

Cooley's Meadowrue (*Thalictrum cooleyi*)

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



**U.S. Fish and Wildlife Service
Southeast Region
Ecological Services
Raleigh, North Carolina**

5-YEAR REVIEW
Cooley's Meadowrue (*Thalictrum cooleyi*)

I. GENERAL INFORMATION

A. Methodology used to complete the review

Little information has been published on *Thalictrum cooleyi*. The information used to prepare this report was gathered from peer reviewed scientific publications, status reviews by Rayner (1980) and Leonard (1987), current data from the North Carolina Natural Heritage Program (NCNHP), Florida Natural Areas Inventory (FNAI), Georgia Natural Heritage Program (GNHP), correspondence from botanists knowledgeable of the species and personal field observations. The review was completed by the lead recovery biologist for *Thalictrum cooleyi* in the Raleigh, North Carolina Field Office. The recommendations resulting from this review are a result of thoroughly assessing all available information on *Thalictrum cooleyi*. Comments and suggestions regarding the review were received from peer reviews within and outside the U.S. Fish and Wildlife Service (Service). A detailed summary of the peer review process is provided in Appendix A. No part of the review was contracted to an outside party. Public notice of this review was provided in the Federal Register on April 26, 2007, and a 60-day public comment period was opened. Comments received were evaluated and incorporated as appropriate.

B. Reviewers

Lead Region:

Kelly Bibb, Southeast Region, 404-679-7132

Lead Field Office:

Dale Suiter, Raleigh, N.C., Ecological Services, 919-856-4520 extension 18

C. Background

1. FR Notice citation announcing initiation of this review:

April 26, 2007 (72 FR 20866)

2. Species status: Stable

In the 2008 Recovery Data Call, the status of *Thalictrum cooleyi* was listed as stable. The last status survey for *Thalictrum cooleyi* was completed in 1987, prior to the species becoming federally listed as endangered. While various botanists have visited most of the known populations since that time, no formal status surveys have been conducted since 1987.

3. Recovery achieved

Thalictrum cooleyi = 2 (25% - 50% of species recovery objectives achieved)

4. Listing history

Original Listing

FR notice: 54 FR 5935

Date listed: March 9, 1989

Entity listed: Species

Classification: Endangered

5. Associated rulemakings:

There are no associated rulemakings.

6. Review History: Since *Thalictrum cooleyi* was named as a distinct species in 1959 and listed as endangered in 1989, very little information has been published on this species. The Service conducted a five-year review for this plant in 1991(56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertain to the individual species. The notice stated that the Service was seeking any new or additional information reflecting the necessity of a change in the status of the species under review. The notice indicated that if significant data were available warranting a change in a species' classification, the Service would propose a rule to modify the species' status. No change in *Thalictrum cooleyi's* listing classification was found to be appropriate. A status survey for *Thalictrum cooleyi* was completed in 1987. Between 2005 and 2007, NCNHP staff or other botanists have conducted visits to 12 of 25 subpopulations of *Thalictrum cooleyi* in North Carolina.

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

Thalictrum cooleyi has been assigned a recovery priority number of 2, indicating a high degree of threat, a high potential for recovery, and a taxonomic status of full species.

8. Recovery Plan or Outline

The *Thalictrum cooleyi* Recovery Plan was issued on April 21, 1994.

II. REVIEW ANALYSIS

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

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

B. Recovery Criteria

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

Yes

Thalictrum cooleyi shall be considered for removal from the Federal list when the following criteria are met:

1. It has been documented that at least 16 self sustaining populations exist and that necessary management actions have been undertaken by the landowners or cooperative 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.

To date, five subpopulations comprising four populations of *Thalictrum cooleyi* have been protected in North Carolina. One *Thalictrum cooleyi* population in Georgia is protected by The Nature Conservancy and the only known population in Florida occurs on the Nokuse Plantation and is in an area protected.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends, demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

This species was discovered new to science in 1957 and named a distinct species in 1959. Aside from presence/absence surveys to update Natural Heritage Program records, little work has been done on this species since then. Its growth habit as a weak upright or leaning perennial typically found in areas that are completely covered with grasses and other herbaceous vegetation makes quantitative surveys very difficult.

Between 2005 and 2007, NCNHP staff or other knowledgeable botanists have visited 12 of 25 North Carolina subpopulations (representing 10 populations) of *Thalictrum cooleyi*. Of the 25 subpopulations known from North Carolina, one is believed to be extirpated and no *Thalictrum cooleyi* plants were observed at four other subpopulations during the last visit to the site (by a competent botanist during the appropriate season; NCNHP denotes these populations as F – Failed to Find). We have little population data from the known sites in Georgia with the exception of the Nature Conservancy's Dry Creek Swamp Preserve a 20 acre preserve which is monitored annually. According to Dr. Matthew Aresco, director of Nokuse Plantation, Bruce, Walton County, FL (pers. comm.), the single known Florida population was burned on April 24, 2008. He reported seeing several plants before the prescribed fire and will monitor the site through the growing season. With the exception of the Dry Creek Swamp

Preserve in Georgia, there is no regular monitoring program in place for this species at any of the other known sites.

Despite recent visits to approximately half of the known subpopulations, they have not been monitored in enough detail or with sufficient frequency nor has enough detailed data been collected to predict long term population trends. Due to the growth habit, appearance and general nature of this species, stem counts are rarely conducted in the field. Any reports of stem counts should be considered with great uncertainty unless detailed methodology are described since it would be very easy to overlook many individual plants during a cursory, low intensity count. It is doubtful that we have a clear understanding of how many individual plants occur at any one subpopulation or population. Therefore, it would be more appropriate to record the species status as unknown at this time.

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Little genetics research has been done on this species. Park (1992) found that *Thalictrum cooleyi* has the highest chromosome number in the genus, $2n = 210$, a ploidy level of 30x compared to the base chromosome level of 7 in *Thalictrum*.

The Georgia Natural Heritage Program recognizes seven element occurrences of *Thalictrum cooleyi* in Georgia. Six occurrences are in Worth County and one is in Dougherty County. These occurrences or subpopulations likely only represent two metapopulations. Research by Dr. Wayne Parrott and his graduate students (University of Georgia) indicates that the Georgia populations of *Thalictrum* applied to the species *cooleyi*, might actually be part of a hybrid swarm (Tom Patrick, Botanist, Georgia Natural Heritage Program, 2003, pers. comm.). LeBlond (Retired Botanist, North Carolina Natural Heritage Program, 2008, pers. comm.) visited this site in the 1990s with Bruce Sorrie and Jim Allison and he does not believe the plants are strictly *Thalictrum cooleyi*, but may be more closely related to *Thalictrum revolutum*. The Service agrees that further genetics research, including anatomical, morphological, determination of chromosome number, etc., will be necessary to compare plants from Florida, Georgia and North Carolina before a final determination can be made. In the meantime, state and federal agencies in Georgia are taking a conservative approach and treating the plants as if they are the endangered *Thalictrum cooleyi*.

c. Taxonomic classification or changes in nomenclature:

There have been no changes to the taxonomic classification or nomenclature since *Thalictrum cooleyi* was listed as endangered in 1989.

See section II.C.1.b., above, for additional information regarding the potential for the Georgia populations to be a hybrid swarm.

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

When the recovery plan was written in 1994, *Thalictrum cooleyi* was known from 12 sites (these sites are now considered subpopulations) in the coastal plain of North Carolina and one population in the Florida panhandle. Since that time, additional occurrences have been found in North Carolina, and several sites of uncertain taxonomy (described above) have been found in Georgia. Our records currently indicate a total of nine extant populations including 24 extant subpopulations in NC. Of the 25 subpopulations once known from North Carolina, one is believed to be extinct and no *Thalictrum cooleyi* plants were observed at four other subpopulations during the last visit to those sites (by a competent botanist during the appropriate season); however, those four sites have not been labeled extirpated yet by the NCNHP. Two populations (consisting of seven subpopulations) are known in Georgia. The one population consisting of one subpopulation is still extant in Florida. This information is summarized in Table 1 and Appendix C. Distribution maps are available in Figures 1 and 2.

Table 1. Number of extant populations and subpopulations of *Thalictrum cooleyi* at the time of listing (February 7, 1989) and current (May 10, 2008).

	NC	GA	FL	Total
No. extant populations at listing	?	0	1	?
No. extant subpopulations at listing	12	0	1	13
No. extant populations in 2008	9	2	1	12
No. extant subpopulations in 2008	24	7	1	32

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

All of the known *Thalictrum cooleyi* populations occur in the Coastal Plain Province. The recovery plan states that the species grows in circumneutral soils (pH near 7) in wet pine savannas, grass-sedge bogs and savanna-like areas, often at the border of intermittent drainages or swamp forests. It is found on fine sandy loam soils that are at least seasonally (winter) moist or saturated and are only slightly acidic (pH 5.8-6.6).

f. Other relevant information about the species (propagation, etc.):

The N.C. Botanical Garden is the designated Center for Plant Conservation repository for this species. They have several plants in

cultivation that were grown from Florida and North Carolina collected seeds. Seeds from two North Carolina populations (Natural Heritage Program Element Occurrence Numbers 4 and 8) are stored there for long term preservation of genetic material, for research and reintroduction. They hope to increase seed accessions and conduct research on seed production, seed ecology, storage and germination as funds become available.

In summary, despite recent visits to approximately half of the known subpopulations, *Thalictrum cooleyi* sites have not been monitored in sufficient detail to predict long term population trends. Little genetics research has been done on this species. Further genetics research that compares plants from Florida, Georgia and North Carolina will be necessary to make a final decision on the relationship of the populations in Georgia. In the meantime, state and federal agencies in Georgia are taking a conservative approach and treating the plants as if they are the endangered *Thalictrum cooleyi*.

Further, when the recovery plan was written in 1994, *Thalictrum cooleyi* was known from 12 sites (or what are now considered subpopulations) in North Carolina and one population in Florida. Since that time, additional occurrences have been found in North Carolina, and several sites of uncertain taxonomy (described above) have been found in Georgia. One population is still extant in Florida. Our records currently indicate a total of nine extant populations represented by 24 extant subpopulations in NC. Of the 25 subpopulations previously known from North Carolina, one is believed to be extinct. In addition, no *Thalictrum cooleyi* plants were observed at four additional subpopulations during the last visit to the site (by a competent botanist during the appropriate season). Two populations, consisting of seven subpopulations, are known in Georgia.

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

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

According to Misty Buchanan (Botanist, NCNHP, Raleigh, NC pers. comm.) several subpopulations of *Thalictrum cooleyi* have suffered from habitat modification and/or destruction. *Thalictrum cooleyi* is threatened by fire suppression and the ecological succession (competition and/or shading by woody species) that occurs in areas that are not burned on a regular basis. *Thalictrum cooleyi* is also threatened by timber operations such as harvesting, bedding and ditching. Sites located within utility rights-of-way are threatened by herbicide use or mowing during critical growth periods. Habitat destruction, the result of development or land conversion, also threatens this species, but to a lesser degree than the other

factors listed above. High human population growth rates (recorded and predicted) in Pender and Onslow counties will most likely increase habitat fragmentation and decrease suitable habitat for *Thalictrum cooleyi* (North Carolina State Demographics <http://demog.state.nc.us/>).

A total of five subpopulations comprising four populations are protected in North Carolina. In 2006, the N.C. Division of Parks and Recreation (NCDPR) was granted permission to create the Sandy Run Savannas State Natural Area and began acquiring land from The Nature Conservancy (TNC) and other local landowners soon thereafter. When complete, the Sandy Run Savannas State Natural Area will protect a variety of fire dependent plant communities including areas that are important for the recovery of *Thalictrum cooleyi*. Currently, the NCDPR protects the Neck Savanna, Watkins Savanna and the Sandy Run Savannas (including the Cooley's Meadowrue Powerline Site and the Pine Plantation Survey Site). One site, the Haws Run Mitigation Site, is owned by the N.C. Department of Transportation and is managed by the N.C. Ecosystem Enhancement Program (NCEEP). The Southwest Ridge Savanna site, is owned by the State of North Carolina and managed by the Wildlife Resources Commission as Holly Shelter Game Land. Another site, Shaken Creek Savanna, is owned by TNC.

The only known population in Florida occurs on the Nokuse Plantation and is in an area protected by a conservation easement (Amy Jenkins, Botanist, FL Natural Areas Inventory, pers. comm.). One *Thalictrum cooleyi* population in Georgia (of uncertain genetic lineage) is protected by The Nature Conservancy and managed as the Dry Creek Swamp Preserve (Tom Patrick, GA Natural Heritage Program, pers. comm.).

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

There is currently no evidence to suggest that *Thalictrum cooleyi* is being overutilized for commercial, recreational, scientific or educational purposes.

c. Disease or predation:

No signs of predation or disease have been observed in this species; however, it seems reasonable to believe that herbivores may eat the leaves or flowering stems of this plant while grazing on adjacent vegetation.

d. Inadequacy of existing regulatory mechanisms:

Because of its federal endangered status, *Thalictrum cooleyi* is protected on federal lands; however, there are no known populations on federal lands. *Thalictrum cooleyi* is listed as state endangered by North Carolina under the Plant Protection and Conservation Act of 1979, but this protection is largely limited to the regulation of collecting and trade

(North Carolina Department of Agriculture 02 NCAC 48F.0301). One incident of unlawful collection occurred in 1996. Information in the Raleigh Field Office files indicates that the two collectors were fined \$500 each and the plants were turned over to the NC State University Herbarium. *Thalictrum cooleyi* is also listed as State Endangered in Florida and Georgia.

The U.S. Army Corps of Engineers (USACE) regulates placement of fill in waters of the United States including wetlands (Section 404 of the Clean Water Act) and is responsible for ensuring that such permits do not jeopardize the continued existence of federally protected species. Since *Thalictrum cooleyi* occurs in wetland habitats, it is important that the USACE determine that potential permitted activities would not negatively affect this species, prior to the issuance of a permit.

To the best of our knowledge, the USFWS office has never consulted with another federal agency regarding potential impacts to this species.

e. Other natural or manmade factors affecting its continued existence:
No other natural or manmade factors affecting the continued existence of *Thalictrum cooleyi* are known at this time.

Summary

In summary, the most important factors that justify its endangered status are related to its extreme rarity due to habitat loss from fire suppression and subsequent ecological succession, forestry practices and development due to the inadequate regulatory mechanisms to protect listed plants on private lands. *Thalictrum cooleyi* sites located within utility rights-of-way are threatened by herbicide use or mowing during critical growth periods. Six populations consisting of a total of seven subpopulations are protected on conservation lands in North Carolina, Georgia, and Florida. There is currently no evidence to suggest that *Thalictrum cooleyi* is being overutilized for commercial, recreational, scientific or educational purposes. No signs of predation or disease have been observed in this species. There are no known populations on federal lands. *Thalictrum cooleyi* is listed as state endangered in North Carolina, Georgia and Florida.

D. Synthesis

In summary, despite recent visits to approximately half of the known subpopulations, *Thalictrum cooleyi* sites have not been monitored in sufficient detail to predict long term population trends. Little genetics research has been done on this species. Further genetics research that compares plants from Florida, Georgia, and North Carolina will be necessary to make a final decision on the relationship of the populations in Georgia. In the meantime, state and federal

agencies in Georgia are taking a conservative approach and treating the plants as if they are the endangered *Thalictrum cooleyi*.

In 1994, when the recovery plan was written, *Thalictrum cooleyi* was known from 12 sites (or what are now considered subpopulations) in North Carolina and one population in Florida. Since that time, 12 additional subpopulations have been found in North Carolina, and seven sites, granted of uncertain taxonomy but currently considered *Thalictrum cooleyi*, have been found in Georgia. The one population is still extant in Florida. To summarize, at the time of listing, we knew of 13 sites or subpopulations, range-wide and now we believe that *Thalictrum cooleyi* is extant at nine populations comprising a total of 32 sites or subpopulations.

The most important factors that justify its endangered status are related to its extreme rarity due to habitat loss from fire suppression and subsequent ecological succession, forestry practices and development due to the inadequate regulatory mechanisms to protect listed plants on private lands. *Thalictrum cooleyi* sites located within utility rights-of-way are threatened by herbicide use or mowing during critical growth periods. Six populations consisting of a total of seven subpopulations are protected on conservation lands in North Carolina, Georgia and Florida. There is currently no evidence to suggest that *Thalictrum cooleyi* is being overutilized for commercial, recreational, scientific or educational purposes. No signs of predation or disease have been observed in this species. There are no known populations on federal lands. *Thalictrum cooleyi* is also listed as state endangered in North Carolina, Georgia and Florida.

Due to the small number of populations and threats to the species such as fire suppression, forestry practices and the destruction or modification of habitat and the inadequacy of existing state or federal laws to protect plants on non-federal lands, we believe *Thalictrum cooleyi* still meets the definition of endangered under the ESA.

III. RESULTS

A. Recommended Classification:

No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

A list of recommendations for future actions that will contribute to the recovery of *Thalictrum cooleyi* include:

- revisit known populations that have not been visited in the past three years; monitor the habitat condition of each site including threats; discuss conservation options with landowners where appropriate; update Natural Heritage Program files with this information,

- search for additional populations,
- prioritize known sites for protection,
- protect additional populations,
- develop management plans for all protected populations,
- develop monitoring protocols, initiate long term population monitoring and determine the criteria for sustaining populations,
- conduct research on general biology of the species including life history and reproductive biology (breeding systems, seed production and seedling survivorship),
- compare, genetically, the populations of questionable taxonomy in Georgia with those known from North Carolina and Florida
- work with North Carolina Botanical Garden to conserve seeds and develop propagation protocols.

V. REFERENCES

Leonard, S. 1987. Inventory of populations of *Thalictrum cooleyi* and its occurrence sites in North Carolina. Report to the North Carolina Natural Heritage Program. Raleigh, NC. 16pp.

Park, M.M. 1992. A biosystematic study of *Thalictrum* section *Leucocoma* (Ranunculaceae). Ph.D. dissertation, Pennsylvania State University.

Rayner, D. 1980. Status report on *Thalictrum cooleyi* Ahles, submitted to U.S. Fish and Wildlife Service, Atlanta, GA.

A complete bibliography for *Thalictrum cooleyi* is included in Appendix B.

**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF COOLEY'S MEADOWRUE (THALICTRUM COOLEYI)**

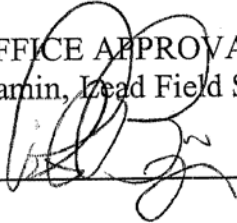
Current Classification Endangered
Recommendation resulting from the 5-Year Review

X **No change is needed**

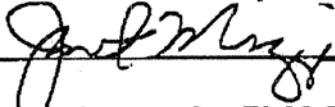
Review Conducted By Dale Suiter, Fish and Wildlife Biologist

FIELD OFFICE APPROVAL:


Pete Benjamin, Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 12/10/08

Janet Mizzi, Cooperating Acting Field Office Supervisor, Fish and Wildlife Service

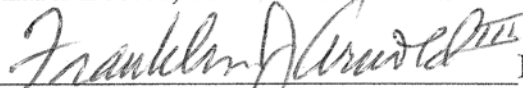
Approve  Date 12/11/08

Sandy Tucker, Cooperating Field Office Supervisor, Fish and Wildlife Service

Approve  Date 12/12/08

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve  Date 1/8/09

Franklin J. Arnold III
Assistant Regional Director
Ecological Services

APPENDIX A
Summary of peer review for the 5-year review of
Cooley's Meadowrue (*Thalictrum cooleyi*)

A. Peer Review Method:

In early May, a draft copy of the five year review was emailed to botanists with the N.C. Plant Conservation Program, N. C. Natural Heritage Program, the N.C. Botanical Garden, the Georgia Natural Heritage Program and the Florida Natural Areas Inventory. Since *Thalictrum cooleyi* occurs within the work area of two other Service Ecological Service offices, the Panama City, Florida and Athens, Georgia Field Offices were asked to review this document. Reviewers provided comments by email, modifications to the original document and/or in “track changes.” Some of the peer reviewers used know the species and are familiar with the habitats where the species occurs and the threats to its long term survival. The other reviewers do not know *Thalictrum cooleyi*, specifically; however, they are familiar with the general flora of the areas where the species occurs and they are also familiar with state and federal regulations, plant conservation issues and the threats to rare species.

B. Peer Review Charge:

Peer reviewers were asked to provide written comments on the information presented in our analysis of the status of the *Thalictrum cooleyi* and to provide comments on the validity of the data. Peer reviewers were asked not to provide recommendations on the legal status of the species.

C. Summary of Peer Review Comments/Report:

Two reviewers replied back and said that they did not have any comments or suggestions on the document. One reviewer provided comments regarding Cooley's Meadowrue plants that are currently in propagation at the N.C. Botanical Garden. Another reviewer provided comments related to the genetics, taxonomy sections and provided additional recommendations for research needs for Cooley's Meadowrue. They also asked that the review include more detailed population data.

D. Response to Peer Review:

The primary author agreed with nearly all comments and concerns received from the peer reviewers and tried to address every comment as appropriate. Since there as been very limited detailed monitoring of this species, it is not possible to provide detailed data, including number of individual plants, at each population or subpopulation.

APPENDIX B
Bibliography of documents mentioning *Thalictrum cooleyi*

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- FNAI. 2000. Field Guide to the Rare Plants and Animals of Florida online. Florida Natural Areas Inventory.
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- Wilczynski, C. J. 1988. Species Biology of *Thalictrum cooleyi*: Studies for Management and Conservation (DRAFT). Chapel Hill, NC: Univerisity of North Carolina. p.8.
- Wilczynski, C.J. 1993. A three year study on the population dynamics of Cooley's meadowrue (*Thalictrum cooleyi*) at Lanier Quarry, Pender County, North Carolina. Carrboro, N.C.: The Nature Conservancy. Unpublished.

APPENDIX C
Summary of populations of *Thalictrum coleyi*.
(EO# = Element Occurrence Number)

FLORIDA

REV EO#	OLD EO#	COUNTY	SURVEY SITE	RANK	FIRST OBSERVED	LAST OBSERVED	OWNERSHIP
1	1	Walton	Howell Bluff South	B	6/25/1964	4/24/2008	Nokuse Plantation (private, conservation)

GEORGIA

REV EO#	OLD EO#	COUNTY	SURVEY SITE	RANK	FIRST OBSERVED	LAST OBSERVED	OWNERSHIP
001	001	Worth	Dry Creek	N/A	N/A	6/26/2001	N/A
002	002	Dougherty	Near Dry Creek	N/A	N/A	N/A	N/A
003	003	Worth	Wiregrass Plantation	N/A	N/A	N/A	N/A
004	004	Worth	Tri County Line	N/A	N/A	N/A	N/A
005	005	Worth	Railroad Marker 15	N/A	N/A	N/A	N/A
006	006	Worth	Pineywood Road	N/A	N/A	N/A	N/A
007	007	Worth	Park Place	N/A	N/A	N/A	N/A

NORTH CAROLINA

REV EO#	OLD EO#	COUNTY	SURVEY SITE	RANK	FIRST OBSERVED	LAST OBSERVED	OWNERSHIP
11	11	Columbus	Schulkens Savanna	CD	7/6/1986	7/00/1989	Plum Creek Timber Co
14	14	Columbus	Nakina, NC	H	6/30/1928	6/30/1928	?
17	17	Pender	Shaken Creek Savanna	A	9/12/1997	5/30/2006	private
18	18	Pender	McLean Savanna	D	8/18/1997	8/18/1997	McLean Family Farms
23	23	Pender	Maple Hill Savannas Macrosite, Pender Co., North of Sandy Run Swamp (Principal EO of Sub EOs 06, 08, 19, 22)	AC	6/29/1963	6/15/2007	various
23.19	19	Pender	Maple Hill School Road Savanna (Sub EO of Principal EO 23)	D	6/21/1998	6/21/1998	?
23.22	22	Pender	Maple Hill Savannas Macrosite, Pender Co., Watkins Savanna IP O'Berry Tract (Sub EO of EO 23)	F	6/19/2001	6/19/2001	?

23.6	6	Pender	Maple Hill Savannas Macrosite, Pender Co., Watkins Savanna and Hardwood Swamp & Vicinity (Sub EO of Principal EO 23)	C	6/29/1963	5/5/2005	private
23.8	8	Pender	Maple Hill Savannas Macrosite, Pender Co., The Neck and Sandy Run Savannas (Sub EO of EO 23)	AB	6/00/1981	6/15/2007	NC State Parks
24	24	Onslow	Maple Hill Savannas Macrosite, Onslow Co., Near Sandy Run Swamp (Principal EO of Sub EOs 01, 04, 05, 16)	A	6/15/1957	6/14/2007	various
24.1	1	Onslow	Maple Hill Savannas Macrosite, Onslow Co., Cooleys Meadowrue Type Locality (Sub EO of Principal EO 24)	D	6/15/1957	5/12/2005	private
24.16	16	Onslow	Maple Hill Savannas Macrosite, Onslow Co., Haws Run Mitigation Site (Sub EO of Principal EO 24)	B	6/13/1996	6/14/2007	NCDOT
24.4	4	Onslow	Maple Hill Savannas Macrosite, Onslow Co., Cooley's Meadowrue Powerline Site (Sub EO of EO 24)	A	6/20/1980	6/14/2007	NC State Parks, Progress Energy
24.5	5	Onslow	Maple Hill Savannas Macrosite, Onslow Co., PLANTATION SURVEY SITE (Sub EO of Principal EO 24)	BC	6/22/1980	5/30/2006	The Nature Conservancy
25	25	Columbus	Mark Pine Bay Meadowrue Site and Snake Island (Principal EO of Sub EOs 09 and 10)	D	1986	8/20/2002	various
25.10	10	Columbus	Mark Pine Bay Meadowrue Site and Snake Island: Snake Island (Sub EO of Principal EO 25)	F	1986	6/26/1988	?

25.9	9	Columbus	Mark Pine Bay Meadowrue Site and Snake Island: Mark Pine Bay Cooleys Meadowrue Site (Sub EO of Principal EO 25)	D	1986	8/20/2002	Plum Creek Timber Co. / NCDOT
26	26	Brunswick	Exum, NC and Vicinity of Juniper Bay (Principal EO of Sub EOs 03, 20, 21)	D	6/11/1958	6/5/2006	various
26.20	20	Brunswick	Exum, NC and Vicinity of Juniper Bay: Juniper Bay Savanna (Sub EO of Principal EO 26)	C	6/22/2000	5/25/2004	International Paper Co.
26.21	21	Brunswick	Exum, NC and Vicinity of Juniper Bay, Exum: SR 1340 (Sub EO of Principal EO 26)	F	8/13/2002	6/5/2006	NCDOT / Brunswick Electric Coop
26.3	3	Brunswick	Exum, NC and Vicinity of Juniper Bay, Exum: Alligator Swamp (Sub EO of Principal EO 26)	F	6/11/1958	6/11/1958	?
27	27	Brunswick	Myrtle Head, Myrtle Head Savanna and Camp Branch Savanna Remnant (Principal EO of Sub EOs 12 and 13)	A	7/6/1988	2/26/1994	various
27.12	12	Brunswick	Myrtle Head, Myrtle Head Savanna (Sub EO of Principal EO 27)	A	7/6/1988	2/26/1994	The Nature Conservancy
27.13	13	Brunswick	Myrtle Head, Camp Branch Savanna Remnant (Sub EO of Principal EO 27)	B	7/30/1988	6/22/1990	Federal Paper Board
28	28	Pender	Southwest Ridge Savanna - Powerline at Ashes Creek	C	6/16/2006	6/16/2006	NCWRC Holly Shelter Game Land / power co.

Figure 1. *Thalictrum cooleyi* populations in North Carolina. Numbers indicate the Natural Heritage Program Element Occurrence (EO) Numbers Map provided by the N.C. Natural Heritage Program.

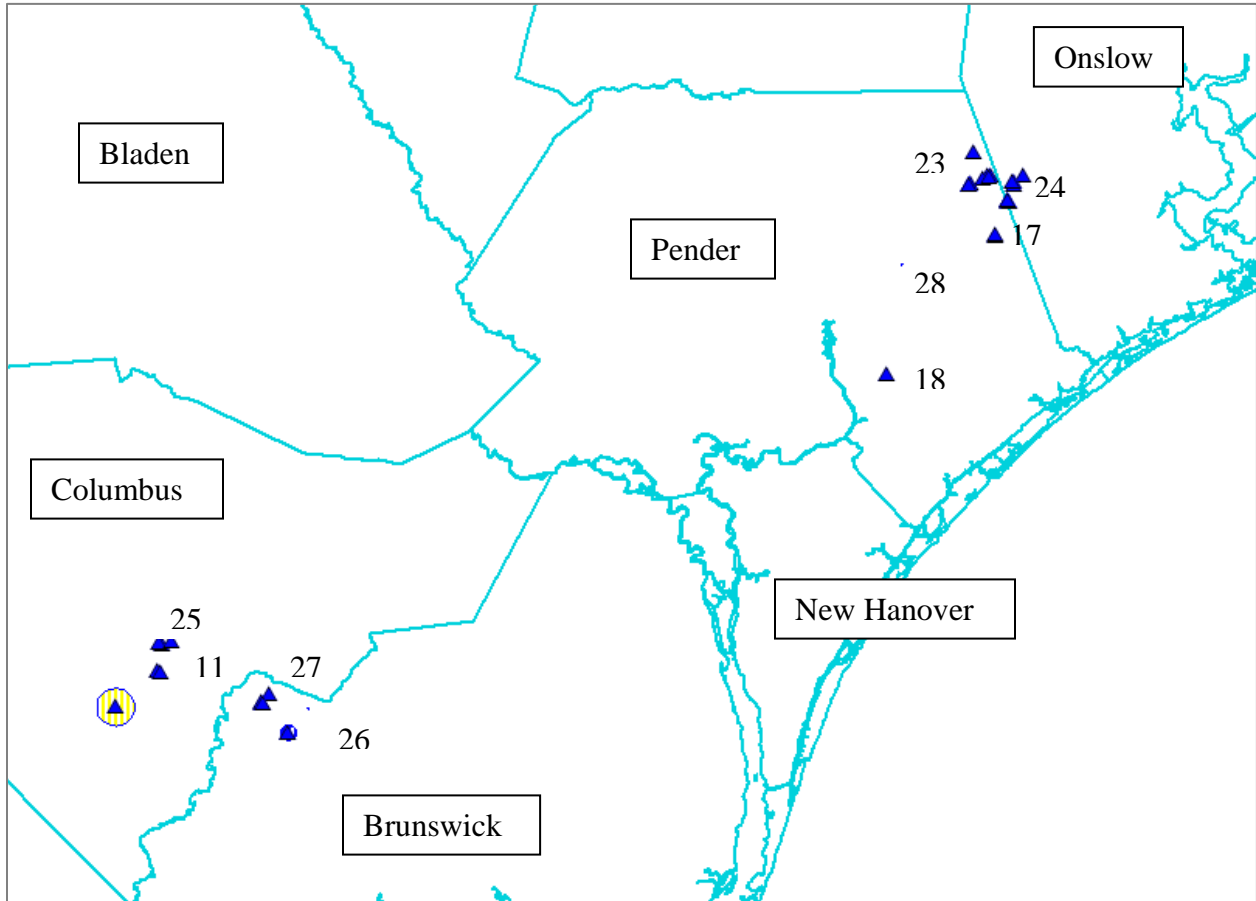


Figure 2. Distribution and state conservation status of *Thalictrum cooleyi* (FWS 2008 map).

