Photo: Joe Crowley

Spotted Turtle

(Clemmys guttata) in Ontario

Ontario Recovery Strategy Series

Draft

2019

Ministry of the Environment, Conservation and Parks

Ontario

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the *Endangered Species Act 2007* (ESA) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

Under the ESA a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Environment, Conservation and Parks Species at Risk webpage at: **www.ontario.ca/speciesatrisk**

Recommended citation

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Cover illustration: Photo by Joe Crowley

ISBN [*MECP will insert prior to final publication.*]

Declaration

The recovery strategy for the Spotted Turtle (*Clemmys guttata*) was developed in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

The recovery strategy does not necessarily represent the views of all individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

The recommended goals, objectives and recovery approaches identified in the strategy are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this strategy is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the advice set out in this strategy.

Responsible jurisdictions

Ministry of the Environment, Conservation and Parks
Environment and Climate Change Canada – Canadian Wildlife Service, Ontario
Parks Canada Agency

Executive summary

The *Endangered Species Act, 2007* (ESA) requires the Minister of the Environment, Conservation and Parks to ensure recovery strategies are prepared for all species listed as endangered or threatened on the Species at Risk in Ontario (SARO) List. Under the ESA, a recovery strategy may incorporate all or part of an existing plan that relates to the species.

The Spotted Turtle (*Clemmys guttata*) is listed as endangered on the SARO List. The species is listed as endangered under the federal *Species at Risk Act* (SARA). Environment and Climate Change Canada prepared the Recovery Strategy for the Spotted Turtle (*Clemmys guttata*) in Canada in 2018 to meet its requirements under the SARA. This recovery strategy is hereby adopted under the ESA. With the additions indicated below, the enclosed strategy meets all of the content requirements outlined in the ESA.

The Critical Habitat section of the federal recovery strategy provides an identification of critical habitat (as defined under the SARA). Identification of critical habitat is not a component of a recovery strategy prepared under the ESA. However, it is recommended that the approach used to identify critical habitat in the federal recovery strategy, along with any new scientific information pertaining to the Spotted Turtle and the areas it occupies, be considered when developing a habitat regulation under the ESA.

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1.0 Adoption of federal recovery strategy

The *Endangered Species Act, 2007* (ESA) requires the Minister of the Environment, Conservation and Parks to ensure recovery strategies are prepared for all species listed as endangered or threatened on the Species at Risk in Ontario (SARO) List. Under the ESA, a recovery strategy may incorporate all or part of an existing plan that relates to the species.

The Spotted Turtle (*Clemmys guttata*) is listed as endangered on the SARO List. The species is listed as endangered under the federal *Species at Risk Act* (SARA). Environment Canada and Climate Change prepared the Recovery Strategy for the Spotted Turtle (*Clemmys guttata*) in Canada in 2018 to meet its requirements under the SARA. This recovery strategy is hereby adopted under the ESA. With the additions indicated below, the enclosed strategy meets all of the content requirements outlined in the ESA.

1.1 Species assessment and classification

The following list is assessment and classification information for the Spotted Turtle (*Clemmys guttata*). Note: The glossary provides definitions for the abbreviations and technical terms in this document.

- SARO List Classification: Endangered
- SARO List History: Endangered (2005), Special Concern (2004)
- COSEWIC Assessment History: Special Concern (1991), Endangered (2004, 2014)
- SARA Schedule 1: Endangered (2005)
- Conservation Status Rankings: G-rank: G5; N-rank: N2; S-rank: S2

1.2 Area for consideration in developing a habitat regulation

Under the ESA, a recovery strategy must include a recommendation to the Minister of the Environment, Conservation and Parks on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below will be one of many sources considered by the Minister, including information that may become newly available following completion of the recovery strategy, when developing the habitat regulation for this species.

The Critical Habitat section of the federal recovery strategy provides an identification of critical habitat (as defined under the SARA). Identification of critical habitat is not a component of a recovery strategy prepared under the ESA. However, it is recommended that the approach used to identify critical habitat in the federal recovery

strategy, along with any new scientific information pertaining to the Spotted Turtle and the areas it occupies, be considered when developing a habitat regulation under the ESA.

Glossary

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee established under section 14 of the Species at Risk Act that is responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act, 2007* that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. Ranks are determined by NatureServe and, in the case of Ontario's S-rank, by Ontario's Natural Heritage Information Centre. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by the letter G, N or S reflecting the appropriate geographic scale of the assessment. The numbers mean the following:

1 = critically imperilled
2 = imperilled
3 = vulnerable
4 = apparently secure
5 = secure
NR = not yet ranked

Endangered Species Act, 2007 (ESA): The provincial legislation that provides protection to species at risk in Ontario.

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This Act establishes Schedule 1 as the legal list of wildlife species at risk. Schedules 2 and 3 contain lists of species that at the time the Act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act, 2007* that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

List of abbreviations

COSEWIC: Committee on the Status of Endangered Wildlife in Canada
COSSARO: Committee on the Status of Species at Risk in Ontario
ESA: Ontario's *Endangered Species Act, 2007*

ISBN: International Standard Book Number
MECP: Ministry of the Environment, Conservation and Parks
MNRF: Ministry of Natural Resources and Forestry
SARA: Canada's *Species at Risk Act*
SARO List: Species at Risk in Ontario List

Appendix 1. Recovery strategy for the Spotted Turtle (*Clemmys guttata*) in Canada

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Spotted Turtle (*Clemmys guttata*) in Canada

Spotted Turtle

2018

Government of Canada
Gouvernement du Canada

Canada

Recommended citation:

Environment and Climate Change Canada. 2018. Recovery Strategy for the Spotted Turtle (*Clemmys guttata*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. ix + 61 pp.

For copies of the recovery strategy, 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[1].

Cover illustration: © Joe Crowley

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[1] http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] agreed to establish complementary legislation and programs that provide for 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 recovery strategies for listed Extirpated, Endangered, and Threatened species 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 Spotted Turtle and has prepared this recovery strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Province of Ontario (Ministry of Natural Resources and Forestry[3]) and the Province of Quebec (Ministère des Forêts, de la Faune et des Parcs), as per section 39(1) of SARA.

Success in the recovery 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 strategy and will not be achieved by Environment and Climate Change Canada, the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Spotted Turtle and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment and Climate Change Canada, the Parks Canada Agency, and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area[4] be described

[2] http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2
[3] On June 26, 2014 the Ontario Ministry of Natural Resources became the Ontario Ministry of Natural Resources and Forestry.
[4] These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

Acknowledgments

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Acknowledgment and thanks are given to all other parties that provided advice and input used to help inform the development of this recovery strategy including various Indigenous organizations and individual citizens, and stakeholders who provided input and/or participated in consultation meetings.

Executive Summary

The Spotted Turtle (*Clemmys guttata*) is listed as Endangered on Schedule 1 of the *Species at Risk Act* (SARA). The species is listed as Endangered in Ontario under the provincial *Endangered Species Act, 2007* (ESA 2007). It is a small freshwater turtle species distinguished by its smooth, arched black carapace[5] which has scattered yellow-orange spots. Spotted Turtles are semi-aquatic and use both terrestrial and aquatic habitats during the active season.

The species' range extends from Michigan, southern Ontario, and Maine southward to Florida. In Canada, the species is found in southern, central, and eastern Ontario, with only two confirmed historical[6] records from Quebec. It is estimated that roughly 6% of the global distribution of Spotted Turtles occurs in Canada.

Spotted Turtle local population[7] abundance has declined significantly within Canada. The distribution of the Canadian population of Spotted Turtle is very scattered, with an estimated total abundance of 2,000 - 3,000 adults. Many remaining local populations are small and some may no longer be viable[8].

The main threats facing the Spotted Turtle include accidental mortality from roads and off-road vehicles, illegal collection, exotic and invasive species and land conversion for agriculture and development. The Spotted Turtle is highly vulnerable to any increases in rates of mortality of adults and older juveniles since the species has delayed sexual maturity and a low reproductive rate.

There are unknowns regarding the feasibility of recovery of the Spotted Turtle. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible.

The long-term (i.e., 50 years) population and distribution objective in Canada is to ensure the persistence of self-sustaining local populations of Spotted Turtle where the species occurs in Canada. The medium term (i.e., 10 to 15 years) sub-objective is to stabilize and if biologically and technically feasible, increase population abundance at local populations by increasing the amount of suitable habitat and/or mitigating threats in Ontario. The broad strategies to be taken to address the threats to the survival and

[5] Carapace: the upper part of the turtle's shell. It is formed from dermal bones fused to ribs and vertebrae (Harding 1997).
[6] Historical: the species has been recorded within the local population within the last 20-40 years.
[7] Local populations are equivalent to Element Occurrences (EOs) identified within NHIC (2011). Interpretations of local populations at the site level for permitted activities will need to be based on current knowledge, best available data and interpretations of project impacts on the precarious life cycle of Spotted Turtles. Permitted activities will follow the Population and Distribution objectives in Section 5 to maintain each extant local population in a self-sustaining state.
[8] Unlikely to persist in the long-term

recovery of the species are presented in the section on Strategic Direction for Recovery (section 6.2).

Critical habitat is identified for 88 (25 extant[9] and 63 historical) local populations of Spotted Turtle in Canada, and includes habitat for all phases of the species life cycle using the following three criteria: 1) habitat occupancy 2) habitat suitability and 3) habitat connectivity. There are several historical locations that may still support Spotted Turtle, however these locations have not been surveyed recently or adequately and/or habitat restoration may be required to ensure persistence of local populations. For these reasons, critical habitat for Spotted Turtle has only been partially identified in this recovery strategy. The Schedule of Studies (Section 7.2) outlines the activities required to complete the identification of critical habitat in support of the population and distribution objectives for this species.

One or more action plans will be completed for the Spotted Turtle and posted on the Species at Risk Public Registry by December 2023.

[9] Extant: the species has been confirmed present within the last 20 years.

Recovery Feasibility Summary

Based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility, there are unknowns regarding the feasibility of recovery of the Spotted Turtle. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be technically and biologically feasible. This recovery strategy addresses the unknowns surrounding the feasibility of recovery.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

   Yes. There are 25 known extant local populations and an estimated 2,000-3,000 adults within the Canadian population of Spotted Turtle (COSEWIC 2014). Although the species has low local population densities and low reproductive potential within its Canadian range, the Spotted Turtle is considered globally secure. There are populations in the US, which may be able to sustain the Canadian population or improve its abundance in Canada through human intervention such as reintroduction techniques. However, the feasibility of such techniques and probability of success has not been assessed.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

   Yes. Although in many parts of its historical range, the habitats used by the Spotted Turtle have been lost and/or degraded as a result of exotic and invasive species, urban, industrial, and agricultural development, and water level management. Suitable habitat remains available within the Canadian range or could be made available, through management and restoration, to support this species. Management and restoration techniques could be used to increase the amount of suitable habitat available for the species and connectivity between local populations.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

   Unknown. The primary threats to the Spotted Turtle include accidental mortality from roads and off-road vehicles, illegal collection, exotic and invasive species and land conversion for agriculture and development. Additional threats include accidental mortality from agricultural practices, habitat loss from water level management and succession due to fire suppression. Public awareness/educational materials have been developed and will continue to be an integral part of the recovery of this species to reduce accidental mortality, exotic and invasive species and illegal collection. Illegal collection events are difficult to monitor and address, although public awareness and enforcement efforts are in

place to address this threat. Continuing these efforts and ensuring Spotted Turtle location information is protected will assist in reducing illegal collection events. Techniques such as using nest cages to reduce nest predation and ecopassages (with connected fencing) to mitigate road mortality have been successfully implemented to mitigate threats to the species in certain areas (Seburn and Seburn 2000; REFERENCE REMOVED[10]). Some best management practices (BMPs) have been implemented and it is likely that others could be developed and tested in a reasonable timeframe and implemented to help recover vulnerable local populations from such threats as accidental mortality, and threats of lower concern including habitat loss from water level management. Targeted habitat protection through legal regulation, land acquisition, and conservation planning, along with stewardship techniques have been used successfully in certain local populations to protect habitat (Seburn and Seburn 2000). Other threats such as activities that alter the water table, especially during winter, pollution and disturbance from human activities can be partially mitigated through public education, habitat restoration, regulation and through targeted conservation/protection of current habitat. Threats with unknown impacts include human-subsidised predators[11], contamination and nutrient loading, disturbance from human activities and climate change. It is uncertain if all threats can be eliminated or mitigated to ensure the survival of the Canadian population.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

Unknown. Some local populations are noted to be in decline (COSEWIC 2014), and in order to ensure the sustainability of the species within its Canadian range, recovery techniques such as introduction or headstarting may be necessary to achieve the population and distribution objectives. The effectiveness of reintroduction techniques has not yet been determined for this species and therefore it is unknown whether such techniques could be implemented successfully in a reasonable timeframe. As well, illegal collection for the pet trade and human consumption is a serious threat to the species and it is unknown whether education/outreach, legislative protection and other recovery techniques will reduce this threat to a level where the species is no longer threatened with local extirpations. As Spotted Turtles are slow to reach sexual maturity (up to 15 years) and suffer high egg and juvenile mortality, population recovery may be slow. Systematic monitoring of the local population abundance is necessary because the species occurs in small, isolated sub-populations (e.g., local populations). Currently, opportunistic occurrence records at a majority of local populations across Ontario are used in abundance estimates (COSEWIC 2014). Efforts to collect appropriate data across Canada will allow experts to accurately assess the current conditions and ensure

[10] Due to the vulnerability of some species to illegal collection, specific references providing sensitive information have been removed from this version of the recovery strategy. See *References* section for more information.
[11] Human-subsidized predators: Predators whose populations increase in response to low densities or absence of top predators and increased food and habitat availability from human sources (e.g., food handouts, garbage, crops, water sources or hiding cover).

local populations are not nearing levels where individuals cannot replace themselves. Due to uncertainties associated with both the effectiveness of recovery techniques, and the abundance estimates and condition of local populations, it is unknown whether recovery techniques will be successful in achieving the population and distribution objectives within a reasonable timeframe.

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1. COSEWIC* Species Assessment Information

Date of Assessment: November 2014

Common Name: Spotted Turtle

Scientific Name: *Clemmys guttata*

COSEWIC Status: Endangered

Reason for Designation: This species has an unusually low reproductive potential, including late age at maturity and low fecundity, and occurs in small, isolated subpopulations. Although some subpopulations are in protected areas, there is evidence from extensive monitoring and projected calculated declines that even these populations are in jeopardy despite low exposure to anthropogenic threats. The main threats to the species are road mortality; collection for the pet, food and traditional medicine trade; and habitat loss due to invasive plants and development. There is no potential for rescue from outside populations.

Canadian Occurrence: Ontario, Quebec

COSEWIC Status History: Designated Special Concern in April 1991. Status re-examined and designated as Endangered in May 2004 and November 2014.

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

2. Species Status Information

In Canada, the Spotted Turtle is listed as Endangered[12] on Schedule 1 of the federal *Species at Risk Act* (SARA). In Ontario, the species is listed as Endangered under the *Endangered Species Act, 2007* (S.O. 2007, ch.6) *(*ESA 2007*)* and receives general habitat protection under the ESA. It is also designated as a Specially Protected Reptile under the Ontario *Fish and Wildlife Conservation Act* (S.O. 1997, ch. 41). In Quebec, it is listed as Likely to be Designated as Threatened or Vulnerable under the provincial *Act Respecting Threatened or Vulnerable Species* (RLRQ c. E-12.01). The Spotted Turtle is also listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which controls the international trade of this species; Appendix II allows trade of a listed species only if an export permit is granted (CITES 2014).

The global rank for Spotted Turtle is Secure (G5) (NatureServe 2017). It is Nationally Imperiled (N2) in Canada and Nationally Secure (N5) in the United States (NatureServe

[12] A wildlife species facing imminent extirpation or extinction.

2017). The species is ranked as Critically Imperiled (S1) in Quebec and Imperiled (S2) in Ontario (NatureServe 2017). Appendix A provides additional ranks and definitions of the NatureServe rankings.The International Union for Conservation of Nature (IUCN) lists the Spotted Turtle as Endangered[13] (van Dijk 2013).

Approximately 6% of the global distribution of Spotted Turtle occurs in Canada (Seburn 2007).

3. Species Information

3.1 Species Description

The Spotted Turtle is a small freshwater turtle species, with a maximum adult carapace size of 14.25 cm (Ernst and Lovich 2009). The smooth, arched carapace is black in colour with scattered yellow-orange spots, although the spots can fade, leaving some older turtles with no spots (Ernst and Lovich 2009). The plastron[14] is typically black and orange in colour and tends to become darker or even entirely black with age (Ernst and Lovich 2009). The head and limbs tend to be black with yellow, orange, and occasionally white spots while the tail may have yellow stripes. The head has a distinctive large orange spot found behind each eye (COSEWIC 2014).

Spotted Turtles exhibit sexual dimorphism[15]. Adult females have orange to yellow mandibles[16] and eyes, while these features of the adult males are brown (Harding 1997). Females have flat plastrons, and relatively small, thin tails while males typically have concave plastrons, and larger, thicker tails. Juveniles have very similar colouring to adult females and are likely to be mistaken for females in the field (COSEWIC 2004).

The Spotted Turtle may be confused with juvenile Blanding's Turtle (*Emydoidea blandingii*) due to a similarity in colour and markings. However, the two species can be distinguished by a number of different features. The Blanding's Turtle has a bright yellow chin and throat, highly domed carapace and a hinged plastron, while the Spotted Turtle does not have a domed carapace, has a hingeless plastron and lacks a yellow chin and throat. The carapace of adult Blanding's Turtles also tends to be much larger (21.8-28.4 cm) than that of the largest reported adult Spotted Turtles (14.25 cm) (COSEWIC 2004).

The species has been known to live over 30 years in Canada, with an estimated maximum age for females of 110 years and 65 years for males (Litzgus 2006). Spotted

[13] Endangered (IUCN): A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
[14] Plastron is the lower part of the turtle's "shell" (Harding 1997).
[15] Sexual dimorphism: the condition in which the males and females in a species have different physical features (Carr 1952)
[16] Mandibles: the turtle's jaw.

Turtles reach sexual maturity between 11 and 15 years of age (Litzgus and Brooks 1998a, b).

3.2 Species Population and Distribution

The distribution of the Spotted Turtle (Figure 1) is limited to portions of eastern North America (Ernst and Lovich 2009), where it occurs in isolated populations from Michigan, southern, central, and eastern Ontario and Maine southward along the Atlantic Coastal Plain to central Florida, and westward through Pennsylvania, Ohio, Indiana, northeastern Illinois and Michigan (COSEWIC 2014; NatureServe 2017).

Figure 1. North American Distribution of Spotted Turtle (adapted from NatureServe 2017). This map represents the general range of the species, and does not depict detailed information on the presence and absence of observations within the range. Please refer to the text for further details on the distribution of the species in Ontario and Quebec.

In Ontario, the species occurs sporadically in southwestern Ontario, including along the Bruce Peninsula, and in central Ontario from the eastern shore of Georgian Bay and east to the Quebec border (REFERENCE REMOVED). Although large amounts of continuous suitable habitat and well documented local populations exist along

Georgian Bay, 80% of the current mean estimated Canadian population occurs in small, isolated patches throughout southwestern and southeastern Ontario, indicating severe fragmentation of the population (COSEWIC 2014; IUCN 2014).

In Quebec, although repeated surveys have been undertaken in potential habitat over the years, only two confirmed historic records exist for the Spotted Turtle in the southwestern portion of the province (Giguère pers. comm. 2012). Of these two records, one is very old (1800s) and the other was a deceased specimen recorded in the 1960s (COSEWIC 2014). The presence of the Spotted Turtle in Quebec has yet to be confirmed. The Spotted Turtle can be difficult to detect, partially because of its preference for habitats that are difficult to traverse (e.g., bogs) and its elusive behaviour (REFERENCE REMOVED; Gillingwater pers. comm. 2012).

In Ontario, there are 109 known element occurrences[17] of Spotted Turtle, of which 25 are considered extant, 81 are considered historical, and three are considered extirpated[18] (COSEWIC 2014). However, some of the remaining extant and historic local populations include only a small number of individuals and may not be viable (Seburn 2007; COSEWIC 2014). As noted in COSEWIC (2014), at least eight of 21 well studied local populations have fewer than 50 mature individuals. Modelling suggests that local populations with 50 individuals have approximately a 40% probability of quasi-extinction[19] in 100 years (Enneson and Litzgus 2009).

The number of local populations in Ontario considered historic has increased over time, but this is likely to be partly due to lack of suitable survey efforts at these sites (COSEWIC 2014). Due to their habit of basking under vegetation and avoiding humans, Spotted Turtle are difficult to survey especially at low densities (COSEWIC 2014). However, there are documented cases of declines in abundance and extirpation at local populations throughout the range, including MacGregor Point Provincial Park, Point Pelee National Park, Pelee Island, Georgian Bay, Southwest Ontario and other areas throughout the range (COSEWIC 2014).

The total population in Canada is estimated at 2,000 - 3,000 individuals (COSEWIC 2014), based on available estimates of local population abundance. Based on annual mortality rates reported in Southwestern Ontario and Georgian Bay, there is a projected >40% decline in the Canadian population of adult Spotted Turtles over the next three generations (123 years) (Litzgus 2006; Enneson 2009; COSEWIC 2014).

[17] Element Occurrence: Area of land and/or water where a species or natural community is, or was, present and has practical conservation value (NatureServe 2014). The term element occurrence is used in this recovery strategy to represent a local population and help to set population and distribution objectives. Element occurrences are not equal to observations as numerous observations can be associated with one element occurrence.
[18] Extirpated: the species is considered not present on site, as no positive record has been noted, despite significant survey effort within the last 40 years.
[19] Population level below which the population is unlikely to rebound or persist

The area of occupancy[20] of the Spotted Turtle in Canada is difficult to estimate due to the difficulty in detecting the species (OMNRF 2015), however, it is likely between 460 km^2 and 2,000 km^2, given the current amount of suitable habitat available across Ontario (COSEWIC 2014).

3.3 Needs of the Spotted Turtle

General Habitat Needs

The Spotted Turtle is a semi-aquatic species[21]. It has distinct seasonal movement patterns (Joyal et al. 2001; Beaudry et al. 2009) as the species moves between aquatic and terrestrial habitats to meet different biological or behavioural needs (REFERENCE REMOVED; Litzgus and Brooks 2000; REFERENCE REMOVED; Reeves and Litzgus 2008; Rasmussen and Litzgus 2010a). Habitat used by Spotted Turtles varies greatly throughout the species' geographical range and amongst different local populations (REFERENCE REMOVED; REFERENCE REMOVED; Seburn unpub. data; Rasmussen and Litzgus 2010a). However, telemetry studies show a high fidelity to core habitat areas, especially overwintering sites and sites of spring aggregation[22] (REFERENCE REMOVED; Litzgus et al. 1999; Litzgus and Brooks 2000; Seburn 2001; A. Yagi pers. comm. in COSEWIC 2014; Rasmussen and Litzgus 2010a).

During the active season, aquatic habitat for the Spotted Turtle in Ontario is typically comprised of wetlands that are shallow (<1 m of water) and rich in organic matter, including swamps, bogs, fens and marshes (REFERENCE REMOVED; Litzgus and Brooks 2000; REFERENCE REMOVED; Gillingwater and Piraino unpub. data; Seburn unpub. data; Reeves and Litzgus 2008). In some parts of Canada Spotted Turtles have demonstrated a strong preference for marsh meadows (Rasmussen and Litzgus 2010a). Spotted Turtles also use ponds, vernal pools[23], seepages[24], sloughs[25], creeks, woodland streams, edges of sheltered bays, drainage ditches, stormwater ponds and man-made channels (REFERENCE REMOVED; Ernst and Lovich 2009). Terrestrial habitat for the Spotted Turtle includes shoreline areas such as beaches, rocky outcrops, as well as upland forests (Litzgus and Brooks 2000), open fields (Ernst and Lovich 2009) and meadows (Gillingwater and Piraino unpub. data). Habitat use differs seasonally, except during the spring, when male and female turtles aggregate, presumably for mating (REFERENCE REMOVED).

[20] COSEWIC calculates area of occupancy (The area within "extent of occurrence" that is occupied by a taxon, excluding cases of vagrancy) using a grid with a cell size of 2km X 2km (Index of Area of Occupancy (COSEWIC 2009)).
[21] Semi-aquatic turtles spend significant amounts of time outside of the aquatic environment, using terrestrial habitats not only for nesting but also to meet other needs (e.g., travelling between wetlands, summer inactivity [in some cases])
[22] Aggregation: a group of organisms
[23] Vernal pools: Seasonally-flooded depressions that typically fill to their maximum depth in the spring from melting snow and other runoff, and often dry out completely in the hotter months of summer.
[24] Seepages: Areas where groundwater trickles to the surface to form pools.
[25] Sloughs: Emergent wetlands that are sometimes partially forested. Water is stagnant or may flow on a seasonal basis

Overwintering

To protect themselves from freezing, Spotted Turtles overwinter in underwater hibernacula[26] for 7 to 8 months of the year, from mid-September/October to March/mid to late April (Litzgus et al. 1999; REFERENCE REMOVED). Spotted Turtles are known to overwinter communally as well as alone. One study found that out of 18 overwintering sites, 11 were used by single turtles and seven were communal sites, containing up to nine individuals (Litzgus et al. 1999). In Ontario, Spotted Turtles have also been observed overwintering communally with Blanding's Turtles (Blythe pers. comm. In COSEWIC 2014; Gillingwater, unpub. data).

Spotted Turtles in Ontario are known to use overwintering sites in various habitats, including swamps (Litzgus et al. 1999), bogs (REFERENCE REMOVED; REFERENCE REMOVED), fens (Seburn unpub. data; Rasmussen and Litzgus 2010b), marshes (Dobbyn pers. comm.; Rasmussen and Litzgus 2010b) and graminoid meadows (Dobbyn pers. comm.), which include structural protection such as woody vegetation, vegetation mounds or burrows (Rasmussen and Litzgus 2010b). Water depth may range between 0-100 cm (Rasmussen and Litzgus 2010b; Blythe pers. comm. in COSEWIC 2014; Hopkins pers. comm. in COSEWIC 2014; GIllingwater unpub. data).

One study in the Georgian Bay area found two types of overwintering sites being used by Spotted Turtles: elevated sphagnum moss hummocks reinforced by roots and stems of vegetation, including trees; and shrubs and rock caverns near shore. Both types of overwintering sites contained standing water in which the Spotted Turtles were submerged (Litzgus et al. 1999). Based on the micro-environments used while overwintering, the Spotted Turtle is suspected to be hypoxic[27] tolerant (Litzgus et al. 1999; Ultsch 2006; Rasmussen and Litzgus 2010b). In Southwestern Ontario, overwintering sites have included tussock marshes with water depth <1 m; cattail stands with water depth less than 50 cm, and wet sedge and grass meadows with water depth ranging from 0-50 cm. (Gillingwater, unpub. data).

Mating

In early spring (as soon as the ice and snow melt), turtles emerge from overwintering sites and aggregate in aquatic habitats to mate (REFERENCE REMOVED; Litzgus and Brooks 1998a). Spotted Turtles have been known to show fidelity to breeding sites (Litzgus et al. 1999; Litzgus and Brooks 2000; Gillingwater and Piraino, unpub. data). In one Ontario location, the same 10-15 adults returned to a single beaver pond in the spring for more than 20 years to mate (G. Bird, M.J. Oldham, J.D. Litzgus, unpubl. data in COSEWIC 2014). In Ontario, mating generally occurs from early April through early July (COSEWIC 2014; Gillingwater, unpub. data), and from March to May in the southwestern portion of the species' range (e.g., Illinois) (Wilson 1994). Spotted Turtles reach sexual maturity between 11 and 15 years of age (Litzgus and Brooks 1998a, b).

[26] Hibernacula: plural form of hibernaculum; the place where an animal hibernates during the winter. Also referred to as overwintering sites

[27] Hypoxic: an environment with low concentrations of oxygen (Litzgus et al. 1999)

Nesting

In the Great Lakes Region, Spotted Turtle females usually lay their eggs from late May to mid-June (Harding 1997; Gillingwater, unpub. data), and oviposition[28] is undertaken primarily at night (Litzgus and Mousseau 2006). Nests are placed in well drained areas with sandy or loamy soils, gravel, organic matter or sphagnum substrates exposed to full sunlight. Nest sites include grass tussocks (Gillingwater and Piraino unpub. data), hummocks of grass, sedge or sphagnum moss marshy pastures (Ernst et al. 1994), and detritus/ soil-filled crevices in Canadian Shield rock outcrops (REFERENCE REMOVED; Litzgus and Brooks 2000). Turtles have also been observed nesting along man-made dykes, on muskrat lodges and on trails (Gillingwater and Piraino unpub. data). The selection of nesting sites is dependent upon both substrate components and perhaps more importantly, upon the habitat's thermoregulatory[29] potential to support turtle eggs to complete incubation. Hence, nesting sites are usually in sunny areas that are either bare or have sparse vegetation (REFERENCE REMOVED; Ernst and Lovich 2009). In Ontario, Spotted Turtles have been found to lay clutches of 3-7 eggs and may not lay eggs every year (Litzgus and Brooks 1998a).

Distance between aquatic habitat and nesting sites can vary greatly depending on site availability. A meta-analysis of distances of Spotted Turtle nests or gravid females to wetlands (in New England and Ontario) identified an average movement distance of 127 m across a 95th percentile (n=93) (Steen et al. 2012). One study found that Spotted Turtles in Ontario travelled an average of 33.5 m and a maximum of 139.0 m from the nearest water to find a nesting site while individuals in Massachusetts travelled on average 36 m, and a maximum of 130 m, from the nearest water (Steen et al. 2012). A study in Maine found that Spotted Turtles travelled an average of 51 m (±34 m), and a maximum of 120 m (n= 12), from water to nesting sites (Joyal et al. 2001).

The sex of each developing embryo is determined by temperature during incubation. Known as temperature-dependent sex determination, incubation of Spotted Turtle eggs in temperatures >30˚C result in females, while incubation temperatures <27˚C result in males (Ewert and Nelson 1991). Hatchlings generally emerge in the fall with the earliest recorded emergence on August 18th in Pennsylvania (Ernst and Lovich 2009). Hatchlings have been documented to overwinter in the nest in Pennsylvania (Ernst and Lovich 2009) and southwestern Ontario (Gillingwater, unpub. data).

Thermoregulation

Turtles regulate their body temperature using the ambient environment; they are able to modify or maintain their temperature by varying their exposure to sun (known as basking), shade, and water (Bulté and Blouin-Demers 2010). During the active season, regulation of internal temperature imposes constraints on the habitat use of the Spotted Turtle (COSEWIC 2014). During the day, individuals take advantage of higher average temperatures and greater basking opportunities offered by terrestrial habitats; at night,

[28] Oviposition: to deposit or lay eggs
[29] Thermoregulation: temperature control

individuals regularly use wetlands or ponds as thermal refuge[30] (Ernst and Lovich 2009). Basking often occurs along the water's edge, on or under vegetation clumps or hummocks or within dense vegetation (within wetlands or close to aquatic habitats) (Gillingwater and Piraino unpub. data; Ernst and Lovich 2009). When inactive, Spotted Turtles hide in mud and detritus on the wetland bottom or in vegetation or muskrat burrows to maintain body temperature (Ernst and Lovich 2009; Gillingwater pers. comm. 2012). During hot days in summer, some individuals may move to shady aquatic sites with floating vegetation or cattails, where water temperatures are lower, to help regulate their body temperature (Gillingwater pers. comm. 2012). Spotted Turtles mainly bask under vegetation, making them more difficult to detect compared to other turtle species which bask on logs or rocks along the water's edge (OMNRF 2015).

Foraging

Spotted Turtles have been noted to consume a variety of items including aquatic insect larvae, snails, cranberries, salamanders, fish, algae, and tadpoles (REFERENCE REMOVED). One foraging study on Lake Huron showed that their diet consisted of 74% aquatic invertebrates, 16.2% fish, 4.6% amphibians (including tadpoles), and 2.3% vegetation (Rasmussen et al. 2009). Many important food items are found in areas with high amounts of aquatic and emergent vegetation or sphagnum moss (Harding 1997; 2002; Ernst and Lovich 2009). Foraging behaviour occurs throughout the active season with individuals being more active throughout May, June and July (Rasmussen et al. 2009).

Summer Inactivity[31]

In summer, it is common for Spotted Turtle individuals to remain inactive on land for days or even weeks (Ernst and Lovich 2009). During these periods, Spotted Turtles move upland into forests and bury themselves into soil or leaf litter (Joyal et al. 2001), or stay in the wetland mud (burrowing under root systems) in muskrat burrows, or under logs (Harding 1997). A study conducted in Maine found that individual turtles travelled up to 80 m upland from the nearest wetland to undertake periods of summer inactivity (Joyal et al. 2001). In more northern populations, it was found that travelling distances to their summer inactivity sites is much smaller (3.5-26 m) (REFERENCE REMOVED; REFERENCE REMOVED). Turtles have also been known to use areas such as open meadow marshes, dried wetlands, edges of wetlands, juniper bushes on rock outcrops to undertake their summer inactivity period (REFERENCE REMOVED).

Some Ontario populations appear to choose microsites that are cooler than the environment when temperatures are the highest, in an attempt to avoid desiccation[32] (REFERENCE REMOVED; REFERENCE REMOVED). However, some studies at the northern limit of the Spotted Turtle's range suggested that their summer inactivity could relate to something other than thermoregulation, since individuals chose microsites that

[30] Thermal refuge: an area that cools down slower than its surrounding area.
[31] This period of inactivity is often referred to as aestivation. However, (REFERENCE REMOVED) found that Spotted Turtles never entered true aestivation but rather restricted or limited their movements.
[32] Desiccation: dehydration; water loss

were not cooler than the environment and were far from water (therefore, not trying to avoid desiccation) (REFERENCE REMOVED; Litzgus and Brooks 2000). Another hypothesis suggests that, in northern populations, summer inactivity could also be related to changes in water depth or food abundance (REFERENCE REMOVED; Litzgus and Brooks 2000).

Movement (commuting and dispersal)[33]
Spotted Turtles may use several types of habitats while moving across their home range[34] (COSEWIC 2014). Spotted Turtles are considered to be primarily aquatic, although individuals spend time on land to meet biological needs such as nesting, thermoregulation, and periods of summer inactivity (Ward et al. 1976; Litzgus and Brooks 2000; REFERENCE REMOVED; REFERENCE REMOVED).

In Ontario, home range lengths vary between 140 m to over 1,500 m (REFERENCE REMOVED; REFERENCE REMOVED; Seburn 2012; Gillingwater unpub. data; Enneson pers. comm. 2014). Home range area for Spotted Turtles in Canada falls between 0.7-8.8 ha, and varies among populations (REFERENCE REMOVED; REFERENCE REMOVED; REFERENCE REMOVED; Rasmussen and Litzgus 2010a; Seburn 2012; Yagi and Litzgus 2012; Gillingwater unpub. data). Smaller home ranges may simply be an artifact of the amount of habitat available at remaining locations (Harding 1997).

Home-range size for gravid females (approximately 16 ha) was found to be threefold larger than that of males (5 ha) in South Carolina (REFERENCE REMOVED); nonetheless, several studies in Canada noted that there were no significant differences reported between the sexes in mean home range area and home range length (REFERENCE REMOVED; Gillingwater and Piraino unpub. data; Rasmussen and Litzgus 2010a; Seburn 2012; Yagi and Litzgus 2012). This suggests that home-range sizes might vary amongst northern and southern populations.

Throughout the year, but particularly during the nesting season, the species requires habitats free of movement barriers between wetland and nesting sites. Females may travel relatively long distances when searching for suitable nesting sites, while males may travel long distances in search of mates (COSEWIC 2014). For example, a gravid female in a northern population was observed to have travelled 335 m in 24 hours while in search of an oviposition site, while the mean travelling distance for the gravid females of that population was 92 m (REFERENCE REMOVED). A study conducted in Maine found that Spotted Turtles in the southern portions of their range travelled between 70-570 m to oviposition sites, and an average of 311 m (range of 110-1,150 m) straight line distance between different wetlands used during the active season (Joyal et al. 2001).

[33] Movement habitat is the habitat (aquatic or terrestrial) that the species uses to move between habitats. Commuting here refers to short-distance movement within the home range in order to complete different life stages (e.g., mating, foraging), while dispersal refers to long-distance movement related to emigration of individuals.
[34] Home range: The area needed by an animal to complete its normal activities (Burt 1943).

Since Spotted Turtles have been documented using both aquatic and terrestrial habitat for dispersal, both are considered movement corridors (REFERENCE REMOVED; Joyal et al. 2001). Spotted Turtle demonstrates a high degree of range fidelity (Barlow 1999) and there is evidence that Spotted Turtles will use the same path to move between habitats from year to year (Joyal et al. 2001). As a result, it is important that these paths remain connected to allow Spotted Turtles to meet their biological and behavioural needs each year.

Some studies indicate that individuals tend to avoid deeper water bodies, which can be considered barriers to this species (REFERENCE REMOVED; Gillingwater and Piraino unpub. data). However, telemetry studies note Spotted Turtles crossing deep (e.g., dredged) channels to access other habitats (Gillingwater and Piraino unpub. data). A study in the Georgian Bay area noted that female Spotted Turtles have been observed swimming across a 50 m channel in Georgian Bay to access a nesting site on a nearby island (Enneson pers. comm. 2014).

Towards the end of the active season, individuals use both terrestrial and aquatic movement corridors to travel to overwintering sites. One study noted the distance travelled to overwintering sites ranged from 87-490 m (Rasmussen and Litzgus 2010a).

3.4 Biological Limiting Factors

Turtles have certain common life history traits that can limit their ability to adapt to high levels of disturbance and that help explain their susceptibility to population declines (REFERENCE REMOVED; Gibbons et al. 2000; Turtle Conservation Fund 2002). In particular, turtles have a reproductive strategy that depends on high adult survival rates to counterbalance the low recruitment rates because of:

1) late sexual maturity;
2) high rate of natural predation on eggs and juveniles under the age of two; and,
3) dependence on environmental conditions for the internal development of eggs and external incubation of eggs without parental care.

As a consequence of these life history traits, turtle populations, including Spotted Turtles, cannot adapt to an increase in adult mortality rates. Long-term studies indicate that high survival rates of adults (particularly adult females) are critical to the maintenance of turtle populations (Seburn 2007). Even a 2-3% increase in the annual adult mortality rate over natural mortality rates could result in population declines (REFERENCE REMOVED, Congdon et al. 1994; Cunnington and Brooks 1996; Enneson and Litzgus 2008).

Spotted Turtle may have low reproductive potential, even compared to other turtle species. In Ontario, Spotted Turtle had the lowest percentage of gravid[35] females in studied populations, with an average of 58% of adult females being gravid (Litzgus and

[35] Gravid: Carrying eggs

Brooks 1998a) while over 80% of female Snapping Turtles (*Chelydra serpentina*), 75% of adult female Wood Turtles (*Glyptemys insculpta*), and 68% of adult female Midland Painted Turtles (*Chrysemys picta marginata*) were found to be gravid (R.J. Brooks pers. comm. in COSEWIC 2004).

The climatic ranges within which the Spotted Turtle can survive limit its range in northern areas (Hutchinson et al. 1966; McKenney et al. 1998). Climate plays a vital role in sexual maturity and recruitment of turtles. Spotted Turtles in northern populations reach sexual maturity much later than their southern counterparts (COSEWIC 2004), which reduces the number of reproductive years of an individual. It has been documented that Spotted Turtles in northern populations reproduce less frequently than southern populations, but are also noted to be larger in size and have a larger clutch size, on average (Litzgus and Mousseau 2006; Rasmussen and Litzgus 2010b). As well, Spotted Turtles rely on the external environment for incubation of eggs. Incubation time constitutes a major limitation for northern turtle populations (REFERENCE REMOVED), as the short northern summer typically makes it possible to produce only one clutch per year and reduces the likelihood that a nest will hatch in any given year. Recruitment can vary from one year to the next depending on weather conditions, particularly during the summer. Spotted Turtle is polygamous[36] (Litzgus and Mousseau 2006) and as such, a male-biased sex ratio could have negative impacts on a population. Sex determination for the Spotted Turtle is temperature-dependent and occurs during incubation (Ernst and Lovich 2009). Some research indicates that more males are produced when incubation temperatures are around 22.5-27°C, while more females are produced at incubation temperatures of 30°C or greater (Ewert and Nelson 1991); therefore, climate change could have an impact on the ratio of males and females recruited into the population.

In Canada, Spotted Turtle is at the northern limit of its range (Seburn and Seburn 2000). Because fewer heat-units[37] are available the further north the species occurs, the shorter nesting and development period constitutes a limiting factor for this species (REFERENCE REMOVED).

3.5 Species Cultural Significance

Turtles play an important role in Indigenous spiritual beliefs and ceremonies. To the First Nations peoples, the turtle is a teacher, possessing a great wealth of knowledge. It plays an integral role in the Creation story, by allowing the Earth to be formed on its back. For this reason, most First Nations people traditionally call North America “Turtle Island”. Indigenous peoples also use the turtle shell to represent a lunar calendar, with the 13 scutes[38] representing the 13 full moons of the year. Turtle rattles, made from turtle shells are used in traditional ceremonies and often represent the turtle in the

[36] Polygamous: typically having more than one mate.
[37] Heat Units: the total amount of heat required for an organism to go through all stages in its life cycle. Therefore, the further north, the colder the average temperature, and the less opportunity there will be for a species to develop.
[38] Scutes: Broad, flat scales

Creation story. Turtles also appear in other traditional stories including the Anishinaabe story “How the turtle got its shell” and the Haudenosaunee story “Turtle races with beaver.” (Bell et al. 2010).

4. Threats

Threats to the Spotted Turtle may vary locally within its Canadian distribution. However the information presented in Table 1 is an overall assessment of threats to the Spotted Turtle in Canada. Where information is known on the significance of threat at the local scale, additional information is provided in the threat description below Table 1.

4.1 Threat Assessment

Table 1. Threat Assessment Table

Threat	Level of Concern[a]	Extent[b]	Occurrence[c]	Frequency[d]	Severity[e]	Causal Certainty[f]
	Threat Information					
Accidental Mortality						
Road networks and off-road vehicles	High	Widespread	Current	Seasonal	High	High
Agricultural practices	Low	Localized	Current	Seasonal	Low	Low
Biological Resource Use						
Illegal collection	High	Widespread	Current	Seasonal	High	Medium
Exotic, Invasive, or Introduced Species						
Exotic and invasive species	High	Localized	Current/ Anticipated	Current	High	High
Habitat Loss, Degradation, or Fragmentation						
Land conversion for agriculture and development (e.g., industrial, urban, rural, cottage)	Medium	Widespread	Historic/ Current	Recurrent	Low	Low
Water level management	Low	Localized	Historic/ Current	Recurrent	Unknown	Low
Changes in Ecological Dynamics or Natural Processes						
Succession due to fire suppression	Low	Localized	Current	Seasonal	Unknown	Low
Human-subsidized predators	Unknown	Localized	Current	Seasonal	Unknown	Medium

Threat	Level of Concern[a]	Extent[b]	Occurrence[c]	Frequency[d]	Severity[e]	Causal Certainty[f]
	Threat Information					
Pollution						
Contamination and nutrient loading	Unknown	Localized	Current	Current/ Seasonal	Unknown	Low
Disturbance or Harm						
Disturbance from human activities	Unknown	Localized	Current	Seasonal	Unknown	Medium
Climate and Natural Disasters						
Climate change	Unknown	Widespread	Anticipated	Seasonal	Unknown	Low

[a] ***Level of Concern****: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table.*

[b] ***Extent:*** *W (widespread) or L (localized);*

[c] ***Occurrence:*** *H (historic), C (current), I (imminent), A (anticipated), or U (unknown);*

[d] ***Frequency****: OT (one-time), S (seasonal), C (continuous), R (recurrent), or U (unknown);*

[e] ***Severity:*** *reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

[f] ***Causal certainty****: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g., expert opinion; Low: the threat is assumed or plausible).*

4.2 Description of Threats

This section describes the threats outlined in Table 1 and emphasizes key points. Although threats are listed individually, an important concern is the long-term cumulative effect of multiple threats on local Spotted Turtle populations. In particular, different sources of habitat loss and fragmentation (such as fragmentation of local populations by roads, loss of habitat to land conversion, and habitat degradation due to water level management, pollution and changes in ecological dynamics) combine to further isolate remaining local populations and cause mortality of individuals, reducing connectivity and resilience of the Canadian population.

Accidental Mortality

Road networks and off-road vehicles

Death from collisions with road vehicles is noted as a growing concern in herpetofaunal[39] studies (e.g., Andrews et al. 2006), especially where roads run through wetlands, and are heavily travelled. For instance, over a study period spanning four years, 716 dead turtles, including Spotted Turtles, were observed along a 3.6 km long section of a roadway beside a wetland in southern Ontario (Robinson pers. comm.

[39] Herpetofauna: reptiles (such as turtles and snakes) and amphibians (such as frogs and salamanders).

2014). Although some collisions with turtles are accidental, drivers intentionally driving over turtles are also a threat; Ashley et al. 2007 found evidence that reptile decoys were hit at a higher rate than by chance with approximately 2.7% of motorists intentionally hitting them.

Road mortality is of greatest concern for species that frequently travel overland, such as the Spotted Turtle (Beaudry et al. 2009). A modelling study revealed that the mortality rates of semi-aquatic turtle species in areas with high traffic volume are above the maintenance threshold, meaning that these populations are unlikely to be able to sustain themselves into the future at the current rate of road mortality (Gibbs and Shriver 2002). In Ontario, the road network has developed rapidly, especially in the southern portion of the province, where the length of major roads has increased by 28,000 km within 60 years (Fenech et al. 2005). Road mortality is of high concern in this province and road sections with high mortality rates of freshwater turtles have been identified in many areas, including national and provincial parks (REFERENCE REMOVED; Crowley and Brooks 2005; Ontario Road Ecology Group 2010).

Females are at greater risk of road mortality because they travel over land during the nesting season (Haxton 2000), may use road shoulders to nest (e.g., Aresco 2005; REFERENCE REMOVED), and, as a result, are more frequently encountered on roads than males (REFERENCE REMOVED). This increased female road mortality rate may be the reason that, in wetlands surrounded by a dense road network, some studies have reported a male-biased sex ratio of turtle populations (Marchand and Litvaitis 2004; REFERENCE REMOVED; Gibbs and Steen 2005). In addition, eggs in nests located on road shoulders may be compacted, crushed or desiccated, and hatchlings emerging from these nests may be killed as they attempt to cross the road, reducing recruitment rates. The extent and impacts of road mortality on local populations of Spotted Turtle require further investigation.

In areas where trails are located on or near nesting sites, females and hatchlings are at greater risk of being disturbed, hit, or killed by off-road vehicles and nests are in danger of being crushed or illegally collected. In one Ontario population, the majority of females were observed nesting along the centre of an all-terrain vehicle (ATV) trail, where vegetation was sparse (COSEWIC 2004). ATVs have been regularly documented in aquatic and nesting habitat in several Spotted Turtle populations in Ontario (Crowley pers. comm. 2012). At least two populations are noted to be threatened by ATVs (COSEWIC 2014). ATV use in wetland habitats during the summer months can lead to the damage or destruction of vegetation which may reduce the quality of the wetland habitat for use by Spotted Turtles (e.g., for overwintering and thermoregulation).

Maintenance of roads and trails can also pose a threat to Spotted Turtles. Maintenance work can be a threat to individuals and nests when grading and vegetation removal/control is required throughout the summer, autumn, and winter and conducted without appropriate turtle habitat mitigation/BMPs.

In addition to causing direct mortality, roads are also barriers to movement between habitats and other local populations (COSEWIC 2014), and can contribute to habitat fragmentation by decreasing turtle dispersal ability (Rizkalla and Swihart 2006). The threat of roads causing habitat fragmentation is considered under the threat “Habitat Loss, Degradation, or Fragmentation - Land conversion for agriculture and development (e.g., industrial, urban, rural, cottage)” as a result of development.

Agricultural practices

Agricultural activities, particularly those involving the use of heavy machinery or mowers and trampling by livestock are a potential source of death and injury to turtles during overland movements, and a potential source of nest failure (COSEWIC 2014). Overgrazing by livestock has also been reported as a threat to the species (COSEWIC 2014) but the severity of these threats to the Spotted Turtle is not well-documented.

Biological Resource Use

Illegal collection

Worldwide, many turtle species are impacted by both casual and large-scale systematic illegal collection for use as pets, food and traditional remedies (Bodie 2001; Moll and Moll 2004). The rate of export of freshwater turtles, for both pet and food trades, is high in the United States (Mali et al. 2014). In the United States, between 1999 and 2010, around 7,866 Spotted Turtles were legally exported for commercial purposes, of which around 15% were taken from the wild (United States Fish and Wildlife Service 2014). The rate of illegal export can be expected to also be high in Canada given the lucrative trade demand. Reptile species are more likely to be involved in the international pet trade if they are categorized as at risk than if they are not considered at risk (Bush et al. 2014), which is consistent with a general demand for rare wildlife (Courchamp et al. 2006). Spotted Turtles use communal overwintering and mating aggregation sites, which makes the species vulnerable to exploitation by pet trade collectors (COSEWIC 2014). One recent news report documented over 1,000 turtles (some of which were Spotted Turtles) being smuggled across the Canada – United States border (CBC News 2014). The turtles were being brought into Canada, indicative of a demand for this species within Canada.

In Canada, the collection, trade, and possession of Spotted Turtle is illegal under federal and provincial legislation. The extent of illegal organized turtle harvest is poorly documented in Canada for the Spotted Turtle. Although it is unclear whether harvesting of Spotted Turtles for food is a widespread practice in Canada, humans are known to consume a number of turtle species (Thorbjarnarson et al. 2000; Moll and Moll 2004). There have been some documented cases of turtles being illegally harvested for food in Ontario, including one case involving the illegal harvest of Spotted Turtle for restaurant use (REFERENCE REMOVED).

Illegal collection of Spotted Turtle removes individuals from all age classes from the population which, given the species’ reproductive strategy (extreme longevity, low recruitment rates), may greatly reduce recruitment (COSEWIC 2014). The annual

removal of even just 1-3% of mature adults from a Spotted Turtle population can have a significant impact on population stability (COSEWIC 2014).

Exotic, Invasive, or Introduced Species

Exotic and invasive species

The introduction of invasive exotic plants can alter the availability and quality of Spotted Turtle habitats. In some areas, particularly around Lake Erie, Lake Huron, and Lake St. Clair, and along some major rivers in Ontario, non-native Common Reed (*Phragmites australis*) has invaded wetlands and coastal areas, forming a monoculture[40] that has altered conditions and decreased habitat quality (REFERENCE REMOVED; COSEWIC 2014; Hudon et al. 2005; Gillingwater pers. comm. 2012). The expansion of road networks also facilitates the spread of invasive plant species, especially in southern Ontario (Gelbard and Belnap 2003). In a study conducted along Lake Erie, it was found that non-native Common Reed had reduced the amount of suitable nesting habitat for many turtle species, because growth of the plant altered the microenvironment (particularly temperature) of turtle nests during the incubation period (REFERENCE REMOVED). The loss of suitable nesting habitat for turtle species due to invasive plants including non-native Common Reed, Japanese Hops (*Humulus japonicus*), and Purple Loosestrife (*Lythrum salicaria*) have also been observed at many other locations throughout southern Ontario (Gillingwater pers. comm. 2012).

The introduction of other non-native species may also have a negative effect on Spotted Turtle. For example, the release of exotic pet turtles (e.g., Red-eared Slider (*Trachemys scripta*)) in natural environments following a period of captivity can result in competition and/or the transmission of diseases to native turtle populations (Cadi and Joly 2003, 2004). These non-native turtles are known to occur in high numbers and breed in the wild in some parts of the province, such as the Greater Toronto Area (MNRF 2014, unpub. data; Seburn 2015).

Habitat Loss, Degradation, or Fragmentation

Land conversion for agriculture and development (e.g., industrial, urban, rural, cottage)

Historically, land conversion for agriculture and development (including road development) has been a significant threat to Spotted Turtle, eliminating and fragmenting large amounts of habitat in southern Ontario since European settlement. By 2002, approximately 72% (1.4 million ha) of pre-settlement wetlands ≥ 10 ha in size in southern Ontario had been converted for other uses, with the most drastic losses being in southwestern Ontario and parts of eastern Ontario (Ducks Unlimited Canada 2010).

Today, the loss of both wetland and terrestrial habitats to agriculture and development continues to pose a threat to Spotted Turtles, but to a lesser degree. Infilling or draining of wetlands for such purposes effectively eliminates turtle habitat, and has resulted in documented mortalities of Spotted Turtles and Blanding's Turtles in Ontario (Gillingwater and Piraino 2004; Gillingwater pers. comm. 2013 in COSEWIC 2014).

[40] Monoculture: An area that is dominated by a single plant species

Development of upland areas may eliminate movement corridors, nesting sites and areas used for periods of summer inactivity. Habitat fragmentation (of either aquatic or terrestrial habitats) by roads, agriculture or other development isolates turtle populations and increases their risk of death during travel through inhospitable areas. Some research has found that turtles are less abundant in more isolated wetlands (Marchand and Litvaitis 2004).

Wetland and impoundment dredging for development or maintenance may affect turtles directly or indirectly. When dredging occurs during the hibernation season, turtles may be removed from overwintering sites and/or be killed by heavy equipment. Overwintering sites might also be destroyed by dredging. Wetland dredging, impoundment dredging and pond open water habitat creation may also impact the Spotted Turtle by altering existing habitat such that it is no longer suitable for the species (Gillingwater, unpub. data), such as when a pond is dug in shallow wetlands and meadow marshes, the latter of which are a significant habitat feature for the species (see Section 3.3).

Water level management

Any alteration of the natural water regime of wetland complexes can result in loss or degradation of aquatic habitat for the Spotted Turtle, by affecting the suitability of sites used for overwintering, breeding, foraging, and thermoregulation. In Canada, Spotted Turtles are often associated with shallow, flooded habitats created by beaver dams (Litzgus et al. 1999; Yagi and Litzgus 2012, 2013). Removal of beaver dams or other water management activities (e.g., ditching, draining or water control structures (dams)) that alter the hydrology of overwintering sites during winter could result in mortality of the Spotted Turtle. Modifications in water level of aquatic habitat can also lead to changes in the characteristics of surrounding terrestrial habitat (e.g., soil humidity, vegetation structure), potentially removing suitable nesting and basking sites. In some cases, it has been suggested that alterations to hydrology that render aquatic habitat unsuitable could pose a significant threat to population viability if alternate habitat is not available in the area (Litzgus et al. 1999).

However, small water control structures installed for the purpose of wetland restoration may benefit Spotted Turtle if they are designed with considerations of the habitat needs of Spotted Turtle and with appropriate mitigation of impacts to the species.

Changes in Ecological Dynamics or Natural Processes

Succession due to fire suppression

Succession in Spotted Turtle habitat may, in some cases, pose a threat to this species (COSEWIC 2014). Suppression of the natural fire regime can allow encroachment of trees and shrubs into vegetated wetlands (e.g., bogs) over time, reducing the amount of open water and rendering habitat unsuitable for the Spotted Turtle (Seburn 2007).

Human-subsidized predators

In many areas, the low density or absence of top predators and increased food availability from human sources (e.g., food handouts, garbage, crops) have led to a

greater abundance of turtle predators than natural conditions would have historically supported (Mitchell and Klemens 2000). Main predators of Spotted Turtles include raccoons, skunks, mink, coyote and foxes (REFERENCE REMOVED; Gillingwater, unpub. data). The abnormally high level of many predator populations can lead to unsustainable rates of predation on turtles. Some studies have found that between 13.9-33% of Spotted Turtle nests at a study site were subject to predation and many adult Spotted Turtles captured have shown evidence of being attacked by predators (e.g. missing limbs, gnaw marks on shell) (REFERENCE REMOVED; REFERENCE REMOVED; Litzgus and Brooks 1998a).

Methods to deal with elevated predation rates have been developed, such as placing predator exclusion cages over nests, and used with varying degrees of success (Seburn 2007; Riley and Litzgus 2013). However, in many cases, it is impossible to implement these methods on the scale required to protect the population from this threat.

Pollution

Contamination and nutrient loading

Turtle habitat can be impacted by the degradation of water quality caused by the runoff of contaminated water from agricultural (nutrients and pesticides) and industrial zones (industrial waste), roads (e.g., de-icing salt), and urban areas (e.g., heavy metals) (Mitchell and Klemens 2000; Bishop et al. 2010). Spotted Turtles could be vulnerable to contaminant accumulation, although the long-term impact is poorly understood. Turtle individuals absorb contaminants in the environment through physiological processes including feeding, breathing, and absorption through tissues or membranes such as eggshells (Bishop et al.2010).

Recent studies indicate that there is little effect of the reliance on benthic food chain on mercury accumulation in Painted and Musk Turtles (REFERENCE REMOVED) and that concentration of mercury in blood and scutes does not affect parasitism level in Painted Turtles (Slevan-Tremblay 2013). However, mercury exposure could be detrimental to the immune system by reducing number of lymphocytes[41]. Similar effects might be impacting Spotted Turtles. Two studies, undertaken in the Great Lakes basin, detected several industrial-based contaminants in Snapping Turtle eggs (Bishop et al*.* 1998; Van Meter et al*.* 2006). It was also noted that abnormal embryo development increased with exposure to polychlorinated aromatic hydrocarbons. Although these studies focused on other species, the potential for similar effects on Spotted Turtle exists as they share similar habitats.

The augmentation of nutrient loads associated with human activity can lead to blue-green algal blooms in waters frequented by turtles (Carpenter et al. 1998), and this can threaten turtles through ingestion of toxins from the algae. Nutrient loading may also result in a shift to phytoplankton[42] dominated plant communities from macrophyte[43]

[41] Lymphocyte: a subtype of white blood cell that assists the immune system fight off infection or disease.
[42] Phytoplankton: Microscopic plant-like organisms.
[43] Macrophyte: An aquatic plant large enough to be seen by the naked eye.

plant communities (e.g., Mesters 1995). In addition, nutrient loading can lead to increased oxygen consumption by bacteria, which, in turn, can result in periods of a total absence of oxygen (anoxia) during winter.

Disturbance or Harm

Disturbance from human activities

Human activity can affect turtles in many ways. Because they are so wary, simply approaching basking individuals can cause them to leave their basking sites and re-enter water. The resulting heat loss, should the disturbance become repetitive, may delay the development of eggs in females, and affect other life cycle activities in both sexes and in all age classes (e.g., food metabolism, spring emergence). Moreover, the presence of humans can delay or interrupt nesting, and a female may abandon their nest prior to completion, leaving the nest more vulnerable to predation (Horne et al. 2003; Moore and Seigel 2006; REFERENCE REMOVED). Repeated disturbance at nesting sites may also force females to use lower quality nesting sites (Moore and Seigel 2006), which in turn can slow incubation and reduce the hatching rate (Horne et al. 2003). This threat has not been well documented for the Spotted Turtle.

Climate Change and Natural Disasters

Climate change

Climate is the main factor that limits the distribution of turtles in the north. Given the effect of climate on recruitment rates, it seems likely that global climate change will have an impact on turtle populations. An increase in the annual average temperature in Ontario of 2.5-3.7ºC by 2050 (compared to 1961-1990) is expected, along with changes in seasonal precipitation patterns (Expert Panel on Climate Change Adaptation 2009). Spotted Turtles exhibit temperature-dependent sex determination where higher temperatures lead to production of proportionately more females and lower temperatures lead to production of proportionately more males (Ernst and Lovich 2009). It has been hypothesized that climate change and the anticipated increase in average temperatures could have an impact on the sex ratio of turtle populations (through a female bias) (Janzen 1994) which could threaten the viability of the species in the future.

Changes in patterns of precipitation due to climate change may cause lower water levels during summer (Lemmen et al. 2008), and these lower levels could in turn increase the availability of nesting sites. However, in the absence of increased precipitation, higher temperatures and increased evaporation could lead to lower water runoff (Expert Panel on Climate Change Adaptation 2009) and dry out wetlands that were once permanent. Decreasing water levels in the Great Lakes may result in significant loss of coastal wetland habitats used by Spotted Turtle. Spotted turtle is believed to be moderately sensitive to climate change compared to other turtles (King and Niiro 2013). Further studies are needed to determine the impacts which climate change will have on the species.

5. Population and Distribution Objectives

The long-term (i.e., 50 years) population and distribution objective is:

- To ensure the persistence of self-sustaining[44] local populations of Spotted Turtle where the species occurs in Canada.

To work towards achieving the long term population and distribution objective, the following medium term (i.e., 10-15 years) sub-objective has been identified:

- In Ontario, stabilize and if biologically and technically feasible, increase population abundance at local populations by increasing the amount of suitable habitat and/or mitigating threats.

The Spotted Turtle is assessed by COSEWIC as Endangered due to low total population size (<2500 mature individuals) and continuing decline in the number of mature individuals (COSEWIC 2014). There is uncertainty around the exact population estimate of Spotted Turtle, but population declines have been observed in multiple local populations throughout the Canadian range (COSEWIC 2014). There is evidence that local populations of Spotted Turtle both within and outside protected areas, and both large and small local populations have declined or even been extirpated (COSEWIC 2014). Larger local populations, local populations in protected areas and local populations with sufficient or abundant suitable habitat are essential to the long-term survival and recovery of the species, while smaller populations contribute to the resilience[45] and redundancy[46] of the Canadian population, and help maintain the species range. Therefore, in the medium-term, stabilizing population abundance at local populations is a first step to maintaining a self-sustaining Canadian population. In some local populations, the quality and connectivity of available habitat will need to be improved for recovery to be achieved. In the long-term, the persistence of self-sustaining local populations throughout the Canadian range will maintain the Canadian distribution of Spotted Turtle, and ensure the survival and recovery of this species in Canada.

This long-lived species has specific ecological requirements, complex life cycle needs, and a limited ability to compensate for the loss of individuals through reproduction or through recruitment from adjacent local populations (often themselves in decline). Most local populations are small to very small and thus vulnerable to extirpation. As a result,

[44] Self-sustaining populations show stable or increasing population trends and show resilience, ie the population size is large enough that there is sufficient genetic diversity and ability to rebound from disturbance and avoid demographic collapse (GoC 2017)
[45] Population size(s) is large enough that there is sufficient genetic diversity and ability to rebound from disturbance and avoid demographic collapse (GoC 2017).
[46] Distribution is widespread and/or there are multiple (sub) populations or locations such that catastrophic loss (e.g., from a local event) is unlikely (GoC 2017).

active broad strategies and general approaches undertaken on several fronts over a long period of time and over a large area will be required to achieve these objectives. Threat mitigation and/or maintaining or increasing suitable habitat where Spotted Turtle occurs (including habitat connecting adjacent local populations) will be key to increasing local population sizes and ensuring the long-term persistence of self-sustaining local populations. Securing sufficient suitable habitat, including maintaining appropriate successional stages and reducing further habitat degradation and fragmentation is particularly important to the survival of Spotted Turtle.

Obtaining more baseline data on abundance and trend information in local populations is needed to assess where local populations are threatened or declining and to develop more quantitative targets for recovery. Where there are data uncertainties conservation planning and protection decisions that may impact this species should be precautionary and evidence-based.

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

At the national scale, the Canadian Herpetological Society (CHS) is the main non-profit organization devoted to the conservation of amphibians and reptiles, including turtles, and conducts the following activities: scientific investigations, public education programs and community projects, compilation and analysis of historical data and the undertaking of projects that support conservation or habitat restoration.

Environment and Climate Change Canada has been funding projects related to Spotted Turtle conservation throughout Quebec and Ontario for many years, through the Habitat Stewardship Program (HSP) and Aboriginal Fund for Species at Risk (AFSAR) since 2001 and the Interdepartmental Recovery Fund (IRF) since 2004. Projects have included activities such as: undertaking targeted surveys for the species; identifying important habitat of local populations; studying the severity of and/or mitigating threats such as road mortality; soliciting observations/ encouraging public reporting of sightings; and educating landowners and/or the public on species identification, threats, and stewardship options. Federal funding has contributed to several of the initiatives described below.

Ontario
An Ontario Multi-Species Turtles at Risk Recovery Team was established in the early 2000s by a group of people interested in turtle recovery. This group focused on six turtle species at risk: Blanding's Turtle; Eastern Musk Turtle (*Sternotherus odoratus*); Northern Map Turtle (*Graptemys geographica*), Spiny Softshell (*Apalone spinifera*); Spotted Turtle; and Wood Turtle. This group has coordinated and initiated a number of recovery efforts including conducting educational and outreach programs on reptiles

and various management initiatives such as nest protection projects and nest site rehabilitation projects (Seburn 2007).

The Ministry of Natural Resources and Forestry (MNRF) has funded numerous turtle conservation and stewardship projects across Ontario through the Ontario Species at Risk Stewardship Fund and other provincial funding programs. In 2010, the MNRF released the Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales (OMNR 2010) (The Stand and Site Guide). The Stand and Site Guide is one of a series of forest management guides used by forest managers when planning and implementing forest management operations. The stand and site guide includes standards, guidelines and best management practices for turtle species found in the Area of the Undertaking, including the Spotted Turtle.

Since 2009, Ontario Nature has been coordinating the development of a new Ontario Reptile and Amphibian Atlas. By soliciting occurrence records from the public, researchers, government and non-government organizations, this project is improving our knowledge of the distribution and status of reptiles and amphibians, including the Spotted Turtle, in Ontario (Crowley pers. comm. 2013; Ontario Nature 2012). Ontario Nature is working with the Natural Heritage and Information Centre (NHIC), MNRF and other organizations to promote the new Ontario Reptile and Amphibian Atlas (http://www.ontarionature.org/atlas).

The Nature Conservancy of Canada (NCC) has been carrying out a large, multi-year reptile inventory and management project, which includes multiple turtle species. There are several turtle survey or monitoring programs (e.g., Ontario Turtle Tally (Toronto Zoo), Kawartha Turtle Watch (Trent University)) and graduate-level research projects, as well as several road mortality studies that have been completed. Studies of turtle habitats, home ranges, population sizes, predation, demographics, habitat use, and ecology of nesting have been conducted in various parts of Ontario.

There are many organizations and agencies that offer outreach/ educational programs about turtle species at risk to school groups, First Nations, and the general public (e.g., Reptiles at Risk on the Road Project, Georgian Bay Reptile Awareness Program, Ontario Nature, MNRF, Ontario Parks, Kawartha Turtle Trauma Centre, Toronto Zoo, and Upper Thames River Conservation Authority). The National Parks and Historic Canals provide opportunities to their visitors to learn about Spotted Turtles and other at risk turtles across Ontario. The Toronto Zoo Adopt-A-Pond program (www.torontozoo.com/adoptapond) is one of several projects that have developed turtle conservation curricula for schools, while the Toronto Zoo Turtle Island Conservation program (http://www.torontozoo.com/conservation/tic.asp) promotes turtle conservation and awareness among First Nation and non-Indigenous groups. Turtle SHELL (Safety, Habitat, Education and Long Life), a charitable organization, has prepared booklets and installed turtle crossing signs. Efforts to secure the nests of turtle species at risk have also been undertaken.

In addition to public outreach and conservation initiatives, the Ontario Turtle Trauma Centre (OTTC) in Peterborough, Ontario rehabilitates wild turtles that were injured in the hopes of recovering and releasing them (https://ontarioturtle.ca/). The centre has admitted over 800 turtles (as of 2013) (Ontario Turtle Trauma Centre 2018).

Many projects are being carried out as a requirement under the Ontario *Endangered Species Act, 2007* that are directly benefiting Spotted Turtle local populations. For example, turtle fencing and ecopassages are now incorporated into the design of most new highways whenever they bisect species at risk turtle habitat (Ontario Road Ecology Group 2010; OMNR 2013). Research is actively being conducted for species at risk turtles in Canada, many of which have been referenced in section 10.

Quebec
The Quebec Turtles Recovery Team was created in 2005. One of its mandates was to develop and implement a recovery plan for five species of turtles: the Wood Turtle, the Northern Map Turtle, the Blanding's Turtle, the Eastern Musk Turtle and the Spotted Turtle (REFERENCE REMOVED). This team merged in 2012 with the Spiny Softshell Recovery Team, thus including a sixth species of turtle. To ensure the implementation of the recovery actions, four Implementation Groups were established, each working on a specific turtle species or groups of species.

An amphibian and reptile database (Atlas des Amphibiens et des Reptiles du Québec) exists and is managed by la Société d'histoire naturelle de la vallée du Saint-Laurent (SHNVSL). The Atlas des Amphibiens et des Reptiles du Québec has been a source database of the Centre de données sur le patrimoine naturel du Québec (CDPNQ) until 2014. The CDPNQ is held by the Ministère des Forêts, de la Faune et des Parcs (MFFP) for data on threatened or vulnerable wildlife species.

Recent targeted surveys have been conducted in two different locations based on the availability of suitable habitat at these locations (REFERENCE REMOVED) and other areas where historical observations were reported; no Spotted Turtle observations have been confirmed from these sites.

In the 1990s, an awareness program was initiated where Spotted Turtles had been historically reported. Follow-up surveys were conducted in 1998-99; however, no Spotted Turtles were reported or found in the area (COSEWIC 2014). No further surveys have been conducted in these areas and no new observations have been reported. Other areas of the province with suitable habitat have been recently surveyed; however, no Spotted Turtle observations have been confirmed.

6.2 Strategic Direction for Recovery

To work towards achieving the population and distribution objectives, seven broad strategies for recovery have been established. The broad strategies are:

1. Use legislative and administrative tools to conserve Spotted Turtle individuals and habitat;
2. Reduce individual mortality, injury, and illegal collection across the range of the Spotted Turtle in Canada;
3. Protect, manage, and restore habitat across the range of Spotted Turtle in Canada;
4. Improve recruitment in locations where local Spotted Turtle populations are in decline or viability is deemed compromised;
5. Conduct communication, outreach, and stewardship activities;
6. Survey and monitor local Spotted Turtle populations, habitat, and threats; and
7. Conduct research on population demographics, habitat characterization and use, and threats/threat mitigation to fill knowledge gaps.

Research and management approaches are recommended for each strategy (Table 2). Threats/limitations in the first column are numbered as follows for concise presentation:
1. Road networks and off-road vehicles
2. Illegal collection
3. Exotic and invasive species
4. Agricultural practices
5. Land conversion
6. Fire suppression
7. Water management
8. Human subsidized predators
9. Contamination and nutrient loading
10. Disturbance from human activities, and
11. Climate change

Table 2. Recovery Planning Table for the Spotted Turtle

Threat or Limitation	Broad Strategy for Recovery	Priority[a]	General Description of Research and Management Approaches
1,2,4,5,7, 9,10	Legislative and administrative tools to conserve Spotted Turtle individuals and habitat	High	• Continue to improve and enforce existing federal and provincial laws, regulations, policies, prohibitions and other regulatory and non-regulatory tools to protect Spotted Turtle individuals and habitat. • Continue to develop and implement mitigation techniques (e.g. best management practices) and evaluate their effectiveness to address threats to individuals and habitat.
1,2,4,5,7, 8,10	Reduce individual mortality, injury, and illegal collection across the range of the Spotted Turtle in Canada.	High	• Develop a federal/provincial strategy to focus on countering illegal collection for pet trade and consumption. • Continue to develop and implement mitigation techniques (e.g., Best Management Practices (BMPs) and alternatives to traditional development) to reduce Spotted Turtle adult mortality and injury. Examples of priority mitigation measures include: o Implement and evaluate mitigation techniques to reduce road mortality rates (e.g., ecopassages), especially in areas with high turtle road mortality. o Implement and evaluate stewardship activities to reduce disturbance of occupied nesting habitat and individuals (e.g., signposting, monitoring of off-road vehicle use on beaches), especially in habitat near urban areas. o Implement and evaluate techniques to control predator populations or restrain access to nesting habitats through direct and indirect measures (e.g., garbage removal, predator management, and fencing). • Promote the implementation of approved BMPs, development alternatives, and mitigation techniques to the general public, First Nations, landowners, land managers, Governments and industry. This addresses priority threats through stewardship, funding, and other techniques.

Threat or Limitation	Broad Strategy for Recovery	Priority[a]	General Description of Research and Management Approaches
3,5,6,7,9	Protect, Manage or Restore Habitat across the range of the Spotted Turtle in Canada.	High	• Protect areas large enough to maintain viable populations and increase connectivity through stewardship, development of BMPs, and/or land conservation. • Assess habitat restoration needs at locations where habitat loss, degradation, and fragmentation are threatening local Spotted Turtle populations. • Identify, develop, implement and evaluate exotic and invasive species management at impacted sites used by Spotted Turtle. • Identify, develop, implement and evaluate restoration techniques at priority sites and monitor use by Spotted Turtles. • Determine disturbance threshold levels for activities that are likely to destroy critical habitat. • Continue to encourage stewardship activities, including financial support through available funding programs.
1,2,3,4,5, 6,9	Improve recruitment in locations where Spotted Turtle is declining or viability is deemed compromised.	High	This strategy must be implemented concurrently with two aforementioned broad strategies: "Reduce individual mortality, injury, and illegal collection" and "Protect, Manage or Restore Habitat" • Document recruitment needs to determine places where Spotted Turtle is declining or viability is deemed compromised. • Implement, evaluate, adapt and improve recruitment techniques in accordance with results obtained and Spotted Turtle ecology. An example of a priority recruitment technique is: o Develop a cost effective head starting protocol/program. This would incorporate nest monitoring, artificial incubation of eggs, and release of juveniles.

Threat or Limitation	Broad Strategy for Recovery	Priority[a]	General Description of Research and Management Approaches
All Threats	Communication, Outreach and Stewardship	Medium	• Develop a communication and outreach strategy or continue to implement existing communication and outreach tools to help address threats to the Spotted Turtle. • Develop outreach/education material, with an emphasis on turtle harvest and trade, for groups most often associated with the use of this species. Produce these materials in the language of the target audience. • Encourage the transfer, use and archiving of information and tools, including Indigenous Knowledge (IK). • Improve and maintain cooperation among stakeholders (e.g., engage partners and promote collaborative work with multiple jurisdictions). • Promote and engage partners (e.g., academics, government, non-government organizations, First Nations) in research initiatives necessary to fill knowledge gaps.
All Threats	Survey and Monitoring	Medium	• Prioritize sites with suitable habitat and historical or potential populations and conduct targeted inventories • Develop and promote the appropriate use of standardized protocols for survey, monitoring, and databases (e.g., data collection, handling, marking). • Conduct targeted surveys for the Spotted Turtle in Quebec to determine if the species is present. • Develop and implement monitoring plans in Ontario (and Quebec if necessary) • Encourage the submission of records for the Spotted Turtle to provincial herpetological atlases as well as the provincial Conservation Data Centres (CDCs).

Threat or Limitation	Broad Strategy for Recovery	Priority[a]	General Description of Research and Management Approaches
All Threats	Research on population, habitat, and threats to fill knowledge gaps.	Medium	• Determine the minimum habitat and population criteria for a viable local population (e.g., suitable habitat area, number of mature individuals) at the appropriate recovery scale. • Increase knowledge of the habitat requirements of the species to further characterize and define the habitats (e.g., nesting, feeding, and overwintering sites) used while carrying out various life cycle activities, particularly by hatchlings and juveniles and to gain a better understanding of the spatial and temporal use of habitat. • Conduct research to evaluate the severity of known threats to populations and document frequency, extent, and causal certainty of threats. • Conduct intensive demographic studies in selected sites across the range to expand knowledge of population size, age composition and sex ratios.

[a] Priority – reflects the degree to which the broad strategy contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.

6.3 Narrative to Support the Recovery Planning Table

Considering the reproductive strategy of the Spotted Turtle (see section 3.4), maintaining the highest possible adult survival rate, especially for females, remains the primary need of the species to achieve recovery. Unfortunately, some biological or behavioural traits of the Spotted Turtle (i.e., nesting on road shoulders, travelling across terrestrial habitats) as well as desirability for the pet trade, make the species highly vulnerable to many threats posed by human activities (e.g., mortality from roads, agricultural practices and off-road vehicles, nest predation, habitat destruction as well as, illegal collection) so it will be important that a proactive, integrated approach be taken to limit threats on adult Spotted Turtles.

Such approaches should focus primarily on where and when most of the adult mortality occurs. Protection and stewardship of the species is critical to help mitigate threats and ensure long term survival of the species within Canada. Habitat protection, management, and restoration are also key to recovery since such approaches contribute to maintaining, improving, or creating suitable habitat, and also contribute to reducing adult mortality (i.e., reducing threat severity). These approaches must be implemented via an integrated approach engaging various stakeholders (e.g., landowners, land users, land planners, First Nations, non-government organizations, and government). In order to inform these stakeholders, as well as begin to mitigate specific threats (e.g., road mortality and illegal collection), specific communication and outreach approaches need to be undertaken. It is also necessary to fill the knowledge gaps which surround this species through a wide range of specific studies to ensure the completion of the long term population and distribution objective. Along with approaches highlighted in Table 2, some knowledge gaps will also be filled via the schedule of studies to identify critical habitat (Table 5).

7. Critical Habitat

Under SARA, critical habitat is defined as “the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species’ critical habitat in the recovery strategy or in an action plan for the species”. Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species’ critical habitat to the extent possible, as well as examples of activities that are likely to result in its destruction. This federal recovery strategy identifies critical habitat to the extent possible, based on the best available information for the Spotted Turtle as of December 2013. Following the publication of this strategy additional critical habitat may be identified if new information supports the inclusion of areas beyond those currently identified. In some of the areas identified as critical habitat, the quality of the habitat will need to be improved for recovery to be achieved.

7.1 Identification of the Species' Critical Habitat

Critical habitat for Spotted Turtle in Canada is identified for 88 local populations (Figure 4, see also Table 4). It is recognized that the critical habitat identified is insufficient to achieve the population and distribution objectives for the species; there are locations that have not been surveyed recently or adequately, where data sharing agreements are required, and/or where there is a lack of certainty in the data needed to identify critical habitat. A schedule of studies outlines the activities necessary to complete the identification of critical habitat (see section 7.2). The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

Critical habitat for Spotted Turtle is based on three general criteria: habitat occupancy, habitat suitability, and habitat connectivity (between occupied areas), which are described in detail below.

7.1.1 Habitat Occupancy

This criterion refers to areas where there is a reasonable degree of certainty of the presence and current use of a habitat by the species.

Habitat is considered occupied when:

- At least one Spotted Turtle individual has been observed in any single year in the last 40 years[47].

In Ontario, most of the remaining local populations include only a small number of individuals (COSEWIC 2014; Seburn 2007). As such, a single observation may be indicative of a local population and has been used to determine habitat occupancy. This is appropriate for Spotted Turtle which is an endangered species, faces considerable threats, and is a species difficult to survey given its cryptic nature and wariness of humans.

A forty-year period has been chosen for the habitat occupancy criterion. It is appropriate given the extended generation time[48] of the species (estimated to be 40.6 years) (COSEWIC 2014). This longevity trait makes the entire life span of the species difficult to study, by complicating the acquisition of an adequate amount of accurate life history data. Application of a forty-year timeframe allows for the inclusion of local populations that likely persist but for which Spotted Turtle individuals may not have been detected in recent years.

Records considered for the identification of critical habitat include data from all valid sources (e.g., professional surveys, incidental sightings, telemetry studies, and nest site

[47] A period from 1974-2013 was used to identify critical habitat in this Recovery Strategy.
[48] Generation time: Average age of parents in a population

and overwintering observations). These records must have spatial precision (≤ 1 km) or provide enough detail to be associated to a specific location (e.g., an individual's home range) to be considered adequate to identify critical habitat. Critical habitat is not identified for locations where repeated survey efforts following appropriate timing and methods have not confirmed Spotted Turtle persistence or habitat use and local extinction is presumed, and/or where recent surveys or other information (e.g., aerial photos) determine that suitable habitat is no longer present (e.g., due to housing development).

7.1.2 Habitat Suitability

Habitat suitability refers to areas possessing a specific set of biophysical attributes that allow individuals to carry out essential life cycle activities (i.e., overwintering, mating, nesting, foraging, thermoregulation, and summer inactivity) as well as their movements. It is important that all required habitat areas are linked aquatically or semi-aquatically, and are in reasonable proximity to one another so that turtles can move between them with ease. Suitable habitat for Spotted Turtle can therefore be described as a mosaic of aquatic and terrestrial habitats, in which specific biophysical attributes can be associated with essential life cycle activities. Within the area of suitable habitat, the biophysical attributes required by the Spotted Turtle will vary over space and time with the dynamic nature of ecosystems. In addition, particular biophysical attributes will be of greater importance to turtles at different points in time (e.g., during different life processes, seasons or at various times over the year).

The biophysical attributes of suitable habitat for the Spotted Turtle are detailed in Table 3 and illustrated in Figure 2.

Given the lack of information on the amount of habitat that is required for Spotted Turtle to complete its life cycle activities within a home range, the following approach has been used to identify an extent of suitable habitat for Spotted Turtle. This description of suitable habitat reflects the fact that certain biophysical attributes do not need to be immediately adjacent to each other, as long they remain connected so that individuals can easily move between them to meet all their biological needs and respond to or avoid disturbances as required. The distances determining the extent of suitable habitat are specific to Spotted Turtle and based on the species' biological and behavioural requirements (see section 3.3).

Suitable habitat for Spotted Turtle consists of overwintering, mating, thermoregulation, nesting, and foraging habitat, and habitat for movement (commuting and dispersal) between these areas (Figure 3), and is defined as:

- The entire suitable aquatic habitat feature (measured up to the high water mark) OR suitable portion of the feature (i.e., littoral zone[49] as measured from

[49] Littoral zone: The area close to shore.

the high water mark to a maximum depth of 9 m), located within a radial distance of 1 km from a known record of Spotted Turtle; AND

- the suitable terrestrial habitat(s) extending up to 130 m (measured landward from the boundary of the aquatic feature)

These criteria will capture the vast majority of potential nesting habitats, which is important considering few precise locations are known. Nest site availability and selection are likely to be especially important for local population persistence given the nature of known factors limiting Spotted Turtle (e.g., long-term reproductive strategy, climatic conditions – see section 3.3). Due to the rarity of these habitats, confirmed nesting sites are identified as critical habitat wherever they occur (regardless of the distance to the nearest aquatic feature). Therefore, suitable habitat for Spotted Turtle also includes:

- the area within a 50 m radial distance from a known nest record of Spotted Turtle

The search for suitable nesting, overwintering, thermoregulation, and foraging habitat constitutes the majority of movements for turtles. The distance used to set the suitable habitat boundary (i.e., 1 km radial distance from an observation) is based on current knowledge of the species' needs. The 1 km radial distance is selected based on the maximum individual home range length observed for Spotted Turtle in Ontario (can exceed 1000 m; REFERENCE REMOVED) and Maine (1125 m; REFERENCE REMOVED). The 1 km radial distance identifies an area of 2 km diameter which is the distance Spotted Turtle has been known to travel within the active season (Lewis and Ritzenthaler 1997; Joyal et al. 2001; Beaudry et al. 2010) and is consistent with observed movements in Canada (REFERENCE REMOVED; Gillingwater and Piraino unpub. data). A habitat-based approach is important to preserve the habitats that remain occupied and available to Spotted Turtle because much of the habitat for the species has already been lost or fragmented within the landscape. The maximum distance was chosen due to the endangered status of the species, its low estimated population, and its high susceptibility to habitat loss and degradation.

Because Spotted Turtles can move long distances to nest, a terrestrial distance of 130 m from an aquatic feature is selected, as the area that will capture over 95% of terrestrial observations, based on a data analysis of Spotted Turtle movements (including data from Ontario) and including nest sites and gravid females (n=93, Steen et al. 2012). The area within 130 m of suitable aquatic habitat provides critical movement corridors through which hatchling Spotted Turtles access wetlands after hatching. In addition, adjacent suitable habitat features (i.e., that are within 260 m of each other, see Figure 3), form a habitat complex, facilitating movement between interconnected aquatic and terrestrial habitats to meet all life cycle functional requirements.

The habitat within a 50 m radial area around nesting observations is important to maintain the microclimatic conditions (e.g., thermal, vegetative and light features) and

serves as a staging area and may also provide for a protective travel corridor for hatchlings to migrate to suitable aquatic habitat. Critical habitat in these suitable areas corresponds to the biophysical attributes of suitable habitat. This approach is designed to protect outlying nests which may not be captured in the 130 m terrestrial critical habitat boundary.

In Ontario, suitable habitat for Spotted Turtle can be partially described using provincially available wetland, waterbody and watercourse mapping; permanent aquatic features are typically well captured. However, small, temporal or ephemeral features often used by Spotted Turtle are not well captured through existing land classification mapping (e.g., Ecological Land Classification mapping), especially where field verification has not taken place. In locations where detailed habitat mapping is not available, the area within a 1 km radial distance of a Spotted Turtle may be used to represent a maximum extent within which suitable habitat may occur (Figure 3). Taking such an approach is appropriate because these small, temporal or ephemeral features can provide important sanctuaries at certain times of the year.

Table 3: Detailed biophysical attributes of suitable habitat for specific life cycle activities of the Spotted Turtle in Canada.

Suitable Aquatic Habitat			
Habitat Feature(s)	*Biophysical Attributes*	*Life cycle Activities*	*References*
Permanent, semi-permanent or ephemeral wetlands, including: • marshes, swamps, bogs, fens • beaver regulated wetlands • vernal pools • ponds • sloughs or seepages • drainage ditches	• presence of water up to 9 m in depth; AND • soft substrate composed of mud or sand; OR • for foraging, thermoregulation and overwintering, features such as sphagnum moss, sedge tussocks, grasses, aquatic and/or emergent vegetation, floating or submerged logs, root systems or muskrat lodges; OR • for overwintering, adequate water depth and do not freeze to the bottom (e.g., sphagnum hummocks forming subterranean cavities)	Overwintering/ Mating/ Foraging/ Thermoregulation/ Summer Inactivity /Movement	REFERENCE REMOVED; Harding (1997); Lewis and Ritzenthaler (1997); Litzgus et al. (1999); Wilson (1994); REFERENCE REMOVED; Barlow (1999); REFERENCE REMOVED
A watercourse or waterbody, including creeks, streams and lakes	• presence of water up to 9m in depth; AND • permeable (no barriers to movement[a]) to Spotted Turtle	Movement/ Foraging	Wilson (1994); REFERENCE REMOVED; REFERENCE REMOVED; Litzgus and Brooks 2000; Rasmussen and Litzgus (2010a)
Suitable Terrestrial Habitat			
Habitat Feature(s)	*Biophyscial Attributes*	*Life Cycle Activities*	*References*
Shoreline areas (e.g., sand bars, beaches, mud flats), upland forest, rocky outcrops, open fields, meadows, marshy areas, sphagnum wetlands	• exposed to full or partial sunlight; AND • substrate suitable for nest excavation, (e.g., rich, dark loamy soil amongst bare to sparse vegetation; areas of grasses, sedges; sphagnum moss hummocks or litter; muskrat lodges; soil or detritus- filled crevices in rocky outcrops; habitat adjacent to wetland or water bodies).	Nesting/ Thermoregulation/ Movement	REFERENCE REMOVED; Harding (1997); Litzgus and Brooks (1998a); Joyal et al. (2001); REFERENCE REMOVED; Beaudry et al. (2010)
Upland forests, woodlands, meadows, rocky outcrops or open fields	• loamy soil or mud amongst bare to sparse vegetation, areas of grasses, decaying vegetation matter, or rotting wood	Thermoregulation/ Summer Inactivity /Movement/	REFERENCE REMOVED; Barlow (1999); Litzgus and Brooks (2000); REFERENCE REMOVED

[a] A barrier to movement could be a structure that does not allow passage (e.g., dam or log jam).

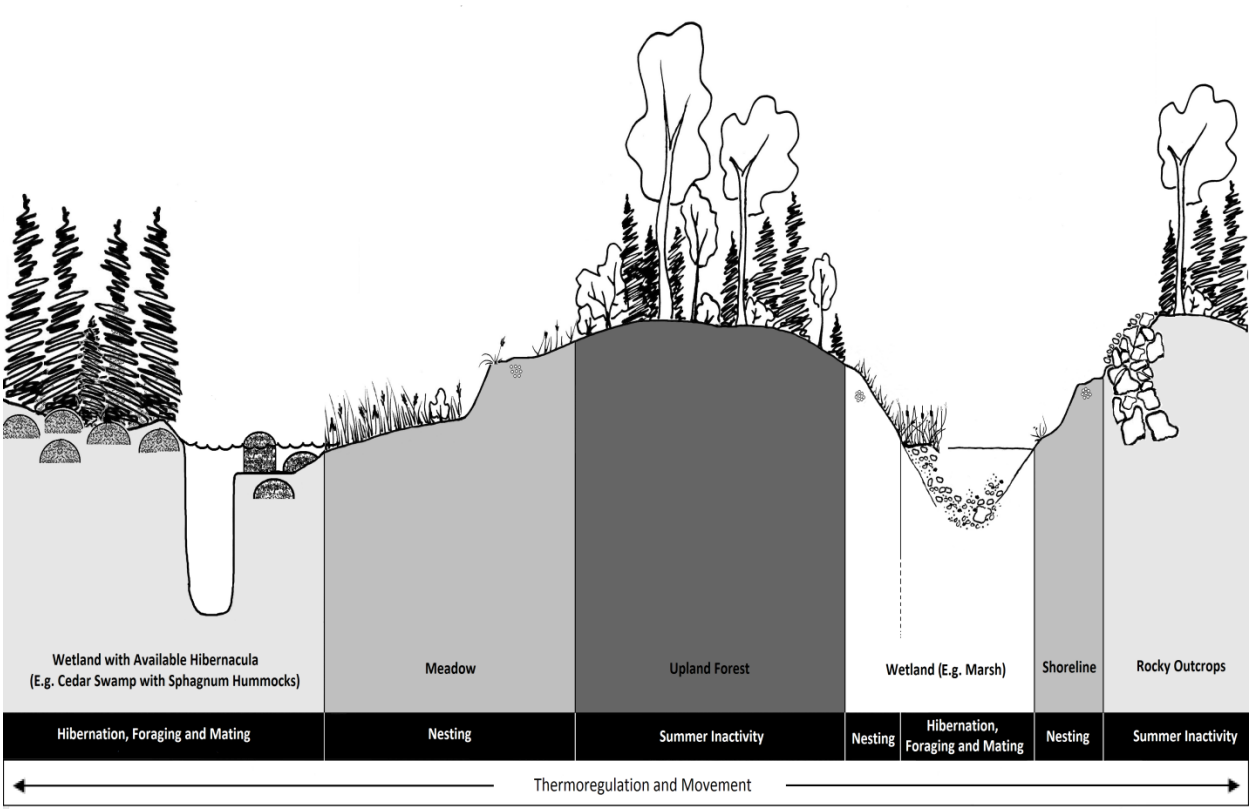

Figure 2: Biophysical attributes of the Spotted Turtle suitable habitat for each life cycle activity.

7.1.3 Habitat Connectivity

Maintaining the natural linkages between habitat types required by Spotted Turtle is necessary for the persistence of local populations. Connectivity between local populations is important for immigration and emigration (movement into and out of local populations, respectively) which increases gene flow (maintaining genetic diversity within and between local populations) and allows the species to react to environmental stressors (e.g., water level changes) by moving to another location. In Canada, habitat loss and fragmentation is a threat to the Spotted Turtle (see 4.2; COSEWIC 2014). This threat can result in the loss of dispersal corridors, isolating local populations, and causing reductions in genetic diversity.

To allow short-distance movements needed to carry out Spotted Turtle life cycle activities (commuting habitat), connectivity is provided within the defined areas of suitable habitat (seasonal movements between habitats as required to complete an annual life cycle) (section 7.1.2, see also Table 3; Figure 3). To allow long-distance movements such as immigration or emigration (outside of a home range) (dispersal movement – see section 3.3), the habitat connectivity criterion connects local populations based on the documented tendencies of Spotted Turtle individuals to undertake both aquatic and terrestrial movements for dispersal and evidence that Spotted Turtle will use the same paths to move between habitats from year to year (Joyal et al. 2001).

The habitat connectivity criterion identifies unoccupied suitable habitat as critical habitat where it occurs within a dispersal distance of two Spotted Turtle observations, and is defined as:

- The entire suitable aquatic habitat feature (measured up to the high water mark) OR suitable portion of the feature (i.e., littoral zone as measured from the high water mark to a maximum depth of 9 m), intervening between two (or more) records of Spotted Turtle (meeting the habitat occupancy criterion (Section 7.1.1)) separated by a maximum distance of 3 km; AND
- the suitable terrestrial habitat(s) extending up to 130 m (measured landward from the boundary of the suitable aquatic feature)

In locations where the habitat connectivity criterion applies, a minimum bounding polygon[50] is used, applied using an occupancy-based approach (around the 1 km radial area from a Spotted Turtle record) (Figure 3). Connective habitat may be refined using a habitat-based approach as more information and local area knowledge becomes available. This criterion captures adjacent suitable habitat which may be used by Spotted Turtle for dispersal and other life cycle activities. These are areas of potential habitat required to promote recovery and be available for individuals of the species as the population increases.

The 3 km distance is based on three times the average linear home range length (i.e.,1 km), which is the minimum separation distance between local populations recommended by NatureServe (NatureServe 2017) to maintain connectivity and reduce the probability of genetic isolation.

[50] Minimum bounding polygon: specified minimum shape that encloses each feature or group of features

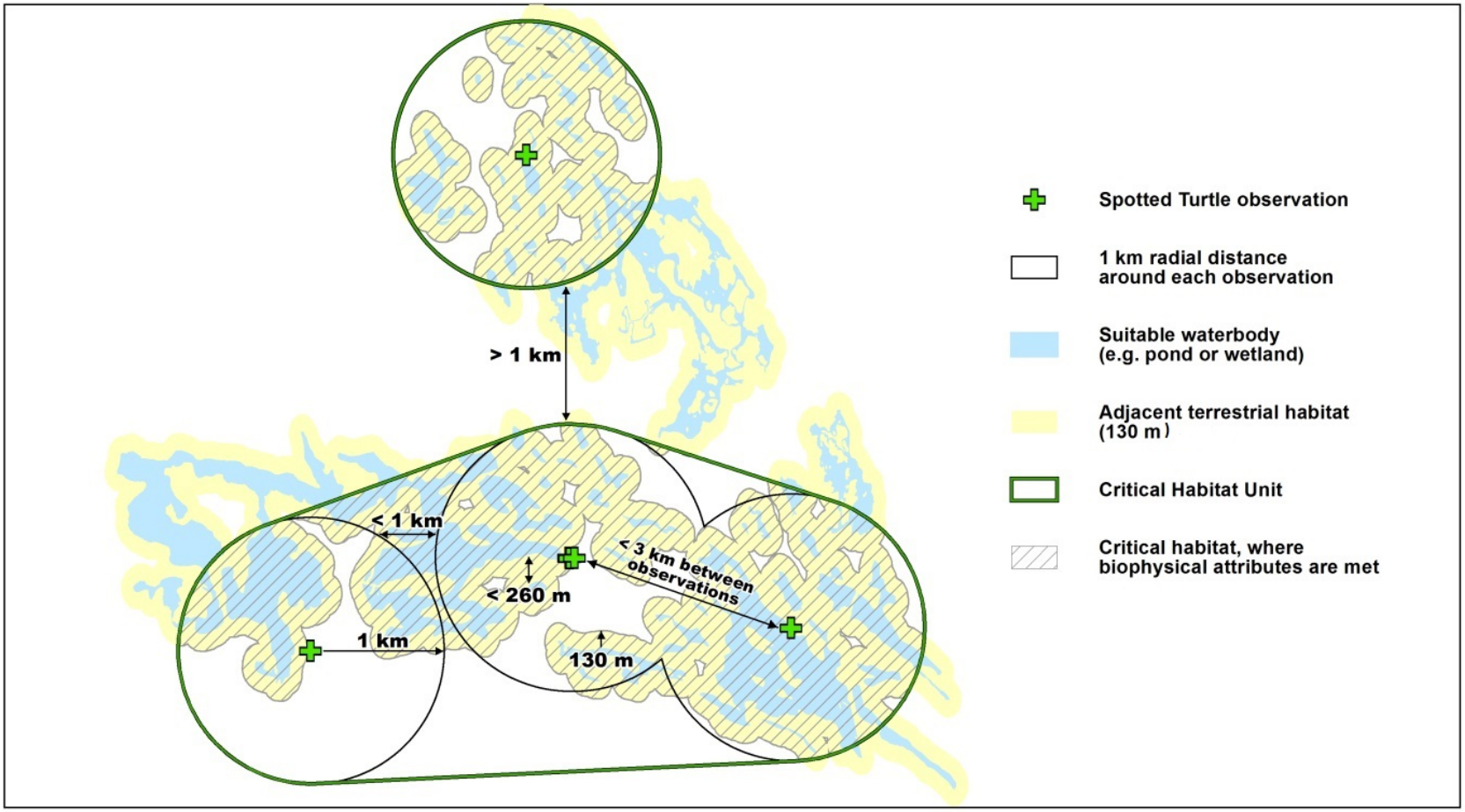

Figure 3. Schematic of Critical Habitat Criteria for Spotted Turtle. Observations that meet the habitat occupancy criterion are used to define suitable habitat (i.e., an area of 130 m around permanent and seasonal wetlands, watercourses and waterbodies located within 1 km around Spotted Turtle records). Because small, temporary wetlands and ponds are not well mapped, a 1 km radial area around the Spotted Turtle record defines a critical habitat unit. A critical habitat unit also includes nesting sites wherever they occur along with surrounding suitable habitat within 50 m of the nesting site. Where the habitat connectivity criterion is applied, the unit boundary is extended (using a minimum bounding polygon), identifying a larger habitat complex for Spotted Turtle. Critical habitat units are merged together where they spatially overlap. Critical habitat is the habitat within a critical habitat unit, and which corresponds to the detailed biophysical attributes described in Table 3.

7.1.4 Application of the Criteria to Identify Critical Habitat for Spotted Turtle

Critical habitat for Spotted Turtle is identified as the extent of suitable habitat (section 7.1.2) where the habitat occupancy criterion is met (section 7.1.1). At the present time, suitable habitat boundaries are partially available (e.g., for permanent wetland and water features) for most local populations; however, small, temporal or ephemeral suitable habitat boundaries are not currently available to support the identification of critical habitat for all local populations in Ontario. In the interim, a broader boundary (i.e., the area within a 1 km radial distance of a Spotted Turtle record) is identified as the area within which critical habitat is found, herein referred to as the critical habitat unit. Where the habitat connectivity criterion is applied (in cases where two or more Spotted Turtle observations meeting the habitat occupancy criteria are separated by up to a maximum distance of 3 km (section 7.1.3)), the critical habitat unit is extended (using a minimum bounding polygon) to identify a larger habitat complex for Spotted Turtle (see Figure 3). Thus, the critical habitat unit represents the maximum extent of critical habitat at a given location. When habitat boundaries are determined, the identification of critical habitat will be updated. Due to changing water levels, storm surges, erosion, and deposition along shorelines, the location and extent of suitable habitat within Spotted Turtle critical habitat units may change over time (Rasmussen and Litzgus 2010a). Urban areas and/or human-made structures (e.g. road surfaces, road shoulders, and pavement) do not correspond to the biophysical attributes of suitable habitat for the Spotted Turtle (see section 7.1.2) and are not considered critical habitat.

Application of the critical habitat criteria to the best available data identified 107 units that contain critical habitat for 88 local populations of Spotted Turtle in Canada. The 88 local populations with critical habitat identified are based from 25 extant and 63 historical local populations from COSEWIC (2014). The remaining historical and extirpated local populations did not meet the critical habitat criteria and do not have critical habitat identified at this time. Due to these circumstances, the critical habitat identified is considered a partial identification of critical habitat and a schedule of studies (section 7.2) has been developed to provide the information necessary to complete the identification of critical habitat that will be sufficient to meet the population and distribution objectives for known extant and historical populations.

Given the vulnerability of the species to illegal harvest, the Minister of Environment and Climate Change, following the advice of COSEWIC, has restricted the release of any information regarding the location of Spotted Turtle populations or their habitat under SARA (section 124). As a result, critical habitat for the Spotted Turtle is presented using 100 x 100 km UTM grid squares (Figure 4, see also Table 4) to avoid disclosure of this sensitive information. The UTM grid squares are part of a standardized grid system that indicates the general geographic areas containing critical habitat, which can be used for land use planning and/or environmental assessment purposes. More detailed information on the location of critical habitat, to support protection of the species and its habitat may be requested on a need-to-know basis by contacting Environment and Climate Change Canada – Canadian Wildlife Service at: ec.planificationduretablissement-recoveryplanning.ec@canada.ca.

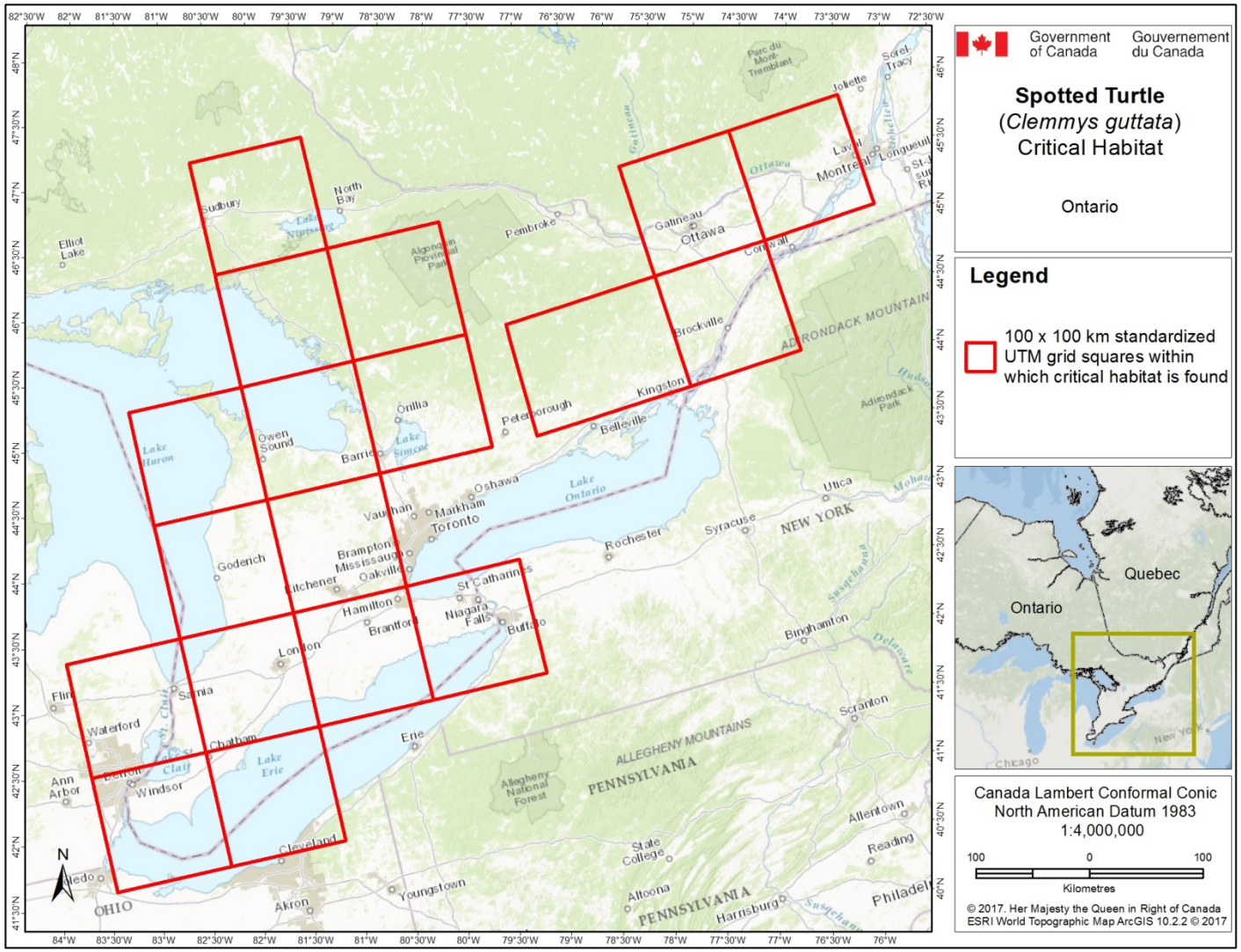

Figure 4. Grid squares that contain critical habitat for Spotted Turtle in Ontario. Critical habitat for Spotted Turtle occurs within these 100 x 100 km standardized UTM grid squares (red outline), where the criteria described in section 7 are met.

Table 4. 100 x 100 km Standardized UTM grid squares identified as containing critical habitat for Spotted Turtle in Canada. Critical habitat for Spotted Turtle occurs within these 100 x 100 km Standardized UTM grid squares, where the criteria described in section 7 is met.

100 x 100 km Standardized UTM grid square ID[a]	UTM Grid Square Coordinates[b]		Number of critical habitat units identified
	Easting	Northing	
17TLG	300000	4600000	12
17TLH	300000	4700000	1
17TMG	400000	4600000	2
17TMH	400000	4700000	7
17TMJ	400000	4800000	2
17TMK	400000	4900000	11
17TNH	500000	4700000	11
17TNJ	500000	4800000	3
17TNK	500000	4900000	15
17TNL	500000	5000000	12
17TNM	500000	5100000	1
17TPH	600000	4700000	3
17TPK	600000	4900000	14
17TPL	600000	5000000	1
18TTQ/18TUQ	260346	4900000	6
18TVQ	400000	4900000	3
18TVR	400000	5000000	2
18TWR	500000	5000000	1
		Total	**107 units**

[a] Based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography/topographic-information/maps/9789), where the first 2 digits represent the UTM Zone, the following letter represents the UTM Row, and the last 2 letters indicate the 100 x 100 km Standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology produced from the Breeding Bird Atlases of Canada (See http://www.bsc-eoc.org for more information on breeding bird atlases). To protect species sensitivities, UTM Standardized grid squares at the intersection of UTM zones are merged with their adjacent grid squares to ensure a 100 x 100 km grid square minimum.

[b] The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 100 x 100 km Standardized UTM grid square that is the critical habitat unit. The coordinates are provided as a general location only.

7.2 Schedule of Studies to Identify Critical Habitat

Critical habitat for the Spotted Turtle is partially identified in this recovery strategy as it may be insufficient to meet the population and distribution objectives (section 5) for the species. There are locations that may support Spotted Turtles that i) have not been recently or sufficiently surveyed or ii) may be contributing to population viability but critical habitat could not be identified due to insufficient data, or iii) where data sharing agreements are required. Targeted surveys of historical occurrences and areas with anecdotal observations, using proper survey methods to determine detection probabilities, are required.

Table 5: Schedule of Studies to Identify Critical Habitat

Description of Activity	Rationale	Timeline
Conduct population surveys and habitat assessments at extant and historical element occurrences where there is insufficient information.	This activity is necessary to confirm the location and extent of populations, determine extent of suitable habitat and possible locations to restore historical occurrences.	2025
Assess the amount of suitable habitat (e.g. nesting, feeding and thermoregulation habitats) for local populations where habitat threats are significant and determine where the area of suitable habitat is likely insufficient.	This activity is required to identify local populations for which the amount of identified critical habitat is potentially insufficient to meet population and distribution objectives and, as a result, for which more critical habitat needs to be identified.	2025
Evaluate habitat use and reproductive success of Spotted Turtles in areas where restoration activities have taken place.	This activity is necessary to identify additional critical habitat to support increases in local populations.	2030

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

Destruction of critical habitat for Spotted Turtle can happen at a variety of scales and in both aquatic and terrestrial habitats. It may occur from an activity taking place either within or outside of critical habitat boundary, and may occur in any season of the year. Within the critical habitat boundary, activities may affect habitat areas which include occupied aquatic habitats and 130 m inland from the high water mark of the occupied aquatic habitat that provide suitable conditions for foraging, thermoregulation, or hibernation. Activities may also affect dispersal corridors that connect these habitats. Within dispersal corridors it is most important to maintain habitat permeability (movement through connective habitat to access adjacent suitable habitats) and, as a result, certain activities that are likely to cause destruction in habitats suitable for foraging, hibernation, and thermoregulation may not cause destruction in corridors so long as sufficient habitat permeability is maintained. Activities taking place outside of the critical habitat boundary may sometimes be less likely to cause destruction of critical habitat than those taking place within the critical habitat boundary.

Activities described in Table 6 are examples of those likely to cause destruction of critical habitat for the species; however, destructive activities are not necessarily limited to those listed.

Table 6: Examples of Activities Likely to Destroy Critical Habitat for the Spotted Turtle

Description of Activity	Description of Effect	Location of the activity likely to destroy critical habitat			
		Within CH Unit			Outside CH unit
		Nesting, foraging, mating, thermoregulation, summer inactivity	Commuting and Dispersal habitat	Overwintering Habitat	
Activities that result in the alteration of hydrology (such as drainage) or filling of wetlands	Complete or partial draining (or other significant hydrological changes) or filling of wetlands (e.g., marsh, bogs) at any time of the year may cause permanent loss of thermoregulation, overwintering, mating, nesting, foraging, summer inactivity and movement habitat. Dams and large retention ponds can also contribute to the fragmentation of suitable habitat and hinder the movement and dispersal of turtles. Raising the water level may result in temporary or permanent saturation of the nesting substrates and may prevent turtles from successfully using the nesting site. Conversely, a repeated decline in water levels can promote vegetation growth at nest sites and prevent their use for nesting. Water supplies and controlled releases can reduce natural erosion processes that contribute to the creation or maintenance of nesting sites. Changes in hydrology may also alter the depth of water sufficient to prevent the species from successfully overwintering (e.g., exposure of hibernating turtles in Canada to frost caused by an abnormal drop in the water level). Water level stabilization can permanently reduce the availability of floodplain habitat (e.g., wetlands) used by the Spotted Turtle for its thermoregulation and feeding. The likelihood of such activities leading to destruction of critical habitat increases during periods of hibernation and nesting. The precise timing of peak flows is critical to nest success. Similarly, the timing of flow rates and water depths has a critical effect on hibernation success. Habitat may be destroyed if these activities change these parameters to the extent that the hibernation and nesting needs of the species are not met. If these activities were to occur outside the bounds of critical habitat, it could result in destruction of critical habitat if the wetland and hydrological characteristics that contribute to critical habitat suitability are not maintained (e.g., suitable water depth). A single event could cause critical habitat destruction.	X	X	X	X

Description of Activity	Description of Effect	Location of the activity likely to destroy critical habitat			
		Within CH Unit			Outside CH unit
		Nesting, foraging, mating, thermoregulation, summer inactivity	Commuting and Dispersal habitat	Overwintering Habitat	
Activities that result in the conversion of habitat, such as residential and/or industrial development; habitat conversion for agriculture; construction of new roads; installation of dams; dredging	Complete or partial development of wetland habitats or critical upland habitats at any time of year may cause permanent loss of thermoregulation, overwintering, nesting, foraging, and summer inactivity habitat. Such development may also impact movement corridors, thus isolating populations. If these activities were to occur outside the bounds of critical habitat, it could result in destruction of critical habitat if the wetland characteristics that contribute to critical habitat suitability are not maintained (e.g., hydrology of critical habitat). A single event could cause critical habitat destruction. Currently, all such activities within critical habitat are likely to result in destruction of critical habitat.	X	X	X	X
Activities that may cause degradation of water quality such as dredging; sedimentation; runoff of domestic, industrial or municipal liquid or solid waste	Discharges of domestic, industrial or municipal liquid or solid waste into water bodies or water courses could contaminate water with hazardous chemical and biological materials, heavy metals or lead to eutrophication. Agricultural activities can also degrade water quality through siltation, discharge of pesticides and fertilizers, as stated above. The degradation of water quality and its resultant reduction of oxygen levels (creating anoxic conditions), within or outside critical habitat, at any time of the year, could permanently or temporarily alter or destroy foraging, summer inactivity, overwintering, and thermoregulation habitats. Continuous, sporadic, or recurrent episodes of such discharges could lead to habitat destruction. Studies are necessary to set thresholds/conditions for these activities.	X		X	X

Description of Activity	Description of Effect	Location of the activity likely to destroy critical habitat			
		Within CH Unit			Outside CH unit
		Nesting, foraging, mating, thermoregulation, summer inactivity	Commuting and Dispersal habitat	Overwintering Habitat	
Construction of new road infrastructure (e.g., roads, road ditches, bridges, and culverts)	Construction of roads (paved, gravel or dirt roads) and bridges at any time of the year may cause permanent destruction (loss) or degradation of nesting, foraging, mating, summer inactivity, and overwintering habitat. Major roads may permanently fragment or isolate suitable habitat and prevent Spotted Turtle access to the resources it needs to complete its lifecycle as well as reduce gene flow. Roads can also act as ecological traps by attracting turtles, particularly adult females, exposing them to a risk of collision. The significant increase in the risk of fatal collisions on roads built for vehicles (trucks, automobiles) is the most important source of concern. If construction or maintenance of road crossings over water (culverts, bridges, etc.) or road ditching is conducted in the winter, there is the possibility of altering water levels and negatively impacting overwintering sites and/or leading to mortality (e.g., the use of cofferdams to remove water from an area as well as the use of heavy machinery which can impact suitable habitat below the high water mark). A single event could cause destruction of critical habitat. If such activities occurred within or outside the boundaries of critical habitat there may be an impact to the habitat or individuals. Water level alterations outside of suitable habitat could lead to decreased water levels over overwintering sites, increasing the risk of Spotted Turtle overwintering mortality. Existing road surfaces, road shoulders and bridges are not included in the description of critical habitat and therefore the continuation of maintenance activities on the roads and bridges following appropriate habitat mitigation Best Managent Pratices are not likely to result in destruction of critical habitat.	X	X	X	x
Shoreline alteration (e.g., re-profiling, dredging, linearization or hardening of stream banks)	Changes to the structure and composition of shores/banks (e.g., removal of native vegetation, addition of stabilizing materials such as concrete, dredging) at any time of the year may create permanent unsuitable conditions for nesting, thermoregulation, and summer inactivity habitat. A single event could cause critical habitat destruction. Currently, all shoreline alteration within critical habitat is likely to result in destruction of critical habitat. Conducting such activities upstream of the critical habitat boundary could also impact shoreline structure and composition downstream of critical habitat and thus result in its destruction.	X			X

Description of Activity	Description of Effect	Location of the activity likely to destroy critical habitat			
		Within CH Unit			Outside CH unit
		Nesting, foraging, mating, thermoregulation, summer inactivity	Commuting and Dispersal habitat	Overwintering Habitat	
Deforestation and forest alteration (e.g., residential and/or industrial and/or commercial development; habitat conversion to crop land; forestry roads, clear-cutting, commercial felled trees, stacking area creation)	Logging conducted under certain tree harvesting systems such as clear-cut, at any time of the year may remove, fragment or degrade suitable summer and travel corridor habitat with the loss of vegetation or litter to burrow into and canopy cover increasing the risk of desiccation during summer inactivity. These logging activities and building new logging road infrastructure may degrade or destroy small shallow wetlands or meadow marshes which the species depends on for survival. Surface hydrology may also be affected, altering rates of run-off, filtration, increasing erosion and siltation. A single event could cause destruction of critical habitat. Such activities would have to occur within critical habitat to result in habitat destruction. Selective tree cutting and sustainable forestry practices are unlikely to degrade critical habitat if conducted under appropriate mitigation methods to reduce impacts on Spotted Turtle habitat quality.	X	X	X	
Activities associated with intensification of agricultural practices (e.g. conversion and use of land for intensive row crops and grazing, large scale pesticide and fertilizer application)	Conversion of lands to intensive farming practices (e.g., field corn) at any time of the year may lead to permanent alteration of nesting and thermoregulation habitat (e.g., reduced feeding opportunities through the removal of vegetation and bare ground). Increased use of pesticides and fertilizers may degrade or permanently alter overwintering and foraging habitat directly (e.g., through impairments to water quality) and indirectly (e.g., habitat loss and changes to food availability). A single event could cause destruction of habitat. If these activities were to occur outside the bounds of critical habitat, it could result in destruction of critical habitat if the wetland characteristics that contribute to critical habitat suitability are not maintained (e.g., hydrology of critical habitat). Further studies are needed to set thresholds/conditions to which such activities undertaken outside of critical habitat are likely to result in habitat destruction.	X	X	X	X
Fire suppression in natural habitats	The suppression of natural fire regimes can lead to the succession of suitable nesting, overwintering, and foraging habitat into habitat which can no longer support these activities. For example, trees and shrubs may fill in an area leading to more shade as well as less open habitat for nesting sites. A single event could cause destruction of habitat. These activities would have to occur within the boundaries of critical habitat to impact the habitat. Currently, all fire suppression activities within critical habitat are likely to result in destruction of critical habitat.	X	X	X	

Description of Activity	Description of Effect	Location of the activity likely to destroy critical habitat			
		Within CH Unit			Outside CH unit
		Nesting, foraging, mating, thermoregulation, summer inactivity	Commuting and Dispersal habitat	Overwintering Habitat	
Activities that introduce exotic and/or invasive species (e.g., planting non-native species, moving fill)	Introduction of exotic and/or invasive species may lead to degradation or complete loss of habitat through the reduction of nesting, thermoregulation, and overwintering habitat. For example, dense stands of non-native Common Reed (*Phragmites australis)* can overgrow nesting sites, preventing turtles from nesting. They can also decrease sun exposure, altering thermoregulation habitat. Such stands can also fill in wetland habitat and prevent turtles from being able to forage easily for food. Activities which introduce exotic and/or invasive species, either within or adjacent to critical habitat, could lead to its destruction. A single event within critical habitat could lead to habitat destruction because once seeds are introduced it can lead to rapid expansion of invasive species.	X	X	X	X
Operation of off road vehicles (e.g., ATVs)	Operation of off road vehicles in wetland habitat can cause destruction and alteration to hydrology and habitat composition. This activity can also compact the soil and promote the introduction and establishment of invasive species. Such impacts could affect overwintering, nesting and summer inactivity habitat by preventing the turtles from excavating nests and destroying the structure of overwintering and summer inactivity sites. If this activity were to occur within the bounds of critical habitat, it could result in destruction of critical habitat if the wetland characteristics that contribute to critical habitat suitability are not maintained (e.g., hydrology of critical habitat). These impacts are most likely to occur between March and November but could also occur between December and February. Further studies are necessary to set thresholds/conditions for these activities.	X	X	X	

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

Medium-term performance indicators (15 years):

> Population abundance of the Spotted Turtle has been stabilized or increased at local populations within Ontario[51].

Long-term performance indicators (50 years):

> Spotted Turtle persists in self-sustaining local populations where the species occurs throughout itsCanadian range.

9. Statement on Action Plans

One or more action plans will be posted on the SAR Public Registry for the Spotted Turtle by December, 2023. Parks Canada multi-species action plans identify recovery measures specific to national parks and other national heritage places where species occur (for a list of current multi-species action plans including the Spotted Turtle, refer to the documents section of the SAR Public Registry).

[51] The element occurrence rank will be used to measure performance. If the element occurrence rank of a local population remains stable or has improved from that of the rank in 2014 then progress has been made towards recovery. If the rank declines progress has not been successful and alternative measures may be necessary.

10. References

Due to the vulnerability of some species to illegal collection, specific references providing sensitive information have been removed from this version of the recovery strategy. To support protection of the species and its habitat, the exhaustive list of references may be requested on a need-to-know basis by contacting Environment and Climate Change Canada's Recovery Planning section at ec.planificationduretablissement-recoveryplanning.ec@canada.ca.

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Appendix A: Subnational Conservation Ranks of Spotted Turtle (*Clemmys guttata*) in Canada and the United States

Table A-1. Ranks of Spotted Turtle in Canada and the United States. (NatureServe 2017)

Spotted Turtle (*Clemmys guttata*)				
Global (G) Rank	**National (N) Rank (Canada)**	**Sub-national (S) Rank (Canada)**	**National (N) Rank (United States)**	**Sub-national (S) Rank (United States)**
G5	N2	Québec (S1) Ontario (S2)	N5	Connecticut (S4), Delaware (S3), District of Columbia (S1), Florida (S3?), Georgia (S3), Illinois (S1), Indiana (S2), Maine (S3), Massachusetts (S4), Maryland (S5), Michigan (S2), New Hampshire (S3), New Jersey (S3), New York (S3), North Carolina (S3), Ohio (S3), Pennsylvania (S3),Rhode Island (S5), South Carolina (S5), Vermont (S1), Virginia (S4), West Virginia (S1)

Rank Definitions (Master et al. 2012)

S1: Critically Imperilled: At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.

N2/S2: Imperilled: At high risk of extirpation in the jursidction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

S3: Vulnerable: At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.

S3?: Vulnerable (inexact): An inexact numeric rank. At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.

S4: Apparently Secure: At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.

G5/N5/S5: Secure: At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats).

Appendix B: 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*[52]. 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[53] (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies 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 strategy itself, but are also summarized below in this statement.

Most activities undertaken to protect the Spotted Turtle and its habitat will also be beneficial to other species that use similar habitat. The protection of wetland habitats will contribute to maintain the rich biodiversity supported by those habitats. Moreover, threat reduction and mitigation measures targeting the Spotted Turtle can contribute to reduce mortality in other animal species (e.g., use of ecopassages to reduce road mortality, efforts to eliminate pollution from aquatic environments). Some of these measures are likely to be found in other recovery documents, particularly those that deal with aquatic and riparian species. Table B-1 presents examples of species that may benefit from the recovery of the Spotted Turtle population in Canada.

[52] www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[53] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

Table B-1. Some of the species at risk that may benefit from conservation and management of turtle habitat in those areas where Spotted Turtle occurs.

Common Name	Scientific Name	SARA Status
Eastern Foxsnake (Carolinian population)	*Pantherophis gloydi*	Endangered
Eastern Foxsnake (Great Lakes/St. Lawrence population)	*Pantherophis gloydi*	Endangered
King Rail	*Rallus elegans*	Endangered
Pugnose Shiner	*Notropis anogenus*	Endangered
Queensnake	*Regina septemvittata*	Endangered
Eastern Prairie Fringed-orchid	*Platanthera leucophaea*	Endangered
Spiny Softshell	*Apalone spinifera*	Threatened
Blanding's Turtle (Great Lakes/St. Lawrence population)	*Emydoidea blandingii*	Threatened
Least Bittern	*Ixobrychus exilis*	Threatened
Eastern Hog-nosed snake	*Heterodon platirhinos*	Threatened
Massasauga (Great Lakes/St. Lawrence population)	*Sistrurus catenatus*	Threatened
Eastern Musk Turtle	*Sternotherus odoratus*	Special Concern
Snapping Turtle	*Chelydra serpentina*	Special Concern
Eastern Milksnake	*Lampropeltis triangulum*	Special Concern
Eastern Ribbonsnake (Great Lakes population)	*Thamnophis sauritus*	Special Concern
Northern Map Turtle	*Graptemys geographica*	Special Concern
Bridle Shiner	*Notropis bifrenatus*	Special Concern
Grass Pickerel	*Esox americanus vermiculatus*	Special Concern
Yellow Rail	*Coturnicops novemboracensis*	Special Concern

The above does not represent an exhaustive list. Given that specific needs may differ between species, implementation of recovery actions should be evaluated for impacts on the co-occurring species. Wherever possible, natural ecosystem processes should be maintained and allowed to evolve without human interference, because these are the processes to which species are adapted.

The possibility that the present recovery strategy inadvertently generates negative effects on the environment and on other species was considered. The recommended actions are non-intrusive in nature, including surveys and outreach. It was therefore concluded that the recovery strategy is unlikely to produce significant negative effects.