

# Management Plan for the Lake Erie Watersnake (*Nerodia sipedon insularum*) in Canada

## Lake Erie Watersnake



2019



Government  
of Canada

Gouvernement  
du Canada

Canada

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For copies of the management plan, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk \(SAR\) Public Registry](https://www.sarregistry.gc.ca/)<sup>1</sup>.

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<sup>1</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html](https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html)

# MANAGEMENT PLAN FOR LAKE ERIE WATERSNAKE (*Nerodia sipedon insularum*) IN CANADA

2019

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of Ontario has given permission to the Government of Canada to adopt the *Blue Racer, Lake Erie Watersnake and Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population)* – *Ontario Government Response Statement* (Part 2) under Section 69 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this management plan.

The federal management plan for the Lake Erie Watersnake in Canada consists of two parts:

Part 1 – *Management Plan for the Lake Erie Watersnake (Nerodia sipedon insularum) in Canada*, prepared by Environment and Climate Change Canada.

Part 2 – *Blue Racer, Lake Erie Watersnake and Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population)* – *Ontario Government Response Statement*, prepared by the Ministry of the Environment, Conservation and Parks, 2019.

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**Part 1 – Management Plan for the Lake Erie Watersnake  
(*Nerodia sipedon insularum*) in Canada, prepared by  
Environment and Climate Change Canada**

## Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)<sup>2</sup> agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of management plans for listed species of special concern and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Lake Erie Watersnake and has prepared this management plan, as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the Province of Ontario as per section 66(1) of SARA. SARA section 69 allows the Minister to adopt all or part of an existing plan for the species if the Minister is of the opinion that an existing plan relating to wildlife species includes adequate measures for the conservation of the species. The Province of Ontario provided the *Blue Racer, Lake Erie Watersnake and Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) – Ontario Government Response Statement* (Part 2). Only those portions of the Government Response statement pertaining to the Lake Erie Watersnake are being adopted in this management plan.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Environment and Climate Change Canada and the Parks Canada Agency or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Lake Erie Watersnake and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

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<sup>2</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2](http://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2)

## Acknowledgments

This management plan was prepared by Lee Voisin and Elisabeth Shapiro (Environment and Climate Change Canada, Canadian Wildlife Service – Ontario Region). This document is based on an earlier draft which was prepared by Allison Foran (Environment and Climate Change Canada, Canadian Wildlife Service – Ontario Region) Lauren Strybos and Justine Mannion (formerly of Environment and Climate Change Canada, Canadian Wildlife Service – Ontario Region). Additional preparation and review of the document was completed by Angela McConnell (Environment and Climate Change Canada, Canadian Wildlife Service – Ontario Region). This document benefited from input, review, and suggestions from the following individuals and organizations: John Brett, Krista Holmes, Judith Girard, Liz Sauer, Elizabeth Rezek (Environment and Climate Change Canada, Canadian Wildlife Service – Ontario Region); Kim Borg and Paul Johanson (Environment and Climate Change Canada, Canadian Wildlife Service – National Capital Region) Gary Allen, Tammy Dobbie, Tarra Degazio and Ken Kingdon (Parks Canada Agency); Joe Crowley and Ron Gould (Ontario Ministry of Natural Resources and Forestry).

Acknowledgement and thanks is given to all other parties that provided advice and input used to help inform the development of this management plan including various Indigenous organizations and individuals, individual citizens, and stakeholders who provided input and/or participated in consultation meetings.

## Executive Summary

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the Lake Erie Watersnake Endangered in 1991 and 2006. In 2015, COSEWIC re-examined the subspecies and designated it Special Concern. The Lake Erie Watersnake (*Nerodia sipedon insularum*), is now listed as Special Concern on Schedule 1 of the federal *Species at Risk Act* (SARA) and as Special Concern under Ontario's *Endangered Species Act, 2007* (ESA 2007).

The Lake Erie Watersnake is one of two subspecies of the Common Watersnake, *Nerodia sipedon*, found in Canada. The subspecies is endemic to the islands of the Lake Erie Archipelago, as well as a small area of Lake Erie shoreline along the Ohio mainland. In Canada, the subspecies is found only on four small islands in the western basin of Lake Erie (Pelee, Middle, Hen and East Sister Islands). The subspecies has been recently confirmed on Pelee, Middle and East Sister Islands, while presence has not been recently confirmed on Hen Island (privately owned).

Lake Erie Watersnakes are variable in appearance; they have a background colour of gray or brown and have either no banding pattern or may have faded blotches or banding. Their ventral scales are typically white or yellowish, often with dark speckling. They have a large head and a heavy body.

During the active season, the Lake Erie Watersnake is typically found within 100 m of rocky or sandy shorelines. This aquatic snake feeds in the water but rarely goes more than 200 m from the shore when foraging. The subspecies overwinters in cavities and crevices which are typically found further inland. In recent years, the subspecies' historical diet has been largely replaced by Round Goby (*Apollonia melanostomus*), an invasive species which began colonizing Lake Erie in the early 1990s. The population of Lake Erie Watersnake in Canada may have stabilized in recent years due to this increase in abundance of prey.

The most significant threat to the Lake Erie Watersnake is habitat loss due to shoreline development and alteration and, intentional and accidental human-induced mortality, such as road mortality and persecution. Additional threats with an unknown impact include: a reduction in habitat quality and quantity (from human-caused habitat alteration, severe weather events, invasive Common Reed [*Phragmites australis*], and Double-crested Cormorants [*Phalacrocorax auritus*]), environmental contamination, rates of predation by Wild Turkeys and potential increased infection from Snake Fungal Disease.

The management objective is to: maintain the current abundance and distribution of Lake Erie Watersnake in Canada. Broad strategies to help achieve this management objective are outlined in Section 6.2 of this document. The conservation measures to achieve the management objective of this plan are adopted from the *Blue Racer, Lake Erie Watersnake and Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) – Ontario Government Response*



*Statement* (Part 2) applicable to Lake Erie Watersnake individuals and habitat, none of which are expected to have any significant negative effects on the environment or other species. A collaborative, stewardship first approach to implement conservation measures is important. With the largest population of the Lake Erie Watersnake occurring on Pelee Island, continuing to support partnerships between the municipality, the provincial and federal governments, and local partners is important to collectively meet both the needs of the community and conserve Pelee Island's biodiversity. Performance indicators or population-level abundance and distribution will be used to measure the progress of the species towards recovery, and success of this management plan.

## 1. COSEWIC\* Species Assessment Information

**Date of Assessment:** November 2015

**Common Name (population):** Lake Erie Watersnake

**Scientific Name:** *Nerodia sipedon insularum*

**COSEWIC Status:** Special Concern

**Reason for Designation:** The Canadian distribution of this unique population of watersnakes is confined to four small islands in Lake Erie. In the United States, subpopulations have recovered because of an increased fish prey base, provided by introduced Round Goby. It is uncertain whether a similar recovery has occurred in Canadian subpopulations. There is concern that the largest subpopulation on Pelee Island continues to be threatened by road mortality, shoreline development, and persecution by humans.

**Canadian Occurrence:** Ontario

**COSEWIC Status History:** Designated Endangered in April 1991 and in April 2006. Status re-examined and designated Special Concern in November 2015.

\* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

## 2. Species Status Information

The Lake Erie Watersnake is listed as Special Concern<sup>3</sup> on Schedule 1 of the federal *Species at Risk Act* (SARA). In Ontario, the subspecies is listed as Special Concern<sup>4</sup> under *Ontario's Endangered Species Act, 2007* (ESA). The Lake Erie Watersnake is an Imperiled (T2)<sup>5</sup> subspecies of an otherwise widespread and common (Secure, G5<sup>6</sup>) species, the Common Watersnake (*Nerodia sipedon*) (NatureServe 2018). The Lake Erie Watersnake has a national and subnational (Ontario) conservation rank of Imperiled (N2 and S2, respectively). The Lake Erie Watersnake has also been designated as a Specially Protected Reptile under the Ontario *Fish and Wildlife Conservation Act* (S.O. 1997, c.41). The shoreline habitat available on the Canadian

<sup>3</sup> A wildlife species that could become threatened or endangered because of a combination of biological characteristics and identified threats.

<sup>4</sup> Lives in the wild in Ontario, is not endangered or threatened, but may become threatened or endangered due to a combination of biological characteristics and identified threats.

<sup>5</sup> Imperiled (T2, S2, N2): a species that is at high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors.

<sup>6</sup> Secure (G5): a species that is considered common, widespread, abundant, and lacking major threats or long-term concerns.

islands in Lake Erie represents approximately 38% of the subspecies' global shoreline habitat (King 1998). The Extent of Occurrence<sup>7</sup> and Index of Area Occupancy<sup>8</sup> is estimated at 188 km<sup>2</sup> and 72 km<sup>2</sup>, respectively (COSEWIC 2015).

In the United States, the Lake Erie Watersnake has a national conservation rank of Imperiled (N2), and occurs in the state of Ohio where its subnational conservation rank is Critically Imperiled<sup>9</sup> (S1). The Lake Erie Watersnake was removed from the U.S Fish and Wildlife Service's endangered and threatened species list on August 16, 2011 based on a noted recovery (USFWS 2010), but is still listed as threatened<sup>10</sup> by the state of Ohio (Ohio Department of Natural Resources 2017).

### 3. Species Information

#### 3.1. Species Description

The Lake Erie Watersnake is variable in its appearance with colour and patterning ranging from strong regular banding, to unbanded beige or grey, or to bands and blotches of various colours (Willson and Cunnington 2015). The subspecies typically has a white or yellowish ventral surface which often has dark speckling or stippling (Rowell 2012). The dorsal banding and blotches, paired with other morphological characteristics and diet are used to distinguish the subspecies from the Northern Watersnake, *N. sipedon* (USFWS 2003; Rowell 2012). The subspecies has keeled<sup>11</sup> body scales and a single anal plate (Conant and Collins 1998). Adult male Lake Erie Watersnakes have an average snout-to-vent length (SVL) of between 59.1 and 71.6 cm, while females are typically larger with an average SVL ranging from 80.2 to 88.2 cm (King 1986). The subspecies is skittish in its natural habitat and tends to retreat into the water or under cover objects if cover is nearby when approached (Willson and Cunnington 2015). This non-venomous snake may bite when handled, and display other defensive behaviour include writhing and emitting a foul smelling liquid from its anal glands (Willson and Cunnington 2015).

The Lake Erie Watersnake is ovoviviparous, meaning it gives birth to live young (Ernst and Ernst 2003), between late August and early September (COSEWIC 2006). A study on Pelee Island documented an average litter size of  $27.2 \pm 9.20$  (range 13-46) for 30 individuals (Brooks et al. 2000). They are typically found close to the water's edge,

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<sup>7</sup> Extent of occurrence: the area included in a polygon without concave angles that encompasses the geographic distribution of all known populations of a wildlife species ([http://www.cosewic.gc.ca/eng/sct2/sct2\\_6\\_e.cfm](http://www.cosewic.gc.ca/eng/sct2/sct2_6_e.cfm)).

<sup>8</sup> Index of area of occupancy: an estimate of the number of 2 x 2 km grid squares occupied by extant populations ([http://www.cosewic.gc.ca/eng/sct2/sct2\\_6\\_e.cfm](http://www.cosewic.gc.ca/eng/sct2/sct2_6_e.cfm)).

<sup>9</sup> Critically Imperiled (S1): At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.

<sup>10</sup> A species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists. Continued or increased stress will result in its becoming endangered

<sup>11</sup> Keeled: reptile scales that, rather than being smooth, have a ridge down the center that may or may not extend to the tip of the scale, making them rough to the touch.

but are documented to move up to 580 m inland to overwinter (King 2002a). The subspecies spends five to seven months annually underground from mid-September to mid-April and both communal and single occupancy hibernacula<sup>12</sup> have been observed (USFWS 2003; COSEWIC 2006). Movements between the islands of the Lake Erie Archipelago are rare, but measurements of genetic diversity (King and Lawson 1995) and mark-recapture data show that these long distance movements do occur (D. Jacobs unpub. data). Historically, the diet of the Lake Erie Watersnake has consisted of small fish and amphibians (King et al. 2006b), but the introduction of the Round Goby in the early 1990s has caused Lake Erie Watersnakes to shift their diet. The Round Goby now comprises over 92% of the subspecies' diet, and after this shift, larger body sizes, accelerated growth rates and increased fecundity were observed (King et al. 2006b).

### 3.2. Species Population and Distribution

The Lake Erie Watersnake has one of the smallest distributions of any snake in North America with a global range of less than 40 km in diameter (King 1998). It is restricted to the islands of the Lake Erie Archipelago, as well as a small area of shoreline on Ohio's Catawba-Marblehead Peninsula (USFWS 2003). Of the 22 islands which comprise the Lake Erie Archipelago, it occurs on four Canadian (Pelee Island, Middle Island, Hen Island and East Sister Islands) and 11 American islands (COSEWIC 2015). The subspecies is presumed to occur on Hen Island, however, surveys have not occurred there since 1990 and the island is privately owned. It is unknown if the subspecies still occurs on North Harbour or Middle Sister Islands as no Watersnakes were observed during surveys in the 1980s and 1990s (King et al. 1997). Because of this, COSEWIC (2015) considers Lake Erie Watersnake likely extirpated from North Harbour and Middle Sister Islands. No historical records of the subspecies exist for Chick, Big Chicken and Little Chicken Islands; however these small islands are essentially reefs that can become completely submerged during storms or times of high water levels (COSEWIC 2015). While it is possible that Lake Erie Watersnakes may forage or temporarily take refuge on these islands while moving to another island, there is no evidence that these islands provide habitat for the subspecies (COSEWIC 2015). The four Canadian islands that the subspecies is known to occur on account for approximately 41 km (38%) of the global 109 km of shoreline habitat (King 1998).

From the early 1800s to the early 1900s, the Lake Erie Watersnake was reported in large numbers on several islands in western Lake Erie (COSEWIC 2015). The latter half of the 20<sup>th</sup> century saw a large decline in the subspecies population across its range, however the establishment of the invasive Round Goby fish which increased the snake's prey base, has allowed the snake's population to increase on several U.S islands. Although rare, Lake Erie Watersnake movement between islands does occur, and immigration could contribute to maintaining the Canadian population (COSEWIC 2015).

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<sup>12</sup> Hibernacula: areas where organisms seeks refuge or shelter for overwintering (hibernation).

### 3.3. Needs of the Lake Erie Watersnake

Live-bearing snakes found in northern latitudes require certain habitat types in order to maintain viable populations. The three most important and most often limiting habitat types for snakes are: overwintering habitats, as well as gestation habitats and shelter habitats (which facilitate shedding and digestion and provide refuge from predators) during the active season (Willson and Cunningham 2015). Additional habitat types including foraging, mating and movement habitats are needed for population persistence.

Radiotelemetry studies completed by King (2002a, 2002b, 2003) were used by the USFWS (2003) to categorize all habitat types used by Lake Erie Watersnake into two groups, referred throughout this document as: 1. overwintering habitat and 2. active season habitat.

#### Overwintering Habitat

Overwintering habitat has been documented to include cracks and fissures in bedrock, rock and soil piles and berms, root masses, building foundations, rodent burrows in soil substrates, drainage tiles and old wells (USFWS 2003, COSEWIC 2015). Adult snakes have been observed overwintering both communally and singly (USFWS 2003; D. Jacobs unpub. data). There are also records of hibernacula being shared with Eastern Foxsnakes (*Pantherophis gloydi*), Blue Racers (*Coluber constrictor foxii*) and Eastern Gartersnakes (*Thamnophis sirtalis sirtalis*) (Porchuk and Willson unpub. data).

Radiotracked Lake Erie Watersnakes in Ontario overwintered at sites at least 13 m from the water's edge (range 13-105 m; mean = 53 m). 50% of overwintering sites were found within 56 m of the shore, 75% were within 69 m and 90% were within 95 m of shore (D. Jacobs unpub. data; COSEWIC 2006). On Pelee Island, probable hibernacula locations have been identified up to 500 m from shore based on spring time observations of snakes (R.J. Willson unpub. data). Many of the Lake Erie Watersnakes observed greater than 95 m from the shore are juveniles (R.J. Willson unpub. data).

On the U.S islands, 75% of radiotracked Lake Erie Watersnakes were found to overwinter within 69 m of the shoreline (USFWS 2003). Individuals usually emerge from their hibernacula from mid-to-late April or early May (Willson unpub. data), and disperse towards the Lake Erie shoreline within one to one and a half months (D. Jacobs unpub. data). Along the shoreline, they can be found under rocks, in rock berms, in woody debris or brush piles, under wooden boards or pieces of refuse washed up on the beach and underground (D. Jacobs unpub. data).

#### Active Season Habitat

Active season habitat includes areas used for basking, gestation, shelter, foraging, mating, birthing and movement. Active season habitat is typically used between April or May – September to October, depending on air temperature (King 2003). Studies show

75% of snakes are found to remain within 13 m of the water's edge (in-water and terrestrial) during the active season, except when moving to and from hibernacula (King 2003; USFWS 2003). Like other reptiles, Lake Erie Watersnakes are ectothermic<sup>13</sup> and must rely on their surroundings in order to keep their body temperature within a preferred range. To help raise their body temperature, Lake Erie Watersnakes bask in the sun along the shoreline. In order to lower their body temperature to avoid overheating, they may enter water or take shelter under debris. These activities are facilitated by key habitat components. Along the shoreline, Lake Erie Watersnakes use limestone/dolomite shelves, fragments and ledges, armour stone, cobblestone, vegetation (living or dead), rock and/or soil piles (berms) and discarded sheet metal or wooden boards for basking, gestation, shelter, mating and birthing (COSEWIC 2015). Sandy shorelines without rocks or vegetation close to the water's edge are common on Pelee Island and appear to be used less frequently by the subspecies (Jacobs, Willson and Porchuk unpub. data). However, Lake Erie Watersnakes have been observed resting or basking in these areas (J. Crowley pers. comm in COSEWIC 2015), and will sometimes move onto sandy beaches to finish swallowing prey (Willson unpub. data).

Lake Erie Watersnakes forage in water along the shoreline, and in canals and wetlands (Porchuk unpub. data). The subspecies rarely travels inland more than 50 m from the shoreline during the active season (COSEWIC 2006; D. Jacobs unpub. data). A radio tracking study by the USFWS (2003) found that the linear extent of shoreline used by 75% of the snakes was 437 m or less. Similar to overwintering habitat, individuals show fidelity to particular areas or features along the shoreline during the active season (USFWS 2003, D. Jacobs unpub. data). On Pelee Island, the subspecies has been observed in the canals that are responsible for draining the island and have also been found using inland ponds and wetlands created by quarrying activities (Porchuk and Willson unpub. data).

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<sup>13</sup> An animal that produces very little body heat internally, relying on heat from its environment to keep its body warm (Bell et al. 2007).

## 4. Threats

### 4.1. Threat Assessment

The Lake Erie Watersnake threat assessment is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system. Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). Limiting factors are not considered during this assessment process. For purposes of threat assessment, only present and future threats are considered. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section. Table 1 is from COSEWIC (2015) and was completed by a group of species experts during the period of COSEWIC status re-assessment.

**Table 1. Threat Calculator Assessment for Lake Erie Watersnake.**

Threat #	Threat description	Impact <sup>a</sup>	Scope <sup>b</sup>	Severity <sup>c</sup>	Timing <sup>d</sup>
4	Transportation & service corridors	Low	Pervasive	Slight	High
4.1	Roads & railroads	Low	Pervasive	Slight	High
5	Biological resource use	Negligible	Pervasive	Negligible	High
5.1	Hunting & collecting terrestrial animals	Negligible	Pervasive	Negligible	High
7	Natural system modifications	Unknown	Small	Unknown	High
7.3	Other ecosystem modifications	Unknown	Small	Unknown	High
8	Invasive & other problematic species & genes	Unknown	Small	Negligible	High
8.1	Invasive non-native/alien species	Unknown	Pervasive	Unknown	High
8.2	Problematic native species	Negligible	Small	Negligible	High
9	Pollution	Unknown	Pervasive	Unknown	High
9.2	Industrial & military effluents	Unknown	Pervasive	Unknown	High

<sup>a</sup> **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

<sup>b</sup> **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

<sup>c</sup> **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

<sup>d</sup> **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [ $< 10$  years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

## 4.2. Description of Threats

### IUCN Threat 4. Transportation & service corridors

#### Threat 4.1 Roads & railroads

While the majority of the Canadian portion of the Lake Erie Archipelago is roadless, almost the entire perimeter of Pelee Island is encircled by a road which runs in close proximity to the water, resulting in a relatively high risk of road mortality (COSEWIC 2015; Willson and Cunnington 2015). Regular observations of road-killed Lake Erie Watersnake are made by provincial biologists and other naturalists (Willson and Cunnington 2015). The colouration of this subspecies allows it to camouflage well on unpaved or dust covered roads. This, paired with its tendency to stop moving when approached by vehicles or humans while exposed on roads, makes it a likely target for vehicular collisions (COSEWIC 2015; Willson and Cunnington 2015). In addition to this, a study on the Ontario mainland has demonstrated that a considerable proportion of drivers will intentionally run over snakes (Ashley et al. 2007). Lawnmowers have also been observed to cause mortality to this subspecies (Willson and Cunnington 2015) and it is possible that boat propellers have a similar effect.

In 1993-95, 1998-99 and during the springs of 2000-02, roadkill surveys were conducted for all snake species on Pelee Island (Brooks and Porchuk 1997; Brooks et al. 2000; Willson 2002). These surveys primarily sought to map the distribution of Lake Erie Watersnakes on Pelee Island and also provided an estimate of the number of individuals killed on the island's roads in peak years. The 1995 survey found 64 dead Lake Erie Watersnakes on Pelee Island's roads (Brooks et al. 2000). The age class of the individuals was not recorded, however four of the 64 records were recorded in August when newborn snakes are present (Willson and Porchuk unpub. data). From this, it can be inferred that at least 60 of the road-killed individuals were adults, juveniles or yearlings. The 2000-02 spring surveys which took place from April 13-May 15 each year, documented 12 adults, two juveniles and seven yearlings as roadkill, with eight of the 12 adult roadkill being female (Willson 2002; Willson unpub data). These data show that many Lake Erie Watersnakes are killed each spring by automobiles. This timing matches their seasonal movement from inland overwintering habitat to shoreline active season habitat. From this, it can be inferred that the subspecies is also killed regularly on roads in September and October as they move back to their inland overwintering habitat, though roadkill surveys have not been conducted at this time of year. At this point, it is unknown whether mortality at the levels documented is likely to incur long-term population consequences similar to that observed for Gray Ratsnakes (*Pantherophis spiloides*) in eastern Ontario (Row et al. 2007). However, given that Pelee Island is home to the largest proportion of Lake Erie Watersnakes in Canada, vehicular mortality could be a significant threat to survival and recovery if road mortality mitigation is not effective.



## IUCN Threat 5. Biological resource use

### Threat 5.1 Hunting & collecting terrestrial animals

Many humans harbour a fear or dislike of snakes which has unfortunately led to the intentional persecution of many snake species; a response which is often heightened when snakes inhabit areas where people swim (COSEWIC 2015; Willson and Cunnington 2015). Lake Erie Watersnakes can grow to be quite large and are often visible along the shoreline of the Lake Erie Islands that they inhabit (COSEWIC 2006). The subspecies is skittish and tends to retreat into the water or under cover objects when approached (Willson and Cunnington 2015). However, Lake Erie Watersnake has a tendency to use areas in close proximity to humans; they are often found close to human dwellings or even in boats (Willson and Cunnington 2015). While the subspecies typically retreats if possible, when handled this non-venomous snake may bite and display other defensive behaviours, such as writhing and emitting a foul smelling liquid from its anal glands (Willson and Cunnington 2015).

Throughout the last 150 years, Lake Erie Watersnakes were notably collected and persecuted throughout its range (COSEWIC 2015; USFWS 2003); there are records of snake extermination campaigns which targeted Lake Erie Watersnake on Rattlesnake Island (Ohio) and Middle Island (Campbell 1991). Several dead Lake Erie Watersnakes were found on Middle Island and East Sister Island in 2006, and while the cause of death could not be definitively determined, it appeared to be consistent with human persecution (Willson and Cunnington 2015). Perceived conflict between species conservation, private property rights and development opportunities can be a potential driver of species persecution (Olive 2012). However, these public concerns can be mitigated through improved engagement, collaboration and outreach on species conservation activities. An increased effort of collaboration between the municipality, provincial and federal governments, local partners and landowners on Pelee Island are promoting information exchange and community-based efforts to reduce this threat. An analysis undertaken in 2009 by Seymour showed that most American island residents no longer intentionally kill snakes. The lowered threat of persecution has in part, resulted in the USFWS delisting the Lake Erie Watersnake in the United States (Seymour 2009).

## IUCN Threat 7 Natural Systems Modification

### Threat 7.3 Other ecosystem modifications

Middle Island and East Sister Island are federally and provincially protected (respectfully), thus habitat loss and degradation are monitored and managed in these areas. Privately owned North Harbour Island has been heavily modified and there does not appear to be much suitable habitat remaining for Lake Erie Watersnake. The Chick Islands, which collectively refer to Big Chicken, Little Chicken and Chick Island are essentially reef outcrops and due to water levels and wave action from Lake Erie, the habitat they offer is likely low-quality and transitory.

Threats that reduce Lake Erie Watersnake habitat quantity and quality include vegetation clearing, mowing and spraying, infilling, rock berm disruption, shoreline hardening and general shoreline property clean-up (USFWS 2003; COSEWIC 2006).

Changes to Lake Erie water levels and severe weather event could potentially have a negative effect on Lake Erie Watersnake subpopulations. Severe weather events would likely affect a significant portion of each subpopulation on small islands. Changes in water level could reduce available habitat on the several islands.

## IUCN Threat 8. Invasive & other problematic species & genes

### Threat 8.1 Invasive non-native/alien species

The invasive European Common Reed (*Phragmites australis*) may pose a threat to the Lake Erie Watersnake by reducing habitat quality and availability. As the plant's density increases, it may reduce solar radiation to levels that are too low for snakes to maintain preferred body temperatures (COSEWIC 2015). Areas of Lighthouse Point Provincial Nature Reserve on the northern point of Pelee Island, which once provided suitable habitat, now have large stands of Common Reed and consequently appear to provide poor habitat conditions for Lake Erie Watersnakes (Willson unpub. data).

Wild Turkeys (*Meleagris gallopavo*) pose a potential threat to the Lake Erie Watersnakes on Pelee Island. About 25 Wild Turkeys were released across Pelee Island in 2002 by the province of Ontario, the Wild Turkey Release Program, the Township of Pelee and the Pelee Island Sportsman's Club. The turkeys have established a large population on the island and a Wild Turkey Hunt began in 2004 (Ontario Ministry of Natural Resources 2007). It is unknown whether Wild Turkey predation of young Lake Erie Watersnakes occurs on Pelee Island.

### Threat 8.2 Problematic native species

Double-crested Cormorants (*Phalacrocorax auritus*) have negatively altered ground cover and tree communities on both Middle and East Sister Islands. It is unknown whether or not this will have an adverse effect on Lake Erie Watersnake. Double-crested Cormorants have been monitored by the Canadian Wildlife Service and Parks Canada since they colonized the area in the early 1980s and populations have continued to increase, reaching 6,000 nests per island in 2004 (C. Weseloh, unpub. data in COSEWIC 2015; Dobbie 2008). Analysis of aerial photographs has shown a corresponding decline in healthy forest cover on East Sister and Middle Sister Islands with less than 20% forest cover remaining in 2010, while Middle Island stabilized at 46% forest cover (Hebert et al. 2014). Management of Double-crested Cormorant nest numbers on Middle Island has continued annually since 2008. Subsequent aerial forest cover analysis, coupled with ground surveys have shown that forest cover on Middle Island is now increasing since 2010 with 61% forest cover recorded in 2016 (Parks Canada Agency unpub. data). It is unknown whether the changing composition

and quality of vegetation cover on these islands are impacting the Lake Erie Watersnake.

Predation of young Lake Erie Watersnakes by Double-crested Cormorants may be a threat on Middle and East Sister Islands (COSEWIC 2015). A juvenile Lake Erie Watersnake was found by researchers in 2001. It appeared to have been killed, but not consumed, by an unknown species of bird (D. Jacobs, unpub. data). To date, there is a lack of evidence pertaining to Double-crested Cormorant predation on Lake Erie Watersnakes. As of 2010, the USFWS did not consider this predation to be a potential threat to American Lake Erie Watersnake subpopulations and there is no evidence to suggest that this threat is elevated for Canadian subpopulations.

Lake Erie Watersnake may be affected by Snake Fungal Disease (SFD) (*Ophidiomyces ophiodiicola*) (Sleeman 2013). This is an increasingly prevalent fungal disease in wild snakes that causes severe skin lesions, leading to widespread morbidity and mortality (Sleeman 2013; Allender et al. 2015). *O. ophiodiicola* has long been present in North America, but it is hypothesized that recent environmental changes (possibly linked to climate change) are driving the current SFD emergence (Lorch et al. 2016). To date, it has been confirmed in Ontario, as well as in nine U.S states, including Ohio where the U.S Lake Erie Watersnake population is located, however it is considered likely to be even more widespread (Sleeman 2013).

The disease spreads directly through contact with infected snakes and indirectly through environmental exposure (i.e., contact with contaminated soil (Sleeman 2013; Allender et al. 2015)). While the population-level effects of SFD remain unclear, it appears to spread easily and is often fatal; there is concern that it may have negative impacts on small snake populations (Sleeman 2013; Allender et al. 2015). For example, SFD is thought to have contributed to a 50% decline in a small Timber Rattlesnake (*Crotalus horridus*) population in New Hampshire between 2006 and 2007 (Clark et al. 2011). Climate change has the potential to further exacerbate the risk of SFD to snake populations, as warming temperatures may lead to increased infection rates in overwintering snakes (Allender et al. 2015).

The first cases of SFD in Ohio were reported from the retroactive testing of five Lake Erie Watersnakes collected in northern Ohio in 2006 (Lorch et al. 2016; Smeenk et al. 2016). In the year following the outbreak, the northern Ohio population had declined by approximately 18% (Lorch et al. 2016). Despite the population growth of Lake Erie Watersnakes in recent years, relatively low population numbers and a geographically restricted distribution may make the subspecies vulnerable to disease outbreaks of SFD (Lorch et al. 2016). SFD has also been confirmed in the closely related Northern Watersnake. In 2009, a Northern Watersnake with a fungal skin infection consistent with SFD was collected from an island in western Lake Erie, Ohio (Sleeman 2013).

As of early 2017, there were four confirmed cases of SFD in Ontario (CWHC 2017). The first recorded case affected one Eastern Foxsnake (*Pantherophis gloydi*) near Lake Erie

in the spring of 2015. To date, three infected Eastern Foxsnakes and one Queensnake (*Regina septemvittata*) have been confirmed (CWHC 2017). The pathogen has also been confirmed without disease in Ontario on Eastern Foxsnake, Queensnake, Massasauga (*Sistrurus catenatus*), five subspecies of gartersnake (*Thamnophis* sp.) and on the Northern Watersnake (CWHC 2017).

## IUCN Threat 9. Pollution

### Threat 9.2 Industrial and military effluents

A study by Fernie et al. (2008) sampled polychlorinated biphenyl (PCB) and dichlorodiphenyldichloroethylene (DDE) concentrations in Lake Erie Watersnakes within the Lake Erie Archipelago. The Lake Erie Watersnake at the three Pelee Island sites had the lowest mean concentrations of both PCB and DDE reported in the entire study. While these represent the lowest concentrations in the study, it is unclear whether these levels can have negative effects on female reproduction, particularly survival of the developing young (Fernie et al. 2008).

## 5. Management Objective

Consistent with the Province of Ontario's recovery goal, the management objective for Lake Erie Watersnake under the federal *Species at Risk Act* is to:

- Maintain the current abundance and distribution of Lake Erie Watersnake in Canada.

This subspecies has a naturally limited distribution and a low probability of natural range expansion. Therefore, this management plan aims to maintain a stable, persistent population within current abundance levels (at or above 3,470 individuals) and distribution across four Canadian islands, Pelee Island, Middle Island, East Sister Island and Hen Island. Recovery will depend on mitigating known threats to the subspecies and by maintaining enough suitable habitat on the islands to support the population.

The most recently available population estimates are around 3,470 mature individuals (COSEWIC 2015). Although no extensive surveys have been conducted on Pelee Island (the largest Canadian population) in recent years, population increases have been documented in the U.S. (USFWS 2010), and similar population increases are suspected to have recently occurred in Canada based on available records (Willson pers. comm. 2015). The distribution objective does not currently include Middle Sister and North Harbour Islands, as available data suggests the subspecies is likely extirpated from these islands.

Viable populations would be expected to persist into the future, provided threats to the Lake Erie Watersnake continued to be managed and mitigated. With the largest population of Lake Erie Watersnake occurring on Pelee Island, this management plan recognizes the importance of community-based approaches to collectively conserve

biodiversity, foster stewardship and protection of the natural environment and support economic sustainability. Conservation measures to support recovery of the Lake Erie Watersnake focus on continuing the collaborative efforts with partners to minimize threats, increase public awareness and manage the species habitat to support the current abundance and distribution of the species in Ontario.

## 6. Broad Strategies and Conservation Measures

### 6.1. Actions Already Completed or Currently Underway

The following actions have been completed or are currently underway to contribute to the conservation of the Lake Erie Watersnake in Canada:

- The Official Plan for the Township of Pelee includes considerations for protecting and enhancing the natural environment of the island. Currently, 18% of Pelee Island has been identified for conservation purposes. The Township of Pelee is currently working with private landowners and partner agencies to create new and expand existing nature reserves on the island and integrate other conservation initiatives. An environmental advisory committee for Pelee Island comprised of municipal, provincial and non-government representatives cooperates on issues of environmental importance (Ministry of the Environment, Conservation and Parks 2019).
- Parks Canada Agency is responsible for maintaining and restoring the ecological integrity of its national parks. Middle Island is part of Point Pelee National Park under the ownership of Parks Canada Agency. Parks Canada Agency developed and implements the *Point Pelee National Park of Canada Management Plan* (including Middle Island)(2010), the *Point Pelee National Park of Canada Middle Island Conservation Plan* (2008) and the *Multi-species Action Plan for Point Pelee National Park of Canada and Niagara National Historic Sites of Canada* (Parks Canada Agency 2016). These documents include goals to protect and to restore the ecological integrity of the Carolinian ecosystem on Middle Island, including the species at risk protected under the *Species at Risk Act*. Lake Erie Watersnake is a species of conservation concern for the park, with one of the few local populations occurring on Middle Island.

#### Habitat Protection and Management

- As of 2012, the following properties were known to contain Lake Erie Watersnake habitat and were owned by organizations that have natural heritage protection as one of their primary objectives:
  - Pelee Island
    - Fish Point Provincial Nature Reserve (Province of Ontario);
    - Lighthouse Point Provincial Nature Reserve (Province of Ontario)
    - Stone Road Alvar Conservation Area (Essex Region Conservation Authority); and

- Stone Road Alvar (see Nature Conservancy of Canada 2008).
- Additional lands owned by a variety of landowners are also in conservation ownership; a total of 18% of Pelee Islands has been identified for conservation purposes (Ministry of the Environment, Conservation and Parks 2019)
  - East Sister Island Nature Reserve (Province of Ontario);
  - Middle Island (Parks Canada Agency);
  - Middle Point Woods (see Nature Conservancy of Canada 2008);

Management at each of these properties varies in accordance to the objectives of the responsible agency.

- Some landowners whose properties contain Lake Erie Watersnake habitat have entered into conservation easements with the NCC.
- Landowners whose properties contain Lake Erie Watersnake habitat (with certain size restrictions) are eligible to apply to participate in the provincial Conservation Land Tax Incentive Program (CLTIP). This program provides a 100% tax relief to landowners for the portion of their property that is considered to comprise endangered species habitat.
- Nature Conservancy of Canada has implemented a community based conservation plan to protect key biodiversity features and functions on Pelee Island
- Invasive species management efforts have occurred throughout the range of the Lake Erie Watersnake, including management of invasive European Common Reed on Pelee Island by the Nature Conservancy of Canada.
- The municipality of Pelee has intentionally created species at risk habitat, such as snake hibernacula

#### Public Outreach

- In recent years, increased communication and consultation has occurred between federal and provincial governments and the municipality and residents of Pelee Island to foster collaboration and recognize the importance of the island's biodiversity while supporting local economic sustainability.
- The municipality has significantly lowered the speed limits on Pelee Island to reduce road impacts to the species.
- In 2003, the Wilds of Pelee Island published a 72-page, colour guide entitled *Pelee Island Human and Natural History: Guide to a Unique Island Community*. Photos and text concerning the Lake Erie Watersnake and other species at risk were featured in the publication. The Wilds of Pelee Island held an Endangered Species Festival on the island from 2001-2003 to show that the preservation of endangered species can be beneficial to the community and the local economy. By raising an estimated \$16,000, the festival demonstrated that conserving endangered species and their habitats could benefit the island's economy via eco-tourism. In 2003, the festival was combined with the 8<sup>th</sup> Annual Meeting of the Canadian Amphibian and Reptile Conservation Network, which brought in

more than 220 people from Ontario, and other regions of Canada and the United States (MacKinnon 2005).

- In 1995, several government and non-government conservation agencies including the Pelee Island Heritage Centre created a natural heritage video. This video was played in the passenger lounge on every ferry passing between Pelee Island and the Ontario mainland for several years and copies were also available for sale. The educational quality of this video may have helped to reduce road mortality and the direct persecution of snakes by humans.
- Pelee Island Heritage Centre, Essex Region Conservation Authority, Ontario Nature and the Ontario Heritage Foundation designed a pamphlet together in 1995. It was made available on the ferry and at the Heritage Centre. This pamphlet provided information on rare species on Pelee Island including the Lake Erie Watersnake, and included information on how tourists and residents could help conserve rare species. This pamphlet is currently out of print (MacKinnon 2005).
- In addition to the natural heritage video and pamphlet, the Pelee Island Heritage Centre also sold conservation t-shirts as part of a public outreach initiative.
- Parks Canada produces exhibits, publications, presentations and interpretive programs at Point Pelee National Park to encourage visitors to learn about and help protect Lake Erie Watersnake. Outreach education through news articles and a local school program also help to promote conservation of the Lake Erie Watersnake beyond the park boundaries.

#### Research and Monitoring

- Since 2011, Parks Canada staff have recorded incidental observations of Lake Erie Watersnake on Middle Island during all research, monitoring and active management visits to the island (Parks Canada Agency unpub. data).
- From 2006-2011 (excluding 2009), Parks Canada has conducted Lake Erie Watersnake mark-recapture surveys on Middle Island with assistance from the province of Ontario, Essex Region Conservation Authority, and volunteers (Parks Canada Agency unpub. data).
- Provincial biologists and R. Willson conducted radiotelemetry studies on Pelee, Middle and East Sister Islands from 2001-2003. During this period, 23 snakes were tracked and 12 hibernacula were located (D. Jacobs unpub. data).
- In 2004 on Pelee Island, visual surveys and limited mark-recapture surveys were conducted to determine population levels and relative density by shoreline type.
- Mark-recapture surveys were undertaken by provincial biologists, Parks Canada staff, and volunteers on Middle and East Sister Island from 2001-2005 (D. Jacobs unpub. data).
- Two hibernacula were constructed within Fish Point and Lighthouse Point Provincial Reserves for Lake Erie Watersnake, Blue Racer and Eastern Foxsnake (Willson and Porchuk 2001).
- Roadkill surveys were conducted for all snake species on Pelee Island from 1993-1995 (Brooks and Porchuk 1997), 1998-1999 (Brooks et al. 2000) and during the springs of 2000 to 2002 (Willson 2002).

- Toxicological analysis, mark recapture and counts of litter size of gravid females were conducted in 1999 (Brooks et al. 2000).
- Select sites on Pelee Island were surveyed by R. King in the 1980s and early 1990s. Population estimates were generated as a result of these surveys.
- Ontario Nature is working with the Natural Heritage and Information Centre, Ministry of Natural Resources and Forestry and other organizations to promote the Ontario Reptile and Amphibian Atlas (<http://www.ontarionature.org/atlas>) to improve citizen science reporting of herpetofauna across Ontario.

## 6.2. Broad Strategies and Conservation Measures

Environment and Climate Change Canada is adopting the government-led and government-supported actions of the *Blue Racer*, *Lake Erie Watersnake* and *Small-mouthed Salamander* and *Unisexual Ambystoma* (*Small-mouthed Salamander dependent population*) – *Ontario Government Response Statement* (Ministry of the Environment, Conservation and Parks 2019) (Part 2) as the broad strategies and conservation measures to address the threats and meet the management objective for the subspecies. Only those portions of the Government Response statement pertaining to the Lake Erie Watersnake are being adopted in this management plan.

## 6.3. Narrative to Support Conservation Measures and Implementation Schedule

The Canadian range of the Lake Erie Watersnake is restricted to the islands of the Lake Erie archipelago, which limits future expansion of the subspecies. In order to apply appropriate conservation measures, it is important to more accurately determine the current population of the Lake Erie Watersnake in Canada. The most recent Canadian surveys took place more than ten years ago, and it is unknown if increased consumption of Round Goby by the subspecies has had the same beneficial effects on the Canadian population as it has for the United States population. Once current population estimates are established, the necessary monitoring protocols can be implemented in order to identify population and distribution trends and address threats as needed. A collaborative, stewardship first approach that partners with the municipality, the provincial and federal governments, and local partners is intended to meet both the needs of the community and species that contribute to Pelee Island's biodiversity, such as Lake Erie Watersnake.

Knowledge gaps relating to the impact, scope, severity and timing of certain threats, including road mortality, and shoreline habitat loss, impacts resulting from changes in island bird populations (i.e., Double-crested Cormorants, and Wild Turkeys) and the potential impact of SFD need to be addressed. The community of Pelee Island celebrates their natural history and significant efforts have been made to address primary threats of habitat loss as well as accidental or intentional mortality, through collaborative conservation efforts and information exchange, and through improved signage and road speed reduction. Continuing efforts that foster community-based



conservation initiatives and promote habitat stewardship and threat mitigation remain very important components to protect the biodiversity of the island, including the Lake Erie Watersnake.

## **7. Measuring Progress**

The performance indicators presented below provide a way to measure progress towards achieving the management objective and monitoring the implementation of the management plan. Every five years, success of management plan implementation will be measured against the following performance indicator:

- The abundance (at or above 3470 mature individuals) and distribution (across the four Canadian islands) of the Lake Erie Watersnake in Canada has been maintained.

## 8. References

- Allender, M.C., D.B. Raudabaugh, R.H. Gleason and A.N. Miller. 2015. The natural, history, ecology, and epidemiology of *Ophidiomyces ophiodiicola* and its potential impact on free-ranging snake populations. *Fungal Ecology* 17: 187-196.
- Ashley, E.P., A. Kosloski and S.A. Petrie. 2007. Incidence of intentional vehicle-reptile collisions. *Human Dimensions of Wildlife* 12:137-143.
- Bell, S.L.M., T.B. Herman and R.J. Wassersug. 2007. Ecology of *Thamnophis sauritus* (Eastern Ribbon Snake) at the northern limit of its range. *Northeastern Naturalist* 14: 279-292.
- Brooks, R.J. and B.D. Porchuk. 1997. Conservation of the endangered blue racer snake (*Coluber constrictor foxii*) on Pelee Island, Canada. Report prepared for the Ontario Ministry of Natural Resources. 26 pp.
- Brooks, R.J., R.J. Willson and J.D. Rouse. 2000. Conservation and ecology of three rare snake species on Pelee Island. Unpublished report for the Endangered Species Recovery Fund. 21 pp.
- Campbell, C.A. 1991. Status of the Lake Erie water snake, *Nerodia sipedon insularum*, in Canada. Committee on the Status of Endangered Wildlife in Canada. 29 pp.
- Clark, R.W., M.N. Marchand, B.J. Clifford, R. Stechert and S. Stephens. 2011. Decline of an isolated timber rattlesnake (*Crotalus horridus*) population: interactions between climate change, disease, and loss of genetic diversity. *Biological Conservation* 144, 886-891.
- Conant, R. and J.T. Collins. 1998. A field guide to reptiles and amphibians of eastern and central North America. 3<sup>rd</sup>, expanded edition. Houghton Mifflin Co., Boston, Massachusetts.
- COSEWIC. 2006. COSEWIC assessment and update status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 23 pp.
- COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.
- Crowley, J., pers. comm. in: COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.

- CWHC. 2017. Snake fungal disease in Canada rapid threat assessment. Prepared by Canadian Wildlife Health Cooperative for Environment and Climate Change Canada.
- Dobbie, T. 2008. Point Pelee National Park of Canada Middle Island Conservation Plan. Parks Canada Agency.
- Ernst, C.H. and E.M. Ernst. 2003. Snakes of the United States and Canada. The Smithsonian Institution, Washington, D.C.
- Fernie, K.J., R.B. King, K.G. Drouillard and K.M. Stanford. 2008. Temporal and spatial patterns of contaminants in Lake Erie Watersnakes (*Nerodia sipedon insularum*) before and after the Round Goby (*Apollonia melanostomus*) invasion. Science of the Total Environment 406: 344-351.
- Hebert, C.E., J. Pasher, D.V.C. Weseloh, T. Dobbie, S. Dobbyn, D. Moore, V. Minelga, J. Duffe. 2014. Nesting cormorants and temporal changes in island habitat. Journal of Wildlife Management 78(2): 307-313.
- Jacobs, D. Unpublished Data in: COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.
- King, R.B. 1986. Population ecology of the Lake Erie water snake, *Nerodia sipedon insularum*. Copeia 1986: 757-772.
- King, R.B. 1998. Distribution and abundance of the Lake Erie Watersnake, *Nerodia sipedon insularum*, on the Ohio islands of western Lake Erie. Cooperative Research Project Final Report. Northern Illinois University. 67 pp.
- King, R.B. 2002a. Hibernation, seasonal activity, movement patterns, and foraging behavior of adult Lake Erie water snakes (*Nerodia sipedon insularum*). Quarterly report to the Ohio Division of Wildlife and the U.S. Fish and Wildlife Service. 27 pp.
- King, R.B. 2002b. Hibernation, seasonal activity, movement patterns, and foraging behavior of adult Lake Erie Watersnakes (*Nerodia sipedon insularum*), Quarterly Report. Submitted to Ohio Division of Wildlife and U.S. Fish and Wildlife Service. Unpublished report. 50 pp.
- King, R.B. 2003. Lake Erie Water Snake abundance and habitat use: implications for recovery. Project SG 196-03. Final Report to the Ohio Lake Erie Commission. DeKalb, IL. 27 pp.
- King, R.B. and R. Lawson. 1995. Color-pattern variation in Lake Erie water snakes: the role of gene flow. Evolution 49: 885-896.

- Lorch, J.M., S. Knowles, J.S. Lankton, K. Michell, J.L. Edwards, J.M. Kapfer, R.A. Staffen, E.R. Wild, K.Z. Schmidt, A.E. Ballmann, D. Blodgett, T.M. Farrell, B.M. Glorioso, L.A. Last, S.J. Price, K.L. Schuler, C.E. Smith, J.F.X. Wellehean Jr. and D.S. Blehert. 2016. Snake fungal disease: an emerging threat to wild snakes. *Philosophical Transactions of the Royal Society B*. 371: 20150457.
- MacKinnon, C.A. 2005. (March 2005 Draft). National recovery plan for the Blue Racer (*Coluber constrictor foxii*). Recovery of Nationally Endangered Wildlife (RENEW). Ottawa, Ontario.
- Ministry of the Environment, Conservation and Parks. 2019. Blue Racer, Lake Erie Watersnake and Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) – Ontario Government Response Statement.  
<https://www.ontario.ca/page/blue-racer-lake-erie-watersnake-small-mouthed-salamander-and-unisexual-ambystoma-small-mouthed>.
- NatureServe. 2018. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Web site: <http://www.natureserve.org/explorer> [accessed January 2018].
- Nature Conservancy of Canada. 2008. Management guidelines: Pelee Island alvars. NCC – Southwestern Ontario Region. London, Ontario. 43 pp.
- Ohio Department of Natural Resources. 2017. Ohio's Listed Species: Wildlife that are considered to be endangered, threatened, species of concern, special interest, extirpated or extinct in Ohio. Publication 5256 (R0717).  
<http://wildlife.ohiodnr.gov/portals/wildlife/pdfs/publications/information/pub356.pdf> [accessed April 2018].
- Olive, A. 2012. Endangered species policy in Canada and the US: a tale of two islands. *American Review of Canadian Studies* 42: 84-101.
- Ontario Ministry of Natural Resources. 2007. Wild Turkey management plan for Ontario. Ontario Ministry of Natural Resources. 44 pp.
- Parks Canada Agency. 2010. Point Pelee National Park of Canada Management Plan. Parks Canada Agency, Ottawa, ON.
- Parks Canada Agency. 2016. Multi-species Action Plan for Point Pelee National Park of Canada and Niagara National Historic Sites of Canada. *Species at Risk Act* Action Plan Series. Parks Canada Agency, Ottawa. iv + 39 pp.

- Parks Canada Agency. Unpublished Data. Collected by Parks Canada Agency staff on Middle Island, Ontario, Canada.
- Porchuk, B.D. 1998. Canadian Blue Racer snake recovery plan. Report prepared for the Recovery of Nationally Endangered Wildlife (RENEW) committee. 55 pp.
- Porchuk, B.D. Unpublished Data in: COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.
- Porchuk, B.D. and R.J. Willson. Unpublished Data in: COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.
- Row, J.R., G. Blouin-Demers, and P.J. Weatherhead. 2007. Demographic effects of road mortality in black ratsnakes (*Elaphe obsoleta*). *Biological Conservation* 137:117-124.
- Rowell, J.C. 2012. The Snakes of Ontario: Natural History, Distribution, and Status. Art Bookbindery, Canada.
- Seymour, M. 2009. Lake Erie Watersnake (*Nerodia sipedon insularum*), 5-year review: summary and evaluation.
- Sleeman, Dr. J. 2013. Snake Fungal Disease in the United States. National Wildlife Health Center, Wildlife Health Bulletin 2013-02. Website: [https://www.nwhc.usgs.gov/disease\\_information/other\\_diseases/snake\\_fungal\\_disease.jsp](https://www.nwhc.usgs.gov/disease_information/other_diseases/snake_fungal_disease.jsp) [accessed September 2015].
- Smeenk, N.A., G.L Lipps Jr., M.C. Allender, K. Backus, M. Freeman, D. Hribar and M. Parsley. 2016. Snake fungal disease, *Ophidiomyces ophiodiicola*, in Ohio, USA. *Herpetological Review* 47(4) 593-594.
- Stanford, K.M., R.B King and D. Wynn. 2010. Summer and winter spatial habitat use by the Lake Erie Watersnake. *Journal of Fish and Wildlife Management* 1:122-130.
- United States Fish and Wildlife Service [USFWS]. 2003. Lake Erie Watersnake (*Nerodia sipedon insularum*) recovery plan. US Fish and Wildlife Service. Fort Snelling, MN. 111 pp. + 7 appendices.

- United States Fish and Wildlife Service [USFWS]. 2010. Federal register final rule: removal of the Lake Erie Watersnake (*Nerodia sipedon insularum*) from the federal list of endangered and threatened wildlife. Website: <http://www.fws.gov/midwest/endangered/reptiles/lews/FRlewsFinalRuleDelistAug2011.html> [accessed August 2017].
- Weseloh, C. Unpublished Data in: COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.
- Willson, R.J. and B.D. Porchuk. 2001. Blue Racer and Eastern Foxsnake habitat feature enhancement at Lighthouse Point and Fish Point Provincial Nature Reserves. 2001 final report. Report prepared for the Ontario Ministry of Natural Resources. 11 pp.
- Willson, R.J. 2002. A systematic search for the blue racer (*Coluber constrictor foxii*) on Pelee Island (2000-2002). Final report prepared for the Ontario Ministry of Natural Resources. 38 pp. + digital appendices.
- Willson, R.J. and G.M. Cunningham. 2015. Recovery Strategy for the Lake Erie Watersnake (*Nerodia sipedon insularum*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. Vi + 24 pp.
- Willson, R.J. pers. comm. 2015. Personal communication with A. Foran and J. Mannion via teleconference. July 2015. Riverstone Environmental Solutions Inc.
- Willson, R.J. Unpublished Data in: COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.
- Willson, R.J. and B.D. Porchuk. Unpublished Data in: COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.
- Woodliffe, A. and B.D. Porchuk. Unpublished Data in: COSEWIC. 2015. COSEWIC assessment and status report on the Lake Erie Watersnake *Nerodia sipedon insularum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 37 pp.

## Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)<sup>14</sup>. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the [Federal Sustainable Development Strategy](#)'s<sup>15</sup> (FSDS) goals and targets.

Conservation planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of management plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the management plan itself, but are also summarized below in this statement.

This federal management plan will clearly benefit the environment by promoting the recovery of the Lake Erie Watersnake and by protecting and enhancing habitat for two co-occurring Endangered snake species: the Eastern Foxsnake (*Elaphe gloydi*) and the Blue Racer (*Coluber constrictor foxii*). Since the subspecies is restricted to islands in Lake Erie, any efforts to protect the species' habitat will also help preserve the limited habitat available on these islands. Several other species at risk occur on the Canadian islands of the Lake Erie Archipelago, including: the Prothonotary Warbler (*Protonaria citrea*), Yellow-breasted Chat (*Icteria virens virens*), Least Bittern (*Ixobrychus exilis*), Blanchard's Cricket Frog (*Acris blanchardi*), Small-mouthed Salamander (*Ambystoma texanum*), Wild Hyacinth (*Camassia scilloides*), Chimney Swift (*Chaetura pelagica*), Eastern Prickly Pear Cactus (*Opuntia humifusa*), Gray Fox (*Urocyon cinereoargenteus*), Kentucky Coffee-tree (*Gymnocladus dioica*), Red Mulberry (*Morus rubra*), Acadian Flycatcher (*Empidonax virescens*), and the Spiny Softshell (*Apalone spinifera*).

The potential for this management plan to inadvertently lead to adverse effects on other species was considered. At this time, conservation measures for the Lake Erie Watersnake focus on research, monitoring, protection, management, stewardship, and outreach. These activities have little potential to lead to adverse effects on other species that may share the habitat or range of the Lake Erie Watersnake.

Consequently, the SEA concluded that this strategy will clearly benefit the environment and will not entail significant adverse effects. For further details, the reader should refer to the following sections of the document in particular: Needs of the Lake Erie

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<sup>14</sup> [www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html](http://www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html)

<sup>15</sup> [www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1](http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1)

Watersnake (Section 3.3), Conservation Measures (Section 6.3) and Narrative to Support Conservation Measures and Implementation Schedule (Section 6.4).



**Part 2 – *Blue Racer, Lake Erie Watersnake and  
Small-mouthed Salamander and Unisexual Ambystoma  
(Small-mouthed Salamander dependent population) – Ontario  
Government Response Statement*, prepared by the Ministry  
of the Environment, Conservation and Parks, 2019**

# Blue Racer, Lake Erie Watersnake and Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population)

## Ontario Government Response Statement



### Protecting and Recovering Species at Risk in Ontario

Species at risk recovery is a key part of protecting Ontario's biodiversity. *The Endangered Species Act, 2007* (ESA) is the Government of Ontario's legislative commitment to protecting and recovering species at risk and their habitats.

Under the ESA, the Government of Ontario must ensure that a recovery strategy is prepared for each species that is listed as endangered or threatened. A recovery strategy provides science-based advice to government on what is required to achieve recovery of a species.

Within nine months after a recovery strategy is prepared, the ESA requires the Ontario government to publish a statement summarizing the government's intended actions and priorities in response to the recovery strategy. The response statement is the government's policy response to the scientific advice provided in the recovery strategy. In addition to the strategy, the government response statement considered (where available) input from

Indigenous communities and organizations, stakeholders, other jurisdictions, and members of the public. It reflects the best available local and scientific knowledge, including Traditional Ecological Knowledge where it has been shared by communities and Knowledge Holders, as appropriate and may be adapted if new information becomes available. In implementing the actions in the response statement, the ESA allows the government to determine what is feasible, taking into account social, cultural and economic factors.

The recovery strategies for the Blue Racer (*Coluber constrictor foxii*), the Lake Erie Watersnake (*Nerodia sipedon insularum*) and the Small-mouthed Salamander (*Ambystoma texanum*) in Ontario were completed on March 2, 2015. On May 30, 2018, an updated and expanded recovery strategy for Small-mouthed Salamander (*Ambystoma texanum*) and Unisexual Ambystoma (Small-mouthed Salamander dependent population) (*Ambystoma laterale – texanum*) was finalized. Unisexual Ambystoma (Small-mouthed Salamander dependent population) are also referred to as Small-mouthed Salamander dependent unisexals in this document. Given their similar distribution and threats, the recovery efforts for the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander, and Small-mouthed Salamander dependent unisexals are addressed collectively in a single government response statement, which has been updated following the completion of the updated recovery strategy noted above. The combined government response statement also recognizes the importance of collaborative implementation of recovery actions with partners on Pelee Island. This GRS does not aim to outline additional habitat protection for the four species; at this time, the general habitat protection under the ESA already in place will continue to apply.

The Blue Racer is a large, non-venomous snake that can grow up to 1.5 m in length. Adult Blue Racers are greyish-blue in colour with a white, cream or bluish-white belly and a characteristic black mask. Juveniles have dark blotches along their body that eventually fade completely.



Blue Racer habitat. Photo by Joe Crowley



## Pelee Island

The Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander, and Small-mouthed Salamander dependent unisexuals are all found on Pelee Island. Within Canada, Blue Racer, Small-mouthed Salamander and Small-mouthed Salamander dependent unisexuals are known to occur exclusively on Pelee Island. Within Canada, the largest population of Lake Erie Watersnake occurs on Pelee Island. Pelee Island is located in the western basin of Lake Erie and has a vast amount of biodiversity and a rich cultural heritage. The community of Pelee Island celebrates its natural history. The Township of Pelee works with private landowners and partner organizations to create and expand nature reserves on the island and works to integrate other conservation-focused initiatives.

The Official Plan for the Township of Pelee outlines in the overall objectives the importance of understanding the value of the island's natural heritage, of fostering stewardship of the natural environment, and of protecting and enhancing the natural environment of the island. An environmental advisory committee for Pelee Island has also been formed to bring together representatives from the municipality, non-governmental organizations, the local conservation authority and provincial ministries to cooperate on issues of

The Lake Erie Watersnake is a non-venomous, highly-aquatic snake that is rarely found far from the shoreline. It averages between 59 and 88 cm and is pale grey to dark brown in colour, with ranging patterns of darker brown or reddish blotches on the back and sides that often connect to form a banding pattern.



Lake Erie Watersnake habitat. Photo by Joe Crowley



environmental importance. The Pelee Island community actively collaborated to support the Nature Conservancy of Canada (NCC) in purchasing over 10% of the island (435 ha) for the proactive preservation of priority conservation lands. Additional lands owned by a variety of land owners and managers are also in conservation ownership for a total of 18% of the island set aside for conservation purposes. The municipality, private landowners and NCC have also taken multiple additional steps to protect and support biodiversity on Pelee Island:

- In order to reduce road impacts to species, the municipality has significantly lowered speed limits on almost all roads on the island.
- Through the updating of waste disposal methods, the Township of Pelee has allowed for previous retaining ponds that were constructed to progress into functioning wetlands.
- All municipal infrastructure projects include site-specific collaboration with the local conservation authority, local Indigenous communities and organizations, and pertinent provincial and federal ministries.
- The municipality has intentionally created endangered species habitat such as snake hibernacula.
- To benefit both terrestrial and aquatic species, many stretches of shoreline habitat are being actively preserved and restored using native vegetation and materials.

The Small-mouthed Salamander is a medium-sized, heavy-bodied salamander that is dark brown to greyish-black with gray-blue patches that resemble lichen on its tail and sides. It can grow to a maximum length of about 18 cm and has a relatively small head and a short, narrow snout.



Small-mouthed Salamander and Unisexual *Amyxistoma* (Small-mouthed Salamander dependent population) habitat. Photo by Joe Crowley

- Many private landowners continue to preserve natural habitat, construct and protect wetlands, plant native species, and use low impact farming practices on their individual properties to support biodiversity and the natural heritage of Pelee Island.
- With the support of the municipality, NCC has secured key natural areas including three alvars, critical shoreline and forested swamp areas. NCC also continues to restore agricultural lands to create habitat corridors and buffers and enhance connectivity for species.
- NCC has implemented a community-based conservation plan to protect key biodiversity features and functions, while supporting continuation of existing land uses and expansion of the island's ecotourism-based economy.
- The municipality, community members, NCC and other partners collaborate to exchange knowledge, promote the island's unique wildlife, interpret the natural surroundings for visitors and promote natural heritage events.

There are a variety of land uses on Pelee Island, including agriculture, hunting, recreation and tourism. Given the island formation, a finite amount of land is available to carry out all activities, which may result in competing land uses. The community's health, as well as prosperity, fundamentally rely on biodiversity and the ecosystem services it provides, such as food, clean water, fresh air and fertile soil. All of these factors highlight the importance of mobilizing partnerships and collectively working to conserve biodiversity while supporting local economic sustainability.

### **Protecting and Recovering the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population)**

The Blue Racer, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) are listed as endangered species under the ESA, which protects both the animals and their habitat. The ESA prohibits harm or harassment of endangered and threatened species and damage or destruction of their habitat without authorization. Such authorization would require that conditions established by the government be met.

The Lake Erie Watersnake is listed as special concern under the ESA. The species was downlisted provincially from endangered to special concern on June 2, 2017, based on the Committee on the Status of Species at Risk in

The Unisexual Ambystoma (Small-mouthed Salamander dependent population), which co-exist with Small-mouthed Salamanders, are intermediate in appearance to other mole salamander species it co-exists with but cannot be readily distinguished from these species without genetic testing.

Ontario's (COSSARO) assessment. The species is included in this GRS to foster continued stewardship and in recognition of the value of collective efforts to conserve biodiversity.

A collaborative, stewardship first approach that partners the municipality, the provincial and federal governments, and local partners is intended to meet both the needs of the community and of the species that help contribute to the island's biodiversity, including Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Small-mouthed Salamander dependent unisexuals.

### **Blue Racer**

The historical distribution of the Blue Racer in North America ranges from extreme southwestern Ontario, west to Minnesota, south to Illinois and east to Ohio. In the United States, the only states with current populations of the Blue Racer are Ohio, Indiana, Illinois, Michigan, Wisconsin and Iowa. In Canada, Blue Racers have disappeared from the mainland in southwestern Ontario and this species is now known to only occur on Pelee Island. Blue Racers inhabit forest edges and dry, open to semi-open habitat types such as alvars, savannahs, grasslands and thickets. They exhibit high fidelity to hibernation sites, which are usually underground cavities that are accessed through cracks and fissures in the bedrock.

The primary threat to the Blue Racer is habitat loss, largely due to succession of vegetation communities. Historically, clearing of land for agriculture and development posed a major threat but has been less significant in recent years. As woody plants succeed in the ecosystem, suitable habitat features for the species disappear, such as open canopies, dry open to semi-open areas, and edge habitat. As is the case with most snake species, road mortality and persecution are also significant threats to the Blue Racer. Working together to reduce negative perceptions of snakes is an important component of conserving biodiversity and addressing these threats for all snake species. It is possible that chemical contamination poses a threat to the species and that introduced Wild Turkeys (*Meleagris gallopavo*) may pose a threat as a potential new predator, though the extent of these potential threats is currently unknown. Continuing to increase the level of knowledge and understanding of interactions between introduced Wild Turkeys and Blue Racers will be of value.

Population estimates for the Blue Racer have not been completed since 2002, when the combined population size for three study sites on Pelee Island was estimated to be approximately 140 adult Blue Racers.

The possible population range identified through this study was 59 to 284. Hatchlings and juveniles have been observed as recently as 2015, suggesting that the population is successfully reproducing. However, anecdotal evidence from some research and site visits since 2002 suggest the Canadian population of the Blue Racer may have experienced further decline in recent years, and a decline in overall habitat quality and quantity has also been noted at several occupied sites on the island.

Given the small population size found in 2002, anecdotal evidence of potential decline since that time, and the threats to the Blue Racer and its habitat, approaches to recovery should focus on working together to increase the level of knowledge of the species, increase the amount of suitable habitat available for the Blue Racer and minimize threats to the species to enable natural increases in the species' population.

### **Government's Recovery Goal for the Blue Racer**

**The government's goal for the recovery of the Blue Racer in Ontario is to maintain the species' distribution and ensure a viable, self-sustaining population.**

### **Lake Erie Watersnake**

The Lake Erie Watersnake is a subspecies of the Northern Watersnake (*Nerodia sipedon*) and is endemic to the islands of Lake Erie and a small peninsula on the Ohio mainland. Previously listed as endangered in Ontario, the species was downlisted to special concern in June 2017 based on updated information that informed COSSARO's assessment. In Ontario, Lake Erie Watersnakes are known to occur on Pelee, East Sister, and Middle Islands. This species was previously known to also occur on Hen, North Harbour and Middle Sister Islands. Recent data suggest that it is likely extirpated from North Harbour and Middle Sister Islands. However, surveys have not occurred on Hen Island, which is privately owned, since the early 1990s. As a result, the 2016 Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report identifies that the species' status on Hen Island is currently unknown. Hen, East Sister, North Harbour, and Middle Sister Islands all lie northwest of Pelee Island in Lake Erie, while Middle Island lies south of the southwest corner of Pelee Island.

Lake Erie Watersnakes are highly aquatic and rarely travel inland more than 50 m from the shoreline during the active season, although they will travel greater distances inland to hibernation sites. Adult snakes may hibernate singly or communally, using underground cavities, burrows, or human-made structures such as old wells or building foundations.



As indicated in scientific literature, significant threats to snakes such as the Lake Erie Watersnake are road mortality and persecution. The colouration of Lake Erie Watersnakes can make them difficult to see against unpaved or dust covered roads. Additionally, fear or dislike of snakes can foster negative human behaviours that may result in harm to individual snakes. Habitat loss due to shoreline development, vegetation clearing, increased presence of shoreline invasive species such as Phragmites (European Common Reed) (*Phragmites australis* ssp. *australis*), and removal of winter hibernation habitat is also a significant threat to the species. Other possible threats to the Lake Erie Watersnake include environmental contaminants and adverse effects of high-density nesting or roosting areas of waterbirds, such as Double-crested Cormorants (*Phalacrocorax auritus*), on habitat.

Populations of the Lake Erie Watersnake experienced historical declines, but may have stabilized in recent years; there is insufficient data to document population trends of Lake Erie Watersnake in Canada. An increase in the abundance of the invasive Round Goby (*Neogobius melanostomus*), which has become an important food source for the Lake Erie Watersnake, has shown to have increased populations in the United States. It is unknown whether there has been a similar effect in Canada due to potential differences in the magnitude of threats that are faced by the species. In 2016, the Committee on the Status of Endangered Wildlife in Canada estimated the number of mature individuals on Pelee Island to be 3,286, and estimated approximately another 200 individuals inhabiting the other islands. Approaches to recovering the Lake Erie Watersnake will focus on minimizing the threats of accidental and intentional human-caused mortality by increasing public awareness and understanding on managing its habitat to support the current abundance and distribution of the species in Ontario.

### **Government's Recovery Goal for the Lake Erie Watersnake**

**The government's goal for the recovery of the Lake Erie Watersnake is to maintain the current abundance and distribution of the species in Ontario.**

### **Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population)**

The Small-mouthed Salamander ranges from eastern Texas to western Alabama and across the central United States, reaching its northern range in Michigan, northern Ohio and Pelee Island in Ontario. The global population is thought to exceed 100,000 but is unknown. In Canada, the species is only known to occur on Pelee Island. Small-mouthed Salamander dependent unisexuals have been found in Michigan, Indiana and Ohio, and several Lake Erie islands. The full global distribution and population are uncertain because

genetic testing is required to identify these animals and this has not occurred for many populations. In Canada, the Small-mouthed Salamander dependent unisexuals are only known to occur on Pelee Island.

Small-mouthed Salamanders, Unisexual *Ambystoma* (Small-mouthed Salamander dependent population) and Blue-spotted Salamanders (*Ambystoma laterale*) (not at risk) all co-occur on Pelee Island. Unisexual *Ambystoma* (Small-mouthed Salamander dependent population) is a genetically distinct, all-female salamander lineage that depends on the other two salamander species to carry out reproduction.

Small-mouthed Salamander and Small-mouthed Salamander dependent unisexuals in Ontario are known historically to occur at five breeding sites on Pelee Island, but the most recent survey efforts (2015-2017) found Small-mouthed Salamanders and Small-mouthed Salamander dependent unisexuals at only three of those five breeding sites. These surveys did, however, identify three additional breeding sites in use by the two species on Pelee Island for a total of six confirmed sites. The status of one additional breeding site, and the current population abundance, are unknown.

The Small-mouthed Salamander and Small-mouthed Salamander dependent unisexuals are members of the Mole Salamander family (*Ambystomatidae*), a family name that refers to the biological characteristic of spending most of their time underground or beneath cover except when breeding.

All Unisexual *Ambystoma* (Small-mouthed Salamander dependent population) salamanders are females and have a unique reproductive strategy whereby the sperm from male Small-mouthed Salamanders or Blue-spotted Salamanders is needed to initiate egg development. Their offspring are unique in that they are also all females and are all considered Unisexual *Ambystoma* (Small-mouthed Salamander dependent) regardless of what species' sperm initiated egg development. While the sperm may or may not be incorporated into the Small-mouthed Salamander dependent unisexual egg, the species does not appear to be able to reproduce in the absence of a Small-mouthed Salamander or Blue-spotted Salamander. Therefore, the persistence of the Unisexual species is dependent on the presence of the other salamander species.

It is thought that these three species that make up the salamander complex on Pelee Island were isolated together in the area roughly 4000 years ago. Small-mouthed Salamander dependent unisexuals vastly outnumber both Small-mouthed and Blue-spotted Salamanders, making up over 80 percent

of all the *Ambystoma* salamanders on the island. Recent survey efforts examined more than 830 samples (adults and larvae) on Pelee Island collected from 2015 to 2017 and found that unisexuals made up over 95 percent of the sample (Hossie and Murray 2017).

The habitat needs of both species include: fish-free, shallow water bodies that retain water from March through July, used for breeding, and adjacent suitable terrestrial areas that are shaded and provide soft moist soils, logs, rocks and leaf litter that are used for cover, shelter and overwintering.

The main threats to the species are habitat degradation, loss and fragmentation. This includes the temporary or permanent loss of water from breeding sites during critical periods, and the loss of forest canopy cover, rotting logs and other ground cover. Small-mouthed Salamanders and Small-mouthed Salamander dependent unisexuals rely on wetlands site and ephemeral pools of water (i.e., temporary pools that form in the spring and typically dry up in the summer) for breeding; therefore, activities and climate conditions that affect the hydrology of the habitat and surrounding areas also pose a threat. Threats from invasive species, such as *Phragmites*, can also reduce suitable habitat conditions for the species. While environmental contaminants (e.g., pesticides, de-icing salt) are known to affect amphibians, the local impacts of environmental contaminants on Small-mouthed Salamander and Small-mouthed Salamander dependent unisexuals are unknown. Additional potential threats to the species include disease (e.g., ranaviruses, chytrid fungi) and predation and habitat alteration caused by Wild Turkeys. As the relative impacts of many of these potential and known threats on local populations are currently unknown, further research is necessary to support recovery actions for the species.

The Small-mouthed Salamander and Unisexual *Ambystoma* (Small-mouthed Salamander dependent) populations on Pelee Island are small and the salamanders themselves are difficult to distinguish from other salamander species without the assistance of genetic testing. Continuing to manage the salamander complex will support recovery for all associated salamander species at risk. Given the lack of population estimates, there is a need to focus on conducting inventories of recent breeding sites and monitoring population trends and habitat usage. Approaches to recovery will focus on working in collaboration with the local community to monitor current populations, manage current habitat effectively, increase the amount of suitable habitat available for Small-mouthed Salamander and dependent unisexuals, and increase our knowledge of potential threats to the species.

## **Government's Recovery Goal for the Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population)**

The government's goal for the recovery of the Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) is to ensure long-term viability and persistence of the Ontario populations by managing threats and increasing population abundance, distribution and connectivity.

### **Actions**

Protecting and recovering species at risk is a shared responsibility. No single agency or organization has the knowledge, authority or financial resources to protect and recover all of Ontario's species at risk. Successful recovery requires inter-governmental co-operation and the involvement of many individuals, organizations and communities. In developing the government response statement, the government considered what actions are feasible for the government to lead directly and what actions are feasible for the government to support its conservation partners to undertake.

### **Government-led Actions**

To help protect and recover the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) the government will directly undertake the following actions:

- Explore opportunities to work collectively with the Township of Pelee, including the Pelee Island Environmental Advisory Committee, the federal government and local partners to develop an integrated (landscape/ place-based) approach to managing species at risk with consideration of ecosystem values and sustainable resources on Pelee Island. This may include:
  - developing a strategic plan for species at risk and their habitats on Pelee Island;
  - continuing to implement the Ontario Invasive Species Strategic Plan to address the invasive species (e.g., Phragmites) that threaten Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population);
  - continuing to implement Ontario's *Invasive Species Act* to address the invasive species identified in the Act (e.g., Phragmites) that threaten Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population);

- supporting the coordination of provincial and federal species at risk legislation (i.e., ESA and *Species at Risk Act* (SARA)), in order to collaboratively continue to protect Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) and their habitats; and,
- educating other agencies and authorities involved in planning and environmental assessment processes on the ESA.
- Explore opportunities to work collectively with the Township of Pelee, including the Pelee Island Environmental Advisory Committee, the federal government and local partners to integrate approaches to stewardship and implementation of recovery activities including:
  - encouraging collaboration, and establishing and communicating annual priority actions for government support in order to reduce duplication of stewardship efforts;
  - supporting conservation, agency, municipal and industry partners, and Indigenous communities and organizations to undertake activities to protect and recover Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population). Support will be provided where appropriate through funding, agreements, permits (including conditions) and advisory services;
  - undertaking communication and outreach to increase public awareness of species at risk in Ontario; and,
  - encouraging the submission of Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) data to the Ontario's central repository through the citizen science projects that they receive data from (e.g., the *Ontario Reptile and Amphibian Atlas*) and directly through the *Natural Heritage Information Centre*.
- Continue to monitor, protect and manage habitat for the four species in protected areas on Pelee Island (e.g., Lighthouse Point and Fish Point Provincial Nature Reserves). Continue to work collaboratively with local partners to enhance and restore habitat for species at risk within these protected areas.

## Government-supported Actions

The government endorses the following actions as being necessary for the protection and recovery of the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population). Actions identified as “high” may be given priority consideration for funding under the Species at Risk Stewardship Program. Where reasonable, the government will also consider the priority assigned to these actions when reviewing and issuing authorizations under the ESA. Other organizations are encouraged to consider these priorities when developing projects or mitigation plans related to species at risk.

### **Focus Area: Habitat Management**

**Objective:** Work collaboratively to increase habitat quality for the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population).

Habitat loss and degradation is a significant threat to all four species. A landscape level approach to habitat management for the species recognizes the finite amount of land available on Pelee Island. Collectively working to develop and implement best management practices will support habitat management and restoration for the four species, particularly for the Blue Racer, Small-mouthed Salamander and Small-mouthed Salamander dependent unisexals as habitat is very limited. Without active management of Blue Racer habitat, the open to semi-open habitat succeeds (e.g., shrubs and trees grow in) over time and becomes unsuitable for the species. In the case of Small-mouthed Salamander and the Small-mouthed Salamander dependent unisexals, the species rely on ephemeral pools and wetlands and suitable adjacent terrestrial areas. As a result, activities impacting the hydrology or tree canopy of these areas could have substantial consequences for these species. Cooperative, preventative efforts to manage habitat for suitability over the long-term will greatly assist in reducing these impacts.

#### **Actions:**

1. **(High)** Using community knowledge and species expertise, develop, promote and implement best management practices to manage existing habitat for the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) including:
  - prescribed burns to prevent woody succession in Blue Racer habitat, with consideration for the safety of neighbouring properties, snakes and other rare species present on-site;

- targeted removal of native or invasive woody vegetation in Blue Racer habitat, with consideration for other species at risk, using appropriate and approved methods;
  - removal of invasive species such as Phragmites along shoreline habitat for Lake Erie Watersnake and at known breeding sites for Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population);
  - managing vegetation to support suitable habitat conditions and maintaining appropriate wetland and forested habitat features such as cover objects and forest cover for Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population);
  - buffering against potential site-level effects of environmental contaminants on water quality in Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) breeding habitat; and,
  - managing existing and new infrastructure, such as drainage works, in a way that reduces the negative effects on Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) habitat, with additional consideration for neighbouring properties.
2. Collaborate with community members and organizations to strategically increase the amount of suitable habitat available for Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) by:

#### **Blue Racer (High)**

- identifying and assessing existing habitat and identifying candidate areas for habitat enhancement, restoration and creation where there are willing partners;
- creating a mosaic of suitable habitat types such as grassland, savannah and edge habitat, with a focus on increasing connectivity between suitable habitat patches;
- creating hibernation, nesting and shelter habitats and monitoring and documenting their effectiveness;



#### **Lake Erie Watersnake**

- identifying and assessing existing habitat and identifying candidate areas for habitat enhancement, restoration and creation where there are willing partners;
- restoring shoreline habitat and increasing structural heterogeneity, and increasing connectivity between areas of habitat;
- creating suitable hibernation and shelter habitats and monitoring and documenting their effectiveness;

#### **Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) (High)**

- identifying and assessing existing habitat and identifying sites adjacent to or between known locations for potential habitat enhancement, restoration and creation where there are willing partners; and,
  - enhancing, restoring and creating suitable habitat such as ephemeral pools and surrounding forested areas in appropriate areas.
3. **(High)** Work with local partners to maintain adequate water levels and quality, and hydrology that sustain the breeding sites and migratory routes for Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population). This may include buffering for the potential effects of climate change on water levels in the future and exploring opportunities to support hydrology at a watershed scale (e.g., restoring riparian habitat).

#### **Focus Area: Awareness and Threat Management**

**Objective:** Work in partnership with the Pelee Island community to reduce threats to the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) through increasing public awareness, promoting local stewardship of the species and their habitats, and implementing threat mitigation techniques.

Landowners, local residents and visitors to Pelee Island have an important role to play in the protection and recovery of the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population). Increasing public awareness and promoting local stewardship are critical to addressing key threats such



as road mortality and persecution. Efforts to increase awareness should build off of work completed to date by conservation partners and other jurisdictions, such as the resources and programs developed in the U.S. to support Lake Erie Watersnake recovery. Steps taken in the future to mitigate threats to the species and their habitat can build on research conducted in the coming years. A continued collaborative approach that focuses on stewardship of the species and their habitat will support the effective implementation of protection and recovery actions.

**Actions:**

4. **(High)** Collaborate with local organizations and initiatives to reduce threats to the species, including road mortality and persecution. For example:
  - developing programs to reduce road mortality, which may include installing signs and publicizing the need for cautious driving, particularly in areas of high mortality for these species;
  - producing educational materials to increase public awareness, such as promoting the need to share the shoreline with Lake Erie Watersnakes; and,
  - implementing techniques to reduce rates of road mortality (e.g., ecopassages, barrier fencing, traffic calming measures), particularly in areas of high mortality for these species.
5. Promote local stewardship of the Blue Racer and the Lake Erie Watersnake that includes:
  - developing social marketing strategies to help influence public perceptions and behaviours that negatively affect snake populations;
  - producing stewardship publications to highlight success stories and engage the public in snake conservation; and,
  - increasing awareness of incentive programs and how landowners can benefit from protecting and restoring Blue Racer and Lake Erie Watersnake habitat.

**Focus Area: Inventory and Monitoring**

**Objective:** Improve knowledge of species' population trends, habitat usage and distribution.

Little is known about the current abundance, local distribution, habitat usage, and population trends of Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population). A greater understanding of the four

species' current population abundance is essential to support the ability to monitor progress and effectiveness of recovery actions and population trends over time. Further information on these topics, as well as additional surveying for potential presence at historical and potential locations would contribute to greater understanding of the status of the four species.

**Actions:**

6. Collaborate with local partners and community members to develop and implement survey and monitoring programs to:

**Blue Racer (High) and Lake Erie Watersnake**

- estimate the population abundance and distribution of the Blue Racer and the Lake Erie Watersnake and monitor trends over time;
- monitor changes in Blue Racer and Lake Erie Watersnake use and suitability of habitat;
- identify areas with high rates of road mortality between occupied habitats;
- survey for the Lake Erie Watersnake on other Lake Erie islands (e.g., Hen, Middle Sister and North Harbour Islands), where feasible, in order to determine if the species is still present in these areas;

**Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) (High)**

- estimate the population abundance and distribution of both salamander species at known sites;
- estimate the proportion of each species relative to the salamander complex;
- monitor suitability of habitat including terrestrial (e.g., canopy cover, soil moisture and cover object availability) and aquatic (e.g., water level, pH, pollutants and fish presence) features;
- monitor population trends and monitor changes in genetic composition and recruitment of the salamander complex over time;
- identify areas with high rates of road mortality between occupied habitats; and,
- survey for the two species at potential sites with suitable habitat in order to identify additional populations and refine knowledge on the distribution of the salamander species.

**Focus Area: Research and Population Management**

**Objective:** Increase knowledge of threats to the species, species-specific habitat requirements and ecological limitations.

Knowledge gaps related to specific habitat requirements and the significance of threats currently exist for all four species. Investigating and filling these knowledge gaps will help to better inform the implementation of recovery actions for these species, such as habitat management efforts and road mortality reduction techniques. Improving our knowledge of the salamander complex on Pelee Island, including genetic composition and any associated limitations, will support future recovery efforts. Increasing our understanding of potential emerging threats, such as disease and climate change, will also support effective mitigation if needed in the future. For both Blue Racer and the two salamander species, impacts of potential diseases could lead to significant impacts given their small population sizes.

**Actions:**

7. Investigate the structural, thermal and chemical properties of hibernation and nest/gestation sites to inform the creation and maintenance of these sites for the Blue Racer and the Lake Erie Watersnake. Assess the effectiveness of created hibernation habitats.
8. Research Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) habitat use (e.g., breeding sites, migration routes and overwintering sites) and habitat connectivity (including dispersal barriers).
9. Investigate the effectiveness of techniques to create breeding ponds for the two salamander species, including the factors that influence the quality of created breeding habitats.
10. Investigate the effects and severity of known and potential threats to Blue Racer and Lake Erie Watersnake, and identify potential mitigation measures as appropriate, including:
  - examining the potential effects of Double-crested Cormorants and Wild Turkeys on the species and/or their habitat; and,
  - investigating the potential effects of disease (e.g., Snake Fungal Disease) and other identified threats to the species and their habitat.

11. Investigate the effects and severity of known and potential threats to Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population), and identify potential mitigation measures as appropriate, including:
  - investigating the extent that environmental contaminants are directly or indirectly affecting the productivity and/or survival rates of the two salamander species;
  - examining the potential effects on the salamander complex of predation by Wild Turkeys and habitat alteration caused by the turkeys;
  - investigating the potential effects of climate change on the species and their habitat, and the relationship between habitat suitability and hydrology; and,
  - investigating the potential effects of disease (e.g., ranaviruses, chytrid fungi), and parasites (e.g., trematode) on Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population).
12. Conduct assessments to determine population targets for achieving self-sustaining and genetically viable Blue Racer, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent) populations in Ontario.
13. Investigate the ecological relationships in the Ambystoma salamander complex on Pelee Island to assess potential demographic constraints to species' recovery (e.g., related to reproductive output, recruitment, and survival in the larval and adult life stages).
14. Investigate the potential need for, and feasibility of, assisted recruitment techniques to support the recovery goal for Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population). If found to be feasible and necessary, implement, evaluate, adapt and improve recruitment techniques with consideration for the species' ecology and the salamander complex as a whole. An example of a priority recruitment technique is:
  - exploring the potential benefits and need for a cost-effective head-starting protocol/program (e.g., reproductive monitoring, artificial incubation of eggs, and release of juveniles).

## Implementing Actions

Financial support for the implementation of actions may be available through the Species at Risk Stewardship Program. Conservation partners are encouraged to discuss project proposals related to the actions in this response statement with program staff. The Ontario government can also advise if any authorizations under the ESA or other legislation may be required to undertake the project.

Implementation of the actions may be subject to changing priorities across the multitude of species at risk, available resources and the capacity of partners to undertake recovery activities. Where appropriate, the implementation of actions for multiple species will be co-ordinated across government response statements.

## Reviewing Progress

The ESA requires the Ontario government to conduct a review of progress towards protecting and recovering a species not later than five years from the publication of this response statement. The review will help identify if adjustments are needed to achieve the protection and recovery of the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population).

## Acknowledgement

We would like to thank all those who participated in the development of the recovery strategies for the Blue Racer, Lake Erie Watersnake, Small-mouthed Salamander and Unisexual Ambystoma (Small-mouthed Salamander dependent population) for their dedication to protecting and recovering species at risk.

### For additional information:

Visit the species at risk website at [ontario.ca/speciesatrisk](http://ontario.ca/speciesatrisk)

Contact the Natural Resources Information Centre

1-800-667-1940

TTY 1-866-686-6072

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