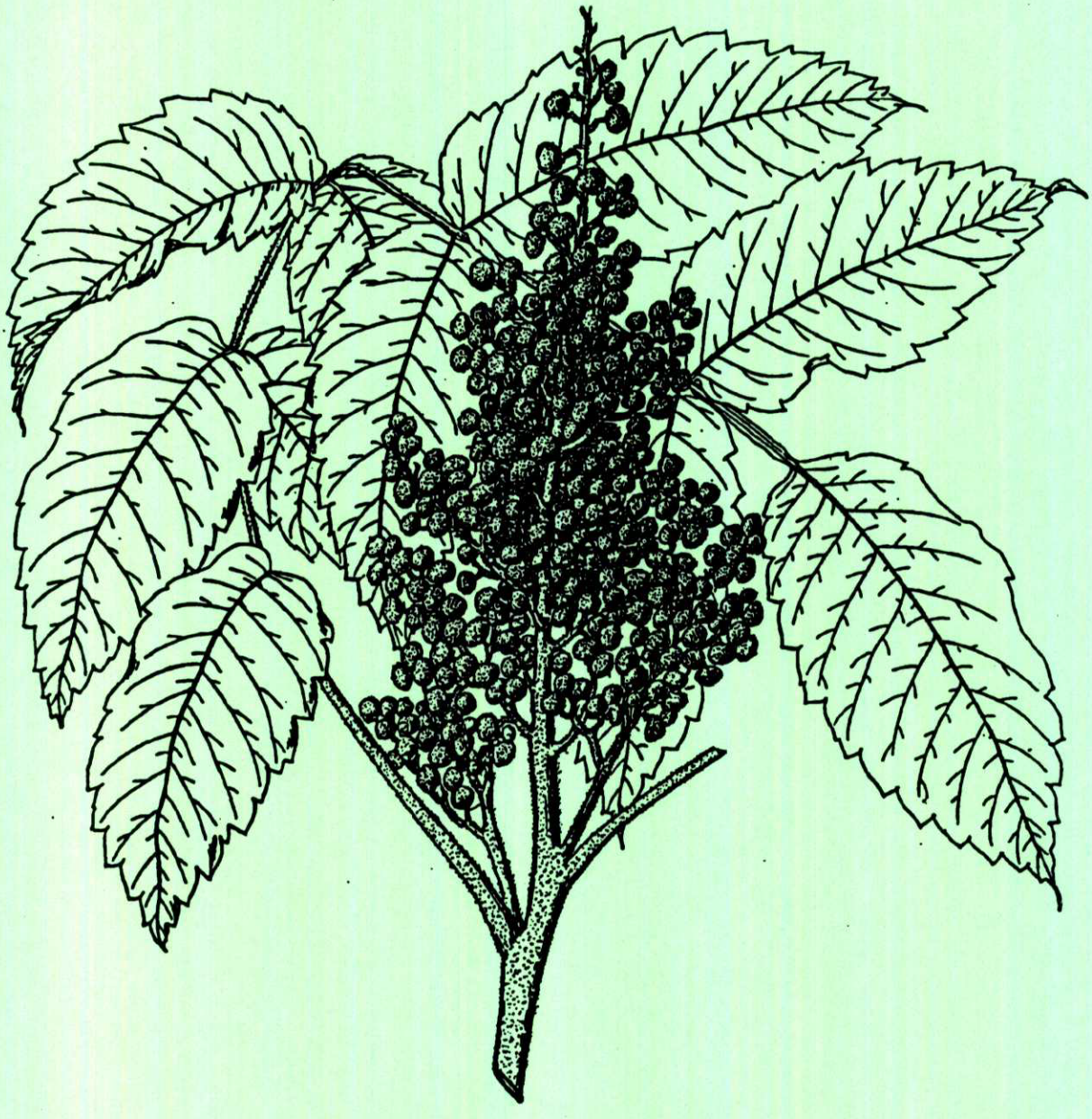
Recovery Plan

Michaux's Sumac

(Rhus michauxii)



U.S. Fish and Wildlife Service

RECOVERY PLAN

for

Michaux's Sumac (*Rhus michauxii*) Sargent

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Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1993. Michaux's Sumac Recovery Plan. Atlanta, Georgia. 30 pp.

Additional copies of this plan may be purchased from:

Fish and Wildlife Reference Service
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EXECUTIVE SUMMARY

Current Status: Rhus michauxii is federally listed as an endangered species. It is currently known from 21 locations (20 in North Carolina and 1 in Georgia). Most of these remaining populations are small and vulnerable, since the majority are on roadsides or power line rights-of-way.

Habitat Requirements and Limiting Factors: This rare shrub is typically found growing on sandy soils in openings or thin woods and appears to be dependent on some form of disturbance for maintenance of the open quality of its habitat. It is threatened by industrial and residential development, fire suppression, conversion of its habitat for silviculture and agriculture, highway construction and improvements, hybridization with other species, and geographic isolation of small, single-sex populations.

Recovery Objectives: To delist the species.

Recovery Criteria: Michaux's sumac will be considered for delisting when there are at least 19 self-sustaining populations that are protected to such a degree that the species no longer qualifies for protection under the Endangered Species Act. These 19 populations may be among the 21 that are extant, or they may include new ones (some of the extant populations may have deteriorated beyond the point of recovery). This determination will be made only after assessing the vigor and long-term survival potential of all known populations.

Actions Needed:

1. Survey suitable habitat for additional populations.
2. Monitor and protect existing populations.
3. Conduct research on the biology of the species.
4. Establish new populations or rehabilitate marginal populations to the point where they are self-sustaining.
5. Investigate and conduct necessary management activities at all key sites.

Total Estimated Cost of Recovery: Because so little is known about actions needed to recover this species, it is impossible to determine costs beyond estimates for the first few years' work (in $1,000's):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Total
1993	10.0	25.0	27.0	30.0	15.0	107.0
1994	10.0	4.0	18.0	16.0	25.0	73.0
1995						
1996						
1997						
1998						
1999						
2000						

Date of Recovery: Impossible to determine at this time.

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PART I

INTRODUCTION

Michaux's sumac (Rhus michauxii) is a rare, usually dioecious, shrub endemic to the inner coastal plain and piedmont of the Carolinas, Georgia, and Florida, where it occupies sandy or rocky open woods. Due to its rarity and vulnerability to threats, the species was federally listed as endangered on September 28, 1989 (U.S. Fish and Wildlife Service 1989). Michaux's sumac is listed as endangered by the State of North Carolina (Sutter 1990) and as extirpated and "of national concern" in South Carolina (Rayner et al. 1984). In Georgia, where the species was only recently rediscovered, it is now proposed for endangered status (T. Patrick, Georgia Freshwater Wetlands and Heritage Inventory, personal communication, 1992). Michaux's sumac is not listed in Florida.

Current and Historical Distribution

Only 21 populations of Michaux's sumac are currently known to exist. Twenty populations are believed to have been extirpated. The distribution by State and county is shown in Table 1.

Description, Ecology, and Life History

Michaux's sumac is one of 13 Southeastern species in the large genus Rhus (Barkley 1937). Also called false poison sumac, because of its superficial resemblance to Rhus vernix, Michaux's sumac is a rhizomatous shrub that grows 0.2 to 1.0 meter in height. Although it is usually dioecious, there are recent indications that stems may be capable of changing sex (Savage et al. 1991). The entire plant is densely pubescent. The narrowly winged or wingless rachis supports 9 to 13 sessile, oblong to oblong-lanceolate leaflets that are each 4 to 9 centimeters long, 2 to 5 centimeters wide, and acute to acuminate. The bases of the leaflets are rounded, and their edges are simply or doubly serrate. Flowering occurs in June. The small flowers are borne in a terminal, erect, dense cluster, with each one being four- to five-parted and greenish-yellow to white. The fruit, which is a red, densely short-pubescent drupe, and 5 to 6 millimeters broad, is borne on female plants from August to October (Radford et al. 1964; Cooper et al. 1977; Sargent 1895; and J. Moore, Red Hills Conservation Association, unpublished field data, 1991). Rhus michauxii differs from other similar species in the genus by its short stature, dense overall pubescence, and evenly serrate leaflets. In spite of John Lyon's description of the plant as poisonous (Ewan and Ewan 1963, Sargent 1895), Michaux's sumac is quite harmless (Warren 1910).

Michaux's sumac grows in sandy or rocky open woods on acidic soils with low cation exchange capacities (Savage et al. 1991) and appears to depend upon some form of disturbance to maintain the open quality of its habitat. Artificial disturbances, such as railroad and right-of-way maintenance, are maintaining some of the openings

Table 1. Distribution by State and county of extirpated and extant populations of Michaux's sumac (Rhus michauxii).

STATE	COUNTY	APPARENTLY EXTIRPATED POPULATIONS	EXTANT POPULATIONS
North Carolina	Davie		1
	Durham	1	
	Franklin	1	1
	Hoke	1	4
	Johnston	1	
	Lincoln	1	
	Mecklenburg	1	
	Moore	1	2
	Orange	1	
	Richmond		5
	Robeson	1	1
	Scotland		5
	Wake	1	1
	Wilson	1	
South Carolina	Florence	1	
	Kershaw	1	
	Oconee	1	
Georgia	Columbia	1	
	Elbert		1
	Gwinnett	1	
	Muscogee	1	
	Newton	1	
	Rabun	1	
Florida	Alachua	1	
TOTAL		20	21

historically provided by naturally occurring periodic fires. Michaux's sumac usually occurs on sand or sandy loam soils.

At most of the extant sites, common associates of Michaux's sumac include the following species: Rhus typhina, R. copallina, R. radicans, R. glabra, R. toxicodendron, Sorghum halapense, Ulmus alata, Carya tomentosa, Solanum sp., Pinus taeda, Pinus palustris, Quercus nigra, Q. alba, Q. margaretta, Q. incana, Q. marilandica, Q. laevis, Liquidambar styraciflua, Sassafras albidum, Diospyros virginiana, Prunus angustifolia, P. serotina, Stillingia sp., Tephrosia sp., Euphorbia sp., Linaria canadensis, Rumex acetosella, Opuntia sp., Rubus spp., Solidago odora, Pityopsis nervosa, Aster linarifolius, Dalea pinnata, Specularia perfoliata, Andropogon virginicus, Lespedeza sp., Gnaphalium sp., and various species of lichen.

Very little specific information is available on the life history and population biology of Michaux's sumac. Most of the surviving populations appear to contain plants of only one sex and therefore reproduce only vegetatively, if at all. Due to the rhizomatous nature of the species, this may mean that the single-sex populations are clones of one or a few individuals; two populations sampled for genetic diversity by Sherman-Broyles et al. (1992) appeared to each consist of a single clone.

Sherman-Broyles et al. (1992) investigated genetic diversity in R. michauxii, R. glabra, and R. copallina using starch gel electrophoresis. They found that Michaux's sumac displayed less genetic variation within its populations than the two more widespread congeners but more variation among its populations. These authors further state:

> Species with limited geographic distributions that occur in small, isolated populations pose special problems for the conservation of genetic diversity. Both the species and its individual populations are not only susceptible to extinction but they may have also lost much of their genetic diversity due to a limited number of reproductive individuals. Recent reviews of the plant allozyme literature have shown that the geographic range of a species has a large effect on the amount of genetic diversity maintained by the species. Endemic species have fewer polymorphic loci, fewer alleles per polymorphic locus and less than 50% of the genetic diversity of more widespread species.... Rhus michauxii has a lower average number of genotypes per population (4.1) than the average (16.1) reported by Ellstrand and Roose (1987) in their review of clonally reproducing species. The average genotypic diversity index for R. michauxii is also lower (0.41 versus 0.62). This may be due to the small population sizes, the degree of isolation among populations and the endemic range of R. michauxii.

However, these authors go on to say that R. michauxii may never have had the levels of genetic variation that its congeners have. The evolution of this species may have involved a genetic bottleneck that led to the loss of considerable genetic diversity.

Although specific pollinators are unknown, Michaux's sumac, like other species in the genus, is probably pollinated by insects. Sherman-Broyles et al. (1992) observed that bees visited the flowers of other sumac species and that birds dispersed the fruits. Although disease is not currently known to be a problem for this species, powdery mildew affects plants in cultivation (R. McCartney, Woodlanders, personal communication, 1991). When conditions are ideal for the mildew, it can result in the dieback of above-ground portions of the plants. Even in these cases, however, the sumac readily resprouts from the rhizomes. In addition, other observers have noted a form of rust on the leaves in wild populations; it is unknown what effect this fungus has on the plants (M. Bucher, North Carolina Field Office, The Nature Conservancy, personal communication, 1991).

Much remains unknown about the demography and reproductive requirements of this species. Fire or some other suitable form of disturbance, such as mowing or careful clearing (outside the June through September flowering and fruiting time), appears to be essential for maintaining the open habitat preferred by Michaux's sumac. Without such periodic disturbance, this type of habitat is gradually overtaken and eliminated by shrubs and trees of adjacent woodlands. As the woody species increase in height and density, they overtop R. michauxii, which is intolerant of dense shade. The current distribution of the species is ample evidence of its dependence on disturbance. Of the 21 remaining populations, 11 are on roadsides or on the edges of artificially maintained clearings. Six others are in areas that have been exposed to periodic fire, another is in an opening on the rim of a Carolina bay (a Carolina bay is an isolated, nonalluvial, ombrotrophic wetland, ovoid to elliptic in shape, with a northwest to southeast orientation, and a low rim of eolian sands). The other three are in wooded sites, and two of these are declining in vigor. Virtually nothing is known about the habitat conditions necessary for successful sexual reproduction.

Threats and Population Limiting Factors

A recently conducted survey by the Center for Plant Conservation identified Rhus michauxii as one of 348 native plant taxa that could become extinct within the next 5 years (P. Olwell, Center for Plant Conservation, personal communication, 1991). The most serious threat to Michaux's sumac is the loss or degradation of the habitat in which it occurs. Since discovery of the species in 1796, almost 50 percent of the known populations have been extirpated, partly as a result of the conversion of habitat for silvicultural and agricultural purposes

and for industrial and residential development. Widespread fire suppression is believed to have resulted in the degradation of habitat and loss of populations in several areas.

Many of the remaining populations are small in numbers of individual stems and in area covered by the plants. Of the 21 remaining populations, 12 have fewer than 100 plants, with 3 of these containing less than a dozen plants each. Only four populations are known to contain both male and female plants. The rhizomatous nature of the species indicates that there are many fewer individual plants in existence than stem counts would indicate. Although sample sizes were relatively low (48 individuals), the work of Sherman-Broyles et al. (1992) indicated that the ratio of number of stems to genotypes is approximately 12 to 1. This low genetic variability within populations makes it more important to maintain as much habitat and as many of the remaining colonies as possible, particularly those containing both sexes.

Because of the proximity of many of the extant Michaux's sumac populations to power lines, railroads, highway rights-of-way, agricultural fields, and pine plantations, there is a possibility for damage to plants from off-target herbicide drift. No instances of this have yet been documented, but the potential cannot be ignored, particularly where aerial application is involved. Right-of-way populations also are vulnerable to destruction from highway or utility corridor expansion, maintenance, or improvement.

In addition to the major threats listed above, those populations on military land are potentially threatened by mechanized military training activities. Although this has not been a documented problem for this species thus far, some of the small sites occupied by the species could easily be destroyed by heavy tracked vehicles such as tanks. Nonetheless, populations probably persist on military lands and State game lands, where they have not survived on adjacent privately-owned land, because of the prescribed burning programs of the Department of Defense and the North Carolina Wildlife Resources Commission and the periodic fires incidental to military training.

Another potential threat to this species, particularly in populations where only a few plants remain, is hybridization with sympatric species such as Rhus glabra and R. copallina. Hardin and Phillips (1985) described what appeared to be an intermediate form between R. glabra and R. michauxii at two sites from which Rhus michauxii had been reported. Sherman-Broyles et al. (1992) found no evidence that hybridization occurs between these species. However, since R. michauxii contains a subset of the allozyme alleles of R. glabra, identification of hybrids with allozymes is difficult. Investigation of this potential would involve controlled crosses and measurement of seed set, viability, and fecundity in resulting seedlings. Because this work would take quite a bit of time to accomplish, the best immediate course of action might be to remove R. glabra from the vicinity of R. michauxii populations.

Conservation Efforts

In North Carolina, where 20 of the remaining 21 populations survive, the North Carolina Natural Heritage Program, The Nature Conservancy, and the U.S. Fish and Wildlife Service (Service) are working with landowners to ensure protection and management of Michaux's sumac sites. The North Carolina Field Office of The Nature Conservancy and the North Carolina Natural Heritage Program, under contract to the Department of Defense, are conducting a rare and endangered plant survey of Fort Bragg and are working with that installation to develop management and protection plans for this and other rare species. Fort Bragg manages its known populations of Michaux's sumac with growing-season burns, conducted on a 3-year cycle. Niche Gardens (a commercial nursery in Chapel Hill) is propagating male and female plants from the Wake County site for augmentation and reintroduction at this and other sites. The North Carolina Botanical Garden has collected seeds and attempted (unsuccessfully, thus far) to propagate plants by root cuttings. The North Carolina Field Office of The Nature Conservancy is proposing to conduct research on the species biology of Michaux's sumac to provide a basis for management and protection plans. They have already collected substantial demographic data from 14 of the North Carolina populations (Savage et al. 1991).

Material has been collected from healthy populations to provide propagules for reintroduction. In 1990, The Nature Conservancy, the University of Georgia, and the Service jointly sponsored a genetic analysis project for R. michauxii. The results, as reported by Sherman-Broyles et al. (1992), were that Michaux's sumac has significantly less variation than its progenitor and congener species. Allelic and genotypic variation within populations of Michaux's sumac seemed to be related to both the present-day size of the population and to whether both sexes were present. Most importantly, from a restoration and management standpoint, this study provided information on how the current genetic variation is distributed among the extant populations. Based upon these findings, restoration efforts are now planned (with funding from The Nature Conservancy's North Carolina Field Office and the Service's Asheville, North Carolina, Field Office), using donor populations with the highest levels of genotypic diversity. Plants of the alternative sex will be introduced into single-sex populations, and reintroductions will be made at sites where plants have disappeared but where suitable habitat remains. Sites will be managed, in cooperation with the landowners, for the benefit of the species.

In 1989, the Georgia Freshwater Wetlands and Heritage Inventory and the Georgia Field Office of The Nature Conservancy, in cooperation with Woodlanders (a commercial nursery in Aiken, South Carolina, specializing in native plants), undertook a project to reintroduce Michaux's sumac to a site in Newton County from which the species had been extirpated. Woodlanders had maintained cultivated stock from this site's original population and volunteered it for the

reintroduction effort. The first transplants fared badly in a severe drought, and a second planting was made. At this writing, 15-20 plants are surviving at the site. The Georgia Freshwater Wetlands and Heritage Inventory is also working with the U.S. Army Corps of Engineers to manage the Elbert County site, where only four stems of Michaux's sumac remain. Management at the latter site is being accomplished by mowing.

State agencies charged with protecting rare plants in the States of North Carolina and Georgia are pursuing the protection of additional sites by agreements with landowners or outright acquisition. Conservation agencies in these States, as well as in South Carolina and Florida (where no known populations remain), are also actively conducting surveys of potential habitat in the hope of finding and protecting additional populations of the species.

PART II

RECOVERY

A. Recovery Objectives

Michaux's sumac (Rhus michauxii) will be considered for delisting when there are at least 19 self-sustaining populations in existence that are protected to such a degree that the species no longer qualifies for protection under the Endangered Species Act (see criteria below). The populations should be distributed throughout the species' historic range. A self-sustaining population is one that is clonally expanding or sexually reproducing and demographically and genetically viable (enabling it to survive and successfully respond to natural habitat changes). The number of individuals necessary, the genotypic identity of populations, and the quantity and quality of habitat needed to meet this criterion will be determined as one of the recovery tasks.

This recovery objective is considered an interim goal because of the lack of data on the biology and management requirements of the species. As new information is acquired, the estimate of self-sustaining populations required for the species' survival may be readjusted. The recovery objective for Michaux's sumac will be reassessed at least annually in light of any new information that becomes available.

The first step toward recovery will be the protection and management of all extant populations to ensure their continued survival. Little is known about the life history and habitat requirements of this species. Therefore, it will be necessary to conduct detailed demographic studies and ecological research to gain the understanding needed to develop appropriate protection and management strategies. The ultimate effects of various kinds of habitat disruption must be determined and, if necessary, prevented. Active management required to ensure continued survival and vigor must be defined and implemented. Therefore, Michaux's sumac shall be considered for removal from the Federal list when the following criteria are met:

1. It has been documented that at least 19 self-sustaining populations exist and that necessary management actions have been undertaken by the landowners or cooperating agencies to ensure their continued survival.

2. All of the above populations and their habitat are protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations.

B. Narrative Outline

1. Protect existing populations and essential habitat. Only 21 populations of Michaux's sumac are currently known to exist, all within the States of North Carolina and Georgia. Until more is known about the species' biology, genetic diversity, specific habitat requirements, and measures necessary to protect the integrity of occupied sites, all existing populations should be protected. The long-term survival of 19 populations in four states is believed to be essential to the recovery of the species as a whole.

1.1 Develop interim research and management plans in conjunction with landowners. Little is known about the specific management practices necessary to ensure the long-term survival of this species. Some form of disturbance, such as fire, appears to be necessary for maintaining the habitat. However, immediate emphasis will be on protection (i.e., prevention of bulldozing, herbicide contamination, and other site alterations that are known to be detrimental), in cooperation with the landowners, until appropriate management procedures have been developed through research. Pre- and post-management monitoring should provide important insights into management needs. Since the plant is found on roadsides and power line rights-of-way, areas that are commonly treated with herbicides, restrictions on the use of these pesticides should be implemented in areas where the species is known to occur.

1.2 Search for additional populations. Although several intensive searches for the species have been conducted within parts of the historic habitat, a thorough, systematic effort to locate additional populations is still needed (very small populations, consisting of only a few plants, particularly at overgrown sites, are easily missed in less intensive efforts). Searches should be preceded by an examination of soil and topographic maps and aerial photographs to determine potential habitat and to develop a priority list of sites to search.

1.3 Determine habitat protection priorities. Because of the small number of existing populations and the pervasive threats to the habitat, it is essential to protect as many populations as possible. However, efforts should be concentrated first on the sites in protective ownership, or where private landowners are cooperative, and where the largest and most vigorous populations (containing both sexes) occur.

1.4 Evaluate habitat protection alternatives. The greatest possible protection should be obtained for those existing populations that are considered critical to the recovery of the species. Fee simple acquisition or conservation easements provide the greatest degree of protection. However, it is not known how much surrounding land is needed to protect the integrity of the populations or to provide for management and protection of the communities containing this species. Protection through management agreements or leases may provide adequate short-term protection, but these should only be considered as intermediate steps in the process of ultimately providing for permanent protection. Short-term protection strategies may be necessary if private landowners are not agreeable to, or monies are not available for, acquisition of conservation easements or fee simple title. Conservation agreements with adjacent landowners or owners of rights-of-way (power companies, highway departments, etc.) should be developed to prevent inadvertent adverse alteration of the habitat.

2. Determine and implement management necessary for long-term reproduction, establishment, maintenance, and vigor. Protection of the species' habitat is the obvious first step in ensuring its long-term survival, but this alone will not be sufficient. Habitat management may be necessary to allow the species to perpetuate its life cycle over the long term. However, since very little is known about this species, further information on its genetic diversity, population biology, and ecology, and an understanding of the natural processes that maintain suitable habitat, is necessary before effective management guidelines can be developed and implemented.

2.1 Determine population size and stage-class distribution for all populations. Population size and stage-class distribution data are essential to predicting what factors may be necessary for populations to become self-sustaining (Menges 1987). Such data are needed for the existing populations and for any newly discovered populations. Data collected should include population size, population area, sex ratio, seed production, seedling establishment, clonal growth, phenotypic variation, and genotypic variation. This task should be combined with the work described under Task 1.2. This will ensure that funds are utilized in the most efficient manner.

2.2 Study abiotic and biotic features of the species' habitat. An understanding of the nature of the habitat occupied by the species is essential to the long-term survival and recovery of Michaux's sumac. Monitoring studies should include populations within a wide range of habitats, both altered and undisturbed. Permanent plots should be selected and established to determine the relationship between abiotic factors (such as soil depth and type, soil moisture content and pH, and light intensity) and biotic factors (such as reproduction, germination, and degree of competition and predation). This information is necessary to determine the appropriate timing and type of management needed to ensure the continued vigor of existing populations and to accurately select good potential sites for reintroduction. Interspecific competitive release must be carefully undertaken, since one outcome of this type of management could be increased competition among clones of R. michauxii. This could result in fewer clones surviving. Also, male clones may be at a competitive advantage over female clones because of lower resource allocation to sexual reproduction (J. Hamrick, University of Georgia, personal communication, 1991). Because of the obvious serious implications for long-term survival of populations, post-management monitoring should be designed to detect if certain clones are spreading at the expense of others.

The vectors of seed dispersal should be determined and their effectiveness under different ecological and spatial conditions should be assessed. If birds are found to be the primary dispersers, this could mean that the seeds require some sort of acid treatment for germination. Also, since most of the remaining populations are small, it's likely that seeds dispersed by birds would be carried out of the population and probably deposited in unsuitable habitats (Hamrick, personal communication, 1992). Major pollinators need to be determined. Although various bees have been observed visiting the flowers, specific pollinators and pollination mechanisms of the species remain unidentified. If it is determined that seed set is limiting, emphasis should first be placed on investigations of environmental, genetic, and pollination factors. If seedling establishment is limited by other than environmental factors (e.g., safe sites) then seed dispersal should be investigated first.

The relative importance of sexual and vegetative reproduction to the long-term survival of the species is unknown and must be determined in order for effective management and protection to take place. As mentioned earlier, R. michauxii may have the ability to change the sex of individual stems or may maintain inflorescences of both sexes (Savage et al. 1991). Further investigation of this is needed, along with documentation of factors (e.g., environmental) that may be dictating the change. Genetic variability within and between populations has been determined through starch gel electrophoresis (Sherman-Broyles et al. 1992), but more extensive genetic work might be useful. New stems could be genotyped, making it possible to determine their relationship to other clones. By this means, the spread of individual clones could be followed over time. This would be especially helpful in determining which clones should be introduced into existing populations or used to reestablish extirpated populations.

Relationships with competing species must be investigated. It is believed that competition from invading species was historically controlled by some form of periodic disturbance, such as fire or light grazing by native herd animals. However, the effects of and exact interactions between this species and potential competitors are unknown.

2.3 Conduct long-term demographic studies. Long-term demographic studies should be conducted in permanent plots located within each study site established for habitat analysis. Plots should be visited annually, for at least 4 consecutive years. The locations of individual plants of all stage-classes should be mapped; data collected should include the sexual composition of the population, overall plant size, the number and size of leaves, inflorescence size, fruit size and number, and seed set. Because of the sex-change possibility (Savage et al. 1991), individual clones should be tagged and monitored every year to determine if they have changed sex. Larger plots, surrounding each of the smaller, more intensively measured and mapped plots, should be monitored for seedling or shoot establishment. Seedlings should be mapped and measured. Any changes in the habitat within each plot (soil disturbance, increases or decreases in light intensity, moisture, etc.) should be noted at each visit.

2.4 Determine the effects of past and ongoing habitat disturbance. Establishment and long-term monitoring of permanent plots may be the most effective means of assessing the effects of disturbance. Appropriate

methodology for this must be determined but will likely include the measurement of many of the parameters specified in Tasks 2.2 and 2.3.

2.5 Define criteria for self-sustaining populations and develop appropriate habitat management guidelines based upon the data obtained from Tasks 2.2 through 2.4. Currently, there is not sufficient data to determine what this species requires in order for populations to be self-sustaining. Successful management of this species will require further information on distribution/ limiting factors, as well as the ecology of germination and seedling establishment. Research, as described under Tasks 2.2 through 2.4, should provide the information needed to protect and manage occupied habitat so that the continued survival of healthy populations is assured.

2.6 Implement appropriate management techniques as they are developed from previous tasks.

2.7 Develop techniques and reestablish populations in suitable habitat within the species' historic range. Techniques for the propagation and transplantation of this species should be summarized and disseminated to appropriate organizations and individuals. Reintroduction efforts will have to be conducted in cooperation with knowledgeable personnel at private nurseries, botanical gardens, and the Center for Plant Conservation. Transplanted populations must be closely monitored in order to determine success and to adjust the methods of reestablishment. Care must be taken to use restoration methods that ensure the maintenance or enhancement of genetic diversity.

3. Maintain and expand cultivated sources for the species and provide for long-term maintenance of selected populations in cultivation. At least two private nurseries (Woodlanders in Aiken, South Carolina, and Niche Gardens in Chapel Hill, North Carolina) are maintaining cultivated specimens of Michaux's sumac. Maintaining the genotypes of small, isolated populations in cultivation should be of high priority. Seed or vegetative propagules should be collected as soon as possible from all populations that are still healthy enough to tolerate such harvest. A ready source of cultivated material should ease the threat of taking from wild populations.

4. Enforce laws protecting the species and/or its habitat. Michaux's sumac is not known to be a significant part of the horticultural trade, but this could become a threat in the future. The Endangered Species Act prohibits taking of the

species from Federal lands without a permit and regulates trade. Section 7 of the Act provides additional protection of the habitat from impacts related to federally funded or authorized projects. In addition, for listed endangered plants, the 1988 amendments to the Act prohibit: (1) their malicious damage or destruction on Federal lands and (2) their removal, cutting, digging, damaging, or destroying in knowing violation of any State law or regulation, including State criminal trespass law.

Michaux's sumac is listed as endangered in North Carolina, where State law prohibits taking of the species without a permit and the landowner's written permission and regulates trade in the species (North Carolina General Statute 19-B, 202.12-202.19). Michaux's sumac is proposed for listing by the State of Georgia, where the Georgia Wildflower Preservation Act of 1973 prohibits digging, removal, or sale of State-listed plants from public lands without the approval of the Georgia Department of Natural Resources, the State management authority.

5. Develop materials to inform the public about the status of the species and the recovery plan objectives. Public support for the conservation of Michaux's sumac could play an important part in encouraging landowner assistance and conservation efforts. This is especially true for the populations that occur in areas being adversely affected by development associated with expanding urban areas. Information materials should not identify the plant's locations so as not to increase the threat of taking.

   5.1 Prepare and distribute news releases and informational brochures. News releases concerning the status and significance of the species and recovery efforts should be prepared and distributed to major newspapers within the range of the species, as well as to smaller newspapers in the vicinity of the species' habitat. Informational brochures and other educational material should be developed and distributed to the Center for Plant Conservation and to botanical gardens that play a conservation/education role.

   5.2 Prepare articles for popular and scientific publications. The need to protect the species in its native habitat and cooperation among local, State, and Federal organizations and individuals should be stressed. Scientific publications should emphasize the additional research that is needed and solicit research assistance from colleges and universities that have conducted studies on this or closely related species.

6. Annually assess success of recovery efforts for the species. Review of new information, evaluation of ongoing actions, and redirection, if necessary, is essential for assuring that full recovery is achieved as quickly and efficiently as possible.

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PART III

IMPLEMENTATION SCHEDULE

Priorities in column one of the following implementation schedule are assigned as follows:

1. Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

2. Priority 2 - An action that must be taken to prevent a significant decline in species population, habitat quality, or some other significant negative impact short of extinction.

3. Priority 3 - All other actions necessary to meet the recovery objective.

Key to Acronyms Used in This Implementation Schedule

FWS - U.S. Fish and Wildlife Service
ES - Ecological Services
SCA - State Conservation Agencies - State plant conservation agencies of participating states. In North Carolina, these are the Plant Conservation Program (North Carolina Department of Agriculture) and the Natural Heritage Program (North Carolina Department of Environment, Health, and Natural Resources); in Georgia, the Freshwater Wetlands and Heritage Inventory (Georgia Department of Natural Resources).
CPC - Center for Plant Conservation

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS		Other	FY 1993	FY 1994	FY 1995	
				Region	Division					
1	1.1	Develop interim research and management plans in conjunction with landowners.	2 years	4	ES	SCA	5.0	5.0	---	
3	1.2	Search for additional populations.	3 years	4	ES	SCA	20.0	10.0	10.0	
1	1.3	Determine habitat protection priorities.	1 year	4	ES	SCA	1.0	---	---	
1	1.4	Evaluate habitat protection alternatives.	2 years	4	ES	SCA	1.0	1.0	---	
2	2.1	Determine population size and stage-class distribution for all populations.	2 years	4	ES	SCA	20.0	20.0	---	
2	2.2	Study abiotic and biotic features of the species' habitat.	5 years	4	ES	SCA	15.0	10.0	8.0	

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS		Other	FY 1993	FY 1994	FY 1995	
				Region	Division					
2	2.3	Conduct long-term demographic studies.	5 years	4	ES	SCA	16.0	6.0	6.0	
2	2.4	Determine the effects of past and ongoing habitat disturbance.	3 years	4	ES	SCA	12.0	6.0	4.0	
2	2.5	Define criteria for self-sustaining populations and develop appropriate habitat management guidelines based upon the data obtained from Tasks 2.2 through 2.4.	1 year	4	ES	SCA	---	---	5.0	
2	2.6	Implement appropriate management techniques as they are developed from previous tasks.	Unknown	4	ES	SCA	?	15.0	20.0	

IMPLEMENTATION SCHEDULE

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS		Other	FY 1993	FY 1994	FY 1995	
				Region	Division					
3	2.7	Develop techniques and reestablish populations in suitable habitat within the species' historic range.	5 years	4	ES	SCA	---	25.0	15.0	
3	3	Develop a cultivated source of plants and provide for long-term seed storage.	3-5 years	4	ES	SCA, CPC	5.0	5.0	1.0	
1	4	Enforce laws protecting the species and/or its habitat.	Ongoing	4	ES	SCA	2.0	2.0	2.0	
3	5.1	Prepare and distribute news releases and informational brochures.	Ongoing	4	ES	SCA, CPC	2.0	1.0	1.0	
3	5.2	Prepare articles for popular and scientific publications.	Ongoing	4	ES	SCA, CPC	1.0	0.5	0.5	

IMPLEMENTATION SCHEDULE

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS		Other	FY 1993	FY 1994	FY 1995	
				Region	~~Division~~					
3	6	Annually assess success of recovery efforts for the species.	Ongoing	4	ES	SCA, CPC	0.5	0.5	0.5	

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