _____ Stratum __________

Plots:
- Saplings - Tally by number.
- Seedlings - Tally by number.
- Shrubs and herbs - Tally bv presence, or estimated cover class, or estimated percent.

| Species | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
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Species outside plots:

Ohio DNR, Natural
Areas & Preserves

SUMMARY DATA

Area ______________________

County ______________________

Stand no. _____ No. of plots _______

Stratum ______________________

Surveyor ______________________

Date ______________________

| Species | $m^2$ | $m^2$/pt | Dom $m^2$/ha | RDom | | | Den | RDen | | Freq | RFreq | | IV | IP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | %/pt | %/ha | % | stems | st/pt | st/ha | % | plots | % | % | | | % | |
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| Total | | | | | | | | | | | | | | | |

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