

Conradina glabra
(Apalachicola rosemary)

**5-Year Review:
Summary and Evaluation**



Torreya State Park, Florida. Photos by Vivian Negron-Ortiz

**U.S. Fish and Wildlife Service
Southeast Region
Panama City Field Office
Panama City, Florida**



5-YEAR REVIEW
***Conradina glabra* (Apalachicola rosemary)**

I. GENERAL INFORMATION

A. Methodology used to complete the review

This review was accomplished using information obtained from the plant's 1994 recovery plan, unpublished field survey results, reports of current research projects, peer reviewed scientific publications, unpublished field observations by Service, State and other experienced biologists, and personal communications. These documents are on file at the Panama City Field Office. A *Federal Register* notice announcing the review and requesting information was published on April 16, 2008 (73 FR 20702). No part of this review was contracted to an outside party. Comments and suggestions from peer reviewers were incorporated as appropriate (see Appendix A). This review was completed by the Service's lead Recovery botanist in the Panama City Field Office, Florida.

B. Reviewers

Lead Field Office: Dr. Vivian Negrón-Ortiz, Panama City Field Office, 850-769-0552 ext. 231

Lead Region: Southeast Region: Kelly Bibb, 404-679-7132

Peer reviewers:

Ms. Tova Spector, Environmental Specialist II, Florida Park Service, Department of Environmental Protection, 4620 State Park Lane, Panama City, Florida 32408

Dr. Christine Edwards, Postdoctoral Research Associate, University of Wyoming, Department of Botany, 3165, 1000 E. University Avenue, Laramie, Wyoming 82071

Dr. Alice A. Winn, Department of Biological Science, Florida State University, Tallahassee, Florida 32306

C. Background

1. FR Notice citation announcing initiation of this review: 73 FR 20702 (April 16, 2008).

2. Species status: Stable (2008 Recovery Data Call). According to managers of Torreya State Park, Liberty County, FL (2008 pers. comm. to V. Negrón-Ortiz), the species status over the short-term appears stable, but uncertain over the long-term. Trends in population numbers over the past years are

unknown because they have not surveyed the plants recently. See section II.C.1.a for current information.

3. Recovery achieved: 2 (26-50% recovery objectives achieved); see section II.B.3 for details on recovery criterion and actions, and how each action has or has not been met.

4. Listing history

Original Listing

FR notice: 58 FR 37432.
Date listed: July 12, 1993
Entity listed: species
Classification: endangered

5. Associated rulemakings:

Not applicable

6. Review History

Status Review: No formal 5-year reviews have been conducted on *C. glabra* since the Recovery Plan was written and approved.

2000, 2001, 2002, 2003; 2004; 2005; 2006; 2007; 2008 (stable) – Recovery Data Call

7. Species' Recovery Priority Number at start of review (48 FR 43098):

The Apalachicola rosemary is assigned a recovery priority of 8 because the degree of threat to its persistence is moderate, it is a species, and has a high recovery potential.

8. Recovery Plan or Outline

Name of plan: Recovery Plan for Apalachicola Rosemary (*Conradina glabra*)

Date issued: September 1994

Dates of previous revisions: N/A

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any vertebrate wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because *C. glabra* is a plant, the DPS policy is not applicable and not addressed further in this review.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

The recovery plan includes a recovery objective for downlisting the species as well as the criterion. The immediate goal is to preserve *C. glabra* from extinction by maintaining naturally-reproducing wild populations on appropriate sites. For downlisting the species from endangered to threatened, the goal is to adequately protect and manage five populations (on public land or under conservation easement). The plan states that these goals will be refined as recovery tasks are implemented and better information is acquired.

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

No. The recovery criteria were based on the available data at the time the plan was published 15 years ago.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

Yes. The recovery plan addressed factor 1 –habitat destruction and modification, which is still a threat, and factor 4 - Inadequacy of existing regulatory mechanisms. See section II.C.2 for description of current information and threats.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

The recovery plan lists a downlisting criterion to adequately protect and manage five populations occurring on public land or under conservation easements. This recovery criterion addresses factors 1 and 4. Factors 2, 3, and 5 are not relevant to *C. glabra*.

We summarize our progress below under existing recovery actions. Recovery actions 1.1, 1.3, and 1.4 address factor 4. Recovery actions 1.2, 2, 3, and 4 address factor 1.

Recovery action 1: Protect existing populations

1.1. Encourage conservation of existing populations on private lands
This action has not been met.

1.2. Conduct annual mapping and monitoring of all known populations

This is an ongoing action conducted by FNAI (Florida Natural Areas Inventory) and Florida Park Service staff and volunteers in recent years. Currently, 60 - 70 % of the Sweetwater Creek Tract (SCT) containing *C. glabra* has been mapped (Spector, 2009, pers. comm.).

1.3. Manage rights-of-way

This recovery action is ongoing and conducted primarily by the Florida Department of Transportation (FDOT) and Florida Gas and Transmission (FGT). Spot application of moderately toxic herbicide Garlon 4 is used to treat exotic shrubs or trees at Torreya State Park (TSP).

1.4. Acquire habitat

Most of the known *C. glabra* were acquired by the State of Florida by purchasing the SCT from the St. Joe Timberland Company in 2002. The SCT is managed as part of the Torreya State Park. This is the only protected sustained population of this plant.

Recovery action 2: Conduct population biology studies

2.1. Study the effects of prescribed fire and forest management practices

This is an ongoing action initiated in 2005 and conducted by the Florida Park Service. The response in ground and canopy cover, and overall *C. glabra* density and individuals under 5 mm height are being monitored for five years following four treatments: 1) mechanical sand pine removal with windrow intact, burn and native plants not planted, 2) mechanical sand pine removal and flatten windrows, burn and native plants not planted, 3) mechanical sand pine removal, native groundcover planted and burn in flattened windrows, and 4) control/no harvest (Spector, 2009, pers. comm.).

Other fire ecology studies have not been conducted. According to Kral (1983), fire may increase *C. glabra* density given that longleaf pine is historically maintained by burning. W. Baker (Biological Consultant, Tallahassee, Florida) agreed that burning is needed to maintain an open habitat, but suggested that frequent fires may be detrimental to survival of *C. glabra*. Sandhills naturally burned every 1-10 years (Myers 1990), but Baker (2008, pers. comm.) considered that *C. glabra's* original range might have been restricted to areas where fire may have only burned every 20 or more years. Therefore, investigations related to the effects of prescribed fire on demography are imperative to be undertaken for determining the fire frequency and season that maximizes population growth rates.

2.2. Conduct life history studies

This is an ongoing action.

Pollination: Pollination studies and fruit set development were conducted by Isom and McGrane (1998) in the three translocated populations at The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve, Florida (The Nature Conservancy's ABRP; Gordon 1996). Fluorescent dye powders were used to monitor pollen transfer. Bees, butterflies, beetles, wasps, and flies were observed visiting the flowers, but insects were not seen transferring pollen. Several bees species, however, were observed with

fluorescent dye adhered to their head and thorax and potentially could be involved in pollination. Seed production was observed but not quantified. According to the authors, some seeds were small and perhaps non-viable, although germination was not attempted. Currently, Ms. Amanda Kubes, a Florida State University graduate student, is examining the effectiveness of pollinators on seed set, information that she plans to use in projecting species distribution models of potential range shifts under future climate change (Note: how effectiveness will be used in projecting distribution needs clarification).

Reproduction: *Conradina glabra*, like most plants, reproduces both sexually and asexually. Clonal growth (clonal reproduction, vegetative reproduction), which results in offspring genetically identical to the parent and potentially physiologically independent of the parent, has been observed in the field (Negron-Ortiz 2009, pers. observ.).

Floral observations indicate that *C. glabra* is potentially gynodioecious (has both female and hermaphrodite plants) (Gray 1965), and outcrossing in hermaphrodites is promoted by protandry (V. Negron-Ortiz, pers. observ.). Protandry refers to a temporal separation in male and female functions of bisexual flowers; in this case, the pollen is shed before the stigma becomes receptive. Gray (1965) observed one population near TSP displaying some degree of male sterility: the anthers were observed malformed or were well formed but the pollen was aborted. Current data is needed to verify if gynodioecy is present.

Demographic studies: Mr. J. Bladow, a Florida State University graduate student, is currently conducting a demographic analysis of *C. glabra* populations to determine which life cycle stages and demographic processes contribute most to population growth.

2.3. Survey for *Conradina glabra* outside its current range

This is an ongoing action conducted by FNAI and FWS botanist (see section VI, action 2).

Recovery action 3: Conduct genetic studies

This action has been met. See section C1b.

Recovery action 4: Propagate *Conradina glabra* and reintroduce and/or augment populations within its historic range

Propagation

Ex situ propagation was initiated in 1987 by the Historic Bok Sanctuary (Bok Sanctuary), Lake Wales, Florida with plants from the intersection of State Route 12 and 271 north of Bristol in Liberty County. Forty-eight cuttings from each of two populations located in rights-of-way were taken and transplanted in potting soil under greenhouse conditions. Cuttings rooting ranged from 76% to 88%, and were more abundant during the summer, although rooting occurred any time of the year (Wallace 1990).

At present, the Bok Sanctuary has three beds of this species along with two that contain sparse plantings totaling 93 plants. These plants are clones of the same source population made in November of 1987 and 1988 (Campbell, 2009, pers. comm.). Neither the Bok Sanctuary nor the National Center for Genetic Resources Preservation in Fort Collins, Colorado possesses stored seeds.

Translocation

Conradina glabra was reintroduced within its original range onto The Nature Conservancy's ABRP in 1991. Forty-eight plots of nine rooted cuttings were planted in each of three xeric sandhill sites at the preserve. Survival of planted cuttings was 94%. Prescribed fire management applied to two of the sites killed 25 % of those plants. Seedling establishment was highest in the burned sites. In general, survival rate was high 1 or 2 years after transplantation, however, long-term results of these transplants are lacking (D. Printis, TNC, 2009, pers. comm.). Longer term monitoring is necessary, because although initial transplant survival rates may be high the results of translocation are often followed by significant reversals over time (Fahselt 2007).

T. Spector (Florida State Park) does not recommend augmentation or translocation of *C. glabra*. She stated that it is unknown what the range of *C. glabra* was historically and that within its current range on the SCT, the population is sufficient to sustain itself in the near term.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends

Conradina glabra is a rare plant limited to Liberty County (Fig. 1). Historical extent and abundance of this species is unknown because the silviculture industry destroyed large areas of this species' sandhill habitat during the 1950s, and the species was not described until 1962. We can assume that the species was once more widespread.

Several locations occur on privately owned silvicultural land and rights-of-way (ROW) with unknown number of estimated plants (Fig. 1). Two of the introduced populations at the Nature Conservancy's ABRP have over 600 individuals, but the third has fewer than 75 (A. Winn, Florida State Univ., 2009, pers. comm.).

The only population on public land is found at the SCT, *Torreya* State Park (Fig. 1). This area was prepared by a bulldozer scraping topsoil and remaining vegetation into linear berms called windrows, planted in slash pine (with 500-700 stems per acre of sand pine), and then logged in the late 1980s (Spector, 2009, pers. comm.). Despite this severe alteration of habitat, SCT contains the majority of *C. glabra*: the estimated number of plants for 60 % to 70 % of the SCT (which

totals 2395.2 acres) range from 87,566 to 300,277 (Spector, 2009, pers. comm.). At present, data on population trends are lacking.



Fig. 1. Map of Florida showing Liberty County and the present range of *C. glabra* at the Sweetwater Creek Tract (red). Dots represent historical locations on rights-of-way and pine plantations (FNAI 2008). The present range of *C. glabra* at the SCT was surveyed and developed by T. Spector (Florida Park Service).

b. Genetics, genetic variation, or trends in genetic variation:

Martin (1992) used starch gel electrophoresis to describe allozyme diversity and genetic structure in this endangered species and its nearest relative, *C. canescens*. The author sampled two disjunct populations: one population containing three subpopulations of *C. glabra* in Liberty County and two *C. canescens* populations located in Santa Rosa County. The results revealed that each of the two disjunct populations was in Hardy-Weinberg equilibrium and had high levels of genetic diversity typical of an outcrossing breeding system (see section II.3 recovery action 2.2). The allozyme study showed that the *C. glabra* populations are genetically divergent from the populations of *C. canescens*. A recent study employing microsatellite data indicated that the species boundaries are not questionable (Edwards 2008a).

Note: The allozyme study misidentified the Milton/blackwater river population of *C. canescens* at Santa Rosa County as *C. glabra* (Edwards, 2009, pers. comm.). The conclusions presented here are accurate.

c. Taxonomic classification or changes in nomenclature:

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Magnoliopsida
Order:	Lamiales
Family:	Lamiaceae
Genus:	<i>Conradina</i> Gray
Species:	<i>glabra</i> Shinnery
Common name:	Apalachicola rosemary

Description: A minty aromatic, profusely branched shrub of about 1 m tall. Leaves are opposite, needle-like, linear-oblongate, sessile, and short (15 mm long and 3 mm wide). Flowers are bisexual and protandrous, 14-18 mm long, usually in axillary fascicles of 1-3 flowers. Corolla rose lavender to white, 2-lipped, lower lip with purplish dots. Stamens four; anther purple and white; style bifid, exerted, equaling or exceeding the stamens. Fruit a cluster of 4 globose nutlets to 1 mm in length.

Conradina, a morphologically homogeneous group of narrow-leaved, aromatic shrubs, is a monophyletic genus comprised of six species of which four are federally listed, as endangered or threatened (Edwards et al. 2008a, b). Species delimitations were unclear because hybridization may have potentially occurred among species (Edwards et al. 2006), thus the taxonomic status of several species were considered questionable. Although morphology and several molecular markers were used to answer this question (Edwards et al. 2006, Edwards et al. 2008b), microsatellite data revealed a clear differentiation of populations following recognized species boundaries, indicating that species have diverged from one another genetically and interspecific hybridization has not occurred recently (Edwards et al. 2008a).

d. Spatial distribution, trends in spatial distribution, or historic range:

In the mid 1900s, Apalachicola rosemary was identified and collected from two disjunct locations, Liberty and Santa Rosa counties. Edwards et al. (2008) microsatellite studies identified the Santa Rosa County population as *C. canescens*, therefore *C. glabra* is restricted to Liberty County, Florida (Fig. 1). Silvicultural site preparation of the sandhills in the The Nature Conservancy's ABRP during the 1950s, prior to ownership by The Nature Conservancy, involved clearing the vegetation, depositing the material in linear windrows, and planting slash pines. Many species, including *C. glabra*, were probably extirpated from the site as a result of this disturbance (Gordon 1996). Thus, it is assumed that this species was once more widespread, however, the historical range and abundance are unknown. According to Spector (2009, pers. comm. to Negrón-Ortiz), existing evidence does not support that this species was once more widespread. Her argument is that the majority of area on the western portion of SCT shares the same land use history yet contains no individuals of *C. glabra*. In addition, a 200 acre portion of the SCT also on the western portion of SCT was planted in sand pine but was not site prepared with windrows. Wiregrass and other groundcover species sensitive to soil disturbance remained intact yet no *C. glabra* was found (Spector, 2009, pers. comm. to Negrón-Ortiz). To date, it is not feasible to reconstruct the historic range because most of this species habitat was converted to pine plantation by the late 1950s and this species was not described until 1962 (Gordon 1996, Shinnars 1962).

e. Habitat or ecosystem conditions:

The various habitats where this species might have occurred are unknown because of the timing of its taxonomic description and the conversion of habitat for silviculture practices (Gordon 1996, Shinnars 1962). At present, Apalachicola rosemary is endemic to the xeric longleaf pine communities (sandhill) east of the Apalachicola River. It also occurs on the upper steepheads in the transition to sandhills, edges of pine plantation, and highway and utility rights-of-way.

Most favorable habitats are open areas with various degrees of cover, from bare sands to areas with other species growing nearby. Density appears greatest in sun or lightly shaded areas, but it decreases as areas become shadier with mature planted pine (Negrón-Ortiz, 2009, pers. observ.). According to the Park Service staff, *C. glabra* might have re-established in open sunny areas after site preparation in 1988, areas that have been slowly shaded, thus plants do not seem to be as robust as those in the sunnier areas.

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

a. Present or threatened destruction, modification or curtailment of its habitat or range:

Habitat modification remains the main threat to date for this species as a result of logging, site preparation and conversion of *C. glabra*'s habitat for silviculture practices. In the past, a large extent of Liberty County was logged mainly for longleaf pine, and many acres were converted to slash pine. The uplands on the SCT were managed for timber for several decades. The St. Joe Timberland Company harvested planted slash pine in 1987, followed by sand pine plantation. Although *C. glabra* has been seen growing at the edges of the pine plantation, plant density is low compared to more open areas. Therefore, shading may be a threat to this species and should be evaluated.

Most of the remaining population of *C. glabra* is now in conservation owned by the State of Florida and managed by the Florida Park Service. The private land east of SCT still contains *C. glabra* and remains in planted pine plantation. This property has not been surveyed and there is no guarantee that this property will not be utilized for tree farming, i.e., privately owned forest managed (clearcutting, mechanical site preparation, and pine plantations), or residential and/or commercial development in the near future. Therefore, tree farming and residential or commercial development are threats.

Long-term persistence of *C. glabra* in the sandhill community requires fire. Sandhill systems are characterized by natural fire frequencies of every 1-10 years (Myers 1990). *Conradina* species are found in habitats with varying fire frequencies (USFWS 1994). Among Florida scrub species, Florida rosemary (*Ceratiola ericoides*) requires longer fire cycles (15–40 year intervals) to maximize soil seed bank (Quintana-Ascencio et al. 2003). Circumstantial evidence suggests that several members of the mint family (e.g., *Conradina*

canescens, *Calamintha ashei*) are killed by fire but recover from seed (www.fws.gov/fire/ifcc/Esr/Library/TEPlants.pdf). According to Gordon (1996), low-intensity fires tend to have a more positive effect on the survival of adults *C. glabra* (although fire temperature was not monitored) than high-intensity fires. Therefore, the use of the wrong fire return interval and intensity is a threat to the species.

The Recovery Plan mentioned that the use of a super toxic herbicide (hexazinone Velpar) is a threat when it is used in timber regeneration areas. According to M. Ludlow (Department of Environmental Protection; 2009, pers. comm. to Negron-Ortiz), spot application of Garlon 4 (a moderately toxic herbicide) is used to treat exotic shrubs or trees at TSP. In addition, there are almost no woody exotics in the area where *C. glabra* occurs. Therefore, this is a minor threat.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

There is no evidence to suggest that this factor is a threat.

c. Disease or predation:

There is no evidence to suggest that this factor is a threat.

d. Inadequacy of existing regulatory mechanisms

Limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed threatened and endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulations or in the course of any violation of a state criminal trespass law. Several populations of *C. glabra* occur on private timberland and ROWs. While the Act requires Federal agencies to carry out programs for the conservation of endangered and threatened species, no such programs are stipulated for private landowners. The State requires permission of private landowners for collecting of state-listed plants from their property.

Conradina glabra is protected under Florida State Law, chapter 85-426, which includes preventions of taking, transport, and the sale of the plants listed under the State Law. The rule Chap. 5B-40, Florida Administrative Code, contains the "Regulated Plant Index" (5B-40.0055) and lists endangered, threatened, and commercially exploited plant species for Florida; defines the categories; lists instances where permits may be issued; and describes penalties for violations (<http://www.virtualherbarium.org/EPAC>).

ROW maintenance activities are not always reviewed for threatened and endangered species impact. However, if there is an activity (e.g., construction, mowing, or maintenance projects) affecting protected species, then the Service can recommend consultation to the Florida Department of Transportation (FDOT) under the Act (M. Mittiga, 2009, pers. comm.). The FDOT routinely consults with the Service on all major road construction activities. Currently, these protections are inadequate.

D. Synthesis

Conradina glabra is an extremely rare species and endemic to a small geographic range in Liberty County, Florida. It is extremely vulnerable because of its limited distribution. The main threat to this species is habitat modification. Conversion of much of the forest land to pulpwood plantations (clearcutting, mechanical site preparation, and pine plantations) probably extirpated some populations. Overcollection is not a threat, and no problems have been detected with disease or predation.

The species occurs on both private and public lands. Plants occurring on private lands and ROW have not been estimated, but the current number at the SCT is quite high. Thus, a comprehensive population survey is needed, and permanent protection and management are necessary to conserve this species.

Conradina glabra continues to meet the definition of an endangered species as a result of habitat destruction or modification due to forestry and the effect of this threat in this plant's present narrow distribution. The recovery criteria for *C. glabra* indicates that the species may be considered for reclassification from endangered to threatened when five populations occurring on public land or under conservation easements are protected and appropriately managed. Currently, the SCT is the only well sustained population. Therefore, we are not recommending reclassification of *C. glabra* from endangered to threatened.

III. RESULTS

- A. Recommended Classification:
 No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Conduct population surveys and censuses. Once population numbers are known and surveys have been conducted to find new populations, consistent censuses would allow for the analysis of long-term trends for this species. This information would help to determine when the species is stable (and may possibly be downlisted) and help to inform conservation managers of appropriate management techniques, and whether restoration of the pine plantation back to sandhill is assisting in the recovery of the species.
 - Complete a comprehensive census (e.g., the total number of individuals, number of flowering vs. non-flowering plants, and whether seedling recruitment is occurring) throughout the present distribution.
 - Conduct surveys/inventories on potentially new sites where similar habitat exists. This action can include the use of aerial photography and species distribution modeling

methods to initially determine potential sites, with subsequent validation or inspection of the sites for plants. If new populations are discovered, protection should be sought.

2. An *ex-situ* plant collection should be actively pursued and implemented. Studies on the viability of seeds, germination, and seedling establishment, in addition to whether a persistent seed bank is present should be addressed.
3. Determine the fire regime (interval and intensity) and monitor the effect of this event on *C. glabra* density, fecundity, and size structure.
4. Continue the restoration of and subsequent management of *C. glabra*'s habitat. This is crucial for the long term population stability (T. Spector, 2009, pers. comm.). Work to acquire land or place land in conservation easement near SCT that is found to be important to *C. glabra*.
5. The recovery plan should be updated to define objective measurable criteria and better address the five factors.

V. REFERENCES

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Conradina glabra***

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

 x No change is needed

The review was completed by botanist Dr. Vivian Negrón-Ortiz, Panama City Field Office.

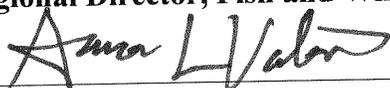
FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 7-7-09

REGIONAL OFFICE APPROVAL:

Acting
Lead Regional Director, Fish and Wildlife Service

Approve  Date 7-7-09

APPENDIX A
Summary of peer review for the 5-year review of
***Conradina glabra* (Apalachicola rosemary)**

A. Peer Review Method

The document was peer-reviewed internally by Lorna Patrick and Harold Mitchell of the Panama City Field Office. Once the comments were added to the document, it was sent to three outside reviewers (see below). The outside peer reviewers were chosen based on their qualifications and knowledge of the species.

B. Peer Review Charge: The below guidance was provided to the reviewers.

1. Review all materials provided by the Service.
2. Identify, review, and provide other relevant data that appears not to have been used by the Service.
3. Do not provide recommendations on the Endangered Species Act classification (e.g., endangered, threatened) of the species.
4. Provide written comments on:
 - Validity of any models, data, or analyses used or relied on in the review.
 - Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.
 - Oversights, omissions, and inconsistencies.
 - Reasonableness of judgments made from the scientific evidence.
 - Scientific uncertainties by ensuring that they are clearly identified and characterized, and those potential implications of uncertainties for the technical conclusions drawn are clear.
 - Strengths and limitation of the overall product.
5. All peer reviews and comments will be public documents, and portions may be incorporated verbatim into our final document with appropriate credit given to the author of the review.

C. Summary of Peer Review Comments/Report

The reviewers considered the document to be well written and an accurate summary of the current state of knowledge of *C. glabra*. Most of the conclusions were considered reasonable and based on adequate data. The most important conclusion of the review is that there is generally an absence of research on this species, especially with regard to studies that assess the numbers and distribution of populations. A few clarifications and editorial comments related to the SCT historical silviculture practices, historical range, and augmentation or translocation were provided by T. Spector. A. Winn provided the number of individuals for the introduced populations at the Nature Conservancy's ABRP. C. Edwards stipulated that the conclusions of the allozyme study were based on misidentified populations; the conclusions were modified and reflect accurate interpretation.

D. Response to Peer Review

All peer reviewer comments were evaluated and incorporated where appropriate.