Committee on the Status of Endangered Wildlife in Canada

Comité sur le statut des espèces menacées de disparition au Canada

Ottawa, Ont. K1A 0H3
(819) 997-4991

STATUS REPORT ON THE LONG'S BULRUSH

SCIRPUS LONGII FERN.

IN CANADA

BY

NICK HILL

STATUS ASSIGNED IN 1994
VULNERABLE

REASON: RESTRICTED RANGE AND LIMITED SEXUAL REPRODUCTION WITH SIGNIFICANT REDUCTION OF ONE SITE DUE TO ROAD DEVELOPMENT.

OCCURRENCE: NOVA SCOTIA

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STATUS REPORT ON ENDANGERED WILDLIFE IN CANADA

Long's Bulrush

COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA

COSEWIC

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JUNE 1990

OH3 (819)
Ottawa, Ont. K1A 0E4 (613) 997-4991

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STATUS REPORT ON THE LONG'S BULRUSH

SCIRPUS LONGII FERN.

IN CANADA

BY

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STATUS ASSIGNED IN 1994
VULNERABLE

Abstract

Long's Bulrush (*Scirpus longii* Fern.) is a robust sedge that grows in a variety of nutrient-poor, freshwater wetlands along the eastern seaboard of North America. In Canada, it is restricted to waterlogged meadows, fens and lakeshores in southwestern Nova Scotia. Plants are extremely slow-growing and form circular clones in the absense of disturbance. Before research on this status report began, the plant's Nova Scotian distribution rested on one site discovered in 1941. Once the plant was recognizable in its non-flowering, vegetative state, eighteen additional sites were described. Although the species has large populations at four of these sites (wet meadows and fens), populations are threatened by alteration to drainage patterns by highway construction, extensive herbivory by muskrats on the plant's culm bases and rhizomes, and the suppression of fire. Other threats include the loss of lakeshore habitats due to cottaging and "All-terrain vehicle" use in fens and meadows. It is proposed, therefore, to list this plant as threatened in Canada due to the limited number of known sites and the vulnerability of populations at many of these sites. The two most important sites for conservation are the wet meadow at Eel Weir Stillwater and the fen complex at Eighteen Mile Brook.

Note: Because of the large size of at least four of the known populations and the plant's ability to propagate vegetatively, COSEWIC members designated this species as vulnerable in Canada. [Chairman, Plants Subcommittee, July 1994)

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I. Species Information

1. Classification and Nomenclature

A. Species

(i) Scientific name: *Scirpus longii* Fern.

(ii) Bibliographic citation: M.L. Fernald (1911) A new species of *Scirpus* from Massachussetts and New Jersey. Rhodora 13: 4-8.

(iii) Type: northeast of Andrews, along Great Egg Harbour River, Cambden County, New Jersey, June 18, 1910, Bayard Long, no. 4014 Gray Herbarium (duplicate in Herb. Acad. Phila.).

(iv) Synonym: none.

(v) Common name: Long's bulrush (Fernald, 1911).

B. Family name: Cyperaceae (Sedge family).

C. Major plant group: Monocotyledonae of Division Anthophyta.

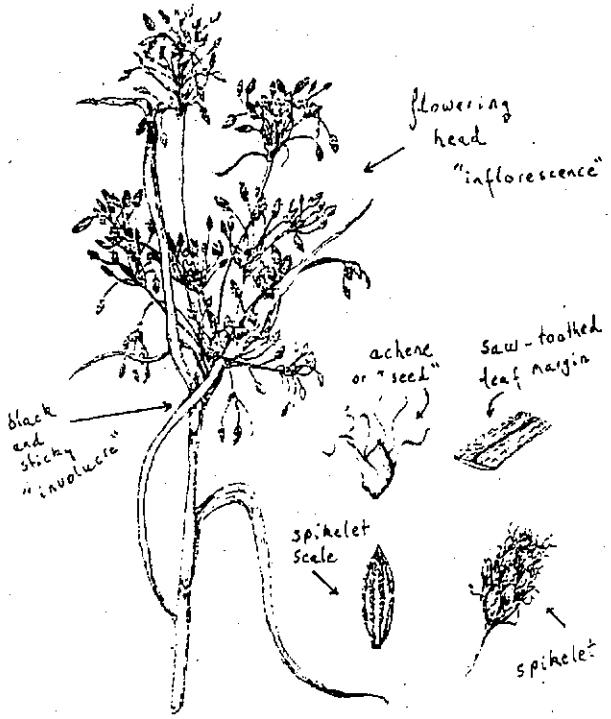
D. Current alternative taxonomic treatments: Most treatments consider *S. longii* Fern. to be a "good" species. Detailed systematic treatment by Schuyler (1963a) fully supports the morphological distinctiveness of the taxon. An ecological study by Schuyler (1963b) further demonstrated its distinctiveness. Scoggan's The Flora of Canada (1978) incorporates the taxon into *Scirpus cyperinus*. Gleason's New Britton and Brown Illustrated Flora (1974) and the synonomized checklist of Kartesz and Kartesz (1980) give *Scirpus longii* specific status.

E. History of taxon: The plant was first recognized as being distinct from either *S. cyperinus* or *S. atrocinctus* Fern. by Witmer Stone in 1909 and by Bayard Long in 1910 (Fernald, 1911). Bayard Long's "keen discrimination" caused Fernald to associate the newly found species with his name.

2. Description

This is a robust, perennial sedge belonging to the true "bulrush" genus, *Scirpus*. It seldom produces flowering shoots (Figure 1 A), therefore the field worker will have to learn to recognize the plant in its normal vegetative condition. This is not as difficult as it might first appear since the plant forms distinctive circular clones (all the growth derived from one initial seed) when it is not disturbed (Figure 1 B). Circular clones do not usually form until the clone

A.



B.

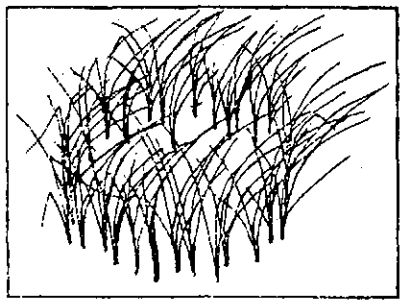


Figure 1 A. Characteristics of flowering shoot (Crow, 1982).

B. Circular clone (Hill & Johansson, 1992).

has achieved a diameter of approximately one metre. The second key feature to recognize are the thick undergound stems, rhizomes, that represent previous years of growth of the plant. More weedy species of *Scirpus*, *S. cyperinus* and S. atrocinctus, may occur in edge habitats surrounding *S. longii* populations. Such habitats include road-side ditches and river-edges. The weedy species are tussock-formers and do not produce long rhizomes (Table 1) or the characteristic ring-shaped clones ("bushel-baskets") of *S. longii*. Rhizome position is also useful to distinguish the plant from a co-occuring sedge, *Carex rostrata*. While the vegetation of *C. rostrata* plants resembles superficially that of *S. longii*, *C. rostrata* rhizomes are not near the surface like those of *S. longii*, but are commonly formed 25 cm or more below the peat surface.

The leaves of *S. longii* are commonly 60-80 cm in length and usually are bent over at two-thirds of their length. This characteristic bending is a good field characteristic, noticeable from a distance. The leaves are tough and their margins (and keel) finely serrate so that handling the sedge can easily cause bleeding. Leafy shoots are restricted to the growing ends of rhizomes and this is responsible for the ring-shaped clones previously described (Figure 1 B).

As stated, flowering culm (stem) formation is a rare event for *S. longii* clones. However, if a flowering culm is spotted, it is useful to confirm that one is dealing with *S. longii*. The flowering culm of *S. longii* is usually about 20 cm taller than that of *S. cyperinus* and the flowering head, or infloresence, is larger due to the longer spikelet stems making up the flowering head. The bracts underneath the inflorescence (Figure 1A) are black and, on humid days, are distinctly sticky. Individual seeds can be pried out of the spikelets; the seed (technically an achene) has five bristles emanating from the seed base but the important key characteristic is the reddish colour of the seed. You will need ripe seeds to note this colour difference. I have not found spikelet length (used in Roland and Smith, 1969) a reliable characteristic as there is overlap in the length distribution of spikelets between *S. longii* and it weedy relatives. Schuyler (1963a) found that the length of the scales comprising the spikelet in *S. longii* was almost double that in the weedy relatives (Table 1). Scale length was found to be of intermediate length in putative hybrids between *S. longii* and *S. cyperinus* (Schuyler, 1963a).

Illustrations: Gleason's New Britton and Brown Illustrated Flora (1974) and Crow (1982, used in Figure 1A). Photographs of pressed specimens, one showing a long rhizome, in Schuyler (1963b) are also helpful.

Table 1. Morphological distinction between three species of *Scirpus**

CHARACTERISTIC	*Scirpus* SPECIES		
	S. cyperinus	*S. atroctinctus*	*S. longii*
GROWTH FORM	dense tussocks	dense tussocks	circular clones
	short inter-connecting rhizomes	short inter-connecting rhizomes	long, radially expanding rhizomes
RHIZOME WIDTH (cm)	1-1.5	1-1.5	1.5-3.0
INVOLUCRE	reddish-brown to black	black	black
	not sticky	not sticky	sticky
SPIKELET SCALE LENGTH (mm)	1.1-2.0	1.4-1.8	2.2-3.1
ACHENE COLOUR	white	white	reddish-brown

* Sources: Schuyler, 1963a and personal observation of fresh and herbarium material.

3. Biological and Economic Significance

Scirpus longii belongs to a complex of coastal plain species in Nova Scotia that are found nowhere else in Canada. These species originated in freshwater wetlands of the Atlantic Coastal Plain of eastern North America but were able to extend their ranges northward when sea levels dropped at the height of the glaciation (Roland and Smith, 1969). Many of these coastal plain species are rare and by preserving them, we ensure that others may be educated first hand by their distribution and ecology.

Secondly, this species is a dominant plant in fens and in stillwater marshes. The undisturbed clones at these sites stabilize wetland substrates. Large clones are typically from 5-10 m in diameter and are about 150-300 years old (roughly extrapolated from a 1 m diameter clone which was 40 years old).

Thirdly, apart from shrubs, this is the most robust plant in the low-nutrient wetlands where it grows. Its culm bases provide food for muskrats during the winter at sites near rivers. Large "push-ups", or muskrat feeding platforms, can be seen in river or lake-side habitats with large *S. longii* populations; these push-ups are composed exclusively from the tops of *S. longii*. In the following summer, old push-ups make ideal nests for jumping mice.

4. Distribution

A. Geographical Range.

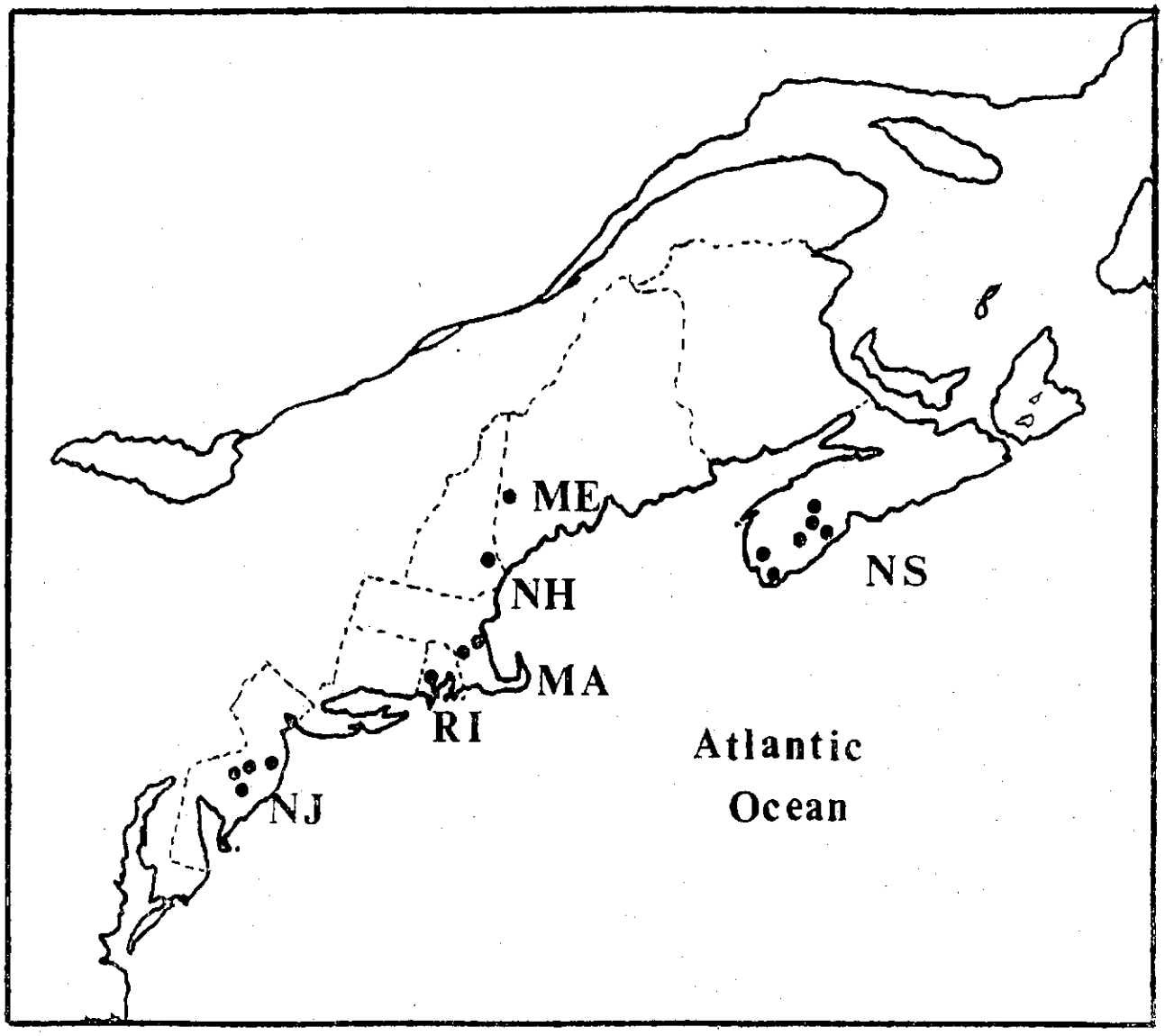
Distribution in United States (Map 1).

The distribution of Long's Bulrush in the United States is given in a status report for the U.S. Fish and Wildlife Service, (Rawinski, 1990). The species is most abundant in the Pine-barrens of New Jersey, is poorly represented in New England (Massachusetts, Rhode Island and New Hampshire), and is locally abundant in the wetlands bordering the Saco River in Maine. It was extirpated from New York and Connecticut.

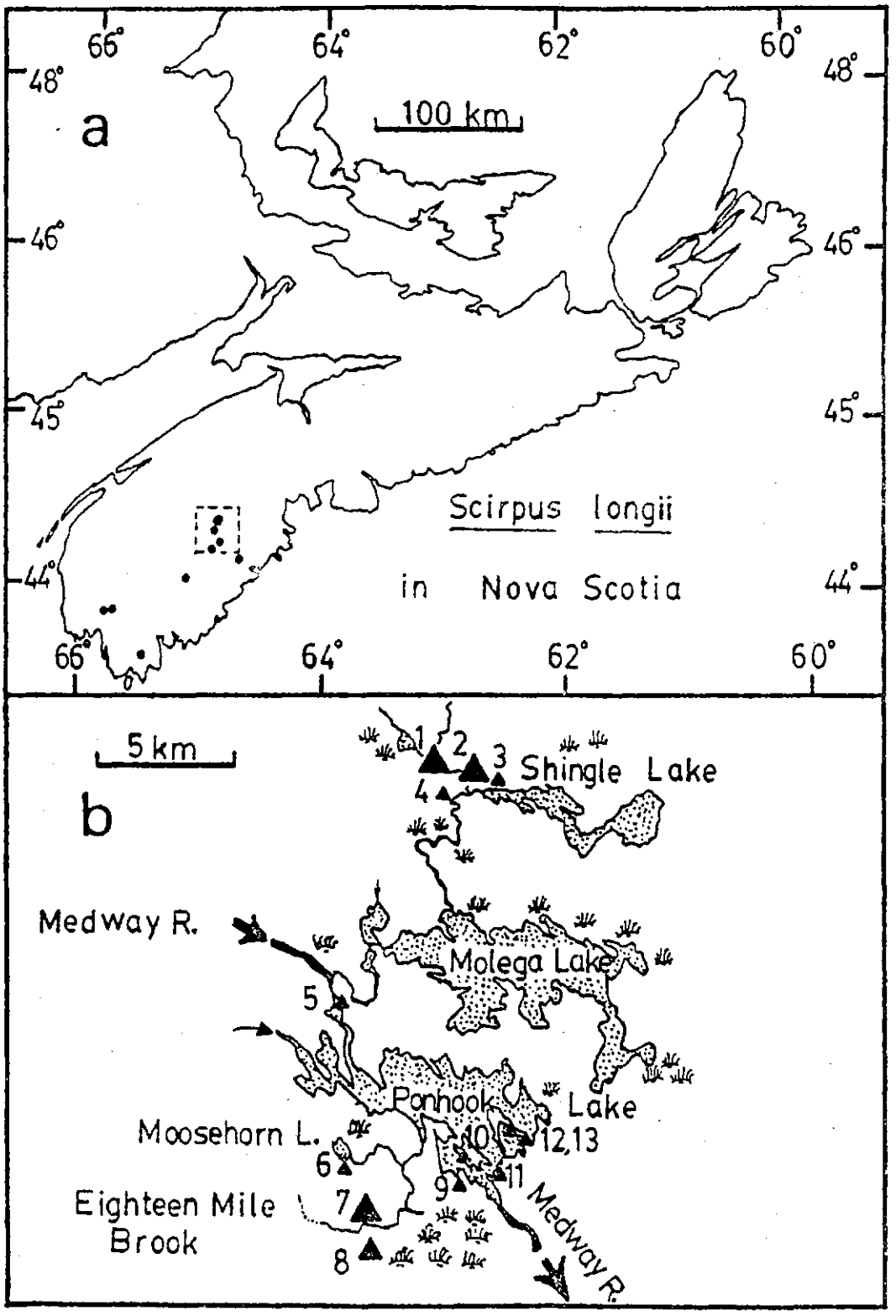
Distribution in Canada (Map 2A &B).

The last workers on the flora of Nova Scotia, Roland and Smith (1969), cited the findings of Weatherby (1942) when describing the Nova Scotian distribution of *Scirpus longii*. More recent publications (Crow, 1982, Scoggan, 1978) also mention one site for *S. longii* in Nova Scotia. This status report demonstrates that the species is rare but scattered throughout the south-western portion of the province (Map 2, A). The species is locally abundant in certain wetlands of the Medway River (Map 2, B).

Scirpus longii still occurs at Ponhook Lake (Map 2 B, sites 9-13) as Weatherby stated (precise location of Weatherby's original site not stated). A "battered individual, probably of this species" (Weatherby, 1942) had been found at Moosehorn Lake in 1941; I found four small



Map 1. World range of Scirpus longii. (•)



Map 2. (a) Scirpus longii in Nova Scotia.
(b) Detail of boxed area in (a).

Triangles represent area over which S. longii is a dominant:
▲ = 10-15 ha, ▲ = 5 ha, ▲ = less than 1 ha.

clones (each < 1 m in diameter) of *S. longii* at the boggy outflow to this lake in 1990.

The largest populations in Nova Scotia cover about 30 ha of stillwater meadow near Shingle Lake (Map 2 B, sites 1 and 2). The second centre of abundance of the species is fenland beside Eighteen Mile Brook (Map 2 B, sites 7 & 8), where *S. longii* occurs over a 15 ha area. Weatherby (1942) recorded *Salix pedicellaris* var. *hypoglauca* from Eighteen Mile fen but not *Scirpus longii*.

There are many small lakeshore bogs supporting *Scirpus longii* in the Medway River system (Map 2 B, and one population found by C. Keddy and I. Wisheu at Riversdale, east side of Medway R.). Only two small lakeshore populations have been found in the Tusket River, at Wilson's Lake (43°56'N, 66° 53' W) and
at Lac d'Ecole (44°56'N, 65°49'W). One small (ca. 100 individual shoots), ATV threatened population occurs at the southeastern corner of Quinns Meadow (43°40'N, 65°29'W). A young population (clones of 1 m dia) occurs at Dunraven Bog (44°05'N, 65°08'W), quite isolated from any others found.

B. Potential Sites For Investigation.

Undoubtedly other locations for *Scirpus longii* will be discovered in southwestern Nova Scotia. Although the southwest has attracted some botanizing, parts of the Tobeatic Area below Kejimkujic National Park have been scarcely investigated. In the course of this field work, I found two new populations of *Lophiola aurea*. One occurred in a bay bog at Shingle Lake, the other at Dunraven Bog, just below the Tobeatic Area, where *L. aurea* covered several hectares of flowing fenland.

C. Status and Location of cultivated materials. None except small-scale transplantation for research purposes by A. E. Schuyler of New Jersey material and by N.M. Hill and E.Reekie of Nova Scotian material.

D. Biogeographic and phylogenetic history. I can find no reference to the evolutionary origins of *S. longii*. Its meiotic chromosome number is 33 as is that of *S. cyperinus*. Schuyler (1963a) describes a series of weedy *Scirpus* as the " *S. cyperinus* complex" but does not include *S. longii* as part of this complex, presumably for ecological and phenological reasons. Fernald (1943) described *S. longii* as " an old Coastal Plain type which like so many other species, became isolated in Nova Scotia before the late Tertiary or Pleistocene submergence of the continental shelf".

5. General Environment and Habitat Characteristics.

Summary: Found in the southwest of Nova Scotia in peat wetlands where competition from shrubs is minimal due to waterlogged conditions or to the removal of shrubs by ice scour. Many wetland types occupied; these include the peaty shores of high watershed lakes, small bogs

associated with lakes or rivers, stillwater meadows and inland fens.

A. Climate: *Scirpus longii* is found in inland stations and at sites close to the coast (Map 2 A,B). The coastal climate is moderated by the sea so that coastal sites do not reach as high summer temperatures as inland sites but they have more frost-free days (Anon, 1986, Nova Scotia Dept. Agriculture and Marketing, Agroclimatic Atlas). Interestingly, many of the sites of the species are in or near climatic zone "1C", which is the optimum zone in the province for both heat and May-September precipitation (> 1800 heat units, 450-500 mm May-Sept. rain).

B. Water quality: Analysis of water chemistry has not been performed for bog and fen sites, however, pH levels for lakes of the Medway River were 4.5 (Ponhook L.) and 4.3 (Shingle L.) and for Tusket River lakes were 4.3 (Wilson L.) and 4.3 (Lac d'Ecole).

C. Physiography and topography: Populations are found from less than 50 feet above sealevel (e.g. Wilson's Lake) to more than 300 feet above sealevel (Dunraven Bog). The species inhabits a range of wetland types from fens with small watersheds to small bogs beside lakes or rivers to the peaty shores of high watershed area lakes. It does not occur directly on the shores of small watershed area lakes. *S. longii* has not been found east of the Medway River watershed and it may be excluded from more easterly watersheds (e.g. the LaHave River) because of their greater soil fertility and soil drainage. The areas are very different geologically, the easterly LaHave region is distinctive in its high density of moraines.

D. Edaphic factors: The species is always found on peat substrates, whether it occurs on lakeshores (Wisheu et al., 1992), stillwater marshes or fens. The pH of these peats is generally low (see above water quality data) and I suspect that the nutrient status (e.g. cations, mineralizable N and P) of these peatlands is also low since these areas are dominated by low-biomass plant communities. All *Scirpus longii* habitats are submerged from November to April; the stillwater meadow site at Shingle Lake (Map 2 b, sites 1&2) remains inundated until mid-May. In summer, most sites remain saturated with water (stillwater meadows, lakeshore bogs) but the surface peat of fens may dry out so that the watertable is more than 15 cm below the surface of hummocks in August (Aug. 20, 1990, Eighteen Mile Brook fen).

E. Dependence on dynamic factors:

The presence of rare coastal plain plants has been associated with the flooding regime of wetlands (Keddy, 1985, Hill and Keddy, 1992). For river system lakes, flooding is highly correlated with the watershed area of the lake and so areas of potential importance can be predicted from maps. *Scirpus longii* grows in a variety of wetland habitats in Nova Scotia where flooding reduces the intensity of competition by shrubs. However, in these wetlands and in bogs in particular, flooding is not correlated with watershed area but is rather related to the local drainage characteristics of the wetland.

Rare coastal plain plants may as a group be poor competitors (Gaudet and Keddy, 1989)

and flooding may be just one of the mechanisms that reduces competitive interactions in wetlands.

In bogs and in the stillwater communities, flooding-induced anaerobiosis probably allows *S. longii* to avoid competition from shrubs and more vigorous graminoids (e.g. *Carex stricta* or *Calamagrostis canadensis*). On the shores of high watershed area lakes, ice scouring appears to remove above ground biomass and prevent the establishment of high biomass plant communities. On the peaty shores of Ponhook Lake ice-scouring appears to pass over the top of secure rhizomatous species and one sees *S. longii* co-occcuring with *Osmunda regalis* on these shores, both perennials with thick rhizomes.

(see F., vi. on influence of fire)

F. Biological Characteristics:

(i) Vegetative physiognomy and community structure.

Five wetland habitat types have been identified for *S. longii* in Nova Scotia (Hill and Johannson, 1992); these are stillwater meadow, fen, "bay" and "barrier" bogs associated with lake or rivershores and peat shores of high watershed area lakes. *Scirpus longii* inhabits the most waterlogged areas of these habitats where shrub growth is most sparse. The stillwater meadows border the slowly-moving Pleasant River in which flood waters back up after heavy rains; the communities are dominated by graminoids (*Carex oligosperma, Carex stricta, Carex bullata* and *Spartina pectinata*) and have scattered clumps of *Myrica gale*. The fens are sphagnous and have a diversity of low shrubs dominated by *Gaylussacia dumosa* and *M. gale* growing over the hummock and hollow microtopography. These are the driest of the *S. longii* habitats and competition from shrubs may be significant.

Small peat wetlands associated with lakeshores or riversides classed as "bay" or "barrier" bogs have different hydrological processes. Bay bogs form when peat accumulates in sheltered bays of lakes, eventually filling in the entire bay. Growth of *Myrica gale* robust at the water's edge of these bogs, but is depressed in the central waterlogged region. Shrub height and cover recovers toward the terrestrial rocky margin of the bay bog, which is the original lake shoreline. *S. longii* is most commonly found in the central region of bay bogs, where the amount of standing water is greatest. "Barrier bogs", on the other hand, are small wetland areas separated from lakes (or rivers) by a rocky barrier. They become flooded in winter when the water level of the neighbouring waterbody rises. Because of the impermeable barrier of rock, these bogs remain flooded after the water level of the lake or river has fallen in spring.

Finally, at high watershed area lakes, populations of *S. longii* occur directly on the peaty shores near the water's edge. These shores are ice-scoured which removes woody shrub growth but not rhizomatous species.

(ii) Regional vegetation type.

Acadian Forest Region, Atlantic Uplands Section (Rowe 1972).

(iii) Frequently associated species. See Table 2.

Table 2. Common associates of *S. longii* in various wetland habitats.

SPECIES	HABITAT			
GRAMINOIDS	Still-water	Bogs*	Fens	Lakes
Calamagrostis canadensis	+	+	+	+
Calamagrostis pickeringii	-	-	+	-
Carex oligosperma	+	+	+	-
Carex bullata	+	+	+	-
Carex stricta	+	-	+	-
Carex bauxbaumi	-	+	+	-
Cladium mariscoides	+	+	-	+
Lophiola aurea	-	+/-	-	+
Spartina pectinata	+	-	-	+
FORBS				
Aster nemoralis	-	+	+	+
Drosera intermedia	-	+	+	+
Euthamia galletorum	+	+	-	+
Proserpina pectinata	+	+	+	-
Sarracenia purpurea	-	+	+	-
Viola lanceolata	+	+	+	+
SHRUBS				
Gaylussacia dumosa	-	-	+	-
Myrica gale	+	+	+	+
Salix pedicellaris	+	+	+	-
FERNS				
Osmunda regalis	-	-	-	+

* Bogs refers to barrier and bay bogs; +/- indicates that a species is a common associate in bay bogs but not in barrier bogs.

(iv) Successional phenomena

Field observation suggests that the species cannot tolerate competition from shrubs and that it occurs in habitats where shrub growth is checked by waterlogging or ice-scouring.

Distributional evidence at the stillwater meadow suggests that the species becomes established quite close to the shoreline of the stillwater where flooding and disturbance are greatest. The frequency of clones was greatest from 0-50 m away from the stillwater edge and steadily decreased thereafter (50-100 and 100-150 m away from the water's edge). There was also the largest proportion of small clones (< 1 m diameter) in meadow nearest the water's edge.

Clone diameters at various sites suggest that individuals have greatest longevity at the stillwater meadow and at the fen sites. Clones at both types of bog sites and on lakeshores are small (<2 m diameter). Fen clones are commonly over 5 m in diameter and a 50 m clone has been found at the stillwater site. This suggests that extensive clone development occurs only where disturbance is minimal. One 1 m wide clone has been dated at the stillwater meadow and is 40 years old.

Once established, *S. longii* may help to stabilize marsh areas (e.g. the wet meadow) and direct succession. One small clone excavated by Clancey and Hill showed that there was a steady increase in the micro-scale elevation of rhizomes of *S. longii* from its origin to its peripheries; after 40 years of growth, the outer rhizomes were on average 4.5 cm higher than rhizome height at the origin of the plant.

(v) Dependence on dynamic factors.

The influence of flooding and ice-scour is discussed in another section (see 5 E, 5 G sect.v). Fire is known to be beneficial to *S. longii* in pine-barren habitat in New Jersey since fire reduces competition and induces flowering in *S. longii* (Schuyler and Stasz, 1985). No one has observed fire in *S. longii* habitat in Nova Scotia, however, I have recently found evidence of a fire in the driest of the species' habitats in Nova Scotia. I have found charred wood 35 cm below the surface of the fen at Eighteen Mile Brook. The oldest cohort of clones at this site with diameters ranging from 5 to 6 m must have become established in the 1890's after a fire swept through the area (pers. comm. Harry Freeman); this date is very close to the estimated age of a 5.5 m dia clone (supposing circle formation was rapid, the radius of a 5.5 m dia clone would be traversed by a rhizome growing at an annual rate of 2.4 cm in 114.6 years).

The species also appears to benefit from herbivory on its culm bases by muskrats. This has been found to increase the incidence of flowering in Nova Scotia. This is discussed under Population Ecology (7).

(vi) Other endangered, threatened and rare species.

Stillwater meadow: *Salix pedicellaris* (rare in Nova Scotia).

Bay bogs: *Lophiola aurea* (Threatened--Cosewic), *Utricularia subulata* (G5---U.S. Nature Conservancy), *Cephalanthus occidentalis* (rare, N.S.).

Barrier bogs: *Asclepias incarnata* (rare, N.S.), *Salix pedicellaris* (rare, N.S.).

Fens: *Lophiola aurea* (Threatened), *Salix pedicellaris* (rare, N.S.)

Lakeshores: *Lophiola aurea* (Threatened), *Lachnanthes tinctoria* (G4--U.S. Nature Conservancy), *Panicum longifolium* (G5--U.S. Nature Conservancy), *Utricularia subulata* (G5), *Woodwardia areolata* (G5)..

6. Population biology

Summary: There are nine areas supporting populations of *Scirpus longii* in Nova Scotia (Map 1 a). *S. longii* is most common around the southern and western sides of Ponhook Lake, about the watershed of Eighteen Mile Brook and near the outflow of Shingle Lake.

At Ponhook Lake (**sites 9, 10, 11, 12, 13**), populations of *Scirpus longii* are small (ea. covers less than 1 ha) and occur either on sloping peaty lakeshores or in "bay bogs" which are above the lakeshore and only flooded overwinter. Lakeshore populations are ice scoured and clones are small (less than 1 m in diameter) and most appear to have been ice damaged. Bay bog populations are larger; the largest occurs at Grassy Point (**site 9**) and is comprised of approximately 9000 individual shoots. Individual clones are not distinguishable at this site, which is due possibly to herbivory by muskrat on the culm bases and rhizomes during overwinter flooding of the bog.

At Eighteen Mile Brook (**site 7**), clones of *S. longii* are mostly discrete and circular in outline. *S. longii* is a dominant species throughout a narrow fen area, approximately 1 km in length by 50 m in width, which is transected by Highway 8. The oldest clones have diameters of 5.5-6.5 m and appear to belong to a cohort that may have established after a fire in the 1840's (see "dynamic factors"). There are scattered clones in fen north of Eighteen Mile Brook, 1-1.5 km due west of the highway bridge over the brook. A second fen site (**site 8**) is 1 km south of the bridge. This population covers a 300 by 100 m area and is also transected by route 8.

There are four small (< 1 m dia.) clones around the outflow of Moosehorn Lake (**site 6**) which drains into Eighteen Mile Brook 3 km downstream from site 7.

There is a complex of populations near the outflow of Shingle Lake (**sites 1,2 ,3,4**) in three distinct wetland types: wet meadow and barrier and bay "bogs". The two largest populations of *S. longii* in Nova Scotia occur in a wet meadow at Eel Weir Stillwater (**site 2**) and in meadow further up the Pleasant River (**site 1**). *S. longii* is a dominant at the meadow at Eel Weir Stillwater over a 15 ha area; small (<0.75 m diameter) hemispheric clones are common near the water's edge and discrete circular clones range from 1 to 10 m diameter. Swarms of several intermingled clones occur; the largest covers a 30 x 50 m area. The meadow site upstream near an old sawmill has a larger population of *S. longii* clones distributed in meadow that is interrupted by two brooks and small patches of woodland. The population structure (i.e., size class distribution of clones) is similar to that at the stillwater although small hemispheric clones are not common.

Three bay bogs (**site 4**) border the Pleasant River, 0.5 to 1.5 km downstream of the stillwater meadow. The first, on the north shore of the river, contains 45, 1m dia. clones. The second, on the opposite shore, contains two intact clones, 1 and 3 m in diameter respectively, and the outlines of two clones of similar sizes which were removed by muskrat herbivory. Other

scattered clumps of small groupings of ramets account for 600 ramets. There were 10, ca. 1 m diameter clones at the third bay bog. The head of this bog had been disturbed by bulldozing to provide a road for new housing.

There are three small populations of *S. longii* on Shingle Lake near its outflow (site 3). Two bay bogs support 200 and 7, ca. 1 m diameter clones, respectively. Growth of clones in the third bog, which is an oval of 75x45 m dimensions, is more sparse. The bog supports ca. 100 clones ranging from 0.5 to 1m in diameter; several have been entirely removed by herbivory.

Six small riverside marsh populations occur along the Medway River north of Echo Lodge above Ponhook Lake (site 5). Most of these small populations have sustained subtantial losses to a herbivore (presumably the muskrat); circular patches of bare marsh are usually more common than intact clones at these sites.

A barrier bog at Riversdale, on the east of the Medway River, 15 km south of Greenfield, is densely populated with *S. longii* which forms almost pure stands in the centre of the bog. *S. cyperinus* occurs at the periphery of the bog and putative hybrids, intermediate in bract length, have been observed.

The remaining populations in Nova Scotia are not part of the Medway River watershed and are widely separated from one another. Nineteen clones occur in an isolated fen east of Dunraven Bog; the largest clone is five metres in diameter but most are one metre in diameter. A small endangered population occurs at the southern end of Quinn's Meadow on the west shore of the Clyde River. It consists of less than 100 individual shoots. Finally, there are two small populations on lakes of the Tusket River (Map 1 a, most southwesterly location). The population at Wilson's Lake in a bay bog is composed of approximately 10 discrete, 1 m diameter clones. That at Lac d'Ecole occurs on organic muck directly on the lakeshore; the circular clones of *S. longii* form a monoculture at the waterline.

Population dynamics

In general, there is little indication of whether populations are expanding or are in decline. Evidence for recent expansion can be taken from the size distribution of the clones which make up the population. In the meadow at Eel Weir Stillwater, there is a mixture of large clones (5-10 m diameter) and small clones (< 1 m diameter). The largest (10 m diameter), discrete circular clones are probably about 400 years old (annual rhizome growth = 1.5 cm). It would not be possible to estimate the history of the larger "mosaics" composed of several individuals. The origin (central area) of several clones have been investigated and it appears that many may be initiated from chunks of rhizome. These chunks may be liberated from existing clones by ice scour or by muskrat damage.

The size class distribution of clones at Eighteen Mile fen differs from the stillwater primarily in that the oldest clones range from 5.5 to 6.5 m in diameter. Charred wood was found 35 cm below the fen which suggests that a fire may have provided the stimulus for flowering and suitable habitat for establishment from seed (cf. Schuyler and Stasz, 1985). Annual rhizome growth in the fen is greater (ca. 2.4 cm/annum) than in the stillwater meadow and it indicates that the 5-6 m cohort of clones may have become established in the fen in the

1870's. The landowner has confirmed this fire as having occurred in the 1890's. Another difference between this fen population and the Eel Weir meadow populations is the lack of small clones (< 1 m dia.) at the fen. This may reflect a difference in the disturbance regimes of the sites. Whereas ice scour and muskrat damage at the wet meadow may produce small sections of rhizome which may then regenerate into small hemispheric clones, at the fen, disturbance from muskrat or ice is very limited.

With only a few exceptions, small populations (e.g. over a 0.1 ha) are composed of small clones with maximum diameters less than 2 m. On lakeshores, it seems that the turn-over rate of individual clones is high because of ice scour disturbance or muskrat herbivory. If turn-over is higher in small populations directly on sloping lakeshores or in small, protected peat wetlands above the zone of ice scour, this could account for the lack of larger, older clones. Exceptional cases are two of the larger populations (covering ca. 0.3 ha) in barrier bogs at Grassy Point and at Riversdale. In both places, individual clone
demarcation is hard to determine. In both places there is evidence (pers. comm. with local landowners and muskrat push-ups) that *S. longii* plants have been grazed routinely which may have affected clonal growth. A third population on a gently sloping mucky shore at Lac d'Ecole covers a small area (ca. 0.1 ha) over which *S. longii* circular clones abut and appear to fuse with one another. At this site with a high watershed area, flooding may help to exclude potential competitors with *S. longii* but disturbance of clones by ice scouring appears to be lower than in other lakes of equivalent watershed area. This may be related to the lake's small surface area.

At the southern side of Ponhook Lake local population eradication and recolonization may be on-going; small populations on lakeshores appear to be quite dynamic and transient. At other sites, such as Wilson's Lake and Dunraven Bog, what appear to be newly established populations are quite isolated from nearest *S. longii* populations. There are 19 small clones at Dunraven Bog which are isolated from other *S. longii* populations. There is no evidence of disturbance to this population and it has probably been established in the past 40 years. A population in the bay bog of Wilson's Lake is one of only of two small populations on the Tusket River watershed. The ca. 1 m diameter clones at Wilson's Lake may have also become established in the last 40 years.

In contrast, the population of approximately 100 individual shoots at Quinn's Meadow on the Clyde River will probably not persist. It appears that *S. longii* is in the process of being outcompeted by faster growing sedges (*Carex bullata* and *Carex stricta*) and that its demise is exacerbated by frequent All Terrain Vehicle passage through the population. Other cases of serious anthropogenic disturbances of *S. longii* populations are the two populations in fens, draining into Eighteen Mile Brook, which were both divided in two by the construction of Highway # 8. The damming of the water flowing through the fen by the highway has in all likelihood, caused the upstream side of these fens to become more flooded and the downstream side of the fens less so. It is evident that the growth of moss, shrubs and the tree, *Larix laricina*, is greater in fens on the downstream side of the highway. This should lead to the loss of *S. longii* because of greater interspecific competition in the eastern portions of these fens.

Phenology

Scirpus longii is a stress tolerant sedge. A dominant meristem produces 10-13 leaves per season and produces 0.8-2.2 cm of rhizome growth per year. In the absence of disturbance, no above ground culms are formed from the meristem or from the dormant buds on rhizomes which normally remain viable for 15 years. Leaves turn golden in early September and die back to their bases in winter. The leaves of the following season are initiated during winter when the plant is flooded. By early May, when other sedges in its flooded wetland habitat (except *Carex folliculata*) exhibit no leaf growth, about 8 cm of yellowish green leaves have been produced by *S. longii*. Maximum height of these leaves is achieved by mid-July and in absence of disturbance, that is all that *S. longii* exhibits.

Leaves are only produced by the rhizome meristem tips and this results in the distinctive ring form of growth of *S. longii* clones; a phalanx-like ring of outer leaves surrounds an inner area of older rhizome segments. Rhizome segments remain viable for 15 years but dead rhizomes are still intact after 40 years in the marsh. Yearly rhizome production is fairly constant. Clancey and Hill (unpublished) have intensively studied a 40 year clone and found that there is little variation in annual rhizome growth (evident from annual winter constrictions in rhizome girth). There are differences in growth rates between wetlands; annual rhizome extension rate at Eel Weir Stillwater was 1.45 cm. y^{-1} and that at Eighteen Mile fen was 2.4 cm y^{-1}. The record of annual growth of the species may be useful for correlating changes in site hydrology with growth. Rhizomes produce intravaginal daughter shoots on average every 8 years; evidence from Reekie and Hill suggests that the production of intravaginal daughter shoots is increased when the fertility regime is artificially increased. This may allow the species to maintain its unbroken phalanx of shoots. Increased fertility does not appear to affect the dormancy of buds on viable rhizome sections (of age 2 to 13 years). This bud bank appears to be activated only when rhizomes have been partially destroyed (e.g. by fire or herbivory).

Reproductive ecology

Vegetative reproduction is the rule if this plant is not disturbed. Buds on rhizomes usually do not develop to form branches (these are formed through intravaginal tillers) and the average period between branching events on all rhizomes of the clone studied by Clancey and Hill (unpublished) was 8.2 +/- S.D. 6.1 years. Dormant buds are particularly important when the actively growing rhizome tip is removed by muskrats. Removal of the tip meristem may remove inhibition of lateral meristems, which in this case are the dormant buds on the viable rhizome. The density of shoots after muskrat herbivory is greater than the density of shoots in undisturbed clones of *S. longii*.

Flowering culm formation from rhizomes is rare. Many populations will include no flowering culms in any given year despite a large number of rhizome meristems and dormant buds. Flowering culm formation appears to depend on disturbance; in one meadow in Nova Scotia, 24 flowering culms were located for a population which comprised an estimated one million leafy shoots. All of the flowering culms were produced from rhizomes that had been grazed by muskrats in the previous winter when the plant was flooded.

Fire causes flowering culm formation in pine barren habitat in New Jersey. Although there is no proof that fire plays a role in the reproduction of *S. longii* in Nova Scotia, a recent finding of charred wood at a depth of 35 cm below the surface of Eighteen Mile fen suggests that the 5-6 m diameter clones may have been a cohort that became established after this fire. My estimate of the age of these clones from rhizome growth rates, was 115 years. There was a fire in the area in the 1890's according to Harry Freeman (pers. comm. 1992) which probably marks the beginning of this cohort.

It is generally assumed that drab inflorescences such as those in the genus *Scirpus* are wind pollinated. Hoverflies were observed to settle on inflorescences of *S. longii* and *S. cyperinus* which I was growing under experimental conditions in open air. It is not known whether these are pollinating insects in the field.

Dispersal of seeds occurs by water or wind. Large aggregations of the extremely light weight seed with delicate bristles break away from the flowering culm and probably have only short dispersal range. However, individual seeds may be carried widely by wind and could conceivably account for the establishment of populations such as that at Dunraven Bog which is isolated from other populations of *S. longii*.

I have germinated fresh seed of *S. longii* on moistened peat maintained in a misting chamber. I have not been able to find seedlings of *S. longii* in the field and judging from the size class distribution of clones, it would appear that germination and establishment of seedlings in the field is a sporadic event. For populations in habitats near flowing water, ice scour disturbance and muskrat herbivory may disrupt clones so that new clones are formed from rhizome fragments. This appears to be the case at the wet meadow sites at Eel Weir Stillwater and for populations occurring directly on sloping lakeshores (e.g. Ponhook Lake).

Overall assessment of reproductive success

The indications are that the species is primarily relying on rhizome fragments to initiate new "clones" at sites with ice scour or herbivory-caused disturbance. At fens, fire may have played a role in the initial establishment of the populations, however, this process has not been observed to occur. Controlled experiments with burning patches of fen, conducted under the supervision of the N.S. Department of Natural Resources, might be useful to determine whether this is a good technique for management of fen populations in Nova Scotia.

7. Population ecology

Herbivory. Herbivory of *S. longii* shoot bases by muskrat can damage a large proportion of *S. longii* individuals. At a barrier bog on Ponhook Lake (Grassy Point), during the winter of 1990-1991, muskrats damaged 20% of *S. longii* shoots (Hill and Clancey, unpublished). Greatest damage occurs in populations on lakes or rivers while those in fens appear largely unaffected by muskrat herbivory. Although damage may be extensive, recovery of above-ground shoot production from remaining *S. longii* rhizomes is rapid. Large numbers of shoots are produced from dormant buds on surviving rhizomes. A small fraction of such shoots produce flowering culms. This has great significance to this otherwise wholely vegetative clonal plant. Hill and

Clancey examined 12 flowering culms in a wet meadow (which produced a total of 24 flowering culms), and found that 11 of 12 were produced directly from the grazed end of a rhizome (ms in preparation). Silvertown (1988) has discussed the evolutionary significance of rare flowering events to clonal plants.

Thus, flowering culm initiation in *Scirpus longii* appears to be triggered by disturbance. The underlying physiological mechanism is obscure. Plants in the New Jersey pine barrens flower after fire damage (Schuyler and Stasz, 1985). Fires are rare in fens and probably do not occur in wet meadow habitat. It may be that disturbance caused by muskrat herbivory has a more important role than fire in increasing genetic recombination of *S. longii* genes in Nova Scotia. Low levels of muskrat herbivory may therefore be beneficial to *S. longii*. Aside from the ascribed benefits to populations from increased genetic recombination, a more immediate benefit is the production of widely dispersable seed which can colonize new areas (cf the isolated Dunraven Bog). Muskrat populations should be monitored to ensure that a rapidly expanding population did not decimate lake or rivershore populations of *S. longii*.

Competition. There is evidence that the circular phalanx presented by *S. longii* clones assists the plant in competition against shrubs. Hill and Johannson observed that shrub height and cover was lower inside circular clones of *S. longii* than immediately outside the perimeter of *S. longii* leafy shoots. *S. longii* rhizomes in the clone interior region do not produce shoots and are mostly dead. The apparent exclusion by *S. longii* of shrubs from the interior region may be due to the structural defense presented by an intact cicular phalanx of stiff leaves or due to the exhaustion of the nutrients by *S. longii* in the inner area. Muskrat herbivory often disrupts unbroken phalanxes of *S. longii* and so may influence the competitive outcome between *S. longii* and shrubs. I am currently analysing soil nitrogen levels inside and outside of clones of *S. longii* to determine whether there is support for the nutrient exhaustion hypothesis outlined above.

Distributional evidence within an individual lakeside bog, suggested that *S. longii* occurs mostly in extremely flooded areas where the growth of shrubs is poor. Given that shrubs may be one of the principal competitors affecting *S. longii*, care should be taken to avoid factors which promote shrub growth.

Hybridization. Schuyler (1963a) has much circumstantial evidence that suggests that plants intermediate in characteristics between the taxa, *S. longii* and *S. cyperinus* are of hybrid origin. I have noted that where sympatric populations of these species occur at a barrier bog on the Medway River (Riversdale), plants with intermediate flowering bract lengths between those of the putative parent species, are common.

8. Land Ownership and Management Responsibility

General. Three of the largest populations, at Eel Weir Stillwater, Eighteen Mile Brook and Grassy Point, are on privately owned land. Landowners have been contacted by N. Hill and are being made aware of the significance of the species.

Land-use qualifications. None, except that which applies to roadside populations which occur on either side of Route 8 near Eighteen Mile Brook (see Map 1b).

9. Management Practices and Experience.

A. Habitat management

There has been no active management to conserve populations of *Scirpus longii*. Sedge hay is cut from wet meadow bordering populations at Eel Weir Stillwater, however, *S. longii* inhabits the most waterlogged, and thus the least desirable, part of the meadow and there is no evidence that present haying is a danger. Quinn's meadow is a drier site and the sparseness of this population may be related to past hay cutting of the meadow.

At Eighteen Mile Brook there are several clones in fen beneath powerlines. Maintenance of powerline underways by periodic cutting of vegetation is beneficial since it retards shrub growth.

B. Performance under changed conditions

The influence of the alteration of fen hydrology at Eighteen Mile Brook, caused by highway consolidation, is reviewed in section 6B, population dynamics.

C. Cultivation

Cultivation of the plant for research purposes was carried out at Acadia University. Plants were collected from Eighteen Mile fen and their growth at different fertility levels is being compared with that of the common bulrush, *Scirpus cyperinus* This is the second year of this study. Fertility levels were established in the first year by adding fish fertilizer to large buckets containing plants growing in a 50:50 mix of sand and commercially available, sphagnum peat. All *S. longii* rhizomes produced flowering culms in the first year of growth. In the second year, there is a noticeable increase in plant vigour at each successive increased fertility level. It appears that increased soil fertility increases intravaginal tiller production.

Seed was collected from the plants grown in buckets and was germinated by placing seeds on peat which was continually moisted in a misting chamber. The germinated seeds were transferred to pots containing peat. Since growth was poor on peat alone, month old seedlings were transferred to a potting mixture containing peat, sand, vermiculite and magamp. All plants were healthy in this medium and plants have been transplanted in a small nursery area at Acadia University to follow the development of clone architecture. The six year old plants have provided useful information to reconstruct clone development using a computer assisted simulation model.

D. Current management policies and actions

Landowners of the wetlands at Eel Weir Stillwater and Eighteen Mile Brook have been made aware of the significant populations on their properties. Both landowners are supportive of the need to conserve these populations. The landowner of the fen system at Eighteen Mile Brook is entertaining the idea of private stewardship through the Wildlife Division of the N.S. Department of Natural Resources.

The landowner of Grassy Point was contacted and is also supportive of conserving the habitat of the species. There has been small-scale disturbance of the habitat by the owner, as vegetation was partially cut in 1990 to clear an area for skeet shooting.

E. Future land use

Curator of Special Places at the Nova Scotia Museum, Bob Ogilvie, and members of the Wildlife Division of the Nova Scotian Department of Natural Resources, have been made aware of the significance of the population at Dunraven Bog. These individuals of these organizations appear receptive to considering the designation of the Dunraven Bog complex as a Nature Reserve.

Nova Scotia Department of Transportation has not been contacted. This department needs to be made aware of the potential damage to bogland caused by highway construction. At present, however, there are no publicized plans to widen Route 8.

10. Evidence of Threats to Survival

A. Present or threatened destruction, modification, or curtailment of habitat or range

a. Drainage alteration. Highway construction has altered drainage at Eighteen Mile Brook. In common with many coastal plain species, *Scirpus longii* appears to be outcompeted by shrubs and also, by faster growing sedges, if the local hydrology is disturbed. For this reason, it would appear, *S. longii* occupies the most waterlogged stations of boggy land.

b. Off-road vehicles. Damaged clones have been observed at small riverside populations near Echo Lodge on the Medway River. This damage caused flowering culm formation at this site. Off-road vehicles have also damaged the remaining individuals at Quinn's Meadow. Despite the benefit of flowering culm initiation caused by damage to rhizomes, the drawback may be that the circular phalanx architecture of the plant is disrupted. Disruption of the phalanx may reduce the ability of the plant to compete against shrubs and other sedges.

c. Muskrat herbivory. See section (C) below.

d. Land development. Many small populations of this species surround the shores of Ponhook Lake. Cottage building on the shores of Ponhook Lake is increasing rapidly as European developers are subdividing larger parcels of land. Initial contacts with developers do not suggest that they are interested in promoting the conservation of rare lakeshore plants to their clients. A small section of the Grassy Point bog, which is surrounded by older cottages, was mown to make a range for skeet shooting.

e. Fire. There is a record of a fire in the area of Eighteen Mile Brook in 1890. This may be a benefit to the species as is discussed elsewhere.

f. Haying and cranberry cultivataion. A local resident stated that the Stillwater marsh at Eel Weir Stillwater used to be cut for hay. She also mentioned cranberry cultivation in the area, however, it was not clear how the hydrology could be manipulated for that purpose.

B. Disease or predation – Herbivory.

Muskrats appear to be the major herbivore on *Scirpus longii* shoots and rhizomes, despite the presence of beaver in the same area (Pers Comm. Paul Tufts, 1992 -- Regional Biologist, Dept. Natural Resources, Yarmouth Co, N.S.). Muskrats cause extensive damage to populations growing near large waterbodies. Approximately 20% of shoots in the small Grassy Point population were consumed over winter of 1990-1991. Evidence of intense herbivory was noted at the meadow at Eel Weir Stillwater in spring of 1991. In this case, much regrowth from dormant buds of remaining rhizomes was observed. There was evidence that grazing stimulated flowering culm formation; twelve of 24 flowering culms were analysed and all showed signs of damage by muskrats. This plant:herbivore interaction appears to be peculiar to northern populations of *S. longii* and has not been documented in populations in the New Jersey Pine Barrens where the species has been most extensively studied. It remains to be seen whether populations in Maine's Saco River watershed experience muskrat herbivory. Changes in muskrat populations will need to be monitored to ensure that damage does not reach unacceptable levels.

Browsing of shoots of *S. longii* by deer, noted at Eighteen Mile Brook, appears to be minimal.

C. Other Natural or Manmade Factors.

Incidence of sexual reproduction is low, especially in the absence of disturbance. This presents a long-term risk for the species since reliance on asexual reproduction is thought to lead to a population with limited genetic variability. In this regard, disturbance events which increase flowering culm production, such as fire in the Pine Barrens populations (Schuyler and Shatz 1983) or herbivory in Nova Scotia (Hill and Clancey, in preparation),
may be necessary if the species is to track the environment over time. Fire should be considered carefully as a potential management technique for fenland populations in Nova Scotia.

11. Present Legal or Other Formal Status

A. Summary

B. International Status

Not listed with C.I.T.E.S.

The Nature Conservancy of the United States assigns a "G2" rating to *Scirpus longii*, meaning that it is a globally imperilled taxon (Argus and Pryer, 1990).

C. United States

General

It is listed as a "category 2" species by the U.S. Fish and Wildlife Service in the publication, Endangered and Threatened Wildlife and Plants: Review of Plant Taxa for Listing as Endangered or Threatened Species: Notice of Review (Federal Register 50: 39526). Rawinski's 1990 report, Final Status Survey Report: The Distribution and Abundance of Long's Bulrush (*Scirpus longii*), to the U.S. Fish and Wildlife Service, Region 5 (Suite 700, One Gateway Center, Newton Corner, MA 02157) supports this listing.

Individual States

The species is known to occur in five states. It has been eradicated from New York state, as have two populations in Massachussetts. The species is secure only in Maine and in New Jersey, where there are 3 and 11 occurrences of the species respectively, which cover 500 acres or more in each state.

D. Canada

Argus and Pryer (1990) assign the species a Canadian ranking, CP2.

E. Provincial

It is found only in Nova Scotia in Canada, despite an erroneous listing of the plant in southern Quebec by Scoggan (1978). Maher et al. (1978) record the species in their listing of rare plants in Nova Scotia.

12. General Assessment.

There are four large populations of this species in Nova Scotia (**sites 1,2, 7 & 8**, map 2b) and several small populations. The large populations have been established in their sites for hundreds of years (ca. 400 years for wet meadow sites 1 & 2, and ca. 120 years for fen sites 7 & 8). Sexual reproduction is very rare at all sites in Nova Scotia. Muskrat herbivory is a

potential danger to all populations near large water courses, although it does stimulate flowering culm production. Alteration of hydrological regimes is an ever-present threat; in this regard, the two large fen populations transected by highway 8 have probably been reduced by the interruption of fen water flow to the northern sides of these fens. Future upgrading of this road may further alter drainage and threaten populations.

Populations on Ponhook Lake face development pressures since it is a widespread practice to clear shorelines to create beaches. Off-road vehicles have caused disruption of *S. longii* populations in meadow and riverside marsh sites.

Since there are no population data available on this species for Nova Scotia prior to the recent studies initiated by the author, no definite statement can be made about an increase or a decline in the total population in recent times.

13. Recommendations for Listing

A. Author's recommendation to COSEWIC

(1) National status -- Threatened

(2) Recommended priority for Canadian action --

To strengthen legislation protecting the habitat of populations of endangered wildlife in Canada.

B. Other status recommendations

(a) Special Places Programme: Nova Scotia Museum.

The complex of wetland habitats near the outflow of Shingle Lake (including a large stillwater meadow, a barrier bog and two bay bogs), should be acquired by the Nova Scotian Museum through the Special Places programme. The current landowner appears not to value this wetland area and would be open to consultation.

The Dunraven Bog complex has many features (apart from an undisturbed cohort of *S. longii* clones) that warrant it becoming an ecological reserve. This is Nova Scotian Crown land and could be managed by the provincial Department of Natural Resources through the Parks Division, or through the aforementioned Special Places programme.

An undisturbed, isolated population of *S. longii* in the Tusket River system occurs in a lakeshore bay bog adjacent to the Nature Reserve at Wilson's Lake. This property, rich in coastal plain species, should become a part of the existing reserve.

(b) N.S. Department of Natural Resources

Priority should be given to the securement of the large wet meadow and the fenland populations; these could be managed under a private stewardship arrangment through the Wildlife Division. Limited experiments on the effect of burning should be carried out by the Wildlife Division of the Nova Scotia Department of Natural Resources. A better understanding of the threat posed by muskrat herbivory could also be attained if globally significant populations of wildlife received a higher profile in the activities of the Wildlife Division of the Department of Natural Resources.

** A monitoring programme for all globally rare species of wildlife in Nova Scotia is a logical development in the programme of the Wildlife Division of the Nova Scotia Department of Natural Resources.

** The Nova Scotian Department of Natural Resources and the Department of Transportation must work together to ensure that future highway construction and alteration of Route 8 does not pose a threat to *S. longii* populations.

c. National recommendation

As there are currently no populations known to occur in National Parks, involvement at the national level may not be required. If a proposed Biosphere Reserve were to be set up in the Tobeatic/Kejimkujic area, the population at Dunraven Bog should be included in its core area.

14. Recommended Critical Habitat.

Two areas of equal priority:

i. The wet meadow sites (1 & 2 on Map 2 b) contain the largest populations of *S. longii* in Nova Scotia. Serious consideration should also be given to including site 3 (the barrier and bay bog on Shingle L.) in the same reserve since several additional rarities occur here.

ii. The fen complex around Eighteen Mile Brook (sites 7 & 8, Map 2 b). This fen complex offers the greatest scope for fire management of the species in Nova Scotia. There is evidence that fire was beneficial in the past at this site.

Legal description of the boundaries are available from the municipal office in Bridgewater. Ownership of the wet meadow and of the fen complex is given in Appendix 1.

15. Sources of Information on the Taxon and its Habitat

A. References cited in report

Anon. 1986. Nova Scotia Resource Atlas. Nova Scotia Department of Development. Nova Scotia Bookstore, Halifax.

Argus, G.W. and K.M. Pryer. 1990. The rare vascular plants of Canada. National Museum of Natural Sciences, Ottawa.

Crow, G.E. 1982. New England's rare, threatened and endangered plants. United States Department of the Interior Fish and Wildlife Service, Northeast Region.

Fernald, M.L. 1911. A new species of *Scirpus* from Massachusetts and New Jersey. Rhodora 13: 4-8.

Fernald, M.L. 1943. Studies in North American species of *Scirpus*. Rhodora 45: 279-296.

Gaudet, C. and P.A. Keddy. 1988. Predicting competitive ability from plant traits: a comparative approach. Nature 334: 242-243.

Gleason, H.A.. 1974. The New Britton and Brown Illustrated Flora of the Eastern United States and Adjacent Canada. Hafner Press, New York.

Hill, N.M. and M. Johansson. 1992. Geographical distribution and ecology of Long's bulrush, *Scirpus longii* (Cyperaceae) in Canada. Rhodora 94: 141-155.

Hill, N.M. and P.A. Keddy. 1992. Predicting rarities from habitat variables: the Atlantic Coastal Plain flora on lakeshores in Nova Scotia. Ecology (In Press).

Kartesz, J.T. and R. Kartesz. 1980. A synonomized checklist of the vascular flora of the united States, Canada and Greenland. Vol. II. The biota of North America. university of North Carolina Press, Chapel Hill, N.C.

Keddy, P.A. 1985. Lakeshores in the Tusket River Valley, Nova Scotia: distribution and status of some rare species, including *Coreopsis rosea* Nutt. and *Sabatia kennedyana* Fern. Rhodora 87: 309-320.

Maher, R.V., D.V. White, G.W. Argus and P.A. Keddy. 1978. The Rare Vascular Plants of Nova Scotia. Syllogeus No. 18, National Museum of Canada, Ottawa.

Rawinski, T.J. 1990. Final status survey report: the distribution and abundance of Long's Bulrush (*Scirpus longii*). U.S. Fish and Wildlife Service (unpublished report).

Roland, A.E. and E.C. Smith. 1969. The Flora of Nova Scotia. Nova Scotia Museum, Halifax.

Rowe, J.S. 1972. Forest regions of Canada. Department of Environment, Canadian Forestry Service Publication 1300.

Schuyler, A.E. 1963a. A biosystematic study of the *Scirpus cyperinus* complex. Proc. Acad. Nat. Sci. Philadelphia 115:283-311.

Schuyler, A.E. 1963b. Sporadic culm formation in *Scirpus longii*. Bartonia 32: 1-5.

Schuyler, A.E. and J.L. Stasz. 1985. Influence of fire on reproduction of *Scirpus longii*. *Bartonia 51: 105-107.*

Weatherby, C.A. 1942. Two weeks in Nova Scotia. Rhodora 44: 229-236.

Wisheu, I.C., C.J. Keddy, P.A. Keddy and N.M. Hill. Disjunct Atlantic coastal plain species in Nova Scotia: Distribution, Habitat and Conservation Priorities. Biol. Conserv. (accepted).

B. Museum collections consulted

There were no specimens of the taxon in Nova Scotia before this study. New specimens were deposited at ACAD (E.C. Smith Herbarium at Acadia University) and NSPM (N.S. Provincial Museum). Collections at PH (Philadelphia Herbarium) and CAN (National Herbarium) were studied.

C. Fieldwork.

A preliminary wide-ranging survey of lakeshores in southwestern Nova Scotia in 1988 revealed two previously unknown populations of *Scirpus longii*. Field work in 1989 by N. Hill and Mats Johansson located the remaining sites (Medway, Tusket, Clyde Rivers and Dunraven Bog) with the exception of several Ponhook Lake populations and the Riversdale population which were located by Cathy Keddy and Irene Wisheu in the same year. Reconnaisance trips were made to sites from 1990-1992 by N. Hill.

D. Knowledgeable individuals

Dr. Alfred Schuyler
Philadelphia Herbarium
Academy of Natural Sciences
19th and the Parkway
Philadelphia, PA, 19103

Tom Rawinski
The Nature Conservancy
Arlington, VA

16. Summary of Materials on File

Scientific data used in this report is held by Nick Hill. Part of the data on the distribution of the species and natural historical observations may be found in Hill and Johansson (1992) and also in Wisheu et al. (submitted to Biol. Cons.). Other data on growth rates and clone formation is being brought together in manuscript form now.

IV. Authorship

17. Initial Authorship and Updating

The report will be maintained and updated by the author. Any new information or corrections should be sent to him.

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