SWAMP PINK (*Helonias bullata*)

RECOVERY PLAN

Prepared by:

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EXECUTIVE SUMMARY
Helonias bullata

CURRENT SPECIES STATUS: *Helonias bullata* is threatened throughout its range. Approximately 205 records exist for the species in eight states -- out of these, a total of 122 extant populations are reported from New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, and Georgia; the sole historical population in New York is considered extirpated. Populations vary widely in size and habitat quality. Approximately 35 populations are located on relatively protected public lands.

HABITAT REQUIREMENTS AND LIMITING FACTORS: *Helonias bullata* is an obligate wetland species occurring along streams and seepage areas in freshwater swamps and other wetland habitats. The major threat to the species is loss and degradation of its wetland habitat due to encroaching development, sedimentation, pollution, succession, and wetland drainage. In addition, the species exhibits extremely low seedling establishment, which appears to be a significant limitation to the colonization of new sites. Other threats include plant collection and trampling.

RECOVERY OBJECTIVE: To delist *Helonias bullata*.

RECOVERY CRITERIA: Stabilize range-wide status of the species by (1) securing permanent land protection for a minimum of 80 sites; (2) ensuring long-term regulatory protection of all extant populations and their habitat at the state and local levels; and (3) if needed, maintaining representative genotypes in cultivation.

ACTIONS NEEDED:

1. Protect all known *Helonias* sites through habitat protection and regulatory enforcement.
2. Characterize extant colonies and define essential habitat.
3. Monitor and minimize on- and off-site threats to viable populations.
4. Identify and implement management techniques.
5. As needed, preserve genotypes in laboratory/storage facilities.
6. Provide public information and education.
7. Review recovery progress and revise plan as necessary.

ESTIMATED COSTS OF RECOVERY ($000):

Year	Need 1*	Need 2	Need 3	Need 4	Need 5	Need 6	Total**
FY 1	39	13	10	5		10	77
FY 2	31	13	10	10		10	74
FY 3	25	10	22	10	2	10	79
FY 4	12	10	3	10	1	6	42
FY 5	12	10	3	10	1	6	42
FY 6	12		3	10	1	6	32
FY 7	12		3	10	1	6	32
FY 8	12		3	10		6	31
FY 9	12		3	5		6	26
FY 10	12		3	5		6	26
	179	56	63	85	6	72	461

* Costs listed do not include an estimated $25 million for habitat acquisition.
** Need 7 does not have associated costs.

TOTAL ESTIMATED RECOVERY COST: Total recovery costs are roughly estimated at $25,500,000.

PROJECTED DATE OF RECOVERY: If recovery tasks are implemented on schedule, delisting will be considered by the year 2002.

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Recovery plans delineate reasonable actions needed to recover and/or protect listed species. Attainment of recovery objectives and availability of funds are subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities.

Recovery plans do not necessarily represent the views or official position of any individuals or agencies involved in plan formulation, other than the U.S. Fish and Wildlife Service. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1991. Swamp Pink (Helonias bullata) Recovery Plan. Newton Corner, Massachusetts. 56 pp.

Copies of this plan can be purchased from:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814
301-492-6403
or
1-800-582-3421

Fees vary according to number of pages.

ACKNOWLEDGMENTS

The technical draft Helonias bullata Recovery Plan was written by Lynn Wilson Oldt, formerly of the U.S. Fish and Wildlife Service's New Jersey Field Office. Lynn, who ably steered the Helonias bullata recovery planning process well into its present course, has since transferred to the Laguna Niguel Field Office in California, but her ideas and initial coordination remain an essential contribution to the recovery of this threatened species.

Mary Parkin consolidated the comments received on the technical and agency drafts and further shaped this planning document. The continuing input of the botanists, land managers, resource experts, and other participants in the recovery planning process has been indispensable in framing the proposed recovery objectives and program for Helonias.

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PART I: INTRODUCTION

Swamp pink (Helonias bullata L.), a distinctive perennial plant, was first collected by Swedish naturalist Peter Kalm near Philadelphia -- most likely around Pennsneck, New Jersey -- in the mid-1700s (Brown 1910). Kalm's specimens were submitted to Linnaeus, who described the species in the first edition of Species Plantarum as a monotypic genus in the Liliaceae (Lily) family (U.S. Fish and Wildlife Service 1988).

Helonias was designated a Federally threatened species on September 9, 1988 due to population decline and serious threats to its habitat (U.S. Fish and Wildlife Service 1988). The species was then assigned a recovery priority of "7C" under guidelines developed by the U.S. Fish and Wildlife Service to help allocate limited recovery funds among listed plants and animals (Federal Register, Vol. 46, No. 184, September 21, 1983).

Its ranking of 7 indicates that Helonias faces a moderate degree of threat, has a high recovery potential (i.e., limiting factors and threats are understood, and limited management is anticipated), and is a monotypic genus. The "C" denotes a potential for being in conflict with a development or construction project, and elevates the species' priority within its numerical category.

DESCRIPTION

Helonias bullata is a smooth perennial herb with thick, stocky rhizomes. Its leaves, which form a basal rosette, are evergreen, oblong-spatulate or oblanceolate, parallel-veined, 0.9-2.5 dm long, 2-4 cm wide, acute, and attenuated at the base. A stout hollow stem arises from the rosette and may grow from a height of 2-9 dm at the time of flowering to 1.5 m at the time of seed maturation. The sparsely bracteate flower stalk is 1-3 dm high when flowering and up to 6 dm when in fruit. The stalk is terminated by a simple and short, dense, bractless, 3-8 cm long raceme. The rootstock is stout with many fibrous roots.

The inflorescence consists of 30-50 fragrant flowers (Sutter 1982, 1984); individual flowers are about 1 cm wide. Pedicels are very short at first, elongating to 4-8 mm. The perianth is composed of six spatulate-oblong, pink to lavender segments that are 5-9 mm long and 1-2 mm wide. As the inflorescence elongates, the perianth persists and retains a pink color interfused with green.

The fruit capsule is 3-lobed, papery, 3-5 mm long and 8-10 mm wide, with an inverted heart shape and consisting of many ovules. The ovule opens into six lobes releasing linear-shaped seeds that are 5 mm long with appendages at both ends (Johnson undated). Mature seeds were not described by Johnson or Sutter.

During the winter months, the leaves of Helonias lie flat or slightly raised from the ground, and are often hidden by fallen leaf litter. The flowerhead of the next season is visible, appearing like a large button in the center of the rosette. Leaves often turn a reddish-brown color over the winter; new, bright green leaves appear in spring (Chris

Peterson, New Jersey Department of Environmental Protection, in litt. 1990). Plants bloom as early as March and often last until May, while seed production occurs in June. Typically small at the time of plant flowering, leaves may increase in length to 4 dm or more as the season progresses.

DISTRIBUTION

Helonias historically occurred in eight states, with a range that extended from Staten Island, New York, to Georgia. The species' current range includes the coastal plain from New Jersey to Virginia and disjunct bog areas in the Southern Appalachians. Helonias is no longer found in New York, and historical references to its occurrence in Pennsylvania are believed to be in error: A Pennsylvania report of a specimen from "Ong's Hat" was probably a mislabling of a site by that name in New Jersey (Larry Morse, The Nature Conservancy, Arlington, Virginia, in litt. 1983), and other references are probably based on Linnaeus' original but apparently mistaken statement in Species Plantarum about habitat "in Pensylvanicae" that was actually located in New Jersey (Brown 1910).

A total of 122 sites in New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, and Georgia currently are known to support the species. The majority of extant populations are found on private lands; at least 35 populations are within publicly owned, protected areas.

Helonias population sizes vary from a few to several thousand plants -- one locality in Delaware has 10,000-25,000 clumps (William McAvoy, Delaware Natural Heritage Program, pers. comm.), and a recently discovered population in North Carolina contains over 100,000 rosettes (Steve Croy, National

that current population counts exhibit some inconsistencies in terms of both how individual populations are delineated and how individual plants are counted; population estimates are thus somewhat inconclusive. Appendix A represents an effort to standardize population monitoring -- these methods will be refined through the course of implementing recovery tasks.

Helonias sites in some states within the species' range have been ranked according to population vigor and habitat quality, using the criteria listed in Appendix B. Both the rankings and the criteria will need to be reviewed when the inconsistencies mentioned above are resolved, but for general recovery purposes the current rankings indicate that, although numerous populations of this species exist, some of which are large and vigorous, many of these populations are small and/or located on poor habitat.

Figure 1 depicts the geographic range of Helonias, and Table 1 lists historical and extant (as of 1980) populations. A summary of the plant's status within each state follows.

DELAWARE: Fifteen extant sites and eight historical sites are known in Delaware. Although one historical site in Delaware was located in the Piedmont province, all other known sites are located in the Coastal Plain province. The 15 extant sites are distributed among all of the state's three counties (New Castle, Kent, and Sussex), and potential habitat may be located in any watershed within the state. Eight populations have been discovered since January, 1990: six in Sussex County and two in Kent County (Keith Clancy, Delaware Natural Heritage Program, in litt. 1991). Three of the state's populations are on public lands; the other 12 are on privately owned lands. Delaware botanists are optimistic that additional colonies may exist along free-flowing streams in western watersheds in the state (Leslie Trew, Delaware Natural Heritage Program, pers. comm.).

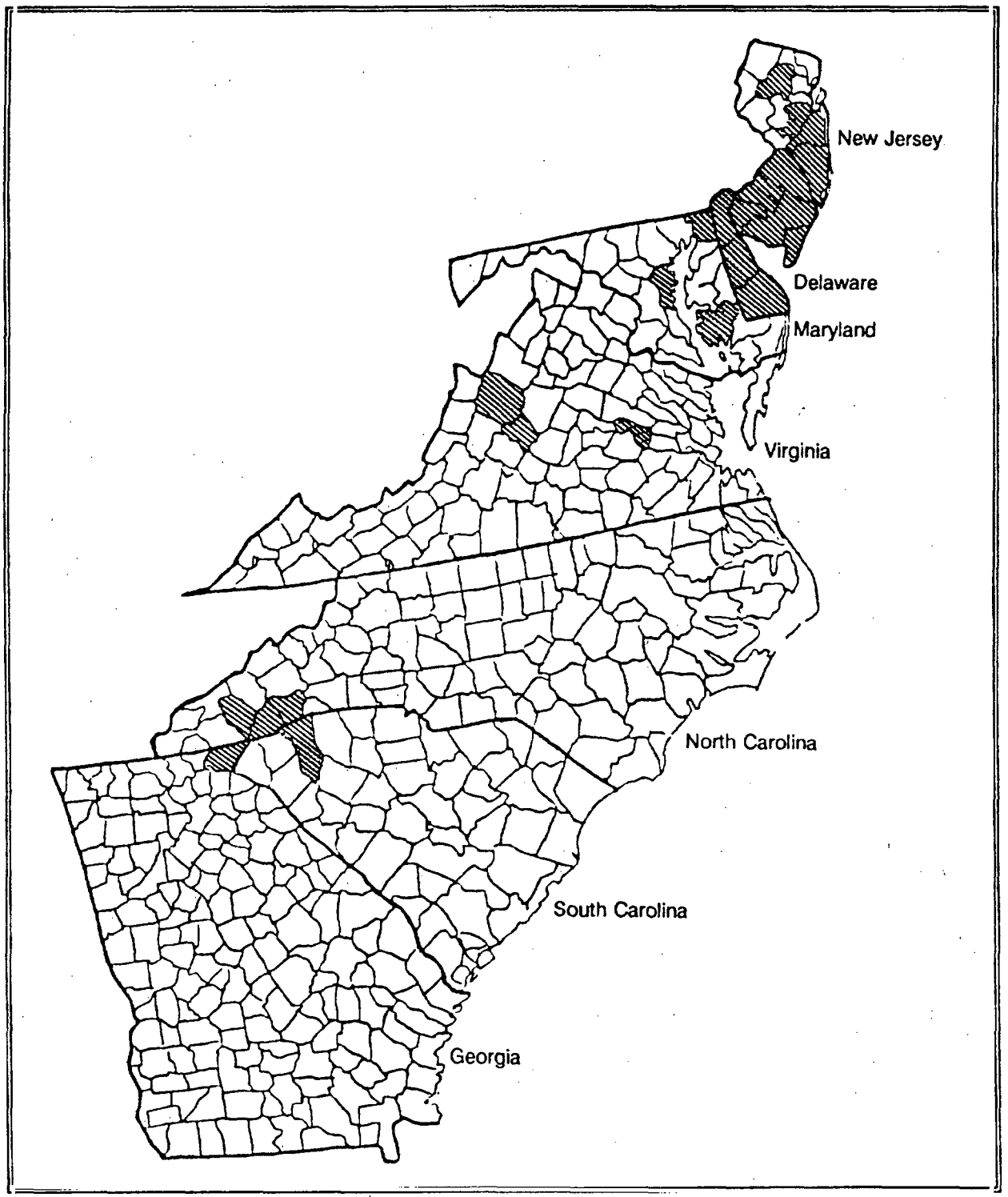

Figure 1. Distribution of Helonias bullata.

Table 1. Historical and Extant Records of *Helonias bullata*.

STATE (SOURCE)/ COUNTY	LAST OBSERVED DATE	COUNTY	LAST OBSERVED DATE
DELAWARE (Delaware Natural Heritage Program, 1991)			
New Castle 1	1881	Sussex 1	1942
New Castle 2	1896	Sussex 2	1985
New Castle 3	1931	Sussex 3	1986
New Castle 4	1938	Sussex 4	1988
New Castle 5	1976	Sussex 5	1988
New Castle 6	1986	Sussex 6	1989
		Sussex 7	1990
Kent 1	1930	Sussex 8	1990
Kent 2	1944	Sussex 9	1990
Kent 3	1985	Sussex 10	1990
Kent 4	1990	Sussex 11	1990
Kent 5	1991	Sussex 12	1990
GEORGIA (Georgia Natural Heritage Inventory, 1989)			
Rabun	1989		
MARYLAND (Maryland Natural Heritage Program, 1991)			
Anne Arundel 1	1941	Cecil 1	1940
Anne Arundel 2	1991	Cecil 2	1991
Anne Arundel 3	1991	Cecil 3	1991
		Dorchester	1991
NEW JERSEY (New Jersey Natural Heritage Program, 1991)			
Atlantic 1	1881	Camden 1	1872
Atlantic 2	1980	Camden 2	1890
Atlantic 3	1990	Camden 3	1914
		Camden 4	1914
Burlington 1	1800s	Camden 5	1915
Burlington 2 (Camden)	1879	Camden 6	1916
Burlington 3	1887	Camden 7	1917
Burlington 4	1890	Camden 8	1942
Burlington 5	1901	Camden 9	1985
Burlington 6	1906	Camden 10	1985
Burlington 7	1929	Camden 11	1985
Burlington 8	1946	Camden 12	1985
Burlington 9	1982	Camden 13	1988
Burlington 10	1985	Camden 14	1989
Burlington 11	1989	Camden 15	1989
Burlington 12	1989	Camden 16	1989
Burlington 13	1989	Camden 17	1989
Burlington 14	198?	Camden 18	1989
		Camden 19	1989
		Camden 20	1989
		Camden 21	1989
		Camden 22	198?
		Camden 23	1990
		Camden 24	1990
		Camden 25	1990
		Camden 26	1990
		Camden 27	1991
		Camden 28	1991

NEW JERSEY (continued)			
Cape May 1	1909	Mercer	1883
Cape May 2	1909		
Cape May 3	1915	Middlesex 1	1892
Cape May 4	1932	Middlesex 2	1893
Cape May 5	1982	Middlesex 3	1910
Cape May 6	1985	Middlesex 4	1932
Cape May 7	1985	Middlesex 5	1946
Cape May 8	1989	Middlesex 6	1983
Cape May 9	1990		
Cape May 10	1990	Monmouth 1	1941
Cape May 11	1990	Monmouth 2	1941
Cape May 12	1990	Monmouth 3	1954
		Monmouth 4	1982
Cumberland 1	1870	Monmouth 5	1988
Cumberland 2	1888	Monmouth 6	1988
Cumberland 3	1891	Monmouth 7	1990
Cumberland 4	1924	Monmouth 8	1990
Cumberland 5	1925		
Cumberland 6 (Salem)	1932	Morris 1	1907
Cumberland 7	1932	Morris 2	1910
Cumberland 8	1933	Morris 3	1945
Cumberland 9	1933	Morris 4	1958
Cumberland 10	1959	Morris 5	1985
Cumberland 11	1970	Morris 6	1990
Cumberland 12	1985		
Cumberland 13	1985	Ocean 1	1908
Cumberland 14	1985	Ocean 2	1910
Cumberland 15	1988	Ocean 3	1915
Cumberland 16	1988	Ocean 4	1931
Cumberland 17	1989	Ocean 5	1934
		Ocean 6	1942
Gloucester 1	1862	Ocean 7	1956
Gloucester 2	1888	Ocean 8	1985
Gloucester 3	1892	Ocean 9	1985
Gloucester 4	1895	Ocean 10	1985
Gloucester 5	1896	Ocean 11	1985
Gloucester 6	1896	Ocean 12	1988
Gloucester 7	1902	Ocean 13	1988
Gloucester 8	1910	Ocean 14	1989
Gloucester 9	1923	Ocean 15	1990
Gloucester 10	1925		
Gloucester 11	1935	Salem 1	1917
Gloucester 12	1937	Salem 2	1935
Gloucester 13	1944	Salem 3	197?
Gloucester 14	1985	Salem 4	1985
Gloucester 15	1985	Salem 5	1985
Gloucester 16	1985	Salem 6	1988
Gloucester 17	1987	Salem 7	1989
Gloucester 18	1989		
Gloucester 19	1989		
Gloucester 20	1989		
Gloucester 21	1990		
Gloucester 22	1991		

NEW YORK (New York Natural Heritage Program, 1990)	
Richmond	1892

NORTH CAROLINA (North Carolina Natural Heritage, 1990)			
Jackson	1987	Transylvania 1	1989
		Transylvania 2	1989
Henderson 1	1978	Transylvania 3	1989
Henderson 2	1988	Transylvania 4	1990
Henderson 3	1990		

SOUTH CAROLINA (South Carolina Heritage Trust, 1989)			
Greenville	1988		
VIRGINIA (Virginia Natural Heritage Program, 1990)			
Augusta 1	1965	Caroline 1	1990
Augusta 2	1975	Caroline 2	1991
Augusta 3	1988	Caroline 3	1991
Augusta 4	1988		
Augusta 5	1988	Henrico	1990
Augusta 9	1988		
Augusta 10	1988	Nelson	1990
Augusta 11	1988		
Augusta 12	1988		
Augusta 13	1988		
Augusta 14	1988		
Augusta 15	1988		
Augusta 16	1991		
Augusta 17	1991		
Augusta 18	1991		
Augusta 19	1991		

GEORGIA: One population is known from Georgia in Rabun County, approximately 100 meters from the North Carolina border. This site is privately owned; however, the State Heritage Inventory and The Nature Conservancy are working cooperatively to develop a monitoring scheme and management agreement with the landowner to ensure future site protection.

MARYLAND: All of Maryland's five extant sites and two historical sites are located in the coastal plain in Anne Arundel, Cecil, and Dorchester Counties (Rodney Bartgis, Maryland Natural Heritage Program, in litt. 1990). All extant sites are on private lands, although negotiations are underway between the Maryland Natural Heritage Program and individual landowners to secure site protection.

NEW JERSEY: With 139 total records and 71 occurrences confirmed since 1980, New Jersey supports over half the total world population of the species. Helonias is found in Morris, Middlesex, Ocean, Monmouth, Atlantic, Burlington, Salem, Cumberland, Camden, Gloucester, and Cape May Counties, and one historical record is known from Mercer County. In several of the southern counties (e.g., Camden and Cumberland), Helonias is locally frequent; in fact, Stone (1911) described Helonias as one of the most characteristic plants of southern New Jersey. Most of the sites are located in the Coastal Plain province along the Pinelands fringe in the Delaware River drainage. De novo searches in recent years have revealed several new populations; the majority of these are small and located next to other colonies, but some contain in excess of 1,000 individuals. Fourteen populations are on managed lands in public ownership (David Snyder, New Jersey Natural Heritage Program, in litt. 1991).

NEW YORK: Richmond County (Staten Island) once supported a population of the species near Rossville (Britton 1882). However, these records have not been reconfirmed since 1890 (Peter Zika, New York Natural Heritage Program, in litt. 1990).

NORTH CAROLINA: Eight sites, one of which may be extirpated, are found in Jackson, Henderson, and Transylvania Counties (Alan Weakley, North Carolina Natural Heritage, in litt. 1990). Several of these populations are located in the Pisgah National Forest within an area known as the Pink Beds. This important area includes one colony of over 100,000 rosettes, found in the summer of 1991. The species, considered stable in North Carolina, occupies all possible suitable habitat at several of the known sites; however, statewide searches for additional suitable habitat have not been conducted (Robert Sutter, The Nature Conservancy, North Carolina, pers. comm.).

SOUTH CAROLINA: One population is known from South Carolina, in Greenville County. This site is contained within a Heritage Preserve, which was acquired by the State in 1980, and is managed by the South Carolina Wildlife and Marine Resources Department.

VIRGINIA: Virginia has extensively searched the available suitable habitat for the species, and populations have been found in Augusta, Caroline, Henrico, and Nelson Counties. The species is probably stable in Virginia (Virginia Natural Heritage Program 1987). Eighteen of the state's 22 occurrences are located within a 10-mile radius of Sherando, on the western slope of the Blue Ridge Mountains (Christopher Ludwig, Virginia Natural Heritage Program, in litt. 1990). Four populations occur in the Coastal Plain; three of these are newly discovered populations that occur within 10 miles of each other in Caroline County. The Blue Ridge populations are grouped along two stream corridors, and had a total of 15,000 plants when counted in 1987 (Virginia Natural Heritage Program 1987). The majority of sites in Virginia are in public ownership: one is on National Park Service land at the Blue Ridge Parkway, 10 are located within the George Washington National Forest, two sites are on an army base (Fort AP Hill), and one is on state-owned land.

ECOLOGY AND LIFE HISTORY

Helonias bullata occurs in a variety of wetland habitats, including:

- swampy forested wetlands bordering meandering streams;
- headwater wetlands;
- sphagnous, hummocky, dense, Atlantic white cedar swamps;
- Blue Ridge swamps;
- meadows;
- bogs; and
- spring seepage areas.

The most evident factor determining the suitability of habitat for Helonias is a constant water supply. The groundwater-influenced wetlands supporting the species are perennially saturated and rarely, if ever, inundated by floodwaters (Rawinski and Cassin 1986). The water table is at or very near the surface and fluctuates only slightly during spring and summer months (Sutter 1982).

Participants at a meeting held on January 11, 1990 to discuss recovery needs for Helonias described general habitat conditions in the species' main range. In New Jersey, Helonias is found predominantly in headwaters of streams in the Delaware River watershed, primarily in red maple-dominated or Atlantic white cedar dominated swamps. These swamps have a mucky substrate and a variable canopy. Seepage is always present, with lateral ground-water movement. It was noted that there is more consistent dispersion of plants within Helonias populations in swamps, indicating the influence of water availability.

Delaware sites are characterized by the presence of Atlantic white cedar, and all known sites in the state are along streams, although this may only be because other habitat types have not been fully surveyed. Maryland populations along streams are associated not with overflow but with seepage pockets, and their soils tend toward acidic. Soils throughout Helonias' range were generally characterized as neutral to acidic. Water pH, vegetation associations, and canopy conditions were discussed as other possible habitat determinants.

Sutter (1982) described soils of North Carolina sites as having a very thin layer of decomposed organic matter (5-10 percent), underlain by a black to very dark gray silt loam that is slightly sticky, with many small roots and fine mica chips. He found the pH to be between 4.2 and 4.9 and the subsoil to be a mixture of sand, loam, and gravel.

Sutter (1982) also found that the canopy of North Carolina sites varied in density from 20-100 percent, possibly indicating that Helonias exhibits varying degrees of shade tolerance. He surmised (pers. comm.) that sites with minimal canopy are less vigorous due in part to competition from other species. In these same areas, browsing by deer was more prevalent and seed set was less successful.

As noted at the 1990 recovery meeting, there appears to be a strong correlation between the presence of conifer tree species (e.g., pitch pine, Atlantic white cedar, American larch, black spruce, and red spruce) and the occurrence of Helonias. Table 2 presents a list of these and other plant species associated with Helonias, compiled from field surveys and various other reports.

Helonias reproduces primarily through clonal rhizomal growth, with a limited degree of sexual reproduction. Due to the species' propensity to reproduce asexually and the resulting potential for limited genetic variability, the question arises as to what constitutes a "population" versus a "colony".

Rather than maintaining a uniform distribution, portions of populations are often extremely dense; for instance, Sutter (1982) reported densities of up to 56 plants (rosettes) per square meter in Southern Appalachian occurrences. The prevalence of clumping is also illustrated in the results of a multi-year study of the impacts of disturbance and development on six New Jersey populations (Peterson 1990). In measuring the difference between expected and actual spacing of Helonias rosettes, Peterson found actual spacing to be significantly closer than expected. This prevalence of clumping is likely the result of clonal rhizomal growth in which plants are most likely to spring up in close proximity to the parent plant. Observed plants also tended to have large neighbors, suggesting that the clonal integration of connected ramets allows physiological cooperation, rather than competition, among neighbors.

Table 2. Vegetation Associates of Helonias bullata.

Acer rubrum	red maple
Alnus serrulata	red alder
Aster puniceus	purple-stemmed aster
Aster radula	rough-leaved aster
Carex collinsii	Collins' sedge
Carex folliculata	long sedge
Carex muricata	lesser prickly sedge
Chamaecyparis thyoides	Atlantic white cedar
Clintonia borealis	yellow clintonia
Coptis trifolia	gold thread
Equisetum sylvaticum	equisetum
Ilex ambiqua	Carolina holly
Ilex verticillata	winterberry
Kalmia latifolia	mountain laurel
Larix lariciana	American larch
Lindera benzoin	spicebush
Lycopus virginicus	Virginia bugleweed
Magnolia virginiana	sweetbay magnolia
Nyssa sylvatica	black gum
Orontium aquaticum	golden club
Osmunda cinnamomea	cinnamon fern
Picea mariana	black spruce
Picea rubens	red spruce
Pinus rigida	pitch pine
Pinus strobus	Eastern white pine
Rhododendron arborescens	smooth azalea
Rosa palustris	swamp rose
Sambucus canadensis	elderberry
Sphagnum spp.	sphagnum moss
Symplocarpus foetidus	skunk cabbage
Tsuga canadensis	Eastern hemlock
Vaccinium cassinoides	witherod
Vaccinium constablei	mountain blueberry
Vaccinium corymbosum	highbush blueberry

Clumping may also be due to limited seed dispersal, in which Helonias seeds, due to their weight, tend to fall out of the capsule and land directly beneath the parent plant (except where the mother plant is particularly tall, enabling the seeds to disperse a short distance). Experiments (Sutter 1982) have shown that a strong wind is necessary for any significant seed dispersal. Under natural conditions, no seeds were found in seed

traps located farther than 20 cm from the nearest inflorescence. A 10-mile/hour wind was found to disperse seeds 30 cm, while a 20-mile/hour wind dispersed seeds up to 160 cm; however, it is unlikely that the species' forested wetland and mountain bog habitat would have winds strong enough to disperse seeds beyond 40 cm. In terms of alternative means of dispersal, the two appendages on Helonias seeds suggest that animals might serve as seed carriers. According to Peterson (1991 draft manuscript), Helonias seeds bear fatty appendages or eliasomes that are consumed by ants. Field studies by Peterson (1991 draft manuscript) revealed that seeds of Helonias bullata were removed significantly more quickly by ants compared to similarly-sized seeds of a control species. These fatty eliasomes also allow the seeds to float for long periods, suggesting that this species is at least occasionally water-dispersed.

Helonias is highly self-compatible (Sutter 1982, 1984). In experiments, Sutter found that 100 percent of flowers set seed in selfed treatments. Controlled experiments conducted by the Maryland Natural Heritage Program (Maddox 1990) and the New York Botanical Garden (Lisa Cady, New York Botanical Garden, pers. comm.) have also shown high seed set and germination. Sutter (1982, 1984) found naturally occurring self-pollination to be less efficient, with 77 percent of the flowers setting seed. Cross-pollination resulted in 89 percent of the flowers producing seed. Sutter reported eight seeds produced per carpel with an average of 24.67 seeds produced per flower.

Because seed set is so high, pollination does not represent a limiting factor in the species' existence. Beetles, black flies, and a variety of other insects have been observed at Helonias flowers, and self-pollination may be implicated.

Despite high seed set and germination, the number of seedlings that survive under experimental conditions is very low and the growth rate of plants is slow (Maddox 1990, L. Cady pers.

comm.). In natural settings, the low seedling survival rate may be attributed to several factors, including limited available suitable habitat, lack of physical space within the colony due to clumping, lack of seed dispersal, and other factors such as damping off. Sutter (1982, 1984) reported that seedling recruitment into the colony occurs mostly at the outer periphery where there is more available area for plants to disperse seeds and for the seeds to germinate. The low rate of seedling establishment reported from field observations appears to be a significant limitation to the potential colonization of new sites (Kathy McCarthy, Maryland Natural Heritage Program, in litt. 1991).

Seed survival also appears to be low. Maddox (1990) found that seeds sown immediately after collection had a 100 percent germination rate (although seedlings were short-lived) as compared to those planted four weeks later, which had no germination. The New York Botanical Garden (L. Cady pers. comm.) had similar results with sowed seeds. While this could mean that seeds are viable for only a brief period, leading to lack of a seed bank, it could alternatively be the case that seeds which do not germinate immediately go dormant. This is known to occur in some plant species. Also, there may be special storage conditions required for seeds to retain viability.

Notably, relatively few plants within a population produce flowers. Sutter (1982, 1984) estimated the rate of inflorescence production at sites in North Carolina to be between 0-6 percent of the plants in any given population. Maddox (1990) reports the proportion of flowering plants from three Maryland sites to be between 12-15 percent. The rate of flower production does not appear to differ greatly in the other states. Some populations are not known to produce any flowers, and others consistently produce flowers each year. Peterson (1990) has found that sizable differences exist among the six New Jersey sites he is studying in the proportion of rosettes that flowered in 1990.

Maddox (1990) suggests that there is no correlation between plant size, plant density, pH, soil moisture, and probability of flowering. The New York Botanical Garden (L. Cady pers. comm.) has observed a single plant that has flowered consistently for several years. Obviously, the factors affecting inflorescence production are not well understood, although it is likely that availability of water and the age of the plant play significant roles, as discussed during the 1990 recovery meeting.

THREATS

Helonias is threatened by habitat loss, fragmentation, and degradation; collection; trampling; and other biological and physical factors.

Over the years, cumulative habitat destruction resulting from development projects, draining and filling of wetlands, and timbering and clearing activities has significantly reduced the amount of available area for Helonias. As one example, many Southern Appalachian bogs have been destroyed by drainage and development, particularly for industrial sites and recreational resorts (e.g., golf courses) -- once destroyed, these bogs are impossible to re-create. With particular regard to the Pink Beds population in North Carolina, this area is currently threatened by plans to expand recreational development in the National Forest; further, one colony in this vicinity has already been seriously degraded by construction of trails and runoff from nearby roads (Rob Sutter, Southeast Office, The Nature Conservancy, pers. comm.).

With the enactment of the Federal Clean Water Act, along with state wetland laws and endangered species protection measures, direct habitat loss has been supplanted by secondary impacts resulting from off-site disturbances as the major threat

to Helonias. While some degree of direct habitat damage is still occurring (noting in particular an illegal 1990 wetland fill that severely degraded a high quality Helonias site in New Jersey), the destruction of wetlands that support Helonias populations and contain suitable habitat has slowed; however, upstream development continues to accelerate. Although definitive data do not currently exist, it is suspected that many extant and seemingly vigorous New Jersey populations are in the process of a slow decline due to, in several instances, the secondary impacts of development of areas surrounding these populations combined with the lack of adequate buffers (Thomas Hampton, New Jersey Natural Heritage Program, in litt. 1990).

While some legislation includes provisions for buffers of varying size around wetlands supporting endangered species (see Appendix C), these buffers may not provide adequate protection to ensure the continued survival of many Helonias populations. For instance, of the existing authorities that currently protect the species in New Jersey, only the Coastal Area Facility Review Act of 1973 (CAFRA) has the ability to require a sufficient buffer around Helonias populations "to insure continued survival of the species" (N.J.A.C. 7:7E-3.36). The New Jersey Pinelands Commission can require a maximum buffer of only 300 feet, while the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.), which regulates development of freshwater wetlands outside of the Pinelands, can require only a maximum buffer of 150 feet around wetlands that support populations of Helonias. At certain sites, buffers provide little more than a visual barrier from the effects of development. Residential and commercial projects have completely enclosed some colonies, creating isolated wetlands subject to various threats from the adjacent development.

Given that this species may require buffers in excess of 500 feet where site topography subjects a colony to habitat degradation (e.g., sedimentation and other changes in water quality) from upstream activities, existing standards for buffers

are clearly inadequate. In some cases, protection of the entire watershed may be needed.

Agriculture has contributed to the loss and degradation of suitable habitat through (1) off-site water withdrawal for irrigation or crop production, (2) drainage of wetlands for crop production, (3) conversion of wetlands for agricultural uses, e.g., cranberry production (Ted Gordon, Pine Barrens Inventory, pers. comm.), and (4) degradation of water quality by the influx of nutrients, sediment, and chemicals to the water. In the last instance, nutrient loading is thought to contribute to increased rates of succession and colonization by opportunistic species such as common reed (Phragmites communis), red maple (Acer rubrum), red alder (Alnus serrulata), and mountain laurel (Kalmia latifolia). Gordon (1989) described conditions at four historical Helonias colonies in New Jersey where soil from farm fields washed through wooded upland buffers into ravines, resulting in an invasion of aggressive weed species such as honeysuckle (Lonicera spp.), poison ivy (Rhus radicans), Virginia creeper (Parthenocissus quinquefolia), and ragweed (Ambrosia temisiifolia), choking out the original flora. Gordon (1989) also includes commercial, industrial and recreational development, housing, placement of fill, and ditching as probable causes of extirpation of populations in his New Jersey study.

Stream improvement for trout has destroyed at least one colony in North Carolina. Other off-site sources of habitat degradation include discharge from sewage treatment plants and other similar operation, as well as watershed perturbations such as siltation resulting from inadequate soil erosion control and modification of the hydrologic regime and/or frequency and duration of "normal" flood events in developed watersheds resulting from random stormwater discharge. Evidence suggests that in developed watersheds, particularly where stormwater is discharged through outfall structures, the frequency and duration of "normal" storm event flooding is altered, leading to adverse

impacts to wetlands from increased floodwater elevations, increased flow rates, and increased deposition of floatables and sediments (Laurance Torok, New Jersey Department of Environmental Protection, in litt. 1990). Helonias appears to be very slow, and perhaps unable, to recolonize openings in suitable habitat, making it susceptible to such perturbations (Virginia Natural Heritage Program 1987). This limited ability to colonize new sites underscores the need to protect existing sites.

Peterson's study (1990) lends credence to observations that off-site disturbances threaten the health and growth of Helonias plants. Three of the six New Jersey sites in his study are believed to have been subjected to habitat disturbance; the plants on these sites have fewer and smaller leaves. Repeated sampling over the next two years should reveal potential differences in mortality and flowering between the disturbed and undisturbed sites.

Plant collection remains a continuing problem. Traditionally, collection of this wildflower has been a common practice of both amateur and professional gardeners, scientific and other collectors (due to its unusual appearance), and curiosity seekers (U.S. Fish and Wildlife Service 1988). The plant is very conspicuous, particularly during the flowering season because it frequently blooms before other wildflowers and before growth of other herbaceous vegetation. In The Pine Barrens, John McPhee (1967) noted that "Pineys" collected swamp pink for sale in the cities. Wildflower and gardening field guides often point to Helonias as a beautiful plant, suitable for home gardens.

Some trade in the species is suspected and the plant is cultivated by a few private nurseries. The general trade prohibitions set forth by the Endangered Species Act of 1973, as amended, which apply to Helonias, make it illegal for any person to import or export the species, transport it in interstate or

foreign commerce in the course of commercial activity, sell or offer it for sale in interstate or foreign commerce, or remove the species from any area under Federal jurisdiction. Seeds from cultivated specimens of threatened plant species are exempt from these provisions, however, provided a statement of cultivated origin appears on their containers.

In addition to collection, foot traffic presents a problem at some sites. By altering hydrologic conditions, soil compaction probably represents a greater threat to the species than trampling of plants. This problem can be somewhat offset by constructing boardwalks; at a site in the George Washington National Forest, a boardwalk was constructed by the Forest Service to alleviate the trampling pressure on a site located there (Robert Glasgow, George Washington National Forest, pers. comm.). However, there is also a concentration of use along boardwalks that may lead to increased collection.

Herbivory could be a limiting factor at particular sites that are small in area or number of plants. Browsing of Helonias flowers, leaves, and new shoots by deer has been noted at many sites; Helonias is one of the earliest spring bloomers and may provide a food source when other herbaceous food is limited. (Rabbits may nip the flower stalks, but are not known to actually eat any portion of the plant.) Repeated browsing prevents plants from flowering. Sutter (1982, 1984), in his study of North Carolina plants, recorded between 70-100 percent of the inflorescences to be damaged in a survey of nine browsed populations. However, considering the limited area available for seed dispersal and the small percentage of seedlings that survive, as well as the plant's propensity for vegetative reproduction, herbivory is not considered to be a major threat to the species as a whole.

The possibility of gypsy moth defoliation, causing heavy tree mortality, may pose a potential threat to Helonias,

depending on how much sunlight the species can tolerate (R. Glasgow in litt. 1990). In North Carolina, oak decline is also creating openings in the canopy at some sites occupied by Helonias. Although this phenomenon is not of the same magnitude as gypsy moth defoliation, it is resulting in changes in understory composition in many places. The possible effects of defoliation and other canopy changes on Helonias are unknown at this time.

CONSERVATION MEASURES

Several conservation and recovery activities are underway, which will contribute to an understanding of Helonias' biology and assist in its recovery.

The most important step taken to date in regard to overall protection of Helonias sites is a public notice (CENAP-OP-R-Swamp Pink, dated January 25, 1990) issued by the U.S. Army Corps of Engineers (Philadelphia District) to potential users of nationwide permits in New Jersey and Delaware. ("Nationwide permit" refers to a type of general permit that authorizes activities upon a national basis unless specifically limited.) The public notice lists general locations of Helonias within these two states and stipulates that prospective applicants must ensure that nationwide permits are used consistently with the endangered species provisions of nationwide permit authorization (33 CFR Part 330.5(b)(3)). It should be noted that compliance with the Federal standard is principally self-regulating.

This public notice not only will aid in protection of Helonias colonies located in headwater wetlands, but is serving as a means of increasing general public awareness of the species. Since publication of the notice, the U.S. Fish and Wildlife

Service has received numerous inquiries from the public and the press about how to protect Helonias.

The New Jersey Department of Environmental Protection, Division of Coastal Resources, following the precedent set by the Corps of Engineers, is adopting a requirement (N.J.A.C. 7:7A-9.5(a)liii) for applicants to submit a statement of compliance with the Federal standard as part of the application process for statewide general permits.

Other means of protection via existing regulatory authorities are described in Appendix C. In addition to pursuing protection of known sites, historical and de novo site searches for Helonias populations are being conducted in New Jersey, Delaware, Virginia, and other states within the species' range.

A number of studies are underway. Supplemented by Section 6 funding from Region 5 of the U.S. Fish and Wildlife Service, the New Jersey Office of Natural Lands Management initiated the Helonias Impact Assessment project in 1990. This is a study of the impacts of disturbance and development on six Helonias populations in the state. Initial data has been collected and was made available in 1990. While this information is enlightening, the most valuable product of the study will be possible only after repeated censusing of these populations. Baseline conditions at the six sites have been established, and their improvement or decline is being monitored to determine the effects of nearby development on the subject populations. The Office of Natural Lands Management will also develop preserve designs for several sites.

In another study, the Maryland Natural Heritage program has been monitoring five sites since 1989 to: (1) obtain information on population size and trends; (2) assess growth, reproduction, and survival of several marked plants at three sites; (3) measure aspects of the environment that may contribute to an

understanding of distribution, growth, and mortality; and (4) experiment with propagating the plant from seed.

The New Jersey Audubon Society, in cooperation with the New Jersey Conservation Foundation and ANJEC, is conducting a study on the tributaries to the Delaware River as part of a three-year project. This project will result is a conservation plan for the Delaware River tributaries in the southern four counties of New Jersey (Gloucester, Salem, Cumberland, and Cape May).

As part of their overall program, the Center for Plant Conservation is maintaining many Helonias propagules in their National Collection, a source of plant material for research, conservation of rare and endangered plants in the wild, and germplasm storage. The New York Botanical Garden, a cooperator with the Center, has successfully cultivated the species. Observations of the plant have contributed to information on cultivation techniques, factors limiting germination and growth, and other biological characteristics, such as frequency and duration of flowering.

RECOVERY STRATEGY

Recovery of Helonias bullata is based on a strategy of reducing threats and introducing management as necessary to ensure the continued existence of all viable populations of the species. Helonias is currently known from 122 sites, although botanists regard several populations to be in irreversible decline. Because it has already undergone a significant reduction in population numbers and available habitat, the integrity of the species can be perpetuated only by maintaining current distribution patterns and genetic diversity.

Habitat protection is imperative for recovery of Helonias bullata. Preventing further loss or fragmentation of plant populations can be accomplished through an integrated strategy of site conservation and regulatory protection.

Site conservation may require, in some instances, significant time and funding, as it will involve protecting the habitat from loss or alteration caused by surrounding or upstream land and water use practices. Additional searches will be conducted (botanists are optimistic that new populations will be found), all viable sites will be identified, threats will be determined, and measures will be taken to fully secure these habitats. Priority will be given to sites that are highly ranked and/or imminently threatened.

During the recovery period, all Helonias sites will be afforded protection through enforcement of Endangered Species Act provisions and other existing regulatory authorities. In order to ensure long-term protection for all viable populations of the species and still enable its eventual delisting, efforts will be made to strengthen regulations protecting threatened and endangered plants at the state and local levels, as well as regulations protecting wetlands.

As necessary, management intervention, e.g., cultivation, colony (re)establishment and/or expansion, or habitat manipulation, will be pursued to ensure continued genetic diversity or stabilize struggling populations.

Information about the species and its recovery will be distributed to the public in an effort to alert people to the dangers of habitat degradation and plant collection. Both of these problems are preventable with public cooperation.

PART II: RECOVERY

RECOVERY OBJECTIVE

The objective of the recovery program is to delist Helonias bullata by ensuring long-term viability of populations throughout the species' current range. Helonias bullata will be considered for delisting when the following conditions are achieved:

Condition 1. Permanent habitat protection is secured for those occurrences that:

a. are ranked as "A" or "B" according to the quality specifications in Appendix B (which follow The Nature Conservancy's ranking system), or

b. are representative of the species' range-wide distribution, or

c. are representative of habitat or genetic diversity.

Approximately 35 populations occur wholly or partially on public lands at this time; out of these, approximately one-third are A or B-ranked. Another 45 populations on private lands meet one or more of the above criteria. These populations include the A and B-ranked sites on private lands in Delaware, Maryland, and New Jersey; additional sites in those states representing habitat diversity or range extension; populations on private lands in Virginia and North Carolina; and the Georgia population. As a preliminary quantitative objective, 80 sites must be permanently

protected to achieve condition 1. This figure is subject to change based on new information derived from genetic studies and additional searches.

Habitat will be considered permanently protected when: (1) adequate acreage is secured through acquisition or easement by government agencies or conservation organizations with primary responsibilities for resource protection; (2) sites on public lands are formally designated as protected areas; and (3) preserve designs and/or management stipulations, based on definitive research results, are in place for each site.

Condition 2. Regulatory protection is sufficiently strong at the Federal, state, and/or local levels to ensure continued range-wide conservation of viable populations and their habitat (including an adequate buffer zone) after the protection afforded by the Endangered Species Act is withdrawn.

Condition 3. As necessary, representative genotypes are established and maintained in cultivation at plant breeding facilities.

RECOVERY TASKS

1. Protect all known Helonias sites. The overriding recovery necessity for Helonias is habitat protection. Measures such as land acquisition and conservation easements will be considered as ways to fully secure the habitat of viable populations. All existing sites will be actively protected by obtaining landowner agreements whenever possible, conducting population monitoring, and enforcing protective regulations. Habitat on public lands should be designated as protected areas or otherwise be exempted from management and development activities that could disturb the species.

1.1 Develop protection strategies for all sites meeting condition 1 of the recovery objective.

1.11 Identify sites meeting the criteria listed in condition 1 of the recovery objective. The Element Occurrence Quality Specifications in Appendix B will be used to rank each known site, and a preliminary assessment of which sites represent either the distribution or diversity criteria under condition 1 will be made by state botanists. Site rankings will be refined when census techniques become standardized (Task 2.2) and when ecological/ genetic data (Tasks 2.1 and 2.3) become available.

1.12 Complete searches for additional sites. Undocumented populations, some of which could be rather large, are particularly threatened. For instance, in the past three years, sizeable populations have been discovered in New Jersey as a result of pre-development wetland investigations, when it is often too late to effectively protect them. Other large, previously unknown populations have been degraded or destroyed by wetland violations. It is very possible that additional viable populations still remain unidentified throughout the species' range. De novo searches for Helonias will be conducted in potential habitat areas throughout its range, and historical records for the species will be field checked. During the course of these searches, promising but unoccupied habitat will be delineated to the extent practicable. Each additional site will be assessed according to the criteria listed under condition 1.

1.13 Determine overall priorities for land protection. On a state-by-state and site-by-site basis, priorities for protection will be determined according to the degree and immediacy of threat as well as the biological significance of the site. Initial priorities will be based on best professional judgment, subject to modification as Tasks 2 and 3 are completed.

1.14 Develop an action plan outlining site-specific land protection strategies. A review of potential sources and methods of habitat protection (for example, review of applicable state and Federal programs and of private conservation organizations interested in this work) will be conducted. Methods for accomplishing watershed protection will be included in this review -- protection through zoning restrictions currently appears to be the best way to address this need.

An action plan for protecting the "essential habitat" of each site identified under Tasks 1.11 and 1.13 will then be developed. Initial determinations of essential habitat will be based on professional judgment; these definitions will be revised as warranted based on the results of Task 2.3. Emphasis will be given to innovative solutions for protecting broad watershed areas, and the plan will include methods of fully protecting habitat on public lands. Protection strategies may be amended as information from Tasks 2 and 3 becomes available.

1.2 Seek landowner cooperation for all sites on private lands. Cooperation from landowners is an extremely important facet of protection for sites located on

private lands, especially since the laws of most states within its range do not prohibit taking of Helonias from private property with landowner permission. Individual landowners will be contacted regarding the presence of Helonias on their property and the significance of this species. Attention will be focused on populations that meet condition 1, and on others as necessary and practicable. Management agreements and deed covenants will be established whenever possible to protect the natural attributes of the property from disturbance.

1.3 Implement habitat protection for the sites defined under Task 1.1. Resource agencies and conservation organizations will seek to protect lands supporting key populations on a "willing seller" basis, following the priorities outlined in Task 1.13 and using the techniques and strategies determined in Task 1.14.

1.4 Develop and maintain conservation plans for each site protected under Task 1.3. Site-specific conservation plans (or, in The Nature Conservancy's parlance, preserve designs) will be developed for all protected sites. Plans for sites on Federal and other public lands will be developed in cooperation with the administering agency, including plans for several Helonias populations currently located on Federal property under stewardship of the U.S. Forest Service, the National Park Service, and the U.S. Navy. Plan products will be brief but specific statements regarding protection agreements, management activities as defined in Task 4, and/or actions for long-term preservation.

1.5 Enforce regulations protecting the species and its wetland habitat. Federal, state, and local laws and

regulations that govern endangered and threatened species will be fully carried out. In addition, the enforcement capability of existing regulations will be strengthened where possible, and non-traditional avenues for endangered species protection that may benefit Helonias (through wetlands legislation, soil erosion control requirements, etc.) will be investigated. Extension of the Corps' public notice (CENAP-OP-R-Swamp Pink) to Maryland will be considered. Promulgation of new regulations and/or amendment of existing regulations, particularly in regard to buffer sizes and off-site sources of habitat degradation, will be sought.

Section 7 Endangered Species Act responsibilities will continue to be carried out to avoid direct and secondary impacts to populations or their essential habitat (which will be further defined in Tasks 2 and 3). Section 7(a)(1) of the Endangered Species Act, which directs Federal agencies to utilize their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation and recovery of listed species, will be emphasized.

2. Characterize extant colonies. Studies to determine genetic variability, population dynamics, and habitat characteristics at several Helonias populations will provide information regarding the species' biology, which will, in turn, aid in conservation efforts.

2.1 Conduct genetic research. Electrophoretic analyses of several populations will be conducted, primarily to investigate genetic variability. Because the species is self-compatible and largely reproduces vegetatively, it may be that the bulk of genetic diversity is found between rather than within populations (NJ Natural

Heritage Program in litt. 1990). Genetic studies will be designed to sample populations in different physiographic provinces and habitat types throughout the species' range. If results show that some provinces or habitat types contain populations with unique genetic components, the information will be used to maximize preservation of genetic diversity in selecting sites for land protection. Results will also be used to refine the definitions of "colony" and "population", and to help in delimiting genetic individuals. Genetic research may help determine the overall extent of clonal reproduction and whether sexual recruitment is a subject for future investigation.

Pending electrophoretic studies, observable differences in plants (which indicate genetic variability), such as vegetative morphology, difference in flowering times, etc., will be recorded.

2.2 Investigate population dynamics.

2.21 Develop rangewide consistency in monitoring methods. A uniform method of delineating colonies and populations, as well as a standard means of estimating colony and population sizes, will be developed in detail. Appendix A provides preliminary guidance in determining what constitutes a population, and suggests parameters that may be considered in monitoring sites, but the question of how to most accurately and efficiently count plants (by rosettes or clumps) must be resolved; methods of counting currently differ significantly between the northern and southern portions of the range.

2.22 Apply this standard method when conducting monitoring activities. This methodology will then be followed in monitoring population sizes and demographic trends at a representative number of sites within each state to estimate population vigor and viability. Population records, and possibly numerical recovery targets, will be revised as indicated by the results of genetic research and other studies.

2.3 Determine habitat characteristics and define essential habitat. On selected sites, data will be gathered on specific habitat requirements of Helonias, including data on seasonal water requirements (quantity, quality, temperature), soil characteristics (type, nutrient content, moisture, temperature, pH), and percent canopy closure. This information will then be analyzed to determine significant habitat parameters for the species.

Based on these habitat parameters, a definition of what constitutes essential habitat for ensuring continued survival and reproduction of individual populations will be developed, and maps delineating essential habitat will be produced. This information will be used as an added tool for determining long-term protection needs as described in Task 1.

3. Eliminate, to the fullest extent possible, on- and off-site threats to viable populations. The success of eliminating threats to currently or potentially viable populations will be contingent on the ability of resource experts and land managers to assess the potential for impact of diverse disturbances on populations and to adequately buffer essential habitats from significant threats.

3.1 Monitor threats. Current disturbances and potential threats to extant Helonias sites will be documented. Possible threats include habitat loss, habitat degradation (from succession, water withdrawal, sediment deposition, changes in water quality or quantity, etc.), trampling, collection, dumping, and disturbance due to off-road and other forms of recreational vehicles. The magnitude and immediacy of these threats will be evaluated on a site-specific basis.

3.2 Assess short and long-term effects of on and off-site disturbances. The primary and secondary effects resulting from current disturbances as identified in Task 3.1 will be investigated. The effects of adjacent disturbances will be investigated at several sites. Areas with varying degrees and types of disturbance will be studied as well as sites at different distances from the source of disturbance. Results from the multi-year New Jersey Helonias Impact Assessment project will provide a foundation for further assessment.

3.3 Determine buffers. Ensuring the continued viability of existing populations will require prevention of both on and off-site disturbances; establishment and regulation of minimum buffer areas is extremely important in protecting the species and its essential habitat. Information from Task 2.3 will provide the basis for determining minimum standards for buffer areas, as well as identifying broader protection needs for specific sites. If current buffer standards are shown to be inadequate, efforts will be made to amend regulatory mechanisms. As needed, protection of entire watersheds upstream from a population will be considered to guard against impacts from sedimentation and other changes in

water quality. When minimum buffer standards have been defined, regulatory agencies will be strongly encouraged to require this buffer size around populations if legally possible.

4. Identify and, as needed, implement management techniques for improving habitat quality or increasing population size/vigor. Known techniques (such as cultivation, clearing of competing vegetation) will be considered and incorporated as appropriate into the conservation plans developed in Task 1.4. These techniques will then be refined and/or added to as warranted by the results of Tasks 2 and 3. Consideration will be given to the benefits and risks of re-establishing colonies on historical sites, establishing new colonies in areas identified as potential habitat, and expansion of existing colonies. The effects of implementing active management will be carefully monitored.

5. As needed, preserve representative genotypes through plant cultivation. If the results of Task 2.1, 2.2, and 3.1 indicate a need, plants from marginal or highly threatened genotypes will be cultivated in qualified plant breeding facilities. Further, if shown to be technically feasible, the possibility of storing Helonias seed and/or plant tissue by cryopreservation will be considered. This would be followed by, as needed, breaking seed dormancy in the laboratory and/or using tissue culture as a method of replicating plants.

6. Provide public information and education. As Helonias is an attractive plant with considerable value to collectors, the means by which public information and education is achieved is a critical component of recovery. Outreach opportunities for educating concerned parties and the general public about the species will be identified, and appropriate informational materials will be developed. For instance, a

color brochure that describes Helonias and the threats to its survival will be developed to increase public awareness and to aid in soliciting the cooperation of landowners and developers regarding site protection. While focusing on Helonias, this type of brochure can also be used to increase general awareness of endangered and threatened plants.

Other opportunities that will be capitalized upon include displays for visitor centers at public recreational areas such as National Forests, National Parks, and various state lands; popular articles exposing the general public to the species and issues of managing endangered and threatened plant species; and visual media that could be presented in conjunction with school and civic programs.

7. Review recovery progress and revise plan as necessary. Progress towards recovery will be reviewed on an annual basis, and this plan will be updated and revised as needed.

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Note: "in litt." references refer to information received through correspondence, following style guidelines in the Endangered Species Listing Handbook, U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation, January 1989.

PART III: IMPLEMENTATION

The Implementation Schedule lists and ranks tasks that should be undertaken within the next three years in order to implement recovery of Helonias bullata. This schedule will be reviewed annually until the recovery objective is met, and priorities and tasks will be subject to revision. Tasks are presented in order of priority.

Key to Priority Designations in Column 1

Task priorities are set according to the following standards:

Priority 1: Those actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: Those actions that must be taken to prevent a significant decline in species population, or some other significant impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the species.

Key to Agency Designations in Column 5

USFWS = U.S. Fish and Wildlife Service

R5 FWE = USFWS Region 5, Fish and Wildlife Enhancement

FA = Other Federal agencies, including the U.S. Forest Service, National Park Service and U.S. Navy

SA = State Natural Heritage Programs and natural resource agencies

CO = Conservation organizations such as The Nature Conservancy

PI = Private institutions such as universities and horticultural facilities

IMPLEMENTATION SCHEDULE

Helonias bullata

September 1991

Priority	Task Description	Task Number	Duration	Responsible Agency		Cost Estimates, $000			Comments
				USFWS	Other	FY1	FY2	FY3	
1	Identify sites meeting criteria for permanent protection.	1.11	1 year	R5 FWE	SA				Partially completed.
1	Monitor threats to extant sites.	3.1	Ongoing		FA,SA, CO	3	3	3	+ 3,000/yr for 7 more years = total cost of $30,000. Done in conjunction with Task 1.5.
2	Complete searches for additional sites.	1.12	3 years		SA	25	15	10	
2	Determine land protection priorities.	1.13	1 year	R5 FWE	SA		1		
2	Develop an action plan outlining land protection strategies.	1.14	2 years	R5 FWE	SA, CO		1	1	
2	Seek cooperation of landowners.	1.2	Ongoing		SA, CO	2	2	2	+ $2,000/yr for 7 more years = total cost of $20,000
2	Implement habitat protection.	1.3	10 years	R5 FWE	SA, CO				Total cost very roughly estimated at $25 million
2	Develop and maintain site-specific conservation plans.	1.4	3 years	R5 FWE	FA, SA, CO	2	2	2	
2	Enforce regulations protecting the species and its wetland habitat.	1.5	Ongoing	R5 FWE	FA, SA	10	10	10	+ $10,000/yr for 7 more years = total cost of $100,000
2	Conduct genetic research.	2.1	2 years		CO, PI	5	5		
2	Investigate population dynamics, using a standard method.	2.2	5 years		SA, FA	3	3	3	+3,000/yr for 2 more years = total cost of $15,000.

Helonias bullata Implementation Schedule, continued. September 1991

Priority	Task Description	Task Number	Duration	Responsible Agency		Cost Estimates, $000			Comments
				USFWS	Other	FY1	FY2	FY3	
2	Determine habitat characteristics and define essential habitat.	2.3	5 years		SA	5	5	7	+ $7,000/yr for 2 more years = total cost of $31,000.
2	Assess effects of on- and off-site disturbances.	3.2	3 years		SA	7	7	7	
2	Determine buffers.	3.3	1 year		SA			12	
2	Identify and, as needed, implement management techniques.	4.	Ongoing		SA, FA	5	10	10	+ $10,000/yr for 5 more years, then $5,000/yr for 2 years = total cost of $85,000.
2	Provide public information and education.	6.	Ongoing	R5 FWE	SA	10	10	10	+ $6,000/yr for 7 more years = total cost of $72,000
3	If needed, preserve representative genotypes through plant cultivation.	5.	5 years		SA, PI			2	+ $1,000/yr for 4 more years = total cost of $6,000, if this task is shown to be necessary.
3	Review recovery progress and revise plan as necessary.	7.	Ongoing	R5 FWE					No funding associated with this task.

APPENDIX A

Preliminary Guidelines for Population Monitoring

DEFINITIONS:

COLONY: A discrete unit of plants separated from other colonies by a physical boundary (road, unsuitable habitat, development, etc.).

POPULATION: One or more colonies. In the absence of genetic analysis a population can be described as those plants occupying a given geographic area or watershed.

ESTIMATING COLONY/POPULATION SIZE:

Count individual plants by obviously or evidently clumped rosettes.
Estimate density (individual plants) per square meter (yard).
Estimate total occupied area in hectares (acres).
(Note whether plants tend to be clumped, single, mixed, or patched.)

MONITORING COLONY/POPULATION DYNAMICS:

Specify number of seedlings, juveniles, flowering adults, non-flowering adults, percent flowering plants.
(Counts should be taken in late spring, noting that more than one cohort of plants may be present.)

RECORDING HABITAT PARAMETERS:

Measurements of pH, soils (series, moisture, composition, nutrients, temperature), depth of the water table, temperature of water table, vegetative associates, and percent canopy.

NOTE: In North Carolina and South Carolina, current standard procedure is to count individual rosettes even though they are often connected by rhizomes. Botanists in these states have found this to be a more practical and accurately replicated technique.

APPENDIX C

AVAILABLE REGULATORY AUTHORITIES

FEDERAL AUTHORITIES

Endangered Species Act of 1973
(87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.)

Prohibits import and export; removal, damage and possession of listed species from lands under Federal jurisdiction; removal, damage, etc. in violation of any state law or regulation; transport in course of commercial activity; or sale of the species. Requires Federal agencies to ensure that their actions do not jeopardize the continued existence of listed species or result in adverse modification of critical habitat. Requires consultation with the U.S. Fish and Wildlife Service when an activity may affect listed species or critical habitat. Directs Federal agencies to utilize their authorities in furtherance of the purposes of the Act by carrying out conservation and recovery activities for listed species.

Clean Water Act of 1977
(86 Stat. 884, 33 U.S.C. 1344)

Regulates the discharge of dredged or fill material and effluents in waters (including wetlands) of the United States. The 1987 amendments (Water Quality Act of 1987) regulate industrial and municipal stormwater discharges to protect water quality in waters of the United States.

Regulations Protecting Proposed, Listed Endangered or Threatened Species on National Forests

Helonias has been listed as "sensitive" on the George Washington National Forest for many years, and has received protection under FSM 2670.44 R-8 supp 37 (4/81). Since its listing as threatened, it now qualifies as a Forest Service PET species, and as such should receive a level of protection that will lead to identification of possible recovery opportunities and ensure that no adverse effects occur.

STATE AUTHORITIES

Georgia Wildflower Preservation Act of 1973
(43:43-1801 to 43-1806)

Prohibits taking of State listed plants from public lands without permit from the Georgia Department of Natural Resources. Prohibits sale and transport of listed species without landowner's written permission.

Maryland Nongame and Endangered Species Conservation Act

Prohibits taking from private land without written landowner permission, taking without a permit from State land, and prohibits trade and possession of listed species. Provides for development of programs for the conservation of listed species.

Maryland Nontidal Wetlands Protection Act
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Regulates activities within nontidal wetlands as of January 1, 1991. Agricultural and most forestry activities are not regulated by permit, but are required to follow best management practices. Documented Helonias habitats are designated as Wetlands of Special State Concern and are provided a 100-foot upland buffer from activities unrelated to forestry or agriculture. Forestry activities are prohibited within a limited zone around a Helonias population.

(New Jersey) Pinelands Protection Act of 1979
(N.J.S.A. 13:18-1 et seq.)

Prohibits development in wetlands within the boundaries of the Pinelands National Reserve (New Jersey). Affords 300-foot buffer to wetlands supporting endangered and threatened species.

(New Jersey) Freshwater Wetlands Protection Act
(N.J.S.A. 13:19B-1 et seq.)

Regulates activities in and adjacent to freshwater wetlands of New Jersey. Regulated activities must not jeopardize a threatened or endangered species or local population or jeopardize or adversely modify their present or documented habitat. Only habitats that support plants listed by the Federal government as endangered or threatened are regulated under this statute. Present or documented habitats are classified as being of exceptional resource value and require a buffer of 75 to 150 feet adjacent to the wetland.

(New Jersey) Coastal Area Facility Review Act of 1973
(N.J.S.A. 13:19-1 et seq.)

Regulates development in designated coastal region of New Jersey. Development of endangered or threatened species habitat is prohibited unless it can be demonstrated that endangered or threatened species habitat would not directly or through secondary impacts be adversely affected. The area regulated includes sufficient buffer to ensure the continued survival of the species.

New Jersey Endangered Plant Species List Act
(N.J.S.A. 13:1B-15.151 to 13:1B-15.158)

Establishes a list of endangered plant species to be utilized by the State's regulatory agencies.

New Jersey Soil Erosion and Sediment Control Act of 1975
(N.J.S.A. 4:24-39)

Stipulates that all land disturbance activities require implementation of control measures for soil erosion and sedimentation.

New Jersey Flood Hazard Area Regulations

Regulates development within the 100-year floodplain in New Jersey. Projects which have the potential to adversely affect endangered species habitat in streams, wetlands, or through the deposition of dredge spoil are considered to be of special concern.

North Carolina Plant Protection and Conservation Act
(General Statute 19B (202.12-202.19)

Protects listed species by prohibiting taking without written landowner permission, intrastate trade (without a permit), and provides for management and monitoring activities.

South Carolina legal protection

All plants on South Carolina heritage preserves have legal protection. No one may collect swamp pink or any other plant without a State permit.

Virginia Endangered Plant and Insect Species Act of 1979.
(Code of Virginia 39:3.1-1020 to 31-030)

Prohibits taking and trade of listed species without a permit.

APPENDIX B

Proposed Helonias bullata Element Occurrence Quality Specifications

The following specifications were developed by David Snyder of the New Jersey Natural Heritage Program, following The Nature Conservancy protocol.

"A" RANKING

Habitat: Pristine or near pristine wetland complexes with no or minimal hydrological impacts and stable conditions. No management necessary to maintain long-term viability. No ditching, agricultural or residential runoff, artificial manipulation of water table, and no evidence of siltation. No logging or clearing of forest canopy. Aggressive exotic plant species none or easily controlled. Upstream or surrounding land in sufficient wooded or other buffer long-term viability.

Population Size and Vigor: 1,000 or more individual clumps (each clump typically consists of one to several rosettes) occupying 2 or more acres (either scattered or essentially throughout).

Exemplary Occurrence: Pristine or near pristine habitat of 50 or more acres with population of 5,000 or more clumps.

"B" RANKING

Habitat: Habitat in near pristine condition with only minor impacts or disturbances, none of which are directly impacting long-term viability of population or essential habitat. Site may have trails or be bisected by road. May be adjacent to agricultural or cleared lands, but no direct impacts observable. Minor or localized siltation, but not directly impacting population. Evidence of clearing or logging but not in immediate area of population. Exotics present but not harming population. All impacts can be mitigated with minimal effort and expense. Reasonable amount of wooded or other buffer in upstream or adjacent areas to ensure long-term viability.

Population Size and Vigor: 500 or greater clumps occupying less than 2 acres. Populations of 200-500 in A-ranked habitat.

"C" RANKING

Habitat: Habitat significantly disturbed and fragmented with declining conditions. Site often located in urban or high-density residential areas. Portions of habitat ditched, dammed, or cleared in areas occupied by plants. Remaining buffer less than optimal. Population recoverable with substantial effort or expense.

Population Size and Vigor: 100 to 499 clumps, regardless of acreage occupied. Some plants may show signs of reduced vigor. Populations of 50-199 in A or B-ranked habitat.

"D" RANKING

Habitat: Heavily, and possibly irreversibly, disturbed. Hydrological impacts significant and directly impacting population. Siltation severe and ongoing. Little or no remaining buffer. Population with little or no potential for recovery.

Population Size and Vigor: Any population regardless of numbers or size. Populations of obvious reduced vigor, often consisting entirely of few or widely scattered single rosettes, lacking the characteristic clumps of healthy populations. Populations of less than 50 plants in A, B, or C-ranked habitat.

APPENDIX D

LIST OF REVIEWERS

The following organizations and individuals reviewed and/or participated in the development of the Helonias bullata Recovery Plan. Comments were incorporated into the final plan as appropriate.

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