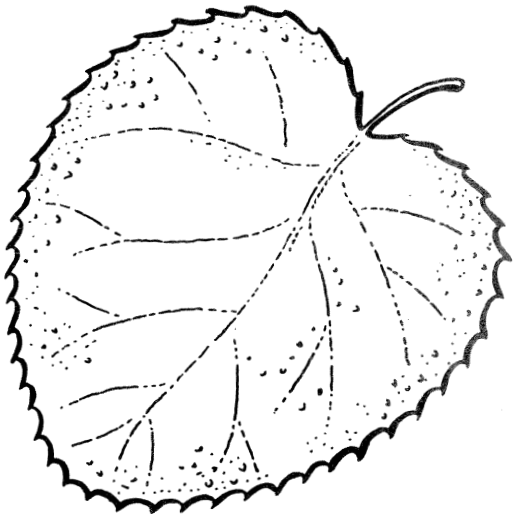
USDA Forest Service General Technical Report SE-11 March 1977

# Conference on Endangered Plants in the Southeast

## PROCEEDINGS



Betula uber

May 11-13, 1976
Asheville, North Carolina

Forest Service - U.S. Department of Agriculture
Southeastern Forest Experiment Station
Asheville, North Carolina

# Conference on Endangered Plants in the Southeast

# PROCEEDINGS

May 11-13, 1976
Asheville, North Carolina

Sponsored by
Southeastern Forest Experiment Station
USDA Forest Service

University of North Carolina-Asheville

Citation:

USDA Forest Service
1977. Conference on endangered plants in the southeast proceedings. USDA For. Serv. Gen. Tech. Rep. SE-11, 104 p. Southeast. For. Exp. Stn., Asheville, N. C.

CONTENTS

# OBJECTIVES OF THE CONFERENCE

James D. Perry[1]/

It is obvious from the program that this conference is not an attempt to derive another list of plants which are endangered in one way or another. Rather, it is an effort to arrive at some ways of standardizing our screening procedures and research priorities. It is generally agreed that we must strengthen and broaden our knowledge of plant distributions, of habitat preferences, of population dynamics, and of species biology in general. Although we all have some built-in notion of what species are rare or endangered in our areas, we need some workable definitions to use in classifying these, and the first two papers concern this.

Subsequent papers explore federal and state legislation affecting our actions and the question of propagation and commercial exploitation of endangered plants, such as the Venus' fly-trap.

In the second session, five papers concern preservation of sufficient suitable habitat--natural areas or even whole communities--and on what bases such areas may be considered worthy of preservation. The remaining papers present research needs, dealing with what botanists should do to expand knowledge of species biology and distribution. This is a pressing need of professional foresters and others who manage public lands. In order to manage public lands in such a way as to preserve areas critical to given species, field personnel need to know what these species are and what their requirements are. In addition, field personnel may lack the time or training to identify plants limited in distribution. An efficient means of inventory, storage, and retrieval of information is needed.

Some of the questions we must face, and hopefully reach some consensus about, are: 1) How may we categorize endangered species in a realistic and consistent way from state to state so future legislation will have teeth in it? 2) What are the best ways to preserve rare, endangered, and endemic species? 3) What research approaches do we need in order to establish priorities as time runs out?

This conference was also envisioned as a means of communicating, so that we from various states can find out what those in other states are doing and the different problems being faced.

---

[1]/ Chairman, Department of Biology, University of North Carolina at Asheville.

# DEFINITION AND CLASSIFICATION OF ENDANGERED AND THREATENED PLANT SPECIES

James F. Matthews[1]

Abstract -- Definitions and categories of classification for endangered and threatened vascular plants, as determined by the N.C. Endangered and Threatened Plant Committee, are detailed, along with the philosophical guidelines used in producing a primary list of rare species and a secondary list of endangered and threatened peripheral species.

The definition and classification of endangered and threatened species is the heart of any successful effort in conservation and protection. Everyone interested in endangered and threatened species has probably been frustrated by plans, programs, definitions and lists which often complicate the situation rather than improve it. We of the North Carolina Endangered and Threatened Plant Committee (The Committee is listed at the end of this paper.) have felt this same frustration. While meeting to prepare a report for a state-wide Symposium on Endangered and Threatened Biota in November 1975, we decided to make some decisions, right or wrong, to initiate positive action toward conservation and protection.

We had to analyze those species to be included, define the categories and evaluate the current status of each species all in the context of the long range process of conservation. The full text of that Symposium is being published by the North Carolina State Museum of Natural History and will be available through the Museum.

What I want to do today is to discuss some of the definitions and categories, and to give some of the philosophical concepts used in reaching decisions. First, it is important to recognize that each state cannot independently develop a list of endangered and threatened species now that the Federal Government has published a list through the Smithsonian Institution (1974) and through the Department of Interior Fish and Wildlife Service (1975). Every state list should be so carefully compiled that it would stand up in court, as it will be tested in the halls of the State Legislature. Inclusion of all the popular wildflowers produces a list that cannot be defended, ends up being riddled, thus losing its veracity. How do you defend the query "But the Federal List has only 88 species for our state and yours has 320, why the discrepancy?" We were committed to generating a defendable primary list of species, realizing that many of the showy, dramatic, and peripheral species would be omitted. Because of this, we also developed a secondary list of endangered and threatened peripheral species. Developing different lists with the possibility of various levels of concern dictates different laws to govern each category, an aspect that will be discussed in a later paper.

---

[1]Professor of Biology, University of North Carolina, Charlotte, N. C. 28223.

Finally, we tried not to become involved in the futile exercise of perserving names. As Core (1955) so aptly said it, "Diversity is not merely subjective or superficial. It is the result of fundamental discontinuity of genetic systems." We wanted to recognize the diversity in the North Carolina flora as realistically as possible. Our basic reference was the Manual of the Vascular Flora of the Carolinas (Radford et al, 1968), and our nomenclature, for the most part, follows their interpretation. We included 91 species in the primary list. Some of these are hybrids, and some have infraspecific designations. Chance hybrids were not included, but species of well documented ancient hybrid origin, such as Wright's cliff-break fern (Pellaea X wrightiana Hooker) and the Tennessee bladder fern (Cystopteris X tennesseensis Shaver) were included because they represent distinct species of no less concern than those derived by other mechanisms. Spontaneous hybrids, even though given a binomial name such as Habenaria X andrewsii White ex Nile or Lysimachia X radfordii Ahles, however rare, were not included, especially since the parental gene pools are known.

In the infraspecific category, we wanted to recognize any gene pool designated as a subspecies or variety which fit our criteria for species included on the list, i.e. Mountain paper birch (Betula papyrifera var. cordifolia (Regel) Fernald). The degree of taxonomic discontinuity is not as important as genetic discontinuity. Whether we, as taxonomists, call something a species, subspecies or variety is insignificant if we are concerned with preserving unique genotypes.

We accepted the Smithsonian definition of endangered and threatened as a working model, with some modifications: Endangered: An endangered species is one whose survival in North Carolina is known to be in serious jeopardy. Its peril may result from destruction or drastic modification of its specific habitat, over-exploitation by man, disease, predation, or specific competition due to natural succession. An endangered species must receive protection, or extinction in North Carolina probably will follow. Threatened: A threatened species is one that may likely become endangered if its habitat is not maintained, or if it is greatly exploited by man. These are often quite rare in North Carolina and should be monitored continuously. They must receive protection within the state.

Defining the term rare is quite difficult, because rareness involves two variables, first the overall distribution and second the relative density or frequency of individual plants within that distribution. The limits of both variables are entirely subjective. A species, i.e., Bladen buttercup (Ranunculus subcordatus E. O. Beal), may be rare because it is represented by very few individual plants and is restricted to a limited geographical area. Another, the Lewis' heart leaf (Hexastylis lewisii (Fernald) Blomquist & Oosting) may be rare because it occurs over a fairly broad range but is in very low density, while another, the Oconee bells (Shortia galacifolia T. & G.), may be rare because of a very limited total distribution within which it is locally abundant. Characterizing species as being rare depends on the interpretation of these variables. Additionally in North Carolina, we found that species are rare because they may be long range disjuncts or endemics, or they may be at the periphery of their range.

A long range disjunct is a rare segment of a species population which is significantly separated from the main area of distribution. Wright's cliff-break (P. X wrightiana Hooker) is now reported from two sites in the North Carolina Piedmont, but is nearly 1,000 miles east of its normal range in the southwestern United States.

An endemic is a species which has its native area totally confined to a small area of North Carolina, and possibly adjacent neighboring states. For a strict North Carolina endemic, Mountain golden heather (Hudsonia montana Nuttall) can be cited; for an endemic extending into a neighboring state, the Venus' fly-trap (Dionaea muscipula Ellis), occurring in three counties of South Carolina, is an example.

An extinct species is one which was endemic in earlier times but is no longer found. The Bigleaf scurfpea (Psoralia macrophylla Rowlee ex Small) was collected only once in 1897 in Polk County. An extirpated species is a disjunct or peripheral species which is no longer found in North Carolina but still occurs elsewhere. Sweet gale (Gale palustris (Lam.) Chev.), a disjunct from Pennsylvania northward, did occur in Henderson County.

Peripheral species may be fairly common north, west and south, but rare at the terminus of their distribution in North Carolina. These native, peripheral species represent an integral part of the North Carolina flora. Their elimination here may represent a significant reduction in the gene pool of that species. The Palmetto palm (Sabal palmetto Lodd. ex Schultes) provides a good example of this. In fact, we have included 319 species in the secondary list of endangered and threatened peripheral species.

Exploitation is also a threat to some species. Ginseng (Panax quinquefolium L.), Goldenseal (Hydrastis canadensis L.) and Venus' fly-trap (D. muscipula Ellis) all face the problem of over-zealous collecting. Often, labelling a species as rare hastens its destruction as enthusiasts rush to "protect" it by transplanting into gardens. Management, to permit survival in nature, does not always mean leaving it alone. The necessity for periodic burning to maintain the population competitiveness of pitcher plants (Sarracenia sp.) is a prime example.

Combining the reasons for rareness with the concepts of endangered and threatened permits eight categories. Value judgments must then be made as to the proper category for each species. Table 1 shows a portion of the designations of the 91 species of primary concern. It should be pointed out that the category of a particular species can change as additional information becomes available. Note that exploited species carry double designations. If an extinct or extirpated species is ever found, it will automatically be transferred to the endangered category.

As noted above, the primary list contains 91 species (2.7% of the vascular flora) and the secondary peripheral list, 319, for a total of 410 rare species of native vascular plants in North Carolina. This total represents 12% of the total vascular flora. These lists are different from those compiled by the Smithsonian Institution in 1974, the North Carolina

Table 1. -- Categories of extinct, endangered, threatened and exploited vascular plants

| | | Extinct | End. endemic | End. throughout | End. disjunct | Thr. endemic | Thr. throughout | Thr. disjunct | Exploited |
|---|---|---|---|---|---|---|---|---|---|
| Carex biltmoreana | Biltmore sedge | | | X | | | | | |
| Cladrastus lutea | Yellowood | | | | | | X | | X |
| Dionaea muscipula | Venus' fly-trap | | | | | X | | | X |
| Eriocaulon lineare | Linear pipewort | | | | | | | X | |
| Gale palustris | Sweet gale | X | | | | | | | |
| Geum radiatum | Spreading avens | | X | | | | | | |
| Sedum rosea | Roseroot | | | | X | | | | |

Department of Natural and Economic Resources in 1973, and the North Carolina Garden Clubs and North Carolina Wild Flower Preservation Society. We are not saying that these lists are wrong or that these species are the only ones worthy of preservation. We need to be concerned with the preservation of all 3,400 species of vascular plants in the state. The list is incomplete, but will be updated with additions, deletions, changes of status, and additional county distributions.

N.C. Endangered and Threatened Plant Committee:

J. W. Hardin, Chm., N.C. State Univ.
R. L. Kologiski, N.C. State Univ.
J. R. Massey, UNC-Chapel Hill
J. F. Matthews, UNC-Charlotte
J. D. Pittillo, Western Carolina Univ.
A. E. Radford, UNC-Chapel Hill

LITERATURE CITED

Core, E. L. 1955. Plant Taxonomy. 459p. Prentice-Hall, Englewood Cliffs, NJ.

Department of Interior Fish and Wildlife Service. 1975. Threatened or endangered fauna or flora. Federal Register Vol. 40, No. 127. Government Printing Office, Washington, DC.

North Carolina Department of Natural and Economic Resources. 1973. Preliminary list of endangered plant and animal species in North Carolina. Raleigh, NC.

Radford, A. E. et al. 1968. Manual of the vascular flora of the Carolinas. 1183 p. Univ. of North Carolina Press, Chapel Hill, NC.

Smithsonian Institution. 1974. Report on endangered and threatened plant species of the United States. 94th Congress, House Document No. 94-51. Government Printing Office, Washington, DC.

# DEFINITION AND CLASSIFICATION OF ENDANGERED AND THREATENED PLANT SPECIES

Thomas M. Pullen 1/

Abstract.--Suggestions are proposed for dealing with the ambiguities which exist in definitions of terms used to describe the relative abundance of plant species.

Additional keywords: Rare plants.

During the last few years scientists, government officials and agencies, and informed citizens have become more and more concerned about the increasing rate of extinctions among extant species of plants. This has focused attention on the necessity for taking inventory and evaluating the status of those species which still remain, and to develop workable conservation plans for those found to be endangered.

Many efforts toward this end have been launched in recent years. Some have been at the state level, others on a regional basis, and as a result of the passage by Congress of the Endangered Species Act of 1973, Public Law 93-205, at the national level. One of the difficulties encountered in such efforts has been, and still is, adequate definition of what constitutes a rare and/or endangered species. The major purpose of this paper is to have a look at this problem.

## DISCUSSION

We find the literature replete with terms describing the relative abundance or the status of plant species. Among those most frequently encountered are common, uncommon, rare, sporadic, threatened, endangered, and extinct. There is little disagreement as to the meaning of the term extinct. When repeated searches of sites where a plant once grew and of nearby similar habitats fails to uncover the plant, there can be little disagreement that the plant no longer exists. On the other hand, definitions of the other and similar terms are very inexact. A species that is considered common in North Carolina might be rated as rare in Mississippi. Most botanists usually consider a species rare when the plants exist in small numbers or when they are few and widely separated. This situations exists either because there have never been many of these plants on the earth or they have reached their present status due to depredations of man or other animals or disease. In any case rare plants, by their very nature should be considered threatened or endangered.

The author suggests the adoption of the definitions set forth in the Endangered Species Act of 1973 for those species we are most concerned about. Therein we find the two terms "endangered" and "threatened." Endangered species are defined as "those in danger of extinction throughout all or a significant portion of their ranges." Threatened species "are those which are likely to become endan-

---

1/ Professor of Biology and Curator of the Herbarium, University of Mississippi, University, Mississippi 38677.

gered within the foreseeable future throughout all or a significant portion of their ranges." The law establishes the following criteria for determining whether a species should be listed as an endangered species:

1. "The present or threatened destruction, modification, or curtailment of its habitat or range;

2. Overutilization for commercial, sporting, scientific or educational purposes;

3. Disease or predation;

4. The inadequacy of existing regulatory mechanisms; or

5. Other natural or man-made factors affecting its continued existence."

We are all familiar with the list of endangered, threatened, or extinct plant species of the United States prepared by the Smithsonian Institution as a result of the passage of the Endangered Species Act. We are also grateful for the tremendous effort that went into this undertaking. There can be no doubt of the value of such a national effort but the author believes that state and local lists are also very important. Locally imperiled species should be preserved even though they may be abundant elsewhere.

# A REVIEW OF THE ENDANGERED SPECIES ACT OF 1973

James D. Williams and Gail S. Baker

OFFICE OF ENDANGERED SPECIES AND INTERNATIONAL ACTIVITIES

U.S. FISH AND WILDLIFE SERVICE

WASHINGTON, D.C.

The Endangered Species Act of 1973 is the strongest legislation ever enacted to protect Endangered and Threatened plants and animals. The Act gives the Department of Commerce and the Interior regulatory and statutory authority on Endangered and Threatened fauna and flora. The 1973 Act provides for two categories of species listing, Endangered and Threatened, as opposed to one category, Endangered, in the 1969 Act. Also new are provisions for State cooperation and participation in the program through cooperative agreements, grants-in-aid funding, and other incentives. The 1973 Act calls for participation where appropriate by all Federal Agencies and directs that no Federal funds can be utilized for an activity that would be detrimental to an Endangered or Threatened species.

This presentation is based on a reveiw of the Endangered Species Act prepared by the staff biologists of the Office of Endangered Species and International Activities. The Endangered Species Act of 1973 (hereinafter referred to as the Act) was passed by the 93rd Congress and signed into law by the President of the United States on December 28, 1973. The Act is the strongest legislation ever enacted to preserve, and protect Endangered and Threatened animals and plants. The Act expands upon previous acts on Endangered species, the most recent being the Endangered Species Conservation Act of 1969. The 1973 Act provides for two categories of species listing, Endangered and Threatened, as opposed to one previous category of endangered in the 1969 Act. It allows for listing on a population basis for animals of any group. Also new are provisions for State cooperation and participation in the program through cooperative agreements, grants-in-aid funding, and other incentives. The new Act calls for participation where appropriate by all Federal agencies and directs that no Federal funds can be utilized for an activity that would be detrimental to an Endangered species.

The Endangered Species Act of 1973 is a very complex piece of legislation and has frequently led to confusion and various erroneous interpretations. The following is a brief review of the Act section by section to point out some of the more important features of the Act. The following paper by Baker and MacBryde explains the provisions of the Act for plants.

Section 2. Findings, Purposes, and Policy

Section 2 presents the reasons for the Act. Because of man's activities, species of wildlife have become extinct and other species are presently

faced with the threat of extinction. Recognized are the educational, scientific, recreational, historical and esthetic values of endangered and threatened species. The need for protection of Endangered species and Threatened species is a world-wide problem and has been recognized by international treaties and conventions. The Act provides a tool to implement international commitments. The States and other interested parties are an integral part of the program to meet both national and international needs for protection of wildlife. Through Federal financial assistance and other incentives State participation is to be encouraged.

The purposes of the Act are to conserve the ecosystems upon which Endangered and Threatened species depend, and provide a program for the conservation of such species. The Act also insures that the U.S. lives up to the international treaties and conventions on conservation to which it is a party. Finally, Congress declared that it was their policy that all Federal departments and agencies should seek to conserve Endangered and Threatened species and should utilize their authorities in furtherance of the purpose of the Act.

Section 3. Definitions

There are 16 terms which are defined for the purposes of the Act. Selected definitions of terms whose meanings are important keys to interpretation of certain sections of the Act are as follows:

(2) The terms "conserve," "conserving," and "conservation" mean to use and the use of all methods and procedures which are necessary to bring and Endangered species or Threatened species to the point at which the measure provided pursuant to this Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking. To most wildlife managers, the term conserve as used in the Act means management.

(4) The term "Endangered species" means any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present overwhelming and overriding risk to man.

(5) The term "fish and wildlife" means any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof.

(9) The term "plant" means any member of the plant kingdom, including seeds, root, and other parts thereof.

(11) The term "species" includes any subspecies of fish or wildlife or plants and any other group of fish or wildlife of the same species or smaller taxa in common spatial arrangement that interbreed when mature.

(14) The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

(15) The term "Threatened species" means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Section 4. Determination of Endangered and Threatened Species

Section 4 provides for the determination of Endangered and Threatened species. The determination of a species as "Endangered" or "Threatened" is based upon one or more of the following factors:

(1) The present or threatened destruction, modification, or curtailment of its habitat or range;
(2) Overutilization for commercial, sporting, scientific, or educational purposes;
(3) Disease or predation;
(4) The inadequacy of existing regulatory mechanisms; or
(5) Other natural or man-made factors affecting its continued existence.

The Secretary of Commerce bears the prime responsibility for the determination of Endangered or Threatened marine species. The Secretary of the Interior has the responsibility for all other species, plus the actual determination process for all species. The procedures involved are detailed in the flow chart in Figure 1.

When species are determined to be Threatened, regulations that are necessary for protection and management may be issued by the Secretary. However, it may not be necessary to issue any regulations for some species. The Secretary can issue regulations that prohibit any act that is promulgated under Section 9 of the Act. An exception to this is when a State has entered into a cooperative agreement, than only those regulations which have been adopted by the State for taking threatened resident species of wildlife shall apply.

When a species is similar in appearance to an Endangered or Threatened species, regulations can be issued for this species to insure protection of the Endangered or Threatened species. The reasons for this are to avoid difficulties of identification by law enforcement personnel, prevent additional threats to Endangered or Threatened species and further the intent of the Act.

All regulations by the Secretary will be published in the Federal Register after consultation with appropriate State and Federal agencies and interested persons and organizations.

FIGURE 1 GENERAL PROCEDURES FOR MODIFYING LISTS OF THREATENED OR ENDANGERED SPECIES

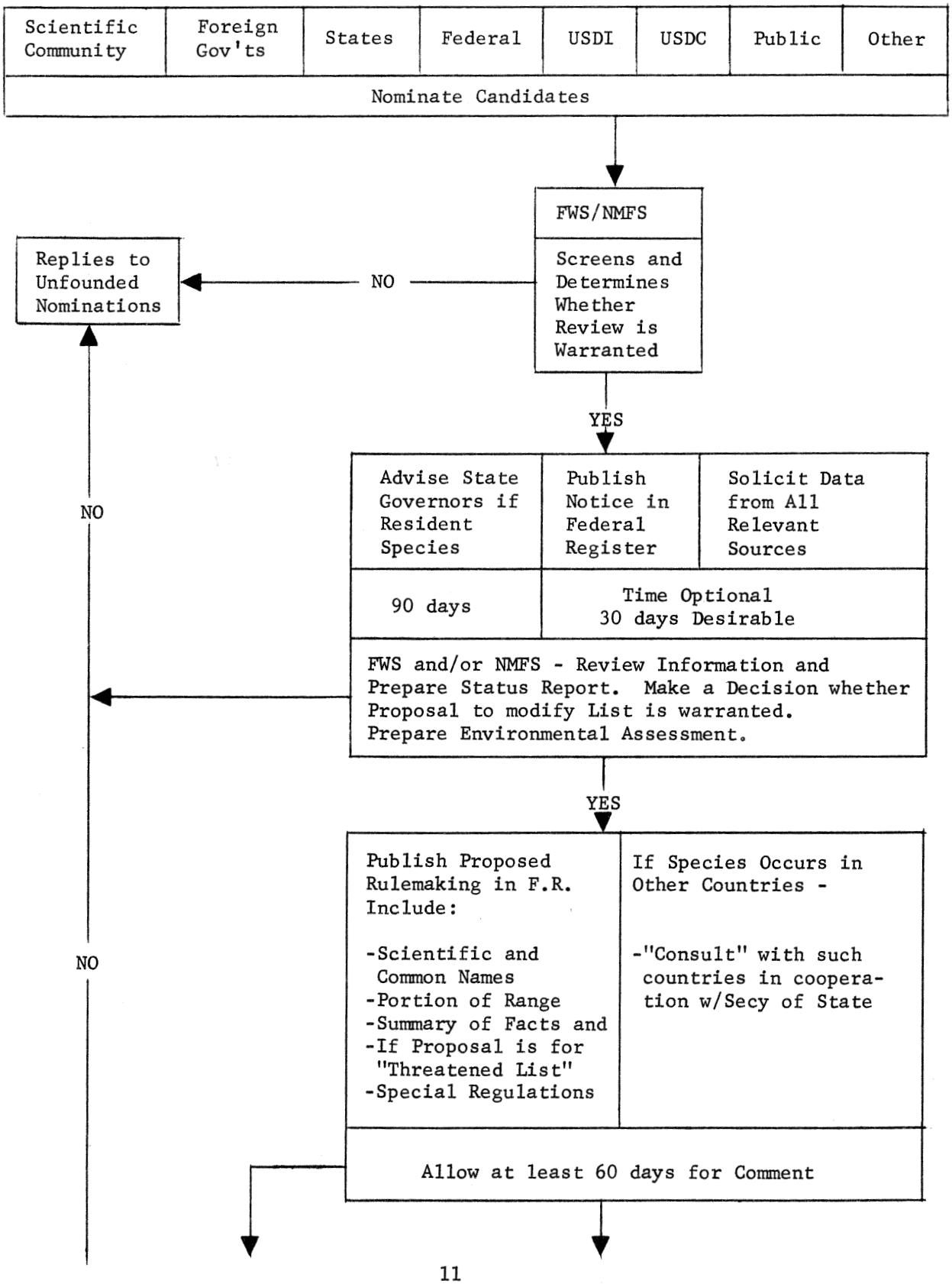
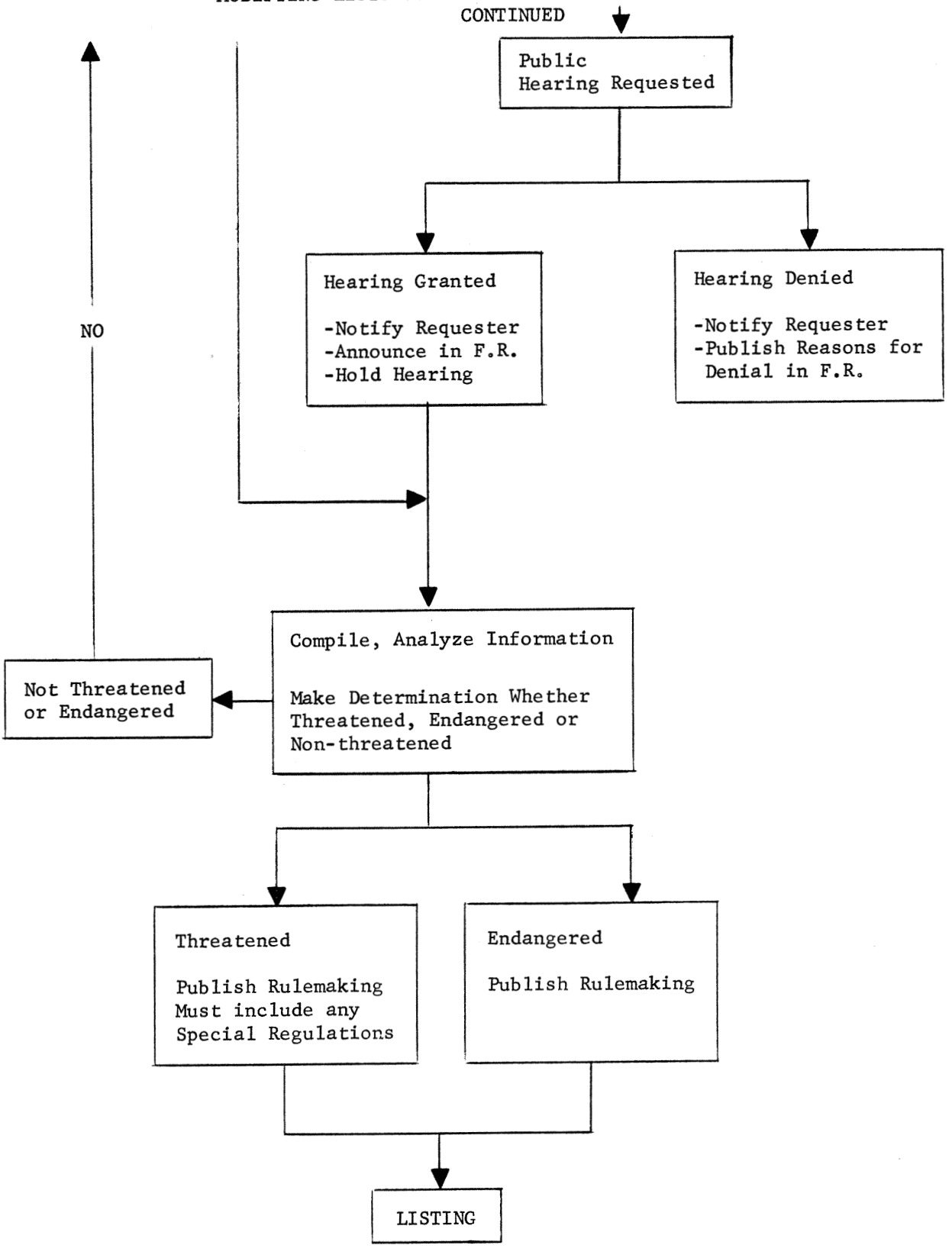


FIGURE 1 GENERAL PROCEDURES FOR MODIFYING LISTS OF THREATENED OR ENDANGERED SPECIES CONTINUED



At the present time (April 1976) the official list contains a total of 427 Endangered species and 11 Threatened species of both foreign and domestic origins. Of the 427 species, 147 are Endangered or Threatened species found in the U.S. and its territories. The present U.S. lists of Endangered and Threatened species includes 33 mammals, 66 birds, 8 reptiles 4 amphibians, 34 fishes, and 2 insects. The list does not include all of the species found in the U.S. Fish and Wildlife 1973 Red Book. It is anticipated that the restructuring of the list should occur within the next year. There are no plants on the list at this time.

Section 5. Land Acquisition

This section authorizes acquisition of land and water habitat for Endangered and Threatened species using Land and Water Conservation funds. This provision was also present in the 1966 and 1969 Acts. To date more than 40,000 acres of habitat for 11 Endangered species has been acquired at the cost of approximately 13 million dollars.

Section 6. Cooperation with States

This section of the Act recognizes the need for close cooperation with the States and provides for management agreements and cooperative agreements to assist the States with their programs. Management agreements between States and the Fish and Wildlife Service provide for administration and management of areas established for the conservation of Endangered species or Threatened species. In cases where conflicts arise between State and Federal laws or regulations, the more restrictive laws or regulations shall apply.

Cooperative agreements, among other things, provide for Federal assistance to the States for implementation of State Endangered and Threatened species programs. For a State to be eligible for a cooperative agreement with the Fish and Wildlife Service, the State agency must have:

(1) Authority to conserve species that have been determined by the State or the Fish and Wildlife Service to be Endangered or Threatened. This authority should be broad enough to cover additional species that may be listed in the future.
(2) Acceptable conservation programs for all resident fish or wildlife species in the State that has been determined to be Endangered or Threatened by the U.S. Fish and Wildlife Service.
(3) Authority to conduct investigations.
(4) Authority to acquire land or aquatic habitats for conservation of resident Endangered and Threatened species.
(5) Provisions for public participation in designating resident Endangered species or Threatened species.

Cooperative agreements provide for 1) the actions that are to be taken by the Secretary and the States, 2) the benefits that are expected to be derived by the cooperative program, 3) the estimated cost of the actions, and 4) the share of the costs by the Federal Government and the States. The Federal share shall not exceed two-thirds of the estimated program costs; however, this share can be increased to 75% for species shared by two or more States.

Review of the State's programs must be made at least annually to assure that their programs are effective and that legal authorities are still appropriate.

Section 7. Interagency Cooperation

Section 7 charges the Secretary to review all Department of Interior programs and to use these programs for furtherance of the Act. All other Federal agencies in consultation with the Secretary and his assistants, are to utilize their authorities in furtherance of the Act by carrying out programs for the conservation of Endangered and Threatened species. These agencies are also to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of these species or result in the destruction or adverse modification of habitat that is determined to be critical for them by the Secretary after consultation with the affected States.

Section 8. International Cooperation

This section provides for international programs for Endangered animal and plant species. Among other items, this section provides the mechanics for financial assistance, encouragement of foreign programs, personnel, investigations, and implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Section 9. Prohibited Acts

Two important prohibitions under the Act make it unlawful for any person subject to the jurisdiction of the United States to take any Endangered fish or wildlife species within the United States or the United States Territorial Sea (take means harass, harm, pursue, hunt, shoot, kill, trap, capture, or collect, or attempt to engage in any such activity), and to violate any of the regulations that may be promulgated by the U.S. Fish and Wildlife Service for Threatened fish or wildlife species. It is also unlawful for any person to violate regulations promulgated by the Secretary on Threatened plant species. The Act does not prohibit the "taking" of Endangered or Threatened plant species.

Section 9 also deals with Endangered and/or Threatened species held in captivity, with violations of the Convention, and with import/export only via official ports designated.

Section 10. Permits

Permits may be issued by the Fish and Wildlife Service that would allow certain actions that are prohibited under the Act (e.g., taking of Endangered and Threatened species of fish and wildlife). These permits are issued for scientific purposes or for propagation or survival programs that would enhance the species. An application for a permit must be filed with the U.S. Fish and Wildlife Service which then reviews and publishes the application in the Federal Register for a 30-day period. If no valid, adverse biological comments are received, the permit is then issued to the individual that will be conducting the programs or activities.

Section 11. Penalties and Enforcement

Section 11 expresses the civil penalties that can be assessed by the Secretary on persons who violate the Act. It also covers criminal violations, rewards, district court jurisdiction, and enforcement. It also provides for citizen suits that can enjoin any person, including governmental agencies or instrumentality who is alleged to be in violation of the Act.

Section 12. Smithsonian Institution Report on Plants

Through this section, the Secretary of the Smithsonian Insitution, in conjunction with affected agencies, was directed to review plant species and develop a recommended list and recommendations for conservation of Endangered and Threatened plant species within one year. This information was presented in a report to the Congress in December 1974.

Section 13. Conforming Amendments

This section amends other acts to be consistent with the Endangered Species Act of 1973.

Section 14. Repeal

This section repeals the Endangered Species Conservation Act of 1969.

Section 15. Funding

This section authorizes funding for the Departments of Interior and Commerce to carry out their responsibilities under the Act.

Section 16. Date

This section provides for the effective date of the Act--December 28, 1974.

Section 17. Relationship to Man's Mammal Protection Act

This section states that except as otherwise provided for in the Act, no provision of the Act will take prededence over any more restrictive, conflicting provisions of the Marine Mammal Protection Act of 1973.

This has been a very brief review of the Endangered Species Act of 1973. For additional information, a copy of the Act, various Federal Register documents listing species and critical habitat and general information on Endangered and Threatened species, please contact the Office of Endangered Species, U.S. Fish and Wildlife Service, Washington, D.C. 20240

# THE ENDANGERED AND THREATENED PLANT PROGRAM OF THE U.S. FISH AND WILDLIFE SERVICE

Gail S. Baker and Bruce MacBryde

OFFICE OF ENDANGERED SPECIES AND INTERNATIONAL ACTIVITIES

U.S. FISH AND WILDLIFE SERVICE

WASHINGTON, D.C.

The Endangered Species Act of 1973 differs from the 1966 and 1969 Acts by including plants. The Smithsonian Institution prepared a list of 3,187 candidate Endangered and Threatened plant taxa as required by the Act. The U.S. Fish and Wildlife Service accepted this list as a petition in the Federal Register on July 1, 1975. The 45 foreign plant taxa on Appendix I of the Convention Fauna and Flora were published in the Federal Register on September 26, 1975. A major difference between the treatment for plants and animals in the Act is that the "taking" of plants is not regulated, although interstate and international commerce are.

The previous paper by Williams discusses the Endangered Species Act of 1973 (Public Law 93-205) in general terms; this paper explains the provisions of this Act for plants.

Previous Endangered Species legislation (1966 and 1969) did not include plants. In Section 3 of the 1973 Act the term "plants" is defined as "any member of the plant kingdom, including seeds, roots and other parts thereof." Section 2(a)(4) of this Act specifies that the U.S. has pledged itself to conserve the 20,000 plants now listed in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Section 12 of the 1973 Act directs the Smithsonian Institution to review species of plants which are or may become endangered or threatened and to report to Congress within one year.

There are several major differences in how plants and animals are dealt with in the Endangered Species Act of 1973.

In Section 3, the term "species" is defined as including "any subspecies of fish or wildlife or plants, and any other group of fish or wildlife of the same species or smaller taxa in common spatial arrangement that interbreed when mature." Hence, population segments of animals are included in the Act, whereas population segments of plants are not included.

Section 5 states that land can be purchased for the conservation of Endangered and Threatened wildlife, fish or plants with funds made avail-

able pursuant to the amended Land and Water Conservation Fund Act of 1965. For plants there is the added restriction that they must be included in the Appendices to the Convention on International Trade in Endangered Species of Wild Fauna and Flora. This international convention has been ratified by the United States and over twenty other countries, and came into force on July 1, 1975.

The purpose of the Convention is to reduce the impact of international trade on plants and animals for which this activity is or may become a threat to their survival. These organisms are listed, depending on the degree of endangerment, on the three appendices of the Convention. Appendix I, the most seriously jeopardized group of animals and plants, includes only foreign plant taxa, but Appendix II includes the entire orchid and cactus families, both of which have many rare taxa in the United States. Appendix II also includes ginseng (Panax quiquefolius) which is native to North America. Appendix III of the Convention includes no plants as yet, but the United States, as a party to the Convention, can unilaterally add plant species to this Appendix to prevent commercial exploitation.

Section 6 deals with cooperative agreements with States and provisions for financial aid from the Federal government to carry out these cooperative programs. Before a State can enter into a cooperative agreement, it must show that a State agency exists which has the authority to establish programs, including the acquisition of land, for the conservation of resident Endangered and Threatened species. There is some question as the whether Section 6 applies to plants. The Fish and Wildlife Service is seeking authority to permit States to enter into cooperative agreements for whatever Endangered and Threatened species they have authority to conserve. A decision on this matter will be reached shortly.

Section 7 deals with interagency cooperation, and directs all Federal agencies to maintain programs for the conservation of Endangered and Threatened species. It also directs them to insure that actions authorized, funded or carried out by them do not jeopardize the existence of such species or modify Critical Habitat of such species. Section 7 is a major strength of the Act with respect to plants.

Perhaps the most important difference between plants and animals in the Act is that the "taking" of Endangered animals is prohibited, whereas the taking of Endangered plants is not. Section 9 spells out the prohibitions for plants. It will be unlawful to:

(1) import or export such plants to or from the United States;
(2) transport such plants in interstate or foreign commerce; and
(3) sell such plants in interstate or foreign commerce.

Section 9 does not prohibit or regulate;

(1) the intrastate sale of such a plant; and
(2) interstate movement of such plants unless it involves commercial activities which include a change in ownership.

Section 10 provides for exceptions to these prohibitions. Permits will be issued by the U.S. Fish and Wildlife Service, as they are for Endangered and Threatened animals, to carry out prohibited acts for scientific purposes or to enhance the propagation or survival of the affected species.

Section 12, as mentioned earlier, directed the Secretary of the Smithsonian Institution to conduct the initial reveiw of possible Endangered and Threatened plants, and to recommend methods of adequately conserving such species. The Smithsonian Institution was given one year to complete this task, and their "Report on Endangered and Threatened Plant Species of the United States" (House Document 94-51) was presented to Congress on January 9, 1975. This report contains the names of over 3000 plant taxa which are perhaps extinct, or possible endangered or threatened. Over 1000 of these are endemic to Hawaii. Other States with very large numbers of plants included in the report are California, Texas, and Florida.

The Endangered Flora Project within the Department of Botany at the Smithsonian Institution was responsible for preparing the report. Their lists were prepared by reviewing floras, taxonomic monographs and revisions. Also, taxonomic specialists were consulted and some collections were checked in herbaria. State lists of rare and endangered plants were also used as reference material. (The report is not a compilation of State lists, however, since a plant may be extirpated, rare or endangered in one State, but very common in another.) In September 1974, a workshop was held under the joint sponsorship of the Smithsonian Institution and the Office of Endangered Species and International Activities of the U.S. Fish and Wildlife Service. The participants included botanists from Federal agencies, universities and botanical gardens. They reviewed the plants on a preliminary list and refined it; much unpublished data and new distributional information was used during the workshop. Since the Smithsonian Institution report lists plants found basically in the 50 States, species occurring outside the U.S. as well were not included unless their exact endangerment status outside the country was known. Only vascular plants are covered by the Act. (DeFilipps (1976) presented a history of the compilation of the report.)

The Endangered Flora Project at the Smithsonian Institution has continued its work. The lists of plants in the original report have been revised on the basis of comments received both by the Smithsonian and the Fish and Wildlife Service. The revised lists will be published in May or June of 1976. In addition, the Endangered Flora Project personnel are preparing computerized distribution maps of the localities of the exploited plants listed in the report, and computerized information sheets for the plants included in their revised lists. They are also preparing a series of Red Data Book entries of U.S. plants for the I.U.C.N. Red Data Book on Angiosperms. This series includes representatives of different geographical regions, diverse plant families and various kinds of threats.

The U.S. Fish and Wildlife Service regards the Smithsonian Institution's report to be a "petition" as provided for in Section 4(c)(2) of the Act. On July 1, 1975, the Smithsonian Institution's list (plus a few additions and

corrections) was published as a "Notice of Review" in the Federal Register. By publication of this list the Service formally initiated a review of the status of these plants pursuant to the Endangered Species Act of 1973.

Previously, on April 21, 1975, a "Notice of Review" for four plants was published in response to a petition from a group of Wisconsin citizens. Subsequent to the publication of both Notices, the governors of all States and U.S. Territories involved were informed and their comments were solicited. Copies of the July 1 Notice were also sent to many other U.S. government agencies and botanists throughout the country. The 45 foreign plant taxa on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora were published in the Federal Register as a proposed rulemaking on September 26, 1975.

As of May 1976, therefore, over 3200 plants are in the process of being considered for determination as Endangered or Threatened. In the near future, the Fish and Wildlife Service is planning to propose:

(1) regulations that would implement the Act with regard to plants and
(2) a determination that about 1700 plants form the Smithsonian revised report are Endangered pursuant to the Endangered Species Act of 1973.

Both the proposed regulations and the proposed list of Endangered plants will probably be published in the Federal Register by the summer of 1976. A minimum 60-day comment period will follow both proposed rulemakings.

Also, a final rulemaking that determines which of those plants on Appendix I of the Convention are to be classified as Endangered on the U.S. list will probably be published in the summer of 1976.

Obviously, the Endangered Species Act of 1973 offers many possibilities for plant conservation. The help of professionals, such as the participants in this conference, is essential for responding wisely and effectively to the Act. Any data on plants, will be welcomes by the Office of Endangered Species. Details on distribution, threats to survival, propagation techniques and recent taxonomic studies are some of the kinds of information which can help the U.S. Fish and Wildlife Service implement the Endangered Species Act of 1973 on behalf of our plant heritage.

## LITERATURE CITED

DeFilipps, R.A. 1976. How proposed lists of threatened and endangered plant species were prepared. In: Symposium on Threatened and Endangered Plants, Society for Range Management and Society of American Foresters, New Mexico Sections, Alburguerque(in preparation).

Public Law 93-205(1973). Endangered Species Act of 1973. 87 Statute 884-903. 93rd Congree, S. 1983, 21pp.

# FEDERAL AND STATE PROGRAMS ON ENDANGERED PLANTS

Frank B. Barick [1/]

Abstract. - Discusses current status of Federal and State laws and programs related to preservation of endangered plants in North Carolina, as well as statutory needs to provide for implementation in North Carolina.

Keywords: Endangered plants, North Carolina, endangered species act, North Carolina Wildlife Resources Commission.

In discussing the subject assigned to me - Federal and State Programs on Endangered Plants - I would like to first briefly review those aspects of the Federal Endangered Species Act relating to plants and recent developments at the federal level in this area. Second, I will discuss the present status of North Carolina laws relating to endangered plants. Third, I will discuss the endangered species program of the North Carolina Wildlife Resources Commission. And fourth, I will briefly discuss future needs for implementing this program.

The Federal Endangered Species Act was passed on December 28, 1973. This was about 2 1/2 years ago. Although the act provided for funding of cooperative programs with the states, no moneys have as yet been released for this purpose. We have received word, however, that such funds will be forthcoming after July 1 of this year.

The general purposes of the Act are succinctly expressed in its introduction and are well worth repeating at this time to help us focus on our mission. The "findings" upon which the Act is based are as follows:

1) Various species of fish, wildlife and plants in the United States have been rendered extinct as a result of economic growth and development untempered by adequate concern and conservation.

2) Other species have been so depleted in numbers as to be faced with extinction.

3) These species are of aesthetic, ecological, educational, historical, recreational and scientific value to the Nation and its people.

As a result of these findings, the United States has pledged itself to conserve to the extent practicable the various species of fish, wildlife and plants faced with extinction.

The Act states that the Federal government shall encourage the states and other interested parties to develop conservation programs designed to conserve endangered species through a system of incentives, i.e. financial support, provided programs so designed meet federal standards.

---

[1/] Chief, Interagency Wildlife Coordination Section, North Carolina Wildlife Resources Commission.

It also established the policy that all federal agencies will seek to conserve endangered species and utilize their authorities in furtherance of this act.

The Act provided for the establishment of cooperative agreements with individual states that would fund specific work projects on a 66 2/3- 33 1/3 percent matching basis and required that such work be in accordance with prior-approved work plans. In order to qualify for participation states are required to demonstrate that:

1) The designated state agency has the authority to conserve endangered species.

2) That the designated state agency has an acceptable program of endangered species preservation.

3) That the agency is authorized to conduct investigations to determine the status and needs of endangered species.

4) That the agency is authorized to acquire land and water habitats and manage same.

5) That the agency will provide for public participation in designating endangered species.

Passage of the Federal Act came after several years of investigation and reporting by fish and wildlife biologists and it was only natural that major responsibility for implementation was assigned to the U. S. Fish and Wildlife Service in the Department of the Interior. Because of this early work there was a considerable body of information at hand on the status of faunal species at the time the Act was passed. As a result, it was possible for the Secretary of the Interior to issue an official list of endangered animal species about the same time as the Act was passed. No such list of plants was available, however, and so the Smithsonian Institute was instructed to compile a preliminary list. This was published last year and a proposed official list is scheduled to be published in the Federal Register later this year. We are advised that this list will contain about 1700 species, about half of which are confined to Hawaii and that about 16 occur in North Carolina as endangered and about 48 as threatened. After a 60-day public comment period the Secretary of the Interior will establish an official federal list of endangered plants. He was given authority for such action by an executive order issued in April of 1976 - just last month.

The Act establishes that a species of plant or animal on the Federal list is officially designated as endangered in any state where it occurs but that the state may indicate where in the state it has that status. Also, additional species may be designated as endangered or threatened by the state agency having jurisdiction over endangered species.

Designation of plants as endangered species and establishing regulations for their protection involves legal complications beyond those that surround animals. Since animals can move across property lines, they are owned by the people in severalty, i.e., all of the people of the state. But plants are affixed to the land and so they are legally part of the real estate. Thus,

regulations regarding the preservation of plants could come into conflict with constitutional and legal property rights. For this reason, some landowners are seriously concerned about the enactment of laws relating to endangered species preservation.

Because of this circumstance, that part of the U. S. Fish and Wildlife Service endangered species program related to cooperative funding of state programs is currently restricted to animal species. It is also restricted to inland water and terrestrial forms, i.e. excludes marine forms. Presumably, provision will be made in the near future to include work on plants and marine forms.

At the present time about a dozen states have completed negotiation of cooperative agreements with the U. S. Fish and Wildlife Service and we in North Carolina are now in the process. Certification that the North Carolina Wildlife Resources Commission has the required authorities has been developed with the cooperation of the State's Attorney General and submitted to Washington. Upon receipt of approval of this documentation, we shall proceed with development of a cooperative agreement and detailed work plan and budget.

So much for the status of Federal laws and programs on endangered species. Let us now turn our attention to North Carolina state laws.

To the best of our knowledge, there is only one law on our books that is specifically designed to protect an endangered plant species. This is Section 129.1 of Chapter 14 of the General Statutes which prohibits the sale or barter of venus flytrap and assigns responsibility for enforcement to the Department of Conservation and Development. Section 129 of Chapter 14 prohibits the taking of wild plants from the land of another without permission but does not assign enforcement authority to any agency and 22 counties are exempt from its provisions. This section includes venus flytrap, trailing arbutus, hemlock and 39 other species and groups of species (such as azaleas or coniferous trees).

Laws which give the Wildlife Resources Commission jurisdiction over endangered species make only tangential reference to plants. Thus, before the Commission can become actively engaged in enactment of protective regulations in this area, it will have to be clothed with additional authority by the State Legislature. The North Carolina Game Law is currently under study for revision and we are hopeful that this deficiency will be remedied by the next legislature. We may be calling upon some of you for assistance in this effort at that time and we would hope that you will respond in a positive way.

In this connection it may be appropriate to raise the question as to why the Wildlife Commission, rather than some other state agency, should have this authority. This question was considered during the course of the 1975 Legislature in conjunction with the attempted passage of the "Model State Endangered Species Act" developed by the U. S. Fish and Wildlife Service. At that time it was agreed by various state agencies and members of the Legislature that the Wildlife Resources Commission was the appropriate agency for administration of endangered species conservation for the following reasons:

1) Wild plants constitute part of the habitat and total ecology of wild animals, over which the Commission already has jurisdiction.

2) The Wildlife Commission already has a staff of professional biologists some of whom can specialize in plant species.

3) The Wildlife Commission has a staff of enforcement personnel who routinely patrol areas where endangered plant species grow. These officers can be trained and/or recruited to enforce endangered plant species regulations.

4) The Wildlife Commission has a long history of regulation formulation as regards wild animals and could readily adapt to formulation of regulations relating to wild plants.

5) The Wildlife Commission has had for many years an on-going cooperative program in wild fish and game management with the U. S. Fish and Wildlife Service.

6) The Wildlife Commission has the authorities required by the Federal Endangered Species Act, except that as noted above, it needs to acquire additional authority in regard to wild plants.

We now need to turn our attention for a few moments to the current endangered species program of the Wildlife Commission. Before doing so, however, we should point out that the Commission has, from its establishment in 1947, always exercised a measure of concern for non-game and endangered species. It sponsored legislation protecting hawks and owls, alligators, bobcats and panthers. It has conducted an active youth education program on all wildlife including songbirds and plants. And it has developed an extensive library of brochures and films on various aspects of natural resources conservation.

With the emergence of endangered species as a special area of concern, the Wildlife Commission established a three-phased program geared to take advantage of federal funding as it became available. Phase I, which was initiated last year, undertook development of a list of persons and agencies having interest and professional expertise in the area of endangered species. Many of you in this room responded to our questionnaire and have been entered in our register. If there are others among you who have not been contacted we would be pleased for you to see me about filling out a form outlining your area of interest. Another part of Phase I was the development of a library on endangered plants and animals. Phase I is well along toward completion but we are anxious to add to it as opportunity occurs. It was undertaken with existing staff and funds, and the special cooperation of the N. C. State Museum. We are especially grateful to Museum Director Dr. John Funderburg for his help.

Phase II, which has not yet been initiated, is waiting on federal funds. It will consist of in-depth studies of species on the endangered and threatened lists that occur in North Carolina. Its purpose will be to develop information on the status and distribution of individual species, to identify factors limiting its survival and measures required to ensure its preservation. These studies will be conducted on a contract basis by interested individuals. Perhaps some of you here today may be interested in conducting such studies or you may know of others who would be interested. We shall be pleased to receive study proposals when funds become available.

Phase III will consist of implementation of findings of Phase II. Implementation may take various forms, such as development of management programs,

acquisition of critical habitat, public information, designation of additional species as endangered or threatened, development of regulations relating to taking and/or commercialization of endangered species, and enforcement of regulations. Phase III has to some extent been inplemented, at least in regard to one species - the red-cockaded woodpecker - in that we have developed habitat management procedures for application on our Sandhills Game Lands which constitute one of the major reservoirs for this species in North Carolina.

Phase III will also entail the establishment of Advisory Committees, possibly one for endangered animals and another for endangered plants. These committees will consist of professional persons as well as representatives of landowner and other interests. Their function will be to advise the Wildlife Resources Commission in regard to official designation of endangered and threatened species and development of regulations governing human activities relating to them. They will also provide input for other management programs. There are probably several here today who could render valuable service in this manner.

The Wildlife Commission will need the active advice and support of many people and other agencies if it is to effectively meet the needs of endangered species. It currently enjoys a good working relationship with other Divisions within the Department of Natural and Economic Resources and cooperates actively with the Department of Agriculture and the N. C. State Museum as well as several Federal agencies. We need to broaden these working relationships and especially those with academic institutions, many of which are represented here today.

In conclusion, we would like to focus on three items that are urgently needed to assure the development of a strong and effective endangered species preservation program in North Carolina. We believe that those in attendance here can help attain these objectives and we actively solicit your support.

The first need is in regard to legislation. We need to amend the present wildlife law so as to fully clothe the Wildlife Commission with authority over the conservation of wild plants. This is necessary so that we can conduct a balanced program that relates to both groups of species that constitute our eco-systems.

The second need is to develop additional sources of funds to provide matching money for federal grants. At the present time, the primary source of funds available to the Wildlife Commission comes from the sale of hunting and fishing licenses. While hunters and fishermen are actively supporting endangered species conservation, excessive use of license money could constitute "diversion of funds" and raise questions in regard to proper handling of finances. The Commission will attempt to fulfill this need through sale of emblems and prints of paintings and will accept contributions to a special endangered species fund. We will be appreciative of your support in this funding effort. If you have any other ideas on how to raise the money please let us hear from you.

The third need for a successful endangered species preservation program is the development of effective communication between you the lay public and us the state agency. We are deeply appreciative of this opportunity to bring you up to date on what we have been doing in this important area. We need to continue this communication and we invite you to let us have the benefit of your thinking in the days and months ahead. We need your advice and guidance because you are the experts and we trust you will be generous with your input.

# EXPLOITATION OF ENDANGERED PLANTS AND THEIR HABITATS

by
Jerry McCollum, Biologist
Georgia Department of Natural Resources

ABSTRACT

Native plants have played an important role in the development of our nation. We no longer depend on native plants for their medicinal or food values to the extent that early Americans did. Some of our native plant species are decreasing in numbers because of various forms of exploitation. Examples are large-scale acreage conversion, commercial development, public projects, commercial collecting and private collecting. If State programs are to be effective in the protection and management of endangered species several program elements need immediate attention. Implementation of information, education, and enforcement program elements are essential. Program staff must also demonstrate to top management that rational and realistic management for endangered plants is possible.

## INTRODUCTION

The exploitation of native plants has been a fact of life throughout history. There have been times when, except for native plants, human beings might have perished. There have been many volumns written on the subject of the use of native flora, and the significant part it has played in the development of our nation. American folklore contains numerous accounts of life-saving plants as well as notorious life-taking plants. Americans have a heritage deeply enriched by native plant life.

Unfortunately, our native flora does not, and never has existed in inexhaustible quantities. Many of our country's greatest naturalists began to warn us as much as a century ago that Americas' native plants and animals exist in finite numbers and special care would have to be taken in order to preserve them. Today in our technologically advanced society, we no longer find it necessary to exploit our native plants for the medicines and foods to insure our personal survival or the survival of our families. Why, then, do we continue to find that some of our native plants are decreasing in numbers at an alarming rate?

It is apparent that certain forms of exploitation continue to assure the demise of certain members of our native flora. It is also apparent that immediate action is needed if the state agencies of the southeast which are responsible for the protection and management of endangered plants, are to be effective in insuring the prolonged existence of this valuable part of our natural heritage.

## EXPLOITATION IN THE NAME OF PROGRESS

### Large-scale Land Use Influences

Large quantities of land which provide habitat for many of our endangered plants are being modified as a result of changing land use practices. For example, thousands of acres of hardwood timber are annually being converted to pine monoculture forest. In addition to the loss of the hardwoods this conversion represents the loss of untold acres of natural stands of understory vegetation, some of which are considered to be endangered.

Some farmland is now being taken out of production, but substantial portions of this are being planted with pine for commercial purposes. Nationwide, approximately 1.25 million acres of cropland is being taken out of crop production annually (Council on Environmental Quality, 1975). This is land which could once again be available as habitat for endangered plants if it were allowed to revert through succession to its natural climax state.

Some hardwood to pine conversion attempts have met with poor results. One example is the wind rowing and conversion of sandridge communities to pine. The result has been stunted tree growth and an otherwise relatively sterile vegetative community. Since this timber crop will return a marginal profit, if any, the planting of the sandridge with pine seems only to achieve the destruction of habitat where studies indicate endangered species may be concentrated (Smithsonian Report, 1975).

The idea fostered by timber interests that the forests of the southeast states should be used primarily as a source for pulp, has placed additional pressures on populations of endangered plants by reducing the overall age and maturity of our southeastern forests and underwritten the policy of converting hardwood stands to plantation pine stands. Companies who practice this unwritten policy use the beech and maple forests of the northeast and the spruce and fir forests of the Pacific Northwest for their source of saw timber.

Ironically, while land suitable for agriculture is being taken out of production in parts of the southeast, additional acres of habitat are being lost to crop production on lands heretofor not used for intensive agriculture. This trend is due in part to the increasing use of irrigation in the southeast. The increase in acreage being irrigated annually is not known, but it is thought to be substantial.

Increased pressure to develop coal reserves and other mineral resources of the southeast also accounts for increases

in loss of endangered plant habitat through strip mining operations.

Commercial Development

According to the Smithsonian Institute's report on Endangered and Threatened Plant Species of the U.S. (1975), endangered species are usually found in narrow niches, such as mountain tops, ravines, river banks, acid bogs or rock cliffs. It is certainly less than a coincidence that much of the second home development boom of the late sixties and early seventies occurred at or near these types of natural features. They are some of the most scenic, remote and unspoiled areas of the southeast region of the country. The destruction of many endangered plants of these areas went largely unnoticed by the developers, the builders, and the buyers partly for lack of interest, but possibly more for lack of knowledge as to alternatives. It is possible, for example, that a state endangered species technical assistance program could have provided information which would have minimized the destruction. Advice to remove the top soil from roadcuts and other construction sites and filling with it when construction was complete may have saved large amounts of organic substraits. Or the assistance might go so far as to suggest sales slogan such as "Rare Homes with Rare Plants" as a means of informing potential buyers of the unique features offered by this development.

In a similar manner, advice given to new home owners about the rare beauty and fragile nature of his plants and how he should care for them would very likely give rise to an attitude of personal stewardship for the entire community.

While this type of development is experiencing a temporary lull, there is evidence that residential development in relatively unspoiled areas continues. The Bureau of Census (1975) reports that since 1970, metropolitan areas have grown at a slower rate than non-metropolitan counties. And the indications are that instead of moving back to the farm, people are moving to within commuters reach of the smaller towns. This indicates that residential development associated with such a move will now be a primary residence - not a second home - built within one of the aforementioned narrow niches. Hence the exploitation of areas likely to harbor endangered plants continues. Other studies (Domestic Council, 1974) indicate "big increases" in the growth rate of the southern Appalachians, one geographic region which was identified by the Smithsonian Report (1975) as an area "with concentrations of endemic species" which may be endangered.

Public Projects

Many controversial statements have documented the exploitation

of fragile resources by public agencies such as the U.S. Corps of Engineers, U.S. Forest Service, and State and federal transportation and agriculture agencies. It is not difficult to find serious disagreement among different government agencies as to which one is actually conducting it's business in the public interest. Admittedly, usually both are, each using its' own criteria for measuring achievement. The simple fact is, that vast acreages of land - some harboring endangered species - have been and are being consumed by public projects throughout the southeast. According to 1973 figures, the U.S. Corps of Engineers had under management, more than 470,000 acres of flat water in its South Atlantic Division alone. Of course, the acreage of habitat consumed by creating that flat water would be considerably greater. Since those figures were released at least two additional major reservoirs have been created in Georgia (i.e., West Point Reservoir and Carter Reservoir), both of which inundated habitat which harbored endangered plants. This is especially true of Carter Reservoir which flooded approximately 8000 acres of habitat along the banks of the Coosawattee River in north Georgia.

The Georgia Statistical Abstract (1968, 1972) published by the State Highway Department indicated that more than 10,200 miles of public roads were constructed from July 1, 1968 to May 12, 1972. More recently proposed roadways include the Appalachian 400 Highway which will slice through thousands of acres of prime north Georgia habitat. With habitat being lost at such alarming rates, it is little wonder that the International Union for Conservation of Nature and Natural Resources (1974) projects the extinction of an additional 185 species by the year 2000.

## EXPLOITATION FOR PROFIT AND FOR LOVE

### Commercial Collecting

The collecting of native plants for sale has been an occupation for some of our people for generations. For others, it is a relatively new business. In either case, this type of exploitation consists of the collecting and transporting of plant materials for the expressed purpose of resale. Commercial collecting operations range in magnitude from one person attempting to scratch out a meager income for himself and his family, to several teams of well-equipped collectors who can easily carry away enough material in a day to turn a handsome profit.

The effects of the commercial collector can be equally as devasting as the bulldozer and earthmover. Entire populations of Golden Seal (Hydrastis canadensis L.), Moccasin Flower (Cypripedium acuale Ait.),and Pitcher-plants (Sarracenia sp. L.) have disappeared over night as a result of commercial collecting operations. There

is little question that exploitation of endangered plants by commercial collectors can have a significant negative influence on the continued existence of the species.

Private Collecting

Various interests in our native plants by the public have led to the unquestionable exploitations of the very object of the interest. Accounts of my own life serve well to illustrate this exploitation by private citizens. As a small child, I remember helping - in my own way - my family dig Genseng (Panax quinquefolium L.) and Golden Seal (H. canadensis L.) near my Ellijay, Georgia home. As a boy growing up on the banks of the Coosawattee River, I was proud to bring home a handfull of Yellow-Lady Slippers (C. calceolus L.) to my mother. As a student of botany, I was taught that rare plants should not be collected except in the interest of science, but collections have been made to trade to other herbaria. And just a few weeks ago a friend came to my house and because he knew how much I studied and admired wildflowers, he brought me a whole bucket full of Large-flowered Trillium (Trillium grandiflorum (Michx.) Salisb.) Finally, accounts were described to me recently of a wildflower club field trip to a very small colony of Golden Seal (H. canadensis L.); several days later the entire colony had disappeared.

The point of these ramblings is that regardless of whether a species is used to death for medicinal purposes, studied to death in the interest of science, or loved to death because of its' spectacular beauty, the result is the same: the methodical and unnecessary destruction of part of our natural heritage.

## PERSPECTIVE OF THE STATE

Mandate for Action

All of the means of exploitation which have previously been discussed with the exception of private collecting have one grave consequence in common. Tremendous numbers of acres of habitat for endangered plants are being lost. Another glaring problem is that there is no universal sense of values in and no universal policy for management of endangered species which exist among environmental groups, private industry, federal and state government agencies, or the scientific community.

It is not always apparent that state agencies have a clear-cut mandate to protect endangered species and their habitats considering the wide spread habitat destruction which continues to occur throughout the southeast. In fact there is seldom a responsibility given by legislation to a state agency which does not in

some way conflict with responsibilities previously deligated to other state agencies.

The mandate to manage and protect endangered species does exist in Georgia in the form of two state laws (The Endangered Wildlife Act of 1973 and The Wild Flower Preservation Act of 1973). And as we would expect, several of Georgia's state agencies have received mandated responsibilities which seem to be in conflict - at least philosophically - with the concepts of endangered species management and protection. The ultimate success of the endangered species program and other programs which face conflicting agency philosophies will depend largely on the cooperative attitudes of all agencies involved in working together openly to resolve points of conflict.

Immediate Needs for Program Development

Endangered species programs of many of the southeastern states have from their beginnings been low budget operations. In Georgia, less than $30,000 annually has been invested except for substantial expenditures by the Georgia Heritage Trust Program for habitat acquisition.

Much of the information which has been compiled to date relating to endangered species in Georgia is the result of a very small program staff working with an army of concerned citizens and other volunteers. While considerable information does exist, it is usually not organized in such a manner as to be either readily useful or even available to persons or agencies who inquire after it. Consequently, little organized information has reached a point where it can be used in the struggle to curtail further destruction of endangered species and their habitats.

First, the state program must be funded at levels where it can perform its duties full-time. In general, state programs receive financial support when they have a broad base of moral support. Therefore, one of the primary objectives of any states' program should be to take steps to broaden its base of support. The most efficient way to do this may be through the development of a strong educational program and an efficient method of distributing information.

There is a critical need for the development of the strongest technical assistance program possible. Every single piece of information which exists related to the states' endangered species should be compiled and organized in a form which will allow the program staff to furnish data upon request to user organizations such as local or county planners and other state and federal agencies. This may be the best means of reducing destruction of endangered

species habitat on a large scale, since it will allow these agencies to react to environmentally sensitive areas during early planning stages.

Finally, one of the most urgent needs to assure sound program development is the implementation of an effective and realistic law enforcement effort. In Georgia, as I am sure is the case in other states, our law enforcement personnel are among our most avid conservationists. Even among these people who normally have a high level of interest, there are legitimate concerns which have been voiced involving law enforcement activities related to endangered plants. The most common objection is that law enforcement personnel would never be able to recognize endangered plants. Certainly this is a problem, but it is a problem with solutions.

The solution might take the form of one of several alternatives. First, and most ideally, in-service training programs can be designed which will teach law enforcement officers how to recognize and identify endangered species of plants. This may be too idealistic if short term implementation is the goal. In Georgia there are 100 species of endangered plants now protected by law.

An alternative may be to select targets (species) of concentration and teach enforcement officers how to recognize these specific ones. The species selected would be based upon previous evidence of exploitation. This enforcement effort would require that enforcement personnel be able to recognize 4 or 5 (possibly as many as 10) species of plants. This is not an unmanageable or unrealistic goal.

A last alternative may be to concentrate our enforcement effort on inspections of commercial operators who deal in native flora. This inspection responsibility could be assigned to qualified botanists or to other personnel who have the training and expertise required to recognize and identify the species in question.

## Conclusion

The passage of legislation which calls for strong protective measures and management programs for endangered species is legitimate cause for celebration. It does not, however, mean that a solution to the problem has been attained. The true test of the effectiveness of any particular piece of legislation can only be measured after the full implementation of the programs which it authorized. The judgement of the effectiveness of State endangered species programs as well as the federal endangered species program is incomplete. A great deal of program implementation remains ahead. In this regard, two items stand out as absolute necessities to the development of a State program which will achieve the goals of endangered species legislation.

First, existing information from all sources (i.e. scientific community, private, state and federal agencies) must be organized and distributed to a level where it can have an influence on the preservation of habitat. Planning agencies can not possibly construct plans in harmony with endangered species habitat if the location of that habitat is not known and the conditions to which endangered species are sensitive are not known.

Second, State endangered species programs must prove themselves to be manageable. In many instances internal management conflict is the reason for the slow development of the program. Executive management has been bored with philosophical rhetoric and the operative staff has been confused and bewildered by such things as lists (in Georgia) of over 600 species of the most infrequently encountered species of plants and animals in the state which are suspected of being endangered. Both groups must be convinced that rational and realistic - though it may not be conventional - management is possible.

## REFERENCES


Council on Environmental Quality, 1975. The Sixth Annual Report of The Council on Environmental Quality (U.S. Government Printing Office, Washington, D.C.).

Domestic Council, 1974. National Growth and Development. (U.S. Government Printing Office, Washington, D.C.).

Forstall, Richard, 1975. "Trends in Metropolitan and Non-Metropolitan Growth Since 1970", presented at Census Bureau - NICHD Conference on Population Distribution.

Smithsonian Institute, 1975. Report on Endangered and Threatened Plant Species of The United States (U.S. Government Printing Office, Washington, D.C.).

U.S. Army Corps of Engineers, 1973. Recreational Statistics (U.S. Government Printing Office, Washington, D.C.).

# VENUS' FLYTRAP: SURVIVAL THREATS AND POTENTIALS

Raymond O. Flagg[1/]

Abstract.--Road construction and pine farming have increased the available sites for natural stands of Venus' flytrap, but drainage projects and intense collecting in recent years have destroyed many populations and severely reduced others. While the flytrap does not seem to be in immediate danger of extinction, it might well be considered unnecessarily threatened, as commercial propagation appears to be practical.

Additional keywords: Dionaea muscipula, habitat.

In 13 years of observing, collecting, and growing Venus' flytraps (Dionaea muscipula Ellis), I have seen old populations disappear, new populations become established, and advances in culture methods.

## HABITAT

The Venus' flytrap is endemic to eastern North and South Carolina. It grows in sandy, humus, acid soil, usually in the company of pines and short compact sphagnum. Flytrap populations thrive in full sun and partial shade, and will tolerate moderately heavy shade. In full sun, partial shading is usually provided in the summer by grasses and small herbs. The suitability of a particular spot appears to be determined by available moisture--populations survive short periods of drying or flooding, but generally a moderate amount of ground moisture is present year-round.

### Destruction

The most destructive activity of man to flytrap habitats is the drainage accompanying building projects, road construction, agriculture, and silviculture. A permanent significant drop in the water level spells the end of the flytrap population at a specific site.

Populations of flytraps also tend to die out as pine fields mature. I do not know whether this is because of increased shading, heavy littering by needles, or a combination of these changes.

### Development

Although the flytrap is restricted in habitat, it is in many respects a "campfollower" species. Most of the places where it grows can be called disturbed areas: roadsides, edges of shallow borrow pits, new pine plantings, ditches around and through older pine plantings, and areas where pine plantings meet ponds or swamps. Thus, man destroys old habitats by drainage and creates new ones by disturbing land levels. Furthermore, controlled burning in pine plantings favors the flytraps. Even though the number of flytraps has been sharply reduced by collecting in the last decade, I wonder if there are not more flytraps now than there were in the days of Sir Walter Raleigh.

---

1/ Director of Botany, Carolina Biological Supply Company, Burlington, N. C.

## COLLECTING

By North Carolina law anyone may take up any plant on his own land or on any private land with signed authorization of the owner or the duly authorized agent.

### Carolina Biological Supply Company

By state permit we may collect up to 500 Venus' flytraps each year. We tend to use the same collecting sites year after year, and make it a point to operate within the laws of man and of conservation.

One of the reasons I enjoy my association with Carolina Biological rests in the judicious husbandry of collecting sites by the conservation-conscious staff. It has been my pleasure to be involved in collecting plants For Carolina Biological for 13 years. In all that time I have never seen a population threatened or endangered by the activities of any employee of the Company. Even if the collecting habits of Carolina Biological did not rest in pure biological appreciation of nature, maintenance of productive sites would appear to be simple wisdom for long-term utilization--over-collecting this year would create supply problems next year.

### "Dime-Store" Trade

Carnivorous plants have novelty and beauty that appeal not only to biologists but also to almost any human being. Collecting activity to fill the layman's demand has placed extreme pressure on many carnivorous plants, especially the Venus' flytrap.

There are individuals who place no value on collecting sites and violate all rules of conservation. I have personally seen evidence of destructive and illegal collections at many locations on state property along highways in Brunswick and Pender Counties in North Carolina. Many flytrap populations along the roadsides in these counties have been completely removed in wanton digging by insensitive, if not biologically ignorant, individuals. Any plant-lover viewing the before and after conditions of such ravished sites is struck with sadness and anger. Some portions of the gene pool of the flytrap have undoubtedly been lost forever. If the laws of North Carolina were enforced along the roadsides, there would be no threat to "shut-your-mouth Sam."

## PROPAGATION

### Natural Sites

Venus' flytraps have survived in the New Jersey Pine Barrens since 1948 (Smith, 1972). In recent years we have successfully translocated flytraps within the natural range, and now use the locations as collecting sites. For example, ten or eleven years ago we took a number of flytraps from our Burlington greenhouse and planted them in Bladen County about 3.5 miles NE of White Oak along a roadside ditch draining into Singletary Creek. (We are not aware of any native sites of Venus' flytraps within a 20-mile radius.) Although the potential niche was small, the few original plants proliferated and the offspring even survived through a minor shift in the niche induced by reworking of the drainage area by the Department of Transportation. Almost annually we collect 75 to 100 flytraps from this little site without diminishing the basic size of the colony. Only large plants are taken; small plants and seedlings are left in place. The size of the colony is restricted by the immediate environment,

most importantly by the availability of water.

Some large suppliers of flytrap "bulbs" indicate they are meeting their needs from plants grown on their own property. While this may be true, I must view it with some doubt as it still appears more economical to purchase "bulbs" from local collectors than to propagate them. Of course, the very cheapness of "bulbs" in large quantities would indicate that flytraps are not difficult to find, and thus not rare.

## Greenhouse

Reputedly, flytrap seed have brief viability (a few months) and seedlings have difficulty in becoming established (Smith, 1972). This may be true with poorly handled seed, but it has been our experience that properly dried and refrigerated seed consistently show good germination and good seedling establishment two years after harvest. With high humidity, elevated temperature, and natural greenhouse light, we have produced flytraps with attractive multi-leaved rosettes (about 5-7 cm in diameter) in less than a year after sowing the seed.

We have produced flytrap seed in the greenhouse, but cross-pollination by hand was necessary.

Hooft (1974) summarized our experience with vegetative propagation of flytraps. When excised healthy petioles with the traps removed are kept in a moist, warm and light environment, small buds form in about a month, complete leaves with traps form in about two months, and roots are produced as decomposition of the original petioles becomes well advanced. With high humidity, elevated temperature, and natural greenhouse light, many of these plantlets develop into fine specimens.

## CONCLUSIONS

Although Venus' flytraps have been subjected to increased pressures in recent years, the species does not appear to be in immediate danger of extinction, as its continuation is encouraged by extensive pine farming within its natural range. The ready availability of collected "bulbs" indicates that there are many wild flytraps; however, many populations have been decimated and the range and activities of collectors are increasing. Aside from collecting wild flytraps, it is now practical to produce these plants from seed and from vegetative propagation.

## LITERATURE CITED

Hooft, J. 1974. Vegetative reproduction in flytraps. Carolina Tips 37:57-58.

Smith, A. P. 1972. Survival and seed production of transplants of Dionaea muscipula in the New Jersey Pine Barrens. Torreya 99:145-146.

# THE NATURAL LANDMARKS PROGRAM

Gary S. Waggoner1/

Abstract,--The National Park Service administers two programs to preserve nationally significant natural areas, the National Park System and the Natural Landmarks Program. The Natural Landmarks Program is a recognition program to encourage the voluntary preservation of significant natural areas on non-Park Service administered lands. Natural region studies and onsite evaluation studies are conducted by scientists under contract to the Service. Sites determined to be nationally significant are entered on the National Registry of Natural Landmarks by the Secretary of the Interior.

The protection of endangered plant species through natural area preservation is approached in two different ways by the National Park Service. Most people are aware of the preservation efforts of the Service as reflected in the National Park System, especially the great natural area parks such as Great Smoky Mountains National Park and Everglades National Park in the southeastern United States. These parks are publicly owned and are administered by the Service. Thus, there is the highest possible degree of protection afforded to endangered or threatened species indigenous to such parks. The Service can control visitor use and access to such habitats, including closure to entry for other than official purposes. The purpose of this paper, however, is to describe the Natural Landmarks Program, a method of encouraging the preservation of natural areas outside the National Park System.

The Natural Landmarks Program, which was administratively created by the Secretary of the Interior in 1962, is managed by the National Park Service pursuant to authority contained in the Historic Sites Act of 1935. The objectives of the Natural Landmarks Program are: 1) to encourage the preservation of sites illustrating the geological and ecological character of the United States, 2) to enhance the educational and scientific value of sites thus preserved, 3) to strengthen cultural appreciation of natural history, and 4) to foster a greater concern in the conservation of the Nation's natural heritage. Under this program the Service strives to assure the preservation of such a variety of nationally significant natural areas that, when considered together, they will illustrate the diversity of the country's natural environment.

In contrast to the actual units in the National Park System, natural landmarks are nationally significant natural areas which are in varying ownership, e.g., private, State, Federal. The Natural Landmarks Program is a voluntary, recognition program and neither ownership nor responsibility for the area changes with designation. Instead, following designation of a

1/ Botanist, Division of Natural Landmarks and Theme Studies, National Park Service Science Center, National Space Technology Laboratories, Bay St. Louis, MS. The author would like to thank Mr. Frank Ugolini, Chief, Division of Natural Landmarks and Theme Studies for his valuable review and constructive suggestions concerning this paper.

landmark by the Secretary of the Interior, the owner(s) is notified that his property has been determined to be of national significance as a superlative example of our natural heritage and he is invited to voluntarily register the property. This registration act is a gentleman's agreement made between the owner(s) of the landmark and the Secretary of the Interior stipulating that the owner(s) intends to preserve the site in such a way as to maintain its inherent natural integrity. This registration act is not legally binding and, therefore, long-term preservation of a registered natural landmark is not as certain as in a unit of the National Park System.

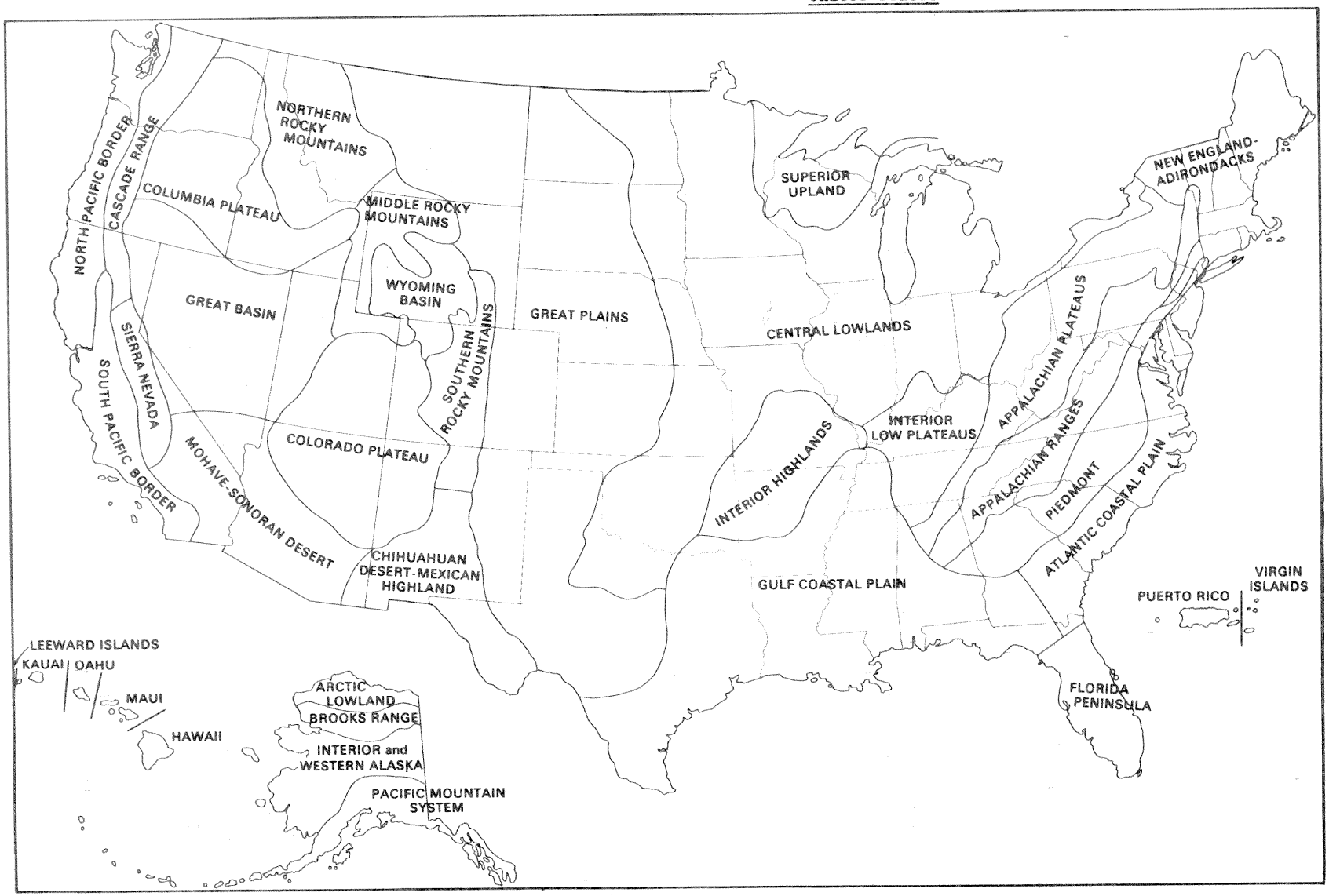
Natural landmarks are determined as a result of a fairly thorough selection process. The National Park Service is presently conducting studies, typically through contracts with universities, of the various natural regions of the United States. In the Southeast, these natural regions include the Atlantic Coastal Plain, the Gulf Coastal Plain, the Florida Peninsula, the Piedmont, the Appalachian Ranges, the Appalachian Plateaus and the Interior Low Plateaus (Map 1). Natural region studies describe and classify the important ecosystem types or community types occurring within a particular region and then provide an inventory of natural areas which significantly illustrate each ecosytem type previously described. Sites are assigned a priority by the natural region study team based on a comparative analysis of similar sites. Important factors considered in this comparative study include the presence of endangered or threatened biota, the naturalness or integrity of the site, the ecological diversity of the site, the rarity or threat to the ecosystem type, the relictual or distributional significance of the site and other similar factors. In addition, each natural region study contains similar information on important geological areas. However, this paper emphasizes the ecological portion of the Natural Landmarks Program.

A second phase of study involves the onsite evaluation of sites highly recommended in the natural region study. This onsite evaluation is also conducted via contract to a competent scientist in the vicinity of the areas to be evaluated. Emphasis in contracting both the natural region studies and the onsite evaluations of ecological sites is usually given to botanists, especially plant ecologists. The onsite evaluation provides more detailed information on each site, a recommended boundary, and a significance statement which briefly states why the site is considered to be of national significance. In most instances, the onsite evaluation studies are conducted by a different scientist thus providing a "second opinion" as to the relative ecological significance of the site.

Once both of these steps are completed, the Natural Landmarks Program staff reviews and verifies the information available, makes additional contacts with other scientists and finally makes a determination as to whether or not the area appears to qualify as a natural landmark. The primary test is one of national significance. National significance is ascribed to those superlative areas which are true, accurate and essentially unspoiled examples of our natural heritage. The Natural Landmarks Program staff presents the best areas to the Secretary of the Interior's Advisory Board on National Parks, Historic Sites, Buildings and Monuments which meets biannually in Washington, D.C. The Advisory Board then makes recommendations to the Secretary with whom rests the ultimate authority for the establishment of natural landmarks.

Map 1. Natural Regions of the U.S.*

* Based on Fenneman's (1928) Physiographic Divisions of the United States.



The National Registry of Natural Landmarks is the official listing of all natural landmarks and is published periodically in the Federal Register. At present, there are 421 established natural landmarks with 61 occurring in the Southeast. Of these 61, 18 have been established as natural landmarks for their geological significance, the remaining 43 are nationally significant ecological areas.

Designation as a natural landmark provides protection primarily as a result of the National Environmental Policy Act of 1969. This Act provides that for all federally financed or licensed activities which have a significant effect on the environment, an environmental impact statement must be written considering, among other things, the occurrence of nationally significant natural areas in the selection of alternatives and mitigating actions. Several States across the Nation have comparable laws regarding State-funded or licensed projects. The principal protection provided by natural landmark designation, therefore, is to call attention to areas containing exceptional natural values so that intelligent planning and land use decisions can be facilitated and if significant natural resources are potentially affected, mitigating actions can be taken to minimize the environmental impact. Numerous situations have occurred where proposed plans have been significantly altered and even abandoned due, at least in part, to the presence of natural landmarks at proposed project sites.

Formal agreements between the National Park Service and the U.S. Forest Service, U.S. Fish and Wildlife Service, and the Bureau of Land Management concerning the designation of natural landmarks on these public lands have created a more permanent form of preservation for these sites. Information on registered natural landmarks is provided to each administering agency so that the information can be incorporated into the management plans for the appropriate public land units. Such plans form the basis for the type of management permitted. Natural landmark designation requires that the integrity of the natural area be maintained; however, the specific type of use permitted is left up to the particular bureau administering the property. In other words, various types of use may be permitted as long as the significant natural values of the site are not impaired. Such compatible uses might include nondestructive scientific use, interpretation for the public, fishing, nature study, photography, hiking and other basically nonconsumptive uses.

Registered natural landmarks have also been established on other federal lands including those administered by the U.S. Air Force, U.S. Navy, U.S. Marines, U.S. Army, The Energy Research and Development Administration, Bureau of Reclamation, Bureau of Indian Affairs and the U.S. Coast Guard. In most instances, the landmark designation brought the special significance of these particular sites to the attention of decisionmakers. The registration of these sites by the respective owners has helped to insure the preservation of several significant natural areas. Registration of natural landmarks on State-owned lands has also helped to insure the long-term protection of significant areas. In some instances, registered natural landmark status merely provides another "layer of protection" to an already recognized natural area but it does reflect perhaps the highest level of importance, that of national significance. In many instances, however, designation as a natural landmark provides the initial, official recognition of important natural areas. This is especially true with sites in private ownership.

While no absolute legal protection is afforded registered natural landmarks, the recognition factor has proven to be quite effective as a means of preservation. The National Park Service is continuously providing information concerning the locations of significant natural areas, regardless of ownership, to those public and even some private organizations responsible for planning developments. This information is received in a very appreciative manner and is relied on heavily in the planning phases of development thus avoiding the needless destruction of known important natural resources. At the present time, the Natural Landmarks Program staff knows of only two instances where natural landmarks have been impacted to the point of losing their inherent natural integrity. Further, Land and Water Conservation Fund monies have been used in several instances by States to acquire natural landmarks for State Natural Areas or other preservation land use categories. The Nature Conservancy, a private, non-profit, natural area preservation organization, also has information on existing natural landmarks as well as potential natural landmarks (sites under study) to assist them in setting priorities for their natural area acquisition efforts. The record shows that the Natural Landmarks Program has been effective in its efforts to encourage the preservation of nationally significant natural areas through the process of recognition on both public and private lands.

The establishment of natural landmarks depends heavily upon the information provided by scientists. The locations of endangered and threatened flora and fauna, the occurrences of disjunct and relict plant communities, the site of outstanding representative examples of regionally typical ecosystem types, and other similar information are all essential to the efficient functioning of the Natural Landmarks Program in its efforts to recognize nationally significant natural areas. Such information can only best be provided by scientists. The Natural Landmarks Program staff is fully aware of the sensitivity of certain types of information including the precise locations of endangered and threatened species, the locations of significant fossil deposits, the occurrences of outstanding, noncommercial caves, and the like. Such information is treated with great care. Advice on the possible limited dispersal of this information is obtained from scientists knowledgeable of the area and the potential threats to the site's continuing integrity. It is vitally important that information on outstanding natural areas including areas harboring endangered or threatened species be made available so that development does not unknowingly destroy unique areas needlessly. The efforts of the National Park Service in this regard are helping to avoid land use plans being made in ignorance of significant ecological information.

Presently, both the Piedmont and the Atlantic Coastal Plain natural region studies involving ecological sites are completed. Two others, the Gulf Coastal Plain and the Appalachian Plateaus natural region studies are scheduled to be completed this summer. The Interior Low Plateaus study has recently been contracted with Dr. Elsie Quarterman, Biology Department, Vanderbilt University, Nashville, Tennessee, but the remaining two natural region studies involving the Southeast have not yet been contracted. If you would like to contribute information regarding a significant natural area, please contact the Chief, Division of Natural Landmarks, National Park Service, Department of the Interior, Washington, D.C. 20240.

# ROLE OF FISH AND WILDLIFE SERVICE CONCERNING ENDANGERED FLORA

Vernon G. Henry[1]/

Abstract.--As the principal agency of the Federal Government with responsibilities for conserving wildlife resources, the Fish and Wildlife Service has had an impact on the flora of this nation. Overall 34 million acres nationally and 1-3/4 million acres in the southeast are managed by the Service as part of their refuge system. All eight major North American biomes are represented by refuge lands and nearly all species of aquatic plants common to North America are found on the 12.5 million acres of wetlands of the refuge system. These lands include 191 natural areas, 43 wilderness areas and 65 special sites preserved for ecological, scientific or cultural values. In the southeast 372,644 acres are in National Historic Landmarks, 41,892 acres are in research natural areas and 418,024 acres are in wilderness areas. Numerous endangered and threatened plants are found on these lands and are protected. Through grant-in-aid programs, states have purchased over 3-1/4 million acres and manage an additional 51 million acres by lease or licensing agreement. These areas have also played a role in conservation of plants. With the passage of the Endangered Species Act of 1973, the Fish and Wildlife Service's role has expanded. The Service is now responsible for listing and delisting, enforcement of prohibited acts, utilizing other programs in furtherance of the purposes of the Act and consulting with all other federal agencies concerning their programs.

## INTRODUCTION

The Fish and Wildlife Service has assumed a more prominent role recently in preserving, maintaining and managing endangered flora as a result of the Endangered Species Act of 1973. This same statement is true to a lesser degree of all land resource management agencies at the federal level and potentially even at the state level. However, to assume that passage of this legislation initiated the Service's involvement with endangered flora would be erroneous. I would like to explore the past, present and future role of the Service concerning flora in general and endangered flora in particular.

The Service is the principal agency through which the Federal Government carries out its responsibilities for conserving the wildlife resources of this nation. One can not conserve wildlife without having a corresponding effect on the flora because the basic ingredient in wildlife management is habitat, which includes all the organic and inorganic elements present. A standard cliche used in wildlife management is that one does not manage wildlife but one manages the habitat. This is somewhat of an oversimplification but the emphasis is well placed. To carry it one step further, management of the habitat normally means management of the vegetation because

---

1/ Endangered Species Specialist, U. S. Fish and Wildlife Service, 17 Executive Park Drive, N. E., Atlanta, Georgia 30329

many of the other elements are difficult at best to manipulate. A perusal of the curriculum of any school of wildlife management would show a strong foundation in botany.

## NATIONAL WILDLIFE REFUGE SYSTEM

One of the major ways in which the Service impacts the flora of this nation is by management of lands under the Service's control. As of June 30, 1975, the lands in the Service's Refuge System totaled 34,136,463 acres in 563 units (U. S. Fish and Wildlife Service 1975a). The Refuge System includes waterfowl refuges, waterfowl production areas, general migratory bird refuges, game ranges, big game refuges, wildlife ranges and coordination areas. These refuges range in size from 0.6 acre to 8.9 million acres (U. S. Fish and Wildlife Service 1976).

In the southeastern region [2/] there are 1,781,626 acres involved in 89 units (U. S. Fish and Wildlife Service 1976).

Vegetation found within the Refuge System includes species common to all eight major North American life zones, or biomes. In the southeast four biomes are involved, i.e., tropical forest, deciduous forest, coniferous forest and grassland. Manipulation of vegetation for wildlife management purposes occurs primarily in three biomes, all of which are present in the southeast, i.e., deciduous forest, coniferous forest, and grassland. These three biomes comprise 23 percent of the total system-wide acreage and 80 percent of all refuges are found in these three biomes.

Although national refuges protect many types of wildlife, they play an especially important role in management of waterfowl, and thus, in management of aquatic flora. Nearly all species of aquatic plants common to North America are found on the 12.5 million acres of wetlands encompassed by the Refuge System (U. S. Fish and Wildlife Service 1976).

The acquisition, leasing and acquiring of easements of lands for the Refuge System has, in many cases, prevented the imminent destruction or conversion to non-native habitat of the lands involved (Bureau of Sport Fisheries and Wildlife 1975).

Overall, the major effect on vegetation is to provide a diversity, both in vegetative types and successional stages (U. S. Fish and Wildlife Service 1976).

### Natural type areas

All refuge lands are not intensively managed; some are retained perpetually in their natural state for several reasons including inaccessibility, need to protect endangered species, legal restrictions or to maintain naturalness. Wilderness areas, scientific sites and natural areas are examples of areas preserved in a natural condition (U. S. Fish and Wildlife

---

2/ Includes: Florida, Georgia, Alabama, Mississippi, Louisiana, Arkansas, Tennessee, Kentucky, North Carolina, South Carolina, Puerto Rico, and Virgin Islands.

Service 1976).

As unique habitats are destroyed throughout the Nation, those within refuges take on greater importance and will receive increased protection to maintain their integrity. Refuge personnel will continue to analyze the need for additional sites for inclusion in these special protection areas (U. S. Fish and Wildlife Service 1976).

At the present time there are 191 natural areas, 43 wilderness areas and 65 special sites preserved and protected for their ecological, scientific and cultural values (U. S. Fish and Wildlife Service 1976). All of these type areas can and do play a role in preserving endangered plants.

The first objective in the recently prepared Environmental Statement prepared on Operation of the National Wildlife Refuge System was as follows: to preserve, restore and enhance in their natural ecosystems all species of animals and plants that are endangered or threatened with becoming endangered on lands of the National Wildlife Refuge System. An annual goal of 142 million use days for threatened and endangered species was set, some of which is for plants (U. S. Fish and Wildlife Service 1976).

In the southeast, Pelican Island is a National Historic Landmark and five areas totaling 372,644 acres are listed as National Natural Landmarks. These are Wassaw Island (10,760 acres)--Wassaw National Wildlife Refuge in Georgia; Beaver Dam Creek Swamp (530 acres)--Wheeler National Wildlife Refuge in Alabama; Big Lake Natural Area (6400 acres)--Big Lake National Wildlife Refuge in Arkansas; Okefenokee Swamp (353,981 acres)--Okefenokee National Wildlife Refuge in Georgia; and White River Sugarberry Natural Area (973 acres)--White River National Wildlife Refuge in Arkansas (U. S. Fish and Wildlife Service 1976).

Research Natural Areas found on refuges in the southeast total 41,892 acres in 31 units on 16 separate refuges (Table 1). These areas involve vegetative types as varied as sphagnum bogs, cordgrass prairie, swamps, marshes, deciduous woody cover, coniferous woody cover and hardwood-pine mixtures. There are also 18 Public Use Natural Areas on nine different refuges in the southeast which total 4514 acres (Table 2).

Wilderness areas totaling 557,670 acres have been designated on refuges nationally and 418,024 acres of these are in the southeast in eleven areas (Table 3). In addition, 7,493,132 acres are proposed in Congress and 13,608,826 additional acres are in some stages of review. The proposals include 13 areas in the southeast totaling 37,701 acres (U. S. Fish and Wildlife Service 1976).

Endangered Plants on refuge lands

With this general background, I wish to now present some specific examples, starting at the southern extremities of this region.

Encyclia boothiana, an epiphytic orchid only known to exist in a few relict populations in mangrove swamps in the Everglades and on the southwest Florida coast may occur in the Key Deer and Great White Heron National Wildlife Refuges.

Table 1 - Natural Areas Found on Southeastern National Wildlife Refuges

| Refuge or Range | Natural Area | Primary Type | Acres |
|---|---|---|---|
| Big Lake | Big Lake Baldcypress | Baldcypress | 500 |
| Blackbeard | Blackbeard Island | Slash Pine-Hardwood | 450 |
| Cape Romain | Bulls Island | Sand Live Oak-Cabbage Palmetto | 500 |
| Cape Romain | Bulls Island | Loblolly Pine-Hardwood | 500 |
| Cape Romain | Bulls Island | Southern Red Cedar | 80 |
| Carolina Sandhills | --- | Longleaf Pine-Scrub Oak | 554 |
| Holly Bend | Hog Thief | Cottonwood | 100 |
| Lake Woodruff | Honey Creek | Southern Cordgrass Prairie-Water Hickory-Carolina Ash-Bald Cypress-Red Maple | 1,140 |
| Mattamuskeet | Sayler's Ridge | Loblolly Pine | 75 |
| Noxubee | Morgan Hill | Red Cedar-Pine-Hardwood | 67 |
| Noxubee | Bluff Lake | Loblolly Pine | 80 |
| Noxubee | Old Robinson Road | Bald Cypress | 46 |
| Okefenokee | Black Jack Island | Sphagnum Bog Lake Swamp and Marshy Area Swamp Island | 15,027 |
| Okefenokee | [illegible]owhouse Island | Live Oak | 10 |
| Okefenokee | Fl[illegible]rd's Island | Southern Scrub Oak | 160 |

Table 1 (Cont'd)

| Refuge or Range | Natural Area | Primary Type | Acres |
|---|---|---|---|
| Okefenokee | Sweet Bay | Sweetbay-Swamp Tupelo-Red Maple | 2,560 |
| Okefenokee | Pine Island | Pond Area | 90 |
| Okefenokee | Territory Prairie | Swamps & Marshy Area | 1,450 |
| Okefenokee | Pondcypress | Pondcypress | 14,989 |
| Piedmont | Five Points | Loblolly Pine-Shortleaf Pine | 118 |
| Sabine | Blue Islands | Sweet Gum Cordgrass Prairie | 112 |
| St. Marks | Otter Lake | Longleaf Pine-Scrub Oak | 93 |
| St. Marks | St. Marks | Slash Pine | 203 |
| St. Marks | St. Marks | Cabbage Palmetto-Slash Pine | 24 |
| St. Marks | St. Marks | Tidal Salt Marshes | 828 |
| Tennessee | Britton Ford | Eastern Red Cedar-Hardwood-Post Oak Black Oak-White Oak-Red Oak-Hickory Sassafras-Persimmon | 750 |
| Wheeler | Bluff City | Eastern Red Cedar | 13 |
| White River | White River Sweetgum | Sweetgum-Nuttall Oak Willow Oak | 410 |
| | | Sugarberry-American Elm-Green Ash | 109 |
| | | Overcup Oak-Water Hickory | 454 |
| Yazoo | Swan Lake Black Willow | Black Willow | 400 |
| Total | | | 41,892 |

Table 2 - Public Use Natural Areas
Of The Southeastern National Wildlife Refuges

| Refuge or Range | Natural Area | Primary Type | Acres |
|---|---|---|---|
| Cape Romain | No name #1 | Estuarine salt-marsh | 200 |
| Chassahowitzka | Battle Creek | Estuary salt-marsh | 40 |
| J. N. "Ding" Darling | Gasparilla's Hideaway | Tropical flora and fauna | 120 |
| J. N. "Ding" Darling | Interpretive Trail | Estuaries-marshes-mangrove | 85 |
| Loxahatchee | Loxahatchee Slough | Wetland-Everglades | 640 |
| Loxahatchee | No name #1 | Pond cypress | 40 |
| National Key Deer | Watson Hammock | Tropical Hammock | 100 |
| Okefenokee | Chesser Island Bay | Bog Wooded Bay | 100 |
| Okefenokee | Chesser Island Hammock | Hardwood Hammock | 11 |
| Okefenokee | Chesser Prairie | Marsh Prairie | 800 |
| Okefenokee | Chesser Prairie Rookery | Bird Rookery | 3 |
| Okefenokee | Floyd's Island | Special Island ecosystem | 575 |
| Santee | Dingle Pond | Aquatic ecosystem | 615 |
| Wheeler | Beaver Dam Creek | Tupelo Swamp | 578 |
| Wheeler | Dancy Bottoms | Mixed hardwood and Pine | 186 |
| Wheeler | Penny Bottoms | White Oak-Hickory-Red Oak | 191 |
| Wheeler | Village Creek | Red Cedar-mixed hardwood and Pine | 105 |
| Lake Woodruff | No name | Hardwood Hammock | 125 |
| Total | | | 4,514 |

Table 3 - Wilderness Areas of the Southeastern National Wildlife Refuges System

| Wilderness Area (Refuge) | State | Refuge Acres | Wilderness Acres |
|---|---|---|---|
| **Designated** | | | |
| Cedar Keys | Florida | 378 | 375 |
| Florida Keys | Florida | | 4,740 |
| Key West | Florida | 2,019 | |
| National Key Deer | Florida | 7,331 | |
| Great White Heron | Florida | 1,996 | |
| Island Bay | Florida | 20 | 20 |
| Passage Key | Florida | 36 | 36 |
| Pelican Island | Florida | 684 | 6 |
| St. Marks | Florida | 95,000 | 17,740 |
| Blackbeard | Georgia | 5,617 | 3,000 |
| Okefenokee | Georgia-Fla. | 371,445 | 353,981 |
| Wolf Island | Georgia | 5,126 | 5,126 |
| Breton | Louisiana | 5,047 | 5,000 |
| Cape Romain | South Carolina | 34,196 | 28,000 |
| Totals-Designated Areas | | 528,895 | 418,024 |
| **Proposed** | | | |
| Big Lake | Arkansas | 10,974 | 1,818 |
| White River | Arkansas | 112,399 | 975 |
| Chassahowitzka | Florida | 29,698 | 16,900 |
| J. N. "Ding" Darling | Florida | 4,307 | 2,735 |
| Lake Woodruff | Florida | 18,417 | 1,106 |
| Savannah | Georgia-S. C. | 13,173 | Nonsuitable |

Table 3 (Cont'd)

| Wilderness Area (Refuge) | State | Refuge Acres | Wilderness Acres |
|---|---|---|---|
| Lacassine | Louisiana | 31,776 | 2,854 |
| Noxubee | Mississippi | 45,763 | 1,200 |
| Cedar Island | North Carolina | 12,526 | 180 |
| Mattamuskett | North Carolina | 50,179 | 590 |
| Pea Island | North Carolina | 5,915 | 180 |
| Swanquarter | North Carolina | 15,500 | 9,000 |
| Santee | South Carolina | 74,353 | 163 |
| Total: Proposed Areas | | 424,980 | 37,701 |

This species is listed in the Smithsonian Institution Report as threatened and is listed as endangered by the Florida Committee on Rare and Endangered Plants and Animals. Although not all are listed on known lists of endangered plants, most of the epiphytic orchids in the United States are threatened to some extent by land clearing and development coupled with drainage for agriculture and residential areas.

Cactus Hammock, located in the southeastern-most portion of Big Pine Key, is being considered for inclusion into the Great White Heron Refuge. This area contains several endangered or threatened plant species including the following cacti: Cereus robinii, Cereus gracilis var. simpsonii, Cereus eriophorus var. fragrans, Opuntia triacantha and Opuntia cubensis. The first three are listed as endangered and the fourth as threatened in the Smithsonian Report. Cereus robinii is also listed as endangered by the Florida Committee on Endangered Plants and Animals and this same group listed prickly apples (Cereus gracilis var. simpsonii) as threatened. One variety of the tree cactus, C. robinii, occurs nowhere else in the world. The prickly pear (Opuntia cubensis) is not found on known lists of endangered flora but, like C. robinii, is found nowhere else in the world and should probably be listed. Wild Cotton (Gossypium hirsutum), listed as endangered by the Florida Committee, is also found in Cactus Hammock.

Moving up the coast, Loxahatchee National Wildlife Refuge harbors at least two species in trouble. One is the Ray fern (Schizaea germanii), a rare fern thought not to occur outside of the Everglades, is listed as endangered by the Smithsonian Report and as rare by the Florida Committee. Indeed, the Everglades community as a whole is rare and endangered by drainage and alteration by man. The everglades habitat under Federal control provides the only sanctuaries into which humans are not allowed and Loxahatchee comprises one of the last unaltered sections of the Everglades. These refuge lands will continue to harbor the basic plant communities of the glades after

other sections no longer exist. Another plant, the cowhorn orchid or butterfly orchid (Cyrtopodium punctatum), listed as threatened by the Florida Committee, was once wide-spread in Cypress swamps in South Florida, including Loxahatchee. It has been virtually eliminated by collectors but re-introduction into suitable habitat would be possible.

Moving northward, Hobe Sound National Wildlife Refuge was one of the last places where Onicidium variegatum, another orchid, was found in abundance in the wild. This species is listed as threatened by the Florida Committee. Re-introduction is a real possibility here since adequate protection could be afforded to get the species reestablished.

In Georgia, we, of course, have the Okefenokee Refuge which contains unique plant communities. The only species I am currently aware of that is included in endangered listings of flora is Pinckneya pubens, which is listed as threatened in the Smithsonian Report.

The umbrella magnolia (Magnolia tripetala) is found in one known location on the Piedmont National Wildlife Refuge and is probably worthy of threatened status, at least at the State level, although not currently listed. Other uncommon plants are found on Piedmont which are not believed to be critically threatened at this time.

In South Carolina, the Carolina Sandhills National Wildlife Refuge contains several plants worthy of mentioning. The sweet pitcher plant (Sarracenia rubra) and the pixie moss (Pyxidanthera brevifolia) are listed as threatened species in the Smithsonian Report. These two species and two others, Sarracenia flava, the yellow pitcher plant, and a hybrid pitcher plant (Sarracenia flava x Sarracenia purpurea) are also listed in the list of Rare and Endangered Vascular Plants of South Carolina. (Unpublished).

Although the above examples do not represent a complete cross section of the National Wildlife Refuge System in terms of states, habitats, etc., I think they do illustrate the role refuges can and do play in conservation of endangered plants.

## GRANT-IN-AID PROGRAM

Another way that the Fish and Wildlife Service has played a role in conservation of endangered plants is through the Federal grant-in-aid programs to the states through the Pittman-Robertson Act. Through this program states have purchased over 3-1/4 million acres and manage an additional 51 million acres through leases or licensing agreements (U. S. Fish and Wildlife Service 1975b). Although purchased for wildlife, these areas have also played an important role in conservation of plants, in the same way as the National Wildlife Refuge System. I do not have specific examples to offer but I have complete confidence that numerous unique and threatened species are found on these lands and have benefitted from the management of these lands.

## ENDANGERED SPECIES ACT OF 1973

That brings us to recent times and the role of the Fish and Wildlife Service under the Endangered Species Act of 1973 (93rd Congress, S.1983, 1973). The Secretaries of Agriculture, Commerce and Interior all have responsibilities under the Act. However, Agriculture's responsibility is limited to importation and exportation of terrestial plants. The other functions under the act relating to plants are the responsibility of the Fish and Wildlife Service and the National Marine Fisheries Service. No agreement is presently in effect between these agencies as to the division of responsibility for plants.

The role of the Service for plants under the Act is basically four-fold. First is the job of listing and delisting species. Second is the enforcement of the prohibited acts set forth in the Act. These prohibited acts concern import and export of listed species, being a party to commercial activity in these species in interstate or foreign commerce and violation of any promulgated regulation regarding the species.

The third role concerns the reviewing of all programs administered by the Service and utilizing these programs in furtherance of the purposes of this Act. The fourth role under the Act is consultation with all other federal agencies to see that they utilize their authorities in furtherance of the purposes of the Act. These last two roles are spelled out in Section 7 of the Act. It directs all Federal agencies to carry out programs for the conservation of endangered and threatened species listed pursuant to the Act and to take necessary action to insure that actions authorized, funded or carried out by them do not jeopardize the continued existence of such species or result in the destruction or adverse modification of critical habitat of such species.

Another provision of the Act that should be mentioned is that funds made available pursuant to the Land and Water Conservation Fund Act of 1965 may be used for acquiring lands for endangered and threatened species, including plants. Through fiscal year 1975 a total of $16.3 million has been appropriated for acquisitions beneficial to endangered species. Projections for the Fish and Wildlife Service indicate $245 million are needed to acquire 455,000 acres in the next six years to adequately carry out the legislative mandate of the Endangered Species Act (U. S. Fish and Wildlife Service 1976).

At the present time there are no native plants listed as endangered or threatened. However, the Smithsonian Institution prepared a report as authorized by Section 12 of the Endangered Species Act, that listed over 3000 plants as endangered or threatened (Smithsonian Institution 1975). This list is currently being given a status review by the Fish and Wildlife Service and a proposed rulemaking to list many of these plants is now being formulated and should be published in the Federal Register shortly.

## DISCUSSION AND SUMMARY

Listing of plants will, of course, place more emphasis on endangered plants and thus, the Fish and Wildlife Service will continue to increase its role in conserving endangered and threatened plants. I think the

material just presented shows that the Service has played a role in the past in conserving plants, although it may have been largely in an indirect way, and this role will expand.

## LITERATURE CITED


Bureau of Sport Fisheries and Wildlife. 1975. The National Wildlife Refuge System. RL1A-R4, U. S. Dept. of the Interior, Fish and Wildlife Service, Washington, D. C. 4 pp.

93rd Congress, S. 1983. 1973. Public Law 93-205. 87 Stat. 884-903.

Smithsonian Institution. 1975. Report on endangered and threatened plant species of the United States. House Document No. 94-51, 94th Congress, 1st Session, U. S. Government Printing Office, Wash., D. C. 200 pp.

U. S. Fish and Wildlife Service. 1975a. Annual report of lands under control of the U. S. Fish and Wildlife Service as of June 30, 1975. Dept. of the Interior, Wash., D. C. 20 pp.

_____. 1975b. 35 years of shared wildlife management. Dept. of the Interior, Wash., D. C. 36 pp.

_____. 1976. Operation of the national wildlife refuge system. Draft Environmental Statement, Dept. of the Interior. 485 pp.

# A COHERENT APPROACH TO THE PROTECTION OF ENDANGERED SPECIES

by
Charles M. Parrish III, Executive Assistant
Georgia Department of Natural Resources

ABSTRACT

At the State level there are several techniques available to ensure protection of endangered plant species, in addition to acquisition of natural areas. Actual purchase of habitat is certainly one method, but it is expensive and the impact, in terms of the number of species protected is not impressive. Other techniques include managing all state-owned lands for endangered species, educating and assisting private landowners and incorporating endangered species criteria as an integral part of A-95 and NEPA environmental reviews. In order for these efforts to be effective, a systematic and thorough endangered plants inventory, undertaken cooperatively by scientists, citizens and government, must be vigorously pursued.

The assigned topic for this discussion was the "Preservation of Endangered Plant Species Through Natural Areas", and while that is an important tool in state preservation efforts, it is only one of a variety of techniques available to us. It becomes an even more limited tool if one means by "Preservation of Endangered Plant Species Through Natural Areas," the actual acquisition in fee simple of those natural areas. The discussion which follows will be about the State of Georgia's program, what we like to think is a coherent, practical and effective, if fledgling program for the protection of endangered plant species.

In order to protect endangered species, we must protect the habitat, and there are a number of tools available to accomplish this objective. The most obvious and direct approach to protection of habitat is to simply go out and buy it. The Georgia Heritage Trust Program, established in 1972 by Governor Jimmy Carter, is a continuing and systematic acquisition program, designed to identify and rank for public acquisition those lands that best exemplify our natural and cultural heritage. The program is comprehensive in that all land acquisition--for wildlife management areas, parks, historic sites, natural areas, water access, scientific and educational purposes, trails--is channelled through the Heritage Trust. The result is coordination, expertise and flexibility in acquisition heretofore impossible. More importantly multi-purpose use of sites is programmed from the beginning, insuring that the public will derive maximum benefit from the site.

While the presence of endangered species is an important criteria in the acquisition of natural areas through the Heritage Trust program, the Department also looks for areas that are relatively undisturbed, that

retain their natural characteristics and contain populations of plants and animals worthy of protection for educational and interpretive purposes as well as for the simple enjoyment of man.

Panola Mountain State Park, a 537-acre park located 18 miles southwest of Atlanta, is such an area. It is characterized by rock outcrops and contains a number of species endemic to granite outcrops such as Elf-orpine, (Diamorpha cymosa (Nutt.) Britton). Panola is a conservation park with a system of self-guided nature trails and interpretive programs to encourage visitors to listen, watch, smell, taste and spiritually touch a small tract of wilderness.

Through the Heritage Trust Program, the State of Georgia has acquired natural areas in order to protect endangered species in several instances, the most notable example of which was the acquisition of the Phillips Tract or the "Big Hammock Natural Area," a 750-acre tract of land located in Tattnall County in the coastal plain in Georgia.

The Phillips Tract consists predominantly of a Pleistocene (or older) Sand Ridge on the northeast side of the Altamaha River flood plain. The site contains one of the last remaining undisturbed evergreen broadleaf hammocks along the entire border of the Altamaha River Swamp from Tattnall County southeast to McIntosh County. Included in the site is a strip of the Altamaha flood plain on the southwest border, and a series of drainageways on the northeast side that are dominated by Pond Cypress (Taxodium ascendens), Black Gum (Nyssa sylvatica), Ogeechee Lime (Nyssa ogeche), and Wax Myrtle (Myrica cerifera).

There are several unique features associated with this sand ridge. The forest contains the largest breeding population of Georgia Plume (Elliottia racemosa) known to exist, and the largest population or stand of Myrtle Oak (Quercus myrtifolia) known to occur in the interior of Georgia (Bozeman, 1971).

The Georgia Plume is presently found in only eight counties in the State of Georgia. The plant is a primitive member of the Heath Family (Erecaceae) with its closest relatives found in Japan (Wood, 1961). It grows commonly as a shrub or small tree and requires a sandy, well-drained soil. Attempts at transplanting this species for the horticultural trade have been quite unsuccessful for over a decade since the plant can be propagated only rarely by seed, and with some difficulty by root sprouts.

The most important aspect of this tract of land is that it contains more plants of Georgia Plume than all the other known populations combined. These plants, which inhabit more than 400 acres in this site, consistently produce more seed than other known populations, a possible reflection of the genetic variability and vitality of the populations. This site is truly a one-of-a-kind, last-of-its-kind, which must be protected.

The myrtle oak (Quercus myrtifolia) is a characteristic shrubtree of the Sand Pine-Scrub forest of the Central Highlands Region of Florida (Laessle, 1958). It has a sporadic distribution almost entirely limited to the Lower Coastal Plain in Georgia where it occurs on marine bars and alluvial sand hammocks of Pleistocene age (Bozeman, 1971). This stand of myrtle oak represents the most inland and most extensive population in the Atlantic Coastal Plain, north of Florida and could very well be a Pleistocene relic.

From the State perspective, management of this site for public education and enjoyment, while preserving and enhancing the resources for which it was acquired,represents a tremendous challenge. Currently, use of the area is limited to educational and research activities with visits by various universities and colleges allowed.

Obviously, acquisition of habitat is the most effective means of protection. Management for preservation is ensured. But what are the limitations of this approach? The answer is largely told in dollars and cents and the story is exemplified by the Georgia Heritage Trust Program. In 1973, at the program's inception, the Georgia General Assembly appropriated $12.5 million for the Heritage Trust and we maintained that an appropriation of that magnitude was needed for at least ten years in order to preserve endangered pieces of Georgias natural and cultural legacy. In 1974 the appropriation to Heritage Trust was $538,449; in 1975, $590,000; and in 1976 $50,000. Economic hard times hit State government severely. The Department of Natural Resources suffered budget cuts of 1.7 million in FY 1976. We bit the bullet, but clearly the message was that many programs would suffer. This was true for many Departmental programs of long-standing as well as for newer and more tentative programs such as Endangered Species Protection.

Even in times of economic growth and well-being, a single-minded approach to protection of endangered species through acquisition would likely fail. There are always limited resources and competing demands. Political support for a large number of single-purpose acquisitions would be unlikely, and, the management problems created by a large number of sites required to protect an endangered or threatened species would be awesome. Even if the State selected sites for maximum density, the impact in terms of the number of species protected would not be that impressive.

We have found, however, that in thinking about the problems I have enumerated above that there are workable alternatives to outright purchase which will result in an effective and vital endangered species program in Georgia.

Certainly, the first task is to ensure that protection of endangered plant species is a criteria in all purchase and management of state-owned land. On property already owned by the State we are adopting management objectives emphasizing a conscious application of the principles of management for the protection of endangered species.

It was through our Systems Planning and Master Planning efforts that we discovered the need to intensify management of state-owned land for protection of endangered species. We have just completed a Parks and Historic Sites System Plan which identified a need to assess the presence of rare or endangered species on all property--that property proposed for acquisition and that already in State ownership. General Development Plans, developed for each park in the State system, indicate the actual physical location of these areas on the park maps. These sites are then designated as "Special Management Areas," and detailed prescriptions for management are drawn up and given to the Park Superintendents to guide their protection efforts. Endangered species experts are prepared to go to these sites to sensitize and train on-site managers to the principles of management for protection of rare and endangered species located in their parks. At Reed Bingham State Park, the Superintendent recently burned a pitcher plant bog. Fortunately, in this case, he took the appropriate action. But it illustrated for us the vital need to educate some fifty Park Superintendents located all over the State, about proper management techniques for endangered species protection.

We anticipate Systems Plans for Wildlife Management Areas and Natural Areas, which will incorporate among their objectives emphasis on preservation of endangered species. General Development Plans, undertaken for each site will, as in the case of Parks, provide prescriptions for Special Management Areas.

Wildlife Management Areas represent real opportunities for special management. Generally, wildlife management areas are large tracts of land often containing a number of natural areas deserving special treatment.

A good example of this kind of opportunity is the Lewis Island Tract on the Altamaha River in McIntosh County. This 5,500-acre tract containing the only known stand of virgin cypress in the State is part of the 18,000-acre Altamaha Waterfowl Management Area. In the future, in addition to being managed for waterfowl, it will represent an important natural and interpretive area.

With the knowledge that we can never hope to acquire all of the habitat necessary to protect threatened or endangered species we will continue to acquire critical pieces of land, like the Phillip's Tract and Lewis Island, and to manage our own land with protection as a major objective.

But a second thrust, and perhaps an even more important one in the long term, involves our work with landowners across the State. In order to be truly effective, the State must work closely,advising and assisting private landowners about the presence and proper management of endangered plant species on their property. That, in turn, necessitates a well publicized and free exchange of information among scientists, landowners,

and the public in general in order to identify and locate species that warrant protection.

A dramatic example of the possibilities of this cooperative approach can be illustrated by our work with a major timber company on the Altamaha River in Southeast Georgia. The area under study involves 250,000 acres of land and 64 river miles along the Altamaha River. The property contains representatives of approximately 12% of the plants and animals on the State list of endangered or threatened species. We have already identified nine species of animals that are on the State list of endangered animals including the Short-Nosed Sturgeon, the Alligator, the Eastern Brown Pelican, and the Southern Bald Eagle, among others. There are likewise at least ten endangered plants that we have either seen or suspect because of appropriate habitat including Pond Spice (Litsea aestivalis) and Swamp Holly (Ilex amelanchier). Our job is to identify areas for special management and to propose the form that the special management should take; whether it be buffer strands along the shoreline or natural areas inland from the river that should not be timbered, or which should be burned, or which need some kind of special prescription. It is very likely that some of the shoreline buffer strands will be donated to the State to manage. However, we are hopeful that some of the inland sites which will remain in private ownership will be managed by prescriptions prepared by State botanists and biologists.

Another example of a request for assistance involved a private industry with headquarters on the Chattahoochee River. They owned habitat appropriate for several endangered plant species and contacted the Department for assistance in establishing a natural wildflower garden emphasizing rare or endangered plants. The property consists of 70 acres of upland hardwood that will probably support pink and yellow lady slippers and a variety of rhododendrons.

In order for the State to take advantage of these opportunities and in order for us to initiate cooperation with landowners, we must do several things. First, we must maintain a diligent and continuing program to inventory endangered species. Within the Department of Natural Resources we have two major programs that address this need. The Natural Areas Unit, through information made available by the State Resources Assessment Program (including topographic maps, soils and vegetation maps and aerial photographs) identified those environments where populations of endangered species are likely to occur. Using that information and following leads provided by fellow botanists and concerned citizens, the Natural Areas Unit conducts field inspections of each site.

A file is maintained on each site. Such an inventory is critical for identifying populations of endangered species that might be destroyed by various development projects. One of the most critical tasks before us now is developing the capability to work with developers in the planning stages of their projects by assisting them in the development of alternatives that lessen the impact of human expansion on endangered species. A good example of the need for this capability is the Appalachian Highway Project or Georgia 400, a development highway proposed for North Georgia.

In the fall of 1975, the Department of Natural Resources reviewed the Draft Environmental Impact Statement for this project. Five alternative routes were described in the Draft EIS and a list of endangered plants accompanied each alternative. They were not located on a map and our inventory was not adequate to assess the accuracy of the list. But the real issue here is that we should have been looking at the problem long before, when the alternatives were being formulated. With an adequate inventory we could have recommended routes that would have avoided critical colonies of endangered species. We must develop that capability.

Our greatest need in Georgia now is to concentrate our efforts on a systematic inventory of endangered plants in our State. The Department, through its environmental review of Federally-supported projects that occur in Georgia, can have a tremendous impact on protection of endangered species. But we must know where they are. We must begin to seek more information and assistance from scientists and we must encourage the public at large to share information.

In the context of our review of federally assisted projects in the State, we must encourage major land-holding Federal agencies in our State, such as the U. S. Forest Service, to identify and designate special management areas within the national forests. While management of the Chattahoochee National Forest seems to be increasingly sympathetic to these kinds of concerns, it is our duty as the state natural resources agency to assist them in data-gathering and to advise them about special management for protection of endangered species.

Section 404 of PL 92-500 mandated that the Federal government issue permits for the discharge of dredged or fill material into navigable waters. This three-phased program, administered by the U. S. Army Corps of Engineers, will eventually require permits for any dredging activities on any stream or wetland in the entire State. As you know, coastal and inland wetlands represent niches that are often rich with endangered or endemic species. This program represents a real opportunity to protect endangered species through our review process.

But the entire program has been threatened in the House by the introduction of the Breaux Amendment to H.R. 9560, which would redefine navigable waters to include only those waters that support interstate or foreign commerce. If we lose the 404 program, we lose a major tool for protecting endangered species.

Another major thrust of our efforts must be toward implementing the Federal Endangered Species Act, which required that once a species is identified as endangered, a management plan must be established to restore the species. We must use publicly owned lands in that effort and we must acquire public lands with that objective in mind. As a small part of that effort, the Natural Areas Unit is establishing a catalog of habitats available for transplanting. The physical

parameters of each site are described in great detail, so that if destruction of an endangered plant is inevitable, it can be moved to an appropriate site.

We also need to turn our efforts to enforcing the rules and regulations already in existence for protection of endangered plants. The Board of Natural Resources has adopted "Rules and Regulations for the Protection of Endangered, Threatened, Rare or Unusual Species". These regulations officially designate a list of plants and animals which will be protected in Georgia and provide a procedure for nomination to the list. Removal of any protected plant species from public land is prohibited unless permitted by the Department. Sale of any protected plant species is prohibited unless the plant was grown on private land and is being sold by the landowner or with the permission of the landowner. Furthermore, removal of protected plants from private land is forbidden without a permit from the Department and written permission from the landowner.

These regulations will provide us with a means to regulate collecting, a practice, which as frequently as transportation projects destroys colonies of endangered plants.

Clearly, we have many tools at our disposal to ensure protection of endangered plant species. But if we are to be truly effective, we must work together in our efforts. Scientists must work with public officials and public officials at the State level must take the initiative with private landowners and must encourage a sensitive attitude on the part of other State agencies and Federal agencies. We must understand together what and where the resources are that we want to protect and how we want to protect them. Then we will be able to make coherent and informed decisions about the future of these resources.

# THE STATE NATURAL HERITAGE PROGRAMS

Robert M. Chipley[1/]

Abstract.--The Nature Conservancy has established the State Natural Heritage Programs to create a systematic process for the management and analysis of ecological data on the elements of natural diversity, which include plant community types, aquatic types, and endangered, threatened and rare flora and fauna. The programs are conducted in cooperation with an agency of the state government. In the Southeast, programs are currently underway in North Carolina, South Carolina, Tennessee, Mississippi, and West Virginia.

There are scientific, practical, and esthetic reasons for wanting to preserve genetic diversity. The purpose of this brief presentation is to point out that, in the case of endangered plants, we can at least come close to this goal, if the task is approached systematically.

Since endangered plants are rarities, frequently confined to unusual or marginal habitats, this means that this ten percent of the flora occupies a very limited amount of ground, probably less than one percent of the land mass (Jenkins 1975). A minimum system of preserves, if accurately aimed at this fraction of the landscape, could probably perpetuate most of these species. The problem becomes, then, the systematic identification and protection of the habitats most critical for this fraction of the American flora.

At The Nature Conservancy, our approach toward the problem of identification and protection of critical habitats has been to create what we term the State Natural Heritage Programs. At present, five of our eight programs are in the Southeast, so we have a particular interest in and commitment to this part of the country. The states in which we currently have ongoing or forthcoming programs are North Carolina, South Carolina, Tennessee, Mississippi, and West Virginia. The stated purpose of the program is to preserve, in the greatest degree possible, the spectrum of natural diversity which exists in the state. The programs are generally conducted under a one-year contract or memorandum of agreement with an appropriate state agency, such as the state department of conservation. At the end of one year, a comprehensive system for the accession, management and analysis of ecological data is delivered to the state.

The Heritage Program generally consists of four phases. These are (1) Program Development, (2) the Pilot Inventory, (3) Protection Planning, and (4) Program Continuation and Implementation.

## PROGRAM DEVELOPMENT

Program Development involves hiring and training the program staff, setting up the office in the state, creating a classification system of what we term the elements of diversity, and installing the data management apparatus. The last two points are the core of the methodology, and will be further elaborated.

---

[1/] Staff Ecologist, State Natural Heritage Programs, The Nature Conservancy, Arlington, Va.

## Classification System

The purpose of the classification system is to create a listing of what we term the elements of natural diversity occurring in the state. As defined by the program, an element is a natural feature of particular interest, either because it is unique or endangered within the state or nationally (such as the Tennessee Cone Flower) or because it represents an important type (such as the Cypress-Tupelo Swamp). The purpose of the classification system is to identify, define, and catalog these elements by class. This structure forms the basis for the orderly gathering of information during the inventory phase of the program. Initially, the classification system will involve a hierarchical ordering of plant communities and aquatic types, and a listing of special species (including those which are endangered, threatened, rare, endemic, peripheral, or otherwise of particular concern and interest). The system may be expanded to include geological, historical, archeological, and other classes of elements. In addition, as further information becomes available, new elements may be added under each class, and some existing elements may be redefined, broadened, or subdivided. The classification is completed with the input of in-state experts, previous scientific work and already existing national and state classification schemes. The underlying assumption of the classification is that, if we can locate protected examples of each of the described types and species, we will have gone a long way toward preserving the natural diversity of the state.

## Data Management System

Information is collected and stored on an element-by-element rather than site-by-site basis. The data management system consists of two components: the manual files and the computer-assisted Lowest Common Denominator File. The extensive manual files contain information on each of the elements in the classification, map files for maintaining and displaying the localities of the various elements, aerial photos, and other pertinent information. The computer-assisted Lowest Common Denominator Element File is designed to incorporate efficiently the minimum amount of data necessary for analysis of the location and characteristics of occurrences of the elements, and direct the user to the manual files only if further information is desired. Minimum data includes the name of the area on which the element is found and its geographical coordinates, the name of the owners and the protection status of the area, the size, and items of general description. This information can be accessed in any of several combinations, depending on the needs of the system-user.

## PILOT INVENTORY

This phase of the program involves the actual collection of data on the elements described in the classification, and the entry of this data into the data management system. Initially leads are generated by reviewing earlier inventories, the general literature, consulting with experts, and investigating museum collections. As these leads are generated, a preliminary analysis will guide the program staff toward information gaps, that is, the types of elements for which we have little or no data. Using this "gap analysis" we will be able to concentrate our data gathering on the types for which we have the least information. At some point in the program, when existing information has been largely exhausted, we can more efficiently target our priorities for conducting in-depth field surveys.

The major outcome of this task is the setting into motion of the data-gathering process. The information flow will be started and established for the continuing operations of the program.

## PROTECTION PLANNING

This phase of the program involves planning for the protection of the ecological elements identified during the inventory. This phase is done independently of the first two phases of the program in that it can be completed during the early stages of the program or near the end of the pilot inventory. The major product of this phase will be the survey of existing and potential protective mechanisms for ecological resources and natural areas in the state.

## PROGRAM CONTINUATION AND IMPLEMENTATION

By the end of the contract period, the state should have at its disposal a continuous process of ecological inventory, data management, and protection planning for the preservation of its natural heritage. At this point, the Conservancy's role changes in scope from an operational to an advisory capacity. The Conservancy will ensure that the transition to state management will be a smooth one, and that any further improvements in methods and technology will be made available to the state.

## APPLICATIONS OF INVENTORY DATA

The inventory data can be analyzed and applied toward several uses, depending on the needs of the data requestor. For preservation purposes, we may wish to know which natural elements are the rarest and most vulnerable in the state; we therefore ask the system to tabulate the number of reported occurrences for given elements, and to tell us whether or not they occur on protected sites. We may then choose the element, such as an endangered plant, with the fewest or no reported occurrences on protected lands as a prime candidate for the limited funds at our disposal.

A further application will be in the field of environmental impact assesment, long hindered by a lack of state, regional, or national perspective. The criticality or significance of any individual site (or alterations to the site) cannot be judged by reference to that site alone. If, however, comparable data exists on many sites, systems, or features within the state, one can gain the perspective necessary for estimating the relative significance of any single site. The Heritage system will provide the structure and methodology for collecting the standardized data by which such comparisons and evaluations can be made.

Another use will be for planning purposes. A state or municipal agency may wish to know which areas are ecologically significant within a certain district; by use of overlays, the system can display ecological information in relation to other land-use parameters such as agriculture, corridors, and urban districts.

One important feature of the computer system is its flexibility. We have practically no set analysis patterns but can rather adjust to fit the needs of the system-user. In other words, if a request is made by a valid user for data on a particular species, we will be able to produce a map of the locations for the species, and a print-out with the general description, size, and owner-

ship of each site where it occurs, when the site was last surveyed, the source of lead for each occurrence, or any combination of these. If information is requested on a county-by-county or grid basis, the computer is able to sort out the requested data. The option exists within the system for suppressing locality information.

It is important to note that, in the State Natural Heritage Programs, the most important product is the process itself. Our goal is to establish a cooperative effort between the public and private sectors for the identification and protection of those areas which best represent the state's natural heritage.

## LITERATURE CITED

Jenkins, R. E. 1975. Endangered plant species: a soluble ecological problem. TNC News 25(4): 20-21.

# NATURAL AREAS IN THE APPALACHIAN SECTION REGISTERED WITH THE SOCIETY OF AMERICAN FORESTERS

Keith A. Argow[1/]

The Natural Areas program of the Society of American Foresters includes the continental United States, Hawaii, and Alaska. The program is administered by geographic sections recognized within the SAF. My comments today are directed towards the Appalachian Section, which in our context includes Virginia and North and South Carolina. Since this is a conference on endangered plants throughout the Southeastern U.S., it should be noted that similar SAF programs are operative in the Tennessee-Kentucky section, the Florida section, the Georgia-Alabama section, and the Gulf States section.

In addition it should be noted that the SAF Natural Areas system is founded upon forest types, as might be expected with a professional forestry society. The program is based upon the publication Forest Types of North America published in 1954 by the SAF. This descriptive guide is in the process of revision now; however, we anticipate few major changes in type classifications. Although established to protect forest types, SAF Natural Areas also protect the flora and fauna inherent in their ecosystems.

The forests of Virginia and North and South Carolina are diverse. They range from the spruce-fir caps of the Smokies to the sand live oak-cabbage palmetto forests of the South Carolina coastal plains. Three physiographical zones are recognized: Appalachian Mountains, Piedmont, and Coastal Plains. Within these three States at least 55 separate forest types occur. This number may be higher due to the possibility that some southern forest types not included in the tally do extend into the coastal plain and some central forest types extend east into Virginia and North Carolina. The SAF has registered a total of 47 natural areas in the section encompassing some 42 forest types. A list of forest cover types occurring in SAF Natural Areas in the Appalachian Section is appended to this paper.

Although at first glance our system would appear to be quite complete, 13 forest types are not represented at all. Noteworthy among the omissions are sugar maple, eastern red cedar, yellow-poplar (pure), longleaf pine, Virginia pine, and pondcypress.

Nineteen forest types are represented only once. Among this group are black cherry, red spruce (pure), scarlet oak, black locust, white oak, northern red oak, shortleaf pine-oak, and water tupelo.

---

[1/]The author is Associate Professor of Forestry at Virginia Polytechnic Institute and State University and is chairman of the Natural Areas Committee for the Appalachian Section of the Society of American Foresters.

## The Purpose of Natural Areas

The SAF Natural Areas system has been established primarily for research purposes. They are "control areas," tracts of land where nature is allowed to take its own course. They provide useful silvicultural and other information about what happens in southeastern forest types when they are unmanaged. By comparing data, we can gage the influence and results of forestry management practices relative to natural ecosystems.

The goal of the Appalachian Section Natural Areas committee is to reserve two representations of each type occurring in the section. Some species which have a wide range and exhibit regional and site variations will require multiple representations within the system to be adequately represented (i.e., loblolly pine).

## History of SAF Appalachian Natural Areas

The first tract of land in the Appalachian Section to be set aside for a natural area was Black Mountain, North Carolina. A part of the Pisgah National Forest, this 1,400-acre natural area on the east slope of Mount Mitchell was established by the U.S. Forest Service in 1933. Ramsey's Draft and Little Laurel Run--both on the George Washington National Forest in Virginia--followed in 1935 and 1937, respectively.

When the committee on natural areas was organized by the president of the SAF in 1947, the first mechanisms were established for SAF registration of natural areas. By 1949 the three foregoing U.S. Forest Service Natural Areas, plus two more areas established by the U.S. Fish and Wildlife Service, became a nucleus of the SAF Natural Areas within the Appalachian Section.

In the National committee's first report, Chairman John F. Shanklin noted that the program had been initiated upon the recognition by the SAF Division of Silviculture that practicing foresters needed a "more comprehensive knowledge of natural developments within virgin forest associations." Shanklin also noted that the action establishing the Committee on Natural Areas came "very late in our Nation's forest development history" and effective action was long overdue.

It became apparent to the new committee that the southern region of the United States was in most need of attention. To this end a grant was secured from Resources for the Future, Inc., to conduct a survey for potential natural areas. F. H. Eyre was appointed project leader and conducted an extensive field reconnaisance. In 1960 the "Survey of Proposed Natural Forest Areas in the Southeast" was published by the SAF.

## Inventory and Ownership

Aside from the Eyre report, the SAF has not conducted extensive inventories of natural ecosystems *per se*. These projects, which can be quite extensive and expensive, are left to State agencies, universities, and national organizations such as the natural heritage inventory program con-

ducted by the Nature Conservancy. The intent of the SAF Natural Area program is to give recognition through registration of significant natural tracts.

The Society of American Foresters does not seek ownership of the areas it registers. In fact, the SAF Natural Area program is entirely a voluntary registration which can be canceled by either party rather readily. More permanent protection is encouraged through formal action by private landowners in designating public lands as research natural areas, botanical areas, etc. If public ownership or some other form of protection of a natural area is desirable, then the assistance of a public agency or the Nature Conservancy is sought. A particular advantage in utilizing the Nature Conservancy is that it maximizes the tax benefits to the private landowner while at the same time preserving the area on the best terms available.

Administration of SAF Natural Areas

Basic responsibility for administering a natural area lies with the landowner. Most public agencies have ample regulations to accomplish this. Some conflicts do arise however in the area of public use, principally recreation. For this reason it is recommended that SAF Natural Areas not be designated on recreation use maps. If they are, a paragraph describing their purpose and the potential damage due to overuse is encouraged on the backside of the map.

Natural areas are not extensively signed. There is a small SAF boundary marker intended for use only on the main access routes. Boundary painting may be appropriate in areas where adjacent lands are under extensive management. Moreover, little publicity is recommended for these areas.

A current listing of natural areas including maps and information relative to ongoing research, etc., is maintained by the national office of the Society of American Foresters in Bethesda, Maryland. Many chapters also maintain current lists. Here in the Appalachian Section, we publish the Appalachian Natural Areas Directory. This publication carries maps, descriptions, and pertinent information for each natural area registered within the three States. It is intended as a method of communicating this information to forest researchers and others who have reason to be interested in the natural area system.

The Natural Areas Committee of the Appalachian Section is hopeful that at least some endangered plants are already represented in our growing natural areas system. We welcome your suggestions on expansion and look forward to working with you.

Attachment:

1. Appalachian Natural Areas Bibliography.

2. Summary of Forest Types Represented in Appalachian Section Natural Areas. 1976.

NATURAL AREAS BIBLIOGRAPHY

APPALACHIAN SECTION, SAF

Argow, Keith A. 1969. Project virgin: An action program for natural areas in the SAF Appalachian Section. J. For. 67:347-349.

Buckman, Robert E., and Richard L. Quintus. 1972. Natural areas of the society of American foresters. SAF. Bethesda, Md. 38 p.

Eyre, F. H. 1960. Survey of proposed forest natural areas in the southeast society of American foresters. Bethesda, Md. 40 p.

Federal Committee on Research Natural Areas. 1968. A directory of research natural areas on federal lands of the United States of America. USGPO. Washington. 129 p.

Franklin, Jerry F. et al. 1972. Federal research natural areas in Oregon and Washington. U.S. For. Serv. Portland.

Ohmann, Lewis E. 1973. Vegetation data collection in temperate forest research natural areas. U.S. For. Serv. St. Paul, Minn. 35 p.

Romancier, Robert M. 1974. Natural area programs. J. For. 72:37-42.

APPALACHIAN SECTION NATURAL AREAS - 1976

Summary of Forest Types Represented

VIRGINIA

| | | |
|---|---|---|
| 1. | Charles C. Steirly | SAF 102 Baldcypress - water tupelo, 19 ac. |
| 2. | Chestnut Ridge | SAF 41 Scarlet oak, 18 ac.<br>SAF 87 Sweetgum - yellow-poplar, 6 ac. |
| 3. | Chincoteague | SAF 87 Loblolly pine - hardwood, 135 ac.<br>Swamp and marshy area, 15 ac. |
| 4. | Clinch Mountain | SAF 29 Black cherry, 23 ac. |
| 5. | Holiday Creek | SAF 75 Shortleaf pine, 2 ac.<br>SAF 77 Shortleaf - Virginia pine, 17.5 ac.<br>SAF 87 Sweetgum - yellow-poplar, 10.5 ac. |
| 6. | Lick Creek | SAF 23 Hemlock, 30 ac.<br>SAF 58 Yellow-poplar - hemlock, 30 ac.<br>SAF 59 Yellow-poplar - white oak - no. red oak, 430 ac.<br>SAF 78 Virginia pine - southern red oak, 180 ac. |
| 7. | Little Laurel Run | SAF 21 White pine, 45 ac.<br>SAF 23 Hemlock, 127 ac.<br>SAF 44 Chestnut oak, 445 ac.<br>SAF 45 Pitch pine, 89 ac.<br>SAF 59 Yellow-poplar - white oak - no. red oak, 62 ac.<br>Barren and brush, 1,324 ac. |
| 8. | Mount Rogers | SAF 25 Sugar maple - beech - yellow birch, 820 ac.<br>SAF 34 Red spruce - Fraser fir, 332 ac.<br>Meadow grass and fern, 148 ac. |
| 9. | Mountain Lake | SAF 23 Hemlock, 75 ac.<br>SAF 24 Hemlock - yellow birch, 100 ac.<br>SAF 30 Red spruce - yellow birch, 60 ac.<br>SAF 43 Bear oak, 935 ac.<br>SAF 54 No. red oak - basswood - white ash, 433 ac. |
| 10. | Ramsey's Draft | SAF 23 Hemlock, 177 ac.<br>SAF 25 Sugar maple - beech - yellow birch, 89 ac.<br>SAF 44 Chestnut oak, 442 ac. |

| | | |
|---|---|---|
| 10. | Ramsey's Draft (continued) | SAF 45 Pitch pine, 26 ac.<br>SAF 52 White oak - red oak - hickory, 991 ac.<br>SAF 55 Northern red oak, 169 ac.<br>SAF 59 Yellow-poplar - white oak - no. red oak, 67 ac. |
| 11. | Rock Quarry | SAF 52 White oak - red oak - hickory, 27 ac.<br>SAF 87 Sweetgum - yellow-poplar, 13 ac. |
| 12. | Roland-Bull Run Mountain | SAF 59 Yellow-poplar - white oak - no. red oak, 20 ac.<br>Brush, 2 ac. |
| 13. | Swift Creek | SAF 52 White oak, 17 ac.<br>SAF 61 River birch - sycamore, 5 ac.<br>SAF 81 Loblolly pine, 26 ac.<br>SAF 82 Loblolly pine - hardwood, 10 ac. |
| 14. | Turkey Ridge | SAF 40 Post oak - black oak, 16 ac. |
| 15. | Willis River | SAF 93 Hackberry - American elm - green ash, 38 ac. |

NORTH CAROLINA

| | | |
|---|---|---|
| 16. | (1) Black Mountain | SAF 17 Pine cherry, 13 ac.<br>SAF 25 Sugar maple - beech - yellow birch, 126 ac.<br>SAF 34 Red spruce - Fraser fir, 542 ac.<br>SAF 44 Chestnut oak, 229 ac.<br>SAF 52 White oak - red oak - hickory, 419 ac. |
| 17. | (2) Chowan River | SAF 101 Baldcypress, 10 ac.<br>SAF 102 Baldcypress - water tupelo, 49 ac.<br>SAF 103 Water tupelo, 15 ac. |
| 18. | (3) Duke Forest | SAF 52 White oak - red oak - hickory, 27 ac.<br>SAF 81 Loblolly pine, 59 ac.<br>SAF 82 Loblolly pine - hardwood, 57 ac.<br>SAF 87 Sweetgum - yellow-poplar, 8 ac. |
| 19. | (4) Great Lake | SAF 98 Pond pine, 60 ac. |
| 20. | (5) Hemlock Bluffs | SAF 23 Hemlock, 1 ac.<br>SAF 44 Chestnut oak, 5 ac.<br>SAF 82 Loblolly pine - hardwood, 14 ac. |
| 21. | (6) Hill Forest | SAF 75 Shortleaf pine, 9 ac.<br>Buffer zone, 1 ac. |

| | | |
|---|---|---|
| 22. | (7) Hofmann Forest Cypress | SAF 101 Baldcypress, 20 ac.<br>SAF 104 Sweetbay - swamp tupelo - red maple, 8 ac. |
| 23. | (8) Kelsey | SAF 22 White pine - hemlock, 72 ac.<br>SAF 59 Yellow-poplar - white oak - no. red oak, 90 ac. |
| 24. | (9) Little Santeelah | SAF 23 Hemlock, 500 ac.<br>SAF 59 Yellow-poplar - white - no. red oak, 3,000 ac. |
| 25. | (10) Milltail Creek | SAF 97 Atlantic white-cedar, 36 ac. |
| 26. | (11) Nere Elexus Day Pond Pine | SAF 98 Pond pine, 25 ac. |
| 27. | (12) North Fork | SAF 34 Red spruce - Fraser fir, 200 ac. |
| 28. | (13) Piedmont Beech | SAF 52 White oak - red oak - hickory, 21 ac.<br>SAF 81 Loblolly pine, 25 ac. |
| 29. | (14) Piney Knob Fork | SAF 22 White pine - hemlock, 60 ac. |
| 30. | (15) Rocky River White Pine | SAF 21 White pine, 10 ac. |
| 31. | (16) Rough Creek | SAF 50 Black locust, 18 ac.<br>SAF 52 White oak - red oak - hickory, 5 ac. |
| 32. | (17) Salyer's Ridge | SAF 81 Loblolly pine, 75 ac. |
| 33. | (18) Schenck | SAF 82 Loblolly pine - hardwood, 25 ac. |
| 34. | (19) Three Forks | SAF 24 Hemlock - yellow birch, 2,203 ac.<br>SAF 30 Red spruce yellow birch, 2,030 ac.<br>SAF 32 Red spruce, 2,632 ac.<br>SAF 34 Red spruce - Fraser fir, 4,372 ac.<br>SAF 44 Chestnut oak, 826 ac.<br>SAF 58 Yellow-poplar - hemlock, 1,377 ac. |
| 35. | (20) Turkey Oak | SAF 72 Southern scrub oak, 90 ac.<br>pocosin, 43 ac. |
| 36. | (21) Upper Piedmont Research Station | SAF 44 Chestnut oak, 4 ac. |
| 37. | (22) Walker Cove | SAF 25 Sugar maple - beech - yellow-poplar, 55 ac. |
| 38. | (23) Windy Falls | SAF 51 White pine - chestnut oak, 103 ac. |

SOUTH CAROLINA

| | | |
|---|---|---|
| 39. | (1) Boiling Spring | SAF 82 Loblolly pine - hardwood, 9 ac. |
| 40. | (2) Bulls Island | SAF 74 Sand live oak - cabbage palmetto, 500 ac.<br>SAF 82 Loblolly pine - hardwood, 500 ac. |
| 41. | (3) Coon Branch | SAF 58 Yellow-poplar - hemlock, 15 ac. |
| 42. | (4) De La Howe Shortleaf Pine | SAF 76 Shortleaf pine - oak, 120 ac. |
| 43. | (5) Gulliard Lake | SAF 92 Sweetgum - Nuttall oak - willow oak, 4 ac.<br>SAF 102 Baldcypress - water tupelo, 14 ac. |
| 44. | (6) Juniper Bay | SAF 97 Atlantic white-cedar, 10 ac. |
| 45. | (7) Little Wambaw Swamp | SAF 102 Baldcypress - water tupelo, 60 ac. |
| 46. | (8) Scrub Oak | SAF 71 Longleaf pine - scrub oak, 39 ac.<br>SAF 72 Southern scrub oak, 8 ac.<br>SAF 92 Sweetgum - Nuttall oak - willow oak, 2 ac.<br>Marshland, 3 ac. |
| 47. | (9) Wassamassaw | SAF 102 Baldcypress - water tupelo, 7 ac.<br>Water, 3 ac. |

# DETERMINING DISTRIBUTION

Roy B. Clarkson[1]

Abstract. -- A knowledge of distribution and abundance is essential to decisions concerning the rarity of a taxon. Useful aids in determining distribution are regional manuals, monographs, books, scientific papers, regional herbaria, local floras, and local herbaria. The final determination of distribution and abundance depends on continuing field work to determine population dynamics.

Additional Keywords: Regional manuals, monographs, regional herbaria, local floras, local herbaria, field work.

It is obvious that a knowledge of the distribution of a taxon lies at the center of an understanding concerning its rarity. The expression "rare & endangered" is explicit in its implications concerning distribution and abundance. The term distribution implies not only the broad range of the taxon but also its occurrence with these limits.

## DETERMINING RANGE

Determining the known geographic range is an important step in achieving an understanding of distribution. Several important aids are available for this task.

Regional Manuals. -- Many individuals have a tendency to turn to regional manuals such as Gray's Manual of Botany, 8th Ed. (Fernald, 1950), New Britton and Brown Illustrated Flora (Gleason, 1952), or Manual of the Southeastern Flora (Small, 1933) and accept the distributions given as describing the range of a taxon. Such manuals are very helpful, however, the weakness noted below should be kept in mind.

The most important consideration in interpreting distributions given in regional manuals is the date of publication. A manual may become outdated very quickly, especially in areas receiving intensive field work. A second inherent weakness in manuals covering a large geographic area is the lack of detail given in the distributions. For example, the range of a naturalized shrub, Scotch Heather, (Calluna vulgaris (L.) Hull) is given by Fernald (1950) in Gray's Manual, 8th Ed. as "Peaty or damp sandy spots, always of small extent, very locally from Nfld., to Mich., S. to N.S., N.E., N.J. and mts. of W.Va.". At first reading this would appear to be a rather widespread plant, however, when detailed studies of actual populations are made this plants shows a remarkably disjunct distribution and is seen to be rare in every part of its range.

Despite these weaknesses, regional manuals, even old ones, are valuable tools for they call attention to taxa needing additional study and provide a starting place for such study.

---

1/ Professor of Biology and Curator of the Herbarium, Biology Department, West Virginia University, Morgantown, WV 26506.

Monographs, Books, Papers: Valuable supplements to distribution information found in regional manuals are found in monographs, other books, and research papers. Monographs concerned with plant systematics and/or plant geography usually contain detailed distribution data. These data are often summarized in distribution maps. Such data are invaluable in updating known distributions. Access to many monographs prepared in the United States as doctoral dissertations may be had through University Microfilms, Inc., Ann Arbor, Michigan. Pertinent material from many monographs are published in such journals as Taxon, Brittonia, American Midland Naturalists, and Castanea or in book form.

Several excellent books contain distribution information and/or maps. These are usually restricted to plants with a limited distribution or to particular plant types. Examples of these are: Harlow & Harper, 1968; Polunin, 1959; Good, 1964; Meusel, et al, 1965; Hulten, 1958, 1968; Little, 1971; Brown & Brown, 1972; and Critchfield & Little, 1966. The date of publication of such books is again an important consideration in interpreting the distribution data. "Index Holmensis" (Tralau, H., 1969, 1972), an index to distribution maps with worldwide and bibliographic references is an especially valuable source of information.

Regional Herbaria: Large regional herbaria have facilities for study and may lend specimens. These provide a basis for updating range information for specimens representing important range extensions are often sent by the collectors to these centers. Names and addresses of herbaria are found in Index Herbariorum (Lanjouw & Stafleu, 1965).

## LOCAL DISTRIBUTION

It is on the local level that the rarity of a taxon is determined. The number of known populations, and the location, size and dynamics of the population can only be determined locally.

Local Floras: Recent local floras such as Flora of West Virginia (Strausbaugh & Core, 1970), Manual of the Vascular Flora of the Carolinas (Radford, Ahles, Bell, 1968) and Flora of Missouri (Steyermark, 1963) are excellent sources of distribution data.

It is difficult to remain current in assessements of plant distribution, even at the local level. For example, since the revision of Strausbaugh & Core's Flora of West Virginia (Vol. 1-4, 1970-1974; Vol. 4 in press) over 20 taxa new to the State have been discovered. Several of these new records extend the known ranges. West Virginia is a relatively small, well botanized area. Larger, less botanized areas may expect a greater number of additions to there flora in a relatively short period of time.

Local Herbaria: Local herbaria are indispensable in distribution studies. Many herbaria have distribution maps for taxa collected in the region. These are useful for quickly checking the overall distribution. Many considerations are necessary in the interpretation of such maps, such as: How well has the area been botanized? Are collections recently made or are the herbarium collections outdated? How widespread are the populations sampled? If collections are sufficient the distribution of the plant may be considered well known, particularly if the taxon is easily seen in the field and identified or if its habitat is restricted to well defined limits.

However, if the taxon is difficult to see in the field, hard to identify

and/or grows in a variety of habitats the distribution may be much more extensive than herbarium vouchers indicate. The distribution of such plants may be considered as undetermined until further field work elucidates the distribution and abundance. Many grasses and sedges are in this category.

The local herbarium is also useful in establishing relevant facts concerning habitat, size of populations, date of collection, and abundance. These facts are necessary to decisions concerning the rarity of the taxon.

## UPDATING INFORMATION

Field Work: Manuals, monographs and herbaria all have a tendency to become static, unless continued efforts are made to update and revise records. All too often field work is de-emphasized in an institution after many years of activity. This allows the collections to become outdated and of limited value as time progresses. Only through vigorous and continuous field work can an up-to-date knowledge of the status of populations be determined. A forest fire, an access road or any of dozens of other things can obliterate or greatly restrict a population. Only through careful assessment of the population dynamics of a taxon can its survival probability be determined.

## PROBLEMS

One of the greatest problems in determining distribution involves nomenclature. Synonomy at the generic, specific and sub-specific levels makes comparisons of lists of endangered and threatened species very difficult. For example a genus is listed as Aureolaria in six state lists, Gerardia in six other lists and Agalinis in five additional lists. (John Kartez, personal interview). At the lower taxonomic levels the problem is even greater. A need for standardization of nomenclature is very pressing.

## LITERATURE CITED


Brown, R. G. and M. L. Brown. 1972. Woody plants of Maryland. 347 p. Univ. of Maryland.

Critchfield, W. B. and E. L. Little, Jr. 1966. Geographic distribution of the pines of the World. Misc. Pub. No. 991, USDA, For. Serv.

Fernald, M. L. 1950. Gray's manual of Botany, 8th Ed. 1632 p. N.Y.: American Book Co.

Gleason, H. A. 1952. The New Britton & Brown illustrated flora of the northeastern United States and adjacent Canada. Vol. I, II, III: 482, 655, 589 p. N.Y.: New York Botanical Garden.

Good, R. 1964. The geography of flowering plants. 3rd Ed. N.Y.: Wiley & Sons.

Harlow, W. M. and E. S. Harrar. 1968. Textbook of Dendrology. 5th Ed. 512 p. N.Y.: McGraw-Hill Book Co.

Hulten, E. 1958. The amphi-Atlantic plants and their phytogeographical connections. Kung. Svenska Vetenskapsakad. Handl. F. Jarde Series 7(1): 1-340. 279 maps.

Lanjouw, J. and F. A. Stafleu. 1964. Index Herbariorum. Part I. The herbaria of the world. 5th Ed. Regum Vegetabile 31: 1-251.

Little, E. L., Jr. 1971. Atlas of United States trees. Vol. I: 9 p. 200 maps. Misc. Pub. No. 1146, USDA For. Serv.

Meusel, H., E. Jager and E. Winert. 1965. Vergleichende chorologie der zentraleuropaischen flora. Jena. Gustav Fischer.

Polunin, N. 1959. Circumpolar Arctic flora. 514 p. Oxford: Oxford University Press.

Radford, A. E., H. E. Ahles and C. R. Bell. 1968. Manual of the vascular flora of the Carolinas. 1183 p. Chapel Hill: Univ. of North Carolina Press.

Small, J. K. 1933. Manual of the Southeastern Flora. Pub. by the Author, New York. Reissued in 1953 by the Univ. of North Carolina Press, Chapel Hill, N.C.; facimile reprint issued in 2 vols. in 1972 by Hofner Pub. Co.

Steyermark, J. A. 1963. Flora of Missouri. 1725 p. Ames: The Iowa State University Press.

Strausbaugh, P. D. and E. L. Core. 1964-1974. Flora of West Virginia, 4 Vol. Rev. Ed. 1-3. West Virginia Univ. Bull. Ser. 70: 7-2. 1025 p. Morgantown.

Tralau, H. (ed.). 1969, 1972. Index Holmensis, a world phytogeographic index. Vol. I -- Equisetales - Gymnospermae; Vol. II -- Monocotyledonae A-I. Scientific Publishers, Ltd. Zurich.

# STUDIES ON THREATENED AND ENDANGERED FOREST RELATED SPECIES OF THE SOUTHEASTERN AREA--A PROGRESS REPORT

Robert Kral 1/

Abstract.--The principal investigator in a cooperative agreement between the Forest Service and Vanderbilt University has initiated a study of threatened and endangered vascular plant species within the 13-state Southeastern Area, their habitat requirements and the effects of forest management practices on their survival and recovery. Mr. Nathan A. Byrd, Multiple Use Specialist for the Service and co-investigator, has coordinated the project which was initiated in June of 1975 and which continues in force through December 1976. Current data on threatened and endangered U. S. species are consulted from which are extracted only those with forest affinities and endemic to the southeastern U. S. A. Each species of these last is being checked as to its geographic range, its habitat, and its distinguishing characteristics. A list of pertinent literature is in preparation. Descriptions of the species are being done, these accompanied by how current management practice might influence, adversely or positively, each species.

The basis for a list of forest related species has been the "Report on Endangered and Threatened Plant Species of the United States," (15 December 1964) which was presented to the Congress by the Smithsonian Institution. Supplements to this list, those containing additions and deletions, are also consulted. From this list only forest related southeastern species have been selected, but the extracted list still involves over 200 species in that most of the southeast is or was forested. Inclusion on the project list of some species of open areas (i.e., cedar glades, granite outcrops, shale barrens, heavy earth formations such as the Black Belt) may be open to question; however, in such areas many of the species are seral to forest and in that sense are forest related. An attempt is being made to visit localities for as many of the species as possible within the limitations of project time. This, where possible, allows for the collection of voucher specimens of the species concerned and for the getting up of field notes on habitats and associated species. Where such is not possible, a consultation of specimens already collected together with an appraisal of available published information becomes necessary. During 1975 and early 1976 the bulk of field work has been in the States of Alabama, Florida, Georgia, and Tennessee. During the summer and fall of 1976 some field work in other parts of the southeastern forest area will be done. Visits to larger herbaria for locality information have been made or are planned. The Smithsonian collections have already been consulted; the very large collections of southeastern plants at the Herbarium, University of North Carolina at Chapel Hill, are also to be studied. A list of pertinent literature for each species is being gotten up largely by Mr. Ronald L. Jones, Assistant on the project and graduate student in Botany at Vanderbilt University.

---

1/ Professor of Botany, Vanderbilt University, Nashville, Tennessee.

## Results and Observations

Circa 100 species are now written up in rough form. Most of the remaining should be both visited in the field and/or written up by the fall of 1976. It is becoming increasingly evident that a listing of occurrence of many of the species is largely of historical value only. In the past decade increasingly large amounts of the habitat formerly occupied by endangered species have been badly bitten into by land developers, dam builders, pine monoculturists, row crop or stock farmers, etc. Thus, for example, many of the localities I personally have known and many gotten from older collections or collectors are no more.

A study of the species on my list shows most to belong to one or another of the following broad categories:

1. Plants of high hydroperiod soils, primarily in the bogs, swamps, flatwoods, and low savanna of the Atlantic and Gulf Coastal Plains. Many of the Orchidaceae, all the Sarraceniaceae, Droseraceae, many Cyperaceae, Juncaceae, Xyridaceae on my list belong here. Whether these are drained for agriculture or for pine plantations the result is the same, the plants are destroyed. A great many are also heliophytic and, therefore, even if the land is not drained, but planted or seeded to pine, the crown closure so desirable from the standpoint of pine production shades such plants out. The greatest number of endangered southeastern plant species probably fits in this category. Unfortunately, the same region is also one of the greatest potential for fast production of volumes of pine. I have no doubt that the greatest challenge to finding a compromise between good forest management and threatened species maintenance lies here.

2. Plants of outcrop areas. Most of the endemic succulents, Saxifrages, many composites belong here. Several are seasonal on or in the temporary pools or shallow soil pockets that form on or near the outcrops (Amphianthus, Isoetes, etc.). A few (i.e., Sedum nevii, Neviusia alabamensis) may occur on outcrops in shade, but most are again heliophytes, forest related only in a successional sense. Most are highly substrate specific, appearing on only certain chalks, limestones, shales, granitic rocks, etc., or on the thin soils overlying or adjacent to such. The greatest threat to many of these is through rock quarrying, through land development for human habitation or recreational use (witness the destruction of large parts of Stone Mountain!!) or through their development for low grade pasture (a major hazard).

3. Plants of high Appalachian forest and balds. Many of the most aesthetically pleasing species are here, in what might constitute the most ecologically sensitive situations of all. Several carices, Lilium grayii, Liatris helleri, Solidago spithamea, Prenanthes roanensis, etc., belong here, some confined to but a few summits in the mountains. Fortunately, many are on government land, either part of National Forest or in National or State Parks. Impact is greatest through exploitations for recreational use or through agriculture in the uplands, primarily grazing. Pressure is increasing from campers, backpackers, and vacationers.

4. Plants of sandhills formations or droughty sandy lands. Among such would be those species confined to the deep sands of the longleaf pine-turkey oak type, the sand pine-evergreen scrub type (as was once so well displayed in the Central Highlands province of Florida). The former is widespread through much of the Atlantic and Gulf Coastal Plain, the latter more local in the Coastal Plain, principally in Florida, but with extensions (and slight facies shifts) northward into Georgia and westward into Alabama. Largely poor agriculturally save for local conversion to fruit production (large scale in Florida!!) these have been a silvicultural challenge to the foresters and have been targets for an increased production of pine, this usually involving removal of competitive scrub species, particularly oak, and thus impacting endangered species. In that the pines are usually row planted, habitat alteration in site preparation or later when pine crowns close is such as to eliminate many of the herbs and shrubs. Fire, used as a management tool in maintenance of longleaf pine reproduction, and always a natural factor in the longleaf pine formations is a considerable factor here. Protection from fire permits further conversion of habitat away from suitable situations for many of these endangered species which are part of disclimax.

5. Plants of special soils related to a particular rock substrate. The Black Belt, for example, occupies parts of a large number of counties in Alabama and Mississippi. Much of this was prairie or savanna at the time of white settlement, but their heavy earths have been so converted to pasture and to row crop agriculture that we have little real information today as to what species they contained originally. Succession to forest appears similar to that occurring on the different calcareous rocks of middle Tennessee and northern Alabama, but forest use does not constitute the real threat to what original country remains.

6. Plants of the rich, mixed mesophytic formations, these best displayed in the Appalachian provinces and interior provinces westward. Many of these appear to occupy very narrow niches, are plants of climax forest soils, and are often among the first to fall victim to poor logging practice, either through resultant insolation, serious soil disturbance involving erosion, or through conversion of the forest either to croplands or pasture. Within the past decade, particularly strip mining has become a major problem. Ironically, the sort of forest practice recommended by the professional forester for most hardwoods (namely careful selection or group selection) would impact these species least; however, any plantwise traveler through this beleaguered part of the forest needs no detailed ecological study to conclude that, on much private and state land, such recommendations are seldom applied.

The abovementioned six cateogries represent the habitats occupied by most of the species on my list. The greatest impact, in the case of most, is through any approach toward monoculture, particularly of southern yellow pine. If the heavy equipment employed in site preparation does not destroy the plants outright, the successful establishment of a canopy of pines provides the finishing touch. If site preparation also involves drainage, it takes no great power of observation to conclude that a plant of high hydroperiod soil will die out. It is also obvious that pasturing of forest land be it high or low has the same ultimate effect. If some of our endangered species are weeds, they are very special weeds that tend not to move around much. A stand of them may be gone the year after pasturing.

## Final Observations

As I see it, the difficulties in saving endangered plant species are as follows:

1. We appear still to be far behind in our inventory. Much of the information that is being fed into computers is based on older records. I do not believe that many of these records are checked out today, or are inadequately checked out; thus, more effort in the field is needed on the part of many more trained personnel than are presently supported for such work. Talk to anyone today who is trying to do a state flora in the United States. In endangered species work much too much support appears to be given to administration. The way habitat is being wiped out, last year's record may be no good today. Continuing field inventory, as any who have done it know, is time consuming, expensive, but necessary.

2. We have a problem with education, even among our resource technicians. Most resource managers are understandably preoccupied with how to use the land in their charge or ownership profitably. Their jobs, their income depend on this. How is it possible to convince them that "x" number of species of grasses and sedges, or some of our less colorful composites, all of which comprise a challenge even to specialists, can be protected and at the same time allow for profitable land use? How is it possible to train a woods crew to identify plants, to do this at minimum loss to the efficiency of an operation? These questions have occurred to you all; we have little time to find answers.

In regard to my own work, certainly endangered species it seems to me ought to fit into the management plans for forested lands. Their disappearance from much of their former area ought to be one of the more alarming symptoms of land trouble in the country today, a warning that a large part of a system of forests that (without human manipulation) have provided vast revenues is being altered perhaps irreversibly and certainly to the loss of all.

In order to identify the problem, it helps to be able to identify the plants. The showiest species may, in the long run, show us the way. Everyone can identify a pitcher plant, a fly-trap, a ladyslipper. Of course, such plants are for the same reason victims of commercial exploitation. However, it may well work out that, under a blanket of sensible protection offered to the more conspicuous endangered elements, associated endangered species of grasses, sedges, etc., that are difficult for most of us to identify may themselves be protected. Thus, for example, when instructions are given to ease up on a particular pitcherplant habitat, several rare sedges and grasses will also benefit. So we are then face to face with what we all know must be done, namely to preserve some blocks of habitat intact, even if these be "nested" within largely manipulated areas.

What appears to be ahead for a lot of us who are concerned with preservation of endangered plant species is:

a. Further and timely census of existing localities, clarification of identifying characteristics both of the species and their habitats. Making this information available quickly to those who work with the land or shape land use policy.

b. Improved communication with land managers, coordination such as will lead to realistic incorporation of endangered species into management plans. This (again) has to involve accurate identification of both the species and their special habitat.

c. To explore further the possibility that a more sophisticated management can evolve, tempered as it will be with a better understanding of all parts of terrestrial systems. The fortunes made from the land as we found it are testimony to the fact that it, meaning all of its quirky species, had a place in making that profit. It should follow that this profitability arose through intact, healthy ecological systems, even the smallest parts of which must have significance economically if not aesthetically.

## Reference Cited

The Secretary, Smithsonian Institution. 1974. Report on endangered and threatened plant species of the United States. 200 pp. plus supplements.

# ENDANGERED SPECIES - QUESTIONS OF SCIENCE, ETHICS AND LAW

J. Frank McCormick[1]

## Abstract

Protection of endangered plant species is commonly sought through scientific research which may provide a better understanding of the environmental changes which threaten plant species. Other efforts focus upon the development of an environmental ethic to protect endangered species out of respect for life in all its varied forms. A final recourse is to secure protection of endangered species under law. The argument presented is that ecological research and evolution of an environmental ethic must be pursued, but neither will protect endangered plant species from extinction. Law and law enforcement are presently inadequate but offer the best promise of effective species preservation.

[1]Director , Graduate Program in Ecology and Professor of Botany. The University of Tennessee, Knoxville, Tennessee.

Species exist as populations. Each species shares a common environment with others and may modify that environment through the influence of biotic structure or products of physiological processes. Species populations interact with one another in the capture, conversion or movement of energy, nutrients and water within complex natural ecosystems. Accordingly, if research on species biology is to be applicable to problems of endangered species, it is imperative that we include analysis of the ecological niche of each species within the context of the total ecosystem.

Endangered species may acquire such status by remaining relatively immutable in a rapidly changing environment. The constant state of flux of the inorganic world has always been a driving force for organic evolution. However, the rate and magnitude of environmental change resulting from recent activities of a single species, Homo sapiens, exceeds the adaptive capacities of most species, most notably Homo sapiens itself. Each species identified as endangered is a symbolic alarm to the ecosystem of which it is a vital component. The cause for alarm is obvious. Actions and forces which alter the environment to a degree that the most sensitive biological components are endangered, in time, must also threaten additional species, interspecific relationships and eventually the entire ecosystem. Too often in an effort to justify proposed projects and also avoid species extinction, endangered species are protected by isolation or transplantation, much as a surgeon would treat for a localized cancer; when in fact the source of endangerment threatens the entire system as does the spread of cancer through the lymphatic system. Effective treatment eliminates the source of infection, purges the environment of contamination and stimulates repair of afflicted components. Unless we resist taking the path of least resistance, and unless we argue protection of the entire habitat, our legacy to future generations will be endangered animals in Zoos and endangered plants in gardens with no natural habitat to which they might return. Like simple surgery, transplantation is an effective deterent to extinction, but only as a last resort.

Extinction like birth and death of individuals is a natural phenomenon, but it is more significant in that beyond a shift in the equilibrium of mortality and natality there is an irretrivable loss of life form. The most significant questions concerning species extinction, like those often associated with death or pregnancy, relate to the cause of the condition as much as to the condition itself. The prescription offered is for biologists to look beyond the symptoms of species health and safety, to become consciously aware of the causes of species being endangered and to become professionally active in an attack upon these causes. The fight takes place in the arenas of science, ethics and law; each of which are at present mutually irrelevant.

In an egocentric society guided by anthropomorphic ethics, it is surprising that only yesterday we came to realize that human health is dependent upon environmental health. How long will it be before we consciously acknowledge the unconscious reality that not only Homo sapiens, not only certain animals, but all species, including plants, are endangered by the consequences of similar stresses, philosophies, policies and actions?

## QUESTIONS OF SCIENCE

Endangered species include those unable to acclimate, adjust or adapt at a rate compatible with environmental change. Species-environmental relationships are by definition and practice the subject of ecology. Certain deficiencies in this young science are in part responsible for the plight of endangered plant species. Illumination of these problems may identify paths to progress.

Ecologists appear to be poor teachers. The lessons of ecology are either poorly taught or there is an organized resistance to their acceptance. We appear to have been spectacularly unsuccessful in explaining the interdependencies of plants, animals and man in the world wide operation of the first and second laws of thermodynamics. Biologists must recognize endangered plant species as sensitive components of an endangered system. Research efforts which focus on individual plant species apart from their role in the ecosystem will be only partially rewarding.

A very serious problem is that most biologists do not recognize the existence of plant species as populations. Ecology texts and courses describe plants as components of "communities", units of landscape structure. Animals on the other hand, are acknowledged to exist as "populations" regulated by complex interactions of density dependent and density independent factors. Plant populations are seldom subjected to the rigorous demographic, experimental and mathmatical analysis which characterize studies of animal population dynamics. Noteworthy exceptions include P.B. Cavers (1967), J.L. Harper (1960), J.M. Hett (1968), J. Pelton (1953), and R.R. Sharitz (1973). The paucity of research on the population dynamics of plants leaves us unnecessarily ignorant of the interactions between plant species and the stresses which threaten their survival. We are particularly lacking in quantitative information essential for prediction, which is an important measure of the power of any science.

The ecological concept of microenvironment recognizes the ultimate subdivision of environment to which species are responsive (Platt, 1958). A corollary to this concept is that there are specific stages in the life cycle and specific physiological processes which are orders of magnitude more sensitive than others to environmental stresses. It is imperative that we go beyond analysis of species distribution and abundance and identify the life cycle stages and life processes most endangered by a changing environment. The dimensions of environment are space and time. Our research design must account for variations in the sensitivities of endangered plant species from time to time and place to place.

The dominance of reduction analysis in scientific methodology is yet another unfortunate characteristic of research in species biology. Reduction analysis can reveal specific determinants of population growth, survival and diversity. Holistic analysis coupled with the reduction approach can not only identify cause and effect relationships between endangered plant populations and environmental stress, but also the threats of environmental stress to species extinction and to the entire ecosystem. Plant populations, common, rare or endangered are so much a part of the complex fabric of natural

made in the following areas if we are to obtain effective legislation: 1) a re-definition of plants as being under the stewardship of landowners rather than as being possessed as property; 2) attainment of legal "standing" for plants as currently enjoyed by other forms of life and even by some inanimate objects; and 3) more realistic environmental law curricula.

Concepts of ownership and possession change rapidly as evidenced by the emancipation of felons, slaves, and women within a few decades. Emancipation of plants as property may be the final blow ushering the demise of the untenable, Baconian philosophy that man has dominion over nature. Garrett Hardin in the preface to Christopher Stone's classic "Should Trees Have Standing" (1974) argues that property is mistakenly treated as a noun instead of a verb, and is accordingly erroneously accepted as a possession. In fact, property exists only in the sense that there are property rights which recognize certain actions may be taken to protect objects against acquisition or mistreatment. In the verbal sense, property is the existence of defenses against uses of objects in contradiction to those uses intended by the steward of record. If the concept of property is modified to include defense against extinction, or if plant species gain the legal standing of other life forms, endangered plant species may enjoy protection under law. Both seem possible in view of the rapidity of changes in concepts of ownership and the narrow (4-3) defeat of Supreme Court Justice Douglas's dissent in the 1972 case of Mineral King vs. Sierra Club. The dissent argued for the legal standing of plants, and it almost passed. A final problem is the inflexible curricula available to those pursuing training in environmental law. Few environmental law curricula include relevant biology, ecology or environmental science courses. Consequently, those in a most advantageous position to speak for endangered plant species are inadequately prepared to do so.

In summary, many plant species are endangered because of scientific negligence. The most rigorous scientific techniques available are seldom applied to the analyses of plant populations, the reductionist philosophy emphasises differences rather than similarities of all life-forms, and the holistic philosophy of ecology has not been effectively applied to studies of endangered plant species. An environmental ethic has not yet evolved which protects plant species in their struggle for existence and the trophy mentality of the Conservation Esthetic has not yet been rejected.

In the absence of ethical behavior, law and law enforcement appear to offer the most expedient protection to endangered plant species. The path to progress forks into two trails, both of which must be explored; both of which lead us away from extinction of endangered species. The longer, more difficult, more idealistic trail leads to the development of an environmental ethic compatible with that prescribed by Leopold (1949), Muir (1918), and Santmire (1970). The shorter, less difficult and more realistic path leads to improved ecological research in plant population dynamics; attainment of legal "standing" for plant species, rejection of the concept of plants as property, and improvements in environmental law curricula. In the absence of ethical restraints, legal restraints upon freedom of action should be considered a last resort. The most serious and tragic consequence of our inability to guide our lives and our nation by an environmental ethic is, by the course of law, a continued loss of corporate and personal freedom.

## LITERATURE CITED


Baldwin, E. B. 1949. An Introduction to Comparative Biochemistry. London. G.B. Cambridge University Press.

Cavers, P. B. and J. L. Harper. 1967. Studies in the dynamics of plant populations. J. Ecol. 55: 59-71.

Harper, J. L. 1960. Factors Controlling Plant Numbers. In J. L. Harper (Ed.) The Biology of Weeds, p. 119-132. Blackwell, Oxford.

Hett, J. M. and O. L. Loucks. 1968. Application of Life Table Analyses to Tree Seedlings in Quetico Provincial Park, Ontario. Forest. Chron. 44: 29-32.

Leopold, A. 1949. A Sand County Almanac. Sierra Club/Ballentine A. New York.

Muir, J. 1918. My First Summer in the Sierra. In Sierra (Ed.) The Writings of John Muir. Boston. Houghton Mifflin Company.

Pelton, J. 1953. Ecological Life Cycle of Seed Plants. Ecol. 34: 619-628.

Platt, R. B. 1958. The Ultimate Subdivisions of the Environment and Species Adjustment. Bull. Ga. Acad. Sci. 16: 84-91.

Santmire, H. P. 1970. Brother Earth. New York. Thomas Nelson Inc.

Sharitz, R. R. and J. F. McCormick. 1973. Population Dynamics of Two Competing Annual Plant Species. Ecol. 54: 723-740.

Stone, C. D. 1974. Should Trees Have Standing? Los Altos, California. William Kaufmann, Inc.

Whitehead, A. N. 1925. Science and the Modern World. New York. MacMillan Publishing Co., Inc.

# SPECIES BIOLOGY: DEFINITION, DIRECTION, DATA AND DECISIONS

J. R. Massey and Paul D. Whitson[1/]

Abstract.--Decisions concerning preservation of rare, endangered and threatened species should be based on biologically sound information. The urgency of the situation dictates that a comprehensive system of information collection, storage and retrieval be developed which will promote the collection of comparable information facilitating decisions on species preservation. A model for such a system for Species Biology Studies is discussed which consists of four basic fields of evidence--reproduction, dispersion, establishment and maintenance. Basic high priority questions in each field of evidence are posed and classification for character classes, and characters with selected character states for studies of reproductive biology of endangered species is presented.

## INTRODUCTION

"Species biology" is a holistic approach to the understanding of individuals, populations and population systems through the use of evidence from many different fields or disciplines. It involves an understanding of organisms with respect to their structure, function and position with a time reference. Such studies of the biology of a species or other taxonomic rank involve the work of generalists as well as specialists. This work represents, in part, a reversion to the much needed types of studies made by naturalists of the last century but with a fundamental difference--the application of the best concepts, techniques and equipment of today's specialists. Another difference is that we must in the case of rare, endangered or threatened species focus on the common goal of species preservation--rather than just intellectual curiosity.

Our studies must have specific direction and established priorities. Our first priority should be to understand a species to the point that we can make biological and economic decisions concerning this species at a particular site, in a specific community-habitat type, at a given locality. Studies of specific taxa must be conducted as soon as possible which focus on questions which will allow us to make sound decisions at the earliest possible date. Assuming that we have mostly identified the first order of taxa to be preserved, the question which must be answered is: What information must be collected which will give us this necessary level of understanding to preserve or conserve species both now and for the future?

## GENERAL SYSTEM

A general model seems necessary for us to relate and develop informational systems and establish priorities as well as to pose basic high priority questions.

---

1/ Curator of the Herbarium, Department of Botany, University of North Carolina, Chapel Hill and Executive Secretary, Federal Committee on Ecological Reserves, National Science Foundation, Washington, D. C.

In the organizational model (Figure 1) we have tried to compartmentalize the essential aspects of a species, which should also be applicable to communities or ecosystems, into four major fields of evidence - reproduction, dispersion, establishment and maintenance. Within these four fields of evidence we

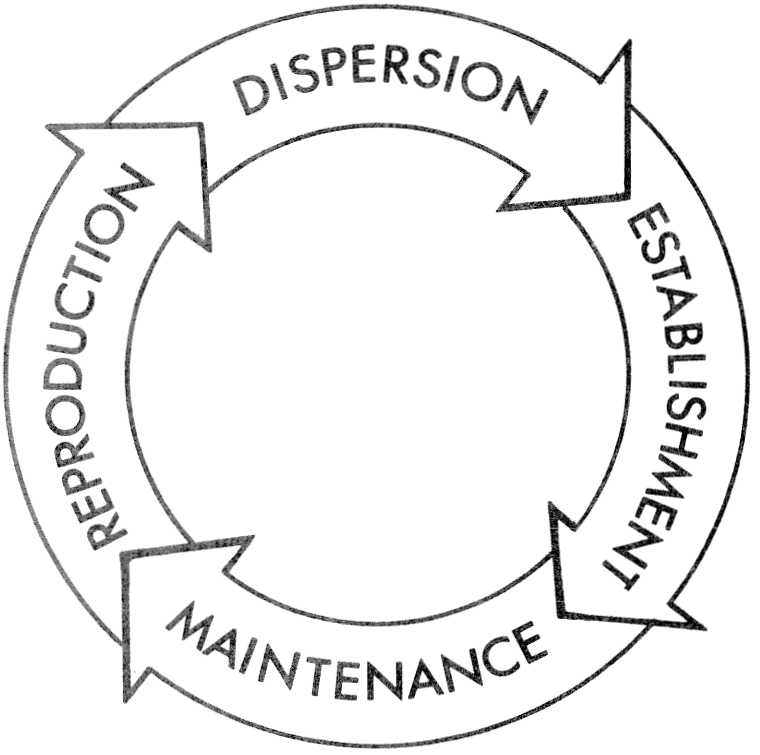



Figure 1. - Fields of evidence for understanding the Species Biology of rare, endangered and threatened plants.

propose two subsystems of information based on priority. To establish priorities we have asked a series of basic questions which seem to require answers early in our species studies which will give us data to make preliminary decisions or assist in guiding further study. Examples of decisions which might be made at this point for a species X are:

1. Species X is indeed endangered, based on field experience, and must be preserved.
2. Species X preservation must include a certain minimal area.
3. Species X preservation depends on the presence of a Species Y.
4. Species X will require habitat management.
5. Species X would best be preserved by the protection of a specific site.
6. Species X is a component of a stable community and little or no management will be required.
7. Species X requires additional study in specific areas before any far-reaching decisions are made.

We propose a preliminary list of questions that species biologists address in each of the four fields of evidence in Priority Class 1. These questions should be answered for each site selected for study and summarized for each species prior to decision-making.

| REPRODUCTION | DISPERSION | ESTABLISHMENT | MAINTENANCE |
|---|---|---|---|
| Is the population reproducing? | Are viable propagules present at a site? | Are new individuals present? | Is there a range of age & maturation classes? |
| What types of reproduction are occurring? | What types of propagules are present? | What is the origin of the new individuals? | What are the age and maturation classes present? |
| What types of breeding systems are operative? | What is dispersed? | What type of establishment processes are operative? | What is the % of the population in each class? |
| What types of pollination systems are found? | What are the dispersal agents? | Where is establishment occurring? | What are the spatial relations of the different age-maturation classes? |
| What is the reproductive potential of the population? | What is the dispersal efficiency? | What is the % of new individuals based on their origin? | What is the survivability of the individuals progressing into the next age class? |

## REPRODUCTIVE BIOLOGY SYSTEM

The next step seems to be the development of a classification of character classes, characters and character states for each of the fields of evidence which will allow us to systematically collect, store, and retrieve information to answer these questions and formulate others. We have developed such a classification for the field of reproductive biology (including pollination) and are in the process of developing similar classifications for other fields.

The subsystems and character classes for reproduction are given in Table 1. Specific characters and selected character states for the high priority subsystem are given in Table 2.

## SUMMARY

The organizational model and classification systems proposed are based on several general assumptions (Table 3) and on the specific assumption that the questions posed are high priority ones and are significant in preservation of rare, endangered and threatened species.

The following examples show the relevance of selected characters from reproductive evidence to decisions on species preservation in general and selection of specific populations or sites.

1. The maintenance of maximum variability with greatest potential for flexibility can best be accomplished by giving protection priority to sexually reproducing populations.

2. The type of breeding system is often a critical factor in determining the size of an area to be protected. To preserve the greatest genetic variability outcrossing species with specific pollen vectors generally will require larger areas than autogamous species or outcrossers with promiscuous pollination.

3. An analysis of pollination systems may indicate that species other than the one being studied also serve as major food sources, nesting sites, etc., for the pollinator of a rare, endangered or threatened species. Preservation of one species is therefore contingent upon preservation of another species.

4. In a series of populations those with high reproductive potential and realization are better candidates for preservation than ones with low potential or realization.

5. In cases where reproductive realization is low, Species Biology Studies may identify causes of this reduction in reproduction which may be corrected to some degree by management practices.

The priority systems should not, however, be misconstrued to mean that only subsystem 1 is important and that the next subsystem can be ignored, or that other questions should not be asked. The answers to questions associated with the first priority group may simply indicate that information from the next priority group or other information is required before any preliminary decisions can be made. The model and character classification scheme are proposed to offer direction and organization for our attack on the problem of understanding and preserving rare, endangered and threatened species.

Table 1.--Classification of pollination-reproductive characters for species biology--subsystems and character classes.

| | | | |
|---|---|---|---|
| SUBSYSTEM 1: High Priority Information | | | |
| I. | Reproductive System | II. | Breeding System |
| III. | Pollination System | IV. | Reproductive Potential |
| SUBSYSTEM 2: Second Order Priority | | | |
| I. | Phenology (Plant-Vector) | II. | Morphology (Plant-Vector) |
| III. | Isolating Mechanisms & Reproductive Barriers | IV. | Analysis of Variation & Reproductive Strategies |

Table 2.--Character classes, characters and character states for pollination-reproductive biology studies.

SUBSYSTEM 1

A. Reproductive System
   1. Amphimixis
   2. Apomixis
   3. Combination

B. Breeding System (fertilization type based on origin of the pollen)
   1. Autogamy
   2. Allogamy
      a. xenogamy
      b. geitonogamy
   3. Combination (allautogamy)

C. Pollination System (see Radford et al., p. 145)
   1. Type of pollination based on agent
      a. anemophily
      b. melittophily
      c. etc.
   2. Pathway
      a. chasmantheric
      b. cleistantheric
   3. Visitor - Plant relationship (see Faegri & van der Pijl, p. 57 ff)
      a. polytropic
      b. oligotropic
      c. monotropic
      d. dystropic
      e. allotropic (allophilic)
      f. hemitropic (hemiphilic)
      g. eutropic (euphilic)
      h. other
   4. Vector(s)
      a. family
      b. scientific name
      c. vector sex

D. Reproductive Potential
   1. Sex
      a. flower
      b. inflorescence
      c. plant
      d. population
   2. Pollen
      a. No. pollen grains/anther
      b. No. anthers/flower
      c. No. flowers/inflorescence
      d. No. inflorescences/plant
      e. No. pollen grains/plant
      f. No. pollen viability - germination
   3. Seed
      a. No. ovules/fruit
      b. No. fruits/flower
      c. No. possible fruits/plant
      d. No. seed set/fruit
   4. Pollen/ovule ratio
   5. Seed germination
      a. percentage (specify conditions)
      b. phenology (specify conditions)
   6. Reproductive potential through time (plant duration, i.e., length of generation)

Table 3.--General assumptions.

| | |
|---|---|
| 1. | Designation of status and legislation will not in themselves preserve rare, endangered and threatened species. |
| 2. | Species preservation can best be accomplished through habitat preservation which will involve selection of sites to be protected and/or managed. |
| 3. | A tentative list of rare, endangered and threatened species is available. |
| 4. | The major goal of Species Biology Studies is to preserve rare, endangered and threatened species through habitat preservation and management. |
| 5. | Distributional records and pertinent literature have been checked or reviewed prior to beginning field studies. |
| 6. | Field sites for study have been selected and described with precision. |
| 7. | Field-laboratory researchers are aware that manipulation at a site or removal of study subjects from a site must be minimal. |
| 8. | Field and laboratory studies and monitoring of protected sites will continue after the preliminary studies and tentative decisions have been made. |
| 9. | High Priority Type Studies may not be sufficient in all cases and more comprehensive studies may be required. |
| 10. | The help of specialists in many fields is solicited and encouraged by those conducting Species Biology Studies. |
| 11. | Information relative to management practices is to be assembled and made available to all concerned. |
| 12. | Dialogue between interested groups and individuals should be promoted through symposia and conferences on a regular basis and some central agency should make published and unpublished data available to all workers. |

## LITERATURE CITED

Faegri, K., and L. van der Pijl. 1971. The principles of pollination ecology. 2nd Revised Edition. New York: Pergamon Press.

Radford, A. E. et al. 1974. Vascular plant systematics. New York: Harper & Row Publishers, Inc.

# NATURAL AREA CLASSIFICATION SYSTEM: A STANDARDIZATION SCHEME

Albert E. Radford[1/]

Abstract.--Any natural area classification system should include biotic assemblages (vegetation with accompanying fauna), climatic regime(s), soil system(s), geologic formation(s), and land form(s) by physiographic province hierarchically arranged with each entry at each level circumscribed and encoded. The System proposed represents an effort to produce a basic standardization scheme for more efficient and effective inventory and storage and retrieval of information on natural areas, vegetation, floras and rare, endangered and threatened species.

## INTRODUCTION

The natural themes for any province: A. Vegetation (with animal dependents), B. Climate, C. Soils, D. Geology, E. Topography are interacting but independent systems that compose the Ecosystem. The basic energy driving the system is sunlight; the basic raw materials are from the intrusive and extrusive magmas, oceans, and atmosphere. Vegetational (with animal dependents) composition, distribution, development is dependent upon climate, soils, geology, topography acting through time. Climate (microclimates) is dependent upon vegetation, soils, geology, topography. Soil composition, distribution and development is dependent upon vegetation, climate geology, topography acting through time. Geological structures, formations, sedimentary rocks are dependent upon climate, vegetation, soils topography and time. Topographic land forms and features, structures and development are dependent upon climate, vegetation, geology, soils and time. All of these interacting, interdependent independent themes and systems form the basis for the natural area classification schemes used in this report.

The ecological natural history themes for any province study or any conservation effort should provide the framework for a comprehensive survey of biotic and abiotic features. All types of communities from the pioneer to the climax developed during time over the different rock types under each significant climatic regime on the major topographic features should be included in the representative site samples of a complete survey of the area. The successional communities, the topo-edaphic climaxes, the continua should be part of the master theme study or conservation effort. Biogenesis has to be integrated with pedogenesis in explaining the present and past development of species and communities; climatogenesis and phylogenesis have to be coupled with succession and soil formation to explain the present composition and distribution of biotic assemblages. In order to understand the origin, migration, evolution of species, floras and faunas as well as the productivity and composition of present communities, man will have to try to conserve the total diversity of species in as broad a range of habitats as possible within the different climates in each province.

## SYSTEM

This Natural Area Classification System, based primarily on Vascular Plants, has been designed for inventory and analysis of Natural Areas, Vegetation, Floras and Rare

---

1/ Director of the Herbarium, Department of Botany, University of North Carolina, Chapel Hill.

and Endangered Species in the eastern United States. This system has been devised to cover (1) all types of successional communities; (2) all types of topo-edaphic climaxes; (3) all vanishing, rare, endangered or relict species, communities and ecosystems; and (4) all disjunct species and communities. The application of a broad natural area classification for any province is necessary for perspective in theme analysis and categorization.

This classification system is based primarily on plant habit (physiognomy) arranged in a time or a successional theme from pioneer annuals to climax angiosperm forests (I-XIV) with upland (I-VII) and lowland (VIII-XIV) toposequences related to moisture (See Table 1). The System based on vegetation physiognomy within a climatic regime and soil order on a major rock formation and landform in a major physiographic province is the first order of the classification. The first suborder, Subsystem, is based on classes of rocks (A-F) or parent materials or water-type. The basic rocks (1) are igneous or metamorphosed igneous; the calcareous (2) are essentially sedimentary carbonate rocks; the carbonaceous (3) are those parent materials high in organic content; the ferruginous (4) are precipitates, sediments or metasediments unusually red and high in iron; the saline rocks (5) are salt or salty; and the siliceous (6) are igneous, sedimentary or metamorphic rocks high in quartz or silicic acid. The rocks are grouped together that produce similar edaphic conditions in a given region.

The second order, Community Classes, are biotic assemblages characteristic of different edaphic conditions within a climatic regime. These classes are relatively broad groups (orders) or assemblages that have been described in the literature over a long period of time. As more inventory experience is gained, the list of classes will be extended. Here the community classes are indicated as monomials, binomials, trinomials, etc. according to the number of strata in the community described. A woody community class with three layers would have each layer described according to its physiognomic composition; e.g. Spruce-fir--Tall herb. The second suborder, Community Subclass, is a combination of specific dominant for the canopy layer and community class for each lower layer; e.g. Red spruce-fraser fir--Tall heath--Low herb or dominant plus habitat; e.g. Pine-savannah.

The basic Community Type (Third order) should be based on quantitative data for a biotic assemblage with a uniform microclimate and edaphic situation (pH, moisture and texture classes should be uniform throughout the area). A one-layered community type would be denoted by a monomial; e.g. Phragmites communis (Reed grass community). Stratified (two-layered) communities are indicated by a binomial with the first name based on dominant canopy species and the second on the dominant "subcanopy" species; e.g.,

| | |
|---|---|
| Community type | Chestnut oak--Low blueberry |
| | Canopy dominant Subcanopy dominant |
| | (Shrub layer with more cover than herb layer, herbs scattered or essentially absent) |
| Community class | Oak-hickory forest--Heath |

---

| | |
|---|---|
| Community type | Buckeye-basswood--Glade fern |
| | Canopy codominants "Subcanopy" dominant |
| | (Herb layer with more cover than shrub, shrub layer essentially absent) |
| Community class | Southern Appalachian Hardwoods--Filicalean perennials |

---

Community type — Scirpus americanus--Sagittaria subulata
Emergent dominant — Submerged dominant
Community class — Cyperaceous perennials--Alismatalean perennials

---

Those communities with three distinctive strata would have a trinomial as the community type name; e.g.,

Community type — Chestnut oak--Mountain laurel--Galax
Canopy dominant — Shrub dominant — Herb dominant
(Cover value (5) for each)
Community class — Oak-hickory forest--Heath--Diapensialean perennials

---

Community type — Water tupelo--Duckweed--Coontail
Canopy dominant--Floating dominant--Submerged dominant
Community class — Cornalean forest--Lemnaceous herb--Nymphaealean herb

---

If the community has four distinctive strata then the community type name would be indicated by the dominant from each of the four layers. If vines occur in two or more layers and have a total cover value of (5), then vine dominant(s) should be part of the community type name following (/) at the end of the binomial; e.g., Chestnut-oak--Low blueberry/Catbrier. Epiphytes with a large cover value should be indicated by (//), then dominant epiphyte name; e.g., Water tupelo-Duckweed--Coontail//Spanish moss.

(Within a "uniform" topo-edaphic and microclimatic situation the habitat is not uniform. The Buckeye-basswood--Glade fern community used as an example above has a few stumps and fallen logs with a distinctive flora (hummophytes), a few seepages with some species restricted to them (crenophytes) and walking fern-covered boulders (petrodophytes). In an inventory of this (or any) community the species should be listed by sub-habitat; e.g. hummophyte, crenophyte, petrodophyte, epiphyte or calciphytes on a calcareous lens or shell sand in a siliceous based community, dry mesophytes over shallow soil in an otherwise mesic habitat, pyrophytes around an old campsite fire, aletophytes on trails through the community etc. within the general community or habitat summary for that particular area or site.)

The Community Subtype (third suborder) would have only the stand dominant indicated, a monomial for two or more layered communities. Eastern Hemlock SAF-23 (See Table 2).

A basic assumption in this classification system is that the animals and lower plant components of these biotic communities will be represented in the vascular plant communities in the diverse habitats.

The first order of the climatic file should include the climatic regimes according to Köppen or some other climatologist. The second order might pertain to temperature, such as the classification of C. Hart Merriam; and the third order should include the edaphic moisture classes as that of the U.S. Department of Agriculture. The soil file should be based on the soil classification system of the U.S. Department of Agriculture with soil order as first order, soil suborder as second order and possibly the soil

type as the third order. The rock file should include the geologic formations as first order; e.g. The Dakota Sandstone, The Morrison Formation; the rock/water classes (Radford and Martin, 1975) as the second order, e.g. basic rock, brackish water; and individual rock types i.e., diabase, hematite and blackish, brown, clear water as the third order.

Under the land forms the first order would include broad features such as basins, beaches, bluffs, hills, plains, lakes with specific types of each as the second order e.g. deltaic-plain, pluvial pool, fault valley; the third order would include the broad habitats such as bottomland field, lake swamp, upland slope etc. (See Radford and Martin, 1975). The province file would be according to Fenneman (1938);e.g. the Appalachian Highlands would be an example of a first order physiographic region, with the Blue Ridge Mountains as an example of a second order province and Pisgah Ridge as a third order subprovince. The individual species, dominants and all others present, in the community type should be listed with the height, duration, growth form, diaspore and fidelity determined for each (see Radford and Martin, 1975). (See Table 2 ).

## CONCLUSIONS

1. Any comprehensive natural area inventory should include the total biotic and habitat diversity.

2. Managed areas of different moisture, pH and texture classes over different parent materials should be conserved within each climatic zone within the province for the perpetuation and study of the native and introduced species, particularly pioneer and transient species.

3. Any standardization scheme for natural area inventories should include vegetational (with faunistic components), climatic, pedologic, geologic, topographic data by province.

4. An acceptable standard natural area inventory system should have each character state properly circumscribed for each entry at each hierarchical level so that future studies and analyses will be comparable and correlative.

5. The Natural Area Classification System should be made as compatible as possible with present classification systems for vegetation, climate, soils, geology, topography and physiographic provinces.

This is an open ended system that can be done as thoroughly as the time and experience of the investigator will permit. The system can be coded for data banking. Natural areas in a conservation system, or those being proposed, should not be continually investigated for the same thing. The information gathered about the region should be made available to subsequent investigators so that new field data resulting from each inventory can be added to the data bank. All taxa should be documented once, not eliminated by eager biologists collecting in each and every visit to an area.

## LITERATURE CITED

Fenneman, N. M. 1938. Physiography of the eastern United States. New York: McGraw-Hill.

Radford, A. E., and D. L. Martin. 1975. Potential ecological natural landmarks: Piedmont Region, eastern United States. Published report for National Park Service.

Table 1

NATURAL AREA CLASSIFICATION SYSTEM SUMMARY

Hierarchical Order: 1. System(S) 1a. Subsystem (SS) 2. Community Class (CC) 2a. Community Subclass (Csc) 3. Community Type (CT) 3a. Community Subtype (Cst)

| SYSTEM(S) | | SUBSYSTEMS (SS) |
|---|---|---|
| I. | PIONEER HERB | A. Basic, B. Calcareous, C. Carbonaceous, D. Ferruginous, E. Saline, F.Siliceous Pioneer |
| II. | PERENNIAL FORB | A. Basic, B. Calcareous, C. Carbonaceous, D. Ferruginous, E. Saline, F. Siliceous Forb |
| III. | GRASS | A. Basic, B. Calcareous, C. Carbonaceous, D. Ferruginous, E. Saline, F. Siliceous Grass |
| IV. | SCRUB-SHRUB | A. Basic, B. Calcareous, C. Carbonaceous, D. Ferruginous, E. Saline, F. Siliceous Shrub |
| V. | WOODLAND | A. Basic, B. Calcareous, C. Carbonaceous, D. Ferruginous, E. Saline, F. Siliceous Woodland |
| VI. | GYMNOSPERM FOREST | A. Basic, B. Calcareous, C. Carbonaceous, D. Ferruginous, E. Saline, F. Siliceous Gymnosperm |
| VII. | ANGIOSPERM FOREST | A. Basic, B. Calcareous, C. Carbonaceous, D. Ferruginous, E. Saline, F. Siliceous Angiosperm |
| VIII. | VASCULAR AQUATIC PLANT | A. Fresh water, B. Brackish water, C. Salt water, D. Bog water, E. Calcareous Water Herb |
| IX. | MARSH HERB | A, Fresh water, B. Brackish, C. Salt, D. Bog, E. Calcareous Marsh Perennial |
| X. | MARSH GRASS | A. Fresh water B. Brackish, C. Salt, D. Bog, E. Calcareous Marsh Grass |
| XI. | WET SCRUB-SHRUB | A. Fresh water B. Wet Brackish, C. Wet Salt, D. Bog, E. Wet Calcareous Shrub |
| XII. | LOW WOODLAND | A. Fresh water B. Wet Brackish, C. Wet Salt, D. Bog, E. Wet Calcareous Woodland |
| XIII. | LOWLAND GYMNOSPERM FOREST | A. Fresh water B. Wet Brackish, C. Wet Salt, D. Bog, E. Wet Calcareous Gymnosperm |
| XIV. | LOWLAND ANGIOSPERM FOREST | A. Fresh water B. Wet Brackish, C. Wet Salt, D. Bog, E. Wet Calcareous Angiosperm |

GENERAL ORGANIZATION

| | | | | | MAP UNIT | | |
|---|---|---|---|---|---|---|---|
| (S) | SYSTEM | VEGETATION I-XIV | CLIMATE C-I-IV (temperature) | SOIL ORDER S I-X | ROCK FORMATION R I-* | LAND FORM L I-VIII | PHYSIOGRAPHIC REGION V 1-24 |
| (CC) | COMMUNITY CLASS | ORGANISM ORDER O 1-112 | SUBCLIMATE C 1-* | S. SUBORDER S 1-47 (Soil type) | ROCK/WATER CLASS R A - F | TOPOGRAPHIC FEATURE | PHYSIOGRAPHIC PROVINCE 1-24 |
| (CT) | COMMUNITY TYPE | DOMINANT (S) #* | MOISTURE CLASS M a-g | TEXTURE CLASS T a-l | ROCK TYPE R a-r | HABITAT H 1-55 | SUBPROVINCE 1- ? |
| (SP) | SPECIES | INDIVIDUAL #* | HEIGHT A 1-11 | DURATION D 1-7 | GROWTH FORM G 1-20 | DIASPORE F 1-13 | FIDELITY F 1-5 |

(See Appendix D in Radford and Martin (1975) for complete system)

*Classification incomplete

Table 2

COMMUNITY SUBCLASSES (Csc)

A combination of stand, canopy or top layered dominant and community class for each layer below; e.g.

(Csc) Chestnut oak--Ericalean shrub (Heath)
Canopy or stand dominant--Community class for shrub layer
(A mixture of ericad species)

(Csc) Water tupelo--Aralean (Lemnaceous) herb
Canopy dominant Community class
(A mixture of duckweed species)

COMMUNITY TYPE (CT)

Dominant indicated for each layer or stratum; e.g.

(CT) Chestnut oak--Mountain Laurel--Galax
Canopy Dom. Shrub Dom. Herb Dom.

COMMUNITY SUBTYPE (Cst)

Only stand dominant indicated, a monomial for a two or more layered community; e.g.

(Cst) Eastern hemlock SAF-23 (Society of American Foresters numbered stand)
Stand or Community Subtype
(Cst) Balsam fir (SAF-5)
Stand or Community Subtype

CODE APPLICATION OF CLASSIFICATION SYSTEM
FOR COMMUNITY TYPE: CHESTNUT OAK--MOUNTAIN LAUREL

(S) VII.III.IX.Z.*V.I.
(CC) 23. 2. 2.F.18.6.
(CT) q26--e6. c. c.p.47.2.
(SP) q26. 10. 2.20.4.3.
(SP) e16. 6. 5.3. 2.3
VII,III,IX,Z,V,I;23.Z.Z.F.47.6;q26--e6,c,c,p.b.33.

| | | | | | | |
|---|---|---|---|---|---|---|
| (S) | Angiosperm Forest Sys. (VII). | Mesothermic (III). | Ultisol (IX). | Unknown (Z) | Ridge (V) | App.Highlands (I) |
| (CC) | Fagalean Forest (23). | Unknown (Z). | Unknown (Z) | Siliceous angios. | Fault Mountain (18). | Blue Ridge (6) |
| (CT) | Chestnut oak--Mountain Laurel (q26-e6). | Dry mesic (c) | Sandy loam (c) | Quartzite (p) | Open slope (47) | Jonas Ridge |
| (SP) | Chestnut oak (q26). | Large (10) | Summer-green (2) | Tree (20) | Barochore (4). | Fidelity 3 |
| (SP) | Mountain laurel (e6) | Tall (6) | Evergreen (5). | Clumped Shrub | Atelechore (2) | Fidelity 3 |

*Z = Missing data.

# CONFERENCE ON ENDANGERED PLANTS IN THE SOUTHEAST

## Summary of the Conference

G. R. Noggle, North Carolina State University

The conference was organized to bring together botanists, foresters, naturalists, and lay persons interested in the conservation and preservation of wild plants. No attempt was made to develop "lists" of endangered or threatened species; rather the emphasis was on examining the forces and circumstances leading to the loss and disappearance of plants in various parts of the Southeastern United States.

The discussions were grouped under five general topics. Following the presentation of several prepared papers, comments and remarks from the audience were heard.

### Definition and Classification of Endangered and Threatened Plant Species

There was general agreement that the definitions developed by the Smithsonian Institution were satisfactory. Endangered: an endangered species is one whose survival is known to be in serious jeopardy. Its peril may result from destruction or drastic modification of its specific habitat, over-exploitation by man, disease, predation, or specific competition due to natural succession. An endangered species must receive protection, or extinction probably will follow. Threatened: a threatened species is one that may likely become endangered if its habitat is not maintained, or if it is greatly exploited by man. These often are quite rare and should be monitored continuously. They must receive protection.

Dr. James F. Matthews of UNC-C discussed the general philosophy of making lists (preferably "determinations") of endangered and threatened plant species. Local, regional, state and national input is needed and many people must be involved in making appropriate determinations. In North Carolina a primary and secondary list has been prepared. Following publication of the lists further changes will be made. Terms such as "rare," "marginal," "relative abundance," "exploited," and others were mentioned in the discussions but no attempt was made to define them. A forthcoming publication summarizing the proceedings of a Symposium held in September 1974 in Raleigh, N. C., deals with many of these questions. The publication Endangered and Threatened Plants and Annuals of North Carolina (300 p.) can be obtained ($8.00) from the North Carolina State Museum of Natural History, P. O. Box 27647, Raleigh, N. C. 27611.

### Federal and State Legislation on Endangered Plants

Gail Baker of the U. S. Fish & Wildlife Service discussed the Endangered Species Act of 1973, a major piece of Federal legislation. This is a strong Act and can have a significant impact on threatened and endangered plants. One section of the Act requires that other Federal agencies and programs must be reviewed by the Secretary of Commerce or Interior if they bear on the conserva-

tion and maintenance of endangered and threatened species. Another section requires cooperation from the States. Cooperative agreements between States and the Federal Government on land acquisition, management of habitats, etc.,can be established. A model cooperative agreement has been prepared by the U. S. Fish & Wildlife Service and is available on request.

In accordance with section 12 of the Act, the Smithsonian Institution prepared a list of about 3,000 threatened or endangered plants in the U. S. and Hawaii. A list of extinct plants also was prepared. The list was published in Volume 40, No. 127, Tuesday, July 1, 1975, of the Federal Register. Such a publication is the first step in getting the scientific community to comment on the list.

Each state must establish guidelines for cooperating under the Endangered Species Act of 1973. Frank Barrack of the North Carolina Wildlife Resources Commission outlined activities in North Carolina concerning the State Endangered Species Act. Several kinds of activities are involved: development of lists (determinations) of endangered and threatened species; in-depth studies of certain listed species (grants to qualified persons), and development of regulations; land acquisition of selected, critical habitats. At all levels the public must be informed of the work underway. The importance of developing in the public a respect for plants is stressed.

Propagation and Commercial Exploitation of Endangered Plants

Jerry McCollum of the Georgia Department of Natural Resources discussed their approach in establishing regulations to handle exploitation of plants. They are stressing habitat preservation wherein many plants might be protected. A law enforcement activity is being placed in the hands of game wardens. In-service training sessions are being conducted for the game wardens.

Arnold Krochmal of the Southeastern Forest Experiment Station described procedures and techniques being used in propagating and growing some wild plants used for medicinal purposes. More basic information is needed on other plants before they can be brought into cultivation.

Raymond O. Flagg of the Carolina Biological Supply Co., Burlington, N. C., described their activities in collecting and propagating Venus flytrap and other insectivorous plants.

From the discussion that followed these presentations it appears that the survival of many plant species is threatened by indiscriminate collection practices. This kind of destruction by commercial operation can only be stopped by legal constraints on the possession and sale of native plants. Law enforcement will be difficult but it can be done.

Preservation of Endangered Plant Species Through Natural Areas

A major theme throughout the entire conference was the preservation of endangered and threatened plants by establishing natural areas and habitats. The speakers described a number of public (Federal, State) and private (Nature Con-

servancy, Society of American Foresters) efforts to identify and conserve natural areas.

Gary Waggoner, National Park Service, described their activities in identifying natural areas (on the basis of endangered species) worthy of preservation. These areas can be within the National Park or under other ownership. National Landmarks can be recognized on a voluntary basis by private owners.

Gary Henry, U. S. Fish & Wildlife Service, described their role in seeing that the regulations established by the Endangered Species Act of 1973 are complied with. The Fish & Wildlife Service manages about 34 million acres of Federal land in their refuge system. The land is identified as Landmark Areas, Research Areas, and Wilderness Areas. All will have certain components identified as dealing with endangered and threatened species. Federal grants are available to states for the acquisition of wildlife areas.

The Georgia Heritage Program was described by Charles Parrish of the Georgia Department of Natural Resources. A small staff has identified a number of habitats worthy of preservation--some because of endangered plants. To date about 21 thousand acres have been purchased. A major function of the Heritage Program is to acquaint citizens with their historical and biological sites and to develop a social consciousness in harmony with conserving and preserving endangered areas.

Robert Chipley outlined programs of the Nature Conservancy. The programs are structured for habitat preservation. Through a memorandum of agreement with a State they identify endangered and threatened species in various habitats. After such determinations a protection plan is developed.

The Society of American Foresters (Keith Argow) initiated a natural area registration program in 1947. Some 50 natural areas have now been identified in the United States. These are based on forest types.

## Research Needs on Endangered Plants

Roy Clarkson, West Virginia University, and Robert Kral, Vanderbilt University, discussed the problems of determining the distribution of plants and their geographical ranges. Regional manuals, monographs, herbarium collections, and journal articles contain much information, but a great deal of field work remains to be done before complete determinations can be made.

Frank McCormick of the University of Tennessee discussed the general philosophy of species preservation. Species exist as populations and must be understood as components of ecosystems. Science, ethics, law, and economics should be pulled together to construct a surface amenable to ecosystem preservation.

James Massey, University of North Carolina at Chapel Hill, set out a framework for understanding species biology and species preservation. Species can be understood in terms of reproduction, dispersal, establishment, and maintenance, all within the ecosystem concept.

As a conclusion to the presentation on species biology, Al Radford, University of North Carolina at Chapel Hill, presented a Natural Area Classification System. The proposed system attempts to describe a basic standardization scheme for more efficient and effective inventory and storage and retrieval of information on natural areas, vegetation, floras and rare, endangered and threatened species.

All of the formal presentations were followed by questions and answers from the approximately 100 persons in attendance. All levels of involvement are essential if an effective program of preservation of endangered and threatened species is to be implemented. "Running along in front of the bulldozer" is important under many situations, and concerned citizens can change the way developers, exploiters, and others view our environment.



☆U.S. GOVERNMENT PRINTING OFFICE: 1978-740-271 5581 REGION NO. 4