Management Plan for the Recovery of Michaux's sumac (*Rhus michauxii* Sarg.) At Big Shoe Hill Preserve Conservation Area Scotland County, North Carolina

Report to be submitted to:

U.S. Fish and Wildlife Service
Raleigh Field Office, Raleigh, North Carolina

N.C. Department of Transportation
Project Development and Environmental Analysis Branch
Natural Environment Unit
Raleigh, North Carolina

The Graduate Faculty of North Carolina State University
In partial fulfillment of the requirements for the
Degree of Master of Forestry

Raleigh, NC

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December 11, 2009

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1.0 INTRODUCTION

In 1989, the U.S. Fish and Wildlife Service (USFWS) listed Michaux's sumac (*Rhus michauxii* Sarg.) as endangered. Consequently, in 1993, a Recovery Plan was completed. The Recovery Plan detailed the reasons for listing Michaux's sumac, and others have become apparent since. Examples of threats include habitat destruction, loss of known populations, fire suppression, alteration of native habitat, residential and industrial development, roadside and utility right-of-way maintenance, and hybridization.

At present 45 known populations of Michaux's sumac occur in Virginia, North Carolina, and Georgia. Four extant populations occur in Virginia, 39 in North Carolina, and two in Georgia. Currently, 13 Michaux's sumac sites are managed in North Carolina (UFWS 2009). In North Carolina, these sites are protected through the U.S. Department of Defense, N.C. Wildlife Resources Commission, Wake County, Mecklenburg County, the City of Raleigh, The Nature Conservancy, N.C. State University, and N.C. Division of Parks and Recreation (USFWS 2009). For a site to qualify as a USFWS Recovery Site, it must have a management plan under implementation. At this time, no recovery management plans have been written for Michaux's sumac (Dale Suiter, USFWS, pers. comm.).

The purpose of this project is to complete a recovery management plan for the transplanted population at Big Shoe Hill Preserve Conservation Area (Shoe Hill) in Scotland County (Figure 1); this site is intended to qualify as a USFWS Recovery Site for Michaux's sumac after it has been deemed self-sustaining.

2.0 JUSTIFICATION FOR TRANSPLANTATION

The USFWS recognizes that some development-related impacts to federally listed species cannot be avoided, and consequently the need arises to transplant individuals or entire populations of federally listed plant species out of project areas into protected sites. Accordingly, in an effort to save a Michaux's sumac population from being extirpated during construction of the North Carolina Department of Transportation's (NCDOT) Transportation Improvement Program project (TIP) R-2502; a portion of this population has been transplanted to the North Carolina Herpetological Society (NCHS) parcel known as Big Shoe Hill Preserve Conservation Area (Shoe Hill) in Scotland County.

NCDOT attained an agreement with NCHS to transplant stems to Shoe Hill in 2005. The transplant site mitigates some of the impacts to Michaux's sumac from the widening of US 1 in Richmond County (R-2502). The site is situated in an undeveloped area and offers suitable habitat for the transplants and future population enhancement. Specifically, the transplantation occurred in a habitat that is comparable to the species' known habitat, as defined in the Recovery Plan.

The overall objective of this transplant site is to contribute to the recovery criteria of developing 19 self-sustaining protected populations and to meet the recovery objective to facilitate delisting (USFWS 1993).

3.0 SITE DESCRIPTION: PRE-EXISTING BIOTIC CONDITIONS

The principal natural community at Shoe Hill is Mesic Pine Flatwoods. This community is characterized by Schafale and Weakley (1990) as a closed to open canopy of longleaf pine (*Pinus palustris* P. Mill) or loblolly pine (*P. taeda* L.). The understory and herbaceous strata may be dense or sparse depending on the past disturbances, such as fire. Hydrology associated with this community is mesic to dry-mesic and the physiographic characteristic is typically flat to rolling topography on Coastal Plain sediments.

At Shoe Hill, the transplant site (Appendix II, Figures 2 & 3) consisted of sparse, mature loblolly pines and a dense shrub layer of loblolly pines and scrub oaks, such as turkey oak (*Quercus laevis* Walt.) and water oak (*Q. nigra* L.). The forest community to the west and south of the transplant site is a closed canopy of loblolly pine with sparse longleaf pine, a moderate understory of scrub oaks, and a depauperate herbaceous layer. The community to the east and north of the transplant site is similar to the transplant site prior to clearing. This area, if cleared, will offer the best potential for future enhancement of Michaux's sumac (Figures 2 & 3). At this time, no exotic, invasive species have been observed at the transplant site.

4.0 SITE SURVEY DATA

4.1 Transplant Site Characteristics

Location (Latitude: Longitude): 34.923444° N, -79.404834° W

Site disturbance history: No information, however one can reasonably presume farming and logging have occurred.

4.2 Edaphic conditions

The mapped soil at the transplant site is Wagram loamy sand (WaB), 0 to 6 percent slope, Arenic Kandiudult (USDA 1967 & 2006). Ten soil samples taken at the transplant site were analyzed by the N.C. Department of Agriculture (NCDA) & Consumer Services Agronomic Division for edaphic conditions (Table 1). Willis (2008) analyzed soil at 42 natural populations of Michaux's sumac. The results below indicate the values are within range of or lower than conditions at natural sites (see Sec. 5.7). In addition, these data can be used for comparisons with future transplant and/or management efforts.

Table 1. NCDA Soil Testing Lab Results for Shoe Hill

Cation Exchange Capacity	Base Saturation (%)	pH	P-I	K-I	Ca %	Mg %	Mn-I	Zn-I	Cu-I	S-I
1.2	67	5.5	46	8	48	16	15	16	18	11
1.1	55	5.1	56	5	36	14	12	9	14	13
1.1	82	5.7	27	7	63	17	18	10	14	8
1.2	50	5.1	62	7	38	13	11	10	15	14
1.3	54	5.2	51	7	38	11	13	15	14	15
1.0	50	4.9	53	8	36	13	11	9	19	17
1.2	50	5.1	59	6	38	13	13	11	16	15
1.1	64	5.3	27	5	45	14	7	7	12	10
1.1	64	5.2	26	6	47	15	9	10	15	9
1.3	77	5.8	39	7	56	17	14	12	21	9

I – nutrient index as used by the NCDA Soil Testing Lab

5.0 SPECIES INFORMATION

5.1 Species Classification

Order: Sapindales

Family: Anacardiaceae

Genus: *Rhus* Linnaeus

Scientific name: *Rhus michauxii* Sarg.

Common name(s): Michaux's sumac, dwarf sumac, false poison sumac

5.2 Species Status

N.C. Natural Heritage: Global G2G3, State S2; Federal: E; State (N.C.): E-SC

5.3 Reasons for rarity

Examples include, but are not limited to habitat destruction, loss of known populations, fire suppression, alteration of native habitat, residential and industrial development, roadside and utility right-of-way maintenance, and hybridization.

5.4 Previous known reintroduction or reintroduction attempts

Braham and others (2006) successfully transplanted clones to Umstead Park (N.C. Division of Parks and Recreation), Hill Forest [N.C. State University (NCSU)], Harris Tract (NCSU), and Schenck Forest (NCSU) that were discovered growing in the proposed interchange for the NCDOT's Northern Wake Expressway and North-South Connector (I-540) in Wake County, N.C. Emrick (2003) also transplanted clones in conflict with training at ARNG-MTC Fort Pickett in V.A.

5.5 General Life History Traits

Michaux's sumac is a dioecious perennial shrub. Stems generally grow between 1.5 and 4 dm (Radford et al. 1968). The entire plant, including the 5-6 mm broad drupe, is densely pubescent with compound leaves, and the inflorescence is on an erect terminal panicle (Radford et al. 1968). The rachis is narrow winged or wingless and bears 9 to 13 sessile, oblong leaflets that are 4-9 cm long, 2-5 cm wide and acute to acuminate (Radford et al. 1968). The small flowers are 4 to 5 parted and greenish-yellow to white.

Michaux's sumac is distinguished from other members of the genus *Rhus* by its height, dense overall pubescence, and evenly serrated leaflets (USFWS 1993).

5.6 Plant Biology

5.6.1 Phenology

Michaux's sumac shoots emerge in early spring and leaves appear in late spring. The duration of anthesis is one month, generally in late June to early July. Male flower emerge before female inflorescences (Pokorski and Emrick 2007). Flowers are occasionally born on first season stems; however, typically less than half of the population produces flowers (Pokorski and Emrick 2007). Fruit maturation occurs August to September and will persist through the winter (Pokorski and Emrick 2007).

5.6.2 Reproduction

Allogamous reproduction does occur; however, most reproduction is by vegetative cloning, via rhizome (Pokorski and Emrick 2007)

5.6.2.1 Pollination

Michaux's sumac is entomophilous, meaning it is pollinated by insects. Species specific pollinators have not been identified (Sherman-Broyles et al 1992; Pokorski and Emrick 2007)

5.7 Habitat Selection

Michaux's sumac is often associated with fire-maintained open woodlands and artificially open habitats such as rights-of-way of roads, railroads, and utilities. In North Carolina

and Virginia, it prefers sites on dry uplands. Because of this association with open habitats, it is believed to be shade-intolerant. In North Carolina, favored substrates are generally low in clay and consist of sands or loamy sands. This is consistent with soils associated with the Sandhills region of North Carolina. Thrush (2002) found that soils associated with the species are usually nutrient-poor or nutrient availability is low due to pH. Willis (2008) suggested sites with low levels of phosphorus, potassium, and zinc are preferable due to reduced inter-specific competition.

6.0 PLANT MATERIAL AND SOURCE

In February 2006, biologists from the NCDOT's Natural Environment Unit (NCDOT – NEU) transplanted plant material from element occurrence (EO) 56.55 (Hoffman Site) and EO 59.54 (Marston Site) to three sites nearby in Scotland County including Shoe Hill. A Protected Plant Conservation Permit and Record issued from N.C. Plant Conservation Program (NCPCP) on February 22, 2006 covered approximately 221 individuals from 2 sites, approximately 70 individual plants from the Hoffman site and approximately 151 individual plants from the Marston Site. It should be noted that this permit acknowledges that the final number of root segments taken from each plant will result in a higher number of individual "pieces" of plant material from original stock due to breakage. Indeed, the final number of individual "pieces" was higher than specified in the original permit.

7.0 MANAGEMENT PROTOCOL

7.1 Site Clearing

The initial site clearing was conducted by employees from the NCDOT - NEU. Relatively open sites were selected at Shoe Hill. Loblolly pine seedlings and saplings were targeted for removal by hand. Larger trees were cut using chainsaws. Most stumps were treated with herbicide to prevent re-growth. A few of the larger trees were girdled to reduce shading while providing snags for birds and wildlife. The goal of the tree removal was to create patchy openings within the forest.

Site clearing was conducted by hand to avoid impacts from driving heavy equipment into the conservation area (soil compaction, rutting, and introduction of invasive weeds). Additional clearing will be conducted on an "as-needed" basis.

I. Responsible Party: NCDOT - NEU

II. Management Activity: Utilized hand clearing and judicious herbicide application to remove excessive vegetation present on site. Left selected trees for wildlife food and shade. Some ground level woody vegetation will be eradicated by the prescribed burn.

The cleared plots are locatable by GPS coordinates taken at the estimated center point (see Appendix III).

7.2 Transplanting Michaux's sumac

Plant material, described in Section 6.0 was randomly distributed at Shoe Hill. Material consisting of roots only was completely buried while material consisting of roots and shoots was buried with the shoot-portion protruding above ground. Seed-heads were removed from shoots and kept in cool, dry storage for later use.

On February 28, 2007, a follow-up transplantation effort was conducted at Element Occurrence (EO) 56.55 (Hoffman Site) to remove plant material remaining from 2006. At this time, 341 additional roots and shoots were removed and replanted at Shoe Hill (Figures). The plant material was planted along transects to facilitate observation and analysis of survival and transplant success. Specifically, roots and shoots were planted in a combination of ways to evaluate long-term survival of plant material given the different methods.

Additionally, the Michaux's sumac seeds that had been collected from EO 56.55 (Hoffman site) and 59.54 (Marston site) were planted at the Shoe Hill. All seeds were held at the North Carolina Botanical Garden in Chapel Hill, N.C. (NCBG) until planted. At the NCBG, seeds were stored in a dry cool location separated by EO and by individual plant. Prior to planting, the seeds were separated into various treatments in order to evaluate success rates of different planting regimes or seed handling procedures. A subset of seeds from each EO was planted in a greenhouse at the NCBG to evaluate performance given "optimal" conditions. At Shoe Hill, 100 seeds of each treatment were randomly distributed into 1-meter plots. A total of 19 plots with varying treatments were

established. Subsequent to planting, during dry periods of late winter 2007, NCDOT biologists watered the seeds to encourage germination.

Seeds from EO 59.54 (Marston site) were used to assess differing methods of seed preparation prior to planting. The seed coat either was left intact (non-scarified) or removed (scarified). Some of these seeds were soaked in water for 24 hours prior to planting (wet) and others were not soaked (dry). Other scarified seeds were separated by color and identified as either light or dark. One hundred seeds were subject to each treatment and randomly distributed onto 1-meter^2 plots at Shoe Hill.

The remaining seeds from the two EO's were combined to encourage genetic diversity and intermixing. The recommendation to combine seeds was made by Johnny Randall, Ph.D. (pers. comm.) of the NCBG as a means of preventing potential reductions in fitness and survival resulting from a genetic bottleneck. This is a valid concern given the close proximity of the two parent EO's. A portion of the mixed EO seeds also was subjected to soaking and scarification treatments prior to planting. A subset of seeds served as "Control" plots as they represented the nominal planting regime of mixed color, mixed maternal/paternal lines, mixed EO's, with dry, scarified seeds.

One thousand nominally-prepared seeds (mixed color, mixed maternal/paternal lines, mixed EO's, dry, scarified seeds) were randomly distributed over approximately 186 meter^2 in the area identified as "Spread". Six hundred seeds were planted in rows (labeled as "Rows" in attached figures) either shallow (0.5 in below surface) or deep (1.5

in below surface) to assess effects of planting depth on survival. Finally, all remaining nominally prepared seeds (approximately 3600 seeds) were randomly distributed at Shoe Hill Preserve to the west and north of the established plots (Figure). Though not subject to particular treatments beyond nominal preparation techniques, successful growth of these seeds at Shoe Hill will be beneficial for the conservation and recovery effort of this species.

7.3 Monitoring

Monitoring of the transplants will be conducted by NCDOT - NEU staff. Each population transplanted within the conservation area will be monitored annually.

I. Responsible Party: NCDOT – NEU

II. Management Activity: Unconstrained species survey

Documentation of the success of management activities is a crucial component of any good adaptive natural resource management plan. Future management activities will be questionable and certainly less effective without adequate, clear baseline data from which to draw conclusions and make decisions. A focus on the following three objectives should allow for proper monitoring to occur:

- All management activities should be documented in detail.
- Survivorship data on transplanted specimens should be collected, assessed and analyzed annually.

- Monitoring data should be standardized and be as quantitative in nature as possible so annual measurements will be statistically comparable.

With these objectives in mind, it is recommended that one general – unconstrained species survey be conducted annually.

7.4 Controlled Burns

Prescribed burns will be conducted every three years if possible.

I. Responsible Party: NCDOT – NEU

II. Management Activity: Conduct a safe, controlled burn according to written burn prescription thus reducing woody competition and debris and providing a fertile site for future planting.

Fire is an effective management tool because Michaux's sumac requires abundant overhead light and reduced competition in order to maintain its population (Emrick and Jones 2008).

All firebreaks will be cleared by hand by NCDOT staff.

7.5 Ongoing Invasive Species and Woody Plant Control

Invasive species and woody plants will be controlled by using prescribed burns, careful herbicide use (mainly for invasives) and cutting stems. Prescribed burns will also reduce

the subcanopy and shrub layers. It will also be important to monitor for encroachment of exotic species into the Michaux's sumac transplant areas over time and address as needed.

I. Responsible Party: NCDOT – NEU

II. Management Activity: Monitor site once per year for exotic, invasive, or woody species and control utilizing mechanical or chemical methods as needed based on specific species being treated.

Special attention and care must be taken at all times to avoid spray impact on the transplant areas. DO NOT allow sprays to drift to desirable plants.

7.6 Reporting

Responsible Party: NCDOT – NEU

Annual monitoring reports should be provided to the USFWS.

8.0 RESOURCES AND CITED LITERATURE

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Appendix I

Species List for Shoe Hill

Date reported: November 5, 2009
Reported by: Tyler Stanton, Lance Fontaine, Ph.D, Steve Mitchell

Canopy, Subcanopy, and Shrub Layer

Pinus taeda L. (loblolly pine)
Pinus palustris P. Mill. (longleaf pine)
Quercus nigra L. (water oak)
Quercus laevis Walt (turkey oak)

Vines

None

Herbs

Andropogon virginicus L. (broomsedge)
Aristida tuberculosa Nutt. (seaside threeawn)
Eupatorium capillifolium Lam. (dogfennel)
Gymnopogon ambiguus Michx. (bearded skeletongrass)
Opuntia humifusa Raf. (devil's-tongue)
Schizachyrium scoparium Michx. (little bluestem)
Symphyotrichum pilosum var. pilosum Willd. (hairy white oldfield aster)

Lichens

Cladonia leporine Fr. (jester lichen)
Cladonia subtenuis Abbayes (Dixie reindeer lichen)

Animal Species

Elaphe obsoleta obsolete Black rat snake

Appendix II

Figures

Appendix III

Shoe Hill Transplant Plot Coordinates

Table 2. Plot coordinates (Latitude/Longitude Decimal degrees)

1	34.923892	-79.406447	**36**	34.923892	-79.406413
2	34.923892	-79.406436	**37**	34.923892	-79.406409
3	34.923883	-79.406435	**38**	34.923883	-79.406423
4	34.923883	-79.406446	**39**	34.923883	-79.406406
5	34.923892	-79.406425	**40**	34.923892	-79.406399
6	34.923892	-79.406415	**41**	34.923892	-79.406413
7	34.923883	-79.406414	**42**	34.923883	-79.406403
8	34.923883	-79.406425	**43**	34.923883	-79.406399
9	34.923892	-79.406403	**44**	34.923892	-79.406413
10	34.923892	-79.406392	**45**	34.923892	-79.406396
11	34.923883	-79.406392	**46**	34.923883	-79.406393
12	34.923883	-79.406404	**47**	34.923883	-79.406323
13	34.923895	-79.406384	**48**	34.923895	-79.406313
14	34.923881	-79.406382	**49**	34.923881	-79.406306
15	34.923842	-79.406436	**50**	34.923842	-79.406333
16	34.923850	-79.406420	**51**	34.923850	-79.405916
17	34.923839	-79.406420	**52**	34.923839	-79.406002
18	34.923834	-79.406430	**53**	34.923834	-79.405949
19	34.923848	-79.406413	**54**	34.923848	-79.406074
20	34.923850	-79.406406	**55**	34.923850	-79.406058
21	34.923842	-79.406403	**56**	34.923842	-79.406001
22	34.923842	-79.406410	**57**	34.923842	-79.405917
23	34.923856	-79.406390	**58**	34.923856	-79.405909
24	34.923856	-79.406380	**59**	34.923856	-79.405935
25	34.923848	-79.406380	**60**	34.923848	-79.405992
26	34.923848	-79.406390	**61**	34.923848	-79.405949
27	34.923856	-79.406373	**62**	34.923856	-79.405998
28	34.923848	-79.406370	**63**	34.923848	-79.406074
29	34.923809	-79.406436	**64**	34.923809	-79.405998
30	34.923809	-79.406430	**65**	34.923809	-79.405964
31	34.923801	-79.406423	**66**	34.923801	-79.405920
32	34.923801	-79.406433	**67**	34.923801	-79.406058
33	34.923815	-79.406413	**68**	34.923815	-79.406078
34	34.923807	-79.406413	**69**	34.923807	-79.406111
35	34.923765	-79.406423			