COSEWIC
Assessment and Status Report

on the

Northern Sunfish
Lepomis peltastes

Saskatchewan - Nelson River populations
Great Lakes - Upper St. Lawrence populations

in Canada

Saskatchewan - Nelson River populations - NOT AT RISK
Great Lakes - Upper St. Lawrence populations - SPECIAL CONCERN
2016

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. 2016. COSEWIC assessment and status report on the Northern Sunfish *Lepomis peltastes*, Saskatchewan - Nelson River populations and the Great Lakes - Upper St. Lawrence populations, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xv + 51 pp. (http://www.registrelep-sararegistry.gc.ca/default_e.cfm).

Previous report(s):

Meredith, G.N. and Houston, J.J. P. 1987. COSEWIC status report on the Longear Sunfish *Lepomis megalotis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 17 pp

Production note:
COSEWIC would like to acknowledge Tim Birt for writing the status report on the Northern Sunfish (*Lepomis peltastes*) in Canada, prepared under contract with Environment Canada. This report was overseen and edited by John Post, Co-chair of the COSEWIC Freshwater Fishes Subcommittee.

Please note that the Northern Sunfish was assessed in 1987 under the name Longear Sunfish *Lepomis megalotis.*

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur le Crapet du Nord (*Lepomis peltastes*), populations de la rivière Saskatchewan et du fleuve Nelson et populations des Grands Lacs et du haut Saint-Laurent, au Canada.

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Northern Sunfish — Cover photo courtesy of Konrad Schmidt.

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COSEWIC
Assessment Summary

Assessment Summary – May 2016

Common name
Northern Sunfish - Saskatchewan - Nelson River populations

Scientific name
Lepomis peltastes

Status
Not at Risk

Reason for designation
This is a small-bodied member of the sunfish family that inhabits shallow vegetated areas of warm lakes, ponds, and slow-flowing rivers. Though relatively rare, it is broadly distributed, and is subject to low threats.

Occurrence
Ontario

Status history
The species was considered a single unit and designated Not at Risk in April 1987. When the species was split into two separate units in April 2016, the "Saskatchewan - Nelson River populations" unit was designated Not at Risk.

Assessment Summary – May 2016

Common name
Northern Sunfish - Great Lakes - Upper St. Lawrence populations

Scientific name
Lepomis peltastes

Status
Special Concern

Reason for designation
This is a small-bodied member of the sunfish family that inhabits shallow vegetated areas of warm lakes, ponds, and slow-flowing rivers. Its spatial distribution is relatively small and likely patchy. It is suspected that the index of area of occupancy and abundance of the species has declined. Threats are variable across its range with some areas of declining habitat quality and other areas with improving habitat quality. Overall, the threats of siltation, contaminants, and invasive species were assessed as high. The species is likely to become Threatened unless these threats are effectively ameliorated.

Occurrence
Ontario, Quebec

Status history
The species was considered a single unit and designated Not at Risk in April 1987. When the species was split into two separate units in April 2016, the "Great Lakes - Upper St. Lawrence populations " unit was designated Special Concern.

COSEWIC
Executive Summary

Northern Sunfish
Lepomis peltastes

Saskatchewan - Nelson River populations
Great Lakes - Upper St. Lawrence populations

Wildlife Species Description and Significance

Northern Sunfish is a small (length usually less than 13 cm), but otherwise typical, sunfish (Centrarchidae) with a deep, laterally compressed body. It has an upwardly angled opercular flap with a red/orange posterior margin. Breeding males are very colourful, having a reddish breast and bright blue wavy lines radiating posteriorly from the eye and opercle, often into the breast. Adult males retain juvenile characteristics including dark vertical bands and spotting on the dorsal and anal fins. A Northern Sunfish produces grunting sounds when courting. This can be an indicator of habitat quality because of its low tolerance of siltation and turbidity.

Distribution

In Canada, Northern Sunfish range includes northwestern Ontario, south and central Ontario, and southern Québec. In the United States, the Northern Sunfish occurs in Minnesota, eastern Wisconsin, northeastern Illinois, northern Indiana, northern Ohio, northwestern Pennsylvania, northwestern New York, and the lower peninsula of Michigan. Because Northern Sunfish is found in Canada in two National Freshwater Biogeographic Zones it is assessed as two designatable units.

Habitat

The species prefers shallow, vegetated areas of warm lakes, ponds, and slowly flowing watercourses. Northern Sunfish usually occurs in clear waters and is considered intolerant of siltation. Substrate usually consists of sand and gravel, as in the Thames River.

Biology

Northern Sunfish spawns during June and July. Eggs are deposited in a saucer-shaped depression in the substrate excavated by the male. Parental care lasts for a period of approximately 1 week and terminates when fry achieve the free swimming stage. Nesting

is often colonial. The species is a generalist feeder, consuming mostly insects taken throughout the water column. It also eats small fishes and fish eggs. Northern Sunfish appears to disperse little and is considered a poor colonizer.

Population Sizes and Trends

Available data do not support quantitative estimates of abundance and population trends, although the species has never been considered common in Canada. Canadian occurrence records extend from 1924, but sampling has been sporadic and effort is often not known, particularly prior to 1995. Population declines are suspected in Québec and parts of southern Ontario because of habitat degradation. Very few Northern Sunfish have been collected in Québec since the early 1980s.

Threats and Limiting Factors

The most important threats, particularly for the Great Lakes – Upper St. Lawrence DU, include siltation and elevated levels of turbidity and contaminants emanating from agricultural and other forms of development. Less important and potential threats include invasive non-native species (particularly Round Goby), collection for the ornamental fish trade, and bycatch in the bait and recreational fisheries. The Saskatchewan-Nelson DU is threatened by invasive largemouth and smallmouth basses and Green Sunfish, whose ranges are expanding in northwestern Ontario. The most important limiting factor is probably the species' low dispersal capacity, which slows recovery following depopulation and diminishes potential for population rescue. Northern Sunfish is also limited by low tolerance of turbidity.

Protection, Status and Ranks

Northern Sunfish is not listed under the Canadian *Species at Risk Act* (SARA) or the Ontario *Endangered Species Act*. In Québec, the species is included on the *Liste des espèces susceptibles d'être désignées menacées ou vulnérables* (list of wildlife species likely to be designated threatened or vulnerable) as mandated by the "*Loi sur les espèces menacées ou vulnérables"* (RLRQ, c E-12.01) (LEMV) (Act respecting threatened or vulnerable species) (CQLR, c E-12.01). Because sunfishes are considered sport fish, Northern Sunfish and its habitat are protected under the federal *Fisheries Act.* Northern Sunfish is not protected by federal legislation in the United States. Global NatureServe rank is Apparently Secure (G4). National rank in Canada is Vulnerable (N3) and in the United States the rank is Apparently Secure (N4). Subnational ranks in Canada are Imperilled (S2) in Québec and Vulnerable (S3) in Ontario. Northern Sunfish is not ranked in Illinois, Indiana, Ohio, Pennsylvania, and Minnesota.

TECHNICAL SUMMARY – DU1

Lepomis peltastes

Northern Sunfish
Saskatchewan-Nelson River populations

Crapet du Nord
Populations de la rivière Saskatchewan et du fleuve Nelson

Range of occurrence in Canada (province/territory/ocean): Northwest Ontario and Saskatchewan-Nelson Basin in Ontario.

Demographic Information

Generation time (usually average age of spawners)	4 yrs
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	N/A
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence	22,100 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value). 208 km² (discrete) >>2000 km^2 (continuous)	208 km²
Is the population “severely fragmented” ie. is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No b. No

Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	Many >>10 using siltation and contaminants as principal threat
Is there an [observed, inferred, or projected] decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] decline in number of subpopulations?	No
Is there an [observed, inferred, or projected] decline in number of "locations"*?	No
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Uncertain Ranges of potential predators/competitors expanding.
Are there extreme fluctuations in number of subpopulations?	No
Are there extreme fluctuations in number of "locations"*?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals**
Northwestern Ontario	Unknown
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild is at least.	Not Done

Threats (actual or imminent, to populations or habitats, from highest impact to least)

i. Invasive species (Green Sunfish and black basses are expanding ranges; severity of threat unknown)

Was a threats calculator completed for this species and if so, by whom? Yes, by John Post, Tim Birt, Nick Mandrak, Jim Grant, Scott Reid, Marc-Antoine Couillard
Moderator: Dwayne Lepitzki

* See Definitions and Abbreviations on COSEWIC website and IUCN (Feb 2014) for more information on this term.

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Possibly Declining Erratic distribution in Minnesota and Wisconsin. Some recent extirpations in Wisconsin. Secure in Michigan.
Is immigration known or possible?	Possible, but very unlikely
Would immigrants be adapted to survive in Canada?	Probably
Is there sufficient habitat for immigrants in Canada?	Yes
Are conditions deteriorating in Canada?[+]	Possibly Invasive native species are expanding ranges
Are conditions for the source population deteriorating?[+]	Yes
Is the Canadian population considered to be a sink?	No
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species?	No

Status History

COSEWIC: The species was considered a single unit and designated Not at Risk in April 1987. When the species was split into two separate units in April 2016, the “Saskatchewan – Nelson River populations” unit was designated Not at Risk.

Status and Reasons for Designation:

Status: Not at Risk	**Alpha-numeric codes:** Not applicable
Reasons for designation: This is a small-bodied member of the sunfish family that inhabits shallow vegetated areas of warm lakes, ponds, and slow-flowing rivers. Though relatively rare, it is broadly distributed, and is subject to low threats.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Population trends are unknown.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. Although the IAO is below the threshold for Endangered, the number of locations greatly exceeds the threshold and the population is not severely fragmented.

[+] See Table 3 (Guidelines for modifying status assessment based on rescue effect).

Criterion C (Small and Declining Number of Mature Individuals): Not applicable. The number of mature individuals is unknown.
Criterion D (Very Small or Restricted Population): Not applicable. The number of mature individuals is unknown.
Criterion E (Quantitative Analysis): Not done.

TECHNICAL SUMMARY – DU2

Lepomis peltastes

Northern Sunfish
Great Lakes - Upper St. Lawrence populations

Crapet du Nord
Populations des Grands Lacs et du haut Saint-Laurent

Range of occurrence in Canada (province/territory/ocean): Southern Ontario and Southern Québec; Great Lakes-Upper St. Lawrence Basin

Demographic Information

Generation time (usually average age of spawners)	4 yrs
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Probably, inferred in Québec
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. No b. Probably c. No
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence	136,700 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value). 764 km² (discrete) >2000 km^2 (continuous)	764 km²
Is the population “severely fragmented” ie. is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No b. No

Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	Many >>10 using siltation and contaminants as principal threat
Is there an [observed, inferred, or projected] decline in extent of occurrence?	Probably Inferred in Québec
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Probably Inferred in Québec
Is there an [observed, inferred, or projected] decline in number of subpopulations?	Possibly in Québec
Is there an [observed, inferred, or projected] decline in number of "locations"*?	Possibly in Québec
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Water quality deteriorating in some subwatersheds, improving in others.
Are there extreme fluctuations in number of subpopulations?	No
Are there extreme fluctuations in number of "locations"*?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals**
Southern/Eastern Ontario, Southern Quebec	Unknown
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild is at least.	Not Done

* See Definitions and Abbreviations on COSEWIC website and IUCN (Feb 2014) for more information on this term.

Threats (actual or imminent, to populations or habitats, from highest impact to least)

i. Siltation
ii. Contaminants
iii. Invasive species (Round Goby)

Was a threats calculator completed for this species and if so, by whom? Yes, by John Post, Tim Birt, Nick Mandrak, Jim Grant, Scott Reid, Marc-Antoine Couillard
Moderator: Dwayne Lepitzki

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Possibly Declining Secure in Michigan.
Is immigration known or possible?	Possible but very unlikely
Would immigrants be adapted to survive in Canada?	Probably
Is there sufficient habitat for immigrants in Canada?	Yes
Are conditions deteriorating in Canada?[+]	Yes, in some subwatersheds; No, in others
Are conditions for the source population deteriorating?[+]	Yes
Is the Canadian population considered to be a sink?	No
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species?	No

Status History

COSEWIC: The species was considered a single unit and designated Not at Risk in April 1987. When the species was split into two separate units in April 2016, the “Great Lakes – Upper St. Lawrence populations” unit was designated Special Concern.

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Special Concern	Not applicable

Reasons for designation:
This is a small-bodied member of the sunfish family that inhabits shallow vegetated areas of warm lakes, ponds and slow flowing rivers. Its spatial distribution is relatively small, and likely patchy. It is suspected that the index of area of occupancy and abundance of the species has declined. Threats are variable across its range with some areas of declining habitat quality and other areas with improving habitat quality. Overall, the threats of siltation, contaminants, and invasive species were assessed as high. The species is likely to become Threatened unless these threats are effectively ameliorated.

[+] See Table 3 (Guidelines for modifying status assessment based on rescue effect).

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): No applicable. Population trends are unknown.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. Although the discrete IAO is below the threshold for Threatened, and the IAO may have declined, the number of locations greatly exceeds the threshold and the population is not severely fragmented.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. The number of mature individuals is unknown.
Criterion D (Very Small or Restricted Population): Not applicable. The number of mature individuals is unknown.
Criterion E (Quantitative Analysis): Not done.

PREFACE

The status of Northern Sunfish was assessed in 1987 (Meredith and Houston 1987). At that time, the taxon was considered to be a subspecies of Longear Sunfish, *Lepomis megalotis*; it has since been elevated to a full species (Page *et al.* 2013) which is assessed in this report. Northern Sunfish was designated Not at Risk due to its occurrence in numerous waterbodies in Ontario and Québec, although it was not considered to be abundant outside Quetico Park. Surveys conducted since 1987 indicate a larger Canadian range than was previously known; however, some concern exists regarding the status of populations in Québec. Sporadic and limited search effort prevents quantitative estimation of abundance trends, particularly in Québec, where the species is certainly rare.

COSEWIC HISTORY

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. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2016)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* 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. Definition of the (DD) category revised in 2006.

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

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on the

Northern Sunfish
Lepomis peltastes

Saskatchewan - Nelson River populations
Great Lakes - Upper St. Lawrence populations

in Canada

2016

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Class	Actinopterygii
Order	Perciformes
Family	Centrarchidae
Scientific Name	*Lepomis peltastes*
English Common Name	Northern Sunfish
French Common Name	Crapet du Nord

Historically, the taxonomic treatment of Northern Sunfish has been inconsistent. Some taxonomists (e.g. Gruchy and Scott 1966; Scott and Crossman 1973; Jennings 2013) considered the taxon to be a subspecies of Longear Sunfish (i.e. *Lepomis megalotis peltastes*;) while others (e.g. Trautman 1981; Bailey *et al.* 2004; Hubbs *et al.* 2004; Page and Burr 2011) ascribed it full species status (*L. peltastes*). Holm *et al.* (2010) treated populations in Ontario simply as *L. megalotis*. Northern Sunfish is presently considered to be a full species, distinct from Longear Sunfish (Page *et al.* 2013), which does not occur in Canada. In the northern U.S., the ranges of the two species do not overlap except in eastern Illinois, where Smith (1979) was unable to find intergrades and, perhaps, in northeast Ohio, where Trautman (1981) also found no intergrades. The two forms differ considerably in morphology (see following section). The Canadian range of Northern Sunfish lies within two major drainages: the Great Lakes-Upper St. Lawrence basin and the Saskatchewan-Nelson basin.

Morphological Description

A rather typical member of the genus *Lepomis*, Northern Sunfish has a deep, laterally compressed body (Figure 1). It can be distinguished from the similar Longear Sunfish, *L. megalotis*, by its smaller size (up to 17 cm in *L. peltastes*; 23.6 cm in *L. megalotis*) and shorter opercular flap, which angles upward and has a red/orange posterior margin (Bailey *et al.* 2004; Holm *et al.* 2010). Trautman (1981) noted differences in meristic characters, specifically, lateral line scales (35-37 in *L. peltastes*; 39-44 in *L. megalotis*) and pectoral fin rays (usually 13 in *L. peltastes*; 14 in *L. megalotis*). Adult male Northern Sunfish retain juvenile characteristics including dark vertical bands and spotting on the dorsal and anal fins (Trautman 1981). Breeding males are very colourful, having a reddish breast and bright blue wavy lines radiating posteriorly from the eye and opercle, often extending into the breast. Morphological differences between Northern Sunfish and Pumpkinseed (*L. gibbosus*), a superficially similar species native to Canadian waters, include more prominent red pigmentation on the opercular flap and dark spots on the dorsal and anal fins in the latter species (Holm *et al.* 2010).

Figure 1. Northern Sunfish, *Lepomis peltastes.* Photo courtesy of Konrad Schmidt.

Population Spatial Structure and Variability

No information is available regarding variation in Northern Sunfish across the Canadian portion of its range. A survey of allozyme variation in populations from Michigan, Wisconsin, and Illinois revealed low heterozygosity relative to Longear Sunfish populations sampled widely in the eastern U.S. Principal components analysis was not able to differentiate Northern and Longear Sunfishes based on allozyme variation (Jennings and Philipp 1992a). Scott and Crossman (1973) indicated there is little morphological variation across the Canadian range.

Special Significance

This species is too small to be commonly targeted by sport fishers. Males in breeding condition are among the most brilliantly coloured of North American fishes. Both sexes produce sound during the breeding season, presumably to attract mates (Gerald 1971; Hubbs *et al.* 2004). Due to its low tolerance of poor water conditions, Northern Sunfish is considered to be an indicator species of habitat quality (Jennings 2013).

DISTRIBUTION

Global Range

The Canadian portion of the range of Northern Sunfish includes northwestern Ontario, southern and eastern Ontario, and southern Québec (Page and Burr 2011; Figure 2). In the United States, Northern Sunfish is distributed across northern Ohio, Indiana, northeastern Illinois, lower peninsula of Michigan, and eastern Wisconsin. A disjunct portion of the range occurs in north-central Minnesota; several additional disjunct, and likely relict, populations are present in southern Minnesota, central/western Wisconsin, southern Illinois and Iowa (extirpated in Iowa).

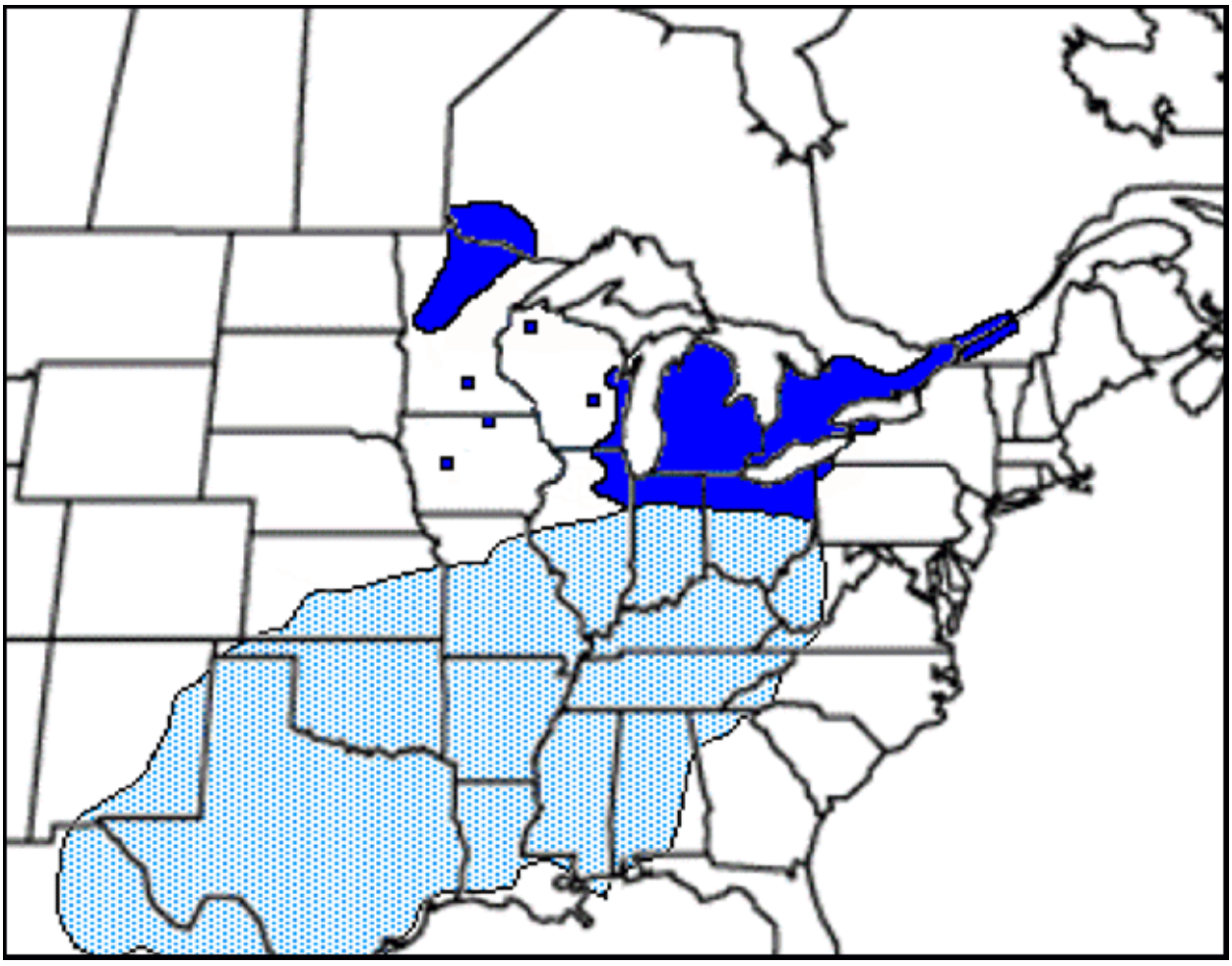

Figure 2. Approximate global distribution of Northern Sunfish *Lepomis peltastes* (dark blue). Range of the closely related Longear Sunfish *L. megalotis* is also shown (light blue). Adapted from Page and Burr (2011).

Canadian Range and Designatable Units

Canadian populations of Northern Sunfish are concentrated in two geographic areas (Figure 3). In northwestern Ontario, Northern Sunfish is present in waters of the Nelson River watershed from Quetico Provincial Park westward through the Rainy River area to Lake of the Woods (Gruchy and Scott 1966; Scott and Crossman 1973). Records also exist from several sites in the vicinity of Lake of the Woods (Figure 4). A gap of approximately 800 km separates populations in northwestern Ontario from those in southern Ontario, where the species is present in waters flowing into Lake Huron, Georgian Bay, Lake St. Clair, Lake Erie, and Lake Ontario (Figure 5). In southern Ontario, the species is known from major watersheds including the Detroit, Thames, Sydenham, Ausable, Saugeen, Grand, Maitland, Trent, Moira, Ottawa, and St. Lawrence rivers. Recent records from the Trent River near Trenton, the Moira River, and lakes north of Kingston have narrowed the gap between populations in southern Ontario and eastern Ontario/Québec.

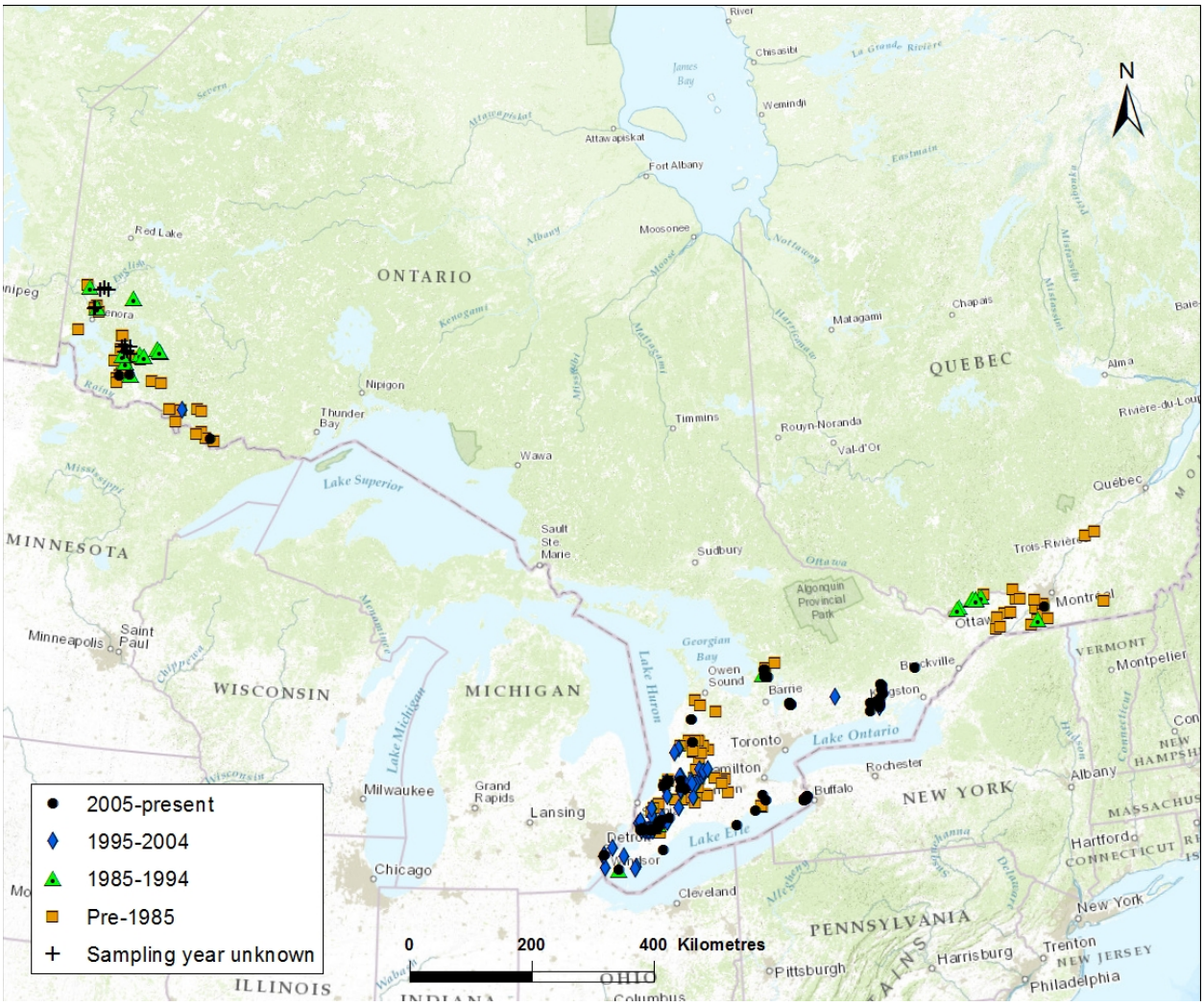

Figure 3. Canadian distribution of Northern Sunfish. Symbols indicate locations and dates of records.

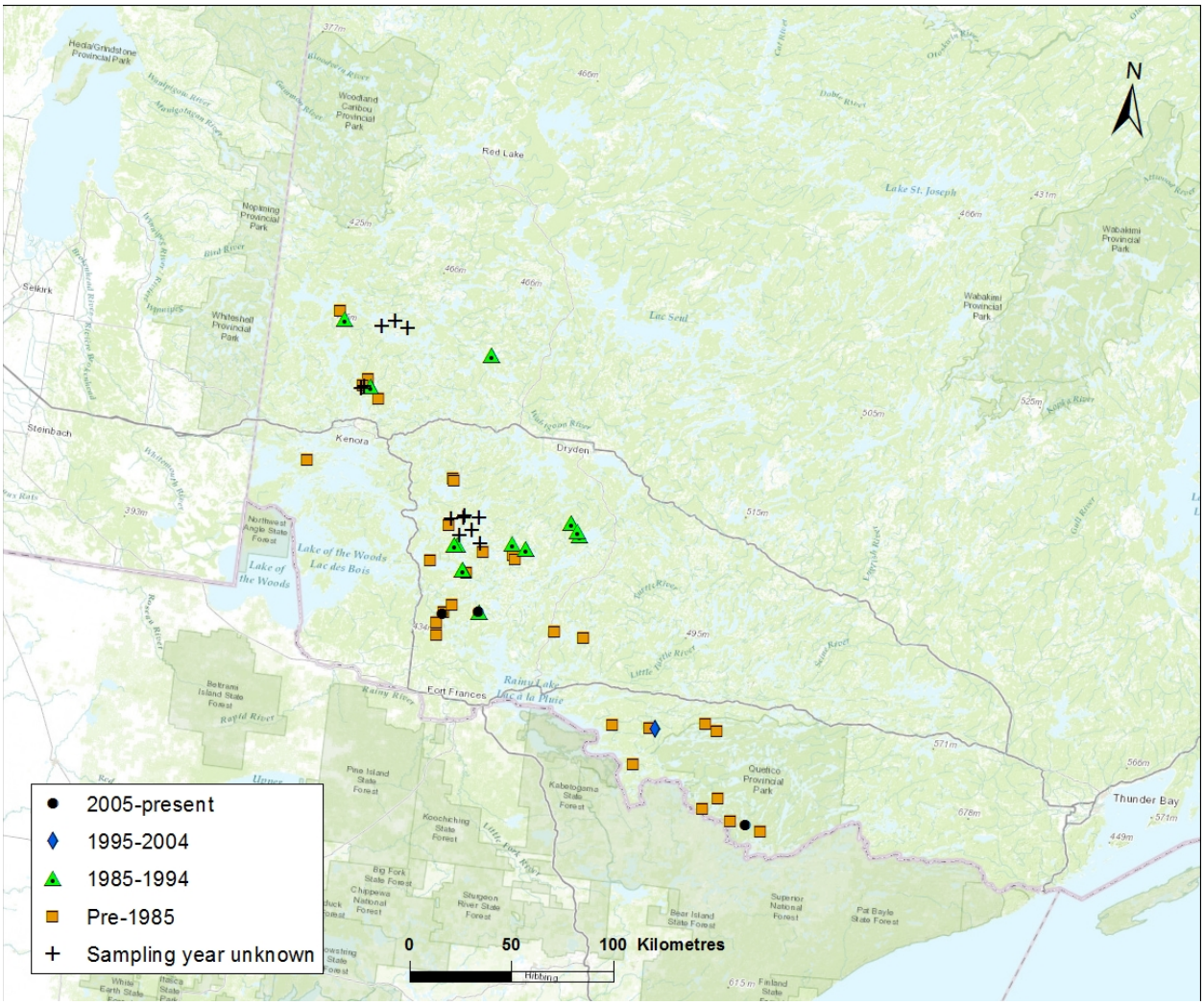

Figure 4. Distribution of Northern Sunfish in northwestern Ontario (Saskatchewan-Nelson DU). Symbols indicate locations and dates of records.

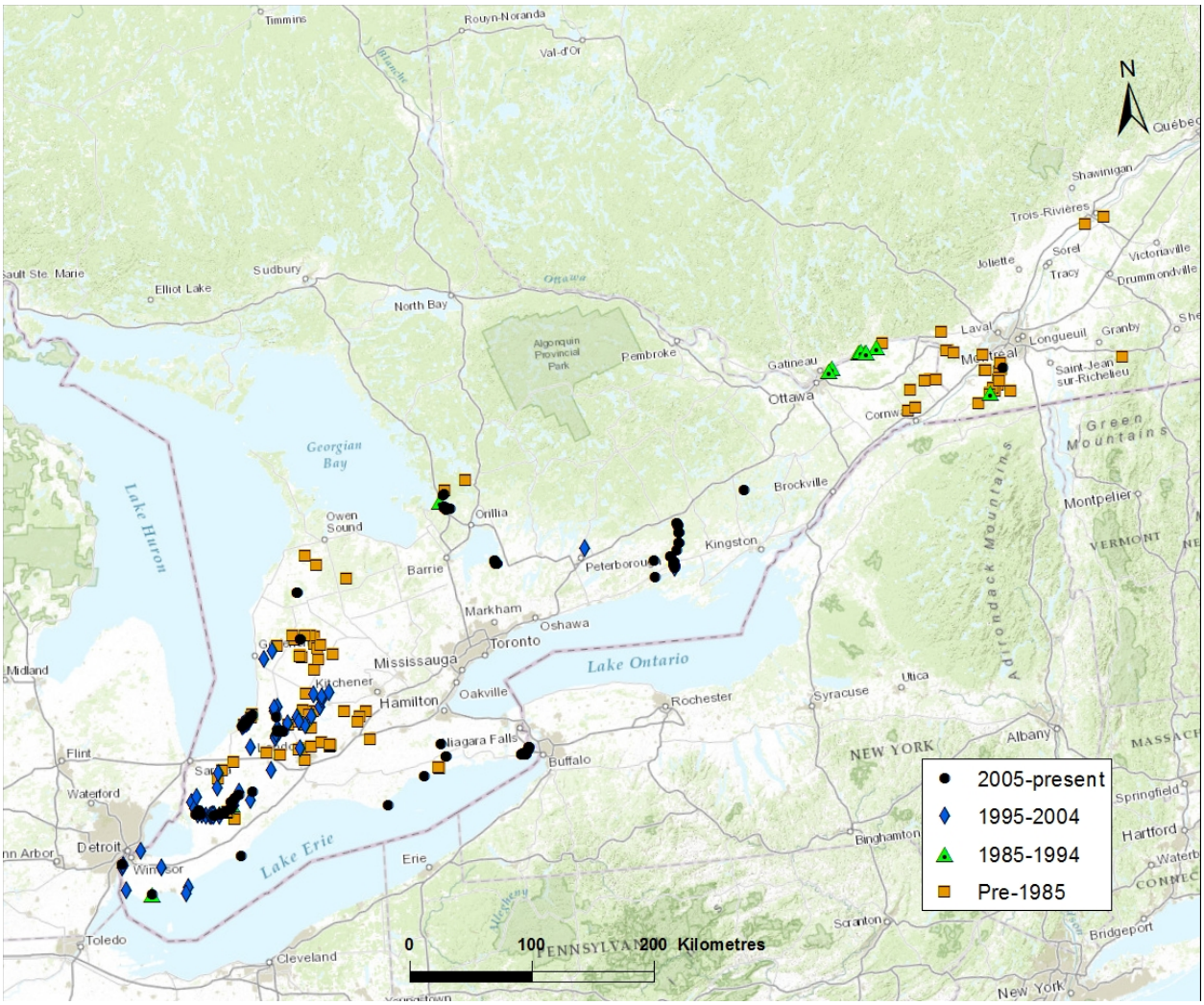

Figure 5. Distribution of Northern Sunfish in southern Ontario and Québec (Great Lakes-Upper St. Lawrence DU). Symbols indicate locations and dates of records.

In Québec, records are limited to tributaries of the St. Lawrence River from Delisle River to Lac St-Pierre (Figure 5). The majority of records from Québec are from the Châteauguay River and lower Outaouais River, with fewer records from the St. Lawrence River around Montréal and Lac St-Pierre. A single record from 1970 exists from Lac Brome (Yamaska River).

Previously, Northern Sunfish was not known from tributaries of Lake Ontario, hence, a gap separating southern Ontario populations from Québec populations was thought to exist (Meredith and Houston 1987). Sampling conducted since the last COSEWIC status update (Meredith and Houston 1987) has revealed populations in this area, particularly in the Moira River and nearby waters. The range is, therefore, more continuous between Québec and southern Ontario than was previously thought.

Designatable units (DUs) must satisfy criteria of discreteness and significance. An argument for discreteness of northwestern Ontario populations and those in southern Ontario and Québec can be made based on two factors. Firstly, northwestern Ontario populations occupy the Saskatchewan-Nelson River Freshwater Biogeographic Zone while populations in southern Ontario/Québec occupy the Great Lakes-Upper St. Lawrence Zone. Fish in the two areas likely have different postglacial dispersal histories (Meredith and Houston 1987; Mandrak and Crossman 1992). Habitat differences, and hence selective pressures, are more likely to be significant between rather than within biogeographic zones. Local adaptations may differentiate populations in the two biogeographic zones (although none is known). Secondly, the unoccupied 800 km gap separating these population clusters likely constitutes a barrier to gene flow.

The significance of the population clusters is less evident. Research on these populations is very limited, hence there is no evidence indicating genetic or ecologic differentiation, i.e. local adaptation has not been demonstrated. The wide disjunction between populations in northwestern Ontario and those in southern Ontario and Québec suggests different recolonization routes from refugial areas following the Wisconsinan glaciation. Canadian populations of Northern Sunfish are likely derived from the Mississippian Refugium; populations in northwestern Ontario likely dispersed through the Warren Route while those in southern Ontario and Quebec likely dispersed through the Chicago and Lower Peninsula of Michigan routes (Mandrak and Crossman 1992). Two DUs are recognized and named according to the biogeographic regions they now occupy, i.e. the Saskatchewan-Nelson DU (populations from northwestern Ontario) and the Great Lakes-Upper St. Lawrence DU (populations from southern Ontario and Québec). Although the significance of separate DUs is equivocal, recognizing them is consistent with treatment by COSEWIC of other freshwater organisms occupying this area (e.g. COSEWIC 2014).

Extent of Occurrence and Area of Occupancy

Using the minimum convex polygon method, the Canadian extent of occurrence (EOO) was determined to be 536,200 km^2. The index of area of occupancy (IAO), calculated using the 2X2 km grid method, is 972 km^2 (discrete measurement) or >>2000 km^2 (continuous measurement). The discrete estimate of IAO includes the summed areas of grid squares containing Northern Sunfish records while the continuous estimate is based on summed areas of continuous stretches of watercourses between the grid squares containing records. For the Saskatchewan-Nelson DU, EOO is 22,100 km^2 and IAO is 208 km^2 (discrete) and >>2000 km^2 (continuous). For the Great Lakes-Upper St. Lawrence DU, EOO is 136,700 km^2 and IAO estimates are 764 km^2 (discrete) and >>2000 km^2 (continuous).

Discrete and continuous estimates of IAO are included as only rough approximations of minimum and maximum values, respectively. But both are likely overestimates of the area required for the most limiting life stage for this colonial nest-spawning fish species. Discrete values are clearly underestimates because Northern Sunfish almost certainly are present in grid squares within the range that were not sampled and therefore not counted. On the other hand, continuous estimates probably overestimate actual IAO values,

because some fraction (potentially a large fraction) of grid squares representing watercourse areas in between squares that contain records do not support Northern Sunfish.

Continuous IAO estimates for both DUs are much greater than 2000 km^2. Precise estimates were not made. Instead, grid squares within each DU were counted until the threshold value for quantitative criteria (i.e. 2000 km^2) was reached. For the Saskatchewan-Nelson DU, continuous grid squares were counted for all watercourses except for Shoal Lake and Lake of the Woods. Because of the large sizes of these waterbodies, a complete count of grid squares would yield a continuous estimate of IAO much greater than 2000 km^2. For the Great Lakes-Upper St. Lawrence DU, the 2000 km^2 threshold was reached by summing grid squares from the Ausable, Maitland, Sydenham, and Thames rivers. Inclusion of the remaining areas within the range of the DU would have yielded an estimate far greater than 2000 km^2.

Due to inconsistent sampling, quantitative comparisons of EOO and IAO through time are not possible. However, the small number of records from Québec combined with the intensity of sampling effort since the last COSEWIC Status Update (Meredith and Houston 1987) suggests that both measures of distribution may have declined. Despite considerable sampling effort throughout the Québec range (see **Search Effort**), recent records of Northern Sunfish exist only from the Châteauguay and Outaouais watersheds. IAO may also be declining in southern Ontario, especially in the upstream portions of the Thames, Grand, and Maitland rivers where most records date from before 1984 (Appendix 1).

Search Effort

Most, or all, records are derived from general fish surveys rather than targeted searches for Northern Sunfish. Since the previous COSEWIC Status Report, considerable search effort has been expended in Ontario by Fisheries and Oceans Canada (DFO) and Ministry of Natural Resources and Forestry (MNRF) personnel (see COSEWIC 2013a). Similarly, in Québec, widespread sampling effort (mostly seining and electrofishing) has been undertaken, largely by the *Réseau de Suivi Ichtyologique* (RSI). The RSI network began in 1995 and has sampled much of the range of Northern Sunfish in Québec including Lac St-Pierre, Lac St-Louis, and Lac St-François over multiple years (outlined in COSEWIC 2013b and references therein). In recent years considerable effort over multiple years has also been expended in watersheds that are not known to support Northern Sunfish such as the St-François River (electrofishing surveys by Ministère de l'Environnement et de la Faune in 1993 and 2006) and the Richelieu River (see COSEWIC 2013b). Only 7 Northern Sunfish specimens have been reported from Québec since the previous COSEWIC Status Report: 5 from the Outaouais River and 2 from the Châteauguay River. Appendix 1 contains available Canadian records of Northern Sunfish from 1924 - 2014.

HABITAT

Habitat Requirements

Northern Sunfish is most often found in shallow areas of warm lakes, ponds, and watercourses with little current. Vegetation is frequently present. Northern Sunfish is usually found in clear waters and is intolerant of turbidity and siltation (Smith 1979; Trautman 1981; Hubbs *et al.* 2004). Substrate usually consists of sand and gravel, as in the Thames River (Keenleyside 1978; Hall-Armstrong *et al.* 1996), although larger substrate material is typical in the Moira and Trent watersheds (Scott Reid, pers. comm.). Spawning occurs in shallow areas with sandy or gravel substrate (Holm *et al.* 2010) and nursery areas consist of shallow areas with mixed vegetation and mineral substrate (Hall-Armstrong *et al.* 1996).

Habitat Trends

Habitat in northwestern Ontario is in remote and generally undeveloped areas including Quetico Provincial Park and is, therefore, generally stable. This contrasts with the situation in southern Ontario and Québec where habitat degradation has been widespread. In both areas, large-scale forest clearing (systematic clearing in southern Ontario began in the nineteenth century, Elliot 1998), development, and agricultural practices have resulted in serious water quality issues, notably siltation and elevated levels of turbidity and contaminants (e.g. Staton *et al.* 2003; Simoneau 2007; Berryman 2008). In recent years, habitat stewardship projects have been undertaken, mostly in southwestern Ontario, to encourage best management practices with the objective of reducing sediment and nutrient inputs from agricultural municipal sources (Erin Carrol, pers. comm. 2015). In Québec, some improvement in habitat quality has been achieved, including reduction of PCB concentrations in the Yamaska River (Berryman 2008). Regulations governing nutrient management and agricultural intensity may mitigate damage related to agriculture (BAPE 2003).

In Ontario, a network of 36 conservation authorities monitors watershed health and some disseminate results via report cards issued at 5-year intervals. Water quality criteria evaluated in report cards include levels of phosphorus and *E. coli*, and the diversity of benthic invertebrate communities. For example, the St. Clair Region Conservation Authority, which monitors 14 watersheds including the Sydenham River, reported in 2013 that total phosphorus in all watersheds exceeded provincial guidelines in all cases. Similarly, *E. coli* levels were higher than provincial guidelines in all but one monitored watershed. Overall water quality has improved over the last 5 years in three watersheds, held steady in seven watersheds, and deteriorated in two watersheds (SCRCA 2013). Over the same time interval, surface water quality reported by the Ausable Bayfield Conservation Authority remained stable (i.e. fair to poor) in most watersheds but improved in the Bannockburn and Main Bayfield watersheds (Brock and Veliz 2013). Between 2007 and 2012, the Upper Thames River Conservation Authority reported improving water quality in 12 watersheds, unchanged water quality in 16 watersheds, and no watershed with declining water quality (UTRCA 2012). Time-series data reflecting change in water quality in the Grand River watershed are not available as a report card; however, a water

management plan documents familiar problems of elevated phosphate, nitrate, and turbidity, accompanied by low dissolved oxygen levels, particularly in central and lower regions of the watershed (Grand River Watershed Water Management Plan 2014). These inputs arise from point and nonpoint sources. While the number of watersheds that are experiencing improvement or deterioration in water quality is unavailable, the water management plan indicates that phosphate levels below wastewater treatment plants are substantially reduced relative to those recorded in the 1970s. Overall, it appears that Northern Sunfish habitat quality in southwestern Ontario, as indicated by total phosphorus, *E. coli*, and benthic invertebrate communities, is generally rated as fair or poor with some watersheds improving or holding stable and others deteriorating.

BIOLOGY

Life Cycle and Reproduction

Northern Sunfish spawns in June and July in Canada in typical sunfish fashion. Territorial males excavate roughly circular nests, often in colonies, in gravel or cobble substrate at a minimum water depth of 12 cm (Jennings and Philipp 1994). Spawning in Michigan occurs at temperatures above 23.3°C (Hubbs and Cooper 1935). Some females release all of their eggs in single nests while others divide their eggs across nests of several males (Jennings and Philipp 1992b). Adhesive eggs, approximately 1 mm in diameter are deposited in the nest and guarded by the male until hatching (3-5 days; Keenleyside 1978). Young are attended to for a few additional days until the yolk sac is absorbed and free swimming is achieved (Jennings 2013). Mature females produce 1,417 - 4,213 eggs (Carlander 1977).

Alternative reproductive tactics are employed by Northern Sunfish; territorial and small cryptically coloured sneaker males have been observed in the Thames River (Keenleyside 1972). Sneaker males gain fertilizations by entering the nests of larger territorial males and releasing sperm when females shed their eggs. In colonial breeding situations, territorial males may also “steal” fertilizations from neighbouring males. Goddard and Mathis (1997a) reported that prospecting females prefer males with larger opercular flaps.

Information on growth rates in Canadian populations is limited. A small study of fish sampled in 1995 from Mahon Lake in Quetico Provincial Park revealed a maximum age of 7 years and mean total length of 78 mm. Growth appears to slow considerably beyond age 2 years, at which time mean total length is 63 mm (Brian Jackson, pers. comm.). Hubbs and Cooper (1935) reported growth increments of 2.0-3.0 cm annually for the first 3 years in Michigan. Jennings (2013) reported similar findings in a small sample of 2- and 3-year-old fish from Beverly Lake in Wisconsin. Maturity is reached at 3-4 years of age and average length of 14 cm. The largest specimen reported by Scott and Crossman (1973) was 15 cm in length and maximum age is probably 8 years. Holm *et al.* (2010) reported a length of 17 cm for the largest specimen known from Ontario.

Female Northern Sunfish usually mature at 3 or 4 years of age (Jennings 2013). Mature males can be smaller (minimum 4.2 cm), especially individuals that adopt the sneaker life-history tactic. Very little information on longevity is available. The limited age distribution of the sample collected at Beverly Lake, Wisconsin, (n=26) suggests a short lifespan. Generation time (i.e. average age of spawners) is estimated to be 4 years.

Physiology and Adaptability

Little is known specifically about the physiology and adaptability of Northern Sunfish. It is active within a temperature range of 7-37.8°C and has little salinity tolerance (Carlander 1977). It is intolerant of siltation and has disappeared from many sites in Ohio, particularly from larger watercourses, as turbidity and siltation have increased (Trautman 1981).

Northern Sunfish is diurnal; it occupies clear waters and likely has good vision. The brilliant colouration in males indicates that visual communication is important during courtship. Similarly, visual displays are used to signal aggression. Production of sound during courtship and mating also suggests that Northern Sunfish, like many fishes, has auditory perception.

Dispersal and Migration

Movement appears to be limited. Spawning sites are thought to be in close proximity to habitat used at other times of year (Carlander 1977; Keenleyside 1978). Berra and Gunning (1972) suggested that the closely related Central Longear Sunfish (*L. m. megalotis*) in three Louisiana streams occupy small home ranges (average length of 42 m) during the warm months but that many individuals abandon these areas during the cold months. Patterns of seasonal dispersal of Northern Sunfish in Canada are not known.

Interspecific Interactions

Northern Sunfish hybridizes with Green Sunfish (*L. cyanellus*), Orangespotted Sunfish (*L. humilis*) (Trautman 1981), Bluegill (*L. macrochirus*) (Scott and Crossman 1973), and Pu**m**pkinseed (Keenleyside 1978; Bolnick 2009). Keenleyside (1978) found evidence that Pumpkinseed and Northern Sunfish partition nesting habitat in the Thames River; Pumpkinseed nests were situated in backwater areas with silty substrate while most Northern Sunfish nests were located at sites with some flow and gravel substrate. Northern Sunfish is found in warmwater stream and lake habitats and is associated with somewhat different species assemblages in each situation. Common species in lake habitats include Bluegill, Pumpkinseed, and Yellow Perch (*Perca flavescens*) (Jennings 2013). Stream habitats containing Northern Sunfish frequently support diverse fish communities (Lyons 1984; Jennings 2013).

Northern Sunfish is an opportunistic feeder but is primarily an insectivore (Scott and Crossman 1973; Jennings 2013). It feeds on a variety of mature and immature insects captured throughout the water column as well as small fishes and fish eggs.

Numerous species include Northern Sunfish in their diets including wading birds and predatory fishes, especially basses (*Micropterus* spp.) (Goddard and Mathis 1997b; Bromilow 2014).

POPULATION SIZES AND TRENDS

Sampling and Abundance

Northern Sunfish has been recorded in Ontario in every decade since the 1920s with increasing frequency in recent decades due to more thorough sampling. In Québec, only 29 records exist; the first observations were in 1941. Most records date from the 1960s and 1970s and few observations exist since 1983 (Appendix 1). Although there is a long time series of Canadian records, the sampling employed does not support estimation of abundance.

Fluctuations and Trends

In the relatively remote areas of northwestern Ontario, the species appears to be widespread, although sampling has not been exhaustive. Populations in this DU are subject to less pressure from agricultural and other forms of development than populations in the Great Lakes-Upper St. Lawrence DU. Furthermore, some of the range in this area lies within Quetico Provincial Park where the species is largely protected from these influences. Populations of this DU are probably stable, although the spread of invasive species may be having negative impact on Northern Sunfish (see Invasive Species in **Threats** section).

Population trends for the Great Lakes-Upper St. Lawrence DU are unclear. Trends in water quality are variable, even within watersheds. Water quality has been stable in recent years in many subwatersheds such as the Lower North Sydenham and Bear Creek Headwaters (SCRCA 2013). Other subwatersheds (e.g. Middle East Sydenham and Bannockburn) have experienced improved water quality in recent years (SCRCA 2013; Brock and Veliz 2013 respectively), while others (e.g. Brown Creek) have experienced deteriorating water quality (SCRCA 2013). Unfortunately, the sampling data are not informative regarding population trends through time.

Populations in Québec appear to be at greatest risk. Habitat degradation is severe in the Châteauguay and Yamaska rivers due to siltation and contaminant inputs (Simoneau 2007; Berryman 2008) and the species is considered to be rare (Jean-François Desroches, pers. comm.; Louis Bernatchez, pers. comm.). Unfortunately, the data available are not sufficient to infer quantitative population trends. For example, more than 50 percent (20 of 39) of Northern Sunfish records from Québec are from the Châteauguay watershed (Appendix 1). Electrofishing surveys conducted in that watershed in 1993 to measure fish diversity produced two Northern Sunfish at a single station. In 2006, additional electrofishing was conducted in the Châteauguay targeting Channel Darter (*Percina copelandi*). Although many stations were sampled, Northern Sunfish was not found (Marc-Antoine Couillard, pers. comm.). The small number of Northern Sunfish collected in recent

years suggests a decline in IAO and EOO. The RSI network collected no Northern Sunfish despite sampling extensively over multiple years at locations that yielded Northern Sunfish historically (e.g. Lac St-Pierre, Lac, St-Louis, Lac St-François). Similarly, extensive sampling in the Yamaska River between 1987 and 1997 failed to find Northern Sunfish (Holm *et al*. 2001; COSEWIC 2013b). Even in the Châteauguay River, the watershed that has yielded the largest proportion of Québec records, the number of fish reported is small considering the magnitude of sampling that has been done. The weight of evidence suggests the species is declining in Québec. This is consistent with results from the threats calculator (Appendix 3), which indicates ongoing declines driven mainly by agricultural pollution.

Rescue Effect

Northern Sunfish is present in states bordering Canadian populations including Minnesota, Michigan (lower peninsula), Ohio, Pennsylvania and New York. The species has declined across much of Ohio (Trautman 1981), Michigan (Hubbs *et al*. 2004), and Illinois (Smith 1979). There is a gap separating populations in Minnesota from those in northwestern Ontario. Considering the low dispersal propensity of the species (Carlander 1977; Keenleyside 1978), there is little opportunity for rescue from the U.S. or between Canadian subpopulations in western Ontario and southern Ontario/Québec.

THREATS AND LIMITING FACTORS

Overall threats impacts were assessed as low in DU1 and high-medium in DU2. Discussion of specific threats follow.

Turbidity and Sediment Loading

The most important threat to Northern Sunfish, particularly in the Great Lakes – Upper St, Lawrence DU, is habitat degradation caused by siltation and contaminants such as chloride (Appendix 2; Appendix 3). The species is sensitive to these stressors (Scott and Crossman 1973; Carlander 1977) and Trautman (1981) has described its widespread decline and replacement by Green Sunfish in Ohio as a result of these factors. In Canada, this threat is most acute in watercourses in southern Ontario and southern Québec, where the intensity of agriculture and other forms of development such as urbanization is high. These problems are well documented in the Sydenham River where most forest cover has been removed and approximately 85% of the watershed has been converted to agricultural use including widespread use of tile drainage (Staton *et al.* 2003). Turbidity was monitored by the Ontario Ministry of Environment and Energy over a 30-year period (1967-1996) and was found to be high, particularly in the north branch. In addition, high levels of suspended solids were accompanied by nutrient loading, particularly phosphate and nitrogen (Staton *et al.* 2003). Success of recent efforts to mitigate silt loading in the Sydenham River and other watersheds remains to be determined (Erin Carroll, pers. comm.).

Rivers in southern Québec are also affected by intensive agricultural development and urbanization. Land use in the Châteauguay watershed is dominated by increasingly intensive agriculture (72% of the surface area; Simoneau 2007). Similarly, approximately 47% of the Yamaska River watershed is devoted to intensive agriculture (Berryman 2008) and contains significant urban areas. Consequently, water quality in much of both systems is poor with high levels of turbidity and contaminants.

Invasive Species

The most likely invasive species to threaten Northern Sunfish in the Great Lakes-Upper St. Lawrence DU is Round Goby (*Neogobius melanostomus*), which was first reported in Lake St. Clair in 1990. The species has spread throughout the Great Lakes (Kornis *et al.* 2012) and the St. Lawrence, and has invaded watersheds occupied by Northern Sunfish including the Trent, Moira (Scott Reid, pers. comm.), Sydenham, Ausable, Thames, and Grand rivers (Poos *et al.* 2010). Although Round Goby has had negative impact on benthic species (e.g. nest predation), its impact on Northern Sunfish remains to be determined.

Expansion of the ranges of predatory Largemouth Bass (*Micropterus salmoides*), and Smallmouth Bass (*M. dolomieu*) may threaten Northern Sunfish in the Saskatchewan-Nelson DU (Crossman and Buerschaper 1976; Brown *et al.* 2009a, b). Green Sunfish is also experiencing range expansion in northwestern Ontario. This species is more tolerant of elevated turbidity than Northern Sunfish and has replaced the latter in some Ohio watercourses where turbidity has increased (Trautman 1981). Green Sunfish is an aggressive competitor, and when introduced elsewhere, has frequently been implicated in significant disruption of native fish communities (e.g. Lemly 1985; Olden and Poff 2005). The ultimate impact of these range extensions is not known. Another invasive species that may negatively affect Northern Sunfish in northwest Ontario is Rusty Crayfish (*Orconectes rusticus*). This large, aggressive species originates from the Ohio Valley and may degrade habitat used by Northern Sunfish by consuming large amounts of aquatic vegetation (Brian Jackson, pers. comm.).

Angling and Bait Fishery

Angling for Northern Sunfish is not prohibited in Ontario. Although the species is small, and therefore not generally targeted by anglers, it is sometimes caught incidentally by anglers fishing for basses or larger sunfishes. It is easily captured and is potentially harmed or killed in the process. Overall, the impact of angling in not known.

Annual sales of baitfishes in Ontario of approximately $14 million reflect the large-scale use of live bait by anglers (some 100 million fishes harvested; OMNR and BAO 2006). In addition to commercial sales, many anglers catch their own baitfishes (Drake and Mandrak 2014). Although regulations prohibit collection of species at risk for the bait industry, a certain level of bycatch of non-target species occurs. In a survey of retail bait outlets, Drake and Mandrak (2014) did not record Northern Sunfish among non-target

species caught as bycatch, although three centrarchid species were noted. Furthermore, Northern Sunfish frequently co-occurs with Redfin Shiner (*Lythrurus umbratilis*), a legal baitfish species, suggesting the potential for bycatch. However, since the latter is seldom targeted by baitfishers, the risk of capturing Northern Sunfish as bycatch is probably low, but not zero (Andrew Drake, pers. comm. 2015). Use of live bait poses the additional threat of potential for introduction of invasive non-native species including pathogens.

Ornamental Fish Trade

A potential threat to Northern Sunfish is the ornamental fish trade (Meredith and Houston 1987). Breeding males are brilliantly pigmented and, therefore, desirable aquarium fish for some hobbyists. The species' small size and interesting behaviour add to its attraction. Longear Sunfish is offered for sale by at least one supplier of aquarium fishes in Taiwan. Although the origin of the stock is unknown, it could actually be Northern Sunfish. The scope and severity of this threat are unknown, but probably very low.

Limiting Factors

Perhaps the most important limiting factor for Northern Sunfish is its restricted movement within, and presumably, among watersheds. The species is considered to be a poor colonizer and is slow to repopulate habitat following its removal (Carlander 1977). Its low tolerance of poor water quality can also be considered a limiting factor.

Number of Locations

Siltation and pollution, the most important threats, emanate from numerous point and non-point sources. The number of locations can therefore be considered to be the number of watersheds occupied. This number is uncertain; however, there are clearly many more than ten (threshold for quantitative criteria).

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Northern Sunfish was previously assessed by COSEWIC as Not at Risk (Meredith and Houston 1987). It is, therefore, not currently listed under the Canadian *Species at Risk Act*. Northern Sunfish can be legally taken as a sport fish and is subject to catch and possession limits. It is therefore protected under the federal *Fisheries Act*, particularly in waters supporting other game and/or commercial species.

In Ontario, Northern Sunfish is considered a "Sunfish" under provincial fishing regulations, so catch limits apply. Destruction or alteration of riparian areas and wetlands are regulated and protected under the following: *Conservation Authorities Act*, *Provincial Planning Act*, *Canadian Environmental Assessment Act*, and *Water Resources Act*. The Ontario *Conservation Authorities Act* is intended to protect aquatic habitat through the

creation of conservation authorities, which promote integrated watershed management and conservation through projects such as tree planting, wetland creation, and erosion control (see **Habitat Trends**).

In Québec, it is included (as *L. megalotis*) on the Liste des espèces susceptibles d'être désignées menacées ou vulnérables (list of wildlife species likely to be designated threatened or vulnerable) in accordance with the *Loi sur les espèces menacées ou vulnérables (RLRQ, c E-12.01)* (LEMV) (Act respecting threatened or vulnerable species) (CQLR, c E-12.01).

In the United States, it is not on the List of Endangered and Threatened Wildlife and Plants.

Non-Legal Status and Ranks

Northern Sunfish is not listed on the IUCN Red List of Threatened Species and has no American Fisheries Society status. NatureServe (NatureServe 2014) rankings of Northern Sunfish in various jurisdictions are shown below.

Global - G5 (Secure)
Canada - N3 (Vulnerable)
Ontario - S3 (vulnerable)
Québec - S2 (imperilled)
U.S. - N5
Illinois, Indiana, Minnesota, Ohio, Pennsylvania - SNR (Not Ranked)

Michigan ranks *L. megalotis* as S5 (widespread and common) while Wisconsin ranks the species as S2. These ranks presumably refer to *L. peltastes* as *L. megalotis* does not occur in either state.

Habitat Protection and Ownership

Recent changes to the federal *Fisheries Act* relating to habitat raise uncertainty about future protection of this species. Most of the land base in watersheds supporting Northern Sunfish in southern Ontario and Québec is privately owned, although some is publicly owned (e.g. Pinery Provincial Park, Point Pelee National Park). Much of northwestern Ontario is crown land, notably Quetico Provincial Park.

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Tim Birt is a Research Associate and Adjunct Assistant Professor at Queen's University. His research activities are currently focused on population genetics and evolution of seabirds. He has also worked with fishes, especially Atlantic Salmon. Tim has authored or co-authored three COSEWIC status reports.

COLLECTIONS EXAMINED

None.

Appendix 1: Northern Sunfish records from Ontario and Québec. Many entries represent more than one individual captured. Sources include: Canadian Museum of Nature (CMN), Royal Ontario Museum (ROM), Ontario Ministry of Natural Resources and Forestry (MNRF), Fisheries and Oceans Canada (DFO), Ministère des Forêts, de la Faune et des Parcs du Québec (MFFP), and St. Clair Region Conservation Authority (SCRCA).

DU1 - Saskatchewan-Nelson

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
08-Jul-60	CMNFI 1965-0030.2	Burditt Lake	CMN
17-Jun-70	CMNFI 1970-0141.3	Rainy River District	CMN
08-Jul-60	21643	Burditt Lake	ROM
09-Jun-69	26748	Cirrus Lake	ROM
26-Jun-67	26835	Darky Lake	ROM
Aug-67	26923	Lake of The Woods	ROM
22-Aug-69	26951	Caviar Lake	ROM
08-Sep-70	27354	Bart Lake	ROM
06-Jun-71	27776	Quetico Lake	ROM
18-Jul-71	27855	Melin Lake	ROM
23-Jul-71	27857	Mahon Lake	ROM
23-Jul-71	27858	Mahon Lake	ROM
25-Jun-75	28659	Little Roland Lake	ROM
15-Jul-73	30216	Lake No 190	ROM
08-Jun-74	30542	Kakagi Lake	ROM
03-Jun-76	32231	Corn Lake	ROM
31-Jul-70	33067	Weld Lake	ROM
02-Aug-70	33068	Ryckman Lake	ROM
05-Jul-78	35953	Deacon Lake	ROM
19-Jul-79	36408	Unnamed Lake	ROM
20-Aug-79	38015	Shoal Lake	ROM
29-Jul-80	41604	Redhorse Lake	ROM
17-Jul-83	52259	Birch Lake	ROM
17-Jul-83	52262	Birch Lake	ROM
03-Aug-83	52263	Tourist Lake (Nl)	ROM
03-Aug-83	52264	Tourist Lake (Nl)	ROM
27-Aug-85	57621	Wawapus Lake	ROM

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
27-Aug-85	57623	Wawapus Lake	ROM
06-Jun-87	89429	Shingwak	ROM
07-Aug-80	-	Darby Creek	ROM
20-Jul-88	-	Osipasinni Lake	ROM
19-Jul-88	-	Osipasinni Lake	ROM
19-Jul-88	-	Osipasinni Lake	ROM
15-Jul-85	-	Kramer Lake	ROM
19-Jul-88	-	Osipasinni Lake (Nl)	ROM
20-Jul-88	-	Osipasinni Lake (Nl)	ROM
20-Jul-88	-	Osipasinni Lake (Nl)	ROM
06-Aug-87	-	(NL) Lake VF 55-08	ROM
28-Jul-86	-	Noonan Lake	ROM
27-Aug-85	-	Wawapus Lake	ROM
18-Jul-88	-	Osipasinni Lake (Nl)	ROM
06-Aug-87	-	(NL) Lake VF 55-08	ROM
05-Jul-84	-	Lowry Lake	ROM
02-Jul-88	-	Hectorine Lake	ROM
02-Aug-83	-	Sandhill Lake	ROM
09-Jul-87	-	Forrest Lake	ROM
20-Jun-83	-	Newman Lake	ROM
11-Jun-83	-	Backlawrence Lake (Nl)	ROM
09-Jun-83	-	Little Moose Lake (Nl)	ROM
05-Jul-84	-	Lowry Lake	ROM
16-Jul-85	-	Kramer Lake	ROM
30-Jun-87	-	Beggs	ROM
08-Jul-87	-	Forrest Lake	ROM
07-Jul-87	-	Forrest Lake	ROM
01-Jul-87	-	Beggs	ROM
19-Aug-87	-	Moosehorn	ROM
10-Jul-86	-	Manitumeig Lake	ROM
19-May-85	-	Loonhaunt Lake	ROM
21-May-85	-	Loonhaunt Lake	ROM
2008-2014	15-4430-54221	Burditt Lake	MNRF
2008-2014	15-4632-54287	Loonhaunt Lake	MNRF
2008-2014	15-6052-53411	Sarah Lake	MNRF

DU2 - Great Lakes - Upper St. Lawrence

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
26-Jul-12	2012-CH-ESD-SYD260712-005A	Sydenham River	DFO
21-Aug-12	2012-FMOS-SR210812-011A	Sydenham River	DFO
01-Aug-12	2012-GPND010812-001A	Beaver Creek	DFO
01-Aug-12	2012-GPND010812-002A	Beaver Creek	DFO
02-Aug-12	2012-GPND020812-001A	Beaver Creek	DFO
02-Aug-12	2012-GPND020812-002A	Beaver Creek	DFO
03-Jul-12	2012-GPND030712-001A	Beaver Creek	DFO
03-Aug-12	2012-GPND030812-001A	Beaver Creek	DFO
03-Aug-12	2012-GPND030812-002A	Beaver Creek	DFO
04-Jul-12	2012-GPND040712-001A	Beaver Creek	DFO
05-Jul-12	2012-GPND050712-001A	Beaver Creek	DFO
11-Jul-12	2012-GPND110712-002A	Beaver Creek	DFO
13-Jun-12	2012-GPND130612-001A	Beaver Creek	DFO
13-Jul-12	2012-GPND130712-001A	Beaver Creek	DFO
13-Jul-12	2012-GPND130712-002A	Beaver Creek	DFO
15-Jun-12	2012-GPND150612-002A	Beaver Creek	DFO
18-Jun-12	2012-GPND180612-001A	Beaver Creek	DFO
18-Jun-12	2012-GPND180612-002A	Beaver Creek	DFO
18-Jul-12	2012-GPND180712-001A	Beaver Creek	DFO
19-Jul-12	2012-GPND190712-001A	Beaver Creek	DFO
19-Jul-12	2012-GPND190712-003A	Beaver Creek	DFO
20-Jun-12	2012-GPND200612-001A	Beaver Creek	DFO
23-Jul-12	2012-GPND230712-001A	Beaver Creek	DFO
24-Jul-12	2012-GPND240712-001A	Beaver Creek	DFO
25-Jun-12	2012-GPND250612-001A	Beaver Creek	DFO
30-Jul-12	2012-GPND300712-001A	Beaver Creek	DFO
31-Jul-12	2012-GPND310712-002A	Beaver Creek	DFO
23-Jul-12	2012-LCS-HURON230712-001A	Old Ausable Channel	DFO
24-Jul-12	2012-LCS-HURON240712-002A	Old Ausable Channel	DFO
24-Jul-12	2012-LCS-HURON240712-004A	Old Ausable Channel	DFO
19-Sep-12	2012-SLCC190912-112A	East Sydenham River	DFO
25-Jun-13	2013-AC-MON-CEDAR250613-001B	Cedar Creek	DFO
07-Aug-13	2013-PNM-LSCD070813-006A	East Otter Creek	DFO

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
09-Jul-13	2013-PNM-LSCD090713-001C	West Otter Creek	DFO
09-Jul-13	2013-PNM-LSCD090713-002C	West Otter Creek	DFO
19-Jun-13	2013-SLCC-DTR190613-121A	Detroit River	DFO
19-Jun-13	2013-SLCC-DTR190613-122A	Detroit River	DFO
23-Sep-02	AUCR02-01-01-BS	Ausable Channel	DFO
23-Sep-02	AUCR02-01-01-WT/MT	Ausable Channel	DFO
24-Sep-02	AUCR02-01-02-BEF	Ausable Channel	DFO
23-Sep-02	AUCR02-01-02-WT/MT	Ausable Channel	DFO
24-Sep-02	AUCR02-01-03-BEF	Ausable Channel	DFO
23-Sep-02	AUCR02-01-03-WT/MT	Ausable Channel	DFO
24-Sep-02	AUCR02-01-04-BEF	Ausable Channel	DFO
23-Sep-02	AUCR02-01-04-HN	Ausable Channel	DFO
23-Sep-02	AUCR02-01-04-WT/MT	Ausable Channel	DFO
24-Sep-02	AUCR02-02-01-BS	Ausable Channel	DFO
24-Sep-02	AUCR02-02-01-HN	Ausable Channel	DFO
24-Sep-02	AUCR02-02-01-WT/MT	Ausable Channel	DFO
24-Sep-02	AUCR02-02-02-BEF	Ausable Channel	DFO
24-Sep-02	AUCR02-02-02-WT/MT	Ausable Channel	DFO
24-Sep-02	AUCR02-02-03-WT/MT	Ausable Channel	DFO
24-Sep-02	AUCR02-02-04-HN	Ausable Channel	DFO
24-Sep-02	AUCR02-02-04-WT/MT	Ausable Channel	DFO
25-Sep-02	AUCR02-03-01-BS	Ausable Channel	DFO
25-Sep-02	AUCR02-03-01-WT/MT	Ausable Channel	DFO
25-Sep-02	AUCR02-03-02-BS	Ausable Channel	DFO
25-Sep-02	AUCR02-03-02-HN	Ausable Channel	DFO
25-Sep-02	AUCR02-03-02-WT/MT	Ausable Channel	DFO
25-Sep-02	AUCR02-03-03-BEF	Ausable Channel	DFO
25-Sep-02	AUCR02-03-03-HN	Ausable Channel	DFO
25-Sep-02	AUCR02-03-03-WT/MT	Ausable Channel	DFO
25-Sep-02	AUCR02-03-04-WT/MT	Ausable Channel	DFO
26-Sep-02	AUCR02-04-01-WT/MT	Ausable Channel	DFO
26-Sep-02	AUCR02-04-02-BEF	Ausable Channel	DFO
26-Sep-02	AUCR02-04-02-BS	Ausable Channel	DFO
26-Sep-02	AUCR02-04-02-WT/MT	Ausable Channel	DFO
26-Sep-02	AUCR02-04-03-BEF	Ausable Channel	DFO

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
26-Sep-02	AUCR02-04-03-HN	Ausable Channel	DFO
26-Sep-02	AUCR02-04-03-WT/MT	Ausable Channel	DFO
26-Sep-02	AUCR02-04-04-HN	Ausable Channel	DFO
26-Sep-02	AUCR02-04-04-WT/MT	Ausable Channel	DFO
07-Jul-04	AUCR04BP070704005	Old Ausable Channel	DFO
14-Jul-04	AUCR04BP140704009	Little Ausable River	DFO
21-Jul-04	AUCR04BP210704016	Ausable River	DFO
23-Jul-04	AUCR04BP230704019	Ausable River	DFO
12-Jul-04	AUCR04BS120704006	Ausable River	DFO
15-Jul-04	AUCR04BS150704011	Ausable River	DFO
15-Jul-04	AUCR04BS150704012	Ausable River	DFO
09-Jul-04	AUCR04SN090704017	Old Ausable Channel	DFO
09-Jul-04	AUCR04SN090704018	Old Ausable Channel	DFO
12-Aug-04	AUCR04SN120804001	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804001	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804002	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804003	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804004	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804005	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804006	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804007	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804008	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804009	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804010	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804011	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804012	Old Ausable Channel	DFO
18-Aug-04	AUCR04SN180804013	Old Ausable Channel	DFO
19-Oct-04	AUCR04SN191004002	Old Ausable Channel	DFO
20-Oct-04	AUCR04SN201004001	Old Ausable Channel	DFO
09-Aug-07	AUS07-090807-001	Ausable River	DFO
09-Aug-07	AUS07-090807-003	Ausable River	DFO
14-Aug-07	AUS07-140807-002	Ausable River	DFO
23-Jul-07	AUS07-230707-001	Ausable River	DFO
25-Jul-07	AUS07-250707-001	Ausable River	DFO
26-Jul-07	AUS07-260707-003	Ausable River	DFO

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
29-Aug-07	AUS07-290807-004	Old Ausable Channel	DFO
28-Aug-02	AUSR02-001	Ausable River	DFO
29-Aug-02	AUSR02-002	Ausable River	DFO
29-Aug-02	AUSR02-004	Ausable River	DFO
28-Aug-02	AUSR02-005	Ausable River	DFO
28-Aug-02	AUSR02-007	Ausable River	DFO
29-Aug-02	AUSR02-008	Ausable River	DFO
29-Aug-02	AUSR02-016	Ausable River	DFO
28-Aug-02	AUSR02-018	Ausable River	DFO
28-Aug-02	AUSR02-022	Ausable River	DFO
13-Sep-02	BEF02-MCK-001	Muddy Creek	DFO
18-Jul-02	BEF02-SYD-004	Sydenham River	DFO
20-Aug-02	BEF02-SYD-005	Sydenham River	DFO
08-Aug-02	BEF02-SYD-006	Sydenham River	DFO
21-Aug-02	BEF02-SYD-007	Sydenham River	DFO
20-Aug-03	DTR03038C	Detroit River	DFO
23-Aug-03	DTR03039	Detroit River	DFO
25-Aug-03	DTR03TC003	Turkey Creek	DFO
25-Aug-03	DTR03TC004	Turkey Creek	DFO
23-Jun-09	ESDPG-SYD09-230609-001	Sydenham River	DFO
23-Jun-09	ESDPG-SYD09-230609-002	Sydenham River	DFO
23-Jun-09	ESDPG-SYD09-230609-005	Sydenham River	DFO
24-Jun-09	ESDPG-SYD09-240609-004	Fansher Creek	DFO
25-Jun-09	ESDPG-SYD09-250609-006	Sydenham River	DFO
08-Jul-09	GPND09-080709-001	Beaver Creek	DFO
09-Jul-08	GRRGP08-090708-005B	Grand River	DFO
09-Jul-08	GRRGP08-090708-006B	Grand River	DFO
20-Oct-04	GSD04BP201004004	Sydenham River	DFO
22-Aug-02	HMM02-001	Hillman Marsh	DFO
06-Aug-02	MOXD02-MTR-001	Belgrave Creek	DFO
07-Aug-02	MOXD02-MTR-002	Maitland River	DFO
29-Jul-02	MOXD02-THR-002	Fish Creek	DFO
30-Jul-02	MOXD02-THR-003	Medway Creek	DFO
30-Jul-02	MOXD02-THR-004	Fish Creek	DFO
31-May-05	OAC05-053105-001	Old Ausable Channel	DFO

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
31-May-05	OAC05-053105-003	Old Ausable Channel	DFO
28-Jun-05	OAC05-062805-001	Old Ausable Channel	DFO
28-Jun-05	OAC05-062805-002	Old Ausable Channel	DFO
28-Jun-05	OAC05-062805-003	Old Ausable Channel	DFO
02-Aug-05	OAC05-080205-001	Old Ausable Channel	DFO
03-Aug-05	OAC05-080305-001	Old Ausable Channel	DFO
03-Aug-05	OAC05-080305-002	Old Ausable Channel	DFO
03-Aug-05	OAC05-080305-004	Old Ausable Channel	DFO
04-Aug-05	OAC05-080405-001	Old Ausable Channel	DFO
27-Jul-10	PDAH-PNM-2010-270710-004B	Sydenham River	DFO
27-Jul-10	PDAH-PNM-2010-270710-005B	Sydenham River	DFO
29-Jul-10	PDAH-PNM-2010-290710-001A	Otter Creek	DFO
01-Jun-10	PDAH-PNS-2010-010610-001A	Old Ausable Channel	DFO
18-Jul-05	PFBK05-071805-002	Pefferlaw Brook	DFO
20-Jul-05	PFBK05-072005-006	Pefferlaw Brook	DFO
11-Oct-05	PFBK05-101105-001	Pefferlaw Brook	DFO
11-Oct-05	PFBK05-101105-007	Pefferlaw Brook	DFO
12-Oct-05	PFBK05-101205-001	Pefferlaw Brook	DFO
12-Oct-05	PFBK05-101205-002	Pefferlaw Brook	DFO
12-Oct-05	PFBK05-101205-004	Pefferlaw Brook	DFO
12-Oct-05	PFBK05-101205-005	Pefferlaw Brook	DFO
13-Oct-05	PFBK05-101305-003	Pefferlaw Brook	DFO
13-Oct-05	PFBK05-101305-006	Pefferlaw Brook	DFO
15-Nov-05	PFBK05-111505-001	Pefferlaw Brook	DFO
15-Nov-05	PFBK05-111505-002	Pefferlaw Brook	DFO
15-Nov-05	PFBK05-111505-003	Pefferlaw Brook	DFO
15-Nov-05	PFBK05-111505-006	Pefferlaw Brook	DFO
15-Nov-05	PFBK05-111505-007	Pefferlaw Brook	DFO
20-Jul-05	PFBK05-200705-005b	Pefferlaw Brook	DFO
16-Aug-10	PG10-160810-001A	Sydenham River	DFO
16-Aug-10	PG10-160810-001B	Sydenham River	DFO
17-Aug-10	PG10-170810-001A	Sydenham River	DFO
17-Aug-10	PG10-170810-001B	Sydenham River	DFO
18-Aug-10	PG10-180810-001A	Sydenham River	DFO
20-Aug-10	PG10-200810-001A	East Sydenham River	DFO

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
27-Aug-10	PG10-270810-001A	East Sydenham River	DFO
11-Jul-07	RCR07-071107-002c	Sydenham River trib.	DFO
14-Jul-07	RCR07-071407-0a1c	Grand River	DFO
07-Aug-07	RCR07-080707-003a	Maitland River	DFO
07-Aug-07	RCR07-080707-003d	Maitland River	DFO
07-Aug-07	RCR07-080707-003e	Maitland River	DFO
16-Sep-03	SYD091603-1BPEF	East Sydenham River	DFO
16-Sep-03	SYD091603-1SN	East Sydenham River	DFO
16-Sep-03	SYD091603-2SN	East Sydenham River	DFO
23-Sep-10	SYDTR10-230910-002A	Sydenham River	DFO
04-Jul-05	TWR05-070405-002	Teeswater River	DFO
04-Jul-05	TWR05-070405-002silvia	Teeswater River	DFO
26-Oct-05	TWR05-102605-001	Teeswater River	DFO
23-Aug-59	CMNFI 1959-0334.9	Lac St-Pierre	CMN
08-Oct-60	CMNFI 1960-0508A.9	Muskoka District	CMN
09-Aug-72	CMNFI 1972-0179.17	Bear Creek	CMN
12-Aug-72	CMNFI 1972-0197.14	Sydenham River	CMN
13-Aug-72	CMNFI 1972-0201.17	Bear Creek	CMN
14-Aug-72	CMNFI 1972-0207.12	Fish Creek	CMN
02-Aug-73	CMNFI 1974-0046.12	Fish Creek	CMN
04-Aug-73	CMNFI 1974-0056.9	Thames River	CMN
04-Aug-73	CMNFI 1974-0058.3	Thames River	CMN
16-Aug-79	CMNFI 1979-1009.1	Maitland River	CMN
13-Sep-79	CMNFI 1979-1118.10	Thames River	CMN
22-Jul-82	CMNFI 1982-0588.7	East Sydenham River	CMN
24-Jul-82	CMNFI 1982-0604.6	Gregory Creek	CMN
16-Aug-79	CMNFI 1986-0107.1	Maitland River	CMN
16-Aug-79	CMNFI 1986-0108.1	Maitland River	CMN
16-Aug-79	CMNFI 1986-0109.1	Maitland River	CMN
16-Aug-79	CMNFI 1986-0110.1	Maitland River	CMN
16-Aug-79	CMNFI 1986-0111.1	Maitland River	CMN
19-Jun-86	CMNFI 1987-0223.8	Cedar Creek	CMN
02-Aug-13	-	Moira River	MNRF
07-Aug-13	-	Trent River	MNRF
08-Jul-13	-	Moira River	MNRF

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
10-Sep-13	-	Moira River	MNRF
10-Sep-13	-	Moira River	MNRF
10-Sep-13	-	Moira River	MNRF
15-Aug-13	-	Moira River	MNRF
15-Aug-13	-	Moira River	MNRF
19-Jul-13	-	Moira River	MNRF
19-Aug-13	-	Moira River	MNRF
19-Aug-13	-	Moira River	MNRF
19-Aug-13	-	Moira River	MNRF
20-Aug-13	-	Moira River	MNRF
21-Aug-13	-	Moira River	MNRF
23-Jul-13	-	Moira River	MNRF
23-Jul-13	-	Moira River	MNRF
23-Aug-13	-	Moira River	MNRF
24-Jul-13	-	Moira River	MNRF
24-Jul-13	-	Moira River	MNRF
24-Jul-13	-	Moira River	MNRF
24-Jul-13	-	Moira River	MNRF
25-Jul-13	-	Moira River	MNRF
25-Jul-13	-	Moira River	MNRF
26-Jul-13	-	Moira River	MNRF
27-Aug-13	-	Moira River	MNRF
27-Aug-13	-	Moira River	MNRF
27-Aug-13	-	Moira River	MNRF
29-Aug-13	-	Moira River	MNRF
29-Aug-13	-	Moira River	MNRF
31-Jul-13	-	Moira River	MNRF
31-Jul-13	-	Moira River	MNRF
31-Jul-13	-	Moira River	MNRF
31-Jul-13	-	Moira River	MNRF
02-Sep-11	-	Trent River	MNRF
21-Jun-41	4061	Rivière Aux Outardes	MFFP
21-Jun-41	24210	Ruisseau Norton	MFFP
11-Jul-41	19902	Lac des Deux Montagnes	MFFP
14-Sep-46	13084	Rivière Delisle	MFFP

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
31-Jul-63	26	Rivière des Anglais	MFFP
08-Sep-64	497	Lac des Deux Montagnes	MFFP
10-Sep-64	457	Lac des Deux Montagnes	MFFP
10-Sep-64	466	Lac des Deux Montagnes	MFFP
Jun-65	4033	Rivière des Outaouais	MFFP
30-Jul-65	4656	Rivière à la Raquette	MFFP
18-Aug-65	3970	Rivière Ouest	MFFP
05-Aug-70	399	Lac Brome	MFFP
03-Aug-73	12294	Lac St-Louis	MFFP
30-Jul-74	12226	Lac St-Louis	MFFP
07-May-75	15435	Ruisseau St-Jean	MFFP
09-May-75	15454	Ruisseau St-Jean	MFFP
22-Jul-75	622	Rivière Châteauguay	MFFP
24-Jul-75	629	Rivière Châteauguay	MFFP
20-Jul-76	321	Rivière Châteauguay	MFFP
26-Jul-76	858	Coulée Des Poissant	MFFP
26-Jul-76	867	Ruisseau Turcot	MFFP
26-Jul-76	869	La Grande Décharge	MFFP
27-Jul-76	849	Ruisseau Pouliot	MFFP
27-Jul-76	855	Le Grand Marais	MFFP
12-Aug-76	45	Ruisseau Howe-Holmes	MFFP
12-Sep-83	13098	Rivière Châteauguay	MFFP
13-Sep-83	3898	Rivière Châteauguay	MFFP
13-Sep-83	13100	Rivière Châteauguay	MFFP
16-Sep-83	3832	Rivière Châteauguay	MFFP
13-Jun-88	-	Rivière des Outaouais	MFFP
01-Jan-89	-	Rivière des Outaouais	MFFP
01-Jan-90	-	Rivière des Outaouais	MFFP
01-Jan-92	-	Rivière des Outaouais	MFFP
16-Sep-92	-	Rivière des Outaouais	MFFP
01-Nov-92	-	Rivière des Outaouais	MFFP
01-Nov-92	-	Rivière des Outaouais	MFFP
Nov-92	290	Lac St. Paul	MFFP
13-Sep-93	12837	Rivière Châteauguay	MFFP
1950	0422CS	Thames River	ROM

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
1924	08153	Georgian Bay	ROM
10-Aug-36	09286	Ausable River	ROM
15-Jul-36	09319	Sydenham River	ROM
15-Jul-36	09352	Sydenham River	ROM
15-Jul-36	09353	Sydenham River	ROM
13/08/1936	09413	Medway Creek	ROM
04-Aug-55	17566	Fanshawe Lake	ROM
10-Aug-51	17887	Blacks Creek	ROM
10-Aug-34	18183	Bayfield River	ROM
1958	20121	Sauble River;Tara Creek;Sauble River Tributary	ROM
1950	22582	Thames River	ROM
17-Aug-53	23869	Avon River	ROM
26-Aug-53	23870	Avon River	ROM
Aug-50	24693	Thames River	ROM
1947	24764	Ausable River	ROM
1956	24839	Saugeen River	ROM
23-Jul-49	24948	Nith River	ROM
31-May-63	25752	Maitland River;South Maitland River	ROM
07-Jul-69	26797	Ausable River	ROM
29-Jun-69	26799	Lake Huron	ROM
23-Jul-73	29885	Delisle River	ROM
24-Jul-73	29943	Delisle River	ROM
20-Jul-73	29945	Delisle River	ROM
30-Jul-73	29967	Boyle Drain	ROM
24-Jul-73	29970	Middle Maitland River	ROM
22-Jul-73	29975	Middle Maitland River	ROM
08-Aug-73	29977	Little Maitland River	ROM
30-Jul-73	29980	Middle Maitland River	ROM
07-Jun-73	30053	Raisin River	ROM
07-Jun-73	30030	Raisin River Tributary	ROM
08-Aug-73	30033	Little Maitland River	ROM
11-Aug-73	30035	Little Maitland River	ROM
17-Jun-73	30205	Middle Maitland River	ROM

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
22-Aug-73	30236	Maitland River	ROM
28-Jul-73	30253	Maitland River	ROM
14-Aug-73	30287	Flat Creek	ROM
27-Jul-73	30291	Kenny Creek	ROM
22-Aug-73	30316	Maitland River	ROM
15-Aug-73	30327	Maitland River	ROM
16-Aug-73	30407	Horner Creek	ROM
17-Aug-73	30409	Maitland River	ROM
15-Aug-74	30759	Little Ausable River	ROM
04-Jun-74	30807	Stoney Creek	ROM
04-Jun-74	30814	Stoney Creek	ROM
11-Jul-74	30864	Unnamed Creek	ROM
21-Jul-74	30904	-	ROM
18-Aug-74	30924	Unknown	ROM
20-Aug-74	30937	Waubuno Creek	ROM
05-Oct-77	36528	Severn River	ROM
02-Jun-82	42077	Old Ausable Channel	ROM
30-Jun-87	54904	Detroit River	ROM
13-Aug-36	55433	Medway Creek	ROM
10-Aug-89	56965	Sydenham River	ROM
Aug-80	60235	Severn River	ROM
28-Sep-97	71024	Old Ausable Channel	ROM
28-Sep-97	71028	Old Ausable Channel	ROM
28-Sep-97	71090	Old Ausable Channel	ROM
27-Nov-97	71169	Flat Creek	ROM
12-Nov-98	71815	Fish Creek	ROM
20-Aug-98	71973	Otonabee River	ROM
16-Jun-00	72369	Avon River	ROM
16-Jun-00	72422	Avon River	ROM
15-Jun-00	72423	Black Creek tributary	ROM
19-Jun-01	72609	Sydenham River	ROM
1983	75813	Thames River	ROM
1983	75814	Thames River	ROM
1983	75815	Thames River	ROM
1983	75816	Thames River	ROM

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
1983	75817	Thames River	ROM
1983	75818	Thames River	ROM
1983	75819	Thames River	ROM
1983	75820	Thames River	ROM
1983	75821	Thames River	ROM
1983	75822	Thames River	ROM
1983	75823	Thames River	ROM
1983	75824	Thames River	ROM
1983	75825	Thames River	ROM
1983	75826	Thames River	ROM
1983	75827	Thames River	ROM
1983	75828	Thames River	ROM
1983	75829	Thames River	ROM
1983	75830	Thames River	ROM
Sep-83	75831	Middle Thames River	ROM
10-Jun-03	75862	Moira River	ROM
28-Aug-02	76688	Ausable River	ROM
29-Aug-02	76947	Ausable River	ROM
28-Aug-02	76956	Ausable River	ROM
29-Aug-02	76980	Ausable River	ROM
04-Jul-05	77267	Teeswater River	ROM
28-Aug-02	77413	Ausable River	ROM
28-Aug-02	77432	Ausable River	ROM
29-Aug-02	77667	Ausable River	ROM
10-Jun-97	78730	Big Creek	ROM
1983	78811	Thames River	ROM
1983	78812	Thames River	ROM
25-Aug-03	79781	Turkey Creek	ROM
01-Jul-05	80239	Rivière Châteauguay	ROM
20-Aug-03	80802	Detroit River	ROM
02-Jun-04	81484	Belle River	ROM
20-Jul-05	82612	Pefferlaw Brook	ROM
27-Aug-08	82973	Gloucester Pool	ROM
26-Oct-05	85023	Teeswater River	ROM
18-Jul-05	89222	Pefferlaw Brook	ROM

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
20-Jul-05	89225	Pefferlaw Brook	ROM
27-Jul-10	89332	Sydenham River	ROM
11-Oct-05	89416	Pefferlaw Brook	ROM
02-Jul-02	93089	Fansher Creek	ROM
26-Sep-02	96447	Old Ausable Channel	ROM
30-Jul-02	99759	Fish Creek	ROM
16-Sep-03	-	East Sydenham River	ROM
25-Sep-02	-	Old Ausable Channel	ROM
29-Jul-02	-	Fish Creek	ROM
26-Sep-02	-	Old Ausable Channel	ROM
30-Jul-02	-	Medway Creek	ROM
24-Sep-02	-	Old Ausable Channel	ROM
25-Sep-02	-	Old Ausable Channel	ROM
26-Sep-02	-	Old Ausable Channel	ROM
10-Sep-03	-	North Sydenham River	ROM
23-Sep-02	-	Ausable Channel	ROM
25-Sep-02	-	Old Ausable Channel	ROM
15-Sep-03	-	East Sydenham River	ROM
24-Jul-80	-	North Thames River	ROM
28-Sep-97	-	Old Ausable Channel	ROM
04-Nov-99	-	Spring Creek	ROM
15-Jun-04	-	Fansher Creek	ROM
28-Jul-04	-	Whirl Creek	ROM
25-Sep-02	-	Old Ausable Channel	ROM
25-Sep-02	-	Old Ausable Channel	ROM
25-Sep-02	-	Old Ausable Channel	ROM
26-Sep-02	-	Old Ausable Channel	ROM
23-Jul-80	-	Flat Creek	ROM
11-Sep-03	-	North Sydenham River	ROM
26-Apr-00	-	Government Drain 5/6	ROM
11-Sep-03	-	North Sydenham River	ROM
24-Sep-02	-	Ausable Channel	ROM
26-Sep-02	-	Old Ausable Channel	ROM
15-Sep-03	-	East Sydenham River	ROM
28-Jul-04	-	Black Creek	ROM

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
02-Jun-75	-	Medway Creek	ROM
24-Sep-02	-	Old Ausable Channel	ROM
17-Jun-75	-	Sydenham River	ROM
26-Sep-02	-	Old Ausable Channel	ROM
16-Sep-03	-	East Sydenham River	ROM
26-Sep-02	-	Old Ausable Channel	ROM
07-Jun-82	-	Old Ausable Channel	ROM
24-Sep-02	-	Ausable Channel	ROM
06-Jun-82	-	Little Bear Creek	ROM
31-May-82	-	Middle Thames River	ROM
23-Sep-02	-	Old Ausable Channel	ROM
26-Sep-02	-	Old Ausable Channel	ROM
26-Sep-02	-	Old Ausable Channel	ROM
24-Sep-02	-	Old Ausable Channel	ROM
24-Sep-02	-	Old Ausable Channel	ROM
07-Jun-82	-	Old Ausable Channel	ROM
24-Sep-02	-	Old Ausable Channel	ROM
16-Sep-03	-	East Sydenham River	ROM
25-Sep-02	-	Old Ausable Channel	ROM
23-Sep-02	-	Ausable Channel	ROM
23-Sep-02	-	Ausable Channel	ROM
16-Jun-01	Released	Sydenham River	ROM
16-Jun-01	Released	Sydenham River	ROM
16-Jun-01	Released	Black Creek	ROM
15-Jun-00	Released	Black Creek	ROM
28-Sep-97	Released	Old Ausable Channel	ROM
18-Jun-01	Released	Sydenham River	ROM
17-Jun-01	Released	Sydenham River	ROM
08-Jul-02	-	East Sydenham River	ROM
23-May-02	-	Black Creek	ROM
26-Jun-02	-	Bear Creek	ROM
11-Jul-02	-	Sydenham River East Branch	ROM
24-Sep-02	96443	Ausable Channel	ROM
26-Sep-02	96452	Old Ausable Channel	ROM
24-Sep-02	99507	Old Ausable Channel	ROM

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
06-Aug-02	99512	Belgrave Creek	ROM
07-Aug-02	99514	Maitland River	ROM
21-Jul-14	2014-AC-MON-COLDWATER210714-002C	Coldwater Creek	DFO
21-Jul-14	2014-AC-MON-COLDWATER210714-003C	Coldwater Creek	DFO
21-Jul-14	2014-AC-MON-COLDWATER210714-005C	Coldwater Creek	DFO
22-Jul-14	2014-AC-MON-COLDWATER220714-001A	Coldwater Creek	DFO
22-Jul-14	2014-AC-MON-COLDWATER220714-002C	Coldwater Creek	DFO
23-Jul-14	2014-AC-MON-COLDWATER230714-003C	Coldwater Creek	DFO
23-Jul-14	2014-AC-MON-COLDWATER230714-004C	Coldwater Creek	DFO
23-Jul-14	2014-AC-MON-COLDWATER230714-005C	Coldwater Creek	DFO
23-Jul-14	2014-AC-MON-COLDWATER230714-006C	Coldwater Creek	DFO
24-Jul-14	2014-AC-MON-COLDWATER240714-002B	Coldwater Creek	DFO
07-Jul-14	2014-AC-MON-LPB070714-003C	Long Point Bay	DFO
15-Jul-14	2014-AC-MON-NAN150714-003A	Nanticoke Creek	DFO
25-Jun-14	2014-AC-MON-RONDEAU250614-002C	Rondeau Bay	DFO
2008-2014	18-3741-49489	Bob's Lake	MNRF
2008-2014	17-6026-49666	Gloucester Pool	MNRF
24-Jul-01	-	Hardy Creek	SCRCA
26-Jul-01	-	Sydenham River	SCRCA
4-Oct-02	-	Sydenham River	SCRCA
4-Oct-02	-	Sydenham River	SCRCA
12-Jul-04	-	Coldstream Reservoir	SCRCA
13-Jul-04	-	Bridgeview Reservoir	SCRCA
13-Jul-04	-	Reservoir #1	SCRCA
15-Jul-04	-	Area Reservoir	SCRCA
6-Aug-04	-	Strathroy Reservoir	SCRCA
6-Aug-04	-	Sydenham River	SCRCA
21-Sep-05	-	Sydenham East Br.	SCRCA

DATE	SPECIMEN ID	WATERCOURSE	SOURCE
20-Jul-09	-	Sydenham East Br.	SCRCA
20-Jul-09	-	Sydenham River	SCRCA
20-Jul-09	-	Sydenham River	SCRCA
21-Jul-09	-	Spring Creek	SCRCA

Appendix 2: Threats Calculator for Saskatchewan-Nelson DU

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	Northern Sunfish, *Lepomis peltastes*-SK-Nelson DU
Element ID	**Elcode**
Date (Ctrl + ";" for today's date):	27/01/2015
Assessor(s):	John Post, Tim Birt, Nick Mandrak, Jim Grant, Scott Reid, Marc-Antoine Couillard Moderator: Dwayne Lepitzki
References:	teleconference 12 Feb 2015

Overall Threat Impact Calculation Help:

		Level 1 Threat Impact Counts	
Threat Impact		**high range**	**low range**
A	Very High	0	0
B	High	0	0
C	Medium	0	0
D	Low	1	1
	Calculated Overall Threat Impact:	Low	Low
	Assigned Overall Threat Impact:		
	Impact Adjustment Reasons:		
	Overall Threat Comments		

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development						
1.1	Housing & urban areas						not applicable
1.2	Commercial & industrial areas						not applicable
1.3	Tourism & recreation areas						not applicable. No planned and KNOWN development in the next 10 yrs
2	Agriculture & aquaculture						
2.1	Annual & perennial non-timber crops						not applicable. Considers physical impacts of agriculture on sunfish habitat (e.g. changes due to removal of riparian vegetation, channelization etc). Does not consider pollution/turbidity issues (see below).
2.2	Wood & pulp plantations						not applicable
2.3	Livestock farming & ranching						not applicable. No tramping known of.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
2.4	Marine & freshwater aquaculture						not applicable.
3	Energy production & mining						
3.1	Oil & gas drilling						not applicable. No fracking
3.2	Mining & quarrying						not applicable. Major mining out of range for this species.
3.3	Renewable energy						not applicable.
4	Transportation & service corridors						
4.1	Roads & railroads						not applicable.
4.2	Utility & service lines						not applicable.
4.3	Shipping lanes						not applicable.
4.4	Flight paths						not applicable.
5	Biological resource use		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals						Not applicable.
5.2	Gathering terrestrial plants						not applicable.
5.3	Logging & wood harvesting						not applicable
5.4	Fishing & harvesting aquatic resources		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Potential collection for aquarium trade and bait fishery bycatch but more likely a threat for other DU. Likely some angling mortality.
6	Human intrusions & disturbance		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	
6.1	Recreational activities						not applicable
6.2	War, civil unrest & military exercises						not applicable
6.3	Work & other activities		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	exposure to fisheries scientific collection in 1-2% of the lakes.
7	Natural system modifications						
7.1	Fire & fire suppression						not applicable
7.2	Dams & water management/use						some hydroelectric development. Likely new dams will be constructed in the next 10 yrs. but only a small number. Existing dams alter water regimes but unlikely to negatively impact Northern Sunfish.
7.3	Other ecosystem modifications						not applicable. siltation and elevated levels of turbidity accounted for under 9.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8	Invasive & other problematic species & genes						
8.1	Invasive non-native/alien species						Impact of Round Goby invasion unknown but not applicable to this DU.
8.2	Problematic native species						hybridization is not an issue for this species. Is possible but impact is unknown.
8.3	Introduced genetic material						not applicable.
9	Pollution	D	Low	Small (1-10%)	Moderate - Slight (1-30%)	High (Continuing)	
9.1	Household sewage & urban waste water		Negligible	Negligible (<1%)	Moderate - Slight (1-30%)	High (Continuing)	chloride and pollutants are a major threat to this species. Urban development is generally highly correlated with increased concentrations of pollution but not high for this DU. Needs to be researched in terms of the actual level of impact of salt on this species.
9.2	Industrial & military effluents		Negligible	Negligible (<1%)	Moderate (11-30%)	High (Continuing)	
9.3	Agricultural & forestry effluents		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	Sedimentation is a big threat. Contaminants emanating from agricultural and other forms of development. Endocrine disruptors are present and problematic from pulp and paper mills. Present but unknown impact in this DU. Forestry effluents are negligible but remain a small threat more for this DU than the Eastern Ont DU. This threat is related more to forestry than agriculture. Negligible impact since forestry uses buffer zones to reduce impact.
9.4	Garbage & solid waste						not applicable
9.5	Air-borne pollutants						not applicable
9.6	Excess energy						not applicable
10	Geological events						
10.1	Volcanoes						not applicable
10.2	Earthquakes/tsunamis						not applicable
10.3	Avalanches/landslides						not applicable
11	Climate change & severe weather						
11.1	Habitat shifting & alteration						not applicable.
11.2	Droughts						not applicable.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.3	Temperature extremes						not applicable. Warmer temperature likely positively affect this species. Centrarchids shifting northward - indication of warming of lakes.
11.4	Storms & flooding						not applicable.
Classification of Threats adopted from IUCN-CMP, Salafsky et al. 2008).							

Appendix 3: Threats Calculator for Great Lakes-Upper St. Lawrence DU

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	Northern Sunfish, *Lepomis peltastes*_Great Lakes-St. Lawrence DU		
Element ID		**Elcode**	
Date (Ctrl + ";" for today's date):	27/01/2015		
Assessor(s):	John Post, Tim Birt, Nick Mandrak, Jim Grant, Scott Reid, Marc-Antoine Couillard Moderator: Dwayne Lepitzki		
References:	teleconference 12 Feb 2015		

Overall Threat Impact Calculation Help:	**Level 1 Threat Impact Counts**	
Threat Impact	**high range**	**low range**
A Very High	0	0
B High	1	0
C Medium	0	1
D Low	1	1
Calculated Overall Threat Impact:	High	Medium
Assigned Overall Threat Impact:		
Impact Adjustment Reasons:		
Overall Threat Comments		

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development						
1.1	Housing & urban areas						not applicable
1.2	Commercial & industrial areas						not applicable
1.3	Tourism & recreation areas						not applicable. No planned and KNOWN development in the next 10 yrs.
2	Agriculture & aquaculture	D	Low	Restricted - Small (1-30%)	Moderate (11-30%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
2.1	Annual & perennial non-timber crops	D	Low	Restricted - Small (1-30%)	Moderate (11-30%)	High (Continuing)	Considers physical impacts of agriculture on sunfish habitat (e.g. changes due to removal of riparian vegetation, channelization etc). Does not consider pollution/turbidity issues (see below). Intensification of row crops in Southern Ontario. Lessening in livestock farming. Intensification of pork production in Quebec but most of range has already been affected. Less in low intensity beef production replaced with hog farming. Remaining range of this DU is most likely to be impacted (Guelph to west of Lake St. Clair) for conversion to row crop to soy bean. Some of Quebec range may be historical given the lack of recent surveying in those areas to confirm presence. Regardless, threat is included based on precautionary principle. Farmers will likely try to cultivate up to water edge. Headwater transformation to tile drains as well as some drain maintenance (channelization of habitat). Threats impact is moderate. Decline in beef production has occurred in the past 10 yrs. Expert opinion is that beef cattle production is unlikely to increase in the Quebec area over the next 10 yrs. Hog farming likely to continue to intensify. Threat impact is pollution rather than habitat loss or modification.
2.2	Wood & pulp plantations						not applicable
2.3	Livestock farming & ranching		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	No trampling known of.
2.4	Marine & freshwater aquaculture						not applicable.
3	Energy production & mining						
3.1	Oil & gas drilling						not applicable. No fracking
3.2	Mining & quarrying						not applicable. Major mining out of range for this species.
3.3	Renewable energy						not applicable.
4	Transportation & service corridors		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
4.1	Roads & railroads		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	some road development planned in the next 10 yrs. in and around the Montreal area.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
4.2	Utility & service lines						not applicable.
4.3	Shipping lanes						not applicable.
4.4	Flight paths						not applicable.
5	Biological resource use		Negligible	Large (31-70%)	Negligible (<1%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals						Not applicable.
5.2	Gathering terrestrial plants						not applicable.
5.3	Logging & wood harvesting						not applicable
5.4	Fishing & harvesting aquatic resources		Negligible	Large (31-70%)	Negligible (<1%)	High (Continuing)	Active licensed bait fishery in southern Ontario. Collection for aquarium trade also a threat. Live bait more or less prohibited in Quebec with new restrictive regulations pending. Likely some level of angling mortality.
6	Human intrusions & disturbance		Negligible	Large (31-70%)	Negligible (<1%)	High (Continuing)	
6.1	Recreational activities		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	Boating is a threat in Ontario and Quebec.
6.2	War, civil unrest & military exercises						not applicable
6.3	Work & other activities		Negligible	Large (31-70%)	Negligible (<1%)	High (Continuing)	Exposure to fisheries scientific collection for inventorying over the next 10 yrs. likely from but non-lethal.
7	Natural system modifications		Negligible	Negligible (<1%)	Extreme (71-100%)	High (Continuing)	
7.1	Fire & fire suppression						not applicable
7.2	Dams & water management/use						Beauharnois dam planned for development but unknown impact. Trent River and Moira River populations fragmented but unaffected by flow regime. Likely a few new dams will be constructed in the next 10 yrs. Existing dams alter water regimes but unlikely to negatively impact Northern Sunfish. Dams stabilize flow patterns that benefit the species. No known effect of the Beauharnois dam.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.3	Other ecosystem modifications		Negligible	Negligible (<1%)	Extreme (71-100%)	High (Continuing)	Phragmites present in Ontario as well as Quebec. Small range of this DU exposed to Phragmites. Impact is system modification from aquatic to terrestrial. Siltation and elevated turbidity accounted for under 9.
8	Invasive & other problematic species & genes		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
8.1	Invasive non-native/alien species		Unknown	Restricted (11-30%)	Unknown	High (Continuing)	Impact of Round Goby invasion unknown but applicable to this DU. Some cases have shown RG to be beneficial. Threat impact is therefore unknown.
8.2	Problematic native species		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Hybridization in Southern Ontario but no documented trends of decline in population. Therefore threat severity is unknown. Sterilization has not been recorded. More research on impacts of hybridization for this species is necessary.
8.3	Introduced genetic material						not applicable.
9	Pollution	BC	High - Medium	Large (31-70%)	Serious - Moderate (11-70%)	High (Continuing)	
9.1	Household sewage & urban waste water	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	Chloride and pollutants are a major threat to this species. Urban development is generally highly correlated with increased concentrations of pollution but not high for this DU. Needs to be researched in terms of the actual level of impact of chloride on this species. Higher pollution impact for this DU due to proximity to urban centres. Nature of concentrations in effluent is different in this DU in comparison to the Sask-Nelson River DU. Turbidity influences severity of threat for pollutants.
9.2	Industrial & military effluents		Negligible	Negligible (<1%)	Moderate (11-30%)	High (Continuing)	PCB' s in Yamaska but levels declining. Possibility of Oil Refinery development. London range impacted by industrial effluent (general manufacturing) in the range of 100's of spills.
9.3	Agricultural & forestry effluents	BC	High - Medium	Large (31-70%)	Serious - Moderate (11-70%)	High (Continuing)	Sedimentation is a big threat. Contaminants emanating from agricultural and other forms of development. Endocrine disruptors are present from pulp and paper mills. Present but unknown impact in this DU. Forestry effluents are negligible. Threat is related more to agriculture than forestry for this DU.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
9.4	Garbage & solid waste						not applicable
9.5	Air-borne pollutants						not applicable
9.6	Excess energy						not applicable
10	Geological events						
10.1	Volcanoes						not applicable
10.2	Earthquakes/tsunamis						not applicable
10.3	Avalanches/landslides						not applicable
11	Climate change & severe weather						
11.1	Habitat shifting & alteration						not applicable.
11.2	Droughts						not applicable.
11.3	Temperature extremes						not applicable. Warmer temperature likely positive for this species. Centrarchids shifting northward- indication of climate warming.
11.4	Storms & flooding						Changes to flow regimes. Northern Sunfish relies on low water flow. In one area, storm felled trees, resulted in additional woody debris, decreased flow, increased siltation, unknown impact.

Classification of Threats adopted from IUCN-CMP, Salafsky et al. (2008).