COSEWIC
Assessment and Status Report

on the

River Darter
Percina shumardi

Saskatchewan – Nelson River populations
Southern Hudson Bay – James Bay populations
Great Lakes-Upper St. Lawrence populations

in Canada

Saskatchewan – Nelson River populations - NOT AT RISK
Southern Hudson Bay – James Bay populations - NOT AT RISK
Great Lakes-Upper St. Lawrence populations - ENDANGERED
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 River Darter *Percina shumardi*, Saskatchewan – Nelson River populations, Southern Hudson Bay – James Bay populations and Great Lakes-Upper St. Lawrence populations, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xix + 53 pp. (http://www.registrelep-sararegistry.gc.ca/default_e.cfm).

Previous report(s):

Dalton, Ken W. 1989. COSEWIC status report on the River Darter *Percina shumardi* in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 12 pp.

Production note:
COSEWIC would like to acknowledge Doug Watkinson, Nick Mandrak and Thomas Pratt for writing the status report on the River Darter (*Percina shumardi*) 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.

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur le Dard de rivière (*Percina shumardi*), populations de la rivière Saskatchewan et du fleuve Nelson, populations du sud de la baie d'Hudson et de la baie James et populations des Grands Lacs et du haut Saint-Laurent, au Canada.

Cover illustration/photo:
River Darter, *Percina shumardi*, collected from the Bird River, Manitoba. Photo: D.A. Watkinson.

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COSEWIC
Assessment Summary

Assessment Summary – May 2016
Common name
River Darter - Saskatchewan – Nelson River populations
Scientific name
Percina shumardi
Status
Not at Risk
Reason for designation
This is a broadly distributed species that is inferred to be stable in abundance and distribution. Potential threats include water management practices and urban and agricultural effluents but these are assessed as having a low overall impact.
Occurrence
Saskatchewan, Manitoba, Ontario
Status history
The species was considered a single unit and designated Not at Risk in April 1989. When the species was split into three separate units in April 2016, the “Saskatchewan - Nelson River populations” unit was designated Not at Risk.

Assessment Summary – May 2016
Common name
River Darter - Southern Hudson Bay – James Bay populations
Scientific name
Percina shumardi
Status
Not at Risk
Reason for designation
This is a broadly distributed, but relatively uncommon, species that is inferred to be stable in abundance and distribution. Potential threats related to water management practices are assessed as low overall.
Occurrence
Manitoba, Ontario
Status history
The species was considered a single unit and designated Not at Risk in April 1989. When the species was split into three separate units in April 2016, the “Southern Hudson Bay - James Bay populations” unit was designated Not at Risk.

Assessment Summary – May 2016
Common name
River Darter - Great Lakes-Upper St. Lawrence populations
Scientific name
Percina shumardi
Status
Endangered
Reason for designation
This is a small-bodied species that inhabits medium to large rivers and shorelines of larger lakes. It has a very restricted distribution, occurs at few locations, and is exposed to high risk of threats from shoreline hardening, exotic species such as Round Goby, dams and water management, dredging, nutrients and effluents from urban waste, spills, and agriculture.
Occurrence
Ontario
Status history
The species was considered a single unit and designated Not at Risk in April 1989. When the species was split into three separate units in April 2016, the “Great Lakes - Upper St. Lawrence populations” unit was designated Endangered.

COSEWIC
Executive Summary

River Darter
Percina shumardi

Saskatchewan – Nelson River populations
Southern Hudson Bay – James Bay populations
Great Lakes-Upper St. Lawrence populations

Wildlife Species Description and Significance

River Darter (*Percina shumardi*) is a small, elongated fish that can be distinguished from other darters by scaled cheeks and operculum and a well-marked dark spot on the upper anterior and lower posterior corners of the spiny dorsal fin. The breast is scaleless, and there are 46-62 lateral line scales. The anal fin of males is enlarged reaching almost to the caudal fin.

River Darter is a little known species and has no direct economic importance; however, it can be numerous in larger rivers and near the shore of larger lakes in Manitoba and northwestern Ontario and likely plays an important ecological role where abundant. It is ranked as Critically Imperilled in portions of its distribution in the United States.

Distribution

River Darter has one of the largest latitudinal distributions for darters, extending north from the Texas coast on the Gulf of Mexico to Nelson River near Hudson Bay in northern Manitoba. It has a continuous distribution through most of Manitoba into northwestern Ontario in the Saskatchewan-Nelson drainage as well as the Hudson Bay drainage west of James Bay. A single specimen has been collected from the Saskatchewan River in Saskatchewan. The species is also found in Lake St. Clair and its tributaries in Ontario. Therefore the River Darter is assessed as three separate designatable units, aligning with the National Freshwater Biogeographic Zones.

Habitat

River Darter is mainly found in medium to large rivers or shorelines of larger lakes that typically have moderate currents and deeper water. River Darter is most abundant on gravel and cobble substrates and is tolerant of turbid waters.

Biology

Individuals can mature as early as age 1 and can live to age 4. In Canada, spawning occurs in May to early July, predominantly in rivers; however, ripe individuals are collected in lakes suggesting spawning may occur in both lentic and lotic environments. During spawning, eggs are buried in sand or gravel and are unattended. Post-hatch larvae swim almost continuously near the water surface suggesting downstream dispersal may occur in rivers as the surface-water velocities would typically be greater than the larval swimming speed.

River Darter feeds primarily during daylight hours and consumes dipterans, trichopterans, ephemeropterans, crustaceans, and gastropods, with dominant prey items varying between sites and seasons.

Population Sizes and Trends

River Darter has been collected at a number of sites in Manitoba and northwestern Ontario, but in low abundance. Surveys made in the last decade using more appropriate gear to sample large rivers and lakes have collected considerably more specimens but changes and fluctuations in population size and density of River Darter cannot be estimated based on available information in these areas. In southern Ontario intensive sampling has identified substantial declines in ranges leading to inferences of population declines.

Threats and Limiting Factors

Knowledge of threats and their impacts on River Darter populations is limited, as there is little information available for threat-specific, cause-and-effect relationships. Limiting factors have not been identified for this species. Physical alteration/modification of habitat from exotic species, shoreline hardening, industrial and agricultural effluents, nutrients, sedimentation, dams, and dredging may possibly impact River Darter in Canada.

Protection, Status and Ranks

In Canada, River Darter has no specific protection, but incidental protection is provided by the federal *Fisheries Act* as its entire range in Canada overlaps with commercial, recreational or Aboriginal species.

The River Darter is not protected under the United States *Endangered Species Act*.

TECHNICAL SUMMARY – DU1

Percina shumardi

River Darter - Saskatchewan - Nelson River populations

Dard de rivière - Populations de la rivière Saskatchewan et du fleuve Nelson

Range of occurrence in Canada: Nelson River and its tributaries in Manitoba, Ontario and single site on the Saskatchewan River, Saskatchewan.

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2011) is being used)	2 years
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?	a. Not Applicable b. Not Applicable c. Not Applicable
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence All years	>512,123 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value). All years Discrete-748 km^2 Continuous- >2000 km^2	>2,000 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)	67 to 100. The number of known locations based on collection records is 67. Many other unsampled locations likely exist in the remote portions of the species' range suggesting that the best estimate is likely >100.
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?	Yes
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**
All subpopulation in this DU	Unknown for all
Total	

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	No quantitative data are available

* 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)

Physical alteration/modification of habitat from dams and changes to the hydrograph as well as nutrient and effluents may possibility impact River Darter in DU1 (Appendix 1). A threat calculator was completed by Nicholas Mandrak, Thomas Pratt, Dwayne Lepitzki, Scott Reid, Margaret Docker, Angele Cyr, John Post and Douglas Watkinson.

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Minnesota, North Dakota
Is immigration known or possible?	Not known, but there are no barriers to fish movement from the Red River drainage in North Dakota or Minnesota or the Rainy River drainages in Minnesota.
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Are conditions deteriorating in Canada?[+]	Yes. Southern portion of the DU has higher nutrient inputs.
Are conditions for the source population deteriorating?[+]	No
Is the Canadian population considered to be a sink?[+]	No
Is rescue from outside populations likely?	Yes

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 1989. When the species was split into three 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 broadly distributed species that is inferred to be stable in abundance and distribution. Potential threats include water management practices and urban and agricultural effluents but these are assessed as having a low overall impact.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Information on population sizes is not available.

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

Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Information on population sizes is not available.
Criterion D (Very Small or Restricted Population): Not applicable. Information on population sizes is not available.
Criterion E (Quantitative Analysis): Quantitative analyses have not been completed.

TECHNICAL SUMMARY – DU2

Percina shumardi

River Darter - Southern Hudson Bay - James Bay populations

Dard de rivière - Populations du sud de la baie d'Hudson et de la baie James

Range of occurrence in Canada: Attawapiskat, Albany, Severn and Winisk river watersheds in Manitoba, and Ontario.

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2011) is being used)	2 years
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?	a. Not Applicable b. Not Applicable c. Not Applicable
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence All years	>64,660 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value). All years Discrete 48 km^2 Continuous >2,000 km^2	>2,000 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)	11 to >50. The number of known locations based on collection records is 11. Many other unsampled locations likely exist in the remote portions of the species’ range suggesting that the best estimate is likely >50.
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?	No
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**
All subpopulation in this DU	Unknown
Total	

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	No quantitative data are available

* 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)

Physical alteration/modification of habitat from dams and changes to the hydrograph may possibility impact River Darter in DU2 (Appendix 2). A threat calculator was completed by Nicholas Mandrak, Thomas Pratt, Dwayne Lepitzki, Scott Reid, Margaret Docker, Angele Cyr, John Post and Douglas Watkinson.

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Not Applicable
Is immigration known or possible?	Not Possible
Would immigrants be adapted to survive in Canada?	Not Applicable
Is there sufficient habitat for immigrants in Canada?	Not Applicable
Are conditions deteriorating in Canada?[+]	Not Applicable
Are conditions for the source population deteriorating?[+]	Not Applicable
Is the Canadian population considered to be a sink?[+]	Not Applicable
Is rescue from outside populations likely?	Not Possible

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 1989. When the species was split into three separate units in April 2016, the “Southern Hudson Bay - James Bay 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 broadly distributed, but relatively uncommon, species that is inferred to be stable in abundance and distribution. Potential threats related to water management practices are assessed as low overall.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Information on population sizes is not available.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Information on population sizes is not available.

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

Criterion D (Very Small or Restricted Population): Not applicable. Information on population sizes is not available.
Criterion E (Quantitative Analysis): Quantitative analyses have not been completed.

TECHNICAL SUMMARY – DU3

Percina shumardi

River Darter - Great Lakes - Upper St. Lawrence populations

Dard de rivière - Populations des Grands Lacs et du haut Saint-Laurent

Range of occurrence in Canada: Lake St. Clair and tributaries, Ontario.

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2011) is being used)	2 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, inferred
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. Not applicable b. Not applicable c. Not applicable
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence Pre-2005 2,244 km² 2005-2014 907 km²	907 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value). Pre-2005 Discrete 64 km² Continuous 1228 km² 2005-2014 Discrete 16 km² Continuous 336 km²	336 km²

Is the population "severely fragmented" i.e. 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?	No
Number of "locations"* (use plausible range to reflect uncertainty if appropriate) North Sydenham River [likely extirpated] East Sydenham River Thames River Lake St. Clair	3
Is there an [observed, inferred, or projected] decline in extent of occurrence?	Yes
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Yes
Is there an [observed, inferred, or projected] decline in number of subpopulations?	Yes. No recent records in the North Sydenham River or Jeanette's Creek, a tributary to the Thames River
Is there an [observed, inferred, or projected] decline in number of "locations"*?	Yes. No recent records in the North Sydenham River
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, inferred
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**
	unknown
Total	

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	No quantitative data are available

* 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)

The threats to River Darter may include exotic species such as Round Goby, physical alteration/modification of habitat from shoreline hardening and dredging, nutrients and effluents from urban waste, agricultural runoff and spills, sedimentation, dams and changes to the hydrograph in DU3 (Appendix 3). A threat calculator was completed by Nicholas Mandrak, Thomas Pratt, Dwayne Lepitzki, Scott Reid, Margaret Docker, Angele Cyr, John Post and Douglas Watkinson.

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Michigan, Ohio
Is immigration known or possible?	Possible. From the USA side of Lake St. Clair and Lake Erie, but not known.
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Are conditions deteriorating in Canada?[+]	Yes
Are conditions for the source population deteriorating?[+]	Yes
Is the Canadian population considered to be a sink?[+]	No
Is rescue from outside populations likely?	Unknown if it is within the natural dispersal ability of the species

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 1989. When the species was split into three separate units in April 2016, the “Great Lakes - Upper St. Lawrence populations” unit was designated Endangered.

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Endangered	B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)
Reasons for designation: This is a small-bodied species that inhabits medium to large rivers and shorelines of larger lakes. It has a very restricted distribution, occurs at few locations, and is exposed to high risk of threats from shoreline hardening, exotic species such as Round Goby, dams and water management, dredging, nutrients and effluents from urban waste, spills, and agriculture.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Information on population sizes is not available.

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

Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv) with a small EOO (907 km²), small and continuing decline in IAO (336 km²), few locations (3) which have declined, and a continuing decline in habitat quality.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Information on population sizes is not available.
Criterion D (Very Small or Restricted Population): Not applicable. Information on population sizes is not available.
Criterion E (Quantitative Analysis): Quantitative analyses have not been completed.

PREFACE

No directed research has been published on the biology of River Darter since the last COSEWIC report in 1989 in which the species was assessed as a single designatable unit as Not at Risk. However, one important Canadian reference, a master's thesis that deals with reproduction and feeding (Balesic 1971) was omitted from the original report. In Manitoba, a broader distribution of the species has been documented in the Assiniboine River and Lake Winnipegosis watersheds since 1990, likely as a result of increased sampling effort with more appropriate gear. A single specimen was collected in Saskatchewan in 1990 (ROM 60976) in the Saskatchewan River. This represents the only known occurrence in this province. Little sampling has been conducted since the last COSEWIC assessment in more remote waterbodies, River Darter was known to occur in northern Manitoba and northwestern Ontario. River Darter continues to be rare in southern Ontario, despite significant sampling. There has been insufficient sampling to determine trends in abundance in Canada.

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.

Environment and Climate Change Canada
Canadian Wildlife Service
Environnement et Changement climatique Canada
Service canadien de la faune
Canada

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

COSEWIC Status Report

on the

River Darter
Percina shumardi

Saskatchewan – Nelson River populations
Southern Hudson Bay – James Bay 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 Percidae

Subfamily Etheostomatinae

Species *Percina shumardi* (Girard, 1859)

English Common Name River Darter (Page *et al*. 2013)

French Common Name Dard de rivière (Page *et al*. 2013)

The River Darter, *Percina shumardi* (Girard, 1859) is one of 45 species of the genus *Percina* in the family Percidae (Page *et al*. 2013).

Morphological Description

River Darter is a small, elongated fish (Figure 1) that grows to a maximum of 94 mm total length in Canada (Watkinson unpubl.). The species has a short, rounded snout and a moderately sized, terminal mouth (Scott and Crossman 1973; Stewart and Watkinson 2004) as well as large eyes that are close together and high on the head (Kuehne and Barbour 1983). The spiny and soft dorsal fins are separated. The River Darter can be distinguished from the Channel Darter (*Percina copelandi*) and Blackside Darter (*Percina maculata*) with a well-marked dark spot on the upper anterior and lower posterior corners of the spiny dorsal fin (Stewart and Watkinson 2004; Holm *et al*. 2009). Scales are ctenoid; there are 46-62 lateral line scales (Holm *et al*. 2009). Scales are also usually found on the cheeks and operculum, while the breast is usually scaleless (Scott and Crossman 1973; Becker 1983). The colouration of the River Darter varies from light brown to dark olive with seven to eight faint saddles on the back and 8 to 15 indistinct lateral blotches or short vertical bars on the sides (Kuehne and Barbour 1983; Holm *et al*. 2009). Distinct suborbital bars drop from the eyes, and small, well-defined, caudal spots may be present (Scott and Crossman 1973). Colouration on breeding males is generally darker (Scott and Crossman 1973; Smith 1979) and they may develop nuptial tubercles on the caudal, anal and pelvic fins, as well as on the vent and on the head along the infraorbital and preopercular mandibular canals (Kuehne and Barbour 1983). The anal fin of spawning males is enlarged reaching almost to the caudal fin (Figure 1; Scott and Crossman 1973).

Figure 1. Male River Darter collected from the Bird River, Manitoba. D.A. Watkinson photo.

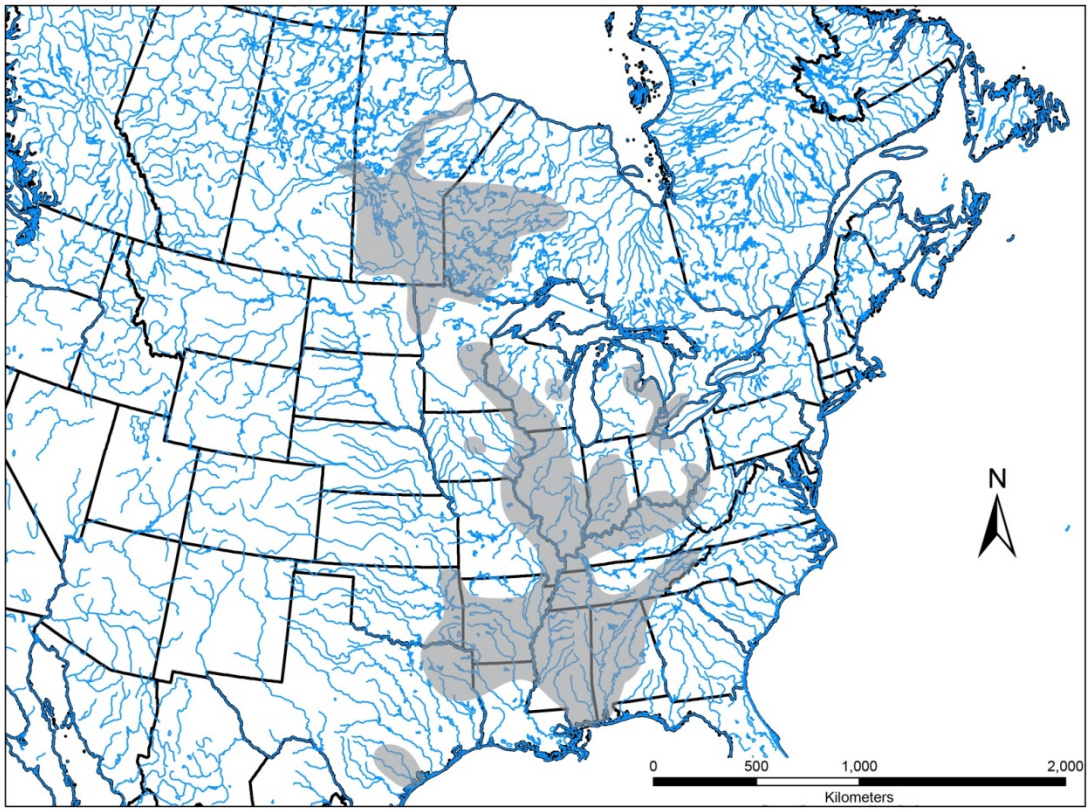

Figure 2. Global distribution of the River Darter (modified from Page and Burr 2011).

Population Spatial Structure and Variability

The River Darter is widely distributed across two National Freshwater Biogeographical Zones (NFBZ), the Saskatchewan - Nelson River and the Southern Hudson Bay - James Bay, and has a restricted distribution in the Great Lakes - Upper St. Lawrence. Movement of fish between these NFBZ is impossible with the exception of the Albany River in the Southern Hudson Bay - James Bay NFBZ, where a portion of the outflow of Lake St. Joseph has been diverted into the Winnipeg River drainage via Lac Seul, part of the English River system since 1957, providing downstream passage into the Saskatchewan - Nelson River drainage.

A preliminary population and genetic study was recently conducted on River Darter (DFO 2015). Tissue samples from >200 River Darter, originating from 16 populations distributed across the three NFBZ, were obtained from Fisheries and Oceans Canada (DFO) and the Royal Ontario Museum. Individuals were sequenced at two mitochondrial DNA (mtDNA) regions; cytochrome c oxidase I (CO1) (525 base pairs) and cytochrome-b (Cyt b) (926 base pairs). The CO1 results were useful for species identification. CO1 identified 24 haplotypes and confirmed the species identification for all specimens (n = 230) with 93% of the individuals sharing a single haplotype. Cyt b was more informative for looking at broad-scale population structure. Twenty-six cytochrome-b haplotypes were identified from 143 individuals sequenced and 45% of all individuals shared a single haplotype present across all three zones. Six haplotypes were unique to the Saskatchewan - Nelson River NFBZ and two unique haplotypes were found in one of the two Southern Hudson Bay - James Bay populations (Badesdawa Lake). The other population, Lake St. Joseph, shared a common haplotype with the Saskatchewan - Nelson River populations, suggesting gene flow has occurred between the biogeographic zones. By definition, wildlife species (DUs) are discrete and significant and, therefore, can't rescue one another; however, water is diverted from the Southern Hudson Bay - James Bay Biogeographic Zone from Lake St. Joseph into the Saskatchewan - Nelson River NFBZ. A control dam on the Root River that allows water to move into is impassible to upstream movement, but has the potential to allow River Darter from Lake St. Joseph to move into Lac Seul, and the Saskatchewan - Nelson River NFBZ. There is no understanding of the magnitude of the gene flow. Two of three individuals from the Great Lakes - Upper St. Lawrence Biogeographic Zone shared a unique haplotype, supporting the genetic distinctiveness of this biogeographic zone. There is evidence of partitioning of haplotype diversity across the Saskatchewan - Nelson River and Great Lakes - Upper St. Lawrence NFBZ. Sequencing more individuals from additional waterbodies in Southern Hudson Bay - James Bay and additional fish in the Great Lakes - Upper St. Lawrence is required to confirm these apparent differences in haplotypes across biogeographic zones (DFO 2015).!

Designatable Units

Based on the COSEWIC National Freshwater Biogeographic Zone classification, populations of River Darter are found in Manitoba, Saskatchewan and northwestern Ontario in the Saskatchewan - Nelson River Biogeographic Zone, DU1, and in northern Ontario in the Southern Hudson Bay - James Bay Biogeographic Zone, DU2. In Ontario, there is also a population in the Great Lakes - Upper St. Lawrence NFBZ, DU3. The genetic evidence supports a level of differentiation between DU3 and the other two DUs. Until additional genetic samples are analyzed to clarify the relationships between DU1 and DU2, three designatable units based on separate NFBZ are recommended for the species.

Special Significance

River Darter distribution spans a large climatic and latitudinal range. The three DUs in Canada are geographically isolated from one another and other River Darter populations within the Mississippi drainage in the United States. Each major drainage system could be genetically distinct. A loss of one of these populations would result in an extensive gap in the range of this species in Canada. River Darter is a little known species and has no direct economic importance; however, it can be numerous in the large rivers and shorelines of lakes in Manitoba and northwestern Ontario and likely plays an important ecological role where abundant. Some states in the United States of America have ranked River Darter as Critically Imperilled (NatureServe 2014).

DISTRIBUTION

Global Range

River Darter has one of the largest latitudinal distributions of any darter species (Figure 2), matched only by Logperch (*Percina caprodes*) and Johnny Darter (*Etheostoma nigrum*) (Page and Burr 2011). Its distribution extends north from the Texas coast on the Gulf of Mexico to the Nelson River near Hudson Bay (CMNFI 1989-0677.1) in northern Manitoba (Scott and Crossman 1973; Stewart and Watkinson 2004; Page and Burr 2011) and east from the Saskatchewan River in Saskatchewan (ROM 60976) to the Lake St. Clair watershed in Ontario.

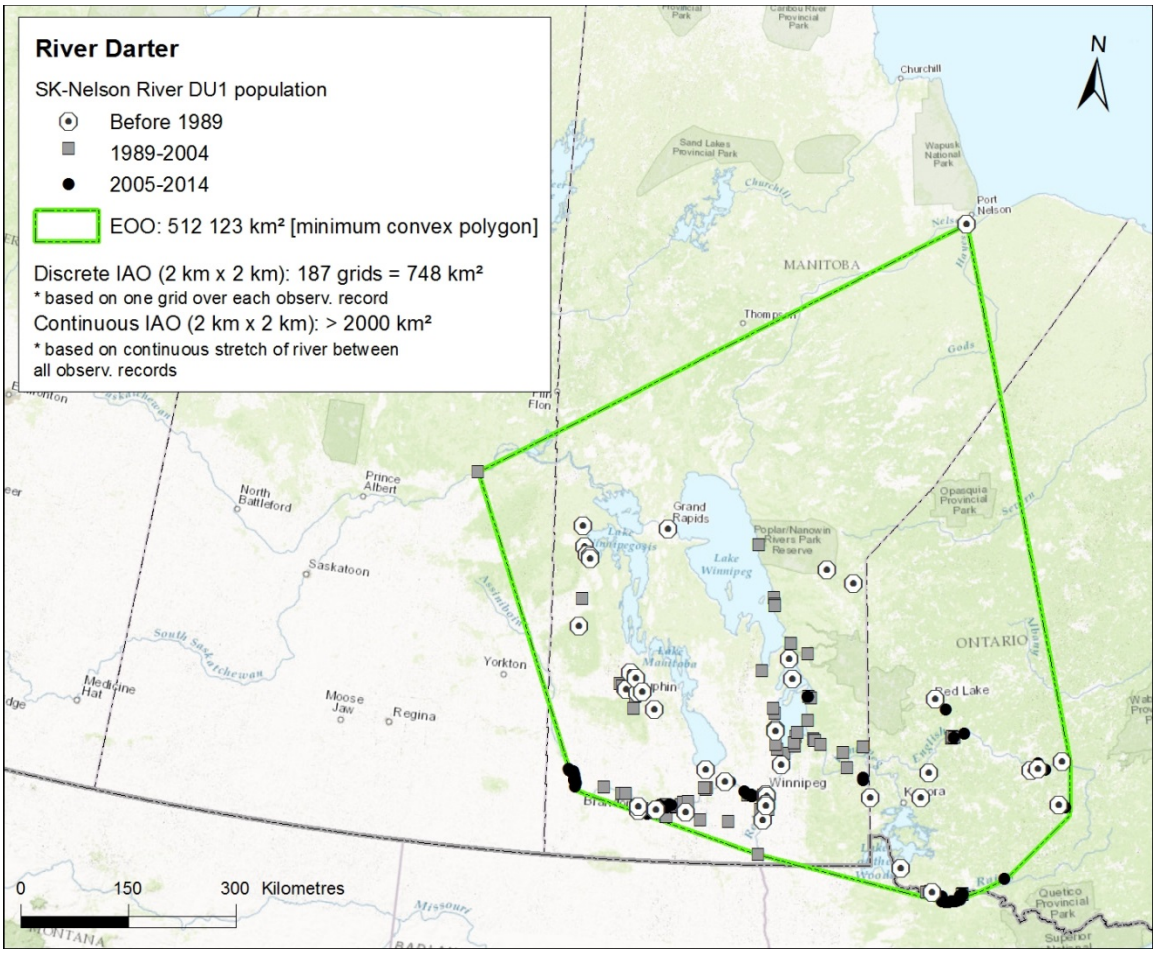

Figure 3. The distribution of River Darter in DU1 - Saskatchewan - Nelson River populations. Occurrences are shown for three time periods and EOO is plotted for all time periods combined.

Canadian Range

In Canada, River Darter occurs in the Nelson River watershed in Manitoba and northwestern Ontario. This includes the watersheds of the Assiniboine, English, Rainy, Red, and Winnipeg rivers and lakes Dauphin, Manitoba, Winnipegosis and Winnipeg (Figure 3). River Darter is also found in the Attawapiskat, Albany, Severn and Winisk river watersheds that flow into the Hudson or James bays (Figure 4). In southern Ontario, River Darter has been found in the Lake St. Clair watershed (Figure 5).

A single specimen was collected in 1990 from the Saskatchewan River in the tailrace of E.B. Campbell Hydroelectric Station (ROM 60976). This specimen is the only known collection in Saskatchewan or the Saskatchewan River (Appendix 4, Figure 4).

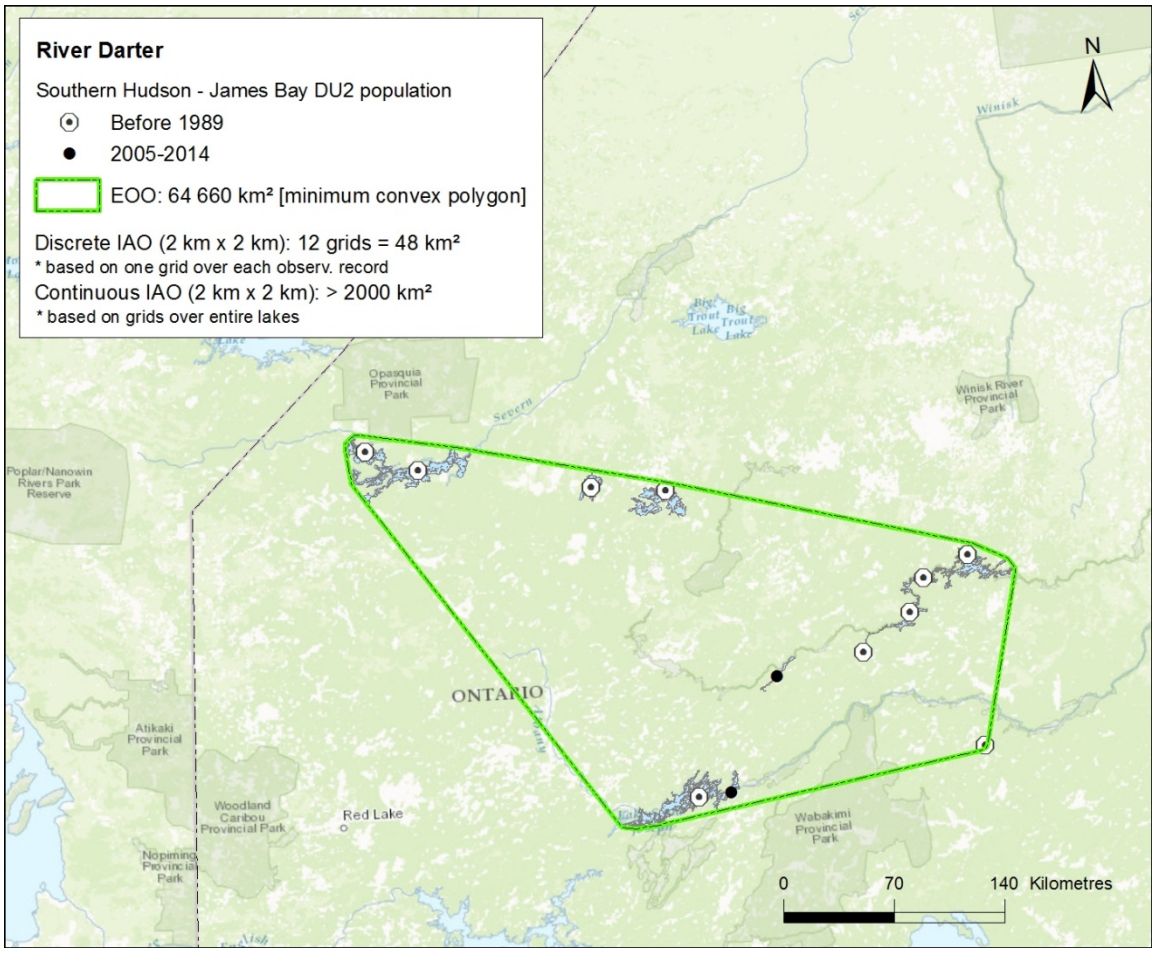

Figure 4. The distribution of River Darter in DU2 - Southern Hudson Bay - James Bay populations. Occurrences are shown for two time periods and EOO is plotted for both time periods combined.

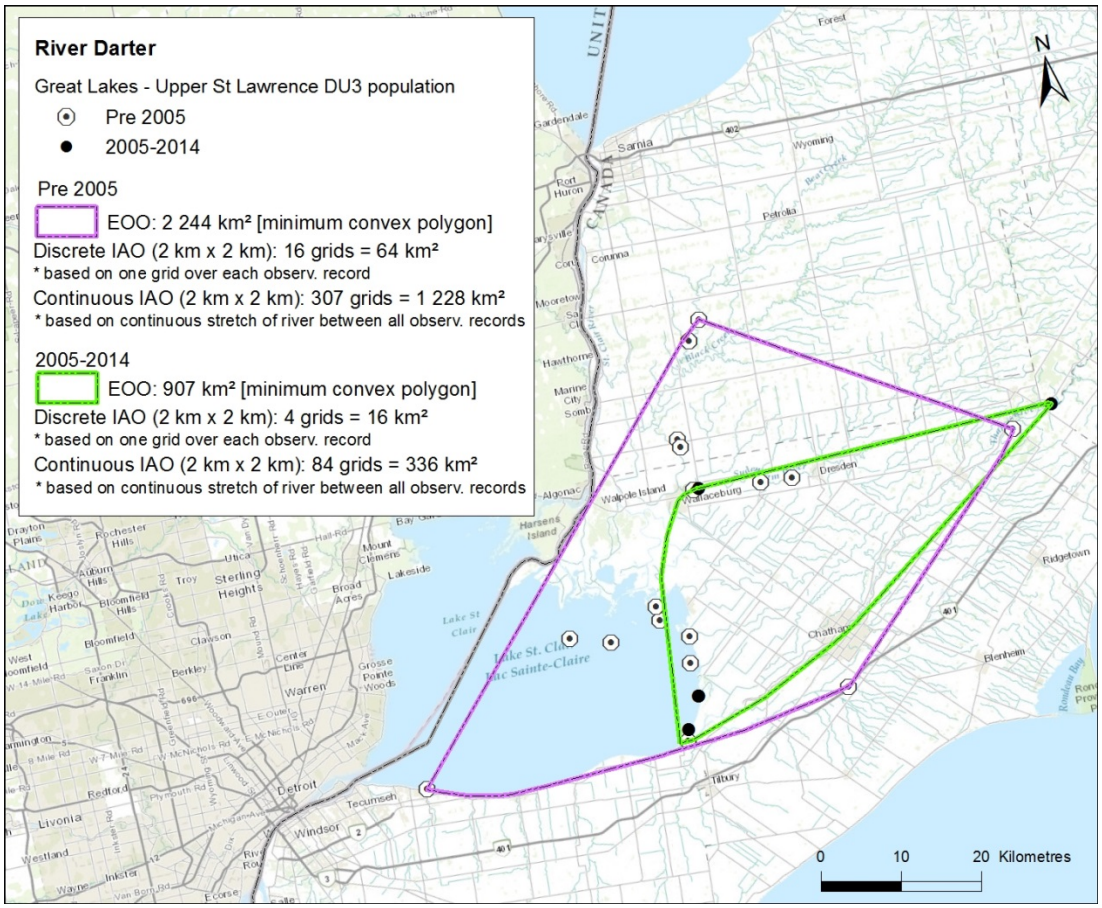

Figure 5. The distribution of River Darter in DU3 - Great Lakes - Upper St. Lawrence populations. Occurrences are shown for pre-2005 and 2005-2014 and EOO is plotted for each time period.

Extent of Occurrence and Area of Occupancy

DU1 - Saskatchewan - Nelson River Populations

Sampling in this DU has been sparse over the previous decades. There is therefore insufficient data on occurrences to examine temporal trends in EOO and IAO so all occurrences have been combined to make these estimates. EOO is estimated to be 512,123 km^2 but it is likely an underestimate due to sparse sampling in the more northerly and mostly wilderness part of its distribution (Figure 3). IAO is estimated as 748 km^2 (discrete) and >2,000 km^2 (continuous). Actual IAO is likely underestimated substantially due to sparse sampling effort.

DU2 - Southern Hudson Bay - James Bay Populations

Sampling in this DU has been sparse over the previous decades. There is therefore insufficient data on occurrences to examine temporal trends in EOO and IAO so all occurrences have been combined to make these estimates. EOO is estimated to be 64,660 km^2 but it is likely an underestimate due to sparse sampling in the more northerly and mostly wilderness part of its distribution (Figure 3). IAO is estimated as 48 km^2 (discrete) and >2,000 km^2 (continuous). Actual IAO is likely underestimated substantially due to sparse sampling effort.

DU3 - Great Lakes - Upper St. Lawrence Populations

Sampling for small-bodied fishes in the DU has been extensive, particularly since 2005, allowing examination of temporal trends in EOO and IAO. Pre-2005 EOO is estimated as 2,244 km^2 and has declined to 907 km^2 in the most recent decade (Figure 5). We report here both discrete and continuous IAO estimates, but due to the intensity of sampling in this region the actual IAO is likely closer to the discrete than continuous estimate. The discrete IAO has declined from 64 km^2 pre-2005 to 16 km^2 post-2005 (Figure 5). The continuous IAO estimate has declined from 1228 km^2 to 336 km^2 over the same time period.

Search Effort

Most often, surveys that have detected the species were not specifically sampling for River Darter. A variety of gear has been used to collect River Darter (Table 1). Since 2009, limited sampling with fine-mesh bottom trawls, like the mini-Missouri trawl, has occurred in Canada. Trawling is a very effective gear for sampling small-bodied benthic species like darters (Herzog *et al*. 2009) and has the potential to expand the known distribution of River Darter and provide a more accurate picture of the status of the species in Canada. Table 1 outlines surveys within the range of River Darter in Canada since 1989.

Table 1. Summary of surveys in the known range of the River Darter since 1989 for DU1, DU2 and DU3.

DU	Waterbody/Watershed	Survey Description (years of survey effort)
1	Dauphin Lake watershed	• Fish community surveys, DFO (1998, 1999) e • Fish community surveys, drains, DFO (2002, 2003, 2004) e
1	Assiniboine River	• Instream flow needs long-track fish survey, DFO (1995, 1996, 2002) d • Instream flow needs stream reach fish survey, DFO (2002, 2003) d • Fish community surveys, drains, DFO (2002, 2003, 2004) e • Silver Chub (*Macrhybopsis storeriana*) survey DFO (2009) i • Targeted River Darter survey, one day, DFO (2014) i
1	Red River watershed	• Fish community surveys, DFO (1998, 1999) e • Species at risk fish survey, DFO (2002, 2003) d • Fish community surveys, drains, DFO (2002, 2003, 2004) e • Silver Chub survey (limited effort) DFO (2009) i
1	Saskatchewan River	• Fish community surveys, DFO (2005, 2006) d

DU	Waterbody/Watershed	Survey Description (years of survey effort)
1	Lake Winnipeg	• Species' distribution and abundance, pelagic trawling surveys, Manitoba Water Stewardship, Lake Winnipeg Consortium, and DFO (2002–present, annually) b • Targeted River Darter surveys, one day, DFO (2014) i
1	Winnipeg River watershed	• Fish community surveys targeting Carmine Shiner (*Notropis percobromus*), DFO (2002 d,e; 2003 a,d,e; 2004 d; 2005 a,d,e; 2006 a,d; 2009 a,i; 2011 a) • Fish community surveys, DFO (2013) d,i • Targeted River Darter surveys, DFO (2014) i
2	Lake St. Joseph	• Targeted River Darter surveys, DFO (2014) i
2	Badesdawa Lake	• Targeted River Darter surveys, DFO (2014) i
3	Lake St. Clair watershed	• Nearshore fish community survey, OMNR† (2005, 2007) a • Fish community survey, Michigan DNR (1996–2001) b • Essex-Erie targeted sampling for fishes at risk, DFO (2007) a, c • Fall trap-net survey, OMNR (1974–2007, annual) e • Young-of-the-year index seine survey, OMNR (annual) a • Benthic fish community survey, DFO (2010) b • Multi-gear sampling DFO (Edwards and Mandrak 2006) a, d, e, f, g, h, j • Fish survey DFO (Marson and Mandrak 2009) a, d, f, j • Poos *et al*. (2007) a, e • Poos *et al*. (2008) a, e, h, j • OMNR, Reid and Hogg (2014) a • Species at Risk sampling, DFO Mandrak *et al*. (2006) a, e
3	Detroit River	• Fish-habitat associations of the Detroit River, DFO and University of Windsor (2003–2004) a, d • Coastal wetlands of Detroit River, DFO and University of Guelph (2004–2005) • Fish community surveys, DFO and OMNR (2003, 2004) d • Benthic fish community survey, DFO (2009, 2010) b
3	Lake Erie	• Interagency trawling survey in western basin, OMNR (1988–2010, annual) b • Coastal wetlands along Lake Erie (2004–2005) e • Nearshore beach seining surveys, OMNR and DFO (2005–2006) a (Reid and Mandrak 2008) • Nearshore seine survey, west and west-central basins, OMNR, (2007) a

† Acronyms: OMNR – Ontario Ministry of Natural Resources; DNR – Department of Natural Resources; DFO – Fisheries and Oceans Canada;

Gear type: a – seine net; b – trawl; c – trap net; d – boat electrofishing; e – backpack electrofishing; f – fyke net; g – minnow trap; h – Windemere trap; i – mini-Missouri or Missouri trawl; j - gill net.

DU1 – Saskatchewan - Nelson River Biogeographic Zone

Non-targeted surveys have been conducted throughout the southern portion of this DU in Manitoba by Fisheries and Oceans Canada (Table 2), confirming and expanding the known distribution of the species since 1989. It is likely that River Darter is more widely distributed in the remote portions of this DU than is currently known and that many more locations exist. The majority of sampling has involved the use of boat or backpack electrofishing; neither is very effective at sampling small-bodied benthic fishes in turbid water. Limited surveys have been conducted with appropriate gear such as the mini-Missouri trawl. Targeted sampling conducted in 2013 and 2014 in northwestern Ontario using a mini-Missouri trawl collected River Darter at most historical sites sampled and had relatively high catch per unit effort (CPUE) (Table 3).

Table 2. Summary of DFO non-targeted sampling in DU1 and 3 since 1995.

DU	Waterbody/Watershed	Number of collections	Gear	Effort (sec or hauls)	Number of fish	Catch Per Unit Effort (fish/sec or fish/haul)
1	Dauphin Lake watershed	47	Backpack efishing	40615	0	-
1	Assiniboine River	6 2257 390	Backpack efishing Boat efishing mini and/or Missouri trawl	6 295810 390	0 14 332	- 0.000047 0.85
1	Red River watershed	81 771 81 21	Backpack efishing Boat efishing mini and/or Missouri trawl 10 m Seine	65089 268546 81 21	0 0 0 0	- - - -
1	Saskatchewan River	411	Boat efishing	28641	0	-
1	Lake Winnipeg	716 24 11	Beam Trawl Boat efishing 10 m Seine	716 9926 11	1 9 0	0.0014 0.0009 -
1	Winnipeg River watershed	5 188 33 18	Backpack efishing Boat efishing mini and/or Missouri trawl 10 m Seine	5 71293 33 18	0 23 0 4	- 0.0003 - 0.22
1	Rainy River	21	Boat efishing	58447	167	0.0029
3	Thames River	26	mini Missouri trawl	26	1	0.04
3	Sydenham River	24	mini Missouri trawl	24	2	0.08

Table 3. Summary of DFO targeted sampling conducted with a mini-Missouri trawl, in DU1 and 2 in 2013 and 2014 (modified from Pratt *et al.* 2015).

DU	Waterbody	Historic location	Date(s)	Gear type	Effort	Mean length (m)	River Darter captured	Density (fish/ha)	CPUE (fish/haul)
1	Rainy River	Yes	19/06/2013 to 22/06/2013	trawl	60	306.0	152	52.0 (11.3)	2.53
			11/09/2013 to 12/09/2013	trawl	12	282.0	17	20.7 (8.6)	1.42
			13/06/2014	trawl	2	365.0	3	10.3 (10.3)	1.5
1	Lake of the Woods	Yes	13/06/2014	trawl	5	174.8	21	97.5 (65.6)	4.2
1	Balne River	Yes	14/06/2014	trawl	4	151.8	0	-	0
1	Red Lake	Yes	15/06/2014	trawl	7	121.0	1	8.1 (8.1)	0.14
1	Chukini River	New	16/06/2014	trawl	3	173.3	5	43.9 (32.2)	1.66
1	English River (lower and upper)	Yes	16/06/2014	trawl	5	134.2	27	140.4 (53.5)	5.4
			13/09/2014	trawl	6	273.3	17	37.6 (20.4)	2.83
1	Barnston Lake	Yes	16/06/2014	trawl	1	220.0	1	18.8 (-)	1
1	Barrel Lake	Yes	19/06/2014	trawl	2	215.0	1	11.8 (11.8)	0.5
1	Sturgeon River	New	14/09/2014	trawl	5	411.2	26	49.5 (20.2)	5.2
1	Lac Seul	Yes	14/09/2014	trawl	4	330.0	2	8.8 (5.4)	0.5
1	Little Turtle Lake	New	16/09/2014	trawl	1	570.0	1	7.0 (-)	1

DU	Waterbody	Historic location	Date(s)	Gear type	Effort	Mean length (m)	River Darter captured	Density (fish/ha)	CPUE (fish/haul)
1	Assiniboine River	Yes	09/10/2014	trawl	8	169.9	36	96.8 (40.4)	4.5
1	Lake Winnipeg	Yes	08/10/2014	trawl	10	66.0	33	182.1 (12.5)	3.3
2	Lake St. Joseph	Yes	12/09/2014	trawl	4	305.0	30	117.8 (68.5)	7.5
2	Badesdawa Lake	New	12/09/2014	trawl	3	306.7	38	109.7 (55.5)	12.67

DU2 – Southern Hudson Bay - James Bay Biogeographic Zone

There has been limited sampling in the remote as well as accessible portions of this DU. Additional sampling would likely find the species has maintained its EOO since 1989. Given the limited sampling conducted in this DU to date, it is likely that River Darter is more widely distributed than is currently known and many more locations exist. In 2014, targeted sampling with a mini-Missouri trawl was conducted in two lakes in this DU that are road accessible (Tables 1; 3).

DU3 – Great Lakes - Upper St. Lawrence Biogeographic Zone

Search effort has been extensive, particularly post-2005, in this DU. More than 1000 sites within the range of River Darter, using a variety of gears, including more recently mini-Missouri trawls, have been sampled (Tables 1; Figure 5; DFO unpubl.).

HABITAT

Habitat Requirements

River Darter is mainly collected in medium to large rivers or nearshore areas of lakes (Balesic 1971; Stewart and Watkinson 2004). It is associated with a variety of substrates, moderate currents and deeper water (Thomas 1970; Pfleiger 1971; Scott and Crossman 1973; Becker 1983; Kuehne and Barbour 1983). Sampling in the Assiniboine River, Manitoba, with Missouri and mini-Missouri trawls, found River Darter to be the third most common species collected (Watkinson, unpublished data). It was collected most frequently in moderate water velocities (0.4-0.85 m/s) and depths (0.8-1.8 m). River Darter catches were highest on the gravel and cobble substrates. Sampling conducted in 2014 with a mini-Missouri trawl, predominantly in lakes of northwestern Ontario, collected River Darter over gravel and cobble substrates at a mean depth of 3.7 m (Table 4). A single specimen collected with a beam trawl in Lake Winnipeg at 15 m depth (Watkinson, unpublished data) is the deepest documented specimen collected.

River Darter is tolerant of turbid waters (Balesic 1971; Pfleiger 1971; Cooper 1983; Sanders and Yoder 1989) and is a common, if not the most common, darter in turbid rivers (Cooper 1983; Kuehne and Barbour 1983; Watkinson, unpublished data). In Manitoba, its abundance is highest in middle reaches of the Assiniboine River where turbidity is typically more moderate, with Secchi readings of ~0.7 m (Watkinson, unpublished data). Clean gravel and cobble substrates may be important for spawning and feeding. Adults and juveniles are often collected together when sampling.

Table 4. Mean measured habitat parameters, including depth, temperature, pH, turbidity, and dissolved oxygen, from selected River Darter collection sites (modified from Pratt *et al.* 2015).

DU	Waterbody	Date(s)	Depth (m)	Temperature (◦C)	pH	Turbidity (NTUs)	Dissolved oxygen (mg/L)
1	Lake of the Woods	13/06/2014	3.7	15.63	7.55	6.3	9.12
1	Red Lake	15/06/2014	3.4	8.52	7.51	0.4	10.39
1	Chukini River	16/06/2014	3.6	10.78	7.56	2.5	9.59
1	English River	16/06/2014	3.5	12.65	7.71	5.6	10.16
		13/09/2014	4.6	14.07	8.10	1.2	9.63
1	Barnston Lake	16/06/2014	3.0	13.79	7.56	5.8	10.03
1	Barrel Lake	19/06/2014	3.8	15.41	7.62	1.3	9.02
2	Lake St. Joseph	12/09/2014	4.8	14.44	7.10	1.3	9.67
2	Badesdawa Lake	12/09/2014	2.5	10.45	7.91	3.1	10.54
1	Sturgeon River	14/09/2014	5.0	14.56	8.02	1.1	10.01
1	Lac Seul	14/09/2014	4.2	13.32	7.89	1.7	9.17
1	Little Turtle Lake	16/09/2014	2.0	12.96	7.80	5.8	9.90

Habitat Trends

A study of changes in anthropogenic stress levels in watersheds that combined indices of freshwater fish biodiversity, environmental conditions and anthropogenic stress across Canada between 1996 and 2006/8 showed minor decreases in anthropogenic stress levels in DU1 and DU2 watersheds, and increases in anthropogenic stress levels in DU3 watersheds (Chu *et al*. 2015). It is uncertain what these changes mean for River Darter populations as no direct links to species' abundance or distribution have been identified.

Lake St. Clair and its watershed have experienced physical alteration/modification of habitat, eutrophication, shoreline hardening, and sedimentation associated with intensive agriculture. Excessive nutrient enrichment and turbidity have been identified as issues in the watershed (Staton *et al*. 2003; TRRT 2004). Habitat in Lake St. Clair changed dramatically after the invasion of Zebra Mussel (*Dreissena polymorpha*) in the late 1980s when water clarity and the abundance of aquatic macrophytes increased significantly (Griffiths 1993). It is uncertain if changes in water clarity have impacted the River Darter population.

Significant changes have occurred in the Sydenham and Thames river watershed as a result of agricultural practices and urbanization (Staton *et al*. 2003: TRRS 2004). Prior to European settlement the Sydenham River watershed consisted of 70% forested areas and 30% wetland areas (Staton *et al*. 2003). Nearly all the wetlands are now drained, and in 1983 only 12% of the forest remained (Staton *et al*. 2003). Currently, these watersheds are dominated by agriculture. Streamside cover appears to have recovered somewhat over the last several years; however, nutrient levels remain high. Turbidity is high in both watersheds and is probably a result of agricultural runoff that is facilitated by the widespread use of tile drainage throughout the watershed (Staton *et al*. 2003). The Sydenham and Thames rivers continue to be below standards set by the provincial government for acceptable levels of key parameters such as total phosphorus and *E. coli*, which could impact fishes via their influence on dissolved oxygen levels (TRRS 2004; SCRCA 2008).

Significant increases in total nitrogen and phosphorus in the Assiniboine and Red river drainages in the past 30 years have led to increased eutrophication of Lake Winnipeg (Jones and Armstrong 2001). Most dams were built well before the last species assessment. Zebra Mussel is now established in Lake Winnipeg and the Red River. The impacts to the lake and river, and specifically River Darter, are unknown at this time. Similar to the Great Lakes, increased water clarity may be expected as well as the potential for significant food web impacts.

Much of the species' range in DU1 and DU2 is located in watersheds that have limited road access with a low human population. Habitat in these portions of the distribution has likely been stable since the last species assessment. Point-source disturbances such as mines and hydro dams are possible in the future. A mainstem dam on the Nelson River is currently under construction.

BIOLOGY

Life Cycle

Individuals can mature as early as age 1 and reach a maximum age 3 (Thomas 1970) or 4 (Smith 1979) in the USA, with a generation time of 2 years. River Darter collected in 2014 from Manitoba and northwestern Ontario reached a maximum age of 4 years and were sexually mature at age 1 (Table 5).

Table 5. Mean total length (l_t), length range (mm), mean weight (g), sex ratio, mean age (yrs), and age range for River Darter captured and assessed from DFO-led surveys. Numbers in brackets represent ± standard error (modified from Pratt *et al.* 2015).

DU	Waterbody	Date(s)	Sample size for l_t and weight	Mean l_t (mm)	Length range (mm)	Mean weight (g)	Sex ratio	Sample size for aging	Mean age (yrs)	Age range
1	Rainy River	19/06/2013 to	145 (l); 144 (w)	53.0 (0.4)	43-67.5	1.2 (0.04)	6♂:71♀	98	2.6	1-4

DU	Waterbody	Date(s)	Sample size for l_t and weight	Mean l_t (mm)	Length range (mm)	Mean weight (g)	Sex ratio	Sample size for aging	Mean age (yrs)	Age range
		22/06/2013								
		08/08/2013 to 13/08/2013	167	42.5 (0.7)	30-72	0.6 (0.04)		65	0.7	0-3
		11/09/2013 to 12/09/2013	16	46.7 (1.9)	40-64.5	0.8 (0.12)	3♂:13♀	9	2.1	1-3
1	Lake of the Woods	13/06/2014	17	43.6 (0.5)	40-47	0.6 (0.02)	4♂:11♀	13	1.4	1-2
1	Red Lake	15/06/2014	1	42		0.43	0♂:1♀	1	1	
1	Chukini River	16/06/2014	5	42.4 (1.8)	37-48	0.6 (0.07)	1♂:1♀	4	1.8	1-2
1	English River	16/06/2014	27	41.4 (0.6)	35-47	0.5 (0.03)	7♂:17♀	25	1.2	1-2
		13/09/2014	17	40.3 (1.6)	30-53	0.5 (0.06)	2♂:14♀	15	0.6	0-3
1	Barnston Lake	16/06/2014	1	41		0.38				
1	Barrel Lake	19/06/2014	1	48.5		0.5				
1	Sturgeon River	14/09/2014	26	42.3 (1.4)	35-60	0.7 (0.09)	13♂:11♀	21	0.4	0-3
1	Lac Seul	14/09/2014	1	30		0.2				
1	Little Turtle Lake	16/09/2014	1	41		0.5				
1	Assiniboine River	09/10/2014	36	69.3 (1.4)	48-93	2.9 (0.20)	0♂:35♀	36	2.8	1-4
1	Lake Winnipeg	08/10/2014	31	43.5 (1.6)	33-66	0.7 (0.10)	8♂:18♀	31	0.8	0-3
2	Lake St. Joseph	12/09/2014	30	33.9 (0.6)	30-40	0.3 (0.02)	8♂:17♀	27	0.1	0-1
2	Badesdawa Lake	12/09/2014	32	36.1 (0.4)	32-43	0.3 (0.01)	11♂:14♀	22	0.3	0-1

Reproduction

The reproductive cycle of River Darter is determined by photoperiod and temperature (Hubbs 1985). In Canada, spawning occurs from May to early July (Balesic 1971). In contrast, in Louisiana, at the southern extent of its range, spawning occurs from January to April (Hubbs 1985). Fish predominantly spawn in rivers but ripe individuals are collected in lakes suggesting that spawning occurs there as well (Balesic 1971). Ripe River Darter have been collected in the Assiniboine River between June 22 and 24 when the water temperature was 24°C (Watkinson, unpublished data). Males typically move to spawning sites first (Holm *et al*. 2009). During spawning, females partially bury themselves in sand or gravel with the male resting on top, holding her in position with his pelvic fins (Dalton 1990). The pair vibrates while eggs are deposited one at a time and then fertilized. Spawning will occur several times over several weeks with different partners. Eggs and young are not guarded (Dalton 1990). A laboratory study of reproductive traits found that eggs were

adhesive and hatched nine days after fertilization in 19-21°C water (Balesic 1971). Larvae were 5-6.5 mm long and swimming within several hours of hatching.

Hybridization has been noted with Logperch (Trautman 1981).

Feeding

River Darter feeds primarily during daylight hours (Thomas 1970) and consumes a wide variety of food items (Balesic 1971). In Illinois and Manitoba, stomach contents included dipterans, trichopterans, ephemeropterans, crustaceans, and fish eggs (Thomas 1970; Balesic 1971). Fish in Manitoba also consumed corixids and fishes (Balesic 1971). In Alabama, Tennessee, and Manitoba, gastropods can be an important component of River Darter diet (Balesic 1971; Starnes 1977; Haag and Warren 2006). A recent study of River Darter prey items collected from DU1 and DU2 in June, September, and October confirmed they consume dipterans, trichopterans, ephemeropterans, crustaceans, and gastropods (Table 6), with dominant prey items varying between sites and seasons, likely reflecting differences in prey availability.

Table 6. Most common diet items in ten River Darter populations collected in 2013-2014 (modified from Pratt *et al.* 2015).

DU	Waterbody	Date(s)	Top Diet Items		
1	Rainy River	19/06/2013 to 22/06/2013	Hydropsychidae	Ephemereliidae	Chironomidae
1	Lake of the Woods	13/06/2014	Chironomidae	Heptageniidae	Hydropsychidae
1	Red Lake	15/06/2014	Trichoptera	Copepoda	Chironomidae
1	Chukini River	16/06/2014	Chironomidae	Trichoptera	Cladocera
1	English River	16/06/2014	Chironomidae	Trichoptera	Ephemeroptera
		13/09/2014	Zooplankton	Chironomidae	Leptophlebiidea
1	Sturgeon River	14/09/2014	Chaoboridae	Chironomidae	Polycentropodidae
1	Assiniboine River	09/10/2014	Hydropsychidae	Heptageniidae	Lymnaeidae
1	Lake Winnipeg	08/10/2014	Chironomidae	Lymnaeidae	Ephemeroptera
2	Lake St. Joseph	12/09/2014	Cladocera	Zooplankton	Amphipods
2	Badesdawa Lake	12/09/2014	Gastropoda	Zooplankton	Cladocera

Physiology and Adaptability

There is little information available regarding River Darter physiology and adaptability. Cavadias (1986) studied swim-bladder lift in the field and laboratory and found that River Darter would adjust swim-bladder lift based on the amount of current to which they were exposed, reducing lift in higher current, and increasing it in lower current.

Dispersal and Migration

River Darter abundance in rivers can vary seasonally, with upstream spawning migrations into rivers occurring in May to July (Balesic 1971). Based on laboratory observations of larval River Darter swimming position near the top of the water column, downstream dispersal may occur in rivers as the surface-water velocities would typically be greater than the larvae's swimming speed (Balesic 1971).

POPULATION SIZES AND TRENDS

DU1 – Saskatchewan - Nelson River Biogeographic Zone

Sampling Effort and Methods

A summary of sampling efforts and methods since 1989 are included in Tables 1, 2 and 3.

Abundance

The original species status report on River Darter concluded that the species was never abundant in Canadian waters (Scott and Crossman 1973; Dalton 1990) as limited collections have been made in Canada (NMC, OMNR, ROM records), with usually only one or two fish taken from a site. The most River Darter reported in a single collection prior to 1989 was 10 specimens (Dalton 1990). Collections made in the last decade using more appropriate gear to sample large rivers have collected considerably more specimens (Table 2 and 3). Non-targeted surveys using Missouri and mini-Missouri trawl surveys in the Assiniboine River found that it was the third most abundant species sampled. Density estimates for River Darter from targeted sampling completed in 2013 and 2014 in this DU ranged from 7-182 individuals/ha (Table 3).

Fluctuations and Trends

Fluctuations and trends in population size and density of River Darter in this DU cannot be estimated. The known distribution of River Darter in this DU has expanded in the past 10 years as more intensive sampling of small-bodied fishes has been completed (Milani 2013; Watkinson, unpublished data) (Appendix 4). The low numbers of River Darter that have historically been collected at a limited number of sample locations is likely an artifact of ineffective sampling gears and low effort prior to the 2000s.

River Darter are known from 67 waterbodies in this DU (Appendix 4). This DU contains hundreds of rivers and lakes that have not been sampled specifically for small, benthic fishes like the River Darter. In all likelihood, the species is more widely distributed and abundant.

River Darter has not been collected in the Red River in the last 20 years despite considerable sampling effort (Table 2); however, historical records do exist (Appendix 4). Targeted sampling on gravel and cobble substrates should be conducted to determine the continued presence or absence of this species in the Red River.

Rescue Effect

River Darter in the North Dakota and Minnesota portions of the Red River can move downstream into Canada as there are no barriers to movement. However, the St. Andrews Lock and Dam at Lockport is likely a barrier to upstream movement by River Darter. The Assiniboine River population is segmented by the Portage Diversion dam. It acts as an upstream barrier to all fish species. There are numerous hydroelectric dams in the Saskatchewan - Nelson River NFBZ on the Nelson, Winnipeg, English and Rainy rivers that only allow for downstream passage. Despite these barriers, the habitat patches in DU1 are very large and populations are not severely fragmented. The diversion of water from Lake St. Joseph over a control dam on the Root River that flows into Lac Seul, which is part of the English/Winnipeg River system, has the potential to allow River Darter from DU2 to move into DU1.

DU2 – Southern Hudson Bay - James Bay Biogeographic Zone

Sampling Effort and Methods

A summary of sampling effort and methods since 1989 are included in Table 1 and 3.

Abundance

Density estimates are only available for River Darter in this DU from lakes St. Joseph (118 individuals/ha) and Badesdawa (110 individuals/ha) (Table 3). Targeted collections found River Darter was most abundant in the two lakes sampled in DU2 (Table 3).

Fluctuations and Trends

Changes in population size and density of River Darter in this DU cannot be estimated. No River Darter had been documented from DU2 since 1980 until the targeted sampling was completed in 2014 (Appendix 4; Table 3). While catches of River Darter were low historically (n=20 fish dispersed over 11 sites, Appendix 4), this was likely an artifact of ineffective sampling gear, the depth at which the species is found, and minimal sampling effort due to the remoteness of much of the DU. It is uncertain if River Darter populations are stable in this DU based on existing distribution and catch data. However, similar to DU1, there are hundreds of rivers and lakes that have not been sampled with appropriate gear but may contain River Darter.

Rescue Effect

Within DU2, the Attawapiskat, Albany, Severn, and Winisk river watersheds all flow independently into Hudson or James bays. Movement of River Darter between these watersheds or the adjacent DUs to the south is not possible. These watersheds are hundreds of kilometres long and not considered severely fragmented.

DU3 – Great Lakes - Upper St. Lawrence Biogeographic Zone

Sampling Effort and Methods

A summary of sampling efforts and methods since 1989 is included in Tables 1 and 2.

Abundance

Detailed data for River Darter are only available from the Thames and Sydenham rivers (Table 2). Fifty collections were made with a mini-Missouri trawl (the optimal method for collecting River Darter), and only three River Darter were caught.

Fluctuations and Trends

Changes and fluctuations in population size and density of River Darter in this DU cannot be estimated. River Darter continues to be rare in this DU. Sampling since the last status report has not yielded more than a few specimens annually, with low catch per unit effort (Table 2). Collections made in Lake St. Clair and its tributaries have expanded our knowledge of the species' range in this DU (Appendix 4).

Rescue Effect

The extent of River Darter movement within the Great Lakes - Upper St. Lawrence Biogeographic Zone in lakes St. Clair or Erie and the Detroit River across the international boundary is unknown. Movement of fish from Michigan and Ohio is possible; however, it is likely very limited as River Darter is very rare in Michigan, possibly extirpated in the Lake Erie watershed in Ohio and ranked as Critically Imperilled in both states (NatureServe 2014). Relatively recent trawling by Michigan DNR (Thomas and Haas 2004) only found River Darter in the Canadian waters of Lake St Clair, near the mouth of Thames River.

THREATS AND LIMITING FACTORS

Physical alteration/modification of habitat from exotic species, shoreline hardening (rip-rap), industrial and agricultural effluents, nutrients, sedimentation, dams and resulting changes to the hydrograph, and dredging may possibly impact River Darter in Canada (Appendix 1-3). DU 1 and 2 were assessed as having an overall low threat impact whereas DU3 was assessed as a high-medium threat impact.

Our knowledge of threats and their impacts on River Darter populations is limited, as there is little threat-specific cause-and-effect information in the literature. No specific limiting factors have been identified for this species. River Darter abundance in DU3 has never been high and the cause of the declines in the adjacent states of Ohio and Michigan is unknown.

Exotic Species

Exotic species may affect River Darter through direct competition for space and habitat, competition for food, and restructuring of aquatic food webs (Thomas and Haas 2004; Poos *et al*. 2010; Burkett and Jude 2015). At least 182 exotic species have invaded the Great Lakes basin (DU3) since 1840 (Ricciardi 2006) and some of these species may affect River Darter populations to some extent. The Round Goby (*Neogobius melanostomus*), whose distribution overlaps with River Darter in Lake St. Clair, the Thames River and portions of the Sydenham River, may negatively impact the River Darter through direct competition for food resources as a number of the two species' prey items are shared (Balesic 1971; French and Jude 2001; Burkett and Jude 2015) and occupy similar habitats. Round Goby can feed on fish eggs and larvae (Thomas and Haas 2004; Poos *et al*. 2010) including potentially those of River Darter. More recently, Burkett and Jude (2015) found that eggs may not constitute an important component of Round Goby diet. Zebra Mussel (*Dreissena polymorpha*) is present in DU1 and DU3, and possible impacts on the River Darter are not known. River Darter may benefit from the presence of the Zebra Mussel as molluscs are consumed by River Darter (Balesic 1971; Haag and Warren 2006). Zebra Mussel can reduce turbidity, this may be detrimental to River Darter, but has not been studied.

Shoreline Hardening

The hardening of shorelines has been suggested as a threat for species at risk fishes (EERT 2008). Degradation and/or loss of gravel and cobble substrates in rivers and the exposed shorelines of lakes is a possible threat to the survival and persistence of River Darter, similar to other darter species (Grandmaison *et al*. 2004; Bouvier and Mandrak 2010; DFO 2011). Bank hardening has been completed along extensive portions of the south shore of Lake St. Clair in DU3. Bank hardening is common in DU1 along the Assiniboine and Red rivers as well as Lake Winnipeg. The extent to which this impacts River Darter is currently unknown.

Contaminants and Toxic Substances

Some of the watersheds in DU1 and DU3 where River Darter occur are impacted by household, urban, industrial, forestry, or agricultural activities that can lead to decreased water quality and can have negative, cumulative impacts (EERT 2008). The potential severity of impact is likely linked to duration and intensity of exposure, and ranges from the killing of individuals or their food, to more subtle effects on all life history stages (EERT 2008). This threat can be chronic or episodic (spills) and may also be cumulative.

Sediment Loadings

Sediment loading occurs in portions of DU1 and all of DU3. Sediment loadings affect inland watercourses, coastal wetlands, and nearshore habitats by decreasing water clarity, increasing the proportion of fine substrates such as silt, and may have a role in the selective transport of pollutants and nutrients including phosphorus. Sediment loading increases turbidity, which affects a species' vision and may inhibit respiration. Siltation can potentially impact prey abundance for River Darter (Holm and Mandrak 1996) as well as smother their eggs laid in the substrate (Finch 2009). The impacts of high sediment loads on the River Darter in Canada are not known. The species is likely more tolerant of high levels of suspended solids (i.e., turbidity) (Pflieger 1975; Trautman 1981) given that it is abundant in turbid systems throughout its range.

Impoundments

Impoundments and dams modify habitat, alter flow regimes and act as barriers to movement. Thomas (1970) found that abundance in rivers was positively correlated with stream gradient, suggesting that impoundments may be detrimental to River Darter. Impoundments increase the amount of fine sediments in the substrate, and River Darter abundance has been observed to decrease following their installation (Trautman 1981). Impoundments are present on most of the major rivers in DU1 including the Red, Assiniboine, Winnipeg, Rainy, English Saskatchewan, and Nelson rivers. DU2 has a limited number of impoundments on the Albany drainage with more planned in this DU.

Physical Alteration/modification of Habitat

Considering that River Darter deposit eggs into the substrate during spawning (Simon 1998), dredging can be inferred as a potential threat to spawning sites (Freedman 2010). Freedman (2010) found that dredged sites had an overall reduction in the numbers and diversity of small fishes likely because of decreased food availability or forage efficiency and impacts resulting from sedimentation. In DU3, dredging occurs in Lake St. Clair and occasionally its tributaries.

Number of Locations

The most plausible threats for River Darter that could impact large portions of the species' distribution include altered ecosystems due to exotic species, contaminants and/or toxic substances, and impoundments. These threats are specific to a river system or lake, so every distinct watershed should be considered a location in each DU. There are a minimum of 67 locations in DU1 and a minimum of 11 locations in DU2. It can be expected that additional sampling in remote or currently under-sampled waterbodies in both DU1 and DU2 would add numerous locations to each DU. DU3 has three locations; these include Lake St. Clair and the East Sydenham and Thames rivers. Note that the North Sydenham location is likely extirpated and therefore not included in the location count.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

In Canada, River Darter has no specific protection, but incidental protection may be provided by the federal *Fisheries Act* as its entire range is shared by commercial, recreational, and/or Aboriginal fisheries in all DUs.

The River Darter is not protected under the United States *Endangered Species Act*.

Non-Legal Status and Ranks

The following ranks apply to the conservation status of the River Darter (NatureServe 2014):

Global status: G5 (Secure)
National Status: N5 (Secure)
Ontario Status: S3 (Vulnerable)
Manitoba Status: S5 (Secure)

The species is considered critically imperilled in Georgia (S1), Kansas (S1S2), Michigan (S1), Ohio (S1), Pennsylvania (S1), and West Virginia (S1) (NatureServe 2014).

Habitat Protection and Ownership

Few, if any, parks and conservation areas have been established specifically to preserve aquatic biodiversity. However, some do protect aquatic biodiversity as a result of their location and management practices (Mandrak and Brodribb 2005). Numerous provincial parks within Manitoba and Ontario may provide some protection for River Darter.

ABORIGINAL TRADITIONAL KNOWLEDGE

At the time of the writing of this report, there was no Aboriginal Traditional Knowledge available for River Darter.

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Douglas Watkinson is a Research Biologist with Fisheries and Oceans Canada in Winnipeg. He has sampled fish in many of the major river systems of the Hudson Bay drainage from northwestern Ontario west to the Rockies. His current research focuses on species at risk, habitat impacts, and aquatic invasive species. He has co-authored five COSEWIC reports and the field guide to The Freshwater Fishes of Manitoba.

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COLLECTIONS EXAMINED

River Darter collections made by Fisheries and Oceans Canada in 2013 and 2014 in DU1 and DU2 were examined for this report. Size, diet and age data were collected and are summarized in this report (Tables 5 and 6).

Appendix 1. Threats Assessment Calculator DU1.

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	River Darter - DU1: Saskatchewan - Nelson River population		
Element ID		**Elcode**	
Assessor(s):	Nicholas Mandrak, Thomas Pratt, Dwayne Lepitzki, Scott Reid, Margaret Docker, Angele Cyr, John Post and Douglas Watkinson		
References:	Teleconf on 26 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	2	2
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		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	housing development on rivers unlikely,
1.1	Housing & urban areas						unlikely development on habitat in the next 10 yrs
1.2	Commercial & industrial areas						not applicable
1.3	Tourism & recreation areas		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
2	Agriculture & aquaculture						
2.1	Annual & perennial non-timber crops						Row crop occuring but not directly in rivers. siltation occuring but accounted for under 9.3. not as intensly coupled with agriculture. Not found in drains. habitat modifcation dealt with under threat 9.3
2.2	Wood & pulp plantations						not applicable
2.3	Livestock farming & ranching						not applicable
2.4	Marine & freshwater aquaculture						not applicable
3	Energy production & mining						
3.1	Oil & gas drilling						not applicable

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.2	Mining & quarrying						not applicable
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)	east side road planned in Winnipeg right over River Darter habitat.
4.2	Utility & service lines		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	pipe lines and electrical transmission lines planned for this DU range
4.3	Shipping lanes						not applicable
4.4	Flight paths						not applicable
5	Biological resource use						
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						bait fishery bycatch? Not applicable. Forzen bait catch in this DU but encounters with Darters are very uncommon and arent present in bait fish by catch.
6	Human intrusions & disturbance		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
6.1	Recreational activities		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	ATV's arent running through river darter habitat.
6.2	War, civil unrest & military exercises						Some DND activities in darter range but not aquatic.
6.3	Work & other activities		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	collection occuring but very low, negligible.
7	Natural system modifications	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	
7.1	Fire & fire suppression						not applicable.
7.2	Dams & water management/use	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	A lot of areas will have impact of dams in this DU but a lot of range will not be affected. Flow management practices are peaking but not severe though.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.3	Other ecosystem modifications		Unknown	Small (1-10%)	Unknown	High (Continuing)	Zebra Mussels affecting the water clarity (detrimental in the DU - increase in water clarity and a decrease in phosphorus) and Round Goby compete with Darters (detrimental). Overall decline from this threat but unknown severity. some evidence to suggest that there are only Goby's left in benthic habitats. considering effects of Goby only under 7.3 for all effects (including competition, space and resources). impact is somewhat unknown since Goby feeds on other eggs and Darter tends to burry eggs.
8	Invasive & other problematic species & genes						
8.1	Invasive non-native/alien species						not applicable. zebra mussels accounted for under 7.3 Smallmouth Bass is likely present and preys on Darters. Unknown impact.
8.2	Problematic native species						not applicable. round goby accounted for under 7.3
8.3	Introduced genetic material						not applicable.
9	Pollution	D	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	
9.1	Household sewage & urban waste water	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	household sewage and urban waste water treated by municipal treatment plant.
9.2	Industrial & military effluents		Negligible	Negligible (<1%)	Serious - Slight (1-70%)	High (Continuing)	most industrial and military effluents present in this DU but treated by municipal treatment. Spills plausible.
9.3	Agricultural & forestry effluents	D	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	slaughter houses, pulp and paper mills applicable.
9.4	Garbage & solid waste		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	garbage and spills present but negligible impact.
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		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
11.1	Habitat shifting & alteration						not applicable.
11.2	Droughts		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	drought occuring but impact unknown. Sometimes drought occuring yearly.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.3	Temperature extremes		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
11.4	Storms & flooding		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	not applicable. Flooding is beneficial to Darters since it increases habitat but not occuring in this part of range due to water management flow controlled by dams.

Appendix 2. Threats Assessment Calculator DU2.

THREATS ASSESSMENT WORKSHEET				
Species or Ecosystem Scientific Name	River Darter - DU2: Southern Hudson Bay - James Bay population			
Element ID		**Elcode**		
Assessor(s):	Nicholas Mandrak, Thomas Pratt, Dwayne Lepitzki, Scott Reid, Margaret Docker, Angele Cyr, John Post and Douglas Watkinson			
References:	Teleconf on 26 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		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
1.1	Housing & urban areas						some housing development planned on habitat in the next 10 yrs
1.2	Commercial & industrial areas						not applicable
1.3	Tourism & recreation areas		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
2	Agriculture & aquaculture						
2.1	Annual & perennial non-timber crops						Row crop occuring but not directly in rivers. siltation occuring but accounted for under 9.3. not as intensly coupled with agriculture. Not found in drains. habitat modifcation dealt with under threat 9.3
2.2	Wood & pulp plantations						quite a bit of logging that occurs but impact is unknown. Could be accounted for under 7.3 as it relates to result of turbidity from loss of trees?
2.3	Livestock farming & ranching						not applicable
2.4	Marine & freshwater aquaculture						not applicable

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3	Energy production & mining		Unknown	Unknown	Unknown	Moderate - Low	
3.1	Oil & gas drilling						potential for great deal of development. unknown.
3.2	Mining & quarrying		Unknown	Unknown	Unknown	Moderate - Low	new mining plausible (or) but unknown. Spatial component in terms of mining claims. Some mining is right on fish habitat. One in Manitoba is beneath lake.
3.3	Renewable energy						potential for great deal of development in the next 10 yrs but unknown.
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 over darter habitat in this DU
4.2	Utility & service lines		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	fair number of hydro electric lines planned for development within this DU range. Oil
4.3	Shipping lanes						not applicable
4.4	Flight paths						not applicable
5	Biological resource use						
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						not applicable
6	Human intrusions & disturbance		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
6.1	Recreational activities		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	ATV's likely running through rivers but whether theyre driving through darter habitat is unlikely.
6.2	War, civil unrest & military exercises						not applicable. Some DND activities in darter range but not aquatic.
6.3	Work & other activities		Negligible	Negligible (<1%)	Negligible (<1%)	Moderate (Possibly in the short term, < 10 yrs)	collection occuring but very low, negligible.
7	Natural system modifications	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	
7.1	Fire & fire suppression						not applicable.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.2	Dams & water management/use	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Impoundments. Dam present at lake St-Joseph which is a diversion dam. Dam developments planned within the next 10 yrs. Albany river has a few generation dams present and no new developments planned. Dams are downstream from River Darter habitat except for the Lake St-Joseph diversion (which affect much of the habitat downstream).
7.3	Other ecosystem modifications						not applicable. zebra mussels arent present yet in this DU nor Goby.
8	Invasive & other problematic species & genes						
8.1	Invasive non-native/alien species						not applicable. zebra mussels accounted for under 7.3. Small Mouth Bass is likely present and preys on Darters. Unknown impact.
8.2	Problematic native species						not applicable. round goby accounted for under 7.3.
8.3	Introduced genetic material						not applicable.
9	Pollution		Negligible	Negligible (<1%)	Serious - Slight (1-70%)	High (Continuing)	
9.1	Household sewage & urban waste water		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	area is quite rural
9.2	Industrial & military effluents		Negligible	Negligible (<1%)	Serious - Slight (1-70%)	High (Continuing)	
9.3	Agricultural & forestry effluents		Negligible	Negligible (<1%)	Moderate (11-30%)	High (Continuing)	forestry effluent very likely as well as pulp and paper mill effluent (eastward - Hearst) plausible but unknown. Sedimentation from forestry is considered.
9.4	Garbage & solid waste		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	garbage present (such as drink cans, etc) but negligible impact.
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		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
11.1	Habitat shifting & alteration						not applicable.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.2	Droughts		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	drought occuring but impact unknown. Waterbody is more intact for these areas and therefore less succeptible to the effects of droughts. Water system is less managed and therefore more natural.
11.3	Temperature extremes		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
11.4	Storms & flooding		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	not applicable. Flooding is beneficial to Darters since it increases habitat but not occuring in this part of range.
Classification of Threats adopted from IUCN-CMP, Salafsky *et al*. (2008).							

Appendix 3. Threats Assessment Calculator DU3.

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	River Darter - DU3: Great Lakes - Upper St. Lawrence population		
Element ID		**Elcode**	
Assessor(s):	Nicholas Mandrak, Thomas Pratt, Dwayne Lepitzki, Scott Reid, Margaret Docker, Angele Cyr, John Post and Douglas Watkinson		
References:	Teleconf on 26 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	1	1
D	Low	1	2
	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						unlikely development on habitat in the next 10 yrs
1.2	Commercial & industrial areas						not applicable
1.3	Tourism & recreation areas						not applicable
2	Agriculture & aquaculture						
2.1	Annual & perennial non-timber crops						not as intensly coupled with agriculture. Not found in drains. siltation dealt with under 9.3. habitat modifcation dealt with under threat?
2.2	Wood & pulp plantations						not applicable
2.3	Livestock farming & ranching						not applicable
2.4	Marine & freshwater aquaculture						not applicable

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3	Energy production & mining						
3.1	Oil & gas drilling						not applicable
3.2	Mining & quarrying						mining of the gravel in the darter beds unknown? Province isnt permitted regardless.
3.3	Renewable energy						footprint of wind mills does not extend into aquatic habitat. Draining has already occurred.
4	Transportation & service corridors	D	Low	Small (1-10%)	Serious - Moderate (11-70%)	High (Continuing)	
4.1	Roads & railroads						not applicable
4.2	Utility & service lines						not applicable
4.3	Shipping lanes	D	Low	Small (1-10%)	Serious - Moderate (11-70%)	High (Continuing)	dredging sites have an overall decrease in population size for darter. More expected over the next 10 years but not at a higher intensity than current. Lake St.Clair marina projects have access plans that imply dredging. Nothing planned for thames, maybe something in lower sydenham. unlikely areas that darter would occupy though. however darters arent restricted to riverine habitat so plausible effect from dredging planned in the next 10yrs.
4.4	Flight paths						not applicable
5	Biological resource use						
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						bait fishery bycatch? Not applicable. Encounters with Darters are very uncommon and arent present in bait fishery by catch areas.
6	Human intrusions & disturbance		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
6.1	Recreational activities						not applicable. ATV's arent running through river darter habitat.
6.2	War, civil unrest & military exercises						not applicable.
6.3	Work & other activities		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Collection for scientific research is occuring and catches are kept and killed summing to 4 individuals over the past 15 yrs. Therefore negligible. Occurs in specific areas.
7	Natural system modifications	BD	High - Low	Pervasive (71-100%)	Serious - Slight (1-70%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.1	Fire & fire suppression						not applicable.
7.2	Dams & water management/use	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	new dams and/or effects of current dams. No new dams proposed for this species nor are they subject to the effects of current dams. Water management use for municipal use or agricultural use is accounted for under 7.3. water flow regime altered upstream but arent from large reservoirs so effect is negligible. Dams built by conservation authorities reduce risk of flood in the spring and in summer reduce the risk of drought. This species actually does not benefit from dams regulating water levels since Darters benefit from flooding events where habitat is increased. not creating large impoundments nor are they greatly affecting flow regimes.
7.3	Other ecosystem modifications	BD	High - Low	Pervasive (71-100%)	Serious - Slight (1-70%)	High (Continuing)	rip rap (detrimental effect) along shoreline and other ecosystem modifications such as zebra mussels affecting the water clarity (might be beneficial) and Round Goby compete with Darters (detrimental). Round Goby is present in Lake St. Clair, lower parts of Sydenham and throughout the Thames. Overall decline from this threat. some evidence to suggest that there are only Goby's left in benthic habitats. considering effects of Goby only under 7.3 for all effects (including competition, space and resources). impact is somewhat unknown since Goby feeds on other eggs and Darter tends to bury eggs.
8	Invasive & other problematic species & genes						
8.1	Invasive non-native/alien species						Zebra mussels may actually be beneficial to Darters since it is thought to feed on Zebra Mussels. But this has not been confirmed. Likely reported benefit is related to water clarity and this is accounted for in 7.3. Zebra mussels may also be detrimental in terms of water quality (again accounted for under 7.3) since they reduce turbidity and increased water clarity could reduce available oxygen. round goby accounted for under 7.3
8.2	Problematic native species						
8.3	Introduced genetic material						not applicable.
9	Pollution	C	Medium	Pervasive (71-100%)	Moderate (11-30%)	High (Continuing)	
9.1	Household sewage & urban waste water	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	effluents and some waste water present via urban activitities, particulary in the London area but ecological footprint unlikely to extend into darter range for this DU.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
9.2	Industrial & military effluents	CD	Medium - Low	Restricted - Small (1-30%)	Serious - Slight (1-70%)	High (Continuing)	Industrial activities downstream of Sarnia? There are occurences of spills such as Gas or industrial spills, even manure spills mainly in specific areas where Darter is present.
9.3	Agricultural & forestry effluents	C	Medium	Pervasive (71-100%)	Moderate (11-30%)	High (Continuing)	agricultural effluents present over part of its range for this DU
9.4	Garbage & solid waste		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	some manure spills occur over Darter habitat. Impact of spills is greater than other threats in the category. Spills cause entire population mortality in the area of occurrence. This species can tolerate turbidity but rather the nutrient loading from a manure spill is lethal.
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		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
11.1	Habitat shifting & alteration						not applicable according to guidelines. Climate change may be applicable but unknown.
11.2	Droughts		Unknown	Pervasive (71-100%)	Unknown	Moderate (Possibly in the short term, < 10 yrs)	drought occuring but randomly one year and not the other.
11.3	Temperature extremes		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	not applicable. While warmer temperature could be detrimental, the range for this DU already has very warm temperatures for rivers and impact is negligible.
11.4	Storms & flooding		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	not applicable. Flooding is beneficial to Darters since it increases habitat but not occuring in this part of range due to water management flow controlled by dams.

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

Appendix 4. All known collection records of River Darter in Canada.

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Royal Ontario Museum	1	Savage J.;Green A. G.	Vermillion River; Between Vermillion Lake and Pelican Lake	28-Jul-31	50.116665	-92
KWS	1	R.K. STEWART-HAY	LAKE DAUPHIN	7-Jun-51	51.2833	-99.80000
Royal Ontario Museum	1	Keleher J. J.	Lake Winnipeg; Bullhead	29-Jul-51	51.583332	-96.73333
Royal Ontario Museum	1	J Keleher	Lake Winnipegosis	11-Aug-55	52.883335	-101.01667
KWS	1	B. CASE, T. VINCENT	ASSINIBOINE RIVER	16-Aug-67	50.0333	-97.95000
Canadian Museum of Nature	1	Willock Thomas A.; Gruchy Charles G.	Lake of the Woods	13-Jun-70	48.958	-94.567
Royal Ontario Museum	1	DW Cuddy	Barrel Lake; 18Mi N of Ignace	23-Jun-70	49.666668	-91.5
Canadian Museum of Nature	1	Gruchy Charles G.; Gruchy Iola M.	Lake of the Woods	28-Jul-70	48.642	-93.983
Royal Ontario Museum	1	Rhude L.;Maher T.	Red Lake; near Cochenour	18-Jun-71	51.066666	-93.816666
Royal Ontario Museum	1	Rhude L.;Maher T.	Minnitaki Lake	22-Jul-71	50.202778	-91.37778
KWS	1	H. BALESIC	LAKE DAUPHIN	1971	51.2833	-99.80000
KWS	1	H. BALESIC	VALLEY RIVER	1971	51.3500	-99.91667
KWS	1	G.E. MOODIE	WILSON RIVER	20-Jul-72	50.9000	-99.40000
KWS	1	R. CLARKE, ET AL.	RED RIVER	1972-74	49.8833	-97.15000
KWS	1	R. RATYNSKI	LAKE WINNIPEG	1976	53.1667	-99.30000
Royal Ontario Museum	1	Wilkinson A.;Shaw S.	Unknown	21-Aug-78	49.833332	-94.15
KWS	1	I. HAGENSON	WHISKEY JACK LAKE	17-Jun-80	52.7000	-95.96667
Royal Ontario Museum	1	Lucko B;Derksen	Apisko Lake	4-Jul-80	52.533333	-95.416664
KWS	1	R. RATYNSKI, KWS	RED RIVER	26-Sep-80	49.7500	-97.15000
Royal Ontario Museum	1	Parmeter P.;Cederwall K.	Grassy Narrows Lake; SW of Lac Seul, E of Umfreville, N shore of small island due N of mainland cemetery	29-Jul-81	50.15	-93.98333
Royal Ontario Museum	1	Stewart K. W.; *Et al*	Red River; 30-100 m north of St. Norbert Floodway Control Gate	24-Sep-81	49.766666	-97.15
KWS	1	BIOLOGY OF FISH CLASS	RED RIVER	24-Sep-81	49.7500	-97.15000
KWS	1	FRANZIN ET.AL.	VERMILLION RIVER	1982	51.1833	-99.83333
KWS	1	FRANZIN ET.AL.	EDWARDS CREEK	1982	51.1333	-99.98333
KWS	1	FRANZIN ET AL.	OCHRE RIVER	1982	51.1000	-99.75000
KWS	1	FRANZIN ET AL.	TURTLE RIVER	1982	51.1167	-99.65000
KWS	1	FRANZIN ET AL.	LAKE DAUPHIN	1982	51.2833	-99.80000
KWS	1	KWS, L. LEAVESLEY, J. STEWART	ASSINIBOINE RIVER	11-Jul-82	49.6500	-99.26667
Royal Ontario Museum	1	Butterfield L.; Mccauley C.	Unnamed; Sioux Lookout 11 km. NW on Marchington Forest Road. Off north shore E part of lake	14-Jul-82	50.133335	-91.85
KWS	1	FRANZIN ET AL.	TURTLE RIVER	10-Aug-82	51.1167	-99.65000
Canadian Museum of Nature	1	University of Manitoba Fish Biology Class	Red River	16-Sep-82	49.867	-97.133
KWS	1	BIOLOGY OF FISH CLASS	RED RIVER	16-Sep-82	49.7500	-97.15000

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
KWS	1	A. SHOSTAK	RED RIVER	23-Sep-82	49.7500	-97.15000
KWS	1	B. YAKE	ASSINIBOINE RIVER	13-Jul-83	49.6500	-99.26667
KWS	1	FIELD ECOLOGY CLASS	LAKE MANITOBA	30-Aug-83	50.1833	-98.33333
KWS	1	BIOLOGY OF FISH CLASS	RED RIVER	15-Sep-83	49.7500	-97.15000
Royal Ontario Museum	1	Stewart K. W.; Stewart J. A.; Pannu D.	Red River; Red River at St. Norbert Floodway Gate in runoff inflow channel of bay	11-Jun-84	49.766666	-97.15
KWS	1	K.W.&J. STEWART, D. PANNU	RED RIVER	11-Jun-84	49.7500	-97.15000
KWS	1	K. DYKE, I. DIXON	LAKE WINNIPEG	16-Jul-84	50.7000	-96.98333
Canadian Museum of Nature	1	Dyke K.; Dixon I.	LAKE WINNIPEG	18-Jul-84	50.7	-96.983
Royal Ontario Museum	1	Dyke K.; Dixon I.	Lake Winnipeg; Beach 5.5 km north of Gimli	18-Jul-84	50.683334	-96.98333
Royal Ontario Museum	1	Janusz R.	Goldeye Creek	23-Jul-84	50.266666	-96.86667
KWS	1	K.W.STEWART, K. DYKE, I. DIXON	RED RIVER	24-Jul-84	49.5667	-97.20000
KWS	1	J. GEE, ET AL.	LAKE WINNIPEG	30-Jul-84	51.3333	-96.66667
Canadian Museum of Nature	1	Stewart Kenneth W.; Stewart J.A.; Pannu D.	Souris River	28-Aug-84	49.633	-99.6
Royal Ontario Museum	1	Stewart K. W.; Stewart J. A.; Pannu D.	Assiniboine River; 100-250 metres west of Treesbank Ferry Crossing (Hwy. 340)	28-Aug-84	49.633335	-98.7
KWS	1	K.W.&J. STEWART, D. PANNU	ASSINIBOINE RIVER	28-Aug-84	49.6833	-99.61667
KWS	1	BIOLOGY OF FISH CLASS	RED RIVER	13-Sep-84	49.7500	-97.15000
Royal Ontario Museum	1	OMNR	Steep Rock River	6-Aug-86	52.783333	-100.95
Royal Ontario Museum	1	OMNR	German Creek	7-Aug-86	52.766666	-100.88333
Royal Ontario Museum	1	OMNR	Bell River	8-Aug-86	52.733334	-100.88333
Royal Ontario Museum	1	OMNR	Overflowing River	10-Aug-86	53.133335	-101.083336
Royal Ontario Museum	1	OMNR	Red Deer River	11-Aug-86	51.883335	-101.01667
Canadian Museum of Nature	1	North/South Consultants Inc.	Nelson River	8-Aug-88	56.95	-92.717
KWS	1	BIOLOGY OF FISH CLASS	RED RIVER	22-Sep-88	49.8500	-95.13333
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	27-May-89	49.8667	-97.20000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	14-Jun-89	49.9000	-100.30000
KWS	1	GFH	RED RIVER	14-Sep-89	50.4000	-96.80000
KWS	1	GFH	ASSINIBOINE RIVER	24-Sep-89	49.7167	-99.08333
KWS	1	BIOLOGY OF FISHES CLASS	ASSINIBOINE RIVER	24-Sep-89	49.6667	-99.26667
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	25-Nov-89	49.8333	-99.86667
KWS	1	B.R. MCCULLOCH, ET AL.	ASSINIBOINE RIVER	6-Jan-90	49.8333	-99.86667
KWS	1	GFH	ASSINIBOINE RIVER	18-Feb-90	49.8333	-99.95000
KWS	1	B.R. MCCULLOCH, ET.AL.	ASSINIBOINE RIVER	18-Feb-90	49.8333	-99.86667
KWS	1	GFH	ASSINIBOINE RIVER	4-Mar-90	49.8333	-99.95000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	4-Mar-90	49.8333	-99.86667
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	29-Jun-90	49.9500	-98.30000

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	5-Jul-90	49.9500	-98.30000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	20-Jul-90	49.9500	-98.30000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	27-Jul-90	49.9500	-98.30000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	1-Aug-90	49.9500	-98.30000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	2-Aug-90	49.9500	-98.30000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	10-Aug-90	49.9500	-98.30000
Royal Ontario Museum	1	Eakins R.	Saskatchewan River; Below the E.B. Campbell Hydroelectric Station at Squaw Rapids	24-Aug-90	53.68	-103.395
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	24-Aug-90	49.9500	-98.30000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	31-Aug-90	49.9500	-98.30000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	7-Sep-90	49.9500	-98.30000
KWS	1	B.R. MCCULLOCH, J.D. TYSON	ASSINIBOINE RIVER	21-Sep-90	49.9500	-98.30000
KWS	1	GFH	POPLAR RIVER	12-Aug-91	53.0000	-97.40000
KWS	1	GFH	POPLAR RIVER	13-Aug-91	53.0000	-97.40000
KWS	1	GFH	POPLAR RIVER	13-Aug-91	53.0000	-97.40000
KWS	1	GFH	BERENS RIVER	15-Aug-91	52.3500	-97.05000
KWS	1	GFH	RED RIVER	12-Sep-91	49.6833	-97.15000
KWS	1	BIOLOGY OF FISH CLASS	RED RIVER	12-Sep-91	49.8500	-95.15000
KWS	1	GFH	WINNIPEG RIVER	21-Sep-91	50.5667	-96.20000
KWS	1	BIOLOGY OF FISHES CLASS	WINNIPEG RIVER	21-Sep-91	50.5833	-96.23333
KWS	1	GFH	CYPRESS RIVER	22-Sep-91	49.5667	-99.08333
KWS	1	BIOLOGY OF FISHES CLASS	CYPRESS RIVER	22-Sep-91	49.5667	-99.06667
KWS	1	GFH	FISHER RIVER	3-Jun-92	51.4333	-97.28333
KWS	1	GFH, PC	BLACK RIVER	15-Jun-92	50.8167	-96.35000
KWS	1	GFH, PC	BLACK RIVER	15-Jun-92	50.8167	-96.35000
KWS	1	GFH, PC	BLOODVEIN RIVER	12-Aug-92	51.7833	-96.70000
KWS	1	GFH, PC	BLOODVEIN RIVER	13-Aug-92	51.7833	-96.70000
KWS	1	GFH,PC	BLOODVEIN RIVER	13-Aug-92	51.7833	-96.70000
KWS	1	GFH, PC	BLOODVEIN RIVER	13-Aug-92	51.7833	-96.70000
KWS	1	GFH,PC	BLOODVEIN RIVER	13-Aug-92	51.7833	-96.70000
KWS	1	GFH,KWS	PIGEON RIVER	18-Aug-92	52.2667	-97.03333
KWS	1	GFH,KWS	PIGEON RIVER	18-Aug-92	52.2500	-97.03333
KWS	1	GFH,KWS	PIGEON RIVER	18-Aug-92	52.2500	-97.03333
KWS	1	GFH,KWS	PIGEON RIVER	18-Aug-92	52.2500	-97.03333
KWS	1	GFH,JMC	LAKE WINNIPEG	29-Jul-93	50.4500	-96.95000
KWS	1	GFH,JMC	LAKE WINNIPEG	29-Jul-93	50.9000	-97.00000
KWS	1	GFH,JMC	LAKE WINNIPEG	30-Jul-93	50.6667	-96.55000

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
KWS	1	GFH,JMC	LAKE WINNIPEG	30-Jul-93	51.6500	-96.35000
KWS	1	GFH,JMC	WINNIPEG RIVER	30-Jul-93	50.5667	-96.21667
KWS	1	GFH,JMC	MANIGOTAGAN RIVER	3-Aug-93	51.1167	-96.33333
KWS	1	GFH,JMC	WINNIPEG RIVER	3-Aug-93	50.5667	-96.20000
KWS	1	GFH,JMC,MS	LAKE WINNIPEG	13-Aug-93	50.6167	-96.58333
KWS	1	GFH,JMC,MS	LAKE WINNIPEG	13-Aug-93	50.5000	-96.60000
KWS	1	GFH,JMC,MS	LAKE WINNIPEG	13-Aug-93	50.5333	-96.61667
Royal Ontario Museum	1	Ontario Hydro	Barnston Lake	18-Aug-93	50.568054	-93.505
Royal Ontario Museum	1	Ontario Hydro	Barnston Lake	18-Aug-93	50.56889	-93.51278
Royal Ontario Museum	1	Ontario Hydro	Barnston Lake	18-Aug-93	50.568333	-93.507774
Royal Ontario Museum	1	Ontario Hydro	Barnston Lake	19-Aug-93	50.572224	-93.52333
Royal Ontario Museum	1	Ontario Hydro	Barnston Lake	19-Aug-93	50.5875	-93.50667
KWS	1	GFH,JMC,KWS	WINNIPEG RIVER	18-Sep-93	50.5667	-96.21667
KWS	1	GFH,JMC,KWS	ASSINIBOINE RIVER	19-Sep-93	49.9333	-98.31667
KWS	1	BIOLOGY OF FISHES CLASS	ASSINIBOINE RIVER	19-Sep-93	49.9500	-98.33333
Royal Ontario Museum	1	Pope R.; Tarandus Associates Limited	English River; downstream of Manitou Falls	23-Jul-94	50.582172	-93.46198
KWS	1	GFH,BM,CP	LAKE WINNIPEG	24-Sep-94	50.6667	-96.55000
KWS	1	GFH,BM,CP	WINNIPEG RIVER	24-Sep-94	50.5667	-96.20000
KWS	1	GFH,BM,CP	ASSINIBOINE RIVER	25-Sep-94	49.9500	-98.35000
Watkinson	1	P. Nelson, W. Franzin, E. Watson	Assiniboine River	28-Aug-96	49.87753	-97.19809
Royal Ontario Museum	1	Gibson S.; Wild G.	Sturgeon River; at bridge on HWY 11 just W of Barwick	8-Aug-98	48.654446	-94.02583
Watkinson	1	M. Forster, E. Watson, P. Nelson	Ochre River	10-May-99	50.90444	-99.81917
Milani	1	Milani	La Salle River	17-Apr-02	49.694320	-97.26246
Milani	1	Milani	Norquay Channel	28-May-02	49.532017	-97.86412
Watkinson	1	D. Watkinson, S. Backhouse, J. Eastman, T. Sheldon	Assiniboine River	17-Jun-02	49.87398	-97.50851
Watkinson	1	D. Watkinson, S. Backhouse, J. Eastman, T. Sheldon	Assiniboine River	18-Jun-02	49.87397	-97.50941
Watkinson	1	D. Watkinson, S. Backhouse, J. Eastman, T. Sheldon	Assiniboine River	26-Jun-02	49.69691	-98.88856
Watkinson	1	D. Watkinson, S. Backhouse, J. Eastman, T. Sheldon	Assiniboine River	26-Jun-02	49.69691	-98.88856
Watkinson	1	D. Watkinson, R. Penner, S. Backhouse, J. Eastman	Assiniboine River	11-Jul-02	49.65046	-99.52442
Watkinson	1	D. Watkinson, R. Penner, S. Backhouse, J. Eastman	Assiniboine River	12-Jul-02	49.61549	-99.39586
Watkinson	1	D. Watkinson, R. Penner, S. Backhouse, J. Eastman	Assiniboine River	18-Jul-02	49.70047	-98.89814
Watkinson	1	D. Watkinson, R. Penner, S. Backhouse, J. Eastman	Assiniboine River	18-Jul-02	49.70047	-98.89814
Watkinson	1	D. Watkinson, R. Penner, S. Backhouse, J. Eastman	Assiniboine River	18-Jul-02	49.72891	-98.79492

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Watkinson	1	D. Watkinson, R. Penner, S. Backhouse, J. Eastman	Assiniboine River	18-Jul-02	49.75717	-98.74536
Milani	1	Milani	Ochre River	23-Jul-02	51.051383	-99.78653
Watkinson	1	D. Watkinson, R. Penner, S. Backhouse, J. Eastman	Assiniboine River	24-Jul-02	49.76529	-98.65610
Milani	1	Milani	Unnamed tributary to Boyne River	27-Aug-02	49.541067	-98.41475
Royal Ontario Museum	1	Portt C.; Coker G.; Kilgour B.	Rainy River; Exposure area 1-downstream limit	19-Sep-02	48.60563	-93.41852
Royal Ontario Museum	1	Portt C.; Coker G.; Kilgour B.	Rainy River; Exposure area 1-upstream limit	19-Sep-02	48.60741	-93.41385
Royal Ontario Museum	1	Portt C.; Coker G.; Kilgour B.	Rainy River; Exposure area 2	19-Sep-02	48.59899	-93.43154
Milani	1	Milani	Rivière Aux Marais	23-Jul-03	49.133400	-97.29205
Watkinson	1	D. Watkinson, R. Penner, P. Nelson	Bird River	14-Aug-03	50.41411	-95.65616
Watkinson	1	D. Watkinson, S. Backhouse, J. Eastman	Bird Lake	26-Aug-03	50.48450	-95.26617
Watkinson	1	D. Watkinson, S. Backhouse, J. Eastman	Bird Lake	26-Aug-03	50.48355	-95.26576
Watkinson	1	D. Watkinson, S. Backhouse, J. Eastman	Bird Lake	26-Aug-03	50.48306	-95.26635
Watkinson	1	D. Watkinson, R. Penner, W. Franzin	Manigotagan River	3-Sep-03	51.10152	-96.28376
Watkinson	1	D. Watkinson, R. Penner, W. Franzin	Manigotagan River	3-Sep-03	51.10152	-96.28376
Watkinson	1	D. Watkinson, R. Penner, W. Franzin	Winnipeg River	15-Sep-03	50.51928	-96.09350
Watkinson	1	D. Watkinson, R. Penner, W. Franzin	Winnipeg River	16-Sep-03	50.22288	-95.57328
Watkinson	1	D. Watkinson, W. Franzin, D. LaRue	Bird River	2-Oct-03	50.41402	-95.65812
Milani	1	Milani	Boundary Creek	23-Jun-04	50.508690	-96.97562
Milani	1	Milani	Wilson River	30-Jun-04	51.199556	-100.10461
Milani	1	Milani	Icelandic River	16-Jul-04	50.964778	-97.03881
Milani	1	Milani	Vermillion River	20-Jul-04	51.169750	-100.05375
Watkinson	1	D.Watkinson	Rainy River	28-Jul-04	48.64462	-94.09466
Milani	1	Milani	Seine River Diversion	30-Jul-04	49.697333	-97.09975
Milani	1	Milani	Swan River	5-Aug-04	52.227806	-100.99253
Watkinson	1	Z. Wang, C. Herbert	Lake Winnipeg	27-Jul-06	51.78858333	-96.87245
Watkinson	1	D. Watkinson, Hrabik, Konrad	Assiniboine River	22-Jun-09	49.66911	-99.60170
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	22-Jun-09	49.66650	-99.57225
Watkinson	1	Hrabik, Herzog, Ostendorf	Assiniboine River	22-Jun-09	49.69642	-99.65923
Watkinson	1	Ostendorf, Macdonald	Assiniboine River	22-Jun-09	49.66868	-99.60188
Watkinson	1	Ostendorf, Macdonald	Assiniboine River	22-Jun-09	49.66660	-99.57387
Watkinson	1	D. Watkinson, Hrabik, Konrad	Assiniboine River	22-Jun-09	49.68023	-99.62896
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	22-Jun-09	49.68126	-99.62903
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	22-Jun-09	49.66915	-99.60145

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Watkinson	1	Hrabik, Herzog, Ostendorf	Assiniboine River	22-Jun-09	49.69610	-99.66040
Watkinson	1	Hrabik, Herzog, Ostendorf	Assiniboine River	22-Jun-09	49.69560	-99.66123
Watkinson	1	D. Watkinson, Hrabik, Konrad	Assiniboine River	23-Jun-09	49.62343	-99.48833
Watkinson	1	D. Watkinson, Hrabik, Konrad	Assiniboine River	23-Jun-09	49.62376	-99.40031
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.62380	-99.40054
Watkinson	1	D. Watkinson, Hrabik, Konrad	Assiniboine River	23-Jun-09	49.61518	-99.42198
Watkinson	1	D. Watkinson, Hrabik, Konrad	Assiniboine River	23-Jun-09	49.61518	-99.42198
Watkinson	1	D. Watkinson, Hrabik, Konrad	Assiniboine River	23-Jun-09	49.63803	-99.52343
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.66439	-99.56976
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.63823	-99.52296
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.62870	-99.41631
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	23-Jun-09	49.61226	-99.47440
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.66644	-99.56918
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.60483	-99.35643
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	23-Jun-09	49.66555	-99.56834
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.60973	-99.37599
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	23-Jun-09	49.63775	-99.52340
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.59965	-99.43960
Watkinson	1	D. Watkinson, Hrabik, Konrad	Assiniboine River	23-Jun-09	49.65580	-99.54082
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.63771	-99.27800
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	23-Jun-09	49.65412	-99.53875
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	23-Jun-09	49.62362	-99.48822
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.62216	-99.48964
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	23-Jun-09	49.66441	-99.57186
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.65520	-99.53916
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.61249	-99.47500
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.62114	-99.45114
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.62437	-99.30176
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	23-Jun-09	49.63777	-99.49998
Watkinson	1	E. Macdonald, D. Ostendorf	Assiniboine River	23-Jun-09	49.63759	-99.49884
Watkinson	1	E. Macdonald, Konrad, R. Hrabik	Assiniboine River	24-Jun-09	49.71403	-99.02308
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.62254	-99.26966
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.67051	-99.25835
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.69302	-99.19563
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.69294	-99.16995
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.68882	-99.09467
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.68907	-99.06300

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.64587	-99.30523
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.67006	-99.25827
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.69208	-99.14013
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.71503	-99.02177
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.69312	-99.22330
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.68385	-99.11196
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.68957	-99.06348
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.68866	-99.07623
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.68559	-99.26036
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.69462	-99.23251
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.71673	-98.98438
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.71445	-99.02243
Watkinson	1	D. Herzog, J. Barnucz	Assiniboine River	24-Jun-09	49.69379	-99.23199
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.71106	-99.21088
Watkinson	1	D. Watkinson, D. Ostendorf	Assiniboine River	24-Jun-09	49.69564	-99.24472
Watkinson	1	D. Watkinson and L. Fraser	Assiniboine River	2-Jul-09	49.86751	-97.43756
Watkinson	1	D. Watkinson and L. Fraser	Assiniboine River	2-Jul-09	49.86620	-97.42700
Watkinson	1	D. Watkinson and L. Fraser	Assiniboine River	2-Jul-09	49.86822	-97.42345
Watkinson	1	D. Watkinson and L. Fraser	Assiniboine River	2-Jul-09	49.86974	-97.42142
Watkinson	1	E. Macdonald and M. Martens	Assiniboine River	2-Jul-09	49.86553	-97.43067
Watkinson	1	D. Watkinson and L. Fraser	Assiniboine River	2-Jul-09	49.87039	-97.41855
Watkinson	1	J. Zeiler and M. Martens	Assiniboine River	7-Jul-09	50.04131	-97.86422
Watkinson	1	J. Zeiler and M. Martens	Assiniboine River	7-Jul-09	50.03705	-97.85266
Watkinson	1	J. Zeiler and M. Martens	Assiniboine River	8-Jul-09	49.92257	-97.58076
Watkinson	1	E. Macdonald and L. Fraser	Assiniboine River	8-Jul-09	49.89571	-97.53408
Watkinson	1	D. Watkinson and L. Fraser	Assiniboine River	20-Jul-09	50.09451	-101.00713
Watkinson	1	D. Watkinson and L. Fraser	Assiniboine River	20-Jul-09	50.07883	-100.98560
Watkinson	1	J. Zeiler and M. Martens	Assiniboine River	20-Jul-09	50.07912	-100.98632
Watkinson	1	L. Fraser and M. Martens	Assiniboine River	21-Jul-09	50.06699	-100.90854
Watkinson	1	L. Fraser and M. Martens	Assiniboine River	21-Jul-09	50.03422	-100.89361
Watkinson	1	L. Fraser and M. Martens	Assiniboine River	21-Jul-09	50.01174	-100.88549
Watkinson	1	D. Watkinson and J. Zeiler	Assiniboine River	21-Jul-09	50.03462	-100.89404
Watkinson	1	D. Watkinson and M. Martens	Assiniboine River	22-Jul-09	49.97932	-100.87707
Watkinson	1	D. Watkinson and M. Martens	Assiniboine River	22-Jul-09	49.96981	-100.88670
Watkinson	1	D. Watkinson and M. Martens	Assiniboine River	22-Jul-09	49.96151	-100.88325
Watkinson	1	J. Zeiler and L. Fraser	Assiniboine River	22-Jul-09	49.96960	-100.88685
Watkinson	1	J. Zeiler and L. Fraser	Assiniboine River	22-Jul-09	49.96183	-100.88442

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Watkinson	1	J. Zeiler and L. Fraser	Assiniboine River	22-Jul-09	49.94843	-100.87117
Watkinson	1	J. Zeiler and L. Fraser	Assiniboine River	22-Jul-09	49.92728	-100.85237
Watkinson	1	J. Zeiler and L. Fraser	Assiniboine River	22-Jul-09	49.92097	-100.85107
Watkinson	1	D. Watkinson and M. Martens	Assiniboine River	22-Jul-09	49.95821	-100.88316
Watkinson	1	D. Watkinson and M. Martens	Assiniboine River	23-Jul-09	49.88045	-100.85299
Watkinson	1	E. Macdonald, M. Martens, J. Zeiler, and L. Fraser	Crowduck Lake	01-Sep-09	50.10649	-95.26996
Watkinson	1	E. Macdonald, M. Martens, J. Zeiler, and L. Fraser	Crowduck Lake	02-Sep-09	50.07041	-95.26487
Gardner	1	Gardner	Rainy River	2013	48.53925	-93.50688333
Gardner	1	Gardner	Rainy River	2013	48.5273	-93.5859
Gardner	1	Gardner	Rainy River	2013	48.59196667	-93.4658
Gardner	1	Gardner	Rainy River	2013	48.60083333	-93.42688333
Gardner	1	Gardner	Rainy River	2013	48.59308333	-93.44861667
Gardner	1	Gardner	Rainy River	2013	48.58261667	-93.46488333
Gardner	1	Gardner	Rainy River	2013	48.52935	-93.55023333
Gardner	1	Gardner	Rainy River	2013	48.53135	-93.53415
Gardner	1	Gardner	Rainy River	2013	48.60088333	-93.42525
Gardner	1	Gardner	Rainy River	2013	48.5978	-93.4316
Gardner	1	Gardner	Rainy River	2013	48.5365	-93.51506667
Gardner	1	Gardner	Rainy River	2013	48.59238333	-93.46556667
Gardner	1	Gardner	Rainy River	2013	48.60888333	-93.41121667
Gardner	1	Gardner	Rainy River	2013	48.54105	-93.49668333
Gardner	1	Gardner	Rainy River	2013	48.5698	-93.46135
Gardner	1	Gardner	Rainy River	2013	48.58941667	-93.46666667
Gardner	1	Gardner	Rainy River	2013	48.53928333	-93.50681667
Gardner	1	Gardner	Rainy River	2013	48.54608333	-93.47108333
Gardner	1	Gardner	Rainy River	2013	48.52806667	-93.58523333
Gardner	1	Gardner	Rainy River	2013	48.60305	-93.42081667
Gardner	1	Gardner	Rainy River	2013	48.59341667	-93.45966667
Gardner	1	Gardner	Rainy River	2013	48.55285	-93.45891667
Gardner	1	Gardner	Rainy River	2013	48.5438	-93.49276667
Gardner	1	Gardner	Rainy River	2013	48.54123333	-93.50435
Gardner	1	Gardner	Rainy River	2013	48.60453333	-93.4172
Gardner	1	Gardner	Rainy River	2013	48.56348333	-93.45806667
Gardner	1	Gardner	Rainy River	2013	48.53423333	-93.52211667
Gardner	1	Gardner	Rainy River	2013	48.54081667	-93.50355
Gardner	1	Gardner	Rainy River	2013	48.52953333	-93.5587

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Gardner	1	Gardner	Rainy River	2013	48.57333333	-93.46195
Gardner	1	Gardner	Rainy River	2013	48.5397	-93.50481667
Gardner	1	Gardner	Rainy River	2013	48.54121667	-93.49698333
Gardner	1	Gardner	Rainy River	2013	48.54383333	-93.4909
Gardner	1	Gardner	Rainy River	2013	48.5389	-93.50693333
Gardner	1	Gardner	Rainy River	2013	48.59728333	-93.43441667
Gardner	1	Gardner	Rainy River	2013	48.539	-93.50618333
Gardner	1	Gardner	Rainy River	2013	48.53153333	-93.5342
Gardner	1	Gardner	Rainy River	2013	48.53891667	-93.50698333
Gardner	1	Gardner	Rainy River	2013	48.56925	-93.46016667
Gardner	1	Gardner	Rainy River	2013	48.6098	-93.4098
Gardner	1	Gardner	Rainy River	2013	48.5938	-93.4528
Gardner	1	Gardner	Rainy River	2013	48.5422	-93.4999
Gardner	1	Gardner	Rainy River	2013	48.5286	-93.5978
Gardner	1	Gardner	Rainy River	2013	48.5257	-93.6387
Gardner	1	Gardner	Rainy River	2013	48.5194	-93.7294
Gardner	1	Gardner	Rainy River	2013	48.5282	-93.8136
Gardner	1	Gardner	Rainy River	2013	48.586	-93.8083
Gardner	1	Gardner	Rainy River	2013	48.6012	-93.4239
Gardner	1	Gardner	Rainy River	2013	48.5886	-93.4648
Gardner	1	Gardner	Rainy River	2013	48.5515	-93.4598
Gardner	1	Gardner	Rainy River	2013	48.5294	-93.5404
Gardner	1	Gardner	Rainy River	2013	48.5258	-93.6223
Gardner	1	Gardner	Rainy River	2013	48.5154	-93.6794
Gardner	1	Gardner	Rainy River	2013	48.5147	-93.7534
Gardner	1	Gardner	Rainy River	2013	48.5842	-93.8122
Gardner	1	Gardner	Lake of the Woods	13/06/2014	48.97126667	-94.55355
Gardner	1	Gardner	Rainy River	13/06/2014	48.52811667	-93.5879
Gardner	1	Gardner	Red Lake	15/06/2014	51.08798333	-93.80893333
Gardner	1	Gardner	Barnston Lake	16/06/2014	50.57611667	-93.47038333
Gardner	1	Gardner	Chukini River	16/06/2014	50.93528333	-93.6044
Gardner	1	Gardner	English River	16/06/2014	50.62551667	-93.26346667
Gardner	1	Gardner	Barrel Lake	19/06/2014	49.6578	-91.48948333
Gardner	1	Gardner	English River	13/09/2014	49.6338	-91.36521667
Gardner	1	Gardner	Lac Seul	14/09/2014	50.20271667	-91.84508333
Gardner	1	Gardner	Sturgeon River	14/09/2014	50.11476667	-91.71986667
Gardner	1	Gardner	Little Turtle Lake	16/09/2014	48.78006667	-92.61613333

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Watkinson	1	D. Watkinson, D. Leroux	Assiniboine River	7-Oct-14	49.70487	-99.66925
Watkinson	1	D. Watkinson, D. Leroux	Assiniboine River	7-Oct-14	49.70121	-99.6676
Watkinson	1	D. Watkinson, D. Leroux	Assiniboine River	7-Oct-14	49.70407	-99.66847
Watkinson	1	D. Watkinson, D. Leroux	Assiniboine River	7-Oct-14	49.70353	-99.66799
Watkinson	1	D. Watkinson, D. Leroux	Assiniboine River	7-Oct-14	49.70373	-99.66816
Watkinson	1	D. Watkinson, D. Leroux	Assiniboine River	7-Oct-14	49.70408	-99.66848
Gardner	1	Gardner	Lake Winnipeg	08/10/2014	51.11991667	-96.35451667
Gardner	1	Gardner	Assiniboine River	09/10/2014	49.70408333	-99.66848333
Watkinson	1	D. Watkinson, D. Leroux	Lake Winnipeg	9-Oct-14	51.11967	-96.35334
Watkinson	1	D. Watkinson, D. Leroux	Lake Winnipeg	9-Oct-14	51.11986	-96.35373
Watkinson	1	D. Watkinson, D. Leroux	Lake Winnipeg	9-Oct-14	51.11983	-96.35563
Watkinson	1	D. Watkinson, D. Leroux	Lake Winnipeg	9-Oct-14	51.11991	-96.35452
OMNR lake Inventory	1	OMNR	Musclow Lake	1975	51.40167	-94.94975
OMNR lake Inventory	1	OMNR	Berens Lake	1974	51.76567	-93.71516
OMNR lake Inventory	1	OMNR	Red Lake	1971	51.10078	-93.84364
OMNR lake Inventory	1	OMNR	Queer Lake	1979	49.74592	-90.98392
Canadian Distribution Database DFO	1	Unknown	Ord Lake	1968	50.14675	-92.96801
Royal Ontario Museum	1	ROM35692	Lac Seul	1969	50.34046	-92.66966
Royal Ontario Museum	1	ROM26937	Lac Seul	unknown	50.3127	-92.28448
Royal Ontario Museum	2	Scott W. B.	Attawapiskat Lake; Patricia Portion	7-Jul-39	52.3	-87.9
Royal Ontario Museum	2	Scott W. B.	Attawapiskat Lake; Patricia Portion	8-Jul-39	52.3	-87.9
Royal Ontario Museum	2	Scott W. B.	Attawapiskat Lake; Patricia Portion	11-Jul-39	52.3	-87.9
Royal Ontario Museum	2	Scott W. B.	Attawapiskat Lake; Patricia Portion	27-Jul-39	52.3	-87.9
Royal Ontario Museum	2	Scott W. B.	Attawapiskat Lake; Patricia Portion	6-Aug-39	52.3	-87.9
Royal Ontario Museum	2	Rowan M.	Sandy Lake; 7H-Xvi	23-Jun-61	53.033333	-93
Royal Ontario Museum	2	Melgard S.	Attawapiskat Lake; U-33	6-Jul-61	52.3	-87.9
Royal Ontario Museum	2	Rowan M.	Lake St Joseph; Patricia Portion	27-Jun-62	51.083332	-90.583336
Royal Ontario Museum	2	Dept Lands & Forests	Weagamow Lake; West of North Caribou Lake	12-Aug-68	52.883335	-91.36667
Royal Ontario Museum	2	Dept Lands & Forests	Weagamow Lake; West of North Caribou Lake	12-Aug-68	52.883335	-91.36667
Royal Ontario Museum	2	Dept Lands & Forests	Weagamow Lake; West of North Caribou Lake	15-Aug-68	52.883335	-91.36667
Royal Ontario Museum	2	Raymond;Culiner	North Caribou Lake	22-Aug-69	52.833332	-90.666664
Royal Ontario Museum	2	Sippell;Pellegrini	Trading Lake; 1.5km S of mouth of outlet off point	15-Aug-77	51.816666	-88.96667
OMNR lake Inventory	2	OMNR	Whitestone Lake	1977	51.94419	-91.94666
OMNR lake Inventory	2	OMNR	Birch Lake	1977	51.41721	-92.22126
OMNR lake Inventory	2	OMNR	Little Sachigo Lake	1978	54.152358	-92.91415

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Royal Ontario Museum	2	Lamarre;Moreau	Finger Lake; About 240 km N of Red Lake, sandy beach at east end of large peninsula at west shore	27-Jun-78	53.15	-93.5
Royal Ontario Museum	2	Robinson;Eckersley	Ozhiski Lake; 140 km ENE of Pickle L in small bay 2 km W of the fish camp	27-Jun-78	52.016666	-88.5
Royal Ontario Museum	2	Lamorre Moreau	Finger Lake; About 240 km N of Red Lake off islands in bay along S shore about 1.5 km W of Severn outflow	28-Jun-78	53.15	-93.5
Royal Ontario Museum	2	Gerrish;Nowak	Kabania Lake; 177 km NE of Pickle Lake by air south shore in mid-lake area	2-Jul-78	52.2	-88.333336
Royal Ontario Museum	2	Naylor; Ross; OMNR	Studd Lake	22-Aug-80	51.216667	-87.95
Gardner	2	Gardner	Lake St. Joseph	12-Sep-14	51.09795	-90.29215
Gardner	2	Gardner	Batysdawa Lake	12-Sep-14	51.7288	-89.78323333
Royal Ontario Museum	3	Nepszy S.	Lake St Clair; Thames River Mouth	31-Oct-73	42.316666	-82.45
Belore	3	OMNR	Lake St. Clair nearshore seine	21-Jul-80	42.4033	-82.4233
Belore	3	OMNR	Mitchell's Bay trawl	5-Aug-83	42.4583	-82.5917
Belore	3	OMNR	Mitchell's Bay trawl	28-Aug-84	42.4583	-82.4550
Belore	3	OMNR	Mitchell's Bay trawl	18-Sep-84	42.4583	-82.4550
Belore	3	OMNR	Mitchell's Bay trawl	1-Oct-84	42.4450	-82.5333
Royal Ontario Museum	3	Powell S.;Hector D.;OMNR;Lake St Clair Fisheries Assessment Unit	Lake St Clair;St Lukes Bay; Lake St Clair	29-Jul-85	42.433334	-82.416664
Belore	3	OMNR	Mitchell's Bay trawl	30-Sep-85	42.4750	-82.4567
Royal Ontario Museum	3	Arnaud F.; Dunham K.	Raleigh Plains Drain; Raleigh Plains Drain at Bloomfield Rd. and under 401 bridge	11-Aug-89	42.34	-82.20167
Royal Ontario Museum	3	Holm E.;Ramshaw W.;Rouse M.	Thames River; Moravian Indian Reserve, 150 to 600 M downstream from bridge on County Road 18	26-Jul-91	42.59111	-81.884445
Belore	3	OMNR	Lake St. Clair nearshore seine	13-Jun-94	42.3217	-82.8433
Royal Ontario Museum	3	Holm E.;Ciuk M.	Bear Creek; 1.6km E of Waubuno above bridge	5-Aug-97	42.787777	-82.30889
Royal Ontario Museum	3	Ciuk M.; Holm E;	Sydenham River (East); Rotating bridge in Tupperville over Sydenham River (east branch) 10 to 70M S of bridge	7-Aug-97	42.59028	-82.26722
Royal Ontario Museum	3	Ciuk M.; Holm E;	Bear Creek; 1.8 KM S OF WAUBUNO 0 TO 50M E OF BRIDGE RESAMPLE OF ACC. 3143	7-Aug-97	42.765556	-82.329445
Royal Ontario Museum	3	Boehm D.;Banks K.	Bear Creek; 1.8 km S of Waubuno 70 To 35M W of Bridge Resample of Acc. 3143	7-Aug-97	42.765556	-82.329445
Royal Ontario Museum	3	Ciuk M.; Holm E;	Bear Creek; 1.8 KM S OF WAUBUNO, 0 TO 50M E OF BRIDGE RESAMPLE OF ACC. 3143	7-Aug-97	42.765556	-82.329445
Royal Ontario Museum	3	Boehm D.;Ciuk M.	Sydenham River (East); Wallaceburg N Shore at Dora Dr., downstream of reinforced bank	1-Oct-97	42.5975	-82.367775
Royal Ontario Museum	3	Boehm D.;Holm E.	Sydenham River; 4 km E of Tupperville	18-Jun-01	42.588333	-82.22083
Royal Ontario Museum	3	D. Marson K. Stammler A. Walpole S. Foley	North Sydenham River; Off boat ramp on East River Rd north of Lambton Line on east side of Sydenham River	10-Sep-03	42.65737	-82.37566
Royal Ontario Museum	3	D. Marson S. Foley A. Walpole K. Stammler	North Sydenham River; South of Lambton Line along East River Road on east side of N. Sydenham	11-Sep-03	42.64879	-82.37357

Database	DU	Collectors	Waterbody	Date	Latitude	Longitude
Royal Ontario Museum	3	Finch M.; Drake A.	Lake St Clair; approximately 750m from mouth of Thames River	10-Aug-06	42.32936	-82.44612
Belore	3	OMNR	Lake St. Clair nearshore seine	4-Jul-08	42.365	-82.4217
Belore	3	OMNR	Lake St. Clair nearshore seine	15-Jul-08	42.365	-82.4217
Bouvier	3	Bouvier	Sydenham River	20-Sep-12	42.59811667	-82.35908333
Belore	3	OMNR	Lake St. Clair nearshore seine	16-Jul-13	42.365	-82.4217
Bouvier	3	Bouvier	Thames River	24/06/2014 to 26/06/2014	42.60976667	-81.8195