COSSARO Candidate Species at Risk Evaluation

for

American Eel (*Anguilla rostrata*)

Committee on the Status of Species at Risk in Ontario (COSSARO)

Assessed by COSSARO as ENDANGERED

January 2013

Anguille d'Amérique *(Anguilla rostrata)*

L'anguille d'Amérique est une espèce migratoire diadrome qui frai dans la mer des Sargasses dans l'océan Atlantique pour retourner à un habitat d'eau douce au stade juvénile. L'anguille américaine est une espèce valide et est le seul membre américain du genre; il n'existe pas de preuve de plus d'une unité désignable en Ontario. L'aire de répartition de l'anguille d'Amérique en Ontario se trouve principalement le long du fleuve St-Laurent, du lac Ontario et de leurs divers tributaires. L'habitat de l'anguille d'Amérique comprend les rivières et lacs dans lesquels elle peut tolérer des températures de 4 à 25 ^{o} C. Les populations d'anguille d'Amérique ont subi d'importantes baisses en Ontario (déclin de ~99 % depuis les années 1970), bien que leurs nombres restent élevés dans les aires de répartition nord-américaines plus au sud. Aucune récolte commerciale ou récréative n'a été permise depuis le milieu des années 2000. Parmi les menaces précises, il y a les obstacles physiques, la mortalité aux installations hydroélectriques, la dégradation de l'habitat et les espèces introduites. En raison du déclin de ses populations et de l'augmentation des menaces et de la croissance de nouvelles menaces pour l'habitat (comme le changement climatique et les espèces introduites), les critères d'évaluation du CDSEPO indiquent que l'anguille d'Amérique est **en voie de disparition** en Ontario.

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PART 1

CURRENT STATUS AND DISTRIBUTION

Current Designations:

GRANK – **G4** (last reviewed 20/10/2011) (NatureServe, 2013)
NRANK Canada – **N4** (Assessed 03/11/2005) (NatureServe, 2013)
COSEWIC – **Threatened** (Reassessed May 2012) (COSEWIC, 2013)
SARA – **No Status** (No Schedule)[1] (Environment Canada, 2013)
ESA 2007 – **Endangered** (OMNR, 2013)
SRANK – **S1?** (NatureServe, 2013)

Distribution in Ontario:

The range of American Eel in Ontario occurs mainly along the St. Lawrence River, the Ottawa River drainage system, and Lake Ontario and its tributaries (Royal Ontario Museum & OMNR, 2008). Niagara Falls was the natural western limit of the species in the Great Lakes watershed. With construction of the Welland Canal, dispersal into the upper Great Lakes was possible; there is also some speculation, and perhaps some archaeological information and traditional knowledge, that the species may have found its way into the upper Great Lakes by natural means such as the Ottawa and French river systems, given "the propensity of eels to use damp substrates to surmount obstacles " (COSEWIC, 2012). In the upper St. Lawrence River and Lake Ontario, eels are almost entirely female (COSEWIC, 2012*).*

Distribution and Status Outside Ontario:

American Eel is a migratory species that is widely distributed in the western Atlantic Ocean. The historical Canadian distribution of the American Eel has been described as "all accessible freshwater, estuaries and coastal marine waters connected to the Atlantic Ocean of Canada, up to the mid-Labrador coast" (COSEWIC, 2012). It is widely distributed in many western Atlantic jurisdictions of North America, and was one of the most widely distributed fish in a sample of 203 lakes of the northeastern United States (Whittier *et al*., 2001; from NatureServe, 2013); the species has been collected from more than 1000 sites and hundreds of streams along the Atlantic coast of North America (NatureServe, 2013). It is "widely distributed in freshwaters, estuaries and coastal marine waters of the western North Atlantic Ocean coastline … from Venezuela to Greenland and Iceland" (NatureServe, 2013). The species spawns only in the Sargasso Sea east of the Bahamas and southwest of Bermuda (NatureServe, 2013). American Eel has been introduced (stocked, released, escaped) to several inland areas

[1] "It is currently being considered for listing under the federal *Species at Risk Act*" (Fisheries & Oceans Canada 2007, Fisheries & Oceans Canada 2013).

of North America (NatureServe, 2013).

PART 2

ELIGIBILITY FOR ONTARIO STATUS ASSESSMENT

2.1 APPLICATION OF ELIGIBILITY CRITERIA

Taxonomic Distinctness

Yes. There is no dispute that American Eel is a valid biological taxon. It is the only North American member of the genus. American Eel and European Eel (*Anguillaanguilla*) can hybridize, and some authors have suggested that they are conspecific but this is not generally supported (COSEWIC, 2012; NatureServe, 2013). Although hybridization occurs in the Sargasso Sea, the two species' gene pools are largely geographically separated with hybrids observed almost exclusively in Icelandic populations (COSEWIC, 2012; NatureServe, 2013).

Designatable Units

One DU. All of the American Eel in Ontario occur within one DU – the Great Lakes and Upper St. Lawrence, despite their occupancy in several National Freshwater Biogeographic zones ("NFBZ"; COSEWIC 2012). Recent genetic evidence supports the conclusion of a single, panmictic breeding population in Ontario, with no evidence of genetic differentiation based on 18 neutral genetic loci (Bernatchez et al. 2011). The Ontario American Eel represent the most extreme inland group and exhibit differences in life history related to sex ratio and size at maturity.

Native Status

Yes. Clearly a native species in Ontario. Archaeological evidence and traditional knowledge also support this conclusion (MacGregor*et al*., 2008; MacGregor*et al*., 2010).

Presence/Absence

Present. Although reduced in numbers and distribution over the past century (COSEWIC 2012), the species is clearly present and resident in Ontario.

2.2 ELIGIBILITY RESULTS

1. The putative taxon or DU is valid. **Yes**

2. The taxon or DU is native to Ontario. **Yes**

3. The taxon or DU is present in Ontario, extirpated from Ontario or extinct? **Present**

PART 3

ONTARIO STATUS BASED ON COSSARO EVALUATION CRITERIA

3.1 APPLICATION OF PRIMARY CRITERIA (Rarity and Declines)

1. Global Rank

Not in any Category. Ranked as G-4 (apparently secure) globally, although it does appear to be decreasing (NatureServe, 2013).

2. Global Decline

Not in any Category. Global population exceeds 1,000,000 individuals but appears to be declining (NatureServe, 2013). A synoptic overview of the status in individual North American jurisdictions suggests that some decline has occurred, particularly in jurisdictions at the fringe of eel range, but many populations are still healthy (NatureServe, 2013). NatureServe (2013) noted that in most parts of their range, historical and current distributions do not appear to have altered significantly. The species' range has also been expanded through anthropogenic influences (stocking, releases, escapes) in several inland areas of North America (NatureServe, 2013).

3. Northeastern North America Ranks

Special Concern. Ranked in 96% of the 27 jurisdictions in which it occurs. Ranked as extremely rare (SX, SH, S1 or S2) in 27% (7 of 26) jurisdictions where it is ranked (NatureServe, 2013)(Appendix 1).This is a change from the 2005 COSSARO evaluation when it was ranked as extremely rare in only 13% of the 24 jurisdictions where it was ranked (Dextrase, 2006).

4. Northeastern North America Decline

Endangered. Historically, American Eel had "one of the largest ranges of anydiadromous (*fresh-salt water migratory*) fish in the Western Hemisphere", and was a dominant member of the freshwater fish community both in numbers and biomass (COSEWIC, 2012; Smith and Saunders, 1955).While the 2005 evaluation noted a 62% decline in the U.S. population (Tremblay *et al*., 2006), the 2012 status report does not state specific population declines in the U.S. (COSEWIC, 2012). Within Canada there are indications of strong decline within the Lake Ontario - upper St. Lawrence American Eel population, but the evidence of decline is less clear for the Gulf of St. Lawrence and Atlantic Eel (COSEWIC, 2012). Overall, the decline appears to be more dramatic in freshwater as compared to saltwater habitats (COSEWIC, 2012). In Newfoundland and Labrador, electrofishing data indicate a significant negative trend in abundance from 1984 to 1996 estimated at 88% (COSEWIC, 2012). Nova Scotia data also showed a steep decline, although COSEWIC (2012) cautioned that trends appear to be highly

variable both temporally and spatially. NatureServe (2013) considers the population to have declined along the Atlantic Coast of Canada and the United States, although there do not appear to be quantitative data. Although American Eel are considered to be common and widely distributed in many parts of the southern Atlantic North American coast (NatureServe, 2013), thus the most recent review of the conservation status of North American fish (Jelks*et al*., 2008) did not include American Eel, because despite declines it is still widespread (COSEWIC, 2012). However, there is good evidence for substantial declines in Northeastern North America.

5. Ontario Occurrences

Insufficient information. The Ontario NHIC does not currently track American Eel occurrences; data are in the staging process but have not yet received an initial review to determine if they are candidates for Element Occurrences (Tanya Taylor pers. comm.). Furthermore, the definition of Elemental Occurrences for American Eel are complicated by their migratory behavior (with a single breeding population in the Sargasso Sea), and lack of any apparent homing (Bernatchez*et al*. 2011). The American Eel population is understood to breed as a single population in the Sargasso Sea (COSEWIC, 2012). Niagara Falls was the natural upstream barrier to inland eel populations in Ontario.

6. Ontario Decline

Endangered. Indices of abundance in the Upper St. Lawrence River and Lake Ontario have declined by over 95% since the 1970s (COSEWIC, 2006). The commercial catch of eel in Ontario declined by 95% from the 1980s to the early 2000s (OMNR 2007), despite sustained high prices (MacGregor*et al*., 2010). In addition to declines in previous decades, there has been a decline in the total number of spawning adults (outmigrating silver phase eels) of 65 % in the 14 years prior to the status report, and declines of greater than 90% in juvenile eel abundance since the early 1980s (COSEWIC, 2012). Tailwater surveys at the Moses-Saunders Dam on the Upper St. Lawrence River show only 8% of the silver eels (spawning adults) in 2010, compared to counts from 2000 (COSEWIC, 2012; Figure 9B). Eel range has retracted to the lower reaches of the Ottawa and Mississippi rivers and tributaries of the upper St. Lawrence River and Lake Ontario due to the construction of dams and hydroelectric facilities (COSEWIC, 2012). American Eel are present in the lower reaches of the Ottawa and Mississippi river watersheds in such low numbers that extirpation is considered likely (COSEWIC, 2012) NOTE: generation time is considered to be 22 years (COSEWIC, 2012) so this criterion should be evaluated either from historic times to present or a period of 3 generations (i.e. 66 years). Traditional knowledge of the abundance and decline of the American Eel in Canada also indicates substantial and on-going decline over long time periods (Algonquins of Ontario, 2012)

7. Ontario's Conservation Responsibility

Threatened. Ontario has a very small portion of the global range of this widespread species (COSEWIC, 2012; MacGregor*et al*. 2010); however, prior to the population

decline, the American Eel population from Lake Ontario and the upper St. Lawrence River was entirely comprised of adult females, which given their large body size, likely resulted in a disproportional contribution to global egg production (A. Dextrase. OMNR, pers. comm., 2013).This would add to the Ontario's conservation responsibility beyond the spatial or numerical contribution of Ontario's American Eel population to global numbers.

3.2 APPLICATION OF SECONDARY CRITERIA (Threats and Vulnerability)

8. Population Sustainability

Endangered. Examination of 4 decades of abundance data on the St. Lawrence River suggested that cumulative mortality due to recruitment overfishing and hydro-electric dams were the most likely cause of the population decline up until the 1980's (COSEWIC, 2012). The COSEWIC (2012) status report noted "the declines in American Eel in these tributaries appear to be largely due to recruitment failures driven by mortalities associated with a series of migration barriers, including hydroelectric facilities".

9. Lack of Regulatory Protection for Exploited Wild Populations

Not in any Category. Commercial and recreational harvests were closed in Ontario in the mid-2000's. As an endangered species, American Eel is protected under Ontario's Endangered Species Act. The species is still harvested in Québec, and adults are vulnerable to harvest before they reach Ontario and when migrating to the Sargasso Sea.

10. Direct Threats

Endangered.

Identified threats include dams as physical barriers, mortality at hydro-electric facilities, and potential threats include habitat alterations such as water level fluctuations and wetland degradation, chemical pollution (e.g. contaminants such as PCBs), marine habitat loss due to overharvest of seaweed in the Sargasso Sea, climate-influenced changes to oceanic currents that may affect eel migration to and from the Sargasso Sea, and potentially Zebra Mussel invasion (*Dreissenapolymorpha*) (Fisheries & Oceans Canada, 2007; OMNR, 2007; MacGregor*et al.,* 2010).An emerging direct threat is an introduced swim bladder parasite (*Anguillicoloidescrassus*) that is in the United States and has been documented (2011-2012) in American Eels in the upper St. Lawrence River (S. Gibson OMNR, pers. comm., 2013). Harvesting no longer occurs in Ontario but still occurs, without quotas, in Québec (MacGregor*et al*., 2010).

Hydro-electric dams were a major factor in past eel declines in Ontario, and continue to be a major threat. Initial declines in the Ottawa and Mississippi river watersheds coincided with the construction of large hydroelectric dams (COSEWIC, 2012). The construction of dams in the St. Lawrence watershed (which includes both Ontario and Quebec) resulted in the loss of free access to an estimated 12,140 km^2 of freshwater eel

habitat; estimated potential recruitment from this amount of habitat far exceeded peak historical fishing harvest (Verreault *et al*., 2004). Verreault *et al*. (2004) concluded "anthropogenic barriers could act as a significant cause of population decline and among all, mitigating their impact should be a priority". Some mitigation has occurred at a specific hydro-electric generating station (the R.H. Saunders GS on the St. Lawrence River), and fish stocking and pilot projects to pass downstream migrating adults past dams are taking place at others, but while there has been some improvement in the number of eels passing through the fish ladder, numbers are still extremely low relative to pre-decline levels (OMNR, 2007).

11. Specialized Life History or Habitat-use Characteristics

Threatened. American Eels are slow to mature (7 to 30+ years), and reproduce only once during their lifetime; however when they reproduce females will produce millions of eggs (NatureServe 2012). With a single, panmictic population that breeds solely outside of Ontario, biological and physical factors outside of Ontario can affect the species' recovery. As Ontario's eel population consists almost solely of adult females, any impact on Ontario's population can have significant effects on the global population (Macgregor *et al.,* 2010). Larval eels are not very mobile, and dispersal from spawning grounds to North American freshwater is dependent upon oceanic currents (MacGregor*et al*. 2010).

Stocking of eels has resulted in the presence of male eels within the Lake Ontario watershed, a situation that is different from that historically when only females were present and males were absent (COSEWIC 2012). Sex determination may be density-dependent (COSEWIC 2012).

3.3 COSSARO EVALUATION RESULTS

1. Criteria satisfied in each status category

List the Number of primary and secondary criteria met in each status category:

ENDANGERED – [2/2]
THREATENED – [1/1]
SPECIAL CONCERN – [1/0]

List the Number of Ontario-specific criteria met in each status category

ENDANGERED – [1]
THREATENED – [1]
SPECIAL CONCERN – [0]

2. Data Deficiency

No. The number of criteria assessed as "insufficient information" is 1. There are sufficient data and trends to support a designation decision for this species.

3. Status Based on COSSARO Evaluation Criteria

The application of COSSARO evaluation criteria suggests that **American Eel** is **Endangered** in Ontario.

PART 4

ONTARIO STATUS BASED ON COSEWIC EVALUATION CRITERIA

4.1 APPLICATION OF COSEWIC CRITERIA

Regional (Ontario) COSEWIC Criteria Assessment

Criterion A – Decline in Total Number of Mature Individuals
Endangered A2b, A4b – Declines in juvenile abundance are inferred to exceed 50% over the last 3 generations (they have declined over 90% since 1972 which equates to approximately 2 generations; various threats such as dams have impacted the species for more than 3 generations; mature adults have declined by approximately 65% over the past 14 years (less than one generation) and are inferred to continue in the future (COSEWIC, 2012).

Criterion B – Small Distribution Range and Decline or Fluctuation
Not in any category

Criterion C – Small and Declining Number of Mature Individuals
Not in any category

Criterion D – Very Small or Restricted Total Population
Not in any category

Criterion E – Quantitative Analysis
Insufficient information. Although considerable anecdotal and some quantitative data exist for the American eel, no population viability analyses or population forecast models have been completed

Rescue Effect
Yes. Panmictic population that all breeds in one area, so it is possible for additional adults to recruit to the area

Special Concern Status
NA

4.2 COSEWIC EVALUATION RESULTS

1. Criteria satisfied in each status category

ENDANGERED – [yes]
THREATENED – [no]
SPECIAL CONCERN – [no]

2. Data Deficiency

No. Although some specific data are missing for the American eel in Ontario, there is still considerable evidence for the evaluation of their status.

3. Status Based on COSEWIC Evaluation Criteria

The application of COSEWIC evaluation criteria suggests that **American Eel** is **Endangered** in Ontario.

PART 5

ONTARIO STATUS DETERMINATION

5.1 APPLICATION OF COSSARO AND COSEWIC CRITERIA

COSSARO and COSEWIC criteria give the same result. **Yes**

5.2 SUMMARY OF STATUS EVALUATION

American Eel is classified as **Endangered** in Ontario.

The American Eel is a diadromous migratory species that spawns in the Sargasso Sea in the Atlantic Ocean and returns to freshwater habitat as juveniles. The American Eel is a valid species and is the only North American member of the genus; no evidence for more than one DU within Ontario exists. The range of American Eel in Ontario is primarily along the St. Lawrence River, Lake Ontario and various tributaries. American Eel habitat includes freshwater rivers and lakes where they can tolerate temperatures from 4 to 25 ºC. American Eel have experienced dramatic declines within Ontario (~99% decline since 1970s), although numbers remain high in more southerly North American ranges. No commercial or recreational harvest has been permitted since the mid 2000s. Specific threats include physical barriers, mortality at hydro-electric facilities, habitat degradation and introduced species. Due to population declines, continuing and increasing threats and growing new habitat threats (such as climate change and introduced species) the COSSARO evaluation criteria indicate that the American Eel is **Endangered** in Ontario.

Indicate whether or not a criterion is satisfied in each of the status categories.

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2. Community and Aboriginal Traditional Knowledge Sources
Presentations made at meeting (2 representative from Algonquins of Ontario) and text in Algonquins of Ontario. 2012. Returning KichisippiPimisi, the American Eel, to the Ottawa River basin.

APPENDIX 1

NORTHEASTERN NORTH AMERICA STATUS RANK AND DECLINE

	Subnational Rank	Sources	Decline	Sources
CT	S5			
DE	S5			
IL	S2			
IN	S2S3			
IA	S3?			
LB	S4			
KY	S4S5			
MA	S3S4			
MB	Not present			
MD	S4			
ME	S5			
MI	SNA			
MN	Not present			
NB	S5			
NF	S5			
NH	S3			
NJ	S5			
NS	S5			
NY	S3			
OH	S2			
ON	S1?			
PA	S5			
PE	S4S5			
QC	S3			
RI	S5			
VA	S5			
VT	S2			
WI	S2			
WV	S2			

Occurs as a native species in 27of 29 northeastern jurisdictions
Srank or equivalent information available for 26 of 27 jurisdictions = (96%)
S1, S2, SH, or SX in 7 of 26 = (27%)