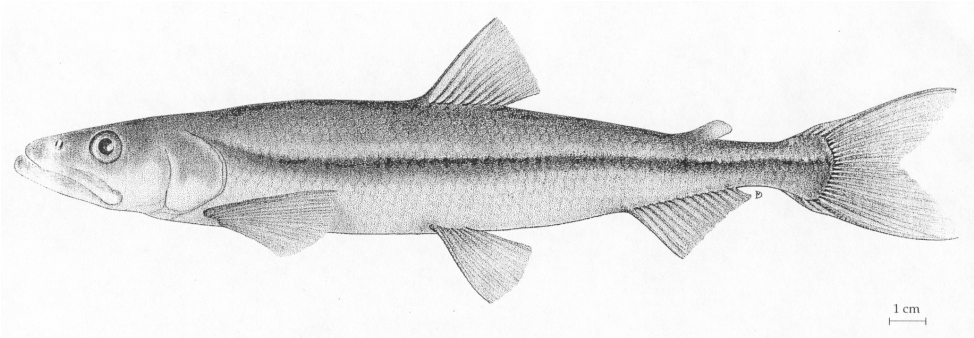
COSEWIC
Assessment and Status Report

on the

Lake Utopia Dwarf Smelt
Osmerus sp.

in Canada



THREATENED
2000

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

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Lake Utopia Dwarf Smelt — Provided by the author. Illustration made by D. McPhail and facilitated by D. McAlpine of the New Brunswick Museum (Natural History Division).

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COSEWIC
Assessment Summary

Assessment Summary – May 2000

Common name
Lake Utopia dwarf smelt

Scientific name
Osmerus sp.

Status
Threatened

Reason for designation
A Canadian endemic, this species is restricted to one lake system which has only two small tributaries which limit spawning habitat. The fish are also subject to exploitation, predation by Atlantic salmon, brook trout and the larger sympatric form of smelt found in the same lake.

Occurrence
New Brunswick

Status history
Designed Threatened in April 1998. Status re-examined and confirmed in May 2000. Last assessment based on an existing status report.

COSEWIC
Executive Summary
from the 1998 Status Report

Lake Utopia Dwarf Smelt
Osmerus sp.

Lake Utopia, southwestern New Brunswick, contains phenotypically and genetically distinct populations of smelt, genus *Osmerus*. One form, “Dwarf Smelt”, matures at between 100 to 120 mm total length while the other form, “Normal Smelt”, matures at 150 to 250 mm total length. Both Dwarf and Normal Lake Utopia Smelt are probably derived from anadromous Rainbow Smelt (*Osmerus mordax*) that colonized the lake postglacially. Dwarf and Normal Smelt are terete-shaped and laterally compressed. Their greatest body depth is anterior to the dorsal fin, their heads are moderately long, and their snouts are elongate and pointed with protruding lower jaws. The maxillary extends beyond the middle of the eye in Normal Smelt and to the mid-eye in Dwarf Smelt. Teeth are well developed, particularly on the tongue and vomer of Normal Smelt. Colouration of Dwarf and Normal Smelt varies from pale green to dark blue on the back, with blue, purple, and pinkish iridescence on the predominantly silvery sides. Males of Dwarf and Normal Smelt develop nuptial tubercles during spawning. Dwarf Smelt have more gill rakers, larger eyes, but smaller mouths than Normal Smelt. Dwarf Smelt average about 36 gill rakers whereas Normal Smelt average about 32 gill rakers. Anadromous *Osmerus mordax* typically have 28 to 32 gill rakers. The morphological differences between Dwarf and Normal Smelt likely reflect adaptations for specialization to alternative trophic niches within the lake.

Distribution

Lake Utopia is part of the Magaguadavic River drainage, Charlotte Co., southwestern New Brunswick and is located about 100 km SW of Saint John. Dwarf Smelt from Lake Utopia were introduced into Meech Lake, Québec where they appear to have established a self-sustaining population.

Population Size and Trends

No formal population census has been conducted in Lake Utopia for either Dwarf or Normal Smelt. Dwarf Smelt appear to be the form at greater risk as their spawning populations were observed in two small brooks with total spawning population sizes of perhaps less than 1000 individuals. By contrast, Normal Smelt spawning populations are likely in the order of several thousand individuals in each of the two larger streams. Dwarf and Normal Smelt are both subject to annual dip-net recreational fisheries. The

exploitation of Normal Smelt in Lake Utopia is low to moderate. The extent of the dip-net fishery on Dwarf Smelt, however, is less well known, owing in part, to the relative remoteness of their spawning streams.

Habitat

Lake Utopia is a relatively shallow lake with average and maximum depths of 11.1 and 25.6 m, respectively. The lake is 7.2 km long and covers an area of approximately 1370 hectares. Spawning habitat of Dwarf and Normal Smelt from Lake Utopia appears to be largely confined to four small streams at head of the northern half of the lake. There is currently no information on the distribution of juvenile Dwarf and Normal Smelt or sub-adults within the lake itself during the non-spawning period.

General Biology

Normal Smelt spawn during the first two weeks of April when stream water temperatures are between 4 and 8°C. Dwarf Smelt typically spawn during early to mid-May at higher water temperatures (perhaps 8 - 10°C). Dwarf and Normal Smelt enter the tributary streams at dusk with the greatest number ascending the streams and spawning between 21:00 and 04:00 h. The eggs are adhesive and adhere to rocks, submerged vegetation and woody debris.

Dwarf Smelt of Lake Utopia appear to be largely zooplanktivorous, consuming *Diaptomous, Cyclops, Leptodora, Daphnia, Epischura,* and *Bosmina*. By contrast, Normal Smelt (at least once they surpass the average size of Dwarf Smelt) are macrophagous, often consuming juvenile smelt (presumably of both forms).Dwarf Smelt from Lake Utopia average about 120 mm total length at maturity while Normal Smelt average 226 mm total length. There are no data concerning age or growth of the forms in Lake Utopia.

Predator-prey relationships are unknown, but Dwarf and Normal Smelt are eaten by native salmonids (Atlantic Salmon and Brook Trout). In addition, Normal Smelt are piscivorous often feeding on smaller sized smelt.

Limiting Factors

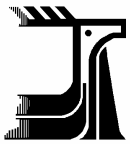
The production of Dwarf and Normal Smelt in Lake Utopia is potentially limited by predation pressure from native salmonids [Atlantic Salmon (*Salmo salar*) and Brook Trout (*Salvelinus fontinalis*)], particularly on smaller sized juveniles and Dwarf Smelt. Salmonid enhancement efforts in the lake could upset this balance and have negative impacts on production of juvenile stages of both forms and adult Dwarf Smelt. Furthermore, large smelt are often piscivorous and may include smaller smelt in their diet.

The most important factor limiting smelt populations in Lake Utopia is the size and number of spawning streams. Precise data are not available, but most spawning by

Normal Smelt occurs in two streams at the northeast end of the lake while Dwarf Smelt appear largely restricted to two much smaller streams at the northwest end of the lake. Normal Smelt spawning streams are lake-headed and appear relatively stable in terms of long term persistence; the Dwarf Smelt spawning streams are more ephemeral and susceptible to habitat degradation owing to their small size.

Protection

Exploitation of the smelt populations of Lake Utopia is limited to local dip-net fisheries during the spring spawning periods (April and May). Most of the effort appears to be focused on the Normal Smelt populations. The fishery is regulated by catch and possession limits. Some protection of spawning streams is afforded indirectly by a game refuge at the northeast end of the lake that includes one of the Normal Smelt spawning streams.



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.

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COSEWIC Status Report

on the

Lake Utopia Dwarf Smelt
Osmerus sp.

in Canada

Eric B. Taylor

1998

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ABSTRACT

Lake Utopia, southwestern New Brunswick, contains phenotypically and genetically distinct populations of smelt, genus *Osmerus*. One form, "Dwarf Smelt", matures at between 100 to 120 mm total length, has 35 to 36 gill rakers, and spawns in small streams in May. The other form, "Normal Smelt", matures at 150 to 250 mm total length, has 30 to 32 gill rakers and spawns in larger, lake-headed streams in early April. The two forms are genetically distinct as assessed by differences in the frequencies of mitochondrial and minisatellite DNA restriction fragment length polymorphisms. Quantitative genetic differences between the forms are suggested by inter-annually stable differences in morphology and spawning time and site. The two forms in Lake Utopia: (i) are reproductively isolated in sympatry and behave as distinct species, (ii) appear to have originated independently from sympatric forms in other lakes, and (iii) may have resulted from speciation within Lake Utopia. Both forms are subject to annual dip-net recreational fisheries. The Normal Smelt appears to be in no immediate danger, but Dwarf Smelt may be especially vulnerable owing to its apparently lower abundance and limited spawning distribution in small, easily disturbed streams.

SPECIES INFORMATION

The Rainbow Smelt, *Osmerus mordax* (Mitchill 1814), is a euryhaline osmerid native to watersheds tributary to the western North Atlantic Ocean from Long Island to Lake Melville on the Labrador coast (Scott and Scott 1988; Nellbring 1989). Throughout this native range, Rainbow Smelt may be anadromous, growing to maturity in nearshore marine environments before returning to freshwater streams to spawn in the spring, or they may reside permanently in freshwater. Like many north temperate freshwater fish, lake-dwelling Rainbow Smelt may exist as "dwarf-" or "normal-sized" individuals, maturing at between 70 mm and 250 mm total length, respectively (Taylor and Bentzen 1993a). Dwarf Smelt are usually morphologically specialized for plankton feeding while Normal Smelt appear to be macrophagous and are often piscivorous (see Taylor and Bentzen 1993a). There are at least five well documented cases of lake populations consisting of sympatric dwarf- and normal-sized forms: Lac Heney, Québec; Green and Onawa lakes, Maine; Lochaber Lake, Nova Scotia; and Lake Utopia, New Brunswick (Lanteigne and McAllister 1983; Taylor and Bentzen 1993a). Sympatric forms differ in size at maturity, morphology, and feeding and reproductive ecology (Delisle 1969; Langteigne and McAllister 1983; Taylor and Bentzen 1993a).

Lanteigne and McAllister (1983) considered the dwarf form of *Osmerus* in northeastern North America to be a distinct species, the Pygmy Smelt (*Osmerus spectrum*) first described by Cope (1870) from specimens in Maine. Taylor and Bentzen (1993a), however, examined relationships among 19 anadromous, and dwarf- and normal-sized freshwater populations by assaying mitochondrial DNA (mtDNA) restriction site variation. The mtDNA data refuted the idea of monophyly of Dwarf Smelt and cast doubt on the validity of the designation *Osmerus spectrum*. There were no restriction sites that were diagnostic for Dwarf or Normal Smelt, and dwarf-sized smelt populations

did not cluster together and separately from normal-sized or anadromous populations. For instance, dwarf-sized smelt from Lake Utopia and Green Lake (previously diagnosed as *Osmerus spectrum*) as well as Dwarf Smelt from Lochaber and Onawa lakes were not monophyletic and were more similar to geographically proximate normal-sized or anadromous populations than to each other (Taylor and Benzten 1993a). Consequently, Taylor and Bentzen (1993a) concluded that Dwarf *Osmerus* were polyphyletic and had diverged repeatedly, perhaps sympatrically, from geographically proximate normal or anadromous populations following deglaciation and that the various populations perhaps comprise a complex of undescribed biological species.

Although casting doubt on the validity of *Osmerus spectrum* as envisioned by Lanteigne and McAllister (1983), the data of Taylor and Bentzen (1993a,b) established that in at least two lakes where they occurred sympatrically (Lake Utopia, N.B. and Lochaber Lake, N.S.), Dwarf and Normal *Osmerus* were genetically distinct and, hence, reproductively isolated. Reproductive isolation in sympatry, coupled with interannually stable morphological and ecological differences between the forms (Figure 1) led Taylor and Bentzen (1993a,b) to conclude that Dwarf and Normal Smelt in Lake Utopia fulfilled the criteria of distinct biological species (sensu Mayr 1963). Both forms in Lake Utopia, however, fall well within the morphological and molecular "boundaries" of *Osmerus mordax* relative to European Smelt (*Osmerus eperlanus*) and Arctic Rainbow Smelt (*Osmerus dentex*) (cf. Taylor and Dodson 1994), which complicates the taxonomic recognition of either or both of Dwarf and Normal Smelt as distinct from *Osmerus mordax*. On average, however, the mtDNA data indicated that Dwarf *Osmerus* from Lake Utopia were slightly more divergent from *Osmerus mordax* found outside Lake Utopia than were Normal Smelt (Taylor and Bentzen 1993a). Further, the divergence that has resulted in genetically distinct populations of Dwarf and Normal Smelt in Lochaber Lake, N.S. has occurred independently from that in Lake Utopia (Taylor and Bentzen 1993a). In all other lake systems where they co-exist, therefore, dwarf- and normal-sized smelt probably have arisen independently and the forms do not represent distinct lineages in northeastern North America (Taylor and Bentzen 1993a).

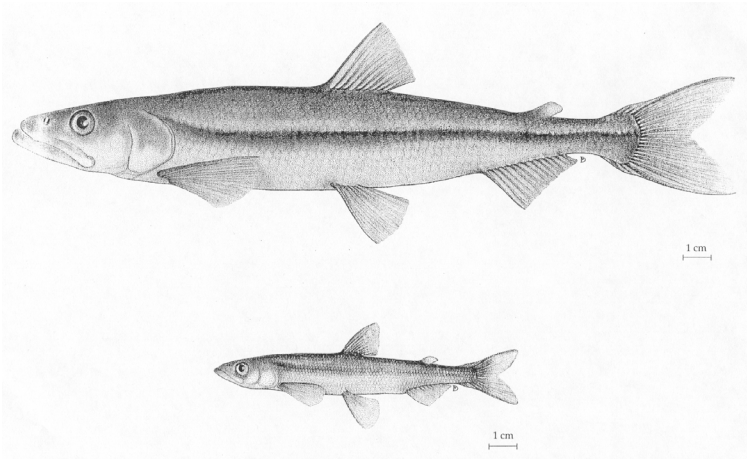

Figure 1. Illustration of Lake Utopia Normal (upper) and Dwarf (lower) Smelt (*Osmerus*). Both specimens were mature males.

Consequently, the status of Dwarf and Normal Smelt from each lake where they are sympatric needs to be evaluated individually. As a first step in this process, this report summarizes what is known of the biology of the Lake Utopia smelt populations, outlines their scientific importance, and discusses issues relevant to their conservation.

DISTRIBUTION

Lake Utopia (45^0 10' N: 66^0 47' W) is part of the Magaguadavic River drainage, Charlotte Co., southwestern New Brunswick and is located about 100 km SW of Saint John (Figure 2). Dwarf Smelt from Lake Utopia were introduced into Meech Lake, Québec in 1924 (Dymond 1939) where they appear to have established a self-sustaining population because mature individuals have been collected as recently as 1991 (Delisle and Veilleux 1969; E.B. Taylor and N. Alfonso, unpublished data). Genetically distinct Dwarf and Normal Smelt also occur in Lochaber Lake, N.S. (Guysborough Co.) and these forms appear to have arisen independently from those in Lake Utopia (Taylor and Bentzen 1993a). Putative sympatric populations of Dwarf and Normal Smelt (i.e. reproductive isolation between forms has not been confirmed by genetic means) also occur in Lac Heney, Gatineau River drainage, Gatineau Co., Québec (Delisle 1969); Green and Onawa lakes, Maine; Lake Champlain (Québec, Vermont, and New York); and Lake Kénogami, Québec (Delisle and Veilleux 1969). Current data indicates that sympatric smelt populations in northeastern North America have had independent origins (Taylor and Bentzen 1993a); the status of these other putative sympatric populations, therefore, will need to be evaluated independently from the Lake Utopia populations.

PROTECTION

Exploitation of the smelt populations of Lake Utopia is limited to local dip-net fisheries during the spring spawning periods (April and May). Most of the effort appears to be focused on the Normal Smelt populations in Mill Lake Stream and Trout Lake Stream (Figure 2) owing to the ease of public access and larger spawning runs (E.B. Taylor, personal observations). Legal methods of fishing include gill nets, bag nets, box nets, dip nets, and angling, but a closed season for the first three methods extends from April 1 through October 14. Gill, box, and bag nets require a licence from the federal Department of Fisheries and Oceans, but none of these permits have been issued since the early 1960s (P. Cronin, N.B. Department of Natural Resources and Energy, R.R. No. 6, Fredericton, New Brunswick, personal communication). The dip net fishery in Lake Utopia and its tributaries is open from April 15 to May 31, with a daily catch and possession limit of 60 fish. There are no size limits in effect. Possession is permitted for domestic consumption only and ice fishing is not permitted on Lake Utopia (Anonymous 1996). A private Atlantic Salmon (*Salmo salar*) smolt farm is operated at the northeast end of the lake. Although the farm is land-based and freshwater-resident salmon are native to Lake Utopia (T. Vickers, N.B. Department of Natural Resources and Energy, R.R. No. 6, Frederiction, New Brunswick, personal communication), any

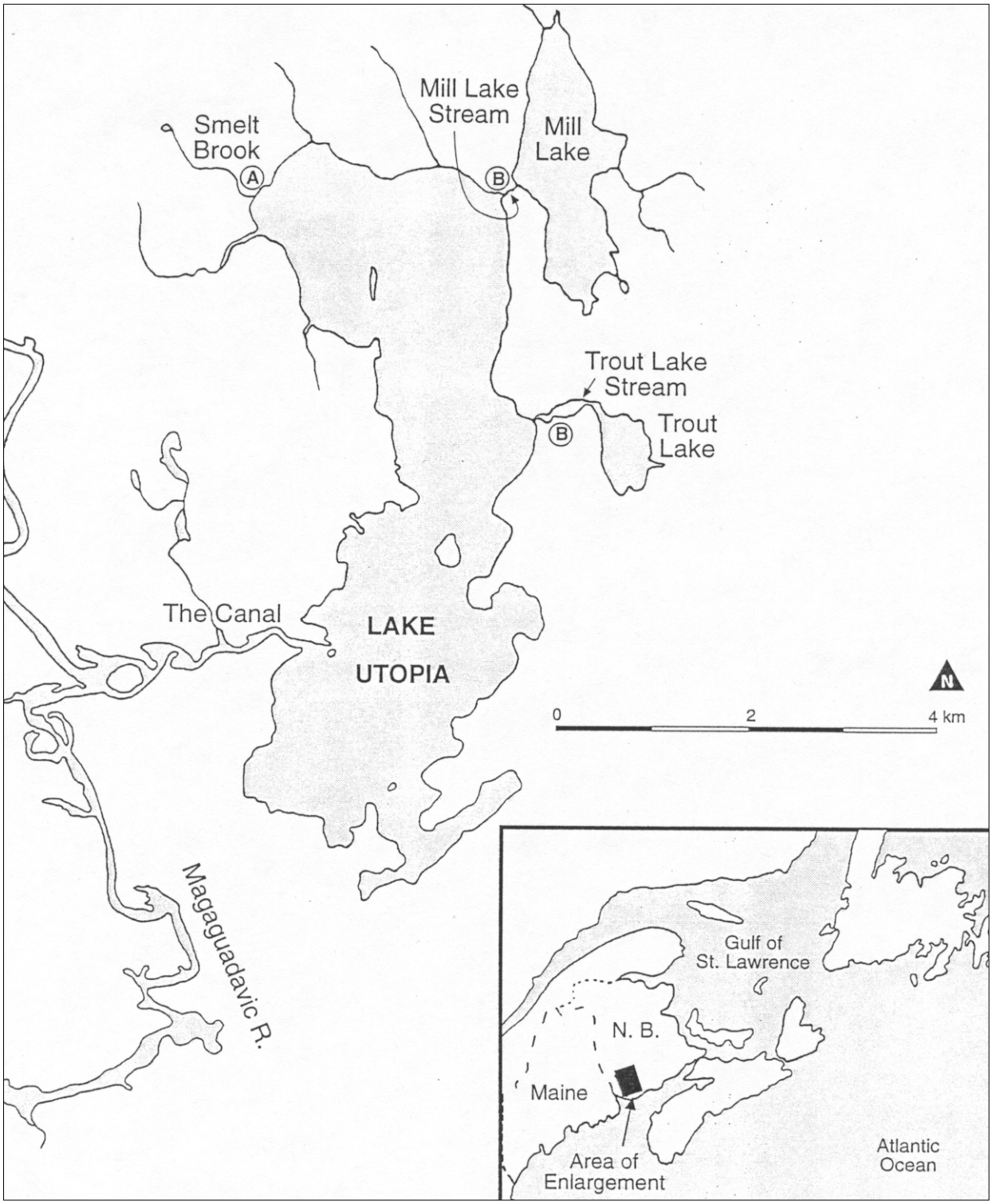

Figure 2. Lake Utopia and surrounding watershed including Dwarf (“A”) and Normal Smelt (“B”) spawning streams.

accidental release of smolts into Lake Utopia could increase predation mortality on Dwarf Smelt and juveniles of both forms. A pulp and paper mill is also located near the southeast part of the lake, but its effluent does not enter Lake Utopia (Vickers, personal communication). Some protection of spawning streams is afforded indirectly by a game refuge at the northeast end of the lake that includes Mill Lake and its outlet stream.

POPULATION SIZE AND TRENDS

No formal population census has been conducted in Lake Utopia for either Dwarf or Normal Smelt. Personal observations by the author, however, over several nights during the spawning runs were made in 1991. Normal Smelt in Mill Lake and Trout Lake streams appeared to number in the order of several thousand individuals. By contrast, numbers of Dwarf Smelt spawning in two streams at the northwest end of the lake appeared to be much less numerous; less than two hundred individuals were observed spawning over two nights. These observations are qualitative at best, but left the impression that in terms of maintaining viable smelt populations in Lake Utopia, Dwarf Smelt appear to be the form at greater risk. The exploitation of Normal Smelt in Lake Utopia in the annual spring dip net fishery is considered to be “low to moderate” (Vickers, personal communication). The extent of the dip-net fishery on Dwarf Smelt, however, is less well-known owing, in part, to the relative remoteness of their spawning streams.

HABITAT

Lake Utopia is a relatively shallow lake with average and maximum depths of 11.1 and 25.6 m, respectively. The lake is 7.2 km long and covers an area of approximately 1370 hectares. The morpho-edaphic index is 0.94 and pH typically ranges from 7.0 at the surface to 6.4 at 25 m. The mid-summer (July) thermocline was at 10-15 m (August 27, 1969) and temperatures ranging from 19°C (surface) to 7.8°C (25 m) were recorded on July 3, 1969. The lake is frozen from early December until the first or second week in April (Vickers, personal communication).

Spawning habitat of Dwarf and Normal Smelt from Lake Utopia appears to be largely confined to four small streams at head of the northern half of the lake (Figure 2). Normal Smelt spawn in Mill Lake and Trout Lake streams, both of which are lake outlet streams. During spawning, these streams had high to moderate flows (up to 1 cm/s) and are 2-5 m in width. Dwarf Smelt spawned in two much smaller (1-2 m wide), slower-flowing streams (< 10 cm/s), both of which are not lake-headed. All of the land surrounding Lake Utopia or its tributary streams is privately owned and there is considerable cottage development, particularly in the south half of the lake.

GENERAL BIOLOGY

Reproduction

Spawning Normal Smelt were collected in both Mill Lake Stream and Trout Lake Stream on 7 April, 1980 at a water temperature of 4^0C while Dwarf Smelt were collected from "Mill Brook" on 12 May, 1980 (Lanteigne and McAllister 1983). Bridges and Delisle (1974) reported Dwarf Smelt spawning in Lake Utopia on May 22, 1972. Collections of Dwarf and Normal Smelt made in 1990 and 1991 also indicated a large difference in spawning time between the forms; Normal Smelt were collected and observed to be ripe on April 8-13, 1991, whereas spawning Dwarf Smelt were collected on May 7, 1990 and May 10-12, 1991 (Taylor and Bentzen 1993b). Dwarf and Normal Smelt were both observed to enter the tributary streams at dusk with the greatest number ascending the streams and spawning between 21:00 and 04:00 (E.B. Taylor, personal observations). Interestingly, the smelt from Meech Lake that originated from a transplant of Dwarf Smelt from Lake Utopia were observed to spawn at the same time as the donor population: May 8, 1963 and May 19, 1971 (Bridges and Delisle 1974; Lanteigne and McAllister 1983).

Feeding Ecology

Dwarf Smelt of Lake Utopia appear to be largely zooplanktivorous, Bajkov (1936) reported stomach contents to consist of *Diaptomous, Cyclops, Leptodora, Daphnia, Epischura,* and *Bosmina*. By contrast, Normal Smelt (at least once they surpass the average size of Dwarf Smelt) are macrophagous, often consuming juvenile smelt (presumably of both forms) (Bajkov 1936, E.B. Taylor, personal observation). Bajkov (1936) also reported that Normal Smelt may be taken by angling with artificial flies at the surface.

Size, Age, Growth, and Morphology

Dwarf and Normal Smelt collected from Lake Utopia in 1981 were reported to average (±SE) 96.9 (1.5) mm and 177.9 (4.1) mm in standard length, respectively (Lanteigne and McAllister 1983). Dwarf Smelt collected in 1990 and 1991 averaged 142.9 (2.34) and 112.9 (1.84) mm total length, respectively (see Taylor and Bentzen 1993a). Normal Smelt collected in 1991 averaged 226.0 (2.89) mm total length (Taylor and Benzten 1993a). There are no data concerning age or growth of the forms in Lake Utopia.

Morphological characterization of Lake Utopia Dwarf and Normal Smelt was summarized by Taylor and Bentzen (1993a). In general, Dwarf Smelt have more gill rakers, larger eyes, but smaller mouths than Normal Smelt. The greatest differences are apparent in gill raker counts. Lanteigne and McAllister (1983) reported mean total gill raker counts of 34.1 (0.11) and 31.1 (0.30) in Dwarf and Normal Smelt, respectively. Similar differences between the forms were reported by Taylor and Bentzen (1993a,b); gill raker counts for Dwarf Smelt collected in 1990 and 1991 averaged 36.2 (0.21) and 35.4 (0.20), respectively, and 32.8 (0.15) in Normal Smelt collected in 1991. Interannual stability of differences in gill raker counts between the forms is consistent with a genetic basis to trophic morphological differentiation between Dwarf and Normal

Smelt. Further, the gill raker counts of Dwarf Smelt appeared to be retained when fish are transplanted to different environments; total gill raker counts of Lake Utopia Dwarf Smelt collected in 1980 were not significantly different from those characterizing Meech Lake dwarf-sized fish (derived from Lake Utopia Dwarf Smelt) collected in 1963 (NMC71-0651, Copeman and McAllister 1978; Lanteigne and McAllister 1983).

LIMITING FACTORS

Production of Lake Utopia smelt is presumably regulated to some extent by the level of primary productivity of the lake. In addition, Lake Utopia contains populations of Atlantic Salmon and Brook Trout (*Salvelinus fontinalis*) both of which have been recorded to prey on smelt in Lake Utopia and elsewhere (Nellbring 1989; Sayers *et al.* 1989). Of five Brook Trout sampled from Lake Utopia during 1996, three were examined for stomach contents and all contained smelt. The Brook Trout ranged in size (TL) from 38.2 to 42.6 cm and the smelt ranged in size from 18.0 to 21.9 cm (Vickers, personal communication). The production of Dwarf and Normal Smelt in Lake Utopia is potentially limited by predation pressure from salmonids, particularly on smaller sized juveniles and Dwarf Smelt. Furthermore, large smelt are often piscivorous and may include smaller smelt in their diet (E.B. Taylor, personal observations). It is likely that a balance exists between smelt and their predators which may be a factor limiting smelt production in Lake Utopia. It is also possible that salmonid enhancement efforts in the lake could upset this balance and have negative impacts on production of juvenile stages of both forms and adult Dwarf Smelt. At present, enhancement of Lake Utopia salmonids is very limited; every other year Atlantic Salmon are planted into the lake at 1 fish for every 2 ha of lake surface area (Vickers, personal communication).

Perhaps the most important factor limiting smelt populations in Lake Utopia is the size and number of spawning streams. Although precise data are not available, the majority of spawning by Normal Smelt occurs in two streams at the northeast end of the lake (Figure 2) while Dwarf Smelt appear largely restricted to two much smaller streams at the northwest end of the lake. Although Trout Lake and Mill Lake streams are lake-headed and appear relatively stable in terms of long term persistence, the Dwarf Smelt spawning streams appeared to be more ephemeral and susceptable to habitat degradation owing to their small size.

SPECIAL SIGNIFICANCE OF THE SYMPATRIC SMELT

The significance of the Lake Utopia smelt populations comprises at least two areas concerned with the recognition of biological diversity. First, Lake Utopia smelt are part of a general phenomenon characteristic of many north temperate freshwater fish faunas where genetically distinct and reproductively isolated population are sympatric and differentiated in morphological and ecological traits (e.g. Svardson 1961; McPhail 1984, 1992; Hindar *et al.* 1986; Foote *et al.* 1989; Verspoor and Cole 1989; Bernatchez and Dodson 1990; Ferguson and Taggart 1991; Taylor *et al.* 1996; Taylor *et al.* 1997). As

the forms are reproductively isolated and ecologically distinct in sympatry, Taylor and Bentzen (1993a,b) argued that Dwarf and Normal Smelt in Lake Utopia fulfilled the criteria for recognition as biological species (sensu Mayr 1963).

The understanding of processes involved in speciation, the splitting of a single lineage into two or more reproductively isolated lineages, is a central theme of evolutionary biology. Such understanding is difficult to obtain directly because while one can observe the products of speciation (the species themselves), the processes involved are historical and, thus, impossible to observe. Notwithstanding this limitation, the principal model of speciation envisions genetic divergences during long term geographic partitioning of a lineage, i.e. allopatry. By contrast, the Lake Utopia smelt populations provide strong evidence of reproductive isolation developing postglacially (e.g. < 12,000 years - see Hughes *et al.* 1985) and in the absence of obvious geographic separation (Taylor and Bentzen 1993a,b). The data and arguments in favour of such relatively rapid, sympatric divergence in Lake Utopia have contributed to an increased appreciation of sympatric speciation as a legitimate and perhaps common mechanism of speciation (Bush 1994). The argument that sympatric speciation, while possible, is a “minor” or “rare” mechanism relative to allopatric speciation (see Gibbons 1996, p. 1499), simply heightens the importance of the Lake Utopia populations where sympatric divergence has been postulated to occur. Some perspective of the scientific importance of the Lake Utopia smelt can be gained by appreciating that similar evidence for sympatric divergence put forth for Lake Utopia smelt has also been suggested to explain the explosive speciation of cichlids in Great Rift and crater lakes of Africa (Meyer *et al.* 1990; Schliewen *et al.* 1994). Further, because the divergence of Lake Utopia smelt populations appears to have occurred independently of divergence between smelt populations in other lakes (see Taylor and Bentzen 1993a) they provide an example of parallel evolution and the possible importance of deterministic processes, such a natural selection, in speciation (Schluter 1996).

Second, Dwarf and Normal Smelt in Lake Utopia are, at present, not distinguished from one another taxonomically and such designations are not necessarily a simple matter (see discussion by Taylor and Bentzen 1993b). The uncertainty concerning their taxonomic recognition, however, cannot obscure the reality of their evolutionary and ecological distinctions and illustrates that considerable biodiversity is “hidden” and taxonomically unrecognized, and perhaps is unrecognizable using our current system of latin binomials (Lindsey 1988). Situations such as the smelt of Lake Utopia, therefore, present a challenge to conservation philosophies and programs focused on current taxonomic procedures.

EVALUATION

The smelt populations in Lake Utopia are apparently stable and in no immediate danger. The major spawning streams of the Normal Smelt are located in a game reserve and fishing pressure appears not to be excessive. A major data limitation relevant to their evaluation is the lack of information on the population trends, spawning habitat area and protection, and fishing pressure on the Dwarf Smelt. As with many other fishes, one of the greatest potential dangers facing the smelt populations are introductions of exotic species

(e.g. Allendorf 1991) or enhancement of native game fish which are predators of smelt. Artificial increases in Atlantic Salmon or Brook Trout in the lake could upset any predator-prey equilibrium that may exist in the lake and may be particularly important for the Dwarf Smelt which are within the size range of salmonid prey throughout their life.

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