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Information in support of a Recovery Potential Assessment of Lake Chubsucker (*Erimyzon sucetta)* in Canada

Information à l'appui de l'évaluation du potentiel de rétablissement du sucet de lac (*Erimyzon sucetta)* au Canada

Lynn D. Bouvier and Nicholas E. Mandrak

Fisheries and Oceans Canada / Pêches et Océans Canada
Great Lakes Laboratory for Fisheries and Aquatic Sciences /
Laboratoire des Grands Lacs pour les Pêches et les Sciences Aquatiques
867 Lakeshore Rd. / 867, Chemin Lakeshore
Burlington ON L7R 4A6 Canada

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ABSTRACT

In April 1994, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended that Lake Chubsucker (*Erimyzon sucetta*) be designated as a species of Special Concern. This status was re-assessed as Threatened in November 2001. When re-examined in November 2008, Lake Chubsucker status was changed to Endangered. The reason given for this designation was that the Lake Chubsucker is “a species with a restricted geographic Canadian range with small extant populations having very specific and narrow habitat preferences, which are under continued stress. It is extremely susceptible to habitat change driven by urban, industrial and agricultural practices resulting in increased turbidity. Two populations have been lost, and of the 11 extant populations, 3 are in serious decline as a result of the continuing and increasing threats posed by agricultural, industrial and urban development that are expected to impact the remaining populations of Lakes Erie and St. Clair.” Lake Chubsucker was listed on Schedule 1 of the *Species at Risk Act* (SARA) when the Act was proclaimed in June 2003. Lake Chubsucker is now listed as Endangered on Schedule 1. The Recovery Potential Assessment (RPA) provides information and scientific advice needed to fulfill various requirements of SARA including permitting activities that would otherwise violate SARA prohibitions and the development of recovery strategies. This research document describes the current state of knowledge on the biology, ecology, distribution, population trends, habitat requirements, and threats to Lake Chubsucker. Mitigation measures and alternative activities related to the identified threats, that can be used to protect the species, are also presented. The information contained in the RPA science advisory report and this document may be used to inform the development of recovery documents and for assessing SARA Section 73 permit applications.

RÉSUMÉ

En avril 1994, le Comité sur la situation des espèces en péril au Canada (COSEPAC) a recommandé que le sucet de lac (*Erimyzon sucetta*) soit désigné comme une espèce préoccupante. Le sucet de lac a été désigné comme espèce menacée en novembre 2001. Lorsque le sucet de lac a été réévalué en novembre 2008, son statut a été changé à espèce en voie de disparition. Cette désignation est justifiée parce que « l'aire de répartition géographique canadienne de cette espèce est restreinte et les populations existantes sont de petite taille. Ces populations montrent des préférences très spécifiques et restrictives en matière d'habitat, lequel est soumis à un stress continu. L'espèce est extrêmement vulnérable aux modifications de l'habitat amenées par les pratiques urbaines, industrielles et agricoles résultant en une augmentation de la turbidité. Deux populations sont disparues, et trois des onze populations existantes connaissent un important déclin en raison des menaces continues et croissantes que posent l'expansion agricole, industrielle et urbaine, qui devraient aussi avoir un impact sur les populations restantes des lacs Érié et Sainte-Claire ». Le sucet de lac a été inscrit à l'annexe 1 de la *Loi sur les espèces en péril* (LEP) lorsque la Loi a été adoptée en juin 2003. Le sucet de lac est maintenant inscrit à l'annexe 1 à titre d'espèce en voie de disparition. L'évaluation du potentiel de rétablissement (EPR) fournit l'information et l'avis scientifique dont on a besoin pour respecter les diverses exigences de la LEP, y compris la délivrance de permis pour mener des activités qui, d'une autre façon, contreviendraient à la LEP, ainsi que pour élaborer des programmes de rétablissement. Le présent document de recherche décrit l'état actuel des connaissances sur la biologie, l'écologie, l'aire de répartition, les tendances démographiques et les besoins en matière d'habitat du sucet de lac ainsi que sur les menaces pesant sur cette espèce. Des mesures d'atténuation et des solutions de rechange pour les activités constituant une menace qui pourraient être mises en œuvre pour protéger l'espèce sont également présentées. L'information continue dans l'avis scientifique portant sur l'EPR et dans le présent document pourrait être utilisée à l'appui de l'élaboration de documents concernant le rétablissement et de l'évaluation de demandes de permis délivrés en vertu de l'article 73 de la LEP.

SPECIES INFORMATION

Scientific Name – *Erimyzon sucetta* (Lacepède, 1803)
Common Name – Lake Chubsucker
Current COSEWIC Status (Year of Designation) – Endangered (2008)
COSEWIC Reason for Designation[1] – A species with a restricted geographic Canadian range with small extant populations having very specific and narrow habitat preferences, which are under continued stress. It is extremely susceptible to habitat change driven by urban, industrial and agricultural practices resulting in increased turbidity. Two populations have been lost, and of the 11 extant populations, 3 are in serious decline as a result of the continuing and increasing threats posed by agricultural, industrial and urban development that are expected to impact the remaining populations of Lakes Erie and St. Clair.
SARA Schedule – 1
Range in Canada – Ontario

BACKGROUND

Lake Chubsucker (*Erimyzon sucetta*) is a small, deep–bodied member of the sucker family (Catostomidae) (Figure 1; Holm *et al.* 2009). It has a thick caudal peduncle, and a wide head with a blunt snout ending in a small, slightly inferior mouth (COSEWIC 2008). Coloration on the back and upper sides can range from deep olive-green to bronze, and these areas have a cross hatching pattern in adults (Holm *et al.* 2009). The lower sides are generally gold to silver, while the belly ranges from greenish-yellow to whitish-yellow (Holm *et al.* 2009). Juvenile Lake Chubsucker generally have a black stripe along the front edge of the dorsal fin and a wide, prominent black lateral stripe terminating in a dark spot at the base of the tail; while the lateral stripe can either be continuous or broken in adults, if present (Holm *et al.* 2009). A distinguishing characteristic of the Lake Chubsucker is that it lacks a lateral line.

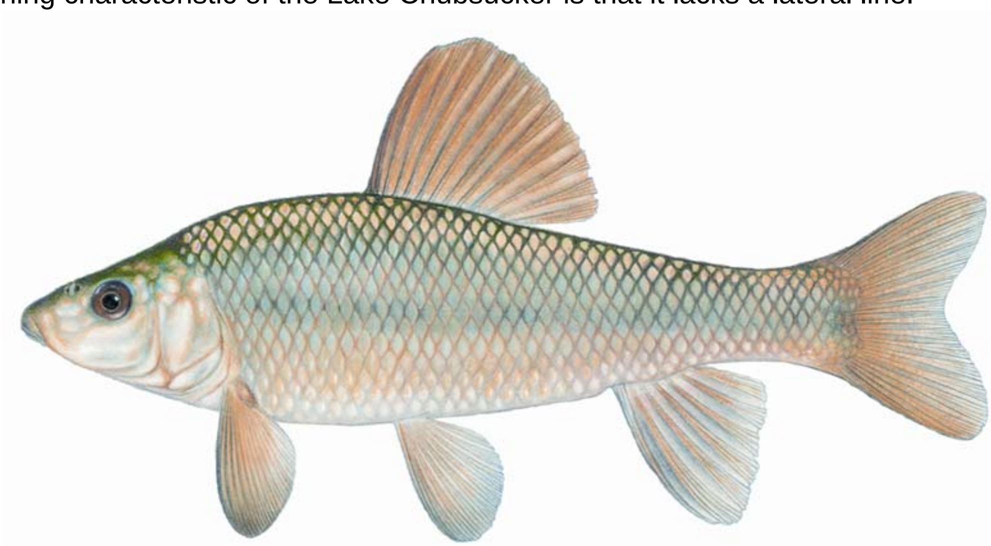

Figure 1. *Lake Chubsucker* (Erimyzon sucetta) © *Joseph Tomelleri.*

In the literature, adult length has been noted as reaching a maximum of 410 mm total length (TL) (Page and Burr 1991), although Canadian specimens tend to be smaller than their

[1] http://www.cosewic.gc.ca/eng

southern counterparts. The Ontario record for the longest recorded Lake Chubsucker measured 280 mm TL (Holm *et al.* 2009).

Lake Chubsucker is a warmwater species, with preferred temperature ranging from 28-34^{o}C (Coker *et al.* 2001). Throughout the Canadian Lake Chubsucker range, it is found in clear, well-vegetated, slow-moving or still waters (COSEWIC 2008). Areas typically inhabited by Lake Chubsucker include backwaters, wetlands, ponds, floodplain lakes, and marshes (COSEWIC 2008). Turbidity is generally very low in these areas, and the substrate is commonly composed of clay, silt, and organic debris (COSEWIC 2008). As an omnivorous bottom feeder, Lake Chubsucker diet is composed of small crustaceans, mollusks, aquatic insects, filamentous algae, and plant material (Holm *et al.* 2009).

Lake Chubsucker is one of 13 known sucker species currently in the Canadian Great Lakes basin (Holm *et al.* 2009). It can be differentiated from members of the genera *Carpiodes, Cycleptus*, and *Ictiobus* by the presence of dorsal fin with a short base lacking a rounded or pointed anterior lobe (COSEWIC 2008). Although not reliably reported from Canada, Lake Chubsucker closely resembles Creek Chubsucker (*Erimyzon oblongus*), which is present in the American tributaries of both lakes Ontario and Erie (COSEWIC 2008). Characteristics used to distinguish these two species include a larger eye diameter, lower lateral line scale count, higher dorsal ray count and a stouter body form for Creek Chubsucker when compared to Lake Chubsucker (COSEWIC 2008).

Primary sources of human-induced mortality and aggregate harm for Lake Chubsucker in Canada include loss of preferred habitat from habitat modifications, wetland drainage, channelization, and increased turbidity, siltation and nutrient loading from agricultural and industrial practices. The presence of exotic species, such as Common Carp (*Cyprinus carpio*) and common reed grass (*Phragmites australis*) may be having a direct impact on Lake Chubsucker preferred habitat. Common Carp is well known to uproot submergent vegetation through foraging activities, while common reed grass can out-compete native plant species. Incidental harvest through the baitfish industry may also play a role in the decline of Lake Chubsucker, although limited information is currently available on the direct effect that this industry may have on Lake Chubsucker.

A meeting of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April 1994 recommended that Lake Chubsucker be designated Special Concern. This status was re-assessed as Threatened in November 2001. When re-examined in November 2008, Lake Chubsucker status was changed to Endangered. The reason given for this designation was that the Lake Chubsucker is “a species with a restricted geographic Canadian range with small extant populations having very specific and narrow habitat preferences, which are under continued stress. It is extremely susceptible to habitat change driven by urban, industrial and agricultural practices resulting in increased turbidity. Two populations have been lost, and of the 11 extant populations, 3 are in serious decline as a result of the continuing and increasing threats posed by agricultural, industrial and urban development that are expected to impact the remaining populations of Lakes Erie and St. Clair.” Subsequent to the November 2001 COSEWIC designation, Lake Chubsucker was listed on Schedule 1 of the *Species at Risk Act* (SARA) when the Act was proclaimed in June 2003. Lake Chubsucker is now listed as Endangered on Schedule 1.A Recovery Potential Assessment (RPA) process has been developed by Fisheries and Oceans Canada (DFO) to provide information and scientific advice needed to fulfill SARA requirements, including the development of recovery strategies and authorizations to carry out activities that would otherwise violate SARA (DFO 2007). This document provides background information on the Lake Chubsucker to inform the RPA.

CURRENT STATUS

In Canada, the current and historic distribution of Lake Chubsucker is limited to 16 confirmed locations, three of which are currently considered to be extirpated. Extant locations include Old Ausable Channel (OAC), L Lake, Walpole Island dyked marshes, Lake St. Clair (including Mitchell's Bay and the undyked areas of Walpole Island), St. Clair National Wildlife Area (NWA), Point Pelee National Park, Rondeau Bay, Big Creek NWA dyked marshes, Long Point Bay (including Big Creek undyked marshes, Turkey Point marshes and Long Point Inner Bay; hereafter, referred to as Long Point Bay), Long Point NWA, and Lyons Creek (Figure 2). Locations separated by impassable barriers, where dispersal is not a possibility, are taken to be separate locations. Extirpated locations include Jeanette's Creek (a tributary of the Thames River), the upper tributaries of Big Creek (Silverthorn Creek, Lynedock Creek, Trout Creek and Stoney Creek) and Tea Creek (a tributary of Lyons Creek).

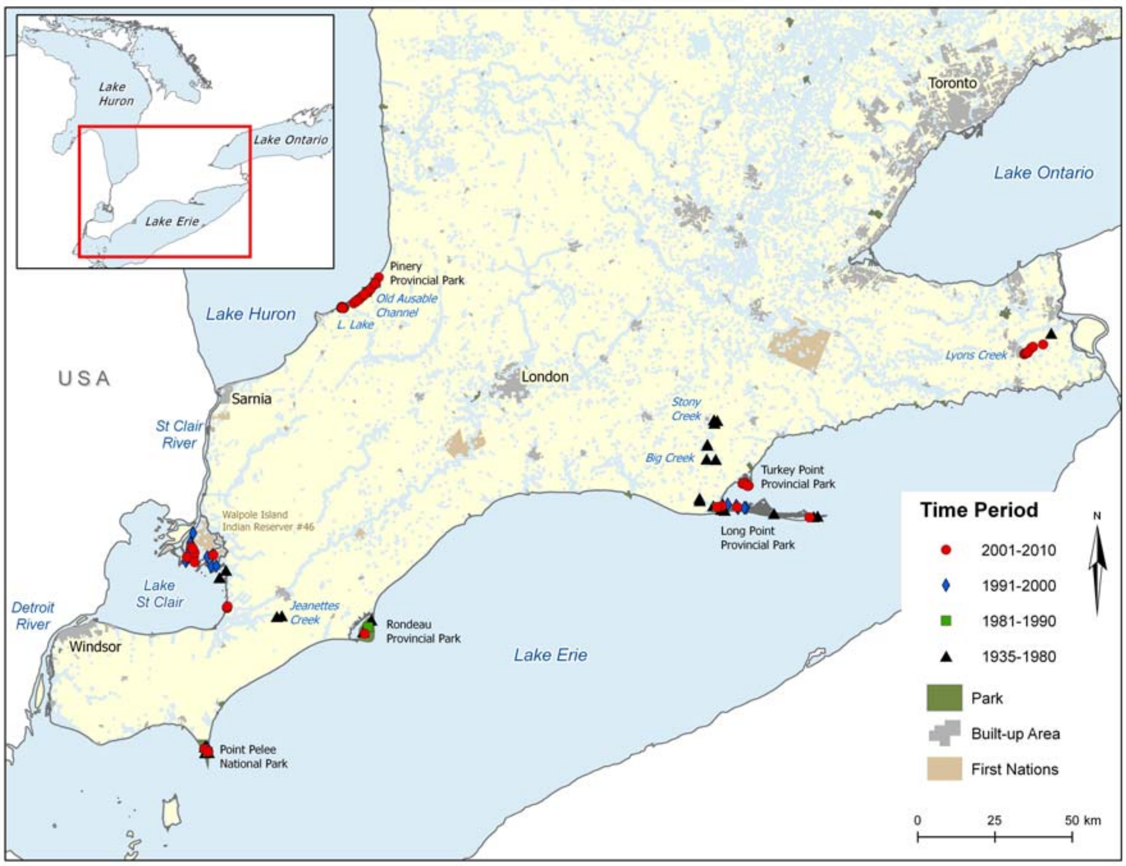

Figure 2. *Distribution of Lake Chubsucker in Canada.*

OLD AUSABLE CHANNEL

It is thought that the Lake Chubsucker occupied the lower Ausable River prior to its diversion in the late 1800s (ARRT 2005). The diversion has since caused a highly turbid system, limiting the distribution of Lake Chubsucker to the protected waters of OAC (Staton *et al.* 2010). Lake Chubsucker was first detected in the OAC in 1982. Subsequent to first detection, Lake Chubsucker have been recorded from this location in 1997 (n=7), 2001 (n=1), 2002 (n=13), 2004 (n=54), 2005 (n=39), 2009 (n=28) and 2010 (n=1). It should be noted that a large Lake Chubsucker winterkill occurred in the OAC in the winter of 2010, which may explain the noticeable difference in the number of individuals caught between 2008-2009 and 2010. The majority of the fish killed were found in the southern end of the residential area (near Pinery boundary) and upstream of the dam in Pinery; however, it should be noted that dead fish were observed from the origin of the OAC to below Pinery dam (K. Jean, Ausable-Bayfield Conservation Authority, pers. comm.). From the winterkill, 68 individuals were collected, ranging in size from 91 to 199 mm TL. Otoliths and scales of all mortalities of the winterkill were aged. Otolith-based ages ranged between 1-6 years; while scale-based ages ranged between 1-5 years; no age 0 fish were observed (Figure 3). A winterkill of this magnitude had not been observed in the OAC since 2003 and it is believed that the contributing factors included a prolonged snow cover and a thick ice pack that lead to oxygen depletion and possibly anoxic waters (K. Jean, Ausable-Bayfield Conservation Authority, pers. comm.).

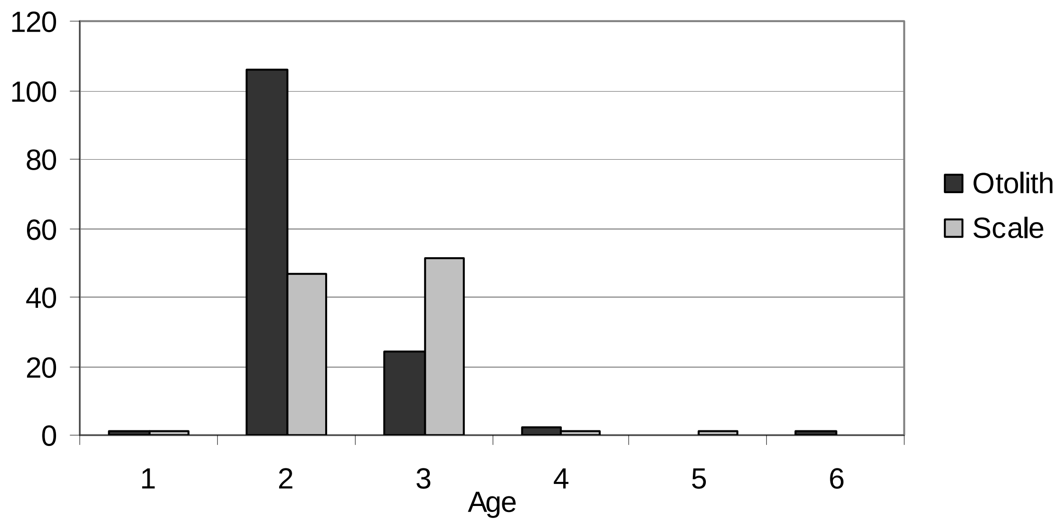

Figure 3. *Age frequency distribution resulting from otolith and scale analysis of fish collected from the Old Ausable Channel after the winterkill of 2010.*

L LAKE

L Lake is an oxbow lake located approximately 3.5 km WSW of the OAC. The first known L Lake sampling event occurred in 2007 with the aid of a boat electrofisher and a seine net. A total of 29 individuals were captured during a 7-day sampling event. Subsequently, L Lake was re-visited in June and August 2010 as part of a depletion survey and a total of 215 individuals were recorded. The length of these individuals ranged from 12 to 143 mm TL (DFO, unpubl. data). Results of the depletion survey indicated a mean population density of 0.0861 (± 0.1385) and 0.0119 (± 0.0181) individuals/m^2 based on data from June and August sampling events, respectively (DFO, unpubl. data).

LAKE ST. CLAIR

For the purposes of the Lake Chubsucker population assessment, all waterbodies directly connected to Lake St. Clair, including Mitchell’s Bay and the undyked waters of Walpole Island, where movement between subpopulation is possible, were grouped. Lake Chubsucker was first recorded from Lake St. Clair in 1949. Subsequent records are sparse and include successful captures in 1952 and 1979 in Mitchell’s Bay, and records scattered from St. Anne Island to the north end of Chemotogan Channel from 1999, 2001 and 2002. Extensive sampling completed in the spring, summer and fall in Mitchell’s Bay in 2003 and 2004, using fyke netting and boat electrofishing failed to collect any individuals.

WALPOLE ISLAND DYKED MARSHES

The Walpole Island marshes Lake Chubsucker records were separated from the Lake St. Clair as the marshes are separated by dykes and movement between these locations is thought to be very unlikely. Lake Chubsucker records exist for the dyked wetlands of Walpole Island for 1999 and 2001. 39 individuals were recorded over a one-day sampling period in 1999, while 125 individuals were recorded over a four-day sampling event in 2001 by the Royal Ontario Museum (ROM). The dyked marshes have not been sampled since 2001.

ST. CLAIR NWA

The St. Clair NWA is located approximately 8.5 km south of Mitchell's Bay. The NWA is separated from Lake St. Clair by use of dykes and fish movement between these two systems is very unlikely. Extensive sampling was completed in the St. Clair NWA in 2003 and 2004 by boat electrofishing and fyke netting. Although Lake Chubsucker did not appear in the 2003 sampling, six individuals (ranging in size from 66-255 mm) were recorded in 2004. The St. Clair NWA is composed of an eastern and a western cell. All individuals were recorded from the western cell, although limited sampling has occurred in the eastern cell.

JEANETTE'S CREEK

Jeanette's Creek is a tributary of the Thames River. Historically, two records of Lake Chubsucker exist for Jeanette's Creek (1963 and 1965) and were recorded approximately 20 km upstream of the confluence with the Thames River. This area has been re-sampled on numerous occasions in recent years and has not yielded the capture of any additional Lake Chubsucker. The site of initial capture has more recently been described as very turbid, channelized, and forming part of an agricultural drain (COSEWIC 2008). This type of habitat is no longer consistent with Lake Chubsucker preferred habitat, and this species is thought to be extirpated from this area.

POINT PELEE NATIONAL PARK

Lake Chubsucker was first recorded from Point Pelee National Park (PPNP) in 1949. Since this first collection, Lake Chubsucker has been recorded from PPNP in 1968, 1972, 1979, 1983, 1993, and 2003. All Lake Chubsucker records from the park are restricted to three ponds; Lakepond, Redhead Pond, and Girardin Pond. However, it should be noted that the most recent verified record from Lakepond is from 1972 despite extensive sampling in 2002 and 2003 (Surette 2006), leading park staff to believe that Lake Chubsucker may no longer be present in Lakepond. The loss of Lake Chubsucker from Lakepond would indicate that there is an overall decline in the Lake Chubsucker area of occupancy at Point Pelee National Park (V. McKay, Parks Canada Agency, pers. comm.). A total of 30 individuals were collected from Redhead and Girardin ponds in 2003 ranging from 46-247 mm TL in size, suggesting that a reproducing population is likely present (COSEWIC 2008).

RONDEAU BAY

The first record of Lake Chubsucker from Rondeau Bay dates back to 1955 when 14 individuals were captured. There have been very limited known occurrences in Rondeau Bay since this date of first capture, with records from 1963, 1983, and 2005. The inner marshes of Rondeau Bay have been sampled on numerous occasions with the aid of seine nets, fine-mesh hoopnets and electrofishing in 2005 and 2007-2009. All records, both historic and current, occur within the Rondeau Bay Provincial Park boundaries.

LONG POINT BAY

For the purposes of this population status assessment, Big Creek undyked marshes, Turkey Point marshes, and Long Point Inner Bay were grouped together and will be referred to as Long

Point Bay. These areas were grouped because they are directly connected to each other and movement between these areas is possible. Lake Chubsucker has been recorded from Long Point Inner Bay in 1955, 1982, 1994, 1999, and 2004. Additional records from the undyked marshes of Big Creek exist from 1979, 1982 and more recently, from 2008 when two individuals were recorded from a site approximately 2 km upstream of where the mouth of the Big Creek flows into Long Point Inner Bay. A total of 22 individuals were captured from Turkey Point in 2007 and an additional two individuals were captured in 2010.

LONG POINT NWA
Long Point NWA is located on the eastern portion of the large spit forming the southern boundary of Long Point Bay. This portion of the spit is characterized by several small ponds, and should be considered a separate location from Long Point Inner Bay as movement between these locations is unlikely. Due to its remote location, there have been very few sampling events in this area. From these limited sampling activities, Lake Chubsucker was captured in 1952, 1975, and 2005 (represented by a single individual).

BIG CREEK UPPER TRIBUTARIES
Historic Lake Chubsucker records exist for several of the tributaries in the upper reaches of the lower Big Creek watershed (1960, 1972, 1973, 1974, and 1979). All voucher specimens were verified to be Lake Chubsucker (E. Holm, Royal Ontario Museum, pers. comm.). Sites where these records originated include Silverthorn Creek, Stoney Creek, Lyndeock Creek, and Trout Creek. Re-sampling of all historic sites in 2008 revealed that many of the historic sites were now buried agricultural drains or are dry (COSEWIC 2008). These sites no longer provide suitable habitat for Lake Chubsucker and this species is thought to be extirpated from the upper tributaries of Big Creek.

BIG CREEK NWA DYKED MARSHES
The dyked marshes of Big Creek NWA should be considered a separate location from the open wetlands of Big Creek NWA and ultimately, a separate location from Long Point Inner Bay as movement between these areas is prevented by the presence of dykes. The dyked marshes were sampled exclusively in 2005 with the aid of a seine net, and resulted in the capture of seven individuals. It is believed that no additional sampling has occurred in this area prior to or subsequent to 2005.

LYONS CREEK
Lyons Creek is a tributary of the Niagara River. It is generally considered to be composed of highly degraded habitat and poor water quality with the exception of a clear segment approximately 2 km long that receives overflow water from the Welland Canal. Approximately half of the Lake Chubsucker records collected since 2004 were located in this clear segment of Lyons Creek. The remaining records are from the 8 km section of Lyons Creek immediately downstream. A total of five, 28, 20, and 13 Lake Chubsucker were captured from Lyons Creek in 2004, 2008, 2009 and 2010, respectively. Sampling events of Lyons Creek in 2010 were also used in the preliminary depletion study described above. Unfortunately, only three of the sites sampled fulfilled the requirements necessary to complete the population estimate analysis. Results indicated that the mean population density was 0.0105 (± 0.0156) individuals/m^2 (DFO, unpubl. data).

TEA CREEK
Tea Creek is a small tributary to Lyons Creek. A single historic record exists for Tea Creek from 1958. This location has been sampled on numerous occasions since 1958 and has not yielded any additional records. The habitat in the vicinity of the historic record at present is considered

to be not suitable for Lake Chubsucker and this species is thought to be extirpated from Tea Creek.

POPULATION STATUS

To assess the Population Status of Lake Chubsucker populations in Canada, each location was ranked in terms of its abundance (Relative Abundance Index) and trajectory (Population Trajectory) (Table 1). The Relative Abundance Index was assigned as Extirpated, Low, Medium, High, or Unknown. Sampling parameters considered included gear used, area sampled, sampling effort, and whether the study was targeting Lake Chubsucker. The number of individual Lake Chubsucker caught during each sampling period was then considered when assigning the Relative Abundance Index. The Relative Abundance Index is a relative parameter in that the values assigned to each population are relative to the most abundant population. In the case of Lake Chubsucker, all populations were assigned an Abundance Index relative to the L Lake population. Catch-data from populations sampled using different gear types were assumed to be comparable when assigning the Relative Abundance Index.

The Population Trajectory was assessed as Decreasing, Stable, Increasing, or Unknown for each population based on the best available knowledge about the current trajectory of the population. The number of individuals caught over time for each population was considered. Trends over time were classified as Increasing (an increase in abundance over time), Decreasing (a decrease in abundance over time) and Stable (no change in abundance over time). If insufficient information was available to inform the Population Trajectory, the population was listed as Unknown.

Certainty has been associated with the Relative Abundance Index and Population Trajectory rankings and is listed as: 1=quantitative analysis; 2=CPUE or standardized sampling; 3=expert opinion.

Table 1. *Relative Abundance Index and Population Trajectory of each Lake Chubsucker population in Canada. Certainty has been associated with the Relative Abundance Index and Population Trajectory rankings and is listed as: 1=quantitative analysis; 2=CPUE or standardized sampling; 3=expert opinion.*

Population	Relative Abundance Index	Certainty	Population Trajectory	Certainty
Old Ausable Channel	Medium	2	Stable	2
L Lake	High	1	Unknown	2
Lake St. Clair	Low	3	Unknown	3
Walpole Island (dyked marshes)	Medium	3	Unknown	3
St. Clair NWA	Low	2	Unknown	3
Jeanette's Creek	Extirpated	2	-	-
Point Pelee National Park	Low	2	Decreasing	3
Rondeau Bay	Low	3	Unknown	3
Long Point Bay	Low	3	Unknown	3
Long Point NWA	Low	3	Unknown	3
Big Creek (upper tributaries)	Extirpated	2	-	-
Big Creek NWA (dyked marshes)	Low	2	Unknown	3
Lyons Creek	Medium	1	Unknown	2
Tea Creek	Extirpated	2	-	-

The Relative Abundance Index and Population Trajectory values were then combined in the Population Status matrix (Table 2) to determine the Population Status for each population. Population Status was subsequently ranked as Poor, Fair, Good, Unknown, or Not applicable (Table 3). Certainty assigned to each Population Status is reflective of the lowest level of certainty associated with either initial parameter (Relative Abundance Index, or Population Trajectory).

Table 2. *The Population Status Matrix combines the Relative Abundance Index and Population Trajectory rankings to establish the Population Status for each Lake Chubsucker population in Canada. The resulting Population Status has been categorized as Extirpated, Poor, Fair, Good, or Unknown.*

		Population Trajectory			
		Increasing	**Stable**	**Decreasing**	**Unknown**
Relative Abundance Index	**Low**	Poor	Poor	Poor	Poor
	Medium	Fair	Fair	Poor	Poor
	High	Good	Good	Fair	Fair
	Unknown	Unknown	Unknown	Unknown	Unknown
	Extirpated	Extirpated	Extirpated	Extirpated	Extirpated

Table 3. *Population Status of all Lake Chubsucker populations in Canada, resulting from an analysis of both the Relative Abundance Index and Population Trajectory. Certainty assigned to each Population Status is reflective of the lowest level of certainty associated with either initial parameter (Relative Abundance Index, or Population Trajectory).*

Population	Population Status	Certainty
Old Ausable Channel	Fair	2
L Lake	Fair*	2
Lake St. Clair	Poor	3
Walpole Island (dyked marshes)	Poor	3
St. Clair NWA	Poor	3
Jeanette's Creek	Extirpated	2
Point Pelee National Park	Poor	3
Rondeau Bay	Poor	3
Long Point Bay	Poor	3
Long Point NWA	Poor	3
Big Creek (upper tributaries)	Extirpated	2
Big Creek NWA (dyked marshes)	Poor	3
Lyons Creek	Poor	2
Tea Creek	Extirpated	2

* L Lake is considered to be the healthiest Lake Chubsucker population. Please see Sources of Uncertainty for additional information related to the population status classification.

HABITAT REQUIREMENTS

SPAWNING AND NURSERY

In Ontario, Lake Chubsucker are thought to be spring spawners, spawning between late April and June, when temperatures reach approximately 20°C (COSEWIC 2008). Spawning habitat consists of shallow waters of bays, the lower reaches of tributaries, or ponds and marshes with aquatic vegetation beds, dead grass, or filamentous algae (Goodyear *et al.* 1982). Spawning behaviour includes males clearing an area in the sand, silt, or often gravel, which is then used by the female to deposit between 3000 and 20 000 eggs (number of eggs is thought to be size-dependent) (COSEWIC 2008). The eggs subsequently hatch when water temperature reaches between 22 and 29°C (Cooper 1983). Nursery habitat has been described as water 2 m in depth composed of submergent and emergent vegetation over a substrate of silt, sand, or clay (Lane *et al.* 1996).

YOUNG-OF-THE-YEAR (YOY) AND JUVENILE

YOY preferred habitat has been described as shallow areas (0 to 2 m) containing heavy aquatic vegetation and substrates of silt, sand, and clay (Goodyear *et al.* 1982; Becker 1983; Lane *et al.* 1996). Lake Chubsucker YOY were captured from Long Point Inner Bay, and a habitat description of the capture location was provided (Leslie and Timmins 1997). This area was described as a heavily vegetated drainage ditch with water temperature between 24 and 28°C (Leslie and Timmins 1997). During the same study, additional YOY individuals were captured from Walpole Island in approximately 10 cm of water under a layer of leaves in a roadside ditch (Leslie and Timmins 1997).YOY captured from L Lake in June 2010 (n=28) were captured when water temperatures were between 22 and 25°C and dissolved oxygen ranged between 6.93 and 9.07 mg/L (DFO, unpubl. data). The substrate at all sampling locations was described as 100% organic. Vegetative cover (combination of submergent, floating and emergent) was greater than

70%, with dominant species of watershield (*Brasenia schreberi*), water lily (*Nymphaea* sp.), milfoil (*Myriophyllum sibiricum*) or chara (*Chara* spp.) (DFO, unpubl. data).

In addition to YOY, age 1+ individuals were also recorded from Long Point, and were found in marshes associated with hairgrass (*Eleocharis* sp.), sedges (*Carex* sp.) and cattails (*Typha* sp.) (Leslie and Timmins 1997). Juveniles captured from L Lake in June 2010 were captured when water temperatures ranged from 21 to 24°C and dissolved oxygen was between 5.39 and 13.71 mg/L (DFO, unpubl. data). Similarly to the YOY habitat description for L Lake, all individuals were captured from sites composed of 100% organic substrate. Vegetative cover at sites where juveniles were found was greater than 75%, with the dominant vegetation type at all sites being listed as chara (DFO, unpubl. data).

ADULT

Adult Lake Chubsucker are generally found in clear, still, well-vegetated waters, such as those provided by backwaters, drainage ditches, floodplain lakes, marshes, oxbows, sloughs, or wetlands (COSEWIC 2008). Substrate in these systems is generally composed of gravel, sand, and silt mixed with organic debris (COSEWIC 2008). In Ontario, adult Lake Chubsucker are commonly found in heavily vegetated systems with very low turbidity. Based on all known Lake Chubsucker records in Ontario where water depth was available, Lake Chubsucker appear to occupy areas with water depth ranging from 0.38 to 2 m; although, it should be considered that the upper bound of this range may reflect sampling restrictions. Lake Chubsucker sampling from L Lake in 2010 indicated that Lake Chubsucker were found in areas where the substrate was classified as being greater than 90% organic (DFO, unpubl. data). It appears that throughout the range of Lake Chubsucker in Ontario, protected coastal wetlands and dyked marshes play a crucial role in the maintenance of preferred Lake Chubsucker habitat and subsequently, are of paramount importance for this species.

RESIDENCE

Residence is defined in SARA as a, “dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding, or hibernating”. Residence is interpreted by DFO as being constructed by the organism. In the context of the above narrative description of habitat requirements during YOY, juvenile and adult life stages, Lake Chubsucker do not construct residences during their life cycle.

THREATS

A wide variety of threats negatively impact Lake Chubsucker across its range. Our knowledge of threat impacts on Lake Chubsucker populations is limited to general documentation, as there is a paucity of threat-specific cause and effect information in the literature. The greatest threats to the survival and persistence of Lake Chubsucker in Canada are related to habitat modification and destruction, increases in turbidity and sediment loading resulting from agricultural practices, and increases in nutrient loading. The presence of pristine, highly vegetated systems in Ontario, where Lake Chubsucker thrive, is very limited. Lesser threats that may be affecting the survival of Lake Chubsucker include the introduction of exotic species and incidental harvest, although the current knowledge on the level of impact that these threats may have on Lake Chubsucker is very limited.

A distinct challenge presents itself when considering the effect of the various threats on Lake Chubsucker of Long Point Bay as the areas being considered (Long Point Inner Bay, Long Point

NWA, Turkey Point marshes, and Big Creek marshes) are very diverse, facing varying pressures from different threats. Therefore, for the purposes of the threat assessment, these four areas will be discussed independently.

It is important to note the threats discussed below may not always act independently on Lake Chubsucker populations; rather, one threat may directly affect another, or the interaction between two threats may introduce an interaction effect on Lake Chubsucker populations. It is quite difficult to quantify these interactions; therefore, each threat is discussed independently.

HABITAT MODIFICATIONS

Physical loss of Lake Chubsucker habitat can occur through habitat modification or destruction. Major causes of habitat loss for Lake Chubsucker in Ontario appear to be wetland draining, loss of habitat through agricultural practices, and shoreline development (COSEWIC 2008; Staton *et al.* 2010). Additionally water level manipulations may indirectly affect Lake Chubsucker by decreasing the amount of Lake Chubsucker preferred habitat that is available. These modifications are altering or destroying the quiet, densely vegetated areas that are vital to all Lake Chubsucker life stages. In addition, these modifications may lead to increased siltation compounding the direct effects of habitat modifications on Lake Chubsucker survival.

The Lyons Creek population of Lake Chubsucker is very dependent on the clean water overflow from the Welland River. A decrease in the amount of water moving from the Welland River to Lyons Creek through this overflow may cause dewatering of the Lake Chubsucker preferred habitat in this system, while stopping this overflow could cause a complete loss of habitat.

Loss of preferred habitat resulting from water level manipulations is an ongoing concern for Lake Chubsucker. As an example, the removal of beaver dams can lead to substantial decreases in water levels, and result in the loss of Lake Chubsucker habitat. Systems such as the OAC and L Lake have been noted to be particularly sensitive to this type of habitat modification. Another example of a water level manipulation practice that may have negative effects on Lake Chubsucker habitat is deliberate water drawdown techniques that have now been widely adopted to aid in aquatic vegetation propagation and ultimately for the management of habitat for waterfowl. One Lake Chubsucker location where this type of water management practice may be of particular concern is the St. Clair NWA. Although the increase in vegetation in these systems may be beneficial to Lake Chubsucker over the long term, substantial losses of preferred habitat occurring during the drawdown period may impact populations in the short term; concerns have also been raised that greatly reduced water levels may concentrate individuals exposing them to increased levels of predation from predatory birds.

Areas identified as being historically susceptible to wetland loss include Rondeau Bay, Long Point Bay, and Point Pelee (COSEWIC 2008). It has been estimated that close to 60% of the historic wetlands that once connected Point Pelee to Hillman Marsh were drained and dyked during late 1800s to mid-1900s for agricultural purposes (Dobbie *et al.* 2006). This loss of historic wetlands has undoubtedly decreased the amount of preferred habitat available for Lake Chubsucker at Point Pelee. Areas most affected by the loss of habitat through agricultural practices include the upper tributaries of the Big Creek. During an attempted sampling visit to Silverthorn Creek, a historic Lake Chubsucker location, it was noted that the drain has now been tiled and completely buried (COSEWIC 2008), while many other areas where Lake Chubsucker were previously found in the upper tributaries of Big Creek have been transformed into channelized municipal drains for agricultural purposes (Staton *et al.* 2010). Areas that have been identified as being particularly affected by shoreline development include Long Point Inner

Bay, which faces increased pressures from construction and maintenance of marinas. Another example is the eastern shore of Lake St. Clair which has undergone substantial shoreline development.

Fortunately, many of the areas presently occupied by Lake Chubsucker are within protected areas (e.g., OAC, L Lake, St. Clair NWA, PPNP, Long Point NWA and Big Creek NWA) where habitat modification is prohibited or strongly regulated. These locations are afforded extra protection and, in some cases, are managed to maintain highly vegetated, productive systems.

TURBIDITY AND SEDIMENT LOADING

Increases in sediment loading and turbidity may be detrimental to Lake Chubsucker survival and recovery. Increases in sediment loading can be attributed to poor agricultural and land management practices, increases in industrial and urban development, dredging activities, and the removal of riparian vegetation. Lake Chubsucker is thought to be intolerant of highly turbid systems, making this threat a leading cause of decreases to the survival of Lake Chubsucker (COSEWIC 2008). In addition to the direct impact of increased turbidity on Lake Chubsucker, high levels of siltation may impede the growth of macrophytes by limiting the amount of sunlight that is able to penetrate the water column (Staton *et al.* 2010).

The extirpation of Lake Chubsucker populations from Tea Creek and Jeanette's Creek have been both attributed to habitat degradation resulting from increased turbidity and siltation from agricultural practices (Staton *et al.* 2010). The historic site where Lake Chubsucker was recorded from Tea Creek is now considered to be a highly degraded, entrenched channel that is no longer suitable for Lake Chubsucker. The Lyons Creek population of Lake Chubsucker is currently maintained by the clear water overflow of the Welland Canal, but this is limited to a small segment of this system. A similar situation exist for the Jeanette's Creek population where the extirpation of Lake Chubsucker from this location was attributed to increased siltation and turbidity from agriculture, industry, and urbanization (TRRT 2005).

During storm events, Big Creek can become very turbid causing an evident turbidity plume in Long Point Inner Bay. Although turbidity values are currently not available for either Big Creek or Long Point Inner Bay, these increased levels of turbidity may be affecting Lake Chubsucker habitat.

NUTRIENT LOADING

Degradation of Lake Chubsucker preferred habitat may also result from increases in nutrient (nitrates and phosphorus) loading. Increased nutrient loading can be the result of fertilizer releases into the waterbody, loading from sewage treatment plants, and nutrient runoff from manure piles. These increased nutrient levels can subsequently lead to the prolific growth of algal blooms and, consequently, to decreased levels of dissolved oxygen once the blooms begin to senesce (EERT 2008). Although Lake Chubsucker is tolerant of low levels of dissolved oxygen (Cooper 1983), when the blooms senesce in the winter months it may result in the deposit of a thick organic material that smothers habitat and creates anoxic zones.

A study at Point Pelee National Park (Sanctuary Pond) was completed in 1994 to determine the cause of elevated nutrient concentrations leading to prolific algal growth (Mayer *et al.* 1999). It was determined that organic matter decomposition was an important mechanism leading to high concentrations of nutrients and that resuspension of bottom sediment, primarily by Common Carp foraging behaviour, were most likely responsible for the hypereutrophic conditions (Mayer *et al*. 1999). Although Lake Chubsucker has yet to be recorded from Sanctuary Pond, Common Carp are present throughout Point Pelee National Park and may be affecting Lake Chubsucker preferred habitat by creating a hypereutrophic environment leading to increased algal growth.

CONTAMINANTS AND TOXIC SUBSTANCES

Lake Chubsucker is considered to be a pollution-intolerant species, although there is a lack of evidence on the direct or indirect effects of contaminants and toxic substances on Lake Chubsucker populations. An area of particular concern related to increased toxic substances is Lyons Creek where contaminated sediment and PCB contamination is an ongoing concern (Staton *et al.* 2010). An intensive PCB contamination study was completed for Lyon's Creek East in the fall of 2002 and 2003 (Milani and Fletcher 2005). The results indicated that the area from the Welland Canal to Highway 140, the area encompassing most of the Lake Chubsucker records, has the highest levels of PCBs and metals in the sediment, higher than sediment quality guidelines (Milani and Fletcher 2005). They also noted that in addition to sediment contamination, this area had the highest benthic invertebrate, fish and mussel PCB concentrations (Milani and Fletcher 2005).

EXOTIC SPECIES

The introduction of exotic fish species to areas occupied by Lake Chubsucker may also have an unfavorable effect on the local Lake Chubsucker population. For the purposes of this document exotic species are defined as a species that is considered to be non-native to the location being discussed. The feeding behaviour of Common Carp is known to have serious negative impacts on aquatic systems by uprooting aquatic vegetation and increasing turbidity levels (Lougheed *et al.* 1998; Lougheed *et al.* 2004). This feeding behaviour may have significant effects on Lake Chubsucker, which require aquatic vegetation for many of their life processes and are extremely sensitive to turbidity. The effect that other exotic fish species may have on Lake Chubsucker populations is currently unknown.

In addition to exotic fish species, exotic aquatic vegetation may also pose a threat to Lake Chubsucker preferred habitat. One species of particular concern is common reed (*Phragmites australis*) which is characterized by its ability to prolifically grow once introduced. Common reed is known to rapidly overtake the wetland areas, negatively affecting native plants, and rendering potential Lake Chubsucker habitat useless for spawning and other life processes. Three locations where the introduction and proliferation of common reed may be particularly harmful to Lake Chubsucker are Point Pelee National Park, Rondeau Bay and Walpole Island.

INCIDENTAL HARVEST

The use of Lake Chubsucker as a baitfish is illegal in Ontario (OMNR 2011a); however, baitfish harvesting and sale occurs within the range of Lake Chubsucker and it may be caught incidentally. There are two typical baitfish harvest methods used in the baitfish industry. The first consists of a lacustrine nearshore baitfish harvest, which generally targets Emerald Shiner (*Notropis atherinoides*) habitat consisting of clear and sandy-bottom areas. This type of habitat is inconsistent with Lake Chubsucker preferred habitat and, therefore, the threat of incidental harvest from this method is thought to be negligible (A. Drake, DFO, pers. comm.). Of greater concern, is the inland baitfish harvest industry. This type of baitfish harvest generally occurs in rivers and streams at road crossings that provide easy access to the waterway. This type of harvest may occur in areas with habitat similar to Lake Chubsucker preferred habitat but, due to the rarity of this species and sparse distribution, the probability of incidental capture is still considered to be low and may only affect a few populations (A. Drake, DFO, pers. comm.). It should also be noted that incidental harvest is highly unlikely to occur in protected areas (e.g., OAC, St. Clair NWA, PPNP, Long Point NWA and Big Creek NWA).

CLIMATE CHANGE

Through discussion on the effects of climate change on Canadian fish populations, impacts such as increases in water and air temperatures, changes (decreases) in water levels, shortening of the duration of ice cover, increases in the frequency of extreme weather events, emergence of diseases, and shifts in predator-prey dynamics have been highlighted, all of which may negatively impact native fishes (Lemmen and Warren 2004). Doka *et al*. (2006) completed an assessment on the projected impacts of climate change on wetland fish assemblages by ranking fish species vulnerability to climate change. A vulnerability matrix was calculated and was based on species status, and thermal and habitat associations (Doka *et al*. 2006). Results indicated that, of the 99 fish species assessed, Lake Chubsucker was ranked as the fourth most vulnerable species. Climate change will have wide-reaching direct and indirect effects on fish species that rely on wetland areas for their survival. Since the effects of climate change on Lake Chubsucker are speculative, it is difficult to determine the likelihood and impact of this threat on each Lake Chubsucker population; therefore, the threat of climate change is not included in the following population-specific threat level analysis.

THREAT LEVEL

To assess the Threat Level of Lake Chubsucker populations in Canada, each threat was ranked in terms of the Threat Likelihood and Threat Impact on a population basis (Table 4, 5). The Threat Likelihood was assigned as Known, Likely, Unlikely, or Unknown, and the Threat Impact was assigned as High, Medium, Low, or Unknown. Threat Impact categorization is location specific, in that impact categorization was assigned on a location-by-location basis. If no information was available on the Threat Impact at a specific location, a precautionary approach was used - the highest level of impact from all sites was applied. The Threat Likelihood and Threat Impact for each population were subsequently combined in the Threat Level Matrix (Table 6) resulting in the final Threat Level for each location (Table 7). Certainty has been classified for Threat Impact and is based on: 1= causative studies; 2=correlative studies; and, 3=expert opinion.

__Table 4.__ Definition of terms used to describe Threat Likelihood, Threat Impact and Certainty.

Term	Definition
Threat Likelihood	
Known (K)	This threat has been recorded to occur at site X.
Likely (L)	There is a > 50% chance of this threat occurring at site X.
Unlikely (U)	There is a < 50% chance of this threat occurring at site X.
Unknown (UK)	There are no data or prior knowledge of this threat occurring at site X.
Threat Impact	
High (H)	Currently, the threat is jeopardizing the survival or recovery of the population. OR If the threat was to occur, it would jeopardize the survival or recovery of the population.
Medium (M)	Currently, the threat is likely jeopardizing the survival or recovery of the population. OR If threat was to occur, it would likely jeopardize the survival or recovery of the population.
Low (L)	Currently, the threat is unlikely jeopardizing the survival or recovery of the population. OR If threat was to occur, it would be unlikely to jeopardize the survival or recovery of the population.
Unknown (UK)	There is no prior knowledge, literature or data to guide the assessment of the impact if it were to occur.
Certainty (as it relates to Threat Impact)	
1	Causative study
2	Correlative study
3	Expert opinion

Table 5. *Threat Likelihood and Threat Impact of each Lake Chubsucker population in Canada. The Threat Likelihood was assigned as Known (K), Likely (L), Unlikely (U), or Unknown (UK), and the Threat Impact was assigned as High (H), Medium (M), Low (L), or Unknown (UK). Certainty is associated with Threat Impact (TI) and is based on the best available data (1= causative studies; 2=correlative studies; and 3=expert opinion). References (Ref) are provided. Gray cells indicate that the threat is not applicable to the population due to the nature of the aquatic system where the population is located.*

	Old Ausable Channel				L Lake				Lake St. Clair			
	TLH	TI	C	Ref	TLH	TI	C	Ref	TLH	TI	C	Ref
Habitat modifications	K	H	3	1,2	U	H	3	13	U	H	3	17
Turbidity and sediment loading	K	L	3	1,2,17	U	H	3	13	U	H	3	17
Nutrient loading	K	H	3	1,2,17	U	M	3	13,17	U	M	3	17
Contaminants and toxic substances	UK	L	3	13	UK	L	3	13	K	L	3	17
Exotic species	K	M	3	1,2	K	M	3	9,13,16	K	M	3	17
Incidental harvest	U	L	3	12	U	L	3	12	U	L	3	12

	Walpole Island (dyked marshes)				St. Clair NWA				Point Pelee National Park			
	TLH	TI	C	Ref	TLH	TI	C	Ref	TLH	TI	C	Ref
Habitat modifications					K	M	3	3,15,17	K	H	3	4
Turbidity and sediment loading					U	L	3	15	L	H	3	4,5,6,17
Nutrient loading					U	L	3	15	K	M	3	4,5,6,7,17
Contaminants and toxic substances					U	L	3	15	K	L	3	4
Exotic species					K	M	3	15	K	M	3	4,5,6,7
Incidental harvest	U	L	3	12	U	L	3	12,15	U	L	3	4,12

	Rondeau Bay				Big Creek (undyked marshes)				Turkey Point			
	TLH	TI	C	Ref	TLH	TI	C	Ref	TLH	TI	C	Ref
Habitat modifications	U	H	3	17	K	H	3	11,15	U	H	3	11
Turbidity and sediment loading	K	H	3	8	K	H	3	11	L	H	3	11
Nutrient loading	K	M	3	8,17	K	M	3	11,15	U	M	3	11
Contaminants and toxic substances	K	L	3	8	U	L	3	11	U	L	3	11
Exotic species	K	M	3	8,9	K	H	3	11,17	K	H	3	11,17
Incidental harvest	L	L	3	12	U	L	3	12	U	L	3	11,17

Table 5 (continued)

	Long Point Inner Bay				Long Point NWA				Big Creek (dyked marshes)			
	TLH	TI	C	Ref	TLH	TI	C	Ref	TLH	TI	C	Ref
Habitat modifications	K	H	3	17	K	H	3	11	K	H	3	15
Turbidity and sediment loading	U	H	3	11,17	U	H	3	11,15	U	L	3	15
Nutrient loading	U	M	3	11,17	U	M	3	11	U	L	3	15
Contaminants and toxic substances	U	L	3	17	U	L	3	11	U	L	3	15
Exotic species	K	H	3	11,17	K	H	3	11,17	U	M	3	15
Incidental harvest	U	L	3	12	L	L	3	11,15	U	L	3	12,15

	Lyons Creek			
	TLH	TI	C	Ref
Habitat modifications	K	H	3	10,17,18
Turbidity and sediment loading	K	H	3	10,17,18
Nutrient loading	K	M	3	10,18
Contaminants and toxic substances	K	M	3	10,14
Exotic species	K	L	3	10,17
Incidental harvest	U	L	3	10,12

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1. ARRT (2005)
2. Nelson *et al.* (2003)
3. EERT (2008)
4. V. McKay, Parks Canada Agency, pers. comm.
5. Dobbie *et al.* (2006)
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14. Milani and Fletcher (2005)
15. J. Robinson, Canadian Wildlife Service, pers. comm.
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17. Lake Chubsucker Recovery Potential Assessment Participants, Burlington Art Centre, 9 March 2011
18. A. Yagi, Ontario Ministry of Natural Resources, pers. comm.

Table 6. *The Threat Level Matrix combines the Threat Likelihood and Threat Impact rankings to establish the Threat Level for each Lake Chubsucker population in Canada. The resulting Threat Level has been categorized as Poor, Fair, Good, or Unknown.*

		Threat Impact			
		Low (L)	Medium (M)	High (H)	Unknown (UK)
Threat Likelihood	Known (K)	Low	Medium	High	Unknown
	Likely (L)	Low	Medium	High	Unknown
	Unlikely (U)	Low	Low	Medium	Unknown
	Unknown (UK)	Unknown	Unknown	Unknown	Unknown

Table 7. *Threat Level for all Lake Chubsucker populations, resulting from an analysis of both the Threat Likelihood and Threat Impact. The number in brackets refers to the level of certainty assigned to each Threat Level, which relates to the level of certainty associated with Threat Impact. Certainty has been classified as: 1= causative studies; 2=correlative studies; and 3=expert opinion. Gray cells indicate that the threat is not applicable to the population due to the nature of the aquatic system where the population is located. Clear cells do not necessarily represent a lack of a relationship between a population and a threat; rather, they indicate that either the Threat Likelihood or Threat Impact was Unknown.*

	Old Ausable Channel	**L Lake**	**Lake St. Clair**	**Walpole Island (dyked marshes)**
Habitat modifications	High (3)	Medium (3)	Medium (3)	
Turbidity and sediment loading	Low (3)	Medium (3)	Medium (3)	
Nutrient loading	High (3)	Low (3)	Low (3)	
Contaminants and toxic substances	Unknown (3)	Unknown (3)	Low (3)	
Exotic species	Medium (3)	Medium (3)	Medium (3)	
Incidental harvest	Low (3)	Low (3)	Low (3)	Low (3)

	St. Clair NWA	**Point Pelee National Park**	**Rondeau Bay**	**Big Creek (undyked marshes)**
Habitat modifications	Medium (3)	High (3)	Medium (3)	High (3)
Turbidity and sediment loading	Low (3)	High (3)	High (3)	High (3)
Nutrient loading	Low (3)	Medium (3)	Medium (3)	Medium (3)
Contaminants and toxic substances	Low (3)	Low (3)	Low (3)	Low (3)
Exotic species	Medium (3)	Medium (3)	Medium (3)	High (3)
Incidental harvest	Low (3)	Low (3)	Low (3)	Low (3)

	Turkey Point	**Long Point Inner Bay**	**Long Point NWA**	**Big Creek (dyked marshes)**
Habitat modifications	Medium (3)	High (3)	High (3)	High (3)
Turbidity and sediment loading	High (3)	Medium (3)	Medium (3)	Low (3)
Nutrient loading	Low (3)	Low (3)	Low (3)	Low (3)
Contaminants and toxic substances	Low (3)	Low (3)	Low (3)	Low (3)
Exotic species	High (3)	High (3)	High (3)	Low (3)
Incidental harvest	Low (3)	Low (3)	Low (3)	Low (3)

Table 7 (continued)

	Lyons Creek
Threat	**Lake Chubsucker**
Habitat modifications	High (3)
Turbidity and sediment loading	High (3)
Nutrient loading	Medium (3)
Contaminants and toxic substances	Medium (3)
Exotic species	Low (3)
Incidental harvest	Low (3)

The Threat Level results were used to assess the overall effect each threat may have on Canadian Lake Chubsucker populations as a whole. Each threat was categorized in terms of both Spatial and Temporal Extent (Table 8). Spatial Extent was categorized as Widespread [threat is likely to affect a majority of Lake Chubsucker locations (i.e., threat affecting 7 or more locations)] or Local [threat is likely to not affect a majority of Lake Chubsucker locations (i.e., threat affecting less than 7 locations)]. Temporal Extent was categorized as Chronic (threat that is likely to have a long-lasting, or re-occurring affect at a location) or Ephemeral (threat that is likely to have a short-lived, or non-recurring affect at a location).

Table 8. *Overall effect of threats on Lake Chubsucker populations. Spatial Extent was categorized as Widespread or Local, while Temporal Extent was categorized as Chronic or Ephemeral (see text for description of categorization).*

Threat	Spatial Extent	Temporal Extent
Habitat modifications	Widespread	Chronic
Turbidity and sediment loading	Widespread	Chronic
Nutrient loading	Local	Chronic
Contaminants and toxic substances	Local	Chronic
Exotic species	Widespread	Chronic
Incidental harvest	Local	Ephemeral

MITIGATIONS AND ALTERNATIVES

Numerous threats affecting Lake Chubsucker populations are related to habitat loss or degradation. Habitat-related threats to Lake Chubsucker have been linked to the Pathways of Effects developed by DFO FHM (Table 9). DFO FHM has developed guidance on generic mitigation measures for 19 Pathways of Effects for the protection of aquatic species at risk in the Ontario Great Lakes Area (Coker *et al*. 2010). This guidance should be referred to when considering mitigation and alternative strategies. Additional mitigation and alternative measures, specific to the Lake Chubsucker, related to exotic species and incidental harvest are listed below.

Table 9. *Threats to Lake Chubsucker populations in Canada and the Pathways of Effect associated with each threat. 1 - Vegetation clearing; 2 – Grading; 3 – Excavation; 4 – Use of explosives; 5 – Use of industrial equipment; 6 – Cleaning or maintenance of bridges or other structures; 7 – Riparian planting; 8 – Streamside livestock grazing; 9 – Marine seismic surveys; 10 – Placement of material or structures in water; 11 – Dredging; 12 – Water extraction; 13 – Organic debris management; 14 – Wastewater management; 15 – Addition or removal of aquatic vegetation; 16 – Change in timing, duration and frequency of flow; 17 – Fish passage issues; 18 – Structure removal; 19 – Placement of marine finfish aquaculture site.*

Threat	Pathways
Habitat modifications	1, 2, 3, 4, 5, 7, 8, 10, 11, 13, 14, 15, 16, 18
Turbidity and sediment loading	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 18
Nutrient loading	1, 4, 7, 8, 11, 12, 13, 14, 15, 16
Contaminants and toxic substances	1, 4, 5 ,6 ,7 ,11 ,12 ,13 ,14, 15, 16 ,18

EXOTIC SPECIES

As discussed in the **THREATS** section, Common Carp and non-native aquatic vegetation introduction and establishment could have negative effects on Lake Chubsucker populations.

Mitigation

- Physically remove non-native species from areas known to be inhabited by Lake Chubsucker. It should be noted that special consideration is required if an aquatic vegetation removal/control program is implemented as this may also result in the loss of preferred Lake Chubsucker habitat.
- Monitor watersheds for exotic species that may negatively affect Lake Chubsucker populations directly, or negatively affect Lake Chubsucker preferred habitat.
- Develop a plan to address potential risks, impacts, and proposed actions if monitoring detects the arrival or establishment of an exotic species.
- Introduce a public awareness campaign and encourage the use of existing exotic species reporting systems.

Alternatives

- Unauthorized
    - None.
- Authorized
    - Use only native species.
    - Follow the National Code on Introductions and Transfers of Aquatic Organisms for all aquatic organism introductions (DFO 2003).

INCIDENTAL HARVEST

As discussed in the **THREATS** section, incidental harvest of Lake Chubsucker through the baitfish industry was recognized as a potentially low risk threat.

Mitigation

- Provide information and education to bait harvesters on Lake Chubsucker to raise awareness, and request the voluntary avoidance of occupied Lake Chubsucker areas.
- Immediate release of Lake Chubsucker if incidentally caught, as defined under the Ontario Recreational Fishing Regulations (OMNR 2011b).
- Education through mandatory training on species at risk for baitfish harvesters.

Alternatives

- Prohibit the harvest of baitfish in areas where Lake Chubsucker are known to exist.

SOURCES OF UNCERTAINTY

Despite concerted efforts to increase our knowledge of Lake Chubsucker in Canada, there are still areas of uncertainty related to population distribution and structure, habitat preferences and to the factors that are limiting their existing.

Many of the locations where Lake Chubsucker are known to exist are represented by a few individuals caught over a limited number of sampling events. Sites, such as the dyked marshes of Walpole Island, St. Clair NWA, Rondeau Bay, Long Point NWA, and the dyked marshes of Big Creek NWA, should be sampled with increased sampling effort to determine if reproducing populations do exist and, if so, the size of the populations. Lake Chubsucker populations that were assigned low certainty in the population status analysis should be considered priority when considering additional field sampling. These baseline data are required to monitor trends in Lake Chubsucker distribution and abundance as well as the success of any recovery measures. A preliminary depletion study was undertaken in 2010 at L Lake and Lyons Creek to determine the feasibility of obtaining population size estimates of extant populations. This type of work should be refined and continued in an attempt to better understand Lake Chubsucker population size. Extant populations should be re-visited to establish baseline information, and to eventually aid in the determination of long-term population trends. There is also uncertainty related to the population trajectory of the L Lake Chubsucker population. Although it is believed that this is the healthiest known Lake Chubsucker population in Canada, the population trajectory is currently based on two sampling events; and therefore, was ranked as ‘Unknown’, which resulted in an overall population status ranking of ‘Fair’. Additional sampling events at this location over time would increase our knowledge on the population trajectory which may result in a higher population status ranking.

Additional exploratory sampling should be completed in areas determined to be composed of suitable Lake Chubsucker habitat, in an attempt to discover undetected populations. Sites that would be good candidates for exploratory surveys would include old oxbow lakes of the lower Ausable River in the vicinity of L Lake and the OAC, as well as tributaries of the Niagara River.

There is a need to identify seasonal habitat requirements for each life stage. Although it is currently assumed that individuals from all Lake Chubsucker life stages occupy the same functional habitat, this assumption should be verified through sampling. This may also allow us to gain a better understanding of preferred habitat of juvenile Lake Chubsucker.

Numerous threats have been identified for Lake Chubsucker populations in Canada, although the direct impact that these threats might have is currently unknown. There is a need for more causative studies to evaluate the impact of each threat on each extant Lake Chubsucker population with greater certainty. In the literature, the threat impacts are generally discussed at a broad level (i.e., fish assemblage level). It is important to further our knowledge on threat likelihood and impact at the species level. Lake Chubsucker is considered to be a pollution-intolerant species, although there is a lack of evidence on the direct or indirect effects of toxic substances on Lake Chubsucker populations. There is a need to determine Lake Chubsucker threshold levels for water quality parameters (e.g., nutrients, dissolved oxygen), as well as a need to identify point and non-point sources of nutrient and sediment inputs and their relative effects on Lake Chubsucker survival. There is a need to do conduct research to determine temperature tolerances for Lake Chubsucker for the various life stages. Further research on the Lake Chubsucker tolerance may provide insight on the causes of Lake Chubsucker extirpation from Tea Creek and Jeanette's Creek, and whether other populations should be flagged as being highly vulnerable to extirpation. Knowledge on temperature and dissolved oxygen tolerance levels for this species may also help to explain which factors are contributing to the large Lake Chubsucker winterkill that occurred in the OAC in 2010. Temperature tolerance information may also provide insight on Lake Chubsucker over-wintering grounds. Increased knowledge on tolerances would provide an opportunity to mitigate the effects of the threat at each highlighted site. Although incidental harvest is listed as a potential threat to Lake Chubsucker, the level of occurrence is currently unknown. Research is needed to determine the level to which Lake Chubsucker are incidentally caught.

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