New England Plant Conservation Program
Conservation and Research Plan

Eriocaulon parkeri Robinson
Parker's Pipewort

Prepared by:
Arthur Haines
Woodlot Alternatives, Inc.

For:

New England Wild Flower Society
180 Hemenway Road
Framingham, MA 01701
508/877-7630
e-mail: conserve@newfs.org ! website: www.newfs.org

Approved, Regional Advisory Council, 2000

SUMMARY

Parker's pipewort, *Eriocaulon parkeri* Robinson (Eriocaulaceae), is a small, aquatic herb of fresh to brackish tidal river shores. It frequently occurs on firm mudflats and is associated with common three-square (*Schoenoplectus pungens*), annual wildrice (*Zizania aquatica*), common water-purslane (*Ludwigia palustris*), and Eaton's beggar ticks (*Bidens eatonii*) in New England. This species has been documented from 53 stations in New England, with occurrences in Maine, Massachusetts, and Connecticut. This number includes four new stations identified through literature review and biologist interview. Maine possesses approximately 31 of New England's 40 extant populations. The majority of these sites found on the shores of Merrymeeting Bay and its tributaries. Parker's pipewort has occurred in seven locations in Massachusetts. Three historical sites are in the Merrimac River watershed in the greater Newburyport area. Connecticut populations have displayed the most significant declines in New England. Of the 12 known stations for Parker's pipewort, plants have been observed at only five sites in the last ten years. Throughout New England, most historical sites are located in urban areas. Habitat loss due to shoreline development and pollution are the most likely threats to this species.

The primary conservation objectives for Parker's pipewort are to study, protect, and maintain both the species and the associated natural communities. Maintaining current state ranks of Parker's pipewort (ME S3, MA S1, CT S1S2) will be utilized as determining the success of this Conservation Plan. Detailed field surveys, demographic study, critical habitat determination, plant reintroduction, long-term protection, land owner contact, reproductive biology study, and habitat improvement will be utilized to meet the overall conservation objective. Most of these activities will occur in all three states in order to fully document the life history and requirements of this species. Demographic study, in concert with critical habitat determination, is currently being performed in Connecticut. This study is pivotal to Parker's pipewort. It is recommended that the study methodology be expanded to include all New England states, additional years of monitoring, and variables that might indicate degree of habitat degradation. Plant reintroduction, though not critical from a New England perspective, is recommended in Connecticut to reverse the significant population declines observed there. Extant populations in the Connecticut River Estuary and Tidal Wetlands Complex will be used as source sites for plants and fruits necessary for this effort.

PREFACE

This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Full plans with complete and sensitive information are made available to conservation organizations, government agencies and individuals with responsibility for rare plant conservation. This excerpt contains general information on the species biology, ecology, and distribution of rare plant species in New England.

NEPCoP is a voluntary association of private organizations and government agencies in each of the six states of New England, interested in working together to protect from extirpation, and promote the recovery of the endangered flora of the region.

In 1996, NEPCoP published *Flora Conservanda*: New England, which listed the plants in need of conservation in the region. NEPCoP regional plant Conservation Plans recommend actions that should lead to the conservation of Flora Conservanda species. These recommendations derive from a voluntary collaboration of planning partners, and their implementation is contingent on the commitment of federal, state, local, and private conservation organizations.

NEPCoP Conservation Plans do not necessarily represent the official position or approval of all state task forces or NEPCoP member organizations; they do, however, represent a consensus of NEPCoP's Regional Advisory Council. NEPCoP Conservation Plans are subject to modification as dictated by new findings, changes in species status, and the accomplishment of conservation actions.

Completion of the NEPCoP Conservation and Research Plans was made possible by generous funding from an anonymous source, and data were provided by state Natural Heritage Programs. NEPCoP gratefully acknowledges the permission and cooperation of many private and public landowners who granted access to their land for plant monitoring and data collection. If you require additional information on the distribution of this rare plant species in your town, please contact your state's Natural Heritage Program.

This document should be cited as follows:

Haines, A. 2001. *Eriocaulon parkeri* (Parker's Pipewort) Conservation and Research Plan. New England Plant Conservation Program, Framingham, Massachusetts, USA (http://www.newfs.org).

I. BACKGROUND

INTRODUCTION

Parker's pipewort (*Eriocaulon parkeri*) is a diminutive, acaulescent, aquatic herb of the Eriocaulaceae (pipewort family). It occurs on tidal river shores and deltas of the east coast United States and Quebec. This species frequently occurs in vegetative state, as a small, dense rosette of thin, pliant leaves.

In New England, Parker's pipewort possesses state ranks of S1 to S3, depending on the state. Globally, it is ranked G3 (globally vulnerable) and is considered rare, local, and as possessing attributes that make it vulnerable to extinction (Brumback and Mehrhoff *et al.* 1996). Demonstrated population declines have occurred in most states and provinces where it occurs, particularly in the southern part of its range. It is primarily threatened by shoreline development and pollution.

This Conservation Plan summarizes existing information on the ecology, taxonomy, and conservation biology of Parker's pipewort. Included are threats to its survival and recommended actions for study and conservation of this species in New England.

DESCRIPTION

Parker's pipewort is a small, aquatic herb that lacks aerial vegetative stems. Though described as a perennial (Kral 2000), aquarium-grown individuals do not live for more than one year (Bill Brumback, New England Wild Flower Society, *personal communication*). It possesses a dense rosette of thin, pliant leaves 1.0–6.0 cm long that are spongy with aerenchyma tissue near the base. The leaves have several longitudinal nerves with numerous cross-veinlets, creating a reticulate pattern. The plant is anchored to the substrate by a system of white, fibrous, un-branched, cross-septate roots. The leafless flowering stems, commonly referred to as scapes, are 1.0–20.0 cm tall and 1–4 are produced from each rosette. Each stem has 4 or 5 longitudinal ridges. At the apex of the stem is a small (3.0–4.0 mm wide) capitulum (or head) comprised of tiny, unisexual flowers. The hemispherical capitulum is subtended by a series of non-reflexed bracts collectively called an involucre. As well, each flower of the capitulum is subtended by a small, receptacular bract. The flowers are dimerous, and therefore possess two sepals and two petals, both of which are diminutive and not easily seen without magnification. The petals have a nectary gland just below the apex. The receptacular bracts, sepals, and petals may bear a few, short, white hairs that are distinctly widened near tip (referred to as clavate-shaped). Staminate flowers (*i.e.*, pollen-bearing) have four stamens borne on a short stalk called an androphore. Carpellate flowers (*i.e.*, ovule-

bearing) have a single, bilocular ovary borne on a comparable short stalk, called a gynophore. The fruit is a small, loculicidal capsule, each bearing two minute, mostly ellipsoid seeds.

Only one other species of *Eriocaulon* occurs in New England. The seven-angled pipewort (*Eriocaulon aquaticum*) is readily separated from Parker's pipewort on the basis of morphology and habitat. In most respects, seven-angled pipewort is larger than Parker's pipewort, with 5–7 ridged flowering stems produced singly from each rosette. The subglobose capitula are 4.0–6.0 mm wide, subtended by reflexed bracts that appear white or gray-white (rather than gray or yellow-brown in Parker's pipewort) due to the abundance of white, clavate hairs on the receptacular bracts, sepals, and petals. Seven-angled pipewort is a species of fresh water lakes and slow-moving rivers, rather than fresh to brackish tidal rivers and estuaries as in Parker's pipewort.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Parker's pipewort was formally described as a new species by Robison (1903) from the Delaware River in New Jersey. Since that time, little change in recognition has occurred. All major works that include the Eriocaulaceae from eastern United States and adjacent Canada have maintained Parker's pipewort as distinct from the more common and wider ranging seven-angled pipewort (Moldenke 1937, Muenscher 1944, Fernald 1950, Kral 1964, Hinds 1986, Gleason and Cronquist 1991, Kral 2000). Fasset (1931) had reservations recognizing Parker's pipewort due to similarities with seven-angled pipewort when stranded on muddy shores. Only Boivin and Cayouette (as listed in Hinds 1986) changed the status of Parker's pipewort to that of a variety under seven-angled pipewort (as *Eriocaulon septangulare* var. *parkeri*). Support for recognition of Parker's pipewort was presented for morphology by Fernald (1941) and chromosome number by Löve and Löve (1958).

SPECIES BIOLOGY

Parker's pipewort is monoecious. It possesses separate staminate and carpellate flowers within the same inflorescence. Pollination in the Eriocaulaceae is described as automogous (self-pollinated) or entomophilous (insect-pollinated) by Cook (1996) and as anemophilous (wind-pollinated) or entomophilous by Gleason and Cronquist (1991). Ruhland (1930) infers that entomophyly is the likely method of pollination due to the presence of nectaries, attractive infloresence, and protandrous flowers. Specific observations in Parker's pipewort have not been made. According to Fernald (1950), sexual reproduction occurs from July to October. Its minute seeds, estimated at 7.7 million per kg (Muenscher 1944), are produced in late summer and fall and are likely dispersed by waterfowl (Cook 1996).

Pipeworts are food for various waterfowl species (Mabbott 1920, McAtee 1918), such as black ducks, wood ducks, and baldpates. It is not known if these species feed

specifically on Parker's pipewort.

Populations appear to be extremely variable from year to year. Dramatic differences in both number and location of plants can occur over periods as little as three years. These observations suggest annual habit or strong relationship with environmental variables.

HABITAT/ECOLOGY

Parker's pipewort is a species of fresh to brackish tidal river shores. It is typically found on wet muck of open mudflats and tidal marshes where sediment accretion and erosion are in balance (Morse and Ogle 1997). Though normally found on firm, fine particle mud, Parker's pipewort sometimes occurs on silt-covered gravel, cobble, and ledge influenced by tidal action. Its position in tidal communities ranges from intertidal to just above high tide. At most localities, plants are submerged during high tide. Elevation of sites ranges from 2 to 3 meters above mean sea level. Water salinity of most sites can be characterized as fresh (less than 0.5 parts per thousand) or oligohaline (0.5–5.0 parts per thousand). In the northern portion of its United States range (*i.e.*, Maine), Parker's pipewort is associated with common three-square, annual wildrice, common water-purslane, estuary beggar ticks, Eaton's beggar ticks, and Atlantic mudwort. Closer to the center of its United States distribution (*i.e.*, southern New England), Parker's pipewort is associated with annual wild rice, common water-purslane, common arrowhead, pickerel weed, Eaton's beggar ticks, pygmy weed, golden club, and arrowleaf.

THREATS TO TAXON

Changes in hydrology

Hydrologic changes result from structures or activities that influence water level or alter tidal flows. Since Parker's pipewort is normally exposed during low tide, permanent inundation is likely detrimental. Inundation can be caused by hydroelectric projects or beavers (as in one case in Connecticut). The latter case would be restricted to small, tributaries of tidal rivers. Hydrologic changes can also result from tide gates. These structures allow downstream river flow but block upstream tidal flow. Tide gates alter hydrology by eliminating daily cycles of temporary inundation. They potentially change upstream salinity, resulting in freshwater wetlands above the gate. Hydrologic changes that affect local sediment dynamics are important threats to Parker's pipewort.

Dredging

Channel dredging is considered a prime threat to Parker's pipewort by Dowhan and

Craig (1976). It has the potential to affect critical habitat in several ways, depending on site and project details. Dredging occurs either from shoreline machinery or from in-stream barges. Shoreline machinery, despite precautions, affects shoreline vegetation through removal (for work space), compaction, and direct loss of habitat if spoils are stockpiled on site. Channel dredging can affect shoreline stability, cause erosion and bank slumping, and eliminate habitat for fresh water tidal species. Dredging can also alter stream flow mechanics and accelerate silt accretion or erosion.

Loss of habitat

Habitat loss can occur through several processes. Inundation, dredging, pollution, and shoreline development have the potential to degrade or eliminate habitat for this species. Pier and dock construction may negatively affect Parker's pipewort through direct shading of plants, disturbances related to docks, and toxic effects (Les 1999, Murphy and Eaton 1983). Shading of plants by docks is dependent on size, height, and orientation of the structure. Disturbances related to docks include construction and use activities (*e.g.*, excavation for pilings, sediment disturbance due to outboard engines). Toxic effects are related to changes in water and sediment quality due to leachates and fuel spillage.

Changes in Sediment Dynamics

Sediment accretion and erosion in coastal rivers are influenced, in part, by weather and anthropogenic impacts. Excessive erosion due to shoreline slumping following dredging activities or increased sediment accretion due to slowing of stream velocity may have negative affects on Parker's pipewort. Morse and Ogle (1997) consider this rare aquatic to favor areas where sediment accretion and erosion are in balance.

DISTRIBUTION AND STATUS

General status

Parker's pipewort is endemic to tidal rivers and estuaries of the east coast. Its geographic range is disjunct—Canadian and American populations are well-separated. In Canada, it occurs in the Ottawa River and Saint Lawrence River estuaries of Quebec and the Miramichi River estuary of New Brunswick. In the United States it occurs from Maine south to North Carolina (Kral 2000), with the exception of New Hampshire and Rhode Island (no documented occurrences in either state) and New York, Pennsylvania, and District of Columbia (no extant occurrences in either state or district). The North American distributions of Parker's pipewort are presented in Figure 1, and the New England distributions are shown in Figures 2 and 3 on the following pages.

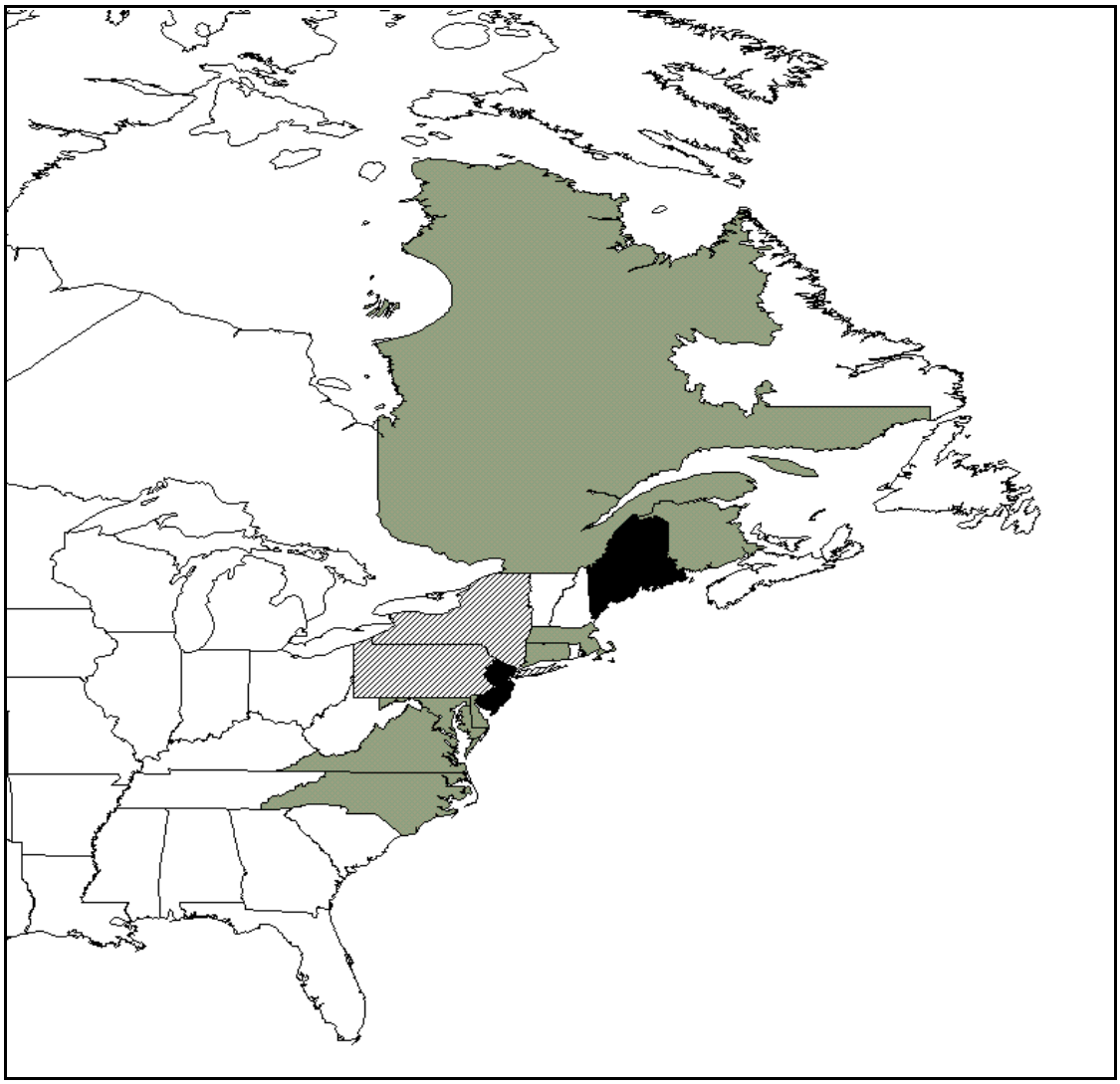

Figure 1. Occurrences of *Eriocaulon parkeri* in North America. Shaded states and provinces have 1-5 extant occurrences, while those shaded in black have more than 5 extant occurrences. States and provinces with diagonal hatching are designated "historic" or "presumed extirpated" (see Table 1 below), where *Eriocaulon parkeri* no longer occurs.

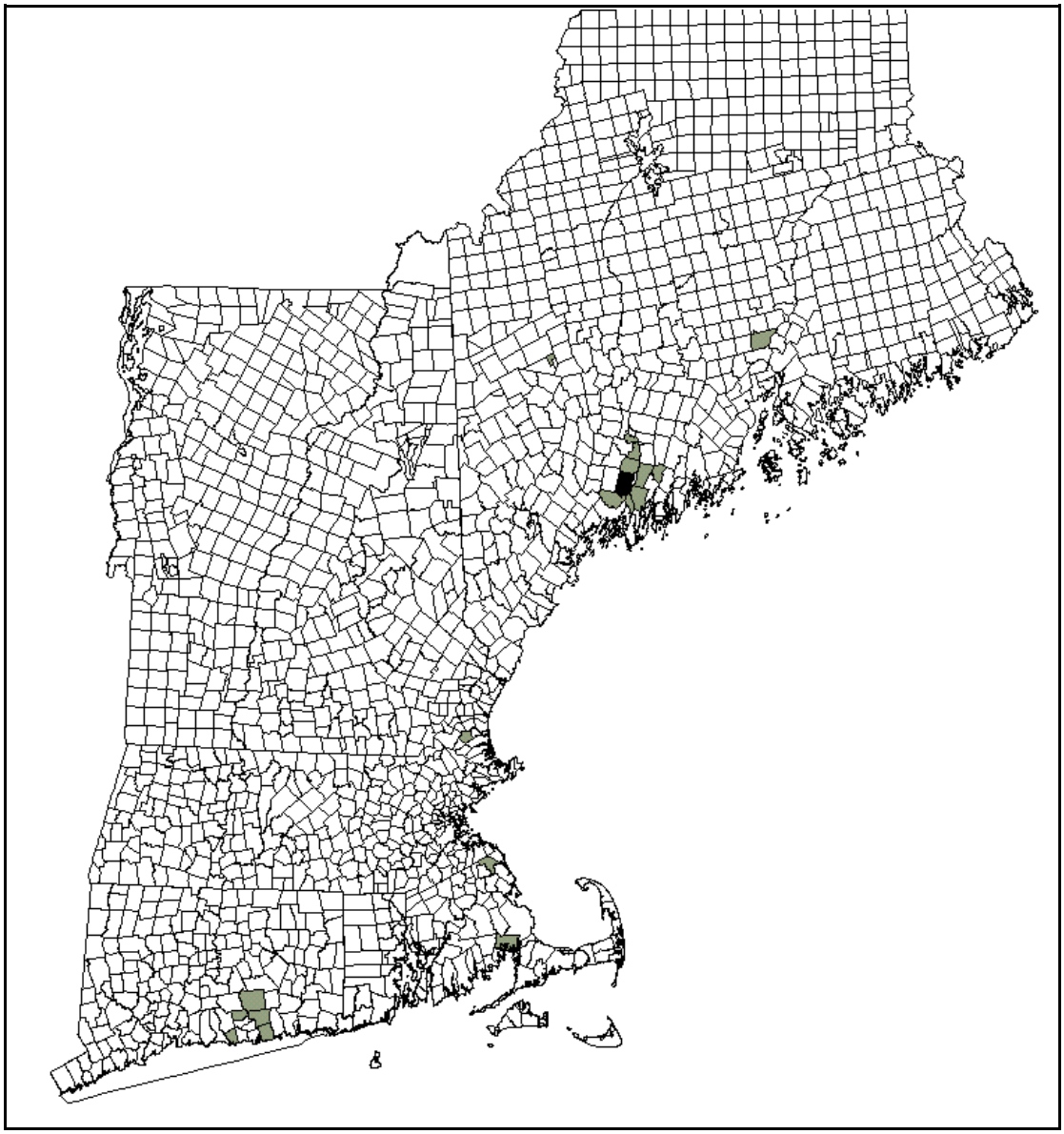

Figure 2. Extant occurrences of *Eriocaulon parkeri* in New England. Town boundaries for New England are shown. Shaded towns have 1-5 occurrences. Towns shaded in black have more than 5 occurrences.

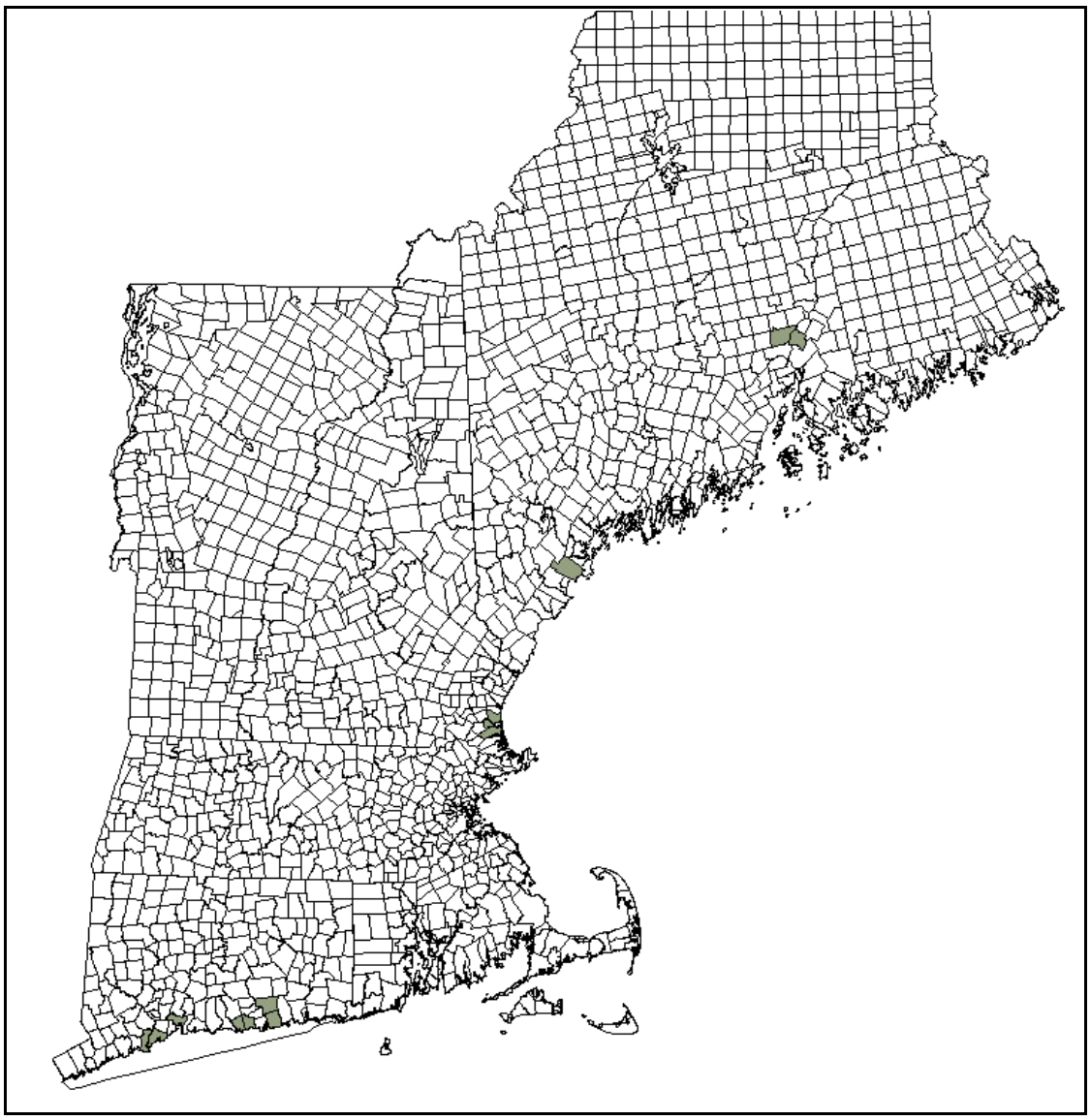

Figure 3. Historic occurrences of *Eriocaulon parkeri* in New England. Town boundaries for New England are shown. Shaded towns have 1-5 occurrences.

The distribution and current state/subnational ranks of *Eriocaulon parkeri* are as follows: Connecticut (S1/S2); Delaware (S2); District of Columbia (SH); Maine (S3); Maryland (S2); Massachusetts (S1); New Brunswick (S1); New Jersey (S2); New York (SX); North Carolina (S1); Ontario, Canada (SRF [state record false]); Pennsylvania (SX); Quebec (S2); Rhode Island (SRF); Virginia (S2). *Eriocaulon parkeri* is designated N3 nationally in the United States, and N2 nationally in Canada.

Table 1. Occurrence and status of *Eriocaulon parkeri* in the United States and Canada based on information from Natural Heritage Programs.

OCCURS & LISTED (AS S1, S2, OR T &E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	OCCURRENCE UNVERIFIED	HISTORIC (LIKELY EXTIRPATED)
Connecticut (S1S2): 5 current and 7 historic occurrences	Maine (S3): 31 current and 3 historic occurrences	Rhode Island (SRF)	District of Columbia (SH): 1 occurrence
Delaware (S2)		Ontario (SRF)	New York: (SX): 2 occurrences
Maryland (S2): 1 occurrence			Pennsylvania (SX)
Massachusetts (S1): 4 current and 3 historic occurrences			
New Jersey (S2): 8 occurrences			
New Brunswick (S1)			
North Carolina (S1)			
Quebec (S2)			
Virginia (S2): 2 occurrences			

Table 2. New England Occurrence Records for *Eriocaulon parkeri* based on data from State Natural Heritage Programs. Shaded occurrences are considered extant.

State	EO #	County	Town
ME	**.001**	**Sagadahoc**	**Bowdoinham**
ME	**.002**	**Sagadahoc**	**Bowdoinham**
ME	.003	Penobscot	Hampden
ME	**.004**	**Lincoln**	**Alna**
ME	**.005**	**Sagadahoc**	**Topsham**
ME	**.006**	**Sagadahoc**	**Bath**
ME	**.007**	**Sagadahoc**	**Bath**
ME	.008	Cumberland	Scarborough
ME	**.009**	**Sagadahoc**	**Woolwich**
ME	**.010**	**Penobscot**	**Hampden**
ME	.011	Penobscot	Orrington
ME	**.012**	**Sagadahoc**	**Bowdoinham**
ME	**.013**	**Sagadahoc**	**Bowdoinham**
ME	**.014**	**Lincoln**	**Dresden**
ME	**.015**	**Sagadahoc**	**Woolwich**
ME	**.016**	**Sagadahoc**	**Richmond**
ME	**.017**	**Kennebec**	**Gardiner**
ME	**.018**	**Sagadahoc**	**Bath**
ME	**.019**	**Sagadahoc**	**Woolwich**
ME	**.020**	**Sagadahoc**	**Bath**
ME	**.021**	**Sagadahoc**	**Woolwich**
ME	**.022**	**Sagadahoc**	**Bowdoinham**
ME	**.023**	**Sagadahoc**	**Bowdoinham**
ME	**.024**	**Sagadahoc**	**Topsham**
ME	**.025**	**Sagadahoc**	**Bowdoinham**
ME	**.026**	**Lincoln**	**Dresden**
ME	**.027**	**Sagadahoc**	**Topsham**
ME	**.028**	**Lincoln**	**Dresden**
ME	**.029**	**Sagadahoc**	**Woolwich**
ME	**.030**	**Sagadahoc**	**Bowdoinham**
ME	**.031**	**Sagadahoc**	**Bowdoinham**
ME	**.032**	**Kennebec**	**Farmingdale**
ME	**.033**	**Sagadahoc**	**Perkins Twp.**
ME	**.034**	**Kennebec**	**Richmond**
MA	.001	Essex	Newbury

State	EO #	County	Town
MA	**.002**	**Plymouth**	**Wareham**
MA	**.004**	**Plymouth**	**Wareham**
MA	**.005**	**Essex**	**West Newbury**
MA	.006	Essex	Newburyport
MA	**.007**	**Plymouth**	**Norwell**
MA	.008	Essex	Salisbury
CT	.001	Fairfield	Stratford
CT	.002	New Haven	Milford
CT	.003	New Haven	New Haven
CT	.004	New London	Lyme
CT	.005	Middlesex	Clinton
CT	.006	Middlesex	Westbrook
CT	**.007**	**Middlesex**	**Clinton**
CT	.008	New London	Old Lyme
CT	**.009**	**Middlesex**	**Chester**
CT	**.010**	**Middlesex**	**East Haddam**
CT	**.011**	**New London**	**Old Lyme**
CT	**.012**	**New London**	**Lyme**

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Parker's pipewort is a rare species in New England (Brumback and Mehrhoff *et al.* 1996). Globally, this taxon is considered vulnerable and possesses qualities that make it susceptible to extinction. The primary conservation goals are to study, protect, and restore populations on coastal rivers in New England. Information gathered during the Connecticut River Estuary and Tidal Wetlands Complex studies will provide critical information regarding the protection and restoration of Parker's pipewort populations.

The primary conservation objectives for Parker's pipewort are to study, protect, and maintain both the species and the associated natural communities. Success of this objective will be measured through maintenance or improvement of current state ranks and meeting the specific conservation plan objectives described below:

1. With landowner permission, perform detailed field surveys of sites known or likely to harbor Parker's pipewort plants.
2. Secure long-term protection for high quality element occurrences.
3. Initiate long-term demographic studies in Maine, Massachusetts, and Connecticut to document population trends in concert with critical habitat determination. This conservation objective will assist and expand on-going studies in Connecticut.
4. Perform reproductive biology studies to determine method of pollination and seed production, germination, and dispersal.
5. Conduct habitat improvement activities at sites with known populations or areas deemed suitable for reintroduction.
6. Reintroduce plants to historic localities in Connecticut where suitable communities still exist.

III. LITERATURE CITED

Brumback, W. E., L .J. Mehrhoff, R. W. Enser, S. C. Gawler, R. G. Popp, P. Somers, D. D. Sperduto, W. D. Countryman, and C. B. Hellquist. 1996. *Flora Conservanda*: New England. The New England Plant Conservation Program (NEPCoP) list of plants in need of conservation. *Rhodora* 98: 233–361.

Connecticut Department of Environmental Protection. 1998. Connecticut River Estuary and Tidal Wetlands Complex. URL: http://dep.state.ct.us/olisp/ramsar/index.htm.

Cook, C. D. K. 1996. *Aquatic Plant Book*. SPB Academic Publishing bv, Amsterdam, Netherlands.

Dowhan, J. J. and R. J. Craig. 1976. Rare and endangered species of Connecticut and their habitats. Report of Investigations 6, State Geological and Natural History Survey of Connecticut, The Natural Resources Center. Available from Department of Environmental Protection, 79 Elm Street, Hartford, Connecticut, 06106, USA.

Fassett, N. C. 1928. The vegetation of the estuaries of northeastern North America. *Proceedings of the Boston Society of Natural History* 39: 73–130.

Fassett, N. C. 1931. Notes from the herbarium of the University of Wisconsin–VI. *Rhodora* 33: 73.

Fernald, M. L. 1941. *Elatine americana* and *E. triandra*. *Rhodora* 43: 208–211.

Fernald, M. L. 1950. *Gray's Manual of Botany*, 8th Edition. Van Nostrand Reinhold Company, New York, USA.

Finlayson, M. and M. Moser (Editors). 1991. *Wetlands*. International Waterfowl and Wetlands Research Bureau. Facts on File, Limited, Oxford, United Kingdom.

Friends of Merrymeeting Bay. 2000. An introduction to Merrymeeting Bay. URL: http://www.col.k12.me.us/mmb/intro.html.

Gleason, H. A. and A. C. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*, 2nd Edition. The New York Botanical Garden, New York, USA.

Hinds, H. R. 1986. *Flora of New Brunswick*. Primrose Press, New Brunswick, Canada.

Kasselmann, C. 1995. *Aquarienpflanzen*. Verlag Eugen Ulmer, Stuttgart, Germany.

Kral, R. 2000. Eriocaulaceae. Pages 198-210 in Flora of North America Editorial Committee (Editors), *Flora of North America: North of Mexico*, Volume 22, Oxford University Press, New York, USA.

Kral, R. 1964. Eriocaulaceae of continental North America north of Mexico. *Sida* 5: 285–232.

Les, D.H. 1999. Impacts of development on Connecticut's coastal resources: a case study of *Eriocaulon parkeri*, a state-threatened species. Unpublished proposal for project funding, Long Island Sound License Plate Fund.

Löve, A. and D. Löve. 1958. The American element in the flora of the British Isles. *Bot. Notiser* 111: 376–388.

Mabbot, D. C. 1920. Food habits of seven species of American shoal-water ducks. United States Department of Agriculture Bulletin 862. Government Printing Office, Washington, D.C., USA.

McAtee, W. L. 1918. Food habits of the mallard ducks of the United States. United States Department of Agriculture Bulletin 720. Government Printing Office, Washington, D.C., USA.

Moldenke, H. N. 1937. Family Eriocaulaceae. Pages 17–27 in *North American Flora*, volume 19, part 1. The New York Botanical Garden, New York, USA.

Morse, L. E. and Y. Ogle. 1997. Element Global Ranking Form: *Eriocaulon parkeri*. The Nature Conservancy, Virginia, USA.

Muenscher, W. C. 1936. Storage and germination of seeds of aquatic plants. Cornell University Agricultural Experiment Station Bulletin 652, New York, USA.

Muenscher, W. C. 1944. *Aquatic Plants of the United States*. Comstock Publishing Associates, New York, USA.

Murphy, K. J. and J. W. Eaton. 1983. Effects of pleasure-boat traffic on macrophyte growth in canals. *Journal of Applied Ecology* 20: 713–729.

Robinson. B.L. 1903. A hitherto undescribed pipewort from New Jersey. *Rhodora* 5: 175–176.

Ruhland, W. 1930. Eriocaulaceae. Pages 39-57 in A. Engler (Editor), *Die Naturlichen Pflanzenfamilien*. Wilhelm Engelmann, Leipzig, Germany.

Schuster, L., D.H. Les, and K. J. Metzler. 1999. Habitat requirements for the state threatened *Eriocaulon parkeri* (Parker's pipewort). Unpublished proposal for project funding, The Nature Conservancy, Middletown, Connecticut, USA.

State of Maine Department of Environmental Protection. 1989. Permit By Rule Standards, Chapter 305. Bureau of Land and Water Quality, Augusta, Maine, USA.

The Nature Conservancy and The Association for Biodiversity Information. 1999. Natural Heritage Central Databases. Arlington, Virginia, USA.

Appendix 1. An explanation of conservation ranks used by The Nature Conservancy and the Association for Biodiversity Information

The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

1 = critically imperiled
2 = imperiled
3 = vulnerable to extirpation or extinction
4 = apparently secure
5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis—that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction—i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks. (The lower the number, the "higher" the rank, and therefore the conservation priority.) On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups—thus G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have made for more than 20 years. An X rank is utilized for sites that known to be extirpated. Not all EO's have received such ranks in all states, and ranks are not necessarily consistent among states as yet.