New England Plant Conservation Program

Salix myricoides Muhl. var. *myricoides* Bayberry willow

Conservation and Research Plan for New England

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SUMMARY

Salix myricoides Muhl. var. *myricoides* (Salicaceae), bayberry willow, is a low to tall shrub primarily of shorelines and interdunal systems. Its main centers of distribution are the regions of eastern Canada and Maine, Great Lakes, and James Bay. It belongs to a group of willows that are taxonomically complex and it is difficult to identify when vegetative without experience. This fact, combined with its remote locations in New England, explains why this species is more common than reports would indicate. *Salix myricoides* is considered to be a G4 species that is Division 2 in New England.

Salix myricoides was formerly known from 11 occurrences the St. John River and Aroostook River. These rivers are similar in their boreal setting, circumneutral substrate, and severity of vernal ice scour. *Salix myricoides* was also thought to occur on the Kennebec River in Maine, but those reports were based on misidentified herbarium specimens (along with a number of other collections in New England). Currently, eight populations are known extant along approximately 77 km of river shore on the St. John River. Only one population is believed to have been extirpated in New England, and the species does not currently face major anthropogenic threats.

The conservation objectives for this taxon are to locate additional populations, revisit a number of populations for which little information exists, and collect cuttings for gene banking purposes. It is stressed that the field taxonomists performing surveys for *Salix myricoides* be trained to recognize the plant vegetatively and that they visit suggested populations to see various willow species in close proximity. Success of this Conservation and Research Plan will be achieved when the plant is documented from more than 20 extant occurrences or it is down-listed from S1 to S3 by the Maine Natural Areas Program (the latter activity would also result in its removal from the list of regional rare species—*Flora Conservanda*: New England).

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.

The New England Plant Conservation Program (NEPCoP) of the New England Wild Flower Society 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.

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I. BACKGROUND

INTRODUCTION

Salix myricoides Muhl., the bayberry willow (Salicaceae), is a short to tall shrub of northeastern North America. It occurs on shorelines and in dune systems; less commonly, it is found in swamps, fens, and on talus. *Salix myricoides* primarily is known from the regions of Canada and Maine, Great Lakes, and James Bay, with scattered and sometimes disjunct locations elsewhere (e.g., Pennsylvania). It is regionally rare (Division 2; Brumback and Mehrhoff et al. 1996) and within New England known only from northern Maine.

Salix myricoides belongs to a notoriously difficult group of willows (i.e., the *S. cordata* Michx. complex) and is frequently misidentified (Dorn 1975, 1995). Further complicating matters, the name *S. myricoides* has been improperly used for the hybrid between *S. eriocephala* Michx. and *S. sericea* Marsh. (see Taxonomic Relationships, History, and Synonymy). Consequently, *S. myricoides* has been much over-reported in New England and both Kartesz (1999) and Magee and Ahles (1999) erroneously attribute this rare willow to all six states.

Within New England, *Salix myricoides* is restricted to the St. John and Aroostook Rivers in northern Maine. Though large stretches of suitable river shore habitat exist, *S. myricoides* is known extant from only eight extant occurrences. The paucity of records for this willow is an artifact of the species' morphology — differentiating vegetative specimens of *S. myricoides* from congenerics is subtle and requires experience. Targeted field surveys by field taxonomists trained in identification of north-temperate, riparian willows will discover additional occurrences of *S. myricoides*.

Conservation of *Salix myricoides* in New England will require education, field surveys, and watershed protection. Protecting the northern rivers from development and degradation will be vital to preserving these species in the northeast, with primary focus on the St. John River upstream of Fort Kent (i.e., the most pristine portion of the river).

DESCRIPTION

Salix myricoides is a shrub that can grow to a height of six meters (Dorn 1995). However, in New England it rarely exceeds 1.5 meters (Arthur Haines, personal observation). It is not a colonial species like some willows (e.g., *S. humilis* Marsh. var. *tristis* (Ait.) Griggs; *S. petiolaris* J. E. Smith); rather, it produces solitary or few-stemmed plants. The year-old branchlets are typically red-brown, though they vary to yellow-green, and range from glabrous to moderately villous-tomentose. The leaf blades are typically narrow-ovate, ovate, or somewhat obovate in New England material and usually 4–9 × 1.5–4 cm. The base of the blade is broad-cuneate (less commonly) to rounded, truncate, or (again, less commonly) subcordate, while the apex is typically acute. The

abaxial (lower) surface of the leaf blade is prominently glaucous, appearing chalky white on most leaves (as opposed to the relatively thin bloom of the related *S. eriocephala*). Fully expanded leaves are thick-herbaceous to subcoriaceous, generally glabrate, and have crenate-serrate to serrate margins. Some specimens will show darkened leaves in drying. Most branches of *S. myricoides* will possess persistent, paired stipules usually 1–10 mm long.

The staminate aments appear before or with the expansion of the leaves (i.e., they are precocious or coetaneous, respectively). They are 1.5–4 cm long and are borne on flowering branchlets 1–18 mm long. Each flower has one nectary and two stamens subtended by a dark-tipped floral bract (1–)1.5–3 mm long. The filaments are glabrous throughout and bear purple-turning-yellow anthers (0.4–)0.6–0.8(–1) mm long. The apical flowers of each ament mature first, with basal flowers maturing subsequently. This sequence of flowering is very unusual in willows (Voss 1985).

The carpellate aments appear barely before or with the expansion of the leaves. They are 2–7 cm long and are borne on flowering branchlets 4–30 mm long. The glabrous ovary is borne on a stipe 1–2.5(–3) mm long. At the base of the stipe is a single nectary. The styles are usually 0.7–1.5 mm long and support two, flat or slender-cylindrical stigma lobes. Each carpellate flower is subtended by a dark-tipped floral scale 1.5–3 mm long. The ovary matures as a glabrous, 2-valved capsule 4–11 mm long that bears 12–18, comose seeds.

Salix myricoides is most likely to be confused with *S. eriocephala* and *S. discolor* Muhl. in New England (see Table 1). Both of the latter willows are morphologically similar to and occur with *S. myricoides* in open, riparian communities in northern Maine. *Salix eriocephala* typically has narrower leaf blades (relative to length) that are usually lanceolate to broad-lanceolate in outline. The margins are regularly and finely serrate. The abaxial surface is usually thinly glaucous, but rarely is green and without bloom. The staminate aments are sessile or borne on flowering branchlets up to six mm long. The anthers are (0.3–)0.4–0.64(–0.7) mm long. Each flower is subtended by a floral bract 0.8–1.5(–2) mm long and the basal flowers of each ament mature first. The carpellate aments of *S. eriocephala*, on average, are borne on shorter flowering branchlets (mostly 2–15 mm long). The carpellate flowers also have shorter styles (0.1–0.7 mm long), plump stigma lobes, and shorter floral bracts (0.8–1.5[–2] mm long).

Salix discolor is easily separated from *S. myricoides* with reproductive material but is extremely difficult vegetatively due to overlapping character states. *Salix discolor* usually has narrow-obovate leaf blades with crenate-toothed margins that may darken in drying. However, the blades of *S. discolor* are relatively thinner (i.e., herbaceous), and may even be somewhat translucent on dried specimens. The bases of the blades usually taper more narrowly (i.e., cuneate) than in *S. myricoides* and the margins have larger, more apically rounded teeth (*S. discolor* has 1–3[–5] teeth per cm of leaf blade margin while *S. myricoides* has 5–9 teeth per cm). Additionally, while red-brown hairs are common on the expanding leaves of *S. discolor* (these hairs often persistent along the adaxial midrib), red-brown hairs are very rare in *S. myricoides*. The staminate flowers of

S. discolor usually have basally pubescent filaments. The carpellate flowers have pubescent ovaries (the hairs persisting in fruit).

Table 1. Comparison of morphological features in *Salix*. 1=not seen by author; most material of this hybrid is carpellate, the staminate material difficult to determine. 2=only carpellate material known and staminate plants have not been observed (Dorn 1975).

Species	Leaf blade	Blade margin	Red-brown hairs	Ovaries	Filaments
S. myricoides	narrow-ovate or ovate to obovate	crenate-serrate to serrulate	usually absent	glabrous	glabrous
S. discolor	oblanceolate or obovate to elliptic	crenate	usually present	pubescent	pilose near base
S. eriocephala	lanceolate to broad-lanceolate	serrulate	absent	glabrous	glabrous
S. ×bebbii	lanceolate	serrulate	absent	sparsely pubescent	unknown[1]
S. ×laurentiana	elliptic to obovate	crenate-serrate	often present	sparsely pubescent	unknown[2]

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Salix myricoides was described in 1803 by Muhlenberg. No type specimen was cited by Muhlenberg in the original diagnosis and Dorn (1995) rectified this by designating a lectotype from material collected in Lancaster, Pennsylvania (*Muhlenberg 571* PH). This willow was long known in regional literature as *S. glaucophylloides* Fern. This name was published in 1914 from material collected in Newfoundland (*Fernald and St. John 10819* GH; Fernald 1914). Both Robert Dorn and George Argus have concluded that the type specimens of *S. myricoides* and *S. glaucophylloides* are conspecific (Voss 1985). The name *Salix myricoides* was published over 100 years earlier and therefore has priority.

Salix myricoides belongs to a group of willows that may be referred to as the *S. cordata* complex. More specifically, it belongs to *Salix* section *Cordatae* subsection *Luteae*. This subsection is circumscribed by a large combination of characters that include flowers with a single nectary subtended by persistent, usually dark-tipped floral bracts, staminate flowers with two stamens, carpellate flowers with glabrous ovaries, and non-pruinose branches. Willows of this subsection are difficult to identify and have been plagued with nomenclatural problems (e.g., several species in the group were named by different authors in the same year; Dorn 1995). In the latest taxonomic study of this

group of willows, Dorn (1995) recognized two varieties of *S. myricoides* in North America. *Salix myricoides* var. *myricoides* is the more common and wider-ranging taxon and is recognized by its glabrous to densely pubescent first-year branches and glabrous to sparsely pubescent mature leaf blades that tend to have toothed margins. *Salix myricoides* var. *albovestita* (C. R. Ball) Dorn is marked by its first-year branches, and often also the leaf blades, which are densely white-tomentose and tend to have entire margins. This latter variety is primarily restricted to the James Bay region of Canada (though the type of that variety is from Pennsylvania, USA). *Salix myricoides* var. *myricoides* is the taxon found in New England (Dorn 1975; hereafter written as "*Salix myricoides*", the varietal epithet implied).

Fernald (1950) apparently misapplied *Salix myricoides* and used this name for putative hybrids between *S. eriocephala* and *S. sericea*. Some of the historical records for *S. myricoides* from the Kennebec and Penobscot Rivers in Maine are based on such specimens that are properly referred to as *S.* ×*bebbii* Anderss. (note that none of the records for *S. myricoides* from those rivers are legitimate).

Salix myricoides has been documented to hybridize with *S. discolor*, yielding *S.* ×*laurentiana* Fern. (Dorn 1975). Thus far, this nothospecies is known only from the St. Lawrence River, Gaspé, Quebec and Newfoundland; however, the parental species are sympatric in northern Maine and *S.* ×*laurentiana* may occur there. It closely resembles *S. myricoides* in many vegetative features, but the ovaries and capsules are sparsely pubescent and the expanding leaves commonly have red-brown hairs (traits inherited from *S. discolor*).

The following names are additional taxonomic synonyms of *Salix myricoides*: *S. acutidens* Rydb.; *S. cordata* Muhl. var. *glaucophylla* Bebb. *in* H.H. Babc.; *S. glaucophylla* Bebb *in* C. F. Wheeler & E. F. Sm.; *Salix glaucophylla* Bebb. var. *brevifolia* Bebb *in* C. F. Wheeler & E. F. Sm.; and *Salix glaucophylloides* Fern. var. *glaucophylla* (Bebb) C. K. Schneid. (Dorn 1995).

SPECIES BIOLOGY

Salix myricoides, similar to other members of its genus, has predominantly insect-pollinated flowers. Though the Salicaceae were formally thought to be closely related to families of wind-pollinated, woody plants (e.g., Betulaceae, Fagaceae, Juglandaceae), the resemblance of willow aments to the inflorescences of those families is superficial. The calyx of willow flowers has been modified into one or more nectaries (Judd et al. 1999). Flies (Diptera), wasps (Hymenoptera), honeybees (*Apis*), bumblebees (*Bombus*), and beetles (Coleoptera) have been observed harvesting pollen and/or nectar from willow flowers in North America (Mosseler 1987). Host-specific pollinators have not been documented in North American willows, as the highly reduced flowers do not appear to have specialized features that limit pollinator access (Mosseler and Papadopol 1989).

The fruit of *Salix myricoides* is a small, two-valved capsule that dehisces longitudinally to release 12–18 comose seeds. The coma of the seed is made up of a ring a fine, silky hairs that facilitates wind dispersal (Argus 1986). Water is also thought to be an important vector for seeds (Judd et al. 1999). This is likely the case with *S. myricoides,* given its riparian habitat.

Most aspects of the phenology of *Salix myricoides* are unknown. For example, dates of emergence of leaves and autumn shedding of leaves have not been recorded. What is known about the flowering and fruiting time has been gathered from few observations. Dorn (1995) states that *S. myricoides* flowers from April through July. However, these are rangewide observations. Only one collection (with duplicates) has been taken in flower from New England. This was on 16 June 1898 in Fort Kent, Aroostook County, Maine. Based on observation of related species, early to mid-June likely represents the primary flowering period for *S. myricoides* (Arthur Haines, personal observation). Fruits are fully formed and the seeds begin to disperse by early July; however, the fruits persist on the plant for some time.

Argus (1986) noted two important conditions for colonization of habitat by willow: moist substrate at the time seeds are shed, and ample sunlight. The majority of willows in New England shed seeds in late spring and early summer, a period of time when the ground is frequently moist from vernal rains. Ample sunlight is important given the heliophilic nature of willows (i.e., the plants are intolerant of shade). The conditions necessary for willow colonization (moist substrate and sunlight) have been shown to be important limiting factors for some species; in fact, more important than the moisture requirements for adult plants (McLeod and McPherson 1973).

Willows are noted to hybridize with other members of the genus (Mosseler and Papdopol 1989). Given that species of *Salix* do not appear to have host-specific pollinators, other factors must account for the relatively few hybrid individuals seen on the landscape (Dorn 1976; Arthur Haines, personal observation). Spatial isolation of species has been discounted as a major pre-mating barrier because willows frequently occur in mixed populations, and different habitats containing separate willow floras can be juxtaposed (Mosseler and Papadopol 1989). Seasonal isolation (i.e., due to differing flowering times) has been suggested as an important pre-mating barrier, given that willow species do not all flower simultaneously (Argus 1974, Mosseler and Papadopol 1989). This hypothesis appears to be supported by the fact that no natural hybrids are known between the early-flowering *S. discolor* and the late-flowering *S. exigua* Nutt., yet controlled hybridization can be performed between these species (and several other early-flowering species with *S. exigua*).

HABITAT/ECOLOGY

Salix myricoides occurs in varied plant communities rangewide — sandy lake shores, interdunal hollows, fens, open river shores, and talus slopes (Dorn 1995). However, within any given region, it appears to be more specific as to where it is found growing. For example, Voss (1985) reports *S. myricoides* as prevalent on sandy lake shores and interdunal hollows of the Great Lakes. In New England, *S. myricoides* is known only from open, ice-scoured shorelines of northern rivers in calcareous till regions. It is most commonly found in open river shore meadows on sand and silt substrates dominated by *Calamagrostis canadensis* (Michx.) Beauv. var. *canadensis*, with additional tall herbs and sporadic shrubs. However, at least one location is known from cobble substrate (ME .009 [T15 R13 WELS]). Where available, lists of associated species by occurrence are provided below.

> ME .006 (Allagash) — *Salix eriocephala* ssp. *eriocephala, S. sericea, S. discolor, S. pellita* (Anderss.) Anderss. *ex* Schneid., *S. lucida* Muhl. ssp. *lucida, Spartina pectinata* Bosc *ex* Link, *Spiraea alba* Du Roi var. *latifolia* (Ait.) Dippel, *Alnus incana* (L.) Moench ssp. *rugosa* (Du Roi) Clausen, and *Vicia cracca* L. ssp. *cracca*.
>
> ME .009 (T15 R13 WELS) — *Tanacetum bipinnatum* (L.) Shultz-Bip. ssp. *huronense* (Nutt.) Breitung, *Silene vulgaris* (Moench) Garcke, *Cornus sericea* L. ssp. *sericea*, and *Campanula rotundifolia* L.
>
> ME .010 (T16 R12 WELS and Allagash) — *Calamagrostis canadensis* var. *canadensis, Salix* spp., *Alnus* spp., *Pedicularis furbishiae* S. Wats.

As previously stated, *Salix myricoides* is a species of open river shores in New England, the open character of these northern rivers created and maintained by vernal ice scour. Rather than colonizing exposed cobbles (as do such New England taxa as *Astragalus alpinus* L. var. *brunetianus* Fern. and *Oxytropis campestris* (L.) DC. var. *johannensis* Fern.), *S. myricoides* usually occupies riparian sites that have taken on a meadow-like character (i.e., the river shores have undergone some period of succession from open-scoured habitat). *Salix myricoides* appears to be similar to several other species that require open, ice-scoured shores, such as *Pedicularis furbishiae* and *Symphyotrichum anticostense* (Fern.) Nesom (Haines 2000). However, unlike those species, *S. myricoides* is probably capable of persisting at sites for some period after woody competitors have colonized the site, given its woody habit and ability to grow to several meters in height. Merritt Lyndon Fernald noted on labels of historic collections from the Aroostook River that *S. myricoides* was “abundant in river-thickets” and that stems were observed “5–12 ft. high” (see Appendix 2).

THREATS TO TAXON

Salix myricoides has no immediate and vital threats to its existence in New England. Its primary distribution is on the St. John River upstream of Fort Kent where river shore development is minimal. It is also capable of tolerating more intense ice-scour than many herbaceous species given its more extensive underground root system. Willows are frequently seen sprouting from ground level after heavy ice-scour seasons on northern Maine rivers (Arthur Haines, personal observation).

Despite the lack of immediate threats to *Salix myricoides*, its security in New England will always be threatened by the possibility (albeit remote) of new hydroelectric projects. Impoundments impact plants by inundation and by slowing the river flow, reducing the severity of vernal ice scour. Without ice scour, the shorelines are colonized by woody species (e.g., *Alnus* spp., *Salix* spp.). In the absence of flood-driven ice, the river shore gradually becomes a dense growth of tall shrubs and loses its ability to support northern plants adapted to open, calcareous river shores. For example, occurrence ME .001 (Fort Fairfield) was extirpated by the Tinker Dam in New Brunswick, which flooded back up into the United States (many species were extirpated by this dam; Haines 2000). This dam still alters the river flow in Fort Fairfield, slowing the water and reducing the severity of vernal ice scour (Arthur Haines, personal observation).

Throughout New England, river shore habitat is threatened by non-native, invasive species. The remote location and severity of vernal ice scour explain why this is not a major concern for *Salix myricoides* on northern Maine rivers. However, some locations on these rivers (e.g., St. John River downstream of Fort Kent; Aroostook River near Fort Fairfield) have been degraded in places by dense growth of the invasive grass, *Phalaris arundinacea* L. This is primarily the result of nearby agricultural practices.

Additional potential threats could include illegal gravel mining and recreational vehicle traffic. Gravel mining in New Brunswick has caused declines of other river beach species (Haines 2001). In the township of Fort Kent, all-terrain vehicles (ATV) traffic have been observed on the river shores of the St. John river in the vicinity of historic populations of *Salix myricoides*. However, neither of these potential threats have been documented as affecting willow populations.

DISTRIBUTION AND STATUS

General Status

Salix myricoides occurs in the Great Lakes region and northeastern North America. In the United States, it is documented from Illinois, Indiana, Maine, Michigan, Ohio, Pennsylvania, and Wisconsin. In Canada, it is known from the provinces of New Brunswick, Newfoundland, Ontario, and Quebec (Dorn 1995; George Argus, National Herbarium, Canada, personal communication). The Nature Conservancy and

NatureServe (1999) also report *S. myricoides* from Connecticut, Massachusetts, New Hampshire, New York, Prince Edward Island, Rhode Island, Vermont, and Virginia. However, all the New England occurrences listed there (save for Maine) are in error and are based on misidentifications and taxonomic confusion (Haines, in preparation). The remaining records (e.g., New York, Virginia, and Prince Edward Island) are likely erroneous as well, given that Dorn (1995) and George Argus (personal communication) report no occurrences from those states/provinces. *Salix myricoides* (both varieties included) is provided a global rank of G4, apparently secure (The Nature Conservancy and NatureServe 1999). This G-rank may need to be revised given that *S. myricoides* is over-reported (along with several other errors that are present on the Condition Summary for *S. myricoides*). Summary information of North American occurrences of *Salix myricoides* can be found in Table 2. The North American distribution is shown in Figure 1.

Status of All New England Occurrences — Current and Historical

In New England, *Salix myricoides* has been documented from ca. 97 km of shoreline along the St. John River (T14 R13 WELS downstream to Fort Kent). It has also been documented from ca. 4 km of shoreline along the Aroostook River (all within Fort Fairfield). Considering only extant occurrences, *S. myricoides* is restricted to ca. 77 km of the St. John River (all of the Aroostook River occurrences are historical or extirpated). The New England distribution is summarized in Figure 2.

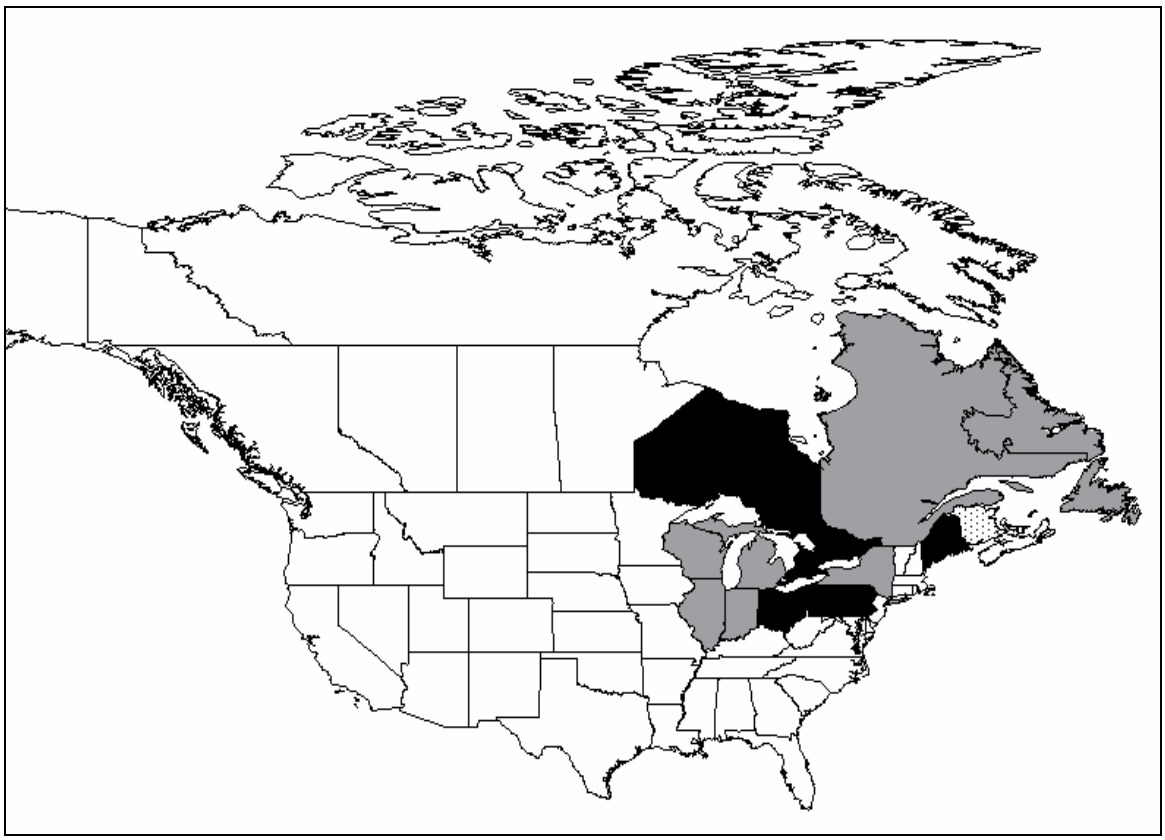

Figure 1. Occurrences of *Salix myricoides* in North America. States and provinces shaded in gray have one to five (or an unspecified number of) current occurrences of the taxon. Note that specimens have not as yet been verified from New York or Prince Edward Island. Areas shaded in black have more than five confirmed occurrences. Areas with stippling are ranked "SR" (status "reported" but not necessarily verified). See Appendix for explanation of state ranks.

Table 2. Occurrence and status of Taxon 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)**
Maine (S1, E): 8 extant and 3 historical occurrences	Ontario (S3)	Connecticut (SR): the report is erroneous and the state rank should be SRF	
Ohio (S2)	Illinois (S?)	Indiana (SR): confirmed occurrences exist	
Pennsylvania (S2)	Michigan (S?)	Massachusetts (SR): the report is erroneous and the state rank should be SRF	
	New York (S?): no specimens seen by Argus or Dorn — possible erroneous report	New Brunswick (SR)	
	Newfoundland (S?)	New Hampshire (SR): the report is erroneous and the state rank should be SRF	
		Prince Edward Island (SR): no specimens seen by Argus or Dorn — possible erroneous report	
		Quebec (SR): confirmed occurrences exist	
		Rhode Island (SR): the report is erroneous and the state rank should be SRF	
		Vermont (SR): the report is erroneous and the state rank should be SRF	
		Wisconsin (SR): confirmed occurrences exist	

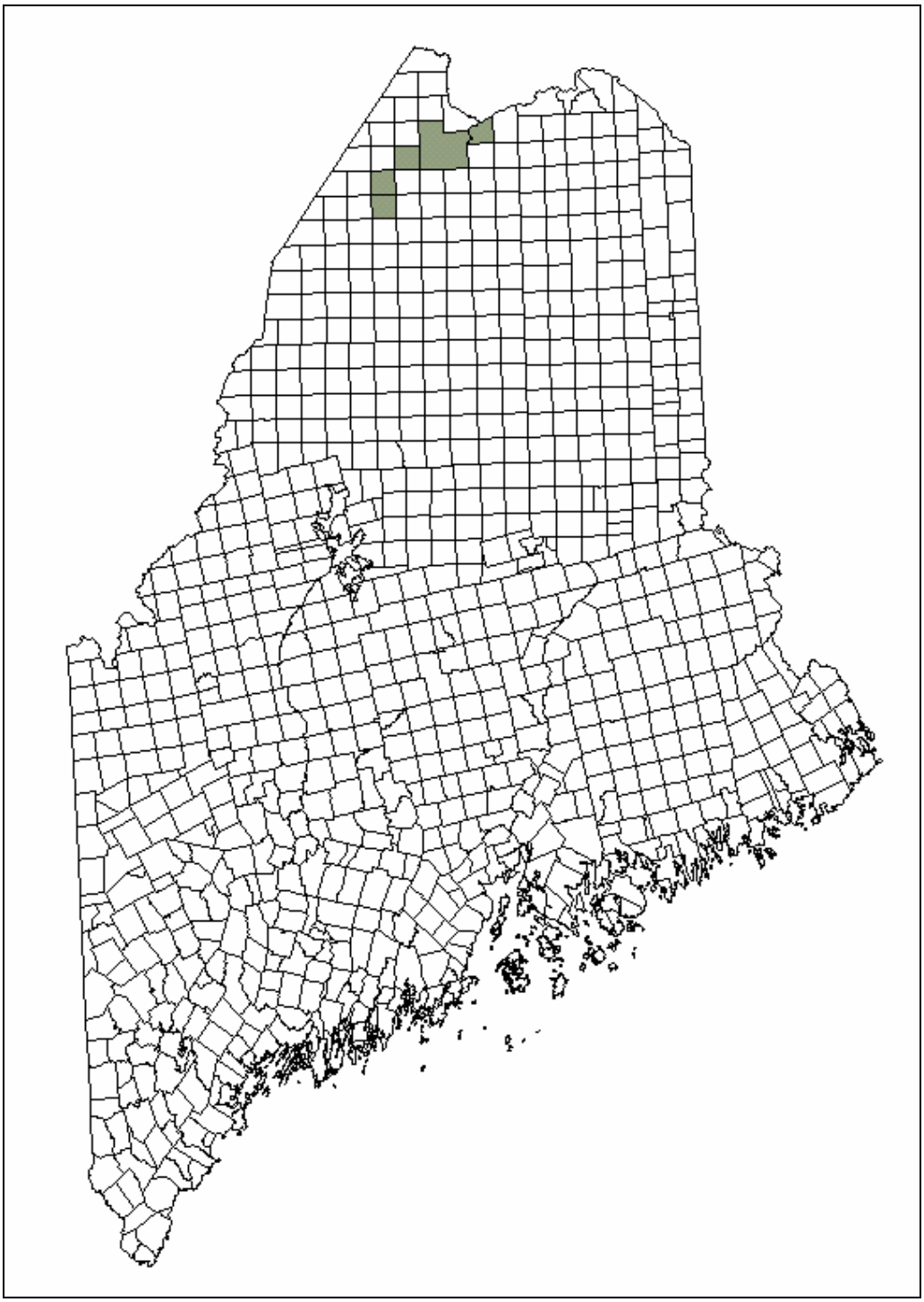

Figure 2. Extant occurrences of *Salix myricoides* in New England. Town boundaries for Maine are shown. Towns shaded in gray have one to five extant occurrences of the taxon.

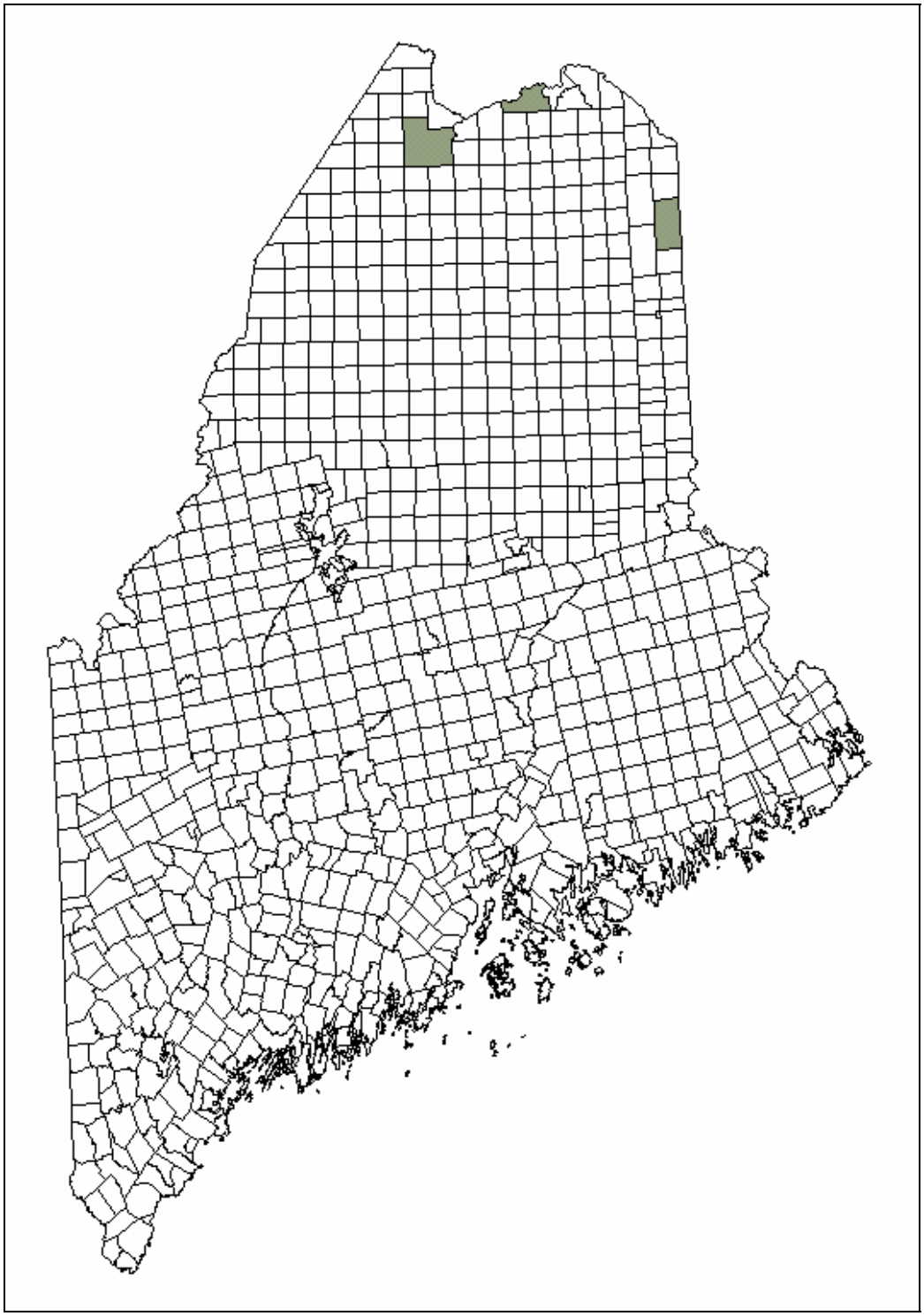

Figure 3. Historical occurrences of *Salix myricoides* in New England. Towns shaded in gray have one to five records of the taxon from sites that have not been seen since at least 1983.

Table 3. New England Occurrence Records for *Salix myricoides*. Shaded occurrences are considered extant.			
State	**EO #**	**County**	**Town**
ME	.001	Aroostook	Fort Fairfield
ME	**.002**	**Aroostook**	**Allagash**
ME	.003	Aroostook	Fort Kent
ME	.004		
ME	.005		
ME	**.006**	**Aroostook**	**Allagash**
ME	**.007**	**Aroostook**	**T14 R13 WELS and T15 R13 WELS**
ME	**.008**	**Aroostook**	**T15 R13 WELS**
ME	**.009**	**Aroostook**	**T15 R13 WELS**
ME	**.010**	**Aroostook**	**T16 R12 WELS and Allagash**
ME	**.011**	**Aroostook**	**St. Francis**
ME	.012	Aroostook	Fort Fairfield
ME	.013	Aroostook	Allagash

II. CONSERVATION

CONSERVATION OBJECTIVES FOR TAXON IN NEW ENGLAND

Salix myricoides is an under-reported species in New England, due both to the remoteness of locations that harbor this species and to its morphology (i.e., vegetative specimens can be confused with other species). The willow is undoubtedly more abundant than current surveys indicate. Further, the species is not presently at risk from anthropogenic threats. Therefore, the overall conservation objective for *S. myricoides* in New England is to locate and inventory 21 or more separate, extant occurrences or document enough individuals such that the Maine Natural Areas Program down-lists the plant to S3 (this latter action would also result in the removal of *S. myricoides* from the list of regionally rare species — *Flora Conservanda*: New England). The two-part definition for success of this conservation objective may be required given that river shore occurrences are sometimes difficult to delimit and may appear as continuous metapopulations (see below for further justification for the use of state ranks). This conservation objective is attainable given that four new occurrences and one historical occurrence were located during surveys along the St. John River in 2001 alone. The objective will be accomplished by field surveys performed by trained field taxonomists.

Scoured river beaches are relatively continuous features along certain upstream stretches of the St. John River, occasionally broken by rock outcrops, steep banks, and later-successional plant communities. However, many of these interrupting features are not large enough to limit gene flow (i.e., winged pollinators and wind-dispersed seeds can bridge the gaps between suitable habitat). Furthermore, it is possible that, given more intensive survey effort, large populations of *Salix myricoides* can be documented that span several kilometers (or more) of river shore (see ME .007 [T14 R13 WELS, T15 R13 WELS]). In fact, populations currently considered to be separate may be merged through the discovery of plants located between them. Such a discovery reduces the number of known populations, even though the total number of known individuals (and the species' security in New England) has been increased. Given the species biology and river system geology, it is reasonable to anticipate that several, very large metapopulations could exist. These metapopulations would add only one population each toward achieving the goal of 21 or more extant occurrences, but would add tremendously toward the total number of individuals and species' security in New England. Therefore, relying solely on a set number of populations occurring on a dynamic river shore system may prove to be a problematic goal to achieve. Allowing use of state rank (or state status) would also provide another measure of success. Should the MNAP deem the species secure and reduces its state rank to S3 (regardless of the actual number of populations), the conservation objective should be considered as achieved.

Conservation efforts should focus on the St. John and Aroostook Rivers, hydrologic features that harbor or were known to harbor populations of *Salix myricoides*. Prime effort needs to be directed toward the St. John River for several reasons. Only two populations have ever been observed on the Aroostook River, both from Fort Fairfield

(i.e., downstream reach near the New Brunswick border). Both populations are within the stretch of river affected by the Tinker Dam impoundment in New Brunswick and one of the occurrences is known to be extirpated. Further, the downstream reaches of the Aroostook River are more heavily impacted by agricultural practices (i.e., the shorelines are more degraded along some stretches of river). Though some relatively undisturbed habitat exists along the Aroostook River upstream of Presque Isle, *S. myricoides* has never been located there. Landscape analysis using recent aerial photographs will be important for identifying river beaches at the proper stage of succession in order to focus survey efforts.

New England occurrences of *Salix myricoides* usually grow within the protected zone of riparian habitat; however, they may not occur at a given site for long periods of time (i.e., centuries) given the dynamic nature of the river shores caused by competing forces of vernal ice scour and plant community succession. Therefore, site-specific land purchases and conservation easements will likely have less of an effect in securing long-term protection for this species. Watershed-level protection is needed, an increasingly difficult item to achieve given the large area and numerous partners that would be involved. However, continued purchases of large properties in the headwater regions (as has been done by The Nature Conservancy) will be an important conservation measure for *S. myricoides* and other northern river shore species.

Possession of material for potential reintroduction to sites is also considered an important part of the long-term conservation of *Salix myricoides* in New England. Propagation of branch cuttings from several sites would provide a source of genetic material in the event a site was affected by unforeseen human impact. Garden in the Woods (Framingham, Massachusetts, USA) would be the appropriate place to grow labeled plants for potential reintroduction purposes.

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IV. APPENDICES

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1. Specimen Citation

2. An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe

1. Specimen Citations

USA. Maine. Aroostook County. Shores of St. John River, in *Calamagrostis canadensis* swales, just upstream of Walker Brook, Allagash, 16 Jul 1996, *Haines s.n.* (MAINE!). River beach, in gravel and cobbles, ice scoured annually, little vegetation; with *Tanacetum bipinnatum, Silene cucubalus, Cornus sericea, Campanula rotundifolia*; Plants typically only 0.5–1 m tall due to recurring ice scour; St. John River, S shore at Gardner's camps opposite Gardner Isld., Allagash, 18 Aug 1983, *Gawler 864* (MAINE!). St. John River, 2 mi above confluence of Allagash River, just off of Maine 161, 46° 06' N 69° 04' W, Allagash, 23 Aug 1983, *Argus 11348* (CAN). Gravelly floodplain. Gravelly bank of Aroostook River, Fort Fairfield, 6 Jun 1911, *Fernald s.n.* (CONN!, GH!, NEBC!, NHA!, VT!). Gravel river-shore; the Aroostook River Basin, 24 Aug 1945, *Chamberlain and Hyland 4331* and *4332* (MAINE!). Near water, E side of Aroostook River, ½ mi. S of bridge at [town] of Ft. Fairfield., Fort Fairfield, 21 Aug 1972, *Campbell s.n.* (MAINE!). On Aroostook River, Fort Fairfield, 16 Aug 1901, *Williams s.n.* (CONN!, VT!). Shrubs or small trees 5–12 ft. high, leaves glossy above when fresh; river beach; about the mouth of Aroostook River, Fort Fairfield, 6 Jun 1901, *Fernald s.n.* (GH!). River-thicket; valley of Aroostook River, Fort Fairfield, 19 Sep 1900, *Fernald s.n.* (NEBC!). River-beach; valley of Aroostook River, Fort Fairfield, Sep 1896, *Fernald s.n.* (NEBC!). Gravelly shore, about the mouth of Aroostook River, Fort Fairfield, 9 Sep 1896, *Fernald s.n.* (NEBC!). Along Aroostook River below bridge; 2–3 ft. tall; locally abundant, Fort Fairfield, 12 Jun 1939, *Hyland 1251* (GH!). Bank of St. John River W of Fort Kent, Fort Kent, 28 Jun 1965, *Richards s.n.* (MAINE!, MASS!). Abundant in river-thickets; valley of St. John River, Fort Kent, 16 Jun 1898, *Fernald 2471* and *2472* (NEBC!). St. John River just below town; *Salix* thicket on river bank, 47° 15' N, 68° 36' W, Fort Kent, 24 Aug 1983, *Argus and Selva 11359* (CAN).One specimen planted, St. Francis, 25 Aug 1965, *Hyland s.n.* (VT!). Circumneutral riverside seep, mixed graminoid/forb/low shrub cover; with *Calamagrostis canadensis*, *Salix* spp., *Alnus* spp., *Pedicularis furbishiae*, etc.; scattered; plants mostly <1 m tall due to recurring ice scour; St. John River, E shore, sporadic from the old Ferry Landing downriver to Long's Rapids, T15 R13 WELS, *Gawler 866* and *867* (MAINE!).

2. An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe

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.