

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Dichanthelium hirstii

Common Name:

Hirst Brothers' Panic grass

Lead region:

Region 5 (Northeast Region)

Information current as of:

06/22/2011

Status/Action

Funding provided for a proposed rule. Assessment not updated.

Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

New Candidate

Continuing Candidate

Candidate Removal

Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

Range is no longer a U.S. territory

Insufficient information exists on biological vulnerability and threats to support listing

Taxon mistakenly included in past notice of review

Taxon does not meet the definition of "species"

Taxon believed to be extinct

Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

X Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing?
Yes

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current Candidate Notice of Review (<http://endangered.fws.gov/>) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories:** Delaware, Georgia, New Jersey, North Carolina
- **US Counties:** Sussex, DE, Calhoun, GA, Sumter, GA, Onslow, NC, Atlantic, NJ, Burlington, NJ
- **Countries:**Country information not available

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories:** Delaware, New Jersey, North Carolina
- **US Counties:** Atlantic, NJ, Burlington, NJ
- **Countries:**Country information not available

Land Ownership:

Both North Carolina populations occur on Federal lands. The Delaware population occurs on a State-owned wildlife management area. Two New Jersey populations occur on land owned by The Nature Conservancy (TNC) and a third population occurs on State-owned land (Wharton State Forest).

Lead Region Contact:

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Biological Information

Species Description:

Dichanthelium hirstii (Hirst Brothers' panic grass) is a perennial grass that produces erect, leafy, flowering stems from May to October. These stems may develop from over-wintering rosettes (a cluster of leaves or other organs arranged in a circle or disk, often at the base of the plant) or from nodes of stems remaining from the previous year (Schuyler 1998a, p. 1). The culms (the aerial stem of a grass or sedge) are 55 to 80 centimeters (cm) (21.7 to 31.5 inches [in]) tall with flat leaf blades that are stiffly erect or narrowly ascending, without hairs, green often tinged with purple, and 4.5 to 11 cm (1.8 to 4.3 in) long and 3 to 5.5 millimeters (mm) (0.12 to 0.22 in) wide. The 1.8 to 2.1 mm (0.07 to 0.08 in) long flowers (spikelets) are produced terminally on a narrowly branched inflorescence (flower cluster on a plant that blooms from the base upwards, usually broadest near the base and tapering upwards) along the stem (called a panicle) that is from 4.5 to 9 cm (1.8 to 3.5 in) long and about 5 mm (0.20 in) wide with branches as much as 2.5 cm (1.0 in) long (Swallen 1961, p. 236).

Toward the middle or latter part of the growing season, leafy rosettes develop from the basal (bottom or base) parts or from rooting of decumbent (reclining on the ground but with the tip ascending) culm nodes of existing plants (Walz 2012). Also during this time, seeds germinate and produce leafy rosettes (Schuyler 1998a, p. 1). Seeds presumably persist in seed banks (Schuyler 1998a, p. 1) similar to those of related species (e.g., *Panicum wrightianum* and *P. acuminatum* var. *uniciphyllum*) found in seed banking studies by Kirkman and Sharitz (1994, pp. 181 to 183, 185) and Wisheu and Keddy (1991, pp. 184 to 185).

Taxonomy:

Hirst Brothers' panic grass was described as the distinct species *Panicum hirstii* by Swallen (1961, p. 235) from a specimen collected in 1958 by Frank Hirst, an active amateur botanist in southern New Jersey. Prior to his death in 2009, Frank Hirst requested that the species' common name be changed from Hirsts' panic grass to Hirst Brothers' panic grass to recognize his brother Robert who discovered the plant with him (McAvoy 2010). Therefore, the species' common name (plural possessive) honors both Frank Hirst and his brother Robert Hirst as co-discoverers. According to a taxonomic review conducted by Schuyler (1996, pp. 95 to 96), the plant had first been collected in 1900 in Sumter County, Georgia, and had been "doubtfully" described by Hitchcock and Chase (1910, p. 197) as *P. roanokense* Ashe. Others considered the plant to be a variant of *P. neuranthum* Griseb (Kral 1983, p. 76) or conspecific with *P. aciculare* Desv. (Gleason and Cronquist 1991, p. 804). In his taxonomic review, Schuyler (1996, pp. 95 to 96) concurred with the findings of Swallen (1961, p. 235), concluding that *P. hirstii* was taxonomically distinct. More recently, systematists have split a group of species from the genus *Panicum* into the genus *Dichanthelium*. In North America, *Dichanthelium* can be recognized easily by the presence of a basal rosette of leaves during the winter and a clear foliar dimorphism (two forms of leaves). This character is not seen in the Central and South American taxa, which led some taxonomists to treat *Dichanthelium* as a subgenus of *Panicum* (Aliscioni *et al.* 2003, p. 797). There is agreement among botanists working with Hirst Brothers' panic grass that *D. hirstii* (Swallen) Kartesz is the appropriate nomenclature for the species (LeBlond 1990, 2004; Schuyler 2004; Natural Resources Conservation Service 2004). The U.S. Fish and Wildlife Service (Service) accepts the Swallen treatment of the taxonomy. The Service has carefully reviewed the available taxonomic information and has concluded the species is a valid taxon.

Habitat/Life History:

All known sites of *Dichantherium hirstii* are wetlands within a matrix of pine/oak forest and the habitats are variously described as ponds, meadows, or savannas (Schuyler 1998a, p. 2). Ecological communities that support *D. hirstii* in Delaware and New Jersey include the following National Vegetation Classification System (NVCS) types (Walz and Cartica 2010, p. 13).

- Yellow Spikerush (*Eleocharis flavescens*) - Bog Yellow-eyed Grass (*Xyris difformis*) Herbaceous Vegetation
- Virginia Meadowbeauty (*Rhexia virginica*) - Warty Panicgrass (*Panicum verrucosum*) Herbaceous Vegetation
- Smooth Sawgrass (*Cladium mariscoides*) - Wrinkled Jointgrass (*Coelorachis rugosa*) Herbaceous Vegetation

In North Carolina ecological communities that support *Dichantherium hirstii* include the following NVCS types (Walz and Cartica 2010, p. 14).

- Pond-cypress (*Taxodium ascendens*) / Maidencane (*Panicum hemitomon*) - Tall Pinebarren Milkwort (*Polygala cymosa*) Temperate Woodland
- *Taxodium ascendens* / Titi (*Cyrilla racemiflora*) - Honeycups (*Zenobia pulverulenta*) Woodland
- *Taxodium ascendens* / Virginia Chainfern (*Woodwardia virginica*) Woodland

The species requires habitats that are at least seasonally or intermittently (irregularly) wet, receiving full sun to light shade, and with substrates that are organic but firm (Kral 1983, p. 76; Schuyler 1998a, p. 2) or shallow muck over quartzite sand (Walz 2012). The plant occurs in flat-bottomed depressions with substantial water level fluctuations dependent on rainfall and ground water dynamics. The species relies on periods of standing water to keep competing species at a minimum (Schuyler 1998a, p. 2). The pinelands pond systems in which *Dichantherium hirstii* is found frequently burn or are burned over during dry cycles and this may be a factor in suppressing competition from woody vegetation (Kral 1983, p. 76). In New Jersey, a new population appeared after a prolonged drought that was followed by a turf-burning fire during the growing season and subsequent flooding (Walz 2012).

Historical Range/Distribution:

The species' historical range included seven sites within Delaware, Georgia, New Jersey, and North Carolina (Schuyler 1996, p. 96). A new site was discovered at Hampton Furnace Pond, Atlantic County, New Jersey, in 2004 for a total of eight known sites for the species. *Dichantherium hirstii* could have been in the pond in the 1950s; Frank Hirst could have missed it, or, more probably, it was dormant at the time of search. The precise time of species first occurrence in that pond is unknown.

Of the eight known sites, two are believed to be extirpated; *Dichantherium hirstii* has not been observed at the known sites in Sumter and Calhoun Counties, Georgia, for over 50 years. One population in Atlantic County, New Jersey, has not been observed since 1992 (NatureServe 2008) and is ranked as historical (believed to be extant and not seen in recent years) by the New Jersey Natural Heritage Program (NJNHP). At this time, it is considered historical instead of extirpated, due to potential reappearance of plants from the seed bank in this floristically dynamic habitat (Walz 2012).

Current Range Distribution:

Dichanthelium hirstii is considered extant at one site in Delaware, three sites in New Jersey, and two sites in North Carolina. In New Jersey, the two extant sites (two populations) include Labounsky Pond and Hampton Furnace Pond and are separated by approximately 29 kilometers (km) (18 miles [mi]). The species has not been observed in Barkwoods Pond in New Jersey since 1992. However, because field surveys have been conducted by TNC irregularly and in non-consecutive years, the conservation status cannot be accurately assessed at this time. Currently, the NJNHP considers this population extant but ranked as historical even though it has not been seen in recent years. It should be kept in mind that the population at Labounsky Pond in New Jersey was not observed from 1985 to 2001 even with regular searches, but it reappeared 17 years later in 2002. *Dichanthelium hirstii* exists in wetlands that are floristically diverse and dynamic, and the reappearance of plants from the seed bank is potentially high when environmental conditions favor germination and survival (Walz 2012).

Population Estimates/Status:

Individual populations of *Dichanthelium hirstii* can naturally vary dramatically in size from year to year. In some years, plants may not appear (Schuyler 1998a, p. 2). The status of each population is described below.

Delaware

The Assawoman Pond site on State-owned land in Sussex County, Delaware, is approximately 0.8 hectare (ha) (2 acres [ac]) in size (McAvoy 2011a). The number of *Dichanthelium hirstii* plants counted at the Assawoman Pond site has fluctuated over the period for which surveys have been conducted (1984 to 2011) (table 1). *Dichanthelium hirstii* numbers have varied from a low of 8 plants in 2009 to a high of 190 plants in 2000. After a low count of 14 plants in 1990, the species rebounded to 104 plants in 1993 and 190 plants in 2000 (McAvoy 2010). In 2007, 55 plants were found (McAvoy and Bennett 2007, p. 2). In a June 2009, survey when Assawoman Pond was still flooded, three flowering culms were counted. After an August drawdown, the pond was re-surveyed, and eight vegetative plants with no autumnal flowering were observed (McAvoy 2010). Survey results have shown that plant numbers are down after wet years (high water throughout most of the growing season) (McAvoy 2010). In 2010 and 2011, 18 plants and 21 plants were counted, respectively (McAvoy 2011a, 2011b). Although the number of plants at the site fluctuates, the Delaware population is believed to be relatively stable or increasing (McAvoy 2004; 2005; 2009; McAvoy and Bennett 2000, p. 4).

New Jersey

The known sites on TNC property in Atlantic County, New Jersey, Barkwoods Pond and Labounsky Pond (collectively known as Hirsts' Ponds), are separated by approximately 1 km (0.6 mi). Barkwoods Pond is approximately 0.6 ha (1.6 ac) in size, and Labounsky Pond is approximately 2.3 ha (5.8 ac) in size. The population size at Hirsts' Ponds has fluctuated depending on water levels, with the species being more abundant in dry years. In the late 1950s and early 1960s, there were years in which *Dichanthelium hirstii* covered large portions of both ponds. Plants were easily found with no or very little effort. By the 1970s, the species was difficult to find and often absent (Snyder 2010).

Dichanthelium hirstii was first discovered at the Barkwoods Pond by Frank and Robert Hirst in 1958. The species has not been seen at Barkwoods Pond since 1992, at which time only nine plants were found after a thorough search. No *D. hirstii* plants were found in Barkwoods Pond during surveys conducted in 1995, 1997, 2000, 2001, 2003, 2007, 2008, 2009, 2010, and 2011 (table 1) (Schuyler 2001, Gordon 2004, 2012; Juelg 2004; Walz and Cartica 2008, p. 1; Noe 2010; Snyder 2010; Walz and Cartica 2010, p. 5). Subsequent autumnal (fall) surveys in 2010 and 2011 conducted by TNC resulted in "failed to find" status of this population. An additional survey by Pine Barrens Inventories confirmed the same for 2011 (Gordon 2012).

The species was first recorded at Labounsky Pond in 1960 by Frank and Robert Hirst. Two "clumps" (large

rhizomatous patches) were observed and photo-documented in 1984. The plant was not found at Labounsky Pond from 1985 to 2001 after thorough surveys in 1992, 1995, 1997, and 2000 (table 1) (Schuyler 1998a, p. 3; Schuyler 2001; Cartica 2005, p. 1; Gordon 2008). In June 2002, 1 vegetative plant and 6 fruiting plants with a total of 34 fruiting culms were found (Snyder 2010), representing the first confirmed sighting of the species at this site in 17 years. In July 2003, five *Dichanthelium hirstii* culms were found at Labounsky Pond (Gordon 2008). A search for the species at Labounsky Pond in 2007 proved negative, but this result may be attributed to higher water levels in the pond (Gordon 2008, Walz and Cartica 2008, p. 1; Snyder 2010). Searches of the pond were conducted annually by TNC in 2007, 2008, and 2009; no *D. hirstii* plants were found (Noe 2010). Extensive searches at Labounsky Pond were also conducted in June 2010 by the New Jersey Department of Environmental Protection – Office of Natural Lands Management (ONLM) with particular emphasis on areas with previous records, but no *D. hirstii* plants were found (Walz and Cartica 2010, p. 5). Subsequent autumnal surveys in 2010 and 2011 conducted by TNC at Labounsky Pond resulted in “failed to find” status of this population. An additional survey by Pine Barrens Inventories confirmed the same for 2011 (Gordon 2012).

The Hampton Furnace Pond site in Wharton State Forest is located in Burlington County, New Jersey, approximately 29 km (18 mi) north-northwest of the Hirsts’ Ponds in Atlantic County, New Jersey. Hampton Furnace Pond is approximately 1.2 ha (2.9 ac) in size, and *Dichanthelium hirstii* covers an area of 0.10 ha (0.25 ac) at the southern end of the pond (Walz 2011). The Hirst brothers searched for *D. hirstii* at this pond in the 1950s but did not find it. During the summer and fall of 2002, surveys by the NJNHP were conducted at this pond, but *D. hirstii* was not found. In July 2004, a *D. hirstii* population of at least 28 fruiting culms was discovered by Russell Juelg and identified by Ted Gordon during a Joint Philadelphia Botanical Club and Torrey Botanical Club Field Trip. Identification of *D. hirstii* was confirmed by A.E. Schuyler (Walz 2012). The site was revisited by ONLM in August 2004, and a total of 28 clumps supporting 131 culms with 114 inflorescences in fruit were observed with 1 to 6 plants per clump. During subsequent surveys of Hampton Furnace Pond in 2006, approximately 30 fruiting culms were found (Gordon 2006, p. 63; Gordon 2007; Gordon 2008; Snyder 2010). In September and October of 2007, a complete census of all *D. hirstii* plants was conducted by ONLM and the numbers of clumps, genets (a group of genetically identical individuals, all originating vegetatively, not sexually, from a single ancestor), ramets (an individual within a genet), culms, inflorescences, and seedlings were recorded. The location of each plant was mapped using a global positioning system (GPS). In 2007, 20 plants were documented supporting 161 vernal inflorescences and 152 autumnal inflorescences for a total of 313 fruiting culms; only 1 plant did not produce an inflorescence with fruit (Walz and Cartica 2008, p. 1; Walz and Cartica 2010, p. 5). In September 2008, the population was stable at 20 clumps. In June 2010, the first vernal (spring) inflorescence survey was conducted at Hampton Furnace Pond, and 32 clumps with 427 vernal inflorescence culms were documented.

Population census surveys at Hampton Furnace Pond were conducted in October 2010, when 303 individual plants were documented with 1,268 culms (average 4 per plant, range 1 to 83 per plant) and 2,498 autumnal inflorescences (average 8 per plant, range 1 to 216 per plant) (Walz 2011). Observations were made of rooting at nodes on decumbent culms and new autumnal rosette formations, suggesting the presence of clonal reproduction (asexual vegetative reproduction from a genetically identical ancestor through a process by which new individuals arise without production of seeds or spores) as well as autumnal seedling establishment (via sexual reproduction with flower and seed production). Water depth adjacent to each plant was recorded and individual plants were located using GPS (Walz and Cartica 2010, p. 5). A brief visit to the site was made in December 2011 to confirm presence of the plants. While the water was too deep to conduct an accurate count, the population was observed in the same area (based on GPS coordinates) documented in 2010; plants were healthy and had remnants of autumnal inflorescences above the water surface. These data mark a significant increase in population size at this pond site from 28 plants in 2004 to 303 plants in 2010 (Walz and Cartica 2010, p. 1).

In the years 2007 to 2011, levels of ground water and pond surface water were recorded. These data revealed that the pond surface water level in the Hampton Furnace Pond is not perched or isolated, but represents the local ground water table in this sandy aquifer. Further analysis of ground water and precipitation data

concluded that the ground water levels respond rapidly to rain events and that precipitation is driving the local aquifer (Walz and Cartica 2010, p. 6). The duration, timing, and depth of standing water in the pond at known occurrences in New Jersey during the growing season appear to be key factors in the annual presence or absence of the species and may account for dramatic fluctuations in population size (Gordon 2008).

North Carolina

The two sites in North Carolina occur on the Camp Lejeune Marine Corps Base in Onslow County. One site, referred to as Lyman Road Cypress Savanna, consists of plants scattered over an area of approximately 0.05 ha (0.12 ac) (Schuyler 1998a, p. 4). Approximately 80 to 100 *Dichantheium hirstii* plants were counted at the Lyman Road Cypress Savanna site in June 1990. The species was confirmed present during surveys conducted in June 1997 and May 2000, but available records do not provide information on the number of plants observed (table 1). *Dichantheium hirstii* was not seen during surveys conducted by North Carolina Natural Heritage Program (NCNHP) and Camp Lejeune biologists at the Lyman Road Cypress Savanna site in June 2005, June 2006, or July 2006. Conditions necessary for production of fruiting culms may not have been present in recent years at this site (NCNHP 2008). The last known survey of this site was in 2010, but no plants were observed (Walz 2011). There has been no obvious change in habitat, other than the natural yearly fluctuation in site hydrology. Despite the species' absence during the last known survey, the species is still considered extant at the Lyman Road Cypress Savanna site because sightings of *D. hirstii* at one of the New Jersey sites were separated by a decade (Buchanan 2010).

The second Camp Lejeune site, referred to as Starretts Meadow, occurs over an area of about 0.03 ha (0.074 ac) (Schuyler 1998a, p. 4). Approximately 28 to 35 basal rosettes and 150 to 200 fruiting clumps were counted at the Starretts Meadow site in July 1990 and June 1994, respectively. Several fruiting clumps were observed at the site in May 2000 (LeBlond 2004). No plants were found during a survey at Starretts Meadow site in 2005. Cool dry conditions may have affected the phenology (recurring biological phenomena such as plant budding, especially as influenced by climatic conditions) of the species at the North Carolina sites in 2005. One clump with four fruiting culms was observed during surveys of the Starretts Meadow site in 2006 (NCNHP 2008). The last known survey of this site was in 2010, and no plants were observed (Walz 2011).

Georgia

In Georgia, *Dichantheium hirstii* was first documented in August 1900 by R.M. Harper at the margin of a pine barren pond in Sumter County. In May 1947, the species was documented by R.H. Thorne in a cypress swamp in Calhoun County. In 1959, it was reported from Early County, but the record lacks detail and remains questionable (Swallen 1961). The species is now considered extirpated in Georgia.

Table 1: *Dichantheium hirstii* Rangewide Population Data 1982 to 2011

	North Carolina		Delaware	New Jersey		
Year	Onslow Co.: Starretts	Onslow Co.: Lyman	Sussex Co.: Assowoman	Atlantic Co.: Barkwoods	Atlantic Co.: Labounsky	Burlington Co.: Hampton
1982				24		
1984			17		2	
1985			20		?	
1986			70			
1987			70			

1988			70			
1989			34			
1990	28-35		14			
1991	Present		25			
1992			44	9	Failed to find	
1993			104			
1994	150-200		32			
1995			73	Failed to find	Failed to find	
1996			73			
1997	Present	Present	63	Failed to find	Failed to find	
1998			68			
1999			164	Failed to find	Failed to find	
2000	2	80-100	190	Failed to find	Failed to find	
2001			90		Failed to find	
2002			129		7	
2003			57	Failed to find		
2004			52			12
2005	Failed to find	Failed to find	81			
2006	1	Failed to find	51			
2007			55	Failed to find	Failed to find	20
2008			39	Failed to find	Failed to find	32
2009			8	Failed to find	Failed to find	
2010			18	Failed to find	Failed to find	303
2011			21	Failed to find	Failed to find	Present

Present = observed but population size not recorded; Blank = no search conducted

Table 2: *Dichanthelium hirstii* Rangewide Maximum Population Sizes

				North					
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	Georgia			Carolina		Delaware	New Jersey		
	Sumter Co., GA	Calhoun Co., GA	Early Co., GA	Onslow Co., NC (Starrletts)	Onslow Co., NC (Lyman)	Sussex Co., DE (Assowoman)	Atlantic Co., NJ (Barkwoods)	Atlantic Co., NJ (Labounsky)	Burlington Co., NJ (Hampton)
Max. Pop. Size & Year	?	?	?	200 (1994)	100 (2000)	190 (2000)	24 (1982)	7 (2002)	303 (2010)

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Encroachment of woody and herbaceous vegetation

At Labounsky Pond in New Jersey, woody vegetation is encroaching into the portion of the pond inhabited by *Dichantheium hirstii*. If not removed, woody vegetation will cause shading that will decrease habitat suitability of the pond for *D. hirstii* (Gordon 2008), because the plants cannot survive in full shade.

At Hampton Furnace Pond, encroachment by native species, such as *Cladium mariscoides* and *Saccharum giganteum* (sugarcane plumgrass), may be a threat if they continue to migrate from the upper pond edge into the pond and crowd out *Dichantheium hirstii* (Walz 2012). In 2011, both of these perennial native species were in higher abundance within the *D. hirstii* zone of the pond than in previous years, and were observed to be competing for space on the same hummocks with *D. hirstii*. Fire is likely the ecological process that keeps these species in check; fire has not occurred at the site since 1999.

Encroachment of woody vegetation at Assawoman Pond in Delaware will always be a concern, but it is being actively managed by the Delaware Natural Heritage Program (DNHP) staff (McAvoy 2004; 2008a; 2010; 2012). This woody vegetation includes primarily *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweet gum), and *Diospyros virginiana* (American persimmon) (Bennett 1998; McAvoy 2008a). An adjacent sandpit, which is lower in elevation than the pond bottom, may be pulling ground water away from the pond. This could result in an early and prolonged draw down, which would allow woody vegetation to become established (McAvoy 2012). Annual, or usually biannual, management efforts are conducted to control woody vegetation in the pond using both manual and chemical methods.

Carex striata (Walter's sedge), a native sedge, was documented at Assawoman Pond in Delaware in 1995 and was found to be expanding in 2009 (McAvoy 2010). If not controlled, *C. striata* will outcompete *Dichantheium hirstii* within the pond (McAvoy 2007). However, DNHP staff monitor the size and distribution of *C. striata* within the pond and apply chemical control when needed. In 2009, competition with the native, but extremely aggressive, species *Sclerolepis uniflora* (bog button) within Assawoman Pond was identified as a serious threat (McAvoy 2010). However, after further observations since 2009, it is now believed that *S. uniflora* and *D. hirstii* occupy different elevations within the pond, so perhaps displacement by *S. uniflora* is not occurring. This issue will continue to be considered and monitored annually to determine if reduction of the *S. uniflora* population in the pond is needed in the future (McAvoy 2012).

Based on the observed impacts to *Dichantheium hirstii* populations, we find encroachment of woody and herbaceous vegetation (specifically *Carex striata*) is a significant threat to the species. The key to

maintaining habitat for *D. hirstii* is consistent, annual monitoring to determine the degree and types of management that are needed to control undesirable vegetation.

Development

Because all known populations of *Dichanthelium hirstii* are located on public or conservation lands, they are generally protected from development activities. *Dichanthelium hirstii* habitat at Labounsky Pond in New Jersey has been impacted by an illegally constructed ditch since the mid to late 1990s. This ditch drains surface water from a heavy equipment storage yard into Labounsky Pond. Runoff of oil, fuel, and lubricants from this storage yard poses a threat to water quality within the pond (Eisenhauer 1998; Patt 2000). TNC has worked with the construction company to address the impacts from the ditch. We have no other information indicating that development activities are impacting *D. hirstii* habitat and, therefore, conclude that development activities do not constitute a threat to the species.

Off-road vehicle use

Off-road vehicle (ORV) use has occurred in the vicinity of the *Dichanthelium hirstii* population at Hampton Furnace Pond in New Jersey. This population is surrounded by a network of roads (within a few hundred meters) that lead to a nearby area where all the vegetation has been destroyed by illegal ORV traffic. The roads were created for the purpose of fighting a 1999 wildfire but quickly became regular thoroughfares for ORVs. While remote, Hampton Furnace Pond is accessible to ORVs and is similar to other intermittent ponds that are routinely used by people who participate in this type of recreational activity (Juelg 2011). There has been no documented damage to *D. hirstii* plants from ORVs to date. Increased surveillance and signage are being used to try to deter ORV use of the roads surrounding the pond. We, therefore, conclude that ORV use is not a significant threat to the species.

Military training

The two known populations of *Dichanthelium hirstii* on Camp Lejeune in North Carolina are within areas zoned for military training exercises, but the specific locations occupied by these populations are not likely to be impacted. The federally endangered red-cockaded woodpecker (*Picoides borealis*) also occurs at one of these sites. While the protective measures for the red-cockaded woodpecker do not provide specific protection to *D. hirstii* sites, the presence of protective buffers for the woodpecker may result in less use of these areas. Although the protections do not exclude Marines on foot or in vehicles, the *D. hirstii* populations are in wet areas that are unfavorable for training and land vehicles. Consequently, the potential for impacts due to military training is low (Marine Corps Base Camp Lejeune, NC 2006, Appendix D, Tenbrink 2012). We, therefore, conclude that military training is not a significant threat to the species.

In summary, we find that *Dichanthelium hirstii* is threatened by the present or threatened destruction, modification, or curtailment of its habitat or range due to the encroachment of woody and herbaceous vegetation.

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

We have no information indicating that overutilization poses a threat to *Dichanthelium hirstii*.

C. Disease or predation:

Disease is not a known threat to *Dichanthelium hirstii*. In the late 1990s, at both the Labounsky and Barkwoods Ponds in New Jersey, grazing by resident Canada geese (*Branta canadensis*) impacted vegetation in the ponds. However, we have no information indicating that impacts from Canada geese constitute a threat to *D. hirstii*. In 2007, deer browse was observed on much herbaceous vegetation at Barkwoods Pond in New

Jersey, but because no *D. hirstii* plants were observed that year, it is uncertain whether deer browse of *D. hirstii* had occurred (Snyder 2010). We are not aware of any other information indicating that deer browse of *D. hirstii* poses a threat to the species. Therefore, we conclude that disease and predation are not significant threats to *D. hirstii*.

D. The inadequacy of existing regulatory mechanisms:

Dichantheium hirstii has varying levels of State protection across its range. Below, we describe the regulatory mechanisms for each State and evaluate their adequacy.

Delaware

In Delaware, *Dichantheium hirstii* is included on the State's rare plant list. Although the State of Delaware does not have a State endangered species act, it has a rare plant conservation program. However, no legal protection is given to plants; any protection is strictly voluntary (McAvoy 2012). The occurrence of the species on a State wildlife management area (Assawoman Pond) provides protection from development. In addition, any activities in the surrounding State-owned area must first be reviewed to determine any potential of impacts to the site or population (McAvoy 2012). Given *D. hirstii* is extant at only one population in Delaware and that population is on State land, the existing regulatory mechanism is adequately achieving its purpose for the Delaware population.

New Jersey

In New Jersey, *Dichantheium hirstii* is State-listed as endangered. However, the New Jersey Endangered Plant List Act does not provide regulatory protection from habitat loss or collection on private lands. It is against State law to collect plant species occurring on State land. Therefore, the Wharton State Forest site is protected from collection. The New Jersey Pinelands Protection Act prohibits development within the Pinelands Area unless it is designed to avoid irreversible adverse impacts on habitats that are critical to the survival of any local populations of federally or State-listed plant or animal species (N.J.A.C. 7:50-6.27 and 6.33). Protections afforded by the Pinelands Protection Act apply only within the "Pinelands Area," specifically that area encompassed by the Pinelands Comprehensive Management Plan (N.J.S.A. 13:18A-1 *et seq.*). Pinelands regulations require 300-foot wetland buffers (N.J.A.C. 7:50-6.14). All New Jersey *D. hirstii* sites are within the New Jersey Pinelands Area and, therefore, afforded protection under the Pinelands Comprehensive Management Plan. Given one of the *D. hirstii* population occurs on State-owned land and the other two populations occur on a TNC preserve and all of them are within the Pinelands Area, existing regulatory mechanisms are adequately achieving their purpose for the New Jersey populations.

North Carolina

In North Carolina, *Dichantheium hirstii* is State-listed as endangered. Any person wishing to collect a listed plant species must have written permission from the property owner as well as a permit from the North Carolina Department of Agriculture's Plant Conservation Program. If species are illegally collected, the penalty is a fine of up to \$2,000 per plant collected. However, since both North Carolina sites occur on a Federal military installation with no public access, *D. hirstii* is protected against collection (Gadd 2012). In addition, both North Carolina sites occur in areas that are generally incompatible with military training and, therefore, have not been impacted historically by training activities. The existing regulatory mechanism is adequately achieving its purpose for the North Carolina populations.

Georgia

In Georgia, although *Dichantheium hirstii* is considered extirpated, the species is protected by the State under provisions of the Wildflower Preservation Act of 1973 (O.C.G.A. 12-6-170). The species cannot be removed from public land without authorization; a tag is required to transport protected species, and selling

protected species is illegal without permission of the landowner.

Based on our conclusions that development, ORV use, military training, and collection are not significant threats to *Dichanthelium hirstii* (see Factors A and B above), we find that inadequacy of regulatory mechanisms is not a threat to the species with respect to these factors. Illegal ORV impacts are a minor threat. The regulatory mechanism is sufficient, but the enforcement has been lacking. Also, we find that there are no existing regulatory mechanisms addressing the threats of encroachment of woody and herbaceous vegetation, competition from rhizomatous perennials, fluctuations in hydrology, and stochastic events.

E. Other natural or manmade factors affecting its continued existence:

Competition from rhizomatous perennials

Competition from rhizomatous perennials, particularly *Eleocharis robbinsii* (Robbins' spikerush) that dominates the turf covering the pond bottoms, is a threat to *Dichanthelium hirstii* in Barkwoods and Labounsky Ponds in New Jersey. Dense growth of *Utricularia fibrosa* (humped bladderwort) and algae may be retarding growth of *D. hirstii* plants at Barkwoods Pond when less water is present (Schuyler 1998a, p. 4). *Cladium mariscoides* and *Saccharum giganteum* at Hampton Furnace Pond in New Jersey may compete with *D. hirstii*. At Assawoman Pond in Delaware, *D. hirstii* does not occur in areas dominated by dense carpets of *Sclerolepis uniflora*, a native rhizomatous perennial that is a State-rare plant. *Sclerolepis uniflora* is quite aggressive at Assawoman Pond and may be outcompeting *D. hirstii* at the site (McAvoy 2004; McAvoy 2008b, p.1). Recent evidence suggests that *S. uniflora* and *D. hirstii* occupy different levels of elevations within pond, so perhaps displacement by *S. uniflora* is not occurring (McAvoy 2012). At the Camp Lejeune sites in North Carolina; at one of these sites, where *Utricularia inflata* (swollen bladderwort) and algae in the water were present, *D. hirstii* plants were much smaller than at the other site, which had deeper and clearer water (Schuyler 1998a, p. 4). Given that populations are small, the vulnerability of the species to competition from rhizomatous perennials is exacerbated.

Hydrology fluctuations

Persistent standing water during the *Dichanthelium hirstii* growing season was observed to result in high mortality of established plants at the Assawoman Pond site in 2000. In all, 111 plants died at the site between 2000 and 2001. Persistent standing water may prevent all germination and establishment of seedlings (McAvoy and Bennett 2002, p. 3). The duration, timing, and depth of standing water on the pond bottom at known occurrences in New Jersey during the growing season appear to be key factors in the annual presence or absence of the species and may account for dramatic fluctuations in population size. Changes to hydrology at *D. hirstii* habitats significantly impact persistence of the species (Gordon 2008). Intermittent ponds have naturally fluctuating seasonal water levels, exhibiting high water in the winter and spring and low water in the summer and fall as the local ground water levels drop. Changes in hydrology can also occur when water withdrawal is increased through residential well use or water diversions occurring in the local watershed. Precipitation events drive sand aquifer water table levels; therefore, major storm events can increase the depth and duration of flooding in these ponds.

Fire

While there is no direct evidence that fire is an ecological process that affects *Dichanthelium hirstii* populations, this species appeared at Hampton Furnace Pond in New Jersey in 2004 after a peat-burning fire in 1999 and subsequent flooding in 2002, which indicates that fire may affect population dynamics. Additional research is needed on fire history and seed bank dynamics.

Climate change

The limited available information on climate change makes it difficult to fully evaluate potential changes to *Dichantheium hirstii* habitat. The Northeast Climate Impact Assessment (Frumhoff et al. 2007) models of future precipitation rates in the Northeast (assessment includes New Jersey, not Delaware or North Carolina), suggest a steady increase in annual precipitation, with a total increase of 10 percent by the end of the century. Under higher emissions scenarios, winter precipitation could increase an average of 20 to 30 percent. Little change is projected in summer precipitation. *Dichantheium hirstii* habitat could be affected if climate change causes altered patterns of precipitation, increased evapotranspiration from warmer temperatures, or increased human water demands. Sea level rise and saltwater intrusion into the ground water that flows to the Assawoman Pond may be a threat to the Delaware population. The pond is about 0.6 km (0.4 mi) from the closest tidal river. The Assawoman Wildlife Area is bordered by the saltwater system of the Assawoman Bay, and freshwater seasonal ponds in the area that are much closer to tidal waters have turned brackish over time (McAvoy 2012). Saltwater has not yet intruded into this site. Other ponds in the area show signs of salinity but not the pond that supports *D. hirstii*. The magnitude of any changes that may occur to *D. hirstii* habitat due to climate change factors is highly uncertain.

Threats associated with small population number and size

Species that occur within a single small population or a small number of small populations are inherently more vulnerable to extinction than are widespread species because of the increased risk of genetic bottlenecks, random demographic fluctuations, and localized catastrophes such as hurricanes, drought, and disease outbreaks. Small, isolated populations often exhibit reduced levels of genetic variability, which diminishes the species' capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (e.g., Barrett and Kohn 1991, p. 4; Newman and Pilson 1997, p. 361). Very small, isolated plant populations are also more susceptible to reduced reproductive vigor due to ineffective pollination, inbreeding, depression, and hybridization. Small, isolated populations face an increased likelihood of stochastic extinction due to changes in demography, the environment, genetics, or other factors (Gilpin and Soulé 1986, (pp. 24–34). The problems associated with small population number and size are further magnified by synergistic interactions with other threats, such as those discussed above (see factors A and C, above).

In summary, we find that *Dichantheium hirstii* is threatened by other natural or manmade factors affecting its continued existence, specifically encroachment of woody and herbaceous vegetation, competition from rhizomatous perennials, and fluctuations in hydrology, and threats associated with small population number and size.

Conservation Measures Planned or Implemented :

The Delaware Division of Fish and Wildlife (DDFW) and DNHP have conducted periodic removal of encroaching native, but aggressive, *Carex striata* and woody vegetation at Assawoman Pond. *Carex striata* was effectively managed at the site through 2004 (McAvoy 2004). Ongoing control of *C. striata* is planned by the DNHP (McAvoy 2010, 2012). It is presumed that the DNHP will continue to address existing and future threats to the species (McAvoy 2010, 2012). However, concerns about encroachment by *Acer rubrum* and *Liquidambar styraciflua* and changes to hydrology of the site remain (McAvoy and Bennett 2000, pp. 5 to 6). In 2005, a small patch of *C. striata* was found in Assawoman Pond and had expanded in 2009. If not controlled, competition by *C. striata* could eliminate habitat for *Dichantheium hirstii* (McAvoy 2007; 2010). Although still present in the pond, *C. striata* is at controllable levels and is currently not competing with *D. hirstii* (McAvoy 2012). In November 2004, 55 potted plants of *D. hirstii* were planted in Assawoman Pond by the DDFW and DNHP. These plants originated from seed collected from the site, which were germinated and reared by the Mt. Cuba Center for the Study of Piedmont Flora in Delaware. The plants were randomly placed and planted within sunny open areas of the pond. Each plant was individually marked, and GPS point locations were recorded. Of the 55 plants, 42 were observed to have survived the translocation on the day

following planting (McAvoy 2007). In 2006, 4 of the 55 plants were documented to have survived (McAvoy and Bennett 2007, p. 1). None of the translocated plants have been found since 2006 (McAvoy 2011a). It is unknown as to why the introductions did not survive (McAvoy 2012).

The Marine Corps has cooperated in *Dichantheium hirstii* protection efforts in recent years by avoiding activities that would adversely affect the species at the Camp Lejeune, North Carolina sites. One site at Camp Lejeune is within a protected zone maintained for red-cockaded woodpecker (LeBlond 1998). The protective measures for the red-cockaded woodpecker do not provide specific protection to *D. hirstii* sites, but the presence of protective buffers for the woodpecker may result in less use of an area. As indicated in the Integrated Natural Resource Management Plan, any activities within *D. hirstii* sites are being reviewed for such activities as training exercises, and a monitoring program, controlled burning, and canopy vegetation management (hand or mechanical) are all conducted at Camp Lejeune (Marine Corps Base Camp Lejeune, NC 2006, Appendix D and p. 5-2, Tenbrink 2012).

In New Jersey, TNC has worked with a construction company to eliminate impacts from the illegally constructed ditch near Labounsky Pond. Active management will be necessary to ensure that impacts are eliminated or minimized. Experimental scarification treatments of the pond bottoms (light to heavy raking of the pond bottom) at Labounsky and Barkwoods Ponds were initiated in 1999 in an attempt to stimulate any naturally occurring seed bank of *Dichantheium hirstii* at these sites (Patt 2000). In the summer of 2002, a small number of *D. hirstii* plants were found at the Labounsky Pond site (Gordon 2004; Juelg 2004). From 2005 through 2007, in a joint effort between TNC, New Jersey Department of Parks and Forestry, and New Jersey Geological Survey, hydrologic monitoring equipment (piezometers and data loggers) was installed at Labounsky and Hampton Furnace Ponds to monitor natural ground water fluctuations in the ponds and surrounding uplands and relate hydrologic fluctuations to population data (Cartica 2006, pp. 1 to 2; Cartica 2007, pp. 1 to 2; Walz and Cartica 2010, pp. 6 to 7). However, at Labounsky Pond, repeated vandalism to the locked well housings and destruction of water level monitoring equipment have hampered hydrology monitoring at this site. Alternative ways to monitor hydrology are being explored. Monitoring at Hampton Furnace Pond has provided a multi-year (2007 to 2011) data set of regional and local ground water hydrology. Monitoring continues with automated, remote, hourly data collection (Walz 2012). To address the potential impacts of ORVs to *D. hirstii* at Hampton Furnace Pond, the New Jersey Conservation Foundation is working with Wharton State Forest to maintain “No Motorized Vehicles” signage in the area and encourage the Wharton State Park conservation officers to regularly patrol the area and enforce the State Park regulations that prohibit driving off of designated roads. Volunteer help is also being organized to help move these conservation efforts forward (Juelg 2011).

Dichantheium hirstii is not included as a species of conservation concern within State Wildlife Action Plans because the species is a plant and the State plans address wildlife only.

Summary of Threats :

The major threats to *Dichantheium hirstii* are encroachment of woody and herbaceous vegetation, competition from rhizomatous perennials, fluctuations in hydrology, and threats associated with small population number and size. The threat to *D. hirstii* due to climate change factors is highly uncertain.

The Service finds that listing this species is warranted throughout all of its range and, therefore, finds that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing

Decisions(PECE)?

Recommended Conservation Measures :

- Continue to monitor and manage known *Dichanthelium hirstii* populations.
- Conduct research on species life history. High priority life history research needs include:
 - Continue hydrologic monitoring at Hirsts’ and Hampton Furnace Ponds in New Jersey and Assawoman Pond in Delaware and initiate hydrologic monitoring at the North Carolina sites to correlate changes in hydrology to species abundance and persistence.
 - Continue to develop a comprehensive monitoring plan for *D. hirstii* populations, associated ecological communities, and hydrology rangewide.
 - Conduct genetics research on the reproductive biology of *D. hirstii*, including ploidy (the number of sets of chromosomes in a cell or organism) level analysis of microsatellite markers (a specific sequence of DNA bases or nucleotides used to determine relatedness between individuals or vegetative parentage) critical for the genetic identification of clonal (asexual reproduction) plants and demographic analyses and for the determination of genetic variation to assess local and regional differences within and between populations.
- Conduct de novo (over again from the beginning) surveys within suitable coastal plain habitats throughout the species’ range.
- Manage encroachment of woody vegetation and rhizomatous perennials by controlled burning or hand removal.
- Enforce restriction of ORVs at Hampton Furnace Pond with the assistance of the New Jersey Conservation Foundation and Wharton State Forest and its enforcement officers.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

While all six extant *Dichanthelium hirstii* populations are located on public land or privately owned conservation lands, threats to the species from encroaching vegetation, competition from rhizomatous perennials, fluctuations in hydrologic conditions, and threats associated with small population number and

size are significant. Given the naturally fluctuating number of plants found at each site and the isolated nature of the wetlands (limiting dispersal opportunities), even small changes in the species' habitat could result in local extirpation. Loss of any known sites would constitute a significant contraction of the species' range. The small number of populations and their small sizes make this species highly vulnerable.

Imminence :

Because most of the significant threats to *Dichantheium hirstii* impact the species over a period of years and, in some cases, are being managed to some extent, we consider the threats to be non-imminent.

 Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

 No Is Emergency Listing Warranted?

Based on the best available scientific information, emergency listing is not warranted at this time. Although there are few populations, they are widely scattered such that there is no single threat likely to result in extirpation simultaneously.

Description of Monitoring:

Information regarding the status of the species is being monitored through annual coordination with New Jersey, Delaware, and North Carolina Natural Heritage Program staff, species experts, and local professional and amateur botanists.

The last comprehensive status survey for the species was conducted in 1998, and included only sites in New Jersey, Delaware, and North Carolina (Schuyler 1998a, p. 1). The historical and rediscovered New Jersey populations are monitored sporadically on a voluntary basis by interested botanists and naturalists. Many of these monitoring efforts go unreported. For example, the Service did not learn until June 2004 that *Dichantheium hirstii* had been rediscovered at Labounsky Pond in the summer of 2002 by local botanists. However, the Hampton Furnace Pond site population has been monitored regularly and intensively by the NJDEP since its discovery in 2004. The Delaware population is monitored annually by the DNHP. The States of New Jersey and Delaware are now cooperating in an effort to conduct consistent monitoring. In 2009 and 2010, New Jersey and Delaware developed a draft monitoring protocol in an effort to coordinate population and hydrology monitoring methodology and population data analysis. New Jersey added vernal inflorescence and water depth monitoring at each clump to their existing protocol and Delaware added counts of the number of inflorescences per culm and nodal spouts. The draft protocol includes the following objectives (Walz and Cartica 2010, pp. 8 to 10).

1. Conduct an annual census of *D. hirstii* at each location. The census effort needs to follow an adaptive monitoring strategy (e.g., if census creates too much physical disturbance to the habitat and plants, less frequent monitoring should be considered).
2. Conduct monthly (June, July, August, and September) population demographic surveys each year.
3. Conduct monthly water level measurement as depth of water at each clump (at time of population sampling).
4. Conduct annual vegetation community monitoring using multiple transects across the pond gradient within the *D. hirstii* population.
5. Conduct a survey of threats to each population noting species encroachment (e.g., *Cladium mariscoides*, *Carex striata* var. *brevis*), drought – chlorotic plants, fire, flooding duration – hydroperiod, herbivory,

trampling, erosion, sedimentation.

6. Annually take note on dates of anthesis, flower, fruit (vernal and autumnal), and senescence.

7. Annual winter survey for presence of over-wintering basal rosettes.

The North Carolina populations are not regularly monitored. The level of monitoring across the different states is not appropriate to provide an adequate update of the species' current status at this time. Given the low numbers of plants found at only six known locations, loss of any known sites would constitute a significant contraction of the species' range.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Delaware, New Jersey, North Carolina

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

Georgia did not provide any new information or comments.

Biologists or botanists or both from New Jersey, Delaware, and North Carolina provided new information and comments.

Literature Cited:

Literature Cited:

(* Indicates e-mail correspondence, unpublished reports, submitted manuscripts, or other grey literature)

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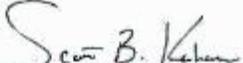
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Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

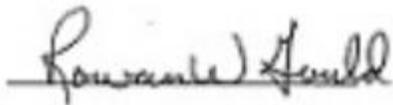
Approve:

Approve: 
Acting Regional Director, Fish and Wildlife Service

07/24/2012

Date

Concur:



11/06/2012

Date

Did not concur:

Date

Director's Remarks: