COSEWIC
Assessment and Update Status Report

on the

Small-flowered Lipocarpha
Lipocarpha micrantha

in Canada

ENDANGERED
2002

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC 2002. COSEWIC assessment and update status report on the small-flowered lipocarpha *Lipocarpha micrantha* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 16 pp.

Previous report:

Sabourin, A., M.J. Oldham and D. Paquette. 1992. COSEWIC status report on the small-flowered lipocarpha *Lipocarpha micrantha* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-16 pp.

Production note: COSEWIC would like to acknowledge Tyler W. Smith, George Douglas and Al Harris for writing the status report on the small-flowered lipocarpha *Lipocarpha micrantha*, prepared under contract with Environment Canada.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

Également disponible en français sous le titre Rapport du COSEPAC sur la situation de la lipocarphe à petites fleurs (*Lipocarpha micrantha*) au Canada – Mise à jour

Cover illustration:
Small-flowered Lipocarpha — photo provided by Al Harris

Catalogue No.CW69-14/255-2003E-IN
ISBN 0-662-33571-6

COSEWIC
Assessment Summary

Assessment Summary – November 2002

Common name
Small-flowered lipocarpha

Scientific name
Lipocarpha micrantha

Status
Endangered

Reason for designation
A disjunct species occurring in only three sites with the largest population at risk from potentially significant habitat and population losses.

Occurrence
British Columbia and Ontario

Status history
Designated Threatened in April 1992. Status re-examined and uplisted to Endangered in November 2002. Last assessment based on an update status report.

COSEWIC
Executive Summary

Small-flowered Lipocarpha
Lipocarpha micrantha

Species information

Lipocarpha micrantha is a small annual sedge. Mature plants have stems and leaves up to 10cm long and 0.5mm wide. The flowers are inconspicuous in heads 2-6mm long.

Distribution

Lipocarpha micrantha is found from Brazil north to southern Canada. Its range in Canada is extremely fragmented, with confirmed populations in the Okanagan Valley in British Columbia and on Sable Island, Lake of the Woods, in Northwestern Ontario. An additional population was discovered in 2000 on Pound Net Bay, Rainy Lake, in northwestern Ontario and likely still persists there. Several populations in southern British Columbia, southern Ontario and southern Quebec have been extirpated.

Habitat

This species is confined to moist sandy beaches with some protection from waves. It does not tolerate competition or organic sediment. This habitat is highly prized for development. As a consequence much of it has been destroyed.

Biology

Lipocarpha micrantha is an annual species. As such it may remain dormant and undetected for years if water levels are unfavourably high. It is very sensitive to habitat conditions, and relatively minor alterations may render an area unliveable for this species.

Population sizes and trends

Four of seven documented populations in Canada have been extirpated. The remaining populations are subject to extreme natural fluctuations, and are very sensitive to development and artificial manipulation of water levels.

Limiting factors and threats

Habitat destruction is directly linked with the loss of three populations, and remains a threat for one of the remaining populations. Artificial manipulation of water levels also threatens the viability of existing populations. Natural population fluctuations make this species especially susceptible to habitat alteration.

Special significance of the species

This is the only member of the genus *Lipocarpha* in Canada. It may enhance the value of shoreline vegetation as forage for waterfowl. It is not known to be of value in any cultural or economic practice.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.

Environment Canada | Environnement Canada
Canadian Wildlife Service | Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

Small-flowered Lipocarpha
Lipocarpha micrantha

in Canada

2002

TABLE OF CONTENTS

List of figures

List of tables

SPECIES INFORMATION

Name and classification

Recent treatments of this species, including the upcoming Flora of North America publication (Tucker, in press) refer it to *Lipocarpha micrantha* (Vahl) G. Tucker, as proposed by Tucker (1987). Older synonyms include *Hemicarpha micrantha* (Vahl) Pax, *Hemicarpha micrantha* (Vahl) Britton, *Hemicarpha micrantha* var. *minor* (Schrad.) Frieland, *Hemicarpha micrantha* (Vahl) Pax var. *micrantha*, and *Scirpus micranthus* Vahl. No other species or subspecies of *Lipocarpha* or *Hemicarpha* occur in Canada.

Lipocarpha micrantha is a sedge, in the family Cyperaceae. Sedges are rarely referred to with a vernacular name. However, in addition to Small-Flowered Lipocarpha, this species has been called Dwarf Bulrush (NatureServe 2001), and the generic names *Lipocarpha* and *Hemicarpha* are also sometimes used as common names. According to Kartesz (1999), the genus *Lipocarpha* comprises the “Halfchaff Sedges”.

Description

Lipocarpha micrantha is a very small annual plant (figure 1). At flowering the stems and leaves are often less than 10cm tall, and are about 0.5mm wide. The flowers are arranged in dense oval spikes 2-6mm long. There are 1-3 spikes on each stem, which are subtended by 1-3 leafy bracts. Each spike has numerous inconspicuous flowers. The reproductive structures are concealed by mucronate scales 1-2mm long (Gleason and Cronquist 1991).

The densely tufted plants resemble the seedlings of many other sedge species that occur in the same habitat. In Canada Lipocarpha micrantha is perhaps most similar in aspect to Cyperus squarrosus, another small annual sedge. Lipocarpha micrantha is distinguished from this and all other Cyperus species by the shape of the flower head. Cyperus flowers are borne in two-sided spikes, whereas Lipocarpha flowers are arranged in a dense cone shaped head. These flower heads are less than 5mm long, so careful inspection is required to verify the identity of the plant.

Full technical descriptions of *Lipocarpha micrantha* can be found in various regional manuals (Gleason & Cronquist, 1991, Fernald 1950, etc.) as well as in the upcoming Flora of North America publication (Tucker, in press).

DISTRIBUTION

Global range

Lipocarpha micrantha ranges from Brazil in the south to the Canadian populations in the north, occurring throughout Central America (for references refer to Sabourin et al. 1992). North of Mexico, the main range extends from Texas, north to Northwestern Ontario, and east to the American East Coast. Disjunct populations are found in Florida, California, British Columbia, and elsewhere as shown in figure 2 (Tucker in press).

Figure 1. *Lipocarpha micrantha, approximately 1.2x lifesize.* Photo by Al Harris.

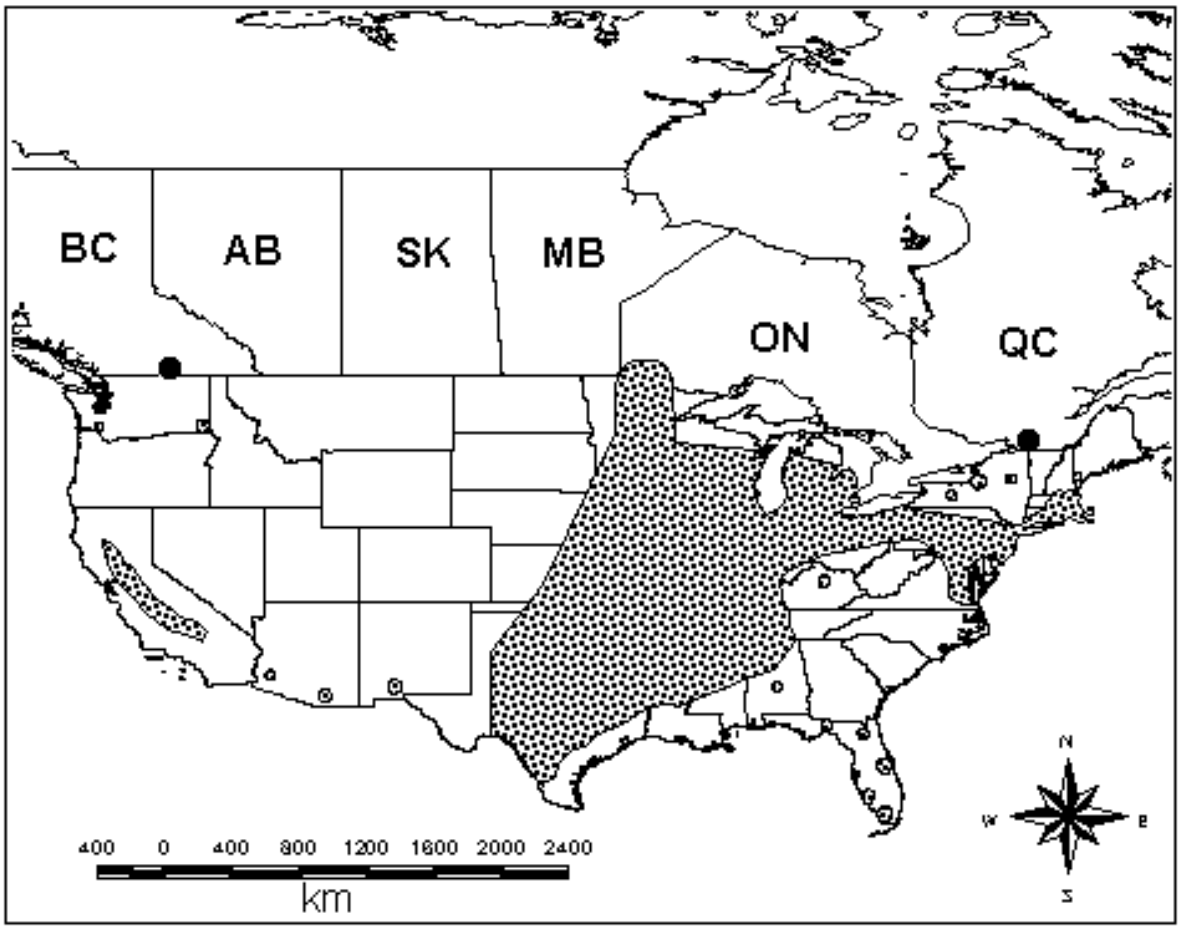

Figure 2. Distribution of *Lipocarpha micrantha* in North America north of Mexico (Extant Canadian occurrences are found in north-western Ontario (stippled area) and south-central British Columbia (solid circle); the historic Quebec population (solid circle) is extirpated).

Canadian range

Lipocarpha micrantha has an extremely fragmented distribution in Canada, as shown in figure 3a and figure 3b. Of seven documented populations (Ceska and Ceska 1982, Oldham and Crins 1988, Sabourin et al. 1992, Oldham 1996, Oldham 2000, Harris et al. 2000), only 3 persist.

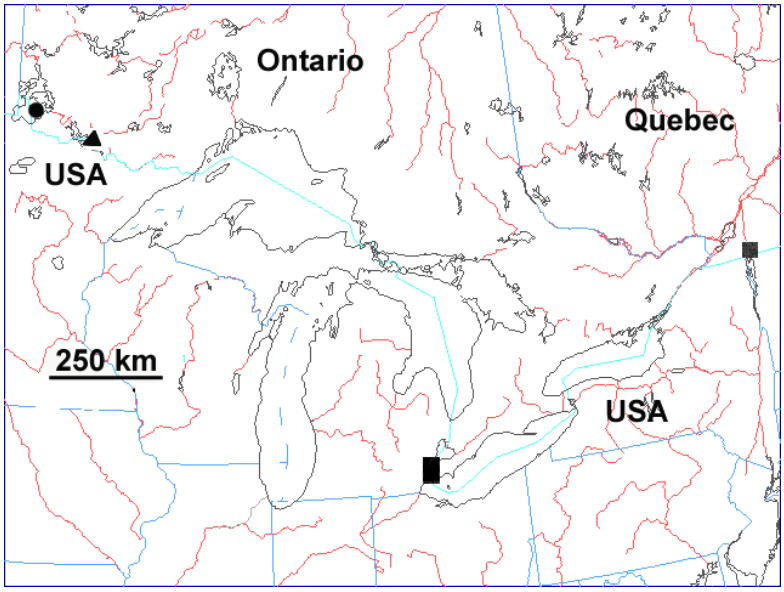

Figure 3a. Distribution of *Lipocarpha micrantha* in Ontario and Quebec. Solid circle marks population located in 2001. Squares mark extirpated populations (two in Ontario, one in Quebec). The triangle marks the Pound Net Bay, Rainy Lake population discovered in 2000.

Figure 3b. Distribution of *Lipocarpha micrantha* in British Columbia. Solid circle marks population located in 2001.

Two extant populations of *Lipocarpha micrantha* were located in Canada in 2001. One population is at Lake Osoyoos, in the Okanagan Valley, British Columbia. The other population is on Sable Island, Lake of the Woods, in Northwestern Ontario. A third population was observed in 2000 at Pound Net Bay, Rainy Lake in Northwestern Ontario. As will be discussed below, *Lipocarpha micrantha* may persist in the seed bank at Pound Net Bay.

Four other populations of *Lipocarpha micrantha* have been reported in the past, but they have been extirpated. The population at Missisquoi Beach in Southern Quebec was last documented in 1957, and has not been relocated since (Labrecque, pers. commun., 2001). The population at Holiday Beach in Southwestern Ontario was last reported in 1987 and wasn't located in 2001. Several historic records of *Lipocarpha micrantha* from the Detroit River, circa 1900, have not been relocated since, despite search efforts in the 1980's. A second Lake Osoyoos population was documented in 1978, but had been extirpated by 1985 (Sabourin et al. 1992). The habitat at this location was destroyed by the development of a recreation area.

HABITAT

Habitat requirements

Lipocarpha micrantha grows on sandy beaches that are subject to seasonal flooding, but are protected from high waves or strong currents. It is usually found in areas of very sparse vegetation, and apparently does not tolerate competition from other plant species. It co-occurs with other species common in these habitats, including a variety of *Cyperus*, *Bidens*, and *Salix* species. *Cyperus squarrosus* has been noted as an associate at every station in Canada. Further details are documented in Sabourin et al. (1992).

Trends

The quality of the habitat at the Missisquoi Beach, Quebec, location is unknown, although previous reports noted that water quality was poor (Sabourin et al. 1992).

The extent and quality of the habitat at the Holiday Beach, Ontario, site has declined significantly since the last survey in 1987 (Oldham, pers.commun., 2001). Water levels in the marsh are now kept artificially high to enhance duck hunting. As a result exposed mudflats have been almost totally eliminated from the open marsh and the swales between the marsh and the lake. Beyond the water control structure, the outlet channel has been dredged. The dredged sand is piled on areas that may have once supported *Lipocarpha micrantha*. One of the only areas where *Cyperus squarrosus* was observed was on wet sand at the edge of the heaped sand. The lakeshore beach is covered with mounds of rotting algae and aquatic macrophytes, probably *Vallisneria americana*. This may be a consequence of changing water quality. Whatever the cause, the dead material is certainly thick enough to smother any plants growing underneath.

In the present condition this habitat is unlikely to support *Lipocarpha micrantha.* It may be possible to restore the habitat while continuing to manage the marsh for duck-hunting. However, some alteration of the water control and channel dredging regime would be required. Further study is required to assess the cause and impact of the decaying aquatic vegetation on the beach.

The beaches north of Holiday Beach on the Detroit River are heavily developed. The populations documented there in 1892 and 1901 have not been relocated

(Sabourin et al. 1992). The existing habitat is unlikely to support a *Lipocarpha micrantha* population, and restoration potential is limited.

Both of the Northwestern Ontario populations, at Sable Island, Lake of the Woods; and Pound Net Bay, Rainy Lake, are subjected to unnaturally regulated water levels. Recreational use of shoreline areas and invasive plant species (*Phalaris arundinacea*, *Phragmites australis*) could also alter the habitat quality. However, no long-term trends in habitat quality or quantity have been noted. In the short term beach habitat quantity fluctuates with water levels. Sable Island and Pound Net Bay were subjected to near record high water levels in 2001. Consequently there was an unusually low amount of available habitat in that season.

Approximately 28km of appropriate *Lipocarpha micrantha* habitat once occurred on Lake Osoyoos, Okanagan Valley, British Columbia. Of this habitat, 70% has been lost to shoreline development. This includes the habitat once occupied by the extirpated population mentioned above. The remaining habitat is found on Indian Reserve land. The band has been considering development plans that would see 75% of the remaining habitat lost. In the event that this development proceeds, the total habitat lost at Lake Osoyoos would exceed 90%.

Protection/ownership

The Sable Island, Ontario, population is in a provincial nature reserve. The Pound Net Bay, Ontario, population is on Crown Land. The Lake Osoyoos population is on private land and has no formal protection. The locations of the extirpated populations are all privately owned.

BIOLOGY

General

Several serious conservation challenges are posed by the biology of *Lipocarpha micrantha.* The annual habit and occurrence in a transient habitat make the location and assessment of viable populations difficult, as detailed below.

Reproduction & Survival

Lipocarpha micrantha is an annual plant. As such it endures conditions unfavourable to growth in the seed stage. After seeds are produced in the fall, the entire population exists only as seed. These seeds will germinate the next time appropriate conditions occur. This may happen in the same location the next summer. However, if conditions are unfavourable for growth, the seeds may not germinate for several years or even decades.

We do not know how long *Lipocarpha micrantha* seeds may remain viable. Nor do we understand how they are dispersed beyond the observation that they occur in habitats frequented by waterfowl, and in locations where seeds could float to new locations.

As a consequence of the annual habit, *Lipocarpha micrantha* may persist undetected at locations searched thoroughly by botanists. An unsuccessful search during highwater, when much potential habitat is temporarily unavailable, is therefore not justification for declaring a population extirpated.

This was the case at Pound Net Bay, Ontario, in 2001, where water levels were well above average. When water levels return to average or below this area will provide abundant habitat for *Lipocarpha micrantha*. The overlooked population may well return from dormant seed, or seed produced by *Lipocarpha micrantha* populations on the American side of the river.

In contrast, in areas where the habitat has been degraded it is unlikely that *Lipocarpha micrantha* will persist regardless of water level. This is the case at Holiday Beach, Ontario. Despite favourable low water levels no plants were found. In this case the population is effectively extirpated, as any remaining viable seeds will be unable to germinate.

It is important to note that even in locations where *Lipocarpha micrantha* has been regularly located, large variation in population size is to be expected between years, and caution should be taken when interpreting long-term trends. Annual species respond dramatically to seasonal variation in growing conditions.

Physiology

The physiological requirements and tolerances of this species are unknown.

Movements/dispersal

Seed may be dispersed by waterfowl or by water. There is some potential for this species to be carried long distances by migrating shorebirds. As a result it may be able to colonize new or historic sites from populations in the United States. This will only be possible for sites where appropriate habitat still exists.

Nutrition and interspecific interactions

Lipocarpha micrantha occurs in sparsely vegetated areas of wet sandy habitats. This is interpreted as a sign that it does not tolerate competition from other plants. It is not found in areas with organic material in the sand (Reznicek, pers. commun., 2001).

Behaviour/adaptability

This species is only found in wet sandy swales and beaches. It is not found on mudflats richer in organic sediment, or drier sandy areas, despite the abundance of these habitats near extant *Lipocarpha micrantha* populations.

POPULATION SIZES AND TRENDS

The Missisquoi Beach, Quebec, population was discovered in 1953. It was again documented in each of 1955, 1956, and 1957. It could not be relocated in 1989, and is presumed to be extirpated (Labrecque, pers. commun. 2001).

The Holiday Beach, Ontario, population was discovered in 1984. 15 plants were found at that time (Oldham and Crins, 1988). The population was relocated in 1987 (Sabourin et al. 1992, Reznicek pers. commun., 2001). The area was searched in August and September of 2001 but no plants were located. Habitat degradation noted above has resulted in the extirpation of *Lipocarpha micrantha* from this location.

The Sable Island location in Northwest Ontario was discovered in 1995, and several thousand plants were noted at the time (Oldham, pers. commun., 2001). The 2001 surveys documented approximately 1800 plants. Detailed data was collected on the population in 2001. In future this information can be used to assess better the long-term trends.

The Pound Net Bay location in Northwest Ontario was discovered in 2000. At that time 75 plants were noted. The entire site was under water in 2001, and no plants were located. As discussed under biology above, this does not indicate that the species has been extirpated from this location.

Between 30,000 and 50,000 plants were located at the Lake Osoyoos, British Columbia location in 2001. This population was first documented in 1982, and has been surveyed several times since (Donovan, pers. commun. 2001). The 2001 survey showed the highest number of plants. The high number is attributed to excellent growing conditions this season, and also to the higher search intensity in 2001.

LIMITING FACTORS AND THREATS

The Missisquoi Beach, Quebec, and Holiday Beach, Ontario populations are presumed extirpated, and recovery is limited by loss of good quality habitat.

The Sable Island and Pound Net Bay, Northwestern Ontario populations are at risk because of their small size. This makes them particularly susceptible to habitat loss. The most pressing concern is the possibility of water level management destroying the existing habitat.

The Lake Osoyoos, British Columbia population is healthy, but under imminent threat of extirpation should proposed developments proceed.

SPECIAL SIGNIFICANCE OF THE SPECIES

Lipocarpha micrantha is the only member of the genus *Lipocarpha* in Canada. It is not used in any economic or cultural context. It may contribute to the forage value of shoreline areas for migratory waterfowl and other wildlife.

EVALUATION

Existing protection or other status

Lipocarpha micrantha is currently listed as Threatened by COSEWIC. It is Endangered in Connecticut (CDEP 1998), Maryland (MWHD 2001), New Jersey (Snyder 2001), New York (Young 2001) and Pennsylvania (PNDI 2001). It is Threatened in Maine (MDCNAD 1999) and Ohio (ODNR 2000). It is listed as Special Concern in Michigan (MNFI 2000) and South Carolina (SCHP 2000). The Nature Conservancy has listed it as a G4 species, and it is an N1 species in Canada (NatureServe 2001). Subnational Nature Conservancy rankings are presented in table 1. It is notable that of the 40 states where *Lipocarpha micrantha* has been reported, 22 states have not yet assigned a status to the species. This likely reflects the difficulties associated with locating and identifying this species. (Amoroso 1999, Caplow, pers. commun., 2001, NHNHI 2001, Townsend 2001).

Table 1. Subnational Nature Conservancy Rankings for *Lipocarpha micrantha* in the United States.

SH	New Hampshire
S1	Connecticut, District of Columbia, Kansas, Maine, Maryland, New Jersey, New York, North Carolina, North Dakota (S1?), Pennsylvania, Rhode Island, Virginia
S2	Ohio, South Carolina
S3	Illinois (S3S4), Michigan
S4	Iowa
SR, S?	Alabama, Arizona, Arkansas, California, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, New Mexico, Oklahoma, Oregon, Tennessee, Texas, Washington, Wisconsin

TECHNICAL SUMMARY

Lipocarpha micrantha (Vahl) G. Tucker
Small Flowered Lipocarpha — Lipocarphe à petites fleurs
British Columbia, Ontario, Quebec (Extirpated)

Extent and Area information	
• *extent of occurrence (EO)(km²)*	<20 km^2 for BC and ON sites
• *specify trend (decline, stable, increasing, unknown)*	declining
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	
• *area of occupancy (AO) (km²)*	about 5 km strip of narrow shoreline habitat (<1 km^2)
• *specify trend (decline, stable, increasing, unknown)*	Declining
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	Yes
• *number of extant locations*	3
• *specify trend in # locations (decline, stable, increasing, unknown)*	Declining
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	57% decline in extant locations
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	declining extent and quality of habitat
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	1 Year
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	30,000 to 50,000
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	unknown but historic loss of 70% of its habitat at the Osoyoos site
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	Yes
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	Yes
• *list each population and the number of mature individuals in each*	Lake Osoyoos 1, 30,000 to 50,000 Lake Osoyoos 2, Extirpated Sable Island, 1,800 Pound Net Bay, 70? Detroit River, Extirpated Holiday Beach, Extirpated Missisquoi Beach, Extirpated
• *specify trend in number of populations (decline, stable, increasing, unknown)*	decline
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	57% decline

Threats (actual or imminent threats to populations or habitats)	
- habitat destruction for development; decaying aquatic vegetation; invasive plant species	
- water level manipulation; recreational use of shorelines	
Rescue Effect (immigration from an outside source)	
• *does species exist elsewhere (in Canada or outside)?*	Yes
• *status of the outside population(s)?*	Unknown
• *is immigration known or possible?*	Yes
• *would immigrants be adapted to survive here?*	Unknown
• *is there sufficient habitat for immigrants here?*	unknown
Quantitative Analysis	

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the following people for assistance with this report. Kara Brodribb, Wasyl Bakowsky, Dan Dufour, Rob Foster, Erica Oberndorfer, Mike Oldham, Kathy Paige, Amy Tesselin, and Christine Thuring assisted with field surveys. Wasyl Bakowsky, Jim Meeker, Mike Oldham, Tony Reznicek and David Szymanski provided location and habitat data. Erica Oberndorfer and Jennifer Penny assisted with the production of maps and compilation of status data. Ron Hall (Osoyoos Band) and Graham Rose (Big Creek Hunt Club) graciously granted access to their properties for survey work. Funding was provided by the Canadian Wildlife Service, Environment Canada and the George Cedric Metcalf Foundation.

LITERATURE CITED

Amoroso, J.L. 1999. Natural heritage program list of the rare plants of North Carolina, 1999 Edition. Web site: http://ils.unc.edu/parkproject/nhp/publications/plants/1999plantlist.pdf [Accessed September 28, 2001]

Ceska, A. and O. Ceska. 1980. Additions to the flora of British Columbia. Canadian Field-Naturalist 94(1): 69-74.

Connecticut Department of Environmental Protection (CDEP). 1998. Natural Diversity Database. Web site: http://dep.state.ct.us/cgnhs/nddb/Nddb2.htm. [Accessed September 28, 2001].

Fernald, M.L. 1950. Gray's manual of botany. Eighth edition. American Book Company, New York, New York. lxiv + 1632 pp.

Gleason, H. A., and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. Second edition. New York Botanical Gardens, Bronx, New York. lxxv + 910 pp.

Great Lakes Information Network (GLIN). 2001. Great Lakes water levels home page. Web site: http://www.lwcb.ca/waterflowdata.html [Accessed September 28, 2001]

Harris, A.G., M.J. Oldham, R.F.Foster, and W.D.Bakowsky. 2000. Preliminary life science inventory of Rainy Lake, Ontario. Unpublished report prepared for the Rainy Lake Conservancy.

Kartesz, J.T. 1999. A Synonymized Checklist and Atlas with Biological Attributes for the Vascular Flora of the United States, Canada, and Greenland. First Edition. In: Kartesz, J.T., and C.A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.).

Lake of the Woods Control Board (LWCB). 2001. Water level and control data. Web site: http://www.lwcb.ca/waterflowdata.html [Accessed August 2001]

Maine Department of Conservation Natural Areas Division (MDCNAD). 1999. *Lipocarpha micrantha* (Vahl) G. Tucker. Rare Plant Fact Sheet PMCYP0H040. Web site: ftp://ftp.state.me.us/pub/conservation/mnap/factsheet/cyp0h040.pdf [Accessed September 28, 2001]

Maryland Wildlife and Heritage Division (MWHD). 2001. Rare, Threatened, and Endangered Plants of Maryland. Web site: http://dnrweb.dnr.state.md.us/download/rteplants.pdf [Accessed September 28, 2001]

Michigan Natural Features Inventory (MNFI). 2000. Michigan's special plants. Web site: http://www.dnr.state.mi.us/wildlife/heritage/mnfi/lists/special_plants_list.pdf [Accessed September 28, 2001]

NatureServe: An online encyclopedia of life [web application]. 2001. Version 1.5 Arlington, Virginia, USA: Association for Biodiversity Information. Available: http://www.natureserve.org/. [Accessed: September 27, 2001]

New Hampshire Natural Heritagae Inventory (NHNHI). 2001. Plant tracking list. Web site: http://www.dred.state.nh.us/forlands/formgt/nhiweb/Documents/w_plantT.pdf. [Accessed September 28, 2001]

Ohio Department of Natural Resources (ODNR). 2000. Ohio rare plant list. Web site: http://www.dnr.state.oh.us/odnr/dnap/heritage/plantlst.html. [Accessed September 28, 2001]

Oldham, M.J. 2000. Botany Highlights. Ontario Natural Heritage Information Centre Newsletter 6(1): 10-11.

Oldham, M.J. 1996. Interesting plant records from northwest Ontario. Ontario Natural Heritage Information Centre Newsletter 3(1).

Oldham, M.J. and W.J. Crins. 1988. New and significant records of Ontario sedges (Cyperaceae). Canadian Field-Naturalist 102(3): 500-507.

Pennsylvania Natural Diversity Inventory (PNDI). 2001. Pennsylvania natural diversity inventory. Web site: http://www.dcnr.state.pa.us/forestry/pndi/pndiweb.htm [Accessed September 28, 2001]

Sabourin, A., M.J. Oldham, and D. Paquette. 1992. Status report on the small-flowered lipocarpha *Lipocarpha micrantha* (syn. *Hemicarpha micrantha*) in Canada. COSEWIC, Ottawa, Ontario.

Snyder, D. B. 2001. Special plants of New Jersey. Web site: http://www.abi.org/nhp/us/nj/njplant1.htm [Accessed September 28, 2001]

South Carolina Heritage Program (SCHP). 2000. South Carolina species of concern. Web site: http://www.abi.org/nhp/us/sc/speclist.htm [Accessed September 28, 2001]

Townsend, J.F. 2001. Natural Heritage Resources of Virginia: Rare Vascular Plants. Natural Heritage Technical Report 01-11. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. Unpublished report. March 2001. 30 pages plus appendices.

Tucker, G.C. In Press. LIPOCARPHA. *in* Flora of North America editorial committee. Flora of North America, Volume 23, Cyperaceae. Oxford University Press, New York, New York.

Tucker, G.C. 1987. The genera of Cyperaceae in the Southeastern United States. Journal of the Arnold Arboretum 68(4): 409-411.

Young, S.M. 2001. New York rare plant status list. New York Natural Heritage Program, Albany, New York.

BIOGRAPHICAL SUMMARY OF CONTRACTORS

Tyler W. Smith has a B.Sc (Ecology) from the University of Guelph. He has been the Field Botanist for Royal Botanical Gardens since 1998. In this position he is responsible for restoration monitoring and planning, herbarium curation, and rare species conservation. He chairs the recovery team for *Trichophorum planifolium*, for which he authored the Recovery Plan. He is also conducting research as a member of the recovery teams for *Morus rubra* and *Pycnanthemum incanum*.

George W. Douglas has a M.Sci. (Forestry) from the University of Washington and a Ph.D (Botany) from the University of Alberta, Edmonton. George has worked with rare plants for over 20 years. He was senior author of The Rare Plants of the Yukon (1981), co-authored The Rare Plants of British Columbia (1985) and was senior author of the Rare Native Plants of British Columbia (1998). He is also the senior editor for the Illustrated Flora of British Columbia (1998-2001) and has been the program botanist for the British Columbia Conservation Data Centre since it's inception in 1991. George has written or co-written 18 COSEWIC status reports during this period.

Al Harris is a biologist with 16 years experience in northern Ontario. He is cofounder of Northern Bioscience, an ecological consulting company based in Thunder Bay Ontario. He also spent seven years as a biologist with OMNR. His most recent focus has been on land classification and wetland ecology in northwestern Ontario. He is senior author of Wetland Ecosystem Classification for Northwestern Ontario; co-author of Terrestrial and Wetland Ecosites for Northwestern Ontario and Wetland Plants of Ontario. Al has also been heavily involved in woodland caribou population monitoring, habitat assessment and management guidelines development in northwestern Ontario. He is past president of the Thunder Bay Field Naturalists, served as regional co-ordinator for the Atlas of the Mammals of Ontario, and co-author of Checklist of the Plants of Thunder Bay District.

AUTHORITIES CONSULTED

Caplow, F. August, 2001. Botanist, Washington Natural Heritage Program, Department of Natural Resources, P.O. Box 47014, Olympia, WA 98504-7014.

Donovan, M. May 2001. Biological Information Coordinator, BC Conservation Data Centre, Ministry of Environment, Lands and Parks. Tel: (250) 356-0928.

Labrecque, J. May 2001. Botaniste, Centre de données sur le patrimoine naturel, Ministère de l'Environnement du Québec, Direction du patrimoine écologique et du développement durable, Édifice Marie-Guyart, 4e étage boîte 21, 675, boul. René Lévesque-Est, Québec (Québec), G1R 5V7.

Oldham, M.J. September 2001. Botanist/Herpetologist. Natural Heritage Information Centre. Ministry of Natural Resources. 300 Water Street, 2nd Floor, North Tower, Peterborough, Ontario K9J 8M5.

Reznicek, A.A. September 2001. Adjunct Professor/Herbarium Curator, Department of Ecology and Evolutionary Biology, University of Michigan, 890 Wickfield Ct., Ann Arbor, MI 48105, United States of America.