COSEWIC
Assessment and Status Report

on the

Silver Shiner
Notropis photogenis

in Canada

THREATENED
2011

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Baldwin, M.E. 1987. COSEWIC updated status report on the Silver Shiner *Notropis photogenis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-23 pp.

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Silver Shiner — ROM 59112, 9.1 cm TL, Fanshawe Lake (photo by E. Holm, ROM, with permission).

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COSEWIC
Assessment Summary

Assessment Summary – May 2011

Common name
Silver Shiner

Scientific name
Notropis photogenis

Status
Threatened

Reason for designation
This small riverine fish is found at fewer than 10 locations and has a small area of occupancy. The susceptibility of the species to continuing habitat loss and degradation with increasing development pressure resulted in an increase in status.

Occurrence
Ontario

Status history
Designated Special Concern in April 1983. Status re-examined and confirmed in April 1987. Status re-examined and designated Threatened in May 2011.

COSEWIC
Executive Summary

Silver Shiner
Notropis photogenis

Species information

The Silver Shiner is an elongate and silvery fish reaching a maximum total length of 14.3 cm. It is distinguished from other shiners by having an anal fin with more than eight rays, a pair of crescents between the nostrils, a clearly defined stripe along the back in front of the dorsal fin, and a dorsal fin that is directly opposite the end of the base of the pelvic fins. It is frequently confused with the Rosyface Shiner and the Emerald Shiner, but these two species lack crescents between the nostrils, have a wider, more diffuse stripe along the back in front of the dorsal fin, and have a dorsal fin which begins well behind the base of the anal fin. There is no evidence of more than a single designatable unit in the Silver Shiner.

Distribution

The Silver Shiner is found only in North America where it is widely distributed in the east central United States, primarily in the Ohio and Tennessee river drainages. The species is less common in tributaries of the lower Great Lakes where it occurs in Michigan, Ohio, Pennsylvania, and Ontario. The Canadian distribution comprises less than 2% of the global distribution. In Canada, it is restricted to southwestern Ontario where it is found in tributaries of lakes St. Clair (Thames River), Erie (Grand River) and Ontario (Bronte Creek). Although discovered in Canada in 1971, it has been identified from Ontario collections made as early as 1936. Recent surveys have resulted in possible range extensions downstream in the Thames and Grand rivers and Bronte Creek.

Habitat

The Silver Shiner is found primarily in large streams with widths usually greater than 20 m. Here it is found in deep riffles or pools adjacent to riffles. Little is known about its spawning habitat, but the limited data available suggests that they may migrate upstream and spawn in deep riffles, perhaps in association with other shiners or chubs. The Silver Shiner is harder to find in late fall, and probably retreats to a few deeper pools in winter. Young are more likely to be found in slower current.

Biology

Although it has not been observed, spawning probably occurs in late May to mid-June in Ontario at water temperatures between 18 and 24°C. Growth is rapid in the first year and individuals reach a length of 3.8-7.1 cm by November. Most individuals are mature by 6 cm and usually spawn at age one or two. Maximum known age is three years, but recent examination of scales and an operculum of a 9 cm individual suggests it could be much higher. The Silver Shiner appears to be an opportunist, feeding at the surface or in mid-water on both adult and aquatic larval insects, worms, crustaceans, water mites, and algae. It sometimes leaps out of the water to catch flying insects. Predators are unknown, but a Smallmouth Bass was observed feeding on a large Silver Shiner.

Population sizes and trends

Re-examination of collections of Rosyface Shiners in museum collections made in Ontario between 1921 and 1963 have yielded a few records of Silver Shiner from the Grand (1 record, 1 specimen), Thames (4 records, 14 specimens) and Saugeen (at least 1 record, 1 specimen) river watersheds. Recent collections in lower Bronte Creek captured 246 individuals in 1994 and 1998. Although still commonly found in the lower half of the Grand River (below Paris, Ontario), recent surveys in more upstream locations have not been successful. A few recent captures have been made in all areas of the Thames River. Should the Silver Shiner become extirpated in Canada, rescue from populations in the United States is unlikely.

Limiting factors and threats

Limiting factors include natural factors such as climate and stream gradient. Anthropogenic threats to the Silver Shiner may include habitat loss and degradation, poor water quality, toxic spills, dams and other barriers, channelization, introduced species, and bait harvesting. In Canada, it is found in rivers adjacent to agricultural land, with a small, but increasing, urban population. As a result of poor land management practices, water quality is impaired by siltation, high nutrient concentrations, and contaminants. Threats from bait harvesting and introduced species may also decrease abundance.

Special significance of the species

Canadian populations are at the northern limit of their distribution, and represent a significant portion of the Great Lakes populations of the Silver Shiner. Its frequent confusion with the Rosyface Shiner and the Emerald Shiner is an obstacle to an understanding of the distribution, abundance and biology of all three species.

Existing protection

Although it is listed as a species of Special Concern on Schedule 3 of the Canadian *Species at Risk Act,* the SARA prohibitions do not apply. In Ontario, it is listed as Special Concern under the *Endangered Species Act* 2007. Thus there is a requirement to prepare a management plan for the species, but there is no direct habitat protection. It is illegal to harvest this species as bait, but it may be incidentally harvested. Although rare at the edge of its range, the Silver Shiner has not been identified as at risk in any jurisdiction in the United States. It is a species included in the recovery plans for the Grand and Thames rivers, which both recommend initiating a monitoring plan to determine range and abundance.

TECHNICAL SUMMARY

Notropis photogenis
Silver Shiner — Méné miroir
Range of occurrence: Southwestern Ontario

Demographic Information

Generation time (average age of parents in the population)	2 to 4 yrs
Is there an observed continuing decline in number of mature individuals?	Unknown
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	Unknown
Inferred percent reduction in total number of mature individuals over the last 3 generations.	Unknown
Projected or suspected percent reduction in total number of mature individuals over the next 3 generations.	Unknown
Inferred percent reduction in total number of mature individuals over any 10 year period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	NA
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence.	6,996 km²
Area of Occupancy [estimated river km] Critical spawning areas unknown, AO calculated (assuming continuous distribution within upstream and downstream records) as river km (measured on 1:50,000 topographic maps) x average river width of 50 m (approximately 386 river km) = 19.3 km²	19.3 km²
Index of Area of Occupancy [2 km x 2 km grids] * Thames River: 86 grids = 344 km² * Grand River: 132 grids = 528 km² * Bronte Creek: 6 grids = 24 km² Total IAO [2km x 2km]: 224 grids = 896 km² Note: as per the EO calculation, Saugeen River and Sixteen Mile Creek are excluded from the IAO calculation	896 km²
Is the total population severely fragmented (*sensu* IUCN)?	Probably
Number of locations (total) Number of current locations based on multiple point source pollutents: 1. North Thames River 2. South Thames River 3. Grand River 4. Conestogo River 5. Nith River 6. Bronte Creek (Saugeen River and Sixteen Mile Creek (Halton Co.) are not included because it is uncertain whether the Silver Shiner is established there.)	Approximately six locations in Canada
Is there an inferred continuing decline in extent of occurrence? Modest increases in EO associated with recent survey efforts	Unknown
Is there an inferred continuing decline in index of area of occupancy? Modest increases in IAO associated with recent survey efforts	Unknown
Is there an observed continuing decline in number of populations?	Unknown
Is there an observed continuing decline in number of locations?	Unknown
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat?	Yes
Are there extreme fluctuations in number of populations?	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 population)

Population	N Mature Individuals
	Unknown
Total	Unknown

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 analysis (necessary data not available)

Threats (actual or imminent, to populations or habitats)

Actual: Increasing development and industrialization in most of the watershed, poor water quality, dams and impoundments, sportfish stocking, and baitfish exploitation, repeated spills from industrialization and agriculture (manure), particularly in the Thames River watershed.
Potential: Major toxic spills from pipeline and road traffic in headwaters, invasive species.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? U.S.: Michigan (S1), Ohio (SNR), Pennsylvania (S4), New York (S2), Indiana (S4), Kentucky (S4S5), West Virginia (S4), Virginia (S4), Tennessee (S4), North Carolina (S3), Maryland (SNA), Alabama (S1), Georgia (S1)	
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	No

Current Status

COSEWIC: Designated Special Concern in April 1983. Status re-examined and confirmed in April 1987. Status re-examined and designated Threatened in May 2011.

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Threatened	B1ab(iii)+2ab(iii)

Reason for Designation:
This small riverine fish is found at fewer than 10 locations and has a small area of occupancy. The susceptibility of the species to continuing habitat loss and degradation with increasing development pressure resulted in an increase in status.

Applicability of Criteria

Criterion A: Does not meet any criteria
Criterion B: Meets Threatened **B1** (EO < 20,000km^2), **B2** (IAO < 2,000 km^2)**,** sub-criterion **a** (fewer than 10 locations), and **b(iii)** (inferred continuing decline in habitat quality owing to urbanization, poor agricultural practices, industrialization, toxic spills, and invasive species)
Criterion C: Does not meet any criteria
Criterion D: Does not meet any criteria
Criterion E: Not done as necessary data not available

PREFACE

The Silver Shiner was last assessed by COSEWIC in 1987 (Special Concern) and placed on Schedule 3. Since that time there have been efforts to re-examine museum collections and to undertake new field surveys to refine the understanding of the distribution of the Silver Shiner. These efforts have extended the known distribution of the Silver Shiner downstream in the major systems in which they are found (Grand and Thames rivers of southwestern Ontario) resulting in a small increase both in the extent of occurrence and the index of the area of occupancy. There has been, however, little increased knowledge of the basic biology of the Silver Shiner since 1987, but knowledge of the watersheds they inhabit has increased owing to recovery planning and surveying for several other vertebrate and mussel species at risk that coexist with the Silver Shiner in the Thames and Grand rivers' watersheds. Increased understanding of threats to the Silver Shiner, particularly in terms of pollutants, and application of new assessment criteria resulted in a change of status from Special Concern to Threatened.

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
(2011)

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 Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune

Canada

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

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2011

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WILDLIFE SPECIES INFORMATION

Name and classification

Class	Actinopterygii
Order	Cypriniformes
Family	Cyprinidae (carp and minnow family)
Scientific Name	*Notropis photogenis* (Cope, 1865)
English Common Name	Silver Shiner
French Common Name	méné miroir

Morphological description

The Silver Shiner is an elongate and silvery fish reaching a maximum total length of 14.3 cm (Figure 1). It has a long and pointed snout and a large eye, with a diameter that is equal to, or slightly less than, the snout length. It has 36-43 lateral scales. The dorsal fin usually starts over, or is slightly behind, the base of the pelvic fins. It has 8-10, usually 9, pelvic rays and 15-17 pectoral rays. There are two black crescents between the nostrils, which are sometimes difficult to see in preserved specimens. A clearly defined narrow dark, or orange, stripe is found along the middle of the back. Preserved individuals have a prominent dark lateral stripe that is usually hidden by silvery scales in life. Breeding males are not brightly coloured. Spawning males develop tubercles on the head, body and fins (Etnier and Starnes 1993, Jenkins and Burkhead 1994).

Figure 1. Silver Shiner, *Notropis photogenis*, ROM 59112, 9.1 cm TL, Fanshawe Lake (photo by E. Holm, ROM, with permission).

The Silver Shiner is a member of one of the most speciose genera of freshwater fishes in North America and is frequently confused with the Rosyface Shiner (*Notropis rubellus*) and Emerald Shiner (*Notropis atherinoides*). In these two shiners, the dorsal fin origin is well behind the base of the pelvic fins, the stripe along the middle of the back is wider and more diffuse (Gruchy *et al.* 1973), the pelvic fin usually has 8 rays, and there are no dark crescent-shaped marks between the nostrils. The Rosyface Shiner has 11-14 pectoral rays and reaches a maximum total length of only 9 (vs. 14.3) cm. The Emerald Shiner has a shorter and less pointed snout. These differences, other than size, are not easily determined in the field where careful examination is often difficult.

Spatial population structure and variability

No studies have been conducted on the genetic structure of Canadian populations. Some work has been done on genetic differences between related species. Coburn (1982) hypothesized that the Silver Shiner was a member of the subgenus *Notropis* in the *photogenis* species group that also included *N. amoenus and N. stilbius*[1]. This relationship was not supported in the analysis by Bielawski and Gold (2001), but they did not come up with any clear relationships between *N. photogenis* and other *Notropis.* Using allozymes and mitochondrial DNA (mtDNA), Dowling and Brown (1989) analyzed phylogenetic relationships between four species (*Luxilus cornutus*[2]*, L. chrysocephalus, Notropis rubellus,* and *N. photogenis*). As expected, *N. rubellus* and *N. photogenis* clustered together as did the two *Luxilus* species based on allozyme results. Analyses of the mtDNA data failed to resolve relationships between species. Depending on the analysis, *Notropis photogenis* would cluster with one of the *Luxilus* spp. rather than *Notropis rubellus.* In a study on differences in the CO1 gene as part of the Barcode of Life initiative, the Silver Shiner was found to be distinguishable from close relatives (Hubert *et al.* 2008). Similar to the mtDNA analysis of Bielaswki and Gold (2001), *Notropis photogenis* clustered with *Luxilus* and not *Notropis.* This discordance (between allozymes and mtDNA) could be due to hybridization, common between these taxa.

Designatable units

The Silver Shiner occurs in at least three watersheds in Canada, and populations within each of these presumably have little contact with each other. These watersheds are all within the Great Lakes – Upper St. Lawrence River Freshwater Biogeographic Zone (see COSEWIC 2010 for definition), and because no studies have been conducted on their genetic structure, the Canadian populations are considered as one designatable unit.

1 The Emerald Shiner and the Rosyface Shiner were considered to belong in a separate (*atherinoides*) species group.
2 At the time of the study, *Luxilus* was in the genus *Notropis*.

Special significance

Canadian populations of the Silver Shiner are at the northern limit of their distribution, and represent a significant portion of the Great Lakes populations, which are sparse compared to populations in the Ohio and Tennessee river systems in the United States. Where abundant, it may represent an important prey source for game fishes such as Smallmouth Bass (*Micropterus dolomieu*). Its frequent confusion with the Rosyface Shiner and the Emerald Shiner is an obstacle to our understanding of the distribution, abundance and biology of all of these species.

DISTRIBUTION

Global range

The Silver Shiner is found only in North America where it is widely distributed in the east-central United States (Figure 2). It occurs primarily in the Ohio and Tennessee river drainages. The species is found less commonly in tributaries of the lower Great Lakes. It is found in extreme northern Georgia and Alabama, north through Tennessee, Kentucky, Indiana, Ohio, southeastern Michigan and southwestern Ontario, and east to southwestern New York, western Pennsylvania, West Virginia, Virginia and North Carolina. Since Baldwin's (1988) status report, minor range extensions for the Silver Shiner have been reported in Pennsylvania (Cooper 1983), Michigan (Bailey *et al.* 2004), Kentucky (Burr and Warren 1986), Tennessee (Etnier and Starnes 1993), Alabama (Boschung and Mayden 2004) and Virginia (USNM 351453, GBIF 2008). It is not known if these extensions represent actual increases in range or increases in our knowledge of its range.

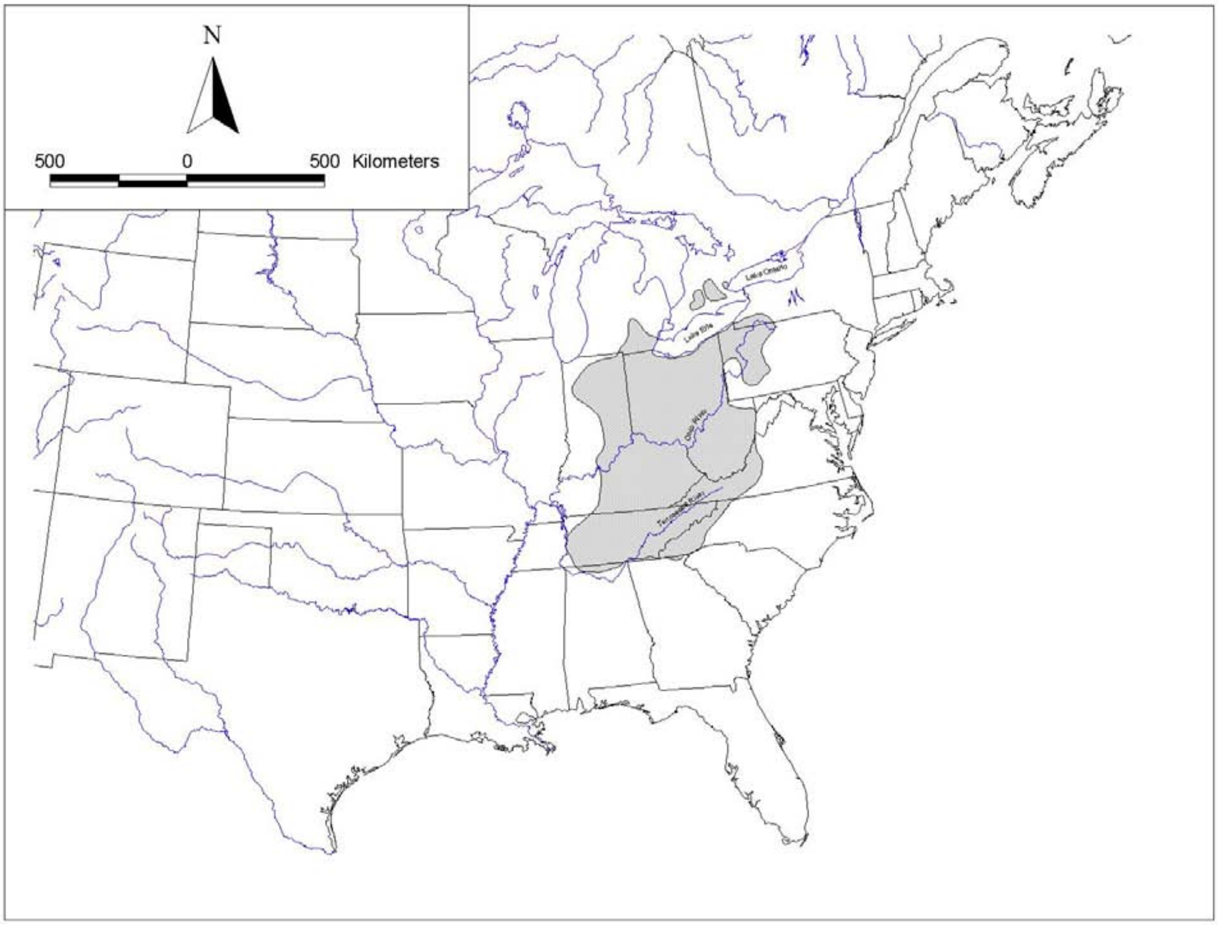

Figure 2. Global distribution of the Silver Shiner.

Canadian range

In Canada, the Silver Shiner is restricted to southwestern Ontario where it is found in tributaries of Lake St. Clair, Lake Erie and Lake Ontario (Figure 3). Although originally reported in 1971, the Silver Shiner was subsequently found in museum collections from as early as 1936 (Baldwin 1988). The Canadian distribution comprises less than 2% of the global distribution based on extent of occurrence, which was estimated to be 6,996 km^2 (see definition in COSEWIC 2007a). The index of the area of occupancy (IAO) based on a 2 x 2 km grid is 896 (or 419 km^2 based on a 1 x 1 km grid). The biological AO was estimated to be 19.3 km^2.

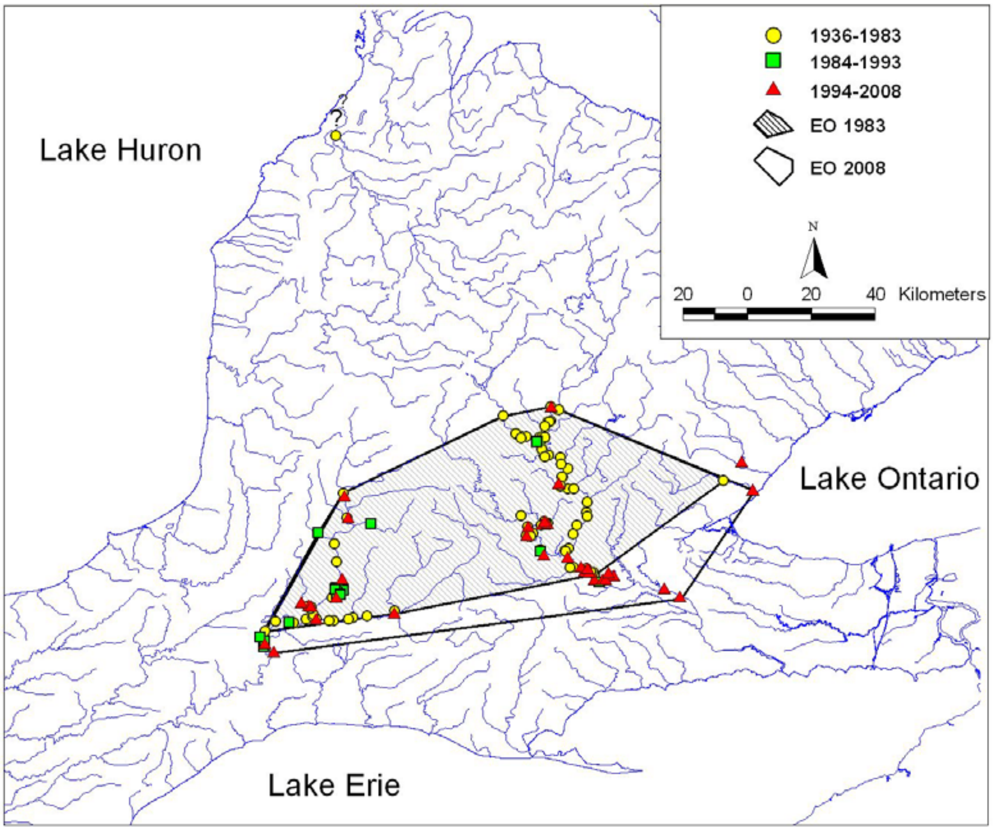

Figure 3. Canadian distribution of the Silver Shiner in three time periods, showing extent of occurrence (EO) in 1983 and 2008.

The Silver Shiner has been found in the Grand River in a 145 km stretch from 7 km below Elora[3] to just below the dam in Caledonia. It also occurs in the lower stretches of two major tributaries, the Nith and Conestogo rivers, and in the lower 100-400 m sections of Laurel Creek, Schneider Creek, the Speed River, and Whitemans Creek. In the Nith River it is found in a stream section from its confluence with the Grand River to a point 58 km upstream. In the Conestogo River it has been found in a 25 km stream section from its mouth to Wallenstein. Although reported from McKenzie and Rogers creeks in the lower Grand River watershed, these records are erroneous[4]. The Silver Shiner has been recently collected from the lower half of the Grand River. Boat seining in 2003 conducted by Fisheries and Oceans Canada (DFO) extended the known range in the main stem 44 km farther downstream from that previously reported by Baldwin (1988). Since 1982, however, there have been only four records of the species in the upper half of the Grand River watershed (above Paris). Two are from the lower Conestogo River: one captured in 1989 (Royal Ontario Museum (ROM) Accession

3 A Canadian Museum of Nature record (CMNFI 1979-1059.2) was originally catalogued at a site well upstream of this point (1.5 km below Belwood Lake). This locality is erroneous and is actually “at Bridgeport” (S. Laframboise, Canadian Museum of Nature, pers. comm. September, 2008), which is well within the known range in the Grand River.

4 Copies of the field collection records and identification sheets maintained in the accession files of the ichthyology collection of the Royal Ontario Museum (Accession 3123) indicate that no Silver Shiners were identified from McKenzie and Rogers creeks. These records resulted from species code transcription errors.

5592) and the other captured in 1990 and in the collection of Wilfrid Laurier University (WLU 12832). The third was identified from the Grand River in 2002 near the upstream limit of the Silver Shiner's distribution (A. Timmerman, Ministry of Natural Resources (MNR), pers. comm., 2008). The fourth was collected in 2007 by DFO at Doon. There has, however, been no sampling that has specifically targeted the habitat of the Silver Shiner and much of the sampling has been done using electrofishers, which are not as effective as seines in yielding Silver Shiners (see **Search Effort**, below).

In the Thames River watershed, Baldwin (1988) documented the range of the Silver Shiner within approximately a 40 km radius of the London city centre (42°59'22"N, 81°14'57"W): from Medway Creek and the Thames, North Thames and Middle Thames rivers. The known range since Baldwin's (1988) status report has increased slightly. It has been found 8.5 km farther downstream in the Thames River and in two additional tributaries of the North Thames River. Thus in the Thames River proper it has been found in a 61 km stretch from below Delaware to the mouth of the Middle Thames River. It has been collected in a 62 km section of the North Thames River from its confluence with the main stem to one km above Motherwell. It is found in the lower 2 km of the Middle Thames River and in three tributaries of the North Thames River: Fish Creek (lower five km), Medway Creek (lower six km), and Trout Creek (lower seven km). In addition to the lotic sections of the North Thames River, one adult (the specimen in Figure 1) and 95 juveniles were found in 1988 at several lentic sites in Fanshawe Lake, a reservoir created by a dam about 14 km upstream from the mouth of the North Thames River.

The species was first discovered in Bronte Creek in 1983 where it was collected at Zimmerman (Baldwin 1988). In 1994, 130 specimens and in 1998 116 specimens were captured 14 km farther downstream in Oakville (Table 1; ROM, unpublished data) indicating that the species is well-established in Bronte Creek.

Table 1. Canadian surveys that resulted in the capture of the Silver Shiner, 1936-2008.

Watershed/Stream	Year(s)	Method	Total captured	Total kept	Target[1]	No. of sites	Collector/Source[2]	Figure
Sixteen Mile Creek drainage								
East Sixteen Mile Creek	1998	electrofisher	1	1		1	G. Coker (ROM records)	3
Bronte Creek drainage								
Bronte Creek, Zimmerman	1983	?	>4	>4		1	WLU surveys	3
Bronte Creek, Petro Canada Park	1994	seine	130	125		1	ROM surveys	3
	1998	seine	115	30		1	ROM surveys	3
	1998	electrofisher	1	1				
Grand River drainage								
Grand River, above Paris	1966	seine ?	?	14		1	OWRC surveys	3
	1971	seine	?	11		1	CMN records	3
	1971	seine	?	5		1	ROM records	3
	1975-1976	seine & electrofisher	?	149		10	MNR surveys	3,4

Watershed/Stream	Year(s)	Method	Total captured	Total kept	Target[1]	No. of sites	Collector/Source[2]	Figure
	1979-1980	seine	255	108	SAR	6	Parker & McKee (CMN records)	3,5
	1981-1982	?	?	?		2	WLU surveys	n/a
	1980-1982	seine	452	172	SS	15	M. Baldwin (CMN records)	3,6
	2002	seine	many	2		1	A. Timmerman, pers. comm.	3
	2007-2008	electrofisher	>2	0		1	DFO surveys	3
Grand River, below Paris	1971	seine	?	9		1	CMN/ROM records	3
	1975-1976	seine & electrofisher	?	46		2	MNR surveys	3,4
	1979	seine	?	2	SAR	1	McKee & Cole (CMN records)	3,5
	1981-1982	seine	31	23	SS	2	M. Baldwin (CMN records)	3,6
	1991	seine	7	5	SAR	1	ROM surveys	3
	1995		1	1		1	D. Boehm (ROM records)	3, 7
	1997	boat electrofisher	3	3	SAR	1	joint MNR/ROM surveys	3,7
	1999-2000	seine	91	47	ESD	5	joint MNR/ROM surveys	3,7
	2000	boat electrofisher	2	2	SAR	1	joint MNR/ROM surveys	3,7
	2003	boat seine ?	25	25	ESD	6	DFO surveys	3,9
	2007	seine	28	0	ESD	3	A. Dextrase surveys	3
Conestogo River	1966	?	1	1			OWRC surveys	3
	1971	?	?	18		1	Bowen & Kidd (CMN records)	3
	1976	?	?	9		2	MNR surveys	3,4
	1976	?	?	2		1	CMN records	3
	1979-1980	seine	119	58	SAR	3	Parker & McKee (CMN records)	3,5
	1980-1982	seine	55	44	SS	3	M. Baldwin (CMN records)	3,6
	1981,1990	?	?	?		2	WLU surveys	3
	1989	electrofisher		1		1	MNR surveys	3
Laurel Creek	1979	?	?	4		1	Taylor & Barton (ROM records)	3
Schneider Creek	1977	?	?	?		1	WLU records	3
Speed River	1981	seine	6	6	SS	1	M. Baldwin (CMN records)	3,6
Whiteman's Creek	1982	?	3	2	SS	1	M. Baldwin (CMN records)	3,6
Nith River	1949	seine ?	?	1		1	ODPD surveys	3
	1966	seine ?	?	10		1	OWRC surveys	3
	1975	seine	44	44		1	CMN records	3
	1976-1981	?	?	?		2	WLU surveys	3
	1979	seine & electrofisher	?	10	SAR	1	Parker & McKee (CMN records)	3,5
	1981-1982	seine	167	72	SS	5	M. Baldwin (CMN records)	3,6
	1981	?	?	?		1	WLU surveys	3
	1989	electrofisher	?	9		2	MNR surveys	3
	1997,2000	seine & electrofisher	29	8	SAR	5	joint ROM/MNR surveys	3,7
	2005	?		2		1	J. Schwindt (UTRCA surveys)	3

Watershed/Stream	Year(s)	Method	Total captured	Total kept	Target[1]	No. of sites	Collector/Source[2]	Figure
Thames River drainage								
Thames River, d/s of North Thames River	1976	seine	?	8		3	MNR surveys	3,4
	1979	seine	9	9	SAR	1	Parker & McKee (CMN records)	3,5
	1981-1982	seine	73	29	SS	2	M. Baldwin (CMN records)	3,6
	1985,1989	seine & electrofisher	6	6	SAR	4	ROM surveys	3
	2003	electrofisher	1	1		1	J. Schwindt (UTRCA surveys)	3,8
	2004	seine ?	18	18		1	DFO surveys	3
Thames River, south branch	1936	seine	?	8		1	C.J. Kerswill (ROM records)	3
	1974	seine	?	7		1	MNR surveys	3,4
	1979	seine	20	20		1	Parker & McKee (CMN records)	3,5
	1981-1982	seine	425	77	SS	3	M. Baldwin (CMN records)	3,6
	2004	electrofisher	?	7		1	J. Schwindt (UTRCA surveys)	3,8
	2007	?	?	1		1	J. Schwindt (UTRCA surveys)	3,8
Middle Thames River	1981	dipnet	4	4	SS	1	M. Baldwin (CMN records)	3,6
	2005		12	12		1	J. Schwindt (UTRCA surveys)	3,8
North Thames River	1946	seine ?	?	4		1	H.P. Clemens (ROM records)	3
	1953	seine ?	?	1		1	Scott & Crossman (ROM records)	3
	1979-1980	seine	?	30		2	Gartner Lee Ltd. (ROM records)	3
	1979	seine & electrofisher	?	2		1	Parker & McKee (CMN records)	3,5
	1981-1982	seine	584	115	SS	5	M. Baldwin (CMN records)	3,6
	1997	electrofisher	1	1	SAR	1	ROM surveys	3,7
	2001, 2003	electrofisher	22	13		3	J. Schwindt (UTRCA surveys)	3,8
Medway Creek	1975	seine	?	23		1	MNR surveys	3,4
	1982	seine	?	2	SS	1	M. Baldwin (CMN records)	3,6
	2003-2008	electrofisher	?	16		3	J. Schwindt (UTRCA surveys)	3,8
Fanshawe Lake	1988	seine	?	95		5	MNR surveys	3
	1988	seine	1	1		1	ROM surveys	3
Trout Creek	1988	seine & electrofisher	1	1		1	ROM surveys	3
Fish Creek	1984	seine	2	2		2	ROM surveys	3
Saugeen River drainage								
?tributary near Port Elgin	1981	?	?	1		1	WLU surveys (see Distribution, Canadian Range)	3
unknown location	1956	seine ?	?	1		1	ODPD surveys (see Distribution, Canadian Range)	n/a

[1] Target: ESD - Eastern Sand Darter, SAR - fish species at risk, SS - Silver Shiner, blank – unknown or general survey
[2] Source: CMN - Canadian Museum of Nature, DFO - Fisheries and Oceans Canada, MNR - Ontario Ministry of Natural Resources, ODPD - Ontario Department of Planning & Development, OWRC - Ontario Water Resources Commission, ROM - Royal Ontario Museum, UTRCA - Upper Thames Region Conservation Authority, WLU - Wilfrid Laurier University

One specimen was collected in 1998 in East Sixteen Mile Creek approximately 9 km ESE of Milton (ROM 71697). Additional surveys are required to determine if this specimen comes from an established population.

There is evidence that it also occurs in the Saugeen River, a Lake Huron tributary. There are two records in the WLU collection, one of which (WLU 8125) was examined by E. Holm, ROM, and identified as a Striped Shiner, *Luxilus chrysocephalus*. The other collection (WLU 6948) from a tributary of the Saugeen River near Port Elgin is missing (E. Kott, pers. comm., 2005), but the information provided indicated that it was identified as a Silver Shiner by M.E. Baldwin in 1981. This record, however, was not reported in Baldwin's (1988) status report and is, therefore, considered questionable. A specimen of Silver Shiner was identified by K. Stewart in 2005 from ROM 24831, a collection identified as Rosyface Shiners from the Saugeen River drainage. The location of this collection within the watershed is unknown. Additional surveys are required in the Saugeen River to determine if there is an established population in that watershed.

Gruchy *et al.* (1973) believed that it was unlikely that the Silver Shiner had been introduced into Canada in bait buckets because it is not a hardy species and is not abundant north of the Ohio River Valley. Four Silver Shiners were transported alive from the Nith River to Toronto in October 2000 by E. Holm, ROM, so introductions among Ontario watersheds are theoretically possible. The species has been captured incidentally by a commercial fisherman in the Grand River (A., Timmerman, MNR, pers. comm., 2008). The total number of locations was estimated by assuming that the most plausible threat involves localized spills of toxic materials from agricultural activity, sewage, roads and oil and gas pipelines (See **Threats and limiting factors**). In addition, site occurrences in smaller tributaries were not considered separate locations if they were within 1 km of larger mainstem rivers given the specialization of the Silver Shiner in mainstem habitats (e.g., Laurel Creek – see above). Using this rationale the number of locations was estimated as six.

HABITAT

Habitat requirements

The Silver Shiner is found primarily in medium or large streams, and rarely in small ones (Baldwin 1988, Jenkins and Burkhead 1994). Trautman (1981) reported the species from moderate to high gradient streams. Parker and McKee (1980) found them in streams with moderate gradients (varying from 0.5 to 1.9, mean=1.4 m/km) with alternating pools and riffles, or in turbulent waters below dams. Recent captures in the Grand River, Ontario, have occurred in gradients as low as 0.3 m/km and they have also been captured in a reservoir.

Trautman (1981) noted that the Silver Shiner was most abundant in "deep, swift riffles and in the swifter eddies and currents of the pools immediately below such riffles." Gruchy *et al.* (1973) also reported them in medium to fast current and in the deep riffles of flowing pools. Baldwin (1983) found that current speed was not correlated with the presence of adult Silver Shiners, whereas young-of-year were generally captured in slower water. Baldwin (1988) indicated that the species occurred primarily in pools that are near current rather than actually in the current. In New York, the Silver Shiner was found in depths of 2-3 feet (0.6-0.9 m) (Lavett-Smith 1985).

In Ontario, stream width varied between 5 and 200 m, but tended to be larger than 20 or 30 m (Gruchy *et al.* 1973, Parker and McKee 1980, Baldwin 1988, and Holm and Boehm 1998). In New York, it was found in Allegheny watershed streams that were 15-60 feet (5-18 m) wide (Lavett-Smith 1985). Baldwin (1983) found that of 21 environmental factors, the most important one that influenced the occurrence of the species was water depth: the Silver Shiner was associated with deeper water. Descriptions of substrates over which Silver Shiners are found are quite variable, and include boulders, rubble, gravel, pebbles, sand, mud, and clay (Parker and McKee 1980, Trautman 1981). Baldwin (1983) found them more often over finer particle substrates.

Trautman (1981) noted that in Ohio, the species usually avoided rooted aquatic plants, but in Ontario aquatic vegetation may be either present or absent (Gruchy *et al.* 1973, Holm and Boehm 1998). Baldwin (1983) did not find that aquatic vegetation was correlated with the presence of the Silver Shiner. The Silver Shiner is recorded from warm streams in Virginia (Jenkins and Burkhead 1994) and water temperature probably limits the northern extent of the range of Silver Shiners in Canada, but the thermal tolerance and preferred temperature of the Silver Shiner is unknown. In Ontario, Silver Shiners have been found in streams that have summer temperatures ranging from 17.6-27°C, but within these limits there is no relationship between temperature and presence of the species, except during spring when warmer temperatures were preferred (Baldwin 1983).

In Ohio, the Silver Shiner is most abundant in clear water (Trautman 1981, Van Meter and Trautman 1970). In New York, they were found in "silty water" (Lavett-Smith 1985). In Ontario, water has been described as clear (Parker and McKee 1980), muddy, or cloudy (Gruchy *et al.* 1973). Baldwin (1983) found no relationship between water clarity and presence of Silver Shiners. She captured them in water ranging from clear (3 Jackson Turbidity Units, JTU[5]) to cloudy (38 Jackson Turbidity Units).

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5 The JTU is a measurement of the turbidity, or lack of transparency, of water. It is measured by lighting a candle under a cylindrical transparent glass tube and pouring a sample of water into the tube until an observer looking from the top of the tube cannot see the image of the candle flame. The number of JTUs varies inversely and nonlinearly with the height of the sample (e.g., a sample which measures 2.3 cm has a turbidity of 1,000 JTUs whereas a sample measuring 72.9 cm has a turbidity of 25 JTU's). (From http://dictionary.babylon.com/JACKSON_TURBIDITY_UNIT_ (JTU).

Water colour, dissolved oxygen, pH, and conductivity (a measurement that is positively correlated with total dissolved solids in water) was unrelated to presence of the Silver Shiner (Baldwin 1983).

Spawning habitat is poorly known, but there is some evidence that spawning occurs in relatively deep riffles in habitat similar to that used by other shiners (*Luxilus*) and chubs (*Nocomis* species) (Stauffer *et al.* 1979, Trautman 1981, E. Holm observations 2002). Etnier and Starnes (1993) observed males with nuptial tubercles in smaller streams in the spring in Tennessee and suggested that they had migrated upstream to spawn.

In November 1981, Baldwin (1983) found Silver Shiners, as well as other fishes, at fewer sites and, when she did find them, they occupied deeper pools. Young-of-year were found in slower water than adults. She also found some evidence that the Silver Shiner retreats to the sheltered habitat of river margins during floods.

Little new insights on habitat requirements have occurred since the summary in Baldwin (1983 and 1988), and more recent habitat descriptions are similar to ones already described. The habitat of the Silver Shiner in Tennessee was described as large creeks and small rivers with firm substrates associated with clear waters and flowing pool habitats with moderate to swift currents (Etnier and Starnes 1993). Jenkins and Burkhead (1994) found the species in Virginia primarily in rivers of moderate gradient in the main channels of the Tennessee River. It was also occasionally found in smaller tributaries in the New River drainage. The Silver Shiner usually patrolled the mid- to upper reaches of the water column in schools or small groups in pools and large backwaters near ample current.

Habitat descriptions of recent surveys in Ontario are similar to those described by Baldwin (1988). In 1997, the Silver Shiner was found in streams that were 24-50 m wide, in depths up to 1.5 m, over substrates of rubble, gravel, boulder and sand, with or without aquatic vegetation. The water had an estimated visibility of 0.5 to 1.2 m, a pH of 8.4-8.6, and conductivity of 500-652 **μ**S (Holm and Boehm 1998). In October 2003, it was captured in runs with medium or slow current at stream widths ranging from 50-135 m, and maximum depth of 1.1-2.5 m. Substrate was primarily sand with some gravel, cobble, silt, and clay. Water temperature varied from 8.3 to 10.2°C (DFO, unpublished data).

Other aquatic species at risk found with the Silver Shiner include three fishes, two reptiles, and three mussels:

Black Redhorse, *Moxostoma duquesnei* (Threatened)
Eastern Sand Darter, *Ammocrypta pellucida* (Threatened)
River Redhorse, *Moxostoma carinatum* (Special Concern)
Northern Map Turtle, *Graptemys geographica* (Special Concern)
Spiny Softshell Turtle, *Apalone spinifera* (Threatened)
Mapleleaf, *Quadrula quadrula* (Threatened)
Round Pigtoe, *Pleurobema sintoxia* (Endangered)
Wavy-rayed Lampmussel, *Lampsilis fasciola* (Endangered)

The Silver Shiner has some tolerance for disturbance as it is found in rivers adjacent to urban centres such as London, Waterloo, Kitchener, Cambridge, and Oakville. Much of the landscape that is not urbanized is agricultural.

Habitat trends

Over historical times, the habitat of the Silver Shiner has clearly deteriorated. Much of the land in the Canadian range of the Silver Shiner has been cleared for agricultural and urban uses. Land for livestock and crops comprises 77.8% of the upper Thames River watershed, 88.1% of the lower Thames River watershed (Taylor *et al.* 2004), and 76% of the Grand River watershed (Cooke 2006). Urban land comprises 8% of the Thames watershed, with London being the main urban centre in the upper Thames River watershed, and 5% in the Grand River watershed distributed mainly in the cities of Waterloo, Kitchener, Cambridge, Guelph and Brantford. The percentage of forest is 4.6% in the lower Thames River watershed, 12.3% in the upper Thames River watershed and 17% in the Grand River watershed, all below the 30% recommended by Environment Canada for healthy watersheds (Maaskant *et al.* 2001). For the Grand and Thames rivers, the following paragraphs characterize the current state of habitat degradation, as indicated by water quality (turbidity, nutrients, chloride, metals and pesticides, and toxic spills). As assessed by water and benthic invertebrate sampling, water quality in Bronte Creek is assessed as very good (Conservation Halton 2010).

In the Grand and Thames rivers, soil erosion rates are often high; resulting in increased turbidity and sedimentation (Taylor *et al.* 2004). Water monitoring studies indicate that the upper Thames River is moderately turbid (9.4-13.2 JTUs) and the lower Thames River is highly turbid (69.5 JTUs). Suspended sediment concentrations are high with values ranging from 0 to 656 mg/l (1991-2000). Along the Grand River mainstem above Caledonia, 10-19% of samples taken during 2000-2004 did not meet the suspended sediment guideline of 25mg/l (Cooke 2006).

In the 1930s, the Grand River was described as “an open sewer” as a result of the dumping of poorly treated or untreated sewage directly into the river (UTRCA 2004). Fanshawe Lake, in the upper Thames River, has experienced algal blooms and elevated coliform counts every summer since the 1980s (Taylor *et al.* 2004). Largely as a result of improvements to sewage treatment, there has been some improvement of the water quality since the 1960s. Phosphorus has been decreasing, although most areas still exceed the guideline of 0.03mg/l (Cooke 2006). Nitrogen compounds are increasing and are well above the guidelines in most areas (Taylor *et al.* 2004, UTRCA 2004, Cooke 2006). Chloride levels in the Grand River have significantly increased over time, especially downstream of the urban centres of Guelph and Kitchener-Waterloo. Levels in the Grand River between 2000 and 2004 at three sites between Kitchener and Brantford average close to 100 mg/l, with some levels close to 300 mg/l at times (LESPRTT 2008).

Metal concentrations (copper, lead and zinc) are declining and at levels below the Canadian Council of Ministers of the Environment guidelines in the Thames River. Pesticide monitoring began in the Thames River in 2004 and 12 sites are monitored. Preliminary results show low concentrations of one or more pesticides at all sites with 2 sites well above provincial and federal guidelines (UTRCA 2004).

Water quality is also negatively impacted by toxic spills. In the Thames River, these are mainly manure, oils and fuel. Over the period of 1988-2000, there were an average of about 14 reported spills per sub-watershed (and 392 in total). During this period, however, in two sub-watersheds where Silver Shiner are found: there were 45 spills in the Avon watershed, and 113 in the Forks (area where North Thames River meets the Thames River) (Taylor *et al.* 2004). The siltation from 2001-2005 was similar; 386 total spills, an average of 14 per sub-watershed (Maskaant and Quinlan 2007).

The Grand and Thames river watersheds are also highly fragmented by dams. In 2001, there were 173 dams in the upper Thames River, and in 1991 there were 63 dams in the lower Thames River. Most of these were private, but there were three large dams that were built for flood control in the upper Thames River (Taylor *et al.* 2004). In the Grand River, there were 135 dams in 2003, including eight major dams used for flood control and low flow augmentation (Reid 2004).

Further habitat deterioration is likely given the projected increases in human population and urban development in the watersheds occupied by the Silver Shiner (see Portt *et al.* 2007, Taylor *et al.* 2004, and **Threats and limiting factors**, below). In 2004, the human population was almost 500,000 in the Thames River watershed and about 875,000 in the Grand River watershed, where it is expected to increase by another 300,000 in the next 20 years (Portt *et al.* 2007). In the “Golden Horseshoe” region (which includes Bronte Creek and Sixteen Mile Creek), the human population is expected to increase by almost 4 million by 2031 (MPIR 2004). Agricultural intensification in both the Grand River and Thames River will also put additional stresses on water quality. In the Grand River watershed, for example, there has been an increase in the proportion of row cropping, which increases the potential for soil erosion, nutrient enrichment, and contamination of the water courses. An increase in livestock density “potentially at problematic levels” and a shift from solid to liquid manure handling systems has the potential to further impair water quality (Portt *et al.* 2007).

Habitat protection/ownership

Fish and fish habitat are conserved and protected by Fisheries and Oceans Canada through the administration of the *Fisheries Act*. The *Fisheries Act* contains provisions that can be applied to regulate flow needs for fish, fish passage, killing of fish by means other than fishing, the pollution of fish-bearing waters, and harm to fish habitat. The regulation of pollution of fish-bearing waters has been delegated to Environment Canada, whereas DFO administers the other provisions. Conservation Authorities (CAs) may have individual agreements with DFO to review proposed work for its potential harmful alteration, disruption or destruction of fish habitat (HADD). Depending on the level of agreement in place, CAs may conduct the initial review of a project to identify any impacts to fish and fish habitat, determine how the proponent can mitigate any potential impacts to fish and fish habitat, issue letters of advice, or work with the proponent and DFO to prepare a fish habitat compensation plan. Applications requiring an authorization for a HADD are referred to DFO by the CA for final approval (N. Leahy, Conservation Ontario, pers. comm., 2009).

Provincial protection of fish habitat is indirect because the Silver Shiner is listed in Ontario’s *Endangered Species Act* 2007 only as Special Concern. In Ontario, riparian lands are protected by the fish habitat provisions of the Provincial Policy Statement (PPS) under Ontario’s *Planning Act.* The PPS prohibits development or site alteration on land within 30 m of fish habitat unless it can be demonstrated in an Environmental Impact Study that there is no negative impact. Municipal planning decisions must follow the PPS. Other provincial regulations that may indirectly protect Silver Shiner habitat include the *Lakes and Rivers Improvement Act,* the *Nutrient Management Act*, the *Environmental Protection Act*, the *Water Resources Act,* and the *Source Water Protection Act* (A. Dextrase, pers. comm., 2009).

Although watercourses are publicly owned, riparian lands are primarily privately owned. Development of these riparian areas is controlled to some extent by the *Planning Act* (see above) and the individual ‘Development, Interference and Alteration’ regulations for all conservation authorities (Ontario Regulations 42/06 and 146/06 to 182/06) consistent with Ontario Regulation 97/04. Through these regulations, conservation authorities are empowered to regulate development and activities in or adjacent to river or stream valleys, Great Lakes and large inland lake shorelines, watercourses, hazardous lands and wetlands. Development taking place on these lands may require a permit from the CA to confirm that the control of flooding, erosion, dynamic beaches, pollution or the conservation of land are not affected. They also regulate the straightening, changing, diverting or interfering in any way with the existing channel of a river, creek, stream, watercourse or for changing or interfering in any way with a wetland (N. Davy, Grand River Conservation Authority, pers. comm., 2009; N. Leahy, Conservation Ontario, pers. comm., 2009).

The Silver Shiner does not occur within any National Parks, National Wildlife Areas or any other federally owned lands. In the lower Grand River it occurs within the Six Nations territory and in Bronte Creek it may occur within Bronte Provincial Park.

BIOLOGY

Little is known of the biology of the Silver Shiner, and most of what is summarized below comes from Baldwin (1988). She based her summary primarily on Parker and McKee (1980) and her own observations (Baldwin 1983). Since then little additional information has been published.

Life cycle and reproduction

Spawning has not been observed, and it has been suggested that it occurs at dusk or at night as reported for the related Emerald Shiner (Jenkins and Burkhead 1994). Based on captures of ripe and spent individuals in Ontario, spawning occurs during a relatively short (2-week) period in late May to mid-June at water temperatures of 18.1-23.5°C (Baldwin 1988). In Ohio, spawning is thought to occur in June or early July (Trautman 1981), but in late April through late May in Tennessee (Etnier and Starnes 1994) and in early May to mid-June in Virginia (Jenkins and Burkhead 1994).

No information has been published on the growth of Silver Shiners since Baldwin (1988) summarized the limited information available. She indicated that young-of-year in October or November ranged from 3.8-7.1 cm standard length[6] (SL) and adults ranged from 3.9-10.9 cm SL. In Virginia, Jenkins and Burkhead (1994) found that 18 mature males ranged from 6.1 to 11.7 cm SL (mean 8.9 cm SL) and 15 mature females ranged from 6.1 to 10.9 cm SL (mean 8.6 cm SL).

6 Standard length (SL) is the distance from the tip of the snout to the base of the caudal fin.

Parker and McKee (1980) examined scales from 20 individuals captured in August and September in Ontario. The fished were aged using the scales, a method that has not been validated for this species. Only one individual was 3+ years, and most individuals had a maximum age of 2+. Examination of gonads from 30 individuals indicated that most individuals were mature by six cm and spawned at age 2, although a few may have spawned after their first winter. Examination of scales and an operculum from a 9.1 cm total length[7] (TL) individual in the ROM collection indicated that it was at least 5+ years old. Additional age analysis using opercula and otoliths is underway. Should these analyses confirm the longer life span of the Silver Shiner, it is likely that the maximum age of Silver Shiner is well over 5 years (D. Fitzgerald,AECOM, pers.comm., 2008).

The Silver Shiner appears to be an opportunist, feeding at the surface or in mid-water on both adult and aquatic larval insects, worms, crustaceans, water mites, and algae. It is primarily an insectivore and feeds particularly on adult insects, sometimes leaping out of the water to capture them (Gruchy *et al.* 1973, Parker and McKee 1980, Trautman 1981, Baldwin 1988).

Herbivory/predation

Predation on the Silver Shiner has not been studied. Parker and McKee (1980) observed a Smallmouth Bass (*Micropterus dolomieu*) feeding on a large Silver Shiner in the Grand River.

Dispersal/migration

Sampling in November 1981 found Silver Shiners (along with most other fish) at far fewer sites than in the summer (Baldwin 1988), possibly indicating that the fish retreated to more limited wintering grounds or to deeper un-sampled water.

Concentrations of Silver Shiners have been observed at the downstream end of dams (Baldwin 1988) suggesting that upstream dispersal was disrupted.

7 Total length (TL) is the distance from the most anterior part of the fish to the end of the caudal fin.

POPULATION SIZES AND TRENDS

There has been an increase in our knowledge of the range of the Silver Shiner that has resulted in an increase in the extent of occurrence from approximately 5400 km^2 in 1983 to approximately 6996 km^2 in 2008[8] (Figure 3). This increase in range is likely a result of more extensive surveys in the lower sections of Bronte Creek and the Thames and Grand rivers, rather than an actual increase in range of the species.

Search effort

Baldwin (1983) tested a variety of gear including traps, gill nets and electrofishers. Except for two specimens captured in an angler's minnow trap, Silver Shiners were captured only in the seine. A bag seine was most effective, and reduced injury to juveniles.

Surveys of the fishes of Ontario were conducted between 1921 and 1928 by Carl Hubbs and others from the University of Michigan, Museum of Zoology (UMMZ). A total of 100 sites were sampled in southern Ontario (Hubbs and Brown 1929). Of these, only two, both sampled in 1928 by Carl Hubbs, are within the current range of the Silver Shiner: one in the North Thames River at St. Marys and the other in the Grand River at Breslau. The Silver Shiner was not identified from these localities, but Carl Hubbs identified the Rosyface Shiner from both (UMMZ 85549 and UMMZ 85599). In 2008, Douglas Nelson, University of Michigan, verified Hubbs' identification and found no Silver Shiners in those collections.

Between 1946 and 1963, the Ontario Department of Planning and Development (ODPD) conducted comprehensive surveys in a selection of river systems in southern Ontario. Watersheds that were surveyed included the Saugeen, Ausable, parts of the North Thames River, tributaries of central Lake Erie, several Grand River tributaries (Speed, Eramosa, Nith, etc.) and tributaries of the west half of Lake Ontario. Only sites in the lower Nith River and a few sites in the North Thames River were within the known range of the Silver Shiner. Specimens that resulted from many or all of these surveys were sent to the Royal Ontario Museum, and many of these were kept and catalogued. Examination of these collections by K. Stewart, E. Holm, and M.E. Baldwin resulted in finding one Silver Shiner in each of three collections: ROM 24831 from the Saugeen watershed, ROM 47160 from the Thames River watershed, and ROM 50738 from the Nith River.

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8 The 1983 area excludes the records from the two lower Grand River tributaries that are erroneous. Both figures do not include the Saugeen River or Sixteen Mile Creek, since it is uncertain if the species is established in these two watersheds. The extent of occurrence was originally calculated in ArcView by E. Holm as 6,800 km^2 . The figure used (6,996 km^2) was calculated by Jenny Wu of Environment Canada.

The Ministry of Natural Resources (MNR) conducted numerous stream surveys in southern Ontario beginning around 1969. The program began to taper off in the 1980s. Surveys were conducted in the Grand River in 1971-1977 (437 sites), in the Thames in 1974-1976 (190 sites), in the Saugeen River in 1970-1978 (306 sites), in Bronte Creek in 1971-1977 (32 sites), and in Sixteen Mile Creek in 1971-1975 (65 sites) (OFDD 2008). The Silver Shiner was identified at 14 sites in the Grand River and at five sites in the Thames River. It was not identified from the Saugeen River, Bronte Creek, or Sixteen Mile Creek (Table 1, Figure 4).

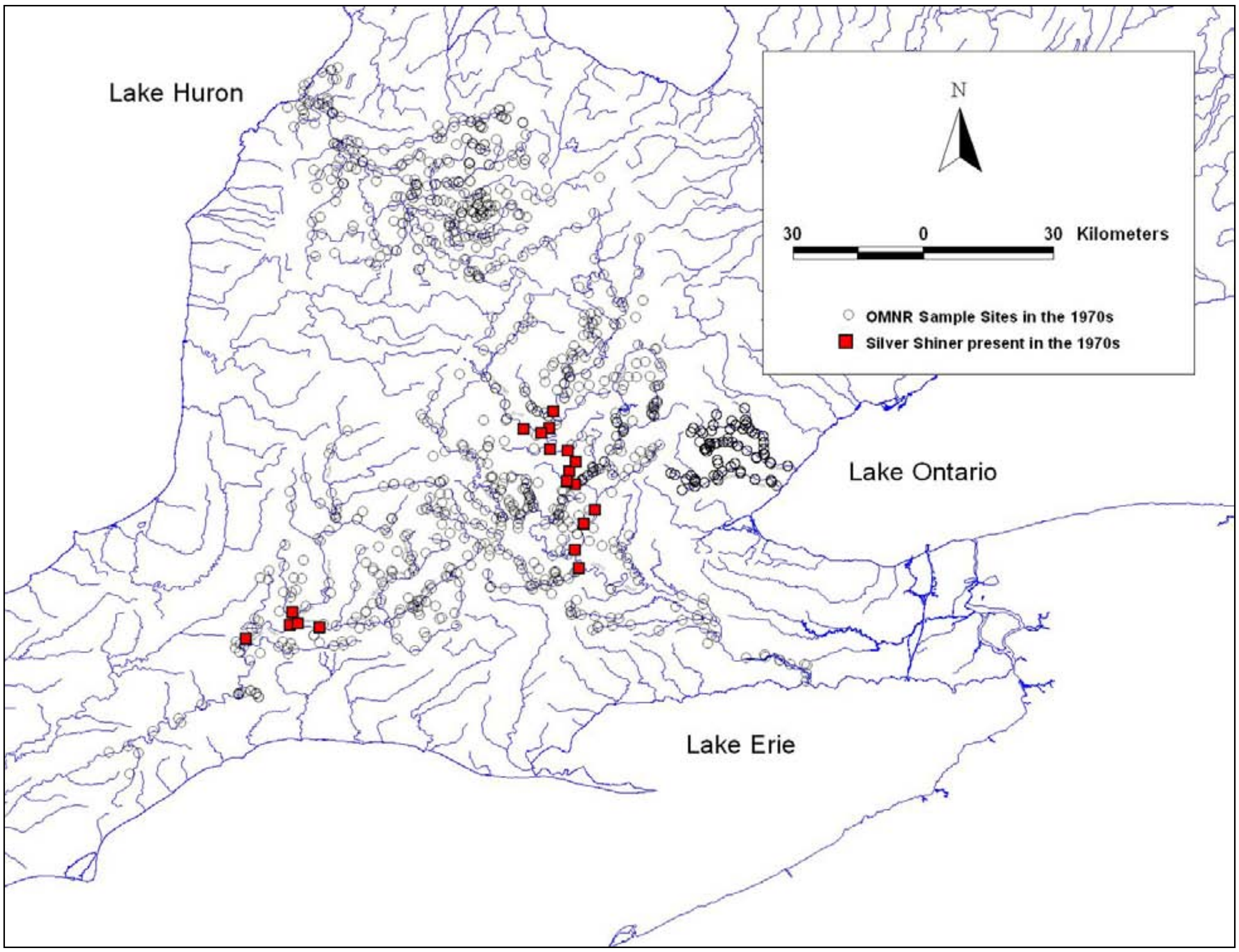

Figure 4. 1970-1979 Ministry of Natural Resources survey sites in the Thames and Grand rivers and Bronte and Sixteen Mile creeks, indicating presence and absence of Silver Shiner.

In 1979, Parker and McKee (1980) surveyed 20 sites in the Grand River drainage and 26 sites in the Thames River drainage. During this survey, the Silver Shiner was captured at 11 sites in the Grand River drainage and at three sites in the Thames River drainage (Table 1, Figure 5).

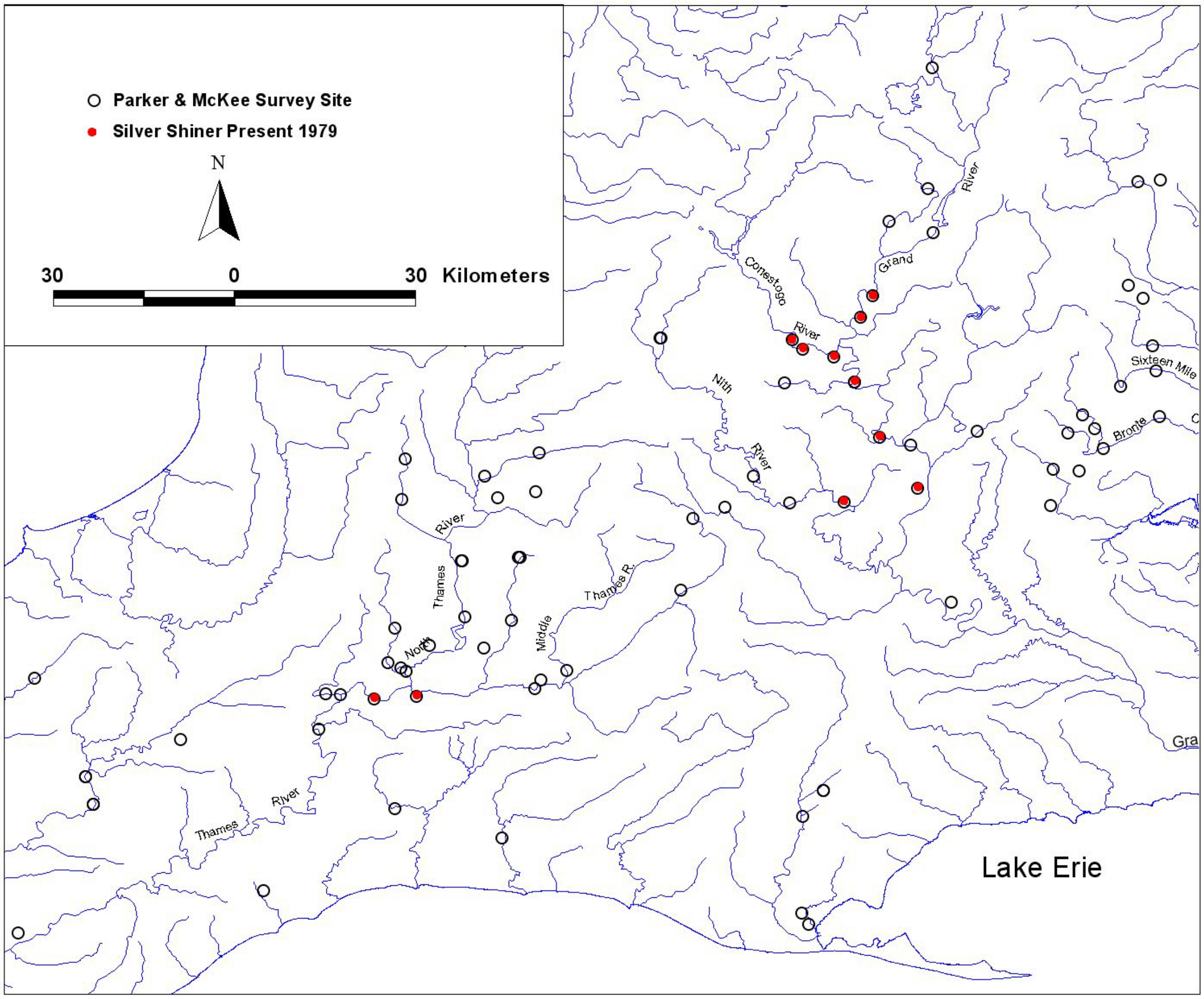

Figure 5. 1979 survey sites by Parker and McKee (1980), indicating presence (red symbols) and absence (white symbols) of Silver Shiner.

In 1981 and 1982, Baldwin (1983) conducted a comprehensive survey for Silver Shiners in the Grand and Thames rivers. She sampled at approximately five km intervals within the range known at the time and usually at two sites farther upstream and farther downstream. She found Silver Shiners at 12 of 19 sites in the Thames River drainage and at 27 of 51 sites in the Grand River drainage (Table 1, Figure 6).

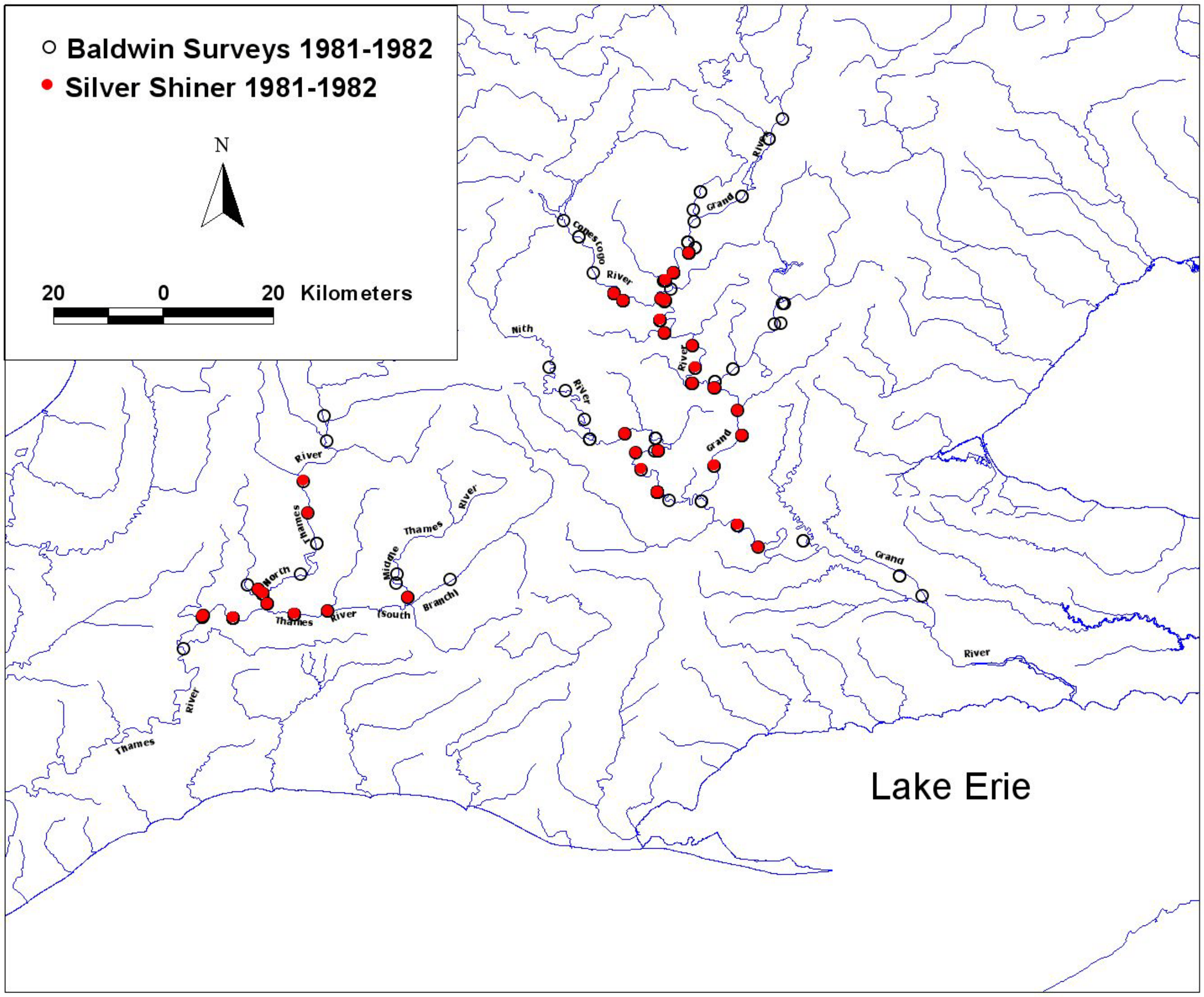

Figure 6. Baldwin (1983) survey sites 1981-1982, indicating presence (red symbols) and absence (white symbols) of Silver Shiner.

Few surveys that specifically targeted the Silver Shiner have been made since 1983. Between 1995 and 2006, surveys for several species at risk, including the Silver Shiner, were conducted in the Grand and Thames river watersheds by the ROM and the MNR (Figure 7). In the Grand River in 1997, four individuals of Silver Shiner were captured at only two of seven sites where the Silver Shiner had been captured in the past and at two new sites (Holm and Boehm 1998). This suggests a decrease in abundance of Silver Shiners in the Grand River. The surveys were, however, carried out in October and November, at a time when populations of many fishes may concentrate in fewer localities (Baldwin 1988). Also most of the sampling was conducted using electrofishers. Therefore, the poor result may also be a result of method of capture and time of sampling.

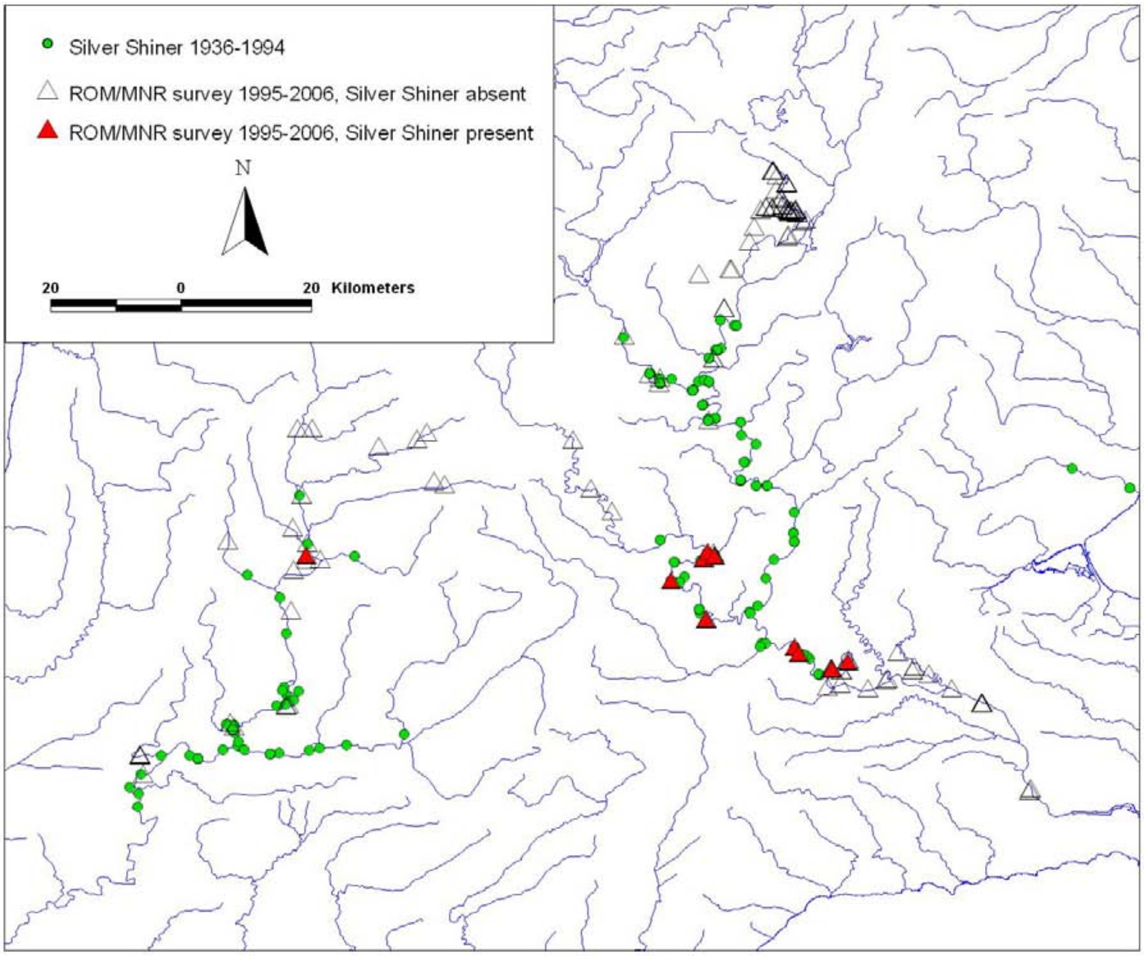

Figure 7. ROM/MNR survey sites 1995-2006, indicating presence and absence of Silver Shiner.

In 2001-2004, the Upper Thames Region Conservation Authority sampled 182 sites in the Thames River and tributaries. Silver Shiners were reported from seven sites, five of which could be confirmed with vouchers (Figure 8) (J. Schwindt, pers. comm. 2005). Additional data on captures of Silver Shiner were provided by J. Schwindt in 2008, increasing the number of capture sites to 10 (Table 1).

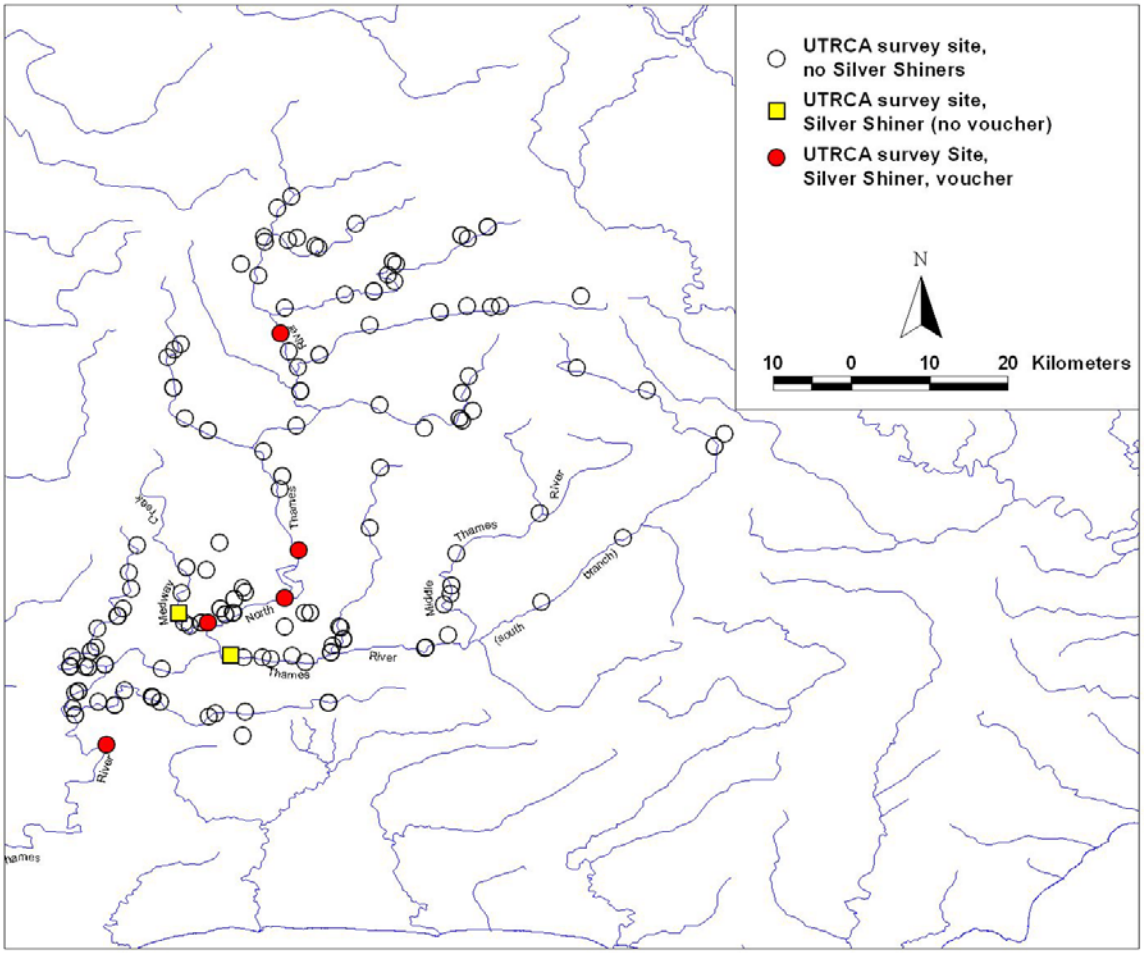

Figure 8. Upper Thames Region Conservation Authority (UTRCA) survey sites 2001-2004 indicating presence and absence of Silver Shiner.

Between 2002 and 2005, DFO conducted several surveys in the Grand River. The Silver Shiner was not specifically targeted, but if it was captured it should have been correctly identified (N. Mandrak, DFO, pers. comm., 2008). Twenty-five individuals were captured at six of 59 sites in a boat seine in 2003 (Table 1). These records extended the range for the Silver Shiner 21 km farther downstream than a ROM/MNR collection taken in 2000 and 44 km farther downstream than that recorded in Baldwin's (1988) status report. Similar to the ROM/MNR survey, sites sampled farther upstream yielded no Silver Shiners (Figure 9).

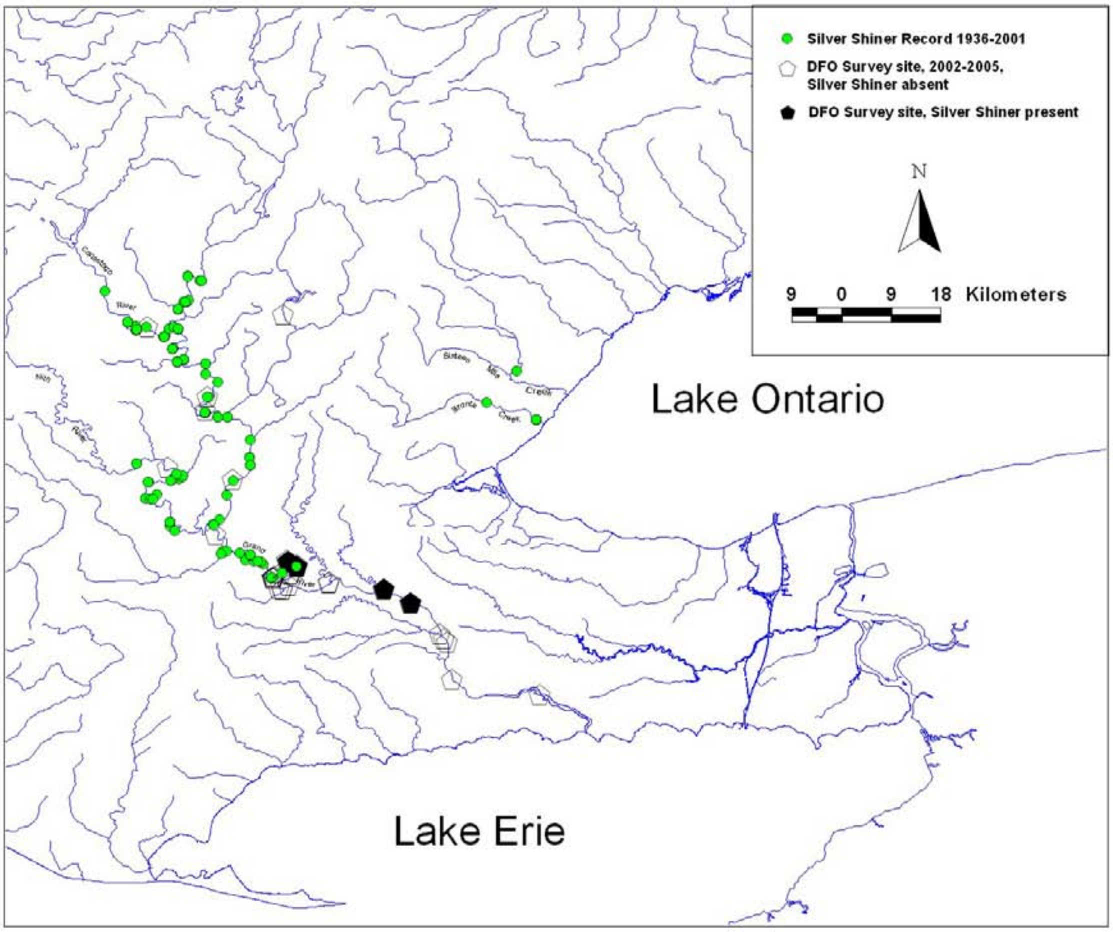

Figure 9. Fisheries and Oceans Canada (DFO) survey sites in the Grand River, 2002-2005, indicating presence and absence of Silver Shiner.

The Ministry of Natural Resources electrofished extensively with “punt” and “drift boat” electrofishers in the Conestogo River between 2004 and 2008 from the Conestogo Dam downstream to the St. Jacob’s Dam but did not capture any Silver Shiners (A. Timmerman, MNR, Guelph District, pers. comm., 2008).

Abundance

The total population of Silver Shiners in Canada is unknown. The number of individuals collected in 238 surveys made between 1936 and 2008 resulted in the capture of more than 3,200 adult and juvenile individuals (Table 1). These surveys were primarily collected by seine and electrofisher and were not designed to assess changes in abundance.

Fluctuations and trends

Population fluctuations have been reported in Michigan and Ohio (Gruchy *et al.* 1973, Trautman 1981). Our knowledge of population changes in Canada is hampered by lack of regular monitoring, problems of identification, selectivity of gear, and time of sampling. Many records of Silver Shiner were made between 1974 and 1982 and Baldwin (1983) suggested that the Silver Shiner underwent a population increase in Canada between 1960 and 1980. New records of Silver Shiner may have resulted from increased survey efforts at downstream locations rather than range expansion. It may, however, be possible that populations have just moved downstream, in response to competitive or predatory pressures or the presence of dams that would block upstream migration. Surveys at downstream locations prior to 1983 are limited, but Baldwin (1983) attempted unsuccessfully to find Silver Shiners at Caledonia in 1981 and 1982, where a single specimen was captured by DFO in 2003.

Rescue effect

Silver Shiner populations in the Great Lakes watershed of the United States are located in Michigan (190 straight line km), Ohio (115 km) and Pennsylvania (110 km). To reach suitable habitat in Ontario, individuals from these populations would have to migrate long distances, much of it through unsuitable lake habitat. The Silver Shiner has never been reported from any of the Great Lakes proper (Baldwin 1988, Cudmore-Vokey and Crossman 2000). Rescue from the more abundant populations in the Mississippi River system is prevented by drainage divides. Thus rescue from populations in the United States is unlikely.

THREATS AND LIMITING FACTORS

Threats

Anthropogenic threats to the Silver Shiner include: 1) agricultural and urban land use; 2) dams and impoundments; 3) sportfish stocking and invasive species; and 4) bait fish harvesting.

Agricultural and urban land use

The watersheds encompassing the natural range of Silver Shiner in Canada, have been dramatically altered in the last 200 years; as most of the forested land was cleared and used for intensive agriculture and growing urban populations (Taylor *et al.* 2004; Portt *et al.* 2007). Two consequences of such development are chronic habitat loss and degradation and acute effects of toxic spills. Southwestern Ontario experiences about as many reported toxic spills (fuel, oils, manure, chemicals) as the rest of Ontario combined. For instance, during the period 1988-1998, 274 manure spills were reported throughout Ontario (except in southwestern Ontario) and a further 229 were reported in southwestern Ontario. Of these Ontario-wide manure spills 46 resulted in fish kills in southwestern Ontario, 85% of the total spills that resulted in fish kills across Ontario (Ontario Spills Action Centre as reported by Upper Thames River Conservation Authority 2011). This high spill level is not surprising in that southwestern Ontario, and the Thames and Grand rivers watersheds specifically, is in the top five areas in Canada in terms of manure production (> 5,000 km/ha, ECO 2011). Indeed, the Redside Dace assessment described manure spills in these watersheds that have killed fish over several kilometres of stream (COSEWIC 2007b).

Over the longer term, in the Grand River watershed, intensive agricultural practices and urbanization have been associated with negative impacts to fish communities (Fitzgerald *et al.* 1998, Wichert and Rapport 1998). Water quality and habitat degradation resulting from agricultural land uses and urban development has negatively impacted Silver Shiner populations in the United States (Rasleigh 2004, Miltner *et al.* 2004). Rasleigh (2004) reported that elevated nutrient and suspended sediment concentrations and the reduced abundance of specialized insectivores (which included Silver Shiner) were associated with high levels of agricultural land cover in the French Broad River basin (North Carolina). In Ohio, suburban development of the Rocky Fork watershed led to the degradation of stream habitat and fish communities; including the local extirpation of the formerly abundant Silver Shiner (Miltner *et al.* 2004). Watershed monitoring programs indicate that poor water quality conditions exist in the Grand and Thames rivers (see **HABITAT TRENDS** section).

The potential negative impacts of poor water quality on the Silver Shiner may take many forms. Numerous studies have demonstrated that turbidity and sedimentation degrades fish habitat by reducing primary productivity, abundance and diversity of macroinvertebrates, quality of spawning habitat, and survival of eggs (Wood and Armitage 1997). The Silver Shiner has very large eyes suggesting that vision is important in prey detection and mating success and may be impaired with increased turbidity. Studies on other fishes indicate that turbidity can reduce reproductive success (Burkhead and Jelks 2001), foraging efficiency and prey consumption (Sweka and Hartman 2003), and growth rates (Sweka and Hartman 2001). Most research has focused on coldwater species, but a few studies have demonstrated negative effects on warm-water species (see Waters 1995), such as the Silver Shiner. In the Little Miami River of Ohio, a short-term decline (less than two years) in Silver Shiner abundance was observed after exposure to elevated suspended sediment downstream of instream pipeline construction (Schubert *et al.* 1987).

In addition to suspended and deposited sediment, poor water quality also results from the addition of too many nutrients including phosphorus and nitrogen in various forms (ammonia, nitrates and nitrites), which make their way into the water courses from urban and agricultural runoff, tile drains, and sewage treatment plants. These nutrients result in the growth of aquatic plants and algae and excess nutrients may result in algal blooms. The decomposition of dead plants decreases oxygen levels making the water inhospitable to aquatic organisms (Munn and Hamilton 2003). Reductions in pollution from agricultural, industrial and urban sources have resulted in an increase (albeit small) in the abundance and distribution of Silver Shiner in Ohio rivers since 1990 (Yoder *et al.* 2005).

Large increases in chloride concentrations due to road salting have been documented in North American streams (Demers and Sage 1990). Concentrations measured downstream of urban centres in the Grand River watershed (see **HABITAT TRENDS** section) are below chronic toxicity thresholds for Fathead Minnow (*Pimephales promelas*) embryos and Rainbow Trout (*Oncorhynchus mykiss*) embryos and eggs, but at times above levels (as low as 210 mg/l) that can adversely affect 5% of aquatic organisms (Environment Canada 2001). In addition to these chronic threats, chemical or fertilizer spills have occurred in the watersheds of the Silver Shiner which have resulted in fish kills (COSEWIC 2009).

<u>Dams and impoundments</u>

Silver Shiner populations in the Grand and Thames river watersheds are fragmented by dams. Across North America, hydrological and ecological changes associated with dams have contributed to the loss or reduction of migratory and smaller-bodied riverine fish (Li *et al.*, 1987, Pringle *et al.*, 2000). Habitat changes, such as altered downstream water temperatures and the creation of reservoir lakes, also favour the invasion or introduction of exotic species (e.g. Brown Trout, *Salmo trutta*) that can further adversely affect native fish populations (Quinn and Kwak 2003). Hoyt and Robinson (1980) reported the disappearance of Silver Shiner from the cold tailwaters of the Barren River Lake dam, 13 years after its construction. In the Grand River, dams and impoundments have contributed to the decline of species dependent on warmwater temperature cues for spawning, and fluvial specialists (Spence and Hynes 1971, Fitzgerald *et al.* 1998, Reid 2004).

Sportfish stocking

There have been concerted sportfish stocking efforts in the core of the range of the Silver Shiner since the 1940s in the Grand River watershed. Annual stockings of 20,000-25,000 Brown Trout have occurred in the upper Grand River from the Shand Dam (above Elora) to West Montrose (about 28 stream km downstream) since 1989 (A. Timmerman, MNR, pers. comm., 2008). This area of the Grand River is recognized as a world class Brown Trout fishery (Portt *et al.* 2007). Brown Trout have also been stocked in the Conestogo River. From 2003 to 2008, a total of 208,759 mostly fingerling and one year olds have been stocked in the Conestogo River. Walleye, *Sander vitreus*, were introduced to the Conestogo River from 1989-1991 and are still present as a naturally reproducing population in parts of the Conestogo and possibly the Grand (A. Timmerman, MNR, pers. comm., 2008).

Fitzgerald *et al.* (1998) and Reid (2004) both hypothesized that predation by introduced sportfish has compounded the adverse affects of habitat degradation on native fishes in the Grand River. No study, however, has been conducted on the impact of stocked Brown Trout on Silver Shiner. Research on other fishes has identified the vulnerability of cyprinids to predation by Brown Trout (Nannini and Belk 2006), and associated declines in the abundance of soft-rayed stream fishes (catostomids and cyprinids) (Garman and Nielsen 1982). As a result of its negative biological impacts on native fauna, the International Union for the Conservation of nature (IUCN) included Brown Trout in its list of 100 of the World's Worst Invasive Alien Species (Lowe *et al.* 2000). In those reaches of the Grand River where their distribution overlaps, the association of Silver Shiner with deep, swift riffles and deep pools would likely result in their vulnerability to predation by large, adult Brown Trout.

Invasive species

It is unknown to what extent the Silver Shiner is susceptible to competition or predation pressures. New species introduced into the Grand River within the last 20 years include the Greenside Darter, *Etheostoma blennioides,* (COSEWIC 2006), the Central Stoneroller, *Campostoma anomalum*, (Holm and Crossman 2001), Black Crappie, *Pomoxis nigromaculatus*, (A. Timmerman, MNR, pers. comm., 2008), and Round Goby, *Neogobius menlanostomus* (J. Barnucz, DFO, pers. comm., 2009). It is unknown what impact these would have on the Silver Shiner, but Canadian freshwater fishes in general tend to be susceptible to invasive fishes (Dextrase and Mandrak 2006) and the Round Goby was identified as a potential threat to the Eastern Sand Darter (Edwards *et al.* 2007; COSEWIC 2009), which also inhabits the two main watersheds (the Thames and Grand rivers) as the Silver Shiner.

Baitfish harvesting

Parker and McKee (1980) indicated that anglers in the Grand River favour the Silver Shiner for use as bait. As a species of Special Concern, however, the Silver Shiner is no longer a legal baitfish. It could be harvested incidentally and has been known to be captured by at least one baitfish dealer in the Grand River (A. Timmerman, MNR, pers. comm., 2008). Within the range of Silver Shiner, the MNR issues only one baitfish harvest licence per area (e.g., a township). Such an exclusive licence permits only one harvester to fish a particular stretch of stream, and prevents competition for the same fishes. In all areas, there are no quotas, but each harvester must submit an annual report that tells the MNR how many bait fishes were harvested. The harvester does not have to break his harvest down into species, or waterbody, so it is not possible to know how many Silver Shiners were harvested (A. Timmerman, MNR, pers. comm., 2008). The risks associated with baitfish harvesting in southern Ontario (and likelihood of fish species at risk being captured) is being studied by Andrew Drake, University of Toronto. Grand River anglers usually capture their bait in creeks smaller than those known to support Silver Shiner (A. Timmerman, MNR, pers. comm., 2008).

Threats summation

The IUCN Threat Calculator was employed by S. Reid (FWFSSC member, 2009, Appendix 1). Most threats identified applied to a majority of the six estimated locations and were individually rated at the low to medium category in terms of impact. When considered in light of cumulative impacts, however, the calculator returned a threat category of “B” (= High).

Limiting factors

Natural factors limiting the distribution of the Silver Shiner are poorly known but undoubtedly include a host of biological factors (e.g., predators, prey, competitors, parasites) and abiotic factors (e.g., water quality and quantity, temperature, current, and barriers). Some of these are manipulated by human beings and discussed below under anthropogenic threats (see also **HABITAT)**. Two factors which cannot be manipulated easily include climate and stream gradient. Colder weather may reduce winter survival and spawning success (Baldwin 1988). Warm temperatures may result in range expansion. Before recent collections in the Grand River, Silver Shiners were found at an average gradient of 1.4 m/km, and were not found at stream gradients below 0.3 m/km or above 5.7 m/km (Parker and McKee 1980). Recent collections suggest that the Silver Shiner may tolerate lower gradients. The most downstream section of the Grand River, where the Silver Shiner was captured in 2003, has a gradient of about 0.3 m/km. Juveniles and one adult have also been captured in lentic areas such as Fanshawe Lake (ROM and MNR data, unpublished), where there is no stream gradient.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Silver Shiner was reassessed as Threatened in May 2011 by COSEWIC, but is currently listed only on Schedule 3 of the federal *Species at Risk Act.* Therefore, it does not receive any special consideration when a project is being reviewed under the *Canadian Environmental Assessment Act*. Currently assessed as Special Concern by Ontario, there is a requirement to prepare a management plan under the provincial *Endangered Species Act* 2000, but there is no direct habitat protection (see **Habitat Protection/Ownership**, above)

The Silver Shiner is rare at the edge of its U.S. range, but even in those states at the edge of the range the Silver Shiner is generally not considered at risk (Table 2). Its limited distribution in Alabama prompted Boschung and Mayden (2004) to recommend special concern status in that state. Although classified as S1, populations appear to be stable in Michigan (Carman 2001). In New York, it is found only in the Allegheny watershed, but it is not considered at risk there (Carlson and Daniels 2004). Populations are also thought to be stable in Ontario (Portt *et al.* 2007).

Table 2. Global, national and subnational heritage ranks for the Silver Shiner (*Notropis photogenis*) (NatureServe 2008).

Rank level	Rank	Jurisdictions	Last Reviewed/Changed
Global	G5		25 Sep1996/25 Sep1996
National	N5	United States	
	N2N3	Canada	
	COSEWIC	Canada	1 April 1987
Subnational	S1	Alabama, Georgia, Michigan	
	S2	New York	
	S2S3	Ontario	
	S3	North Carolina	
	S4	Indiana, Pennsylvania, Tennessee, Virginia	
	S4S5	Kentucky	
	S5	West Virginia	
	SNA	Maryland	
	SNR	Ohio	

The Silver Shiner is ranked as 'sensitive' in Canada and Ontario, by the General Status of Wild Species in Canada. A 'sensitive' species is "not believed to be at risk of immediate extirpation or extinction but may require special attention or protection to prevent them from becoming at risk" (CESCC 2007). The Silver Shiner is part of the Grand River Recovery Plan (Portt *et al.* 2007), and the Thames River Recovery Plan (TRRT 2005). The Thames River Recovery Plan recommends that the Silver Shiner "should be included in general index sampling".

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Erling Holm is Assistant Curator of fishes at the Royal Ontario Museum where he manages a fish collection of over 80,000 lots. Since 1971, he has conducted fish surveys in Ontario, Quebec, and South America. He is the founder of the ROM's Ontario fish identification workshops, where he continues to teach. He has co-authored 12 COSEWIC status reports and has been a member of the Freshwater Fishes Species Specialist Committee and three recovery teams.

COLLECTIONS EXAMINED

Royal Ontario Museum collections of the closely related Rosyface Shiner were examined in December 1985 by M.E. Baldwin. This examination resulted in the reidentification of four lots to *N. photogenis* from the Thames River as early as 1936 and the Nith River as early as 1949. All ROM collections of Rosyface Shiner and Emerald Shiner were examined quickly (through the jar) in 2005 by E. Holm for other potential misidentifications. A few collections were examined in more detail (listed below). This examination of collections resulted in one change of identification from *Notropis rubellus* to *Notropis photogenis*. In 2005, Ken Stewart and Bill Franzin (Freshwater Institute, Fisheries and Oceans Canada) identified one *N. photogenis* from ROM 24831 from the Saugeen River. The two 1928 collections were examined by Douglas Nelson, Collection Manager, University of Michigan Museum of Zoology (UMMZ). ODPD=Ontario Department of Planning and Development; OWRC=Ontario Water Resources Commission.

Cat. No. (no. of specimens), watershed, year captured (collector) – results of specimen examination (examined by E. Holm, unless otherwise noted)

<u>Lots originally identified as *Notropis rubellus*</u>

UMMZ 85549 (18) North Thames River, 1928 (C. L. Hubbs) – confirmed as *N. rubellus* by D. S. Nelson, UMMZ

UMMZ 85599 (77) Grand River at Breslau, 1928 (C. L. Hubbs) – confirmed as *N. rubellus* by D. S. Nelson, UMMZ

ROM 09240 (39) Thames River, (1936) (C. J. Kerswill) – confirmed as *N. rubellus*

ROM 09258 (1) Medway Creek, 1936 (C. J. Kerswill) – confirmed as *N. rubellus*

ROM 09295 (20) Thames River, 1936 (C. J. Kerswill) – 8 specimens reidentified as *Notropis photogenis* by M. E. Baldwin in 1985 and recatalogued as ROM 50740; 12 confirmed as *N. rubellus*

ROM 09316 (11) Sydenham River, 1936 (C. J. Kerswill) – confirmed as *N. rubellus*

ROM 09381 (14) Medway Creek, 1936 (C. J. Kerswill) confirmed as *N. rubellus*

ROM 14086 (91) Thames River, (1941) (Dymond & Harkness) – 1 *Notropis* X *Luxilus* ?, rest *confirmed* as *N. rubellus*

ROM 14563 (6) North Thames River, (1946) (H. P. Clemens) – confirmed as *N. rubellus*

ROM 15959 (1) North Thames River, 1953 (Scott & Crossman) – reidentified as *N. photogenis*

ROM 17876 (1) Lake Erie, 1946 (W. B. Scott) – confirmed as *N. rubellus*

ROM 17877 (2) Black Creek, 1946 (Clemens and Girling) – confirmed as *N. rubellus*

ROM 18128 (6) Saugeen River drainage, 1955 (ODPD) – confirmed as *N. rubellus*

ROM 18129 (4) Saugeen River, 1955 (ODPD) – confirmed as *N. rubellus*

ROM 18151 Nith River, 1949 (ODPD) – confirmed as *N. rubellus*

ROM 18155 (13) Nith River, 1949 (ODPD) – 1 *Notropis photogenis* identified by M.E. Baldwin in 1985 and recatalogued as ROM 50738, rest confirmed as *N. rubellus*

ROM 18509 (1) Teeswater River, 1956 (ODPD) – confirmed as *N. rubellus*

ROM 18531 (24) Sixteen Mile Creek, 1956 (W. B. Scott, ROM) – confirmed as *N. rubellus*

ROM 22543 (6) Saugeen River, (ODPD) – confirmed as *N. rubellus*

ROM 22570 (22) Thames River, 1950 (ODPD):
1G4 (3) confirmed as *N. rubellus* 29/7/50
1N8 (1) confirmed as *N. rubellus* 8/8/50
1N16 (1) confirmed as *N. rubellus 10/8/50*
5a6 (2) confirmed as *N. rubellus* 31/08/1950
1a9 (6) confirmed as *N. rubellus* 27/7/50
2a6 (3) confirmed as *N. rubellus* 17/8/50
2a5 (3) confirmed as *N. rubellus* 16/8/50
5c5 (3) confirmed as *N. rubellus* 7/9/50

ROM 24083 (10) Thames River, 1965 (OWRC) – confirmed as *N. rubellus*

ROM 24475 (16) Thames River,1966 (OWRC) 2 *Cyprinella* and 1 *Luxilus* rest – confirmed as *N. rubellus*

ROM 24633 (18) Thames River, 1950 (ODPD) 1 *Notropis* X *Luxilu*s ?, rest confirmed as *N. rubellus*

ROM 24674 (9) Bronte Creek, 1958 (ODPD) – confirmed as *N. rubellus*

ROM 24708 (8) Grand River, 1949 (ODPD) – confirmed as *N. rubellus*

ROM 24831 (42) Saugeen River drainage, 1956 (ODPD) – 1 reidentified as *N. photogenis* by Ken Stewart in 2005

ROM 24862 (42) Nith River, 1949 (ODPD) – 1 *Notropis* sp, rest confirmed as *N. rubellus*

ROM 25087 (54) Nith River, 1966 (OWRC) – 10 specimens reidentified as *Notropis photogenis* by M.E. Baldwin in 1985 and recatalogued as ROM 50739; rest confirmed as *N. rubellus*

ROM 25196 (43) Conestogo River, 1966 (OWRC) – 1 specimen reidentified as *Notropis photogenis* by M.E. Baldwin in 1985 and recatalogued as ROM 50736; 4 specimens reidentified as *Cyprinella spiloptera* and recatalogued as ROM 50737; rest confirmed as *N. rubellus*

ROM 25205 (24) Grand River, 1966 (OWRC) – 14 removed previously and recatalogued as *Notropis photogenis* (ROM 41600)

ROM 25732 (15) Maitland River, 1966 (ODPD) – confirmed as *N. rubellus*

ROM 27593 (3) Bronte Creek, 1970 (Buerschaper & Smith, ROM) – confirmed as *N. rubellus*

ROM 25961 (161) Medway Creek, 1968 (Buerschaper & Casselman, ROM) - confirmed as *N. rubellus*

ROM 28990 (ca 500) Grand River, 1971 (W.B. Scott, ROM) – confirmed as *N. rubellus*

ROM 30903 (31) Middle Thames River, 1974 (OMNR) – confirmed as *N. rubellus*

ROM 47161 (11) Smith Creek, 1966 (OWRC) – confirmed as *N. rubellus*

ROM 47162 (32) Smith Creek ,1966 (OWRC) – confirmed as *N. rubellus*

<u>Lots originally identified as *Notropis atherinoides*</u>

ROM 42110 (110) Boundary Creek 1982 (ROM) – confirmed as *N. atherinoides*

ROM 24637 (3) Thames River, 1950 (ODPD) – reidentified as *Luxilus* sp

ROM 08645 (9) Grand River at Cayuga, 1929 (R. F. Cain) – 6 *N. atherinoides*, 1 *N. volucellus*, 2 *N. rubellus*

THREATS ASSESSMENT WORKSHEET

See instructions in 'Instructions' worksheet. Scroll down in top pane to view the entire table.

Species or Ecosystem Scientific Name	Silver Shiner		
Element ID		**Elcode**	

Suggested Number of Locations
6

Overall Threat Impact Calculation Help:

Threat Impact		**Level 1 Threat Impact Counts** high range	low range
A	Very High	0	0
B	High	0	0
C	Medium	3	3
D	Low	2	2
	Calculated Overall Threat Impact:	High	High

Assigned Overall Threat Impact: **B = High**

Impact Adjustment Reasons: Overall, most significant threat was considered to be pollution/water quality and the most likely number of locations based on this threat

Overall Threat Comments: completed by S. Reid, Sept. 2010

Threat		**Impact (calculated)**		**Scope**	**Severity**	**Timing**	**Comments**	**Number of Locations**		
								Lowest	**Most Likely**	**Highest**
1	Residential & commercial development	C	Medium	Large	Moderate	High				
1.1	Housing & urban areas	C	Medium	Large	Moderate	High	Large projected increase in human population size in watersheds	3	5	5
1.2	Commercial & industrial areas	D	Low	Small	Slight	High	Large projected increase in human population size in watersheds	3	5	5
1.3	Tourism & recreation areas									
2	Agriculture & aquaculture									
2.1	Annual & perennial non-timber crops									
2.2	Wood & pulp plantations									
2.3	Livestock farming & ranching									
2.4	Marine & freshwater aquaculture									
3	Energy production & mining									

Threat		Impact (calculated)		Scope	Severity	Timing	Comments	Number of Locations		
								Lowest	Most Likely	Highest
3.1	Oil & gas drilling									
3.2	Mining & quarrying									
3.3	Renewable energy									
4	Transportation & service corridors									
4.1	Roads & railroads									
4.2	Utility & service lines									
4.3	Shipping lanes									
4.4	Flight paths									
5	Biological resource use	D	Low	Small	Slight	High			1	
5.1	Hunting & collecting terrestrial animals									
5.2	Gathering terrestrial plants									
5.3	Logging & wood harvesting									
5.4	Fishing & harvesting aquatic resources	D	Low	Small	Slight	High	bait fish harvesting		1	
6	Human intrusions & disturbance									
6.1	Recreational activities									
6.2	War, civil unrest & military exercises									
6.3	Work & other activities									
7	Natural system modifications	C	Medium	Large	Moderate	High		4	4	6
7.1	Fire & fire suppression									
7.2	Dams & water management/use	C	Medium	Large	Moderate	High	Thames and Grand River watersheds highly fragmented by dams	4	4	6
7.3	Other ecosystem modifications									
8	Invasive & other problematic species & genes	D	Low	Restricted	Moderate	High		1	1	1
8.1	Invasive non-native/alien species	D	Low	Restricted	Moderate	High	Grand River brown trout fishery	1	1	1
8.2	Problematic native species									
8.3	Introduced genetic material									
9	Pollution	C	Medium	Large	Moderate	High		4	6	6
9.1	Household sewage & urban waste water	D	Low	Restricted	Moderate	High	Poor water quality in Grand and Thames rivers	4	4	4
9.2	Industrial & military effluents									
9.3	Agricultural & forestry effluents	C	Medium	Large	Moderate	High	Poor water quality in Grand and Thames rivers	6	6	6
9.4	Garbage & solid waste									
9.5	Air-borne pollutants									
9.6	Excess energy									

Threat		Impact (calculated)		Scope	Severity	Timing	Comments	Number of Locations		
								Lowest	Most Likely	Highest
10	Geological events									
10.1	Volcanoes									
10.2	Earthquakes/tsunamis									
10.3	Avalanches/landslides									
11	Climate change & severe weather									
11.1	Habitat shifting & alteration									
11.2	Droughts									
11.3	Temperature extremes									
11.4	Storms & flooding									
Classification of Threats adopted from IUCN-CMP, Salafsky et al. (2008).										