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Your File Votre référence

Our File Notre référence
A-2009-00868 / mb

JUN 10 2010

Mr. William Amos
Ecojustice Canada
35 Copernicus Street, Room 107
Ottawa, Ontario
K1N 6N5

Dear Mr. Amos:

We have completed processing your request under the Access to Information Act (the Act) for:

> "I would like to obtain the most recent drafts of the following four recovery strategies as soon as possible, regardless of their current stage of development.
>
> -Golden-winged Warber (Vermivora chrysoptera) - threatened
> -Blanding's Turtle, Great Lakes / St. Lawrence population (Emydoidea blandingii) - threatened
> -Loggerhead Shrike migrans subspecies (Lanius ludovicianus migrans) - endangered
> -American Ginseng (Panax quinquefolius) - endangered"

Attached please find the complete release package in response to this request. Please be advised that some information has been withheld in accordance with sections 16(2), 21(1)(a) and 21(1)(b) of the Act. A copy of the relevant sections is attached.

Please be advised that you are entitled to file a complaint with the Information Commissioner concerning the processing of your request within sixty days of the receipt of this notice. In the event you decide to avail yourself of this right, your notice of complaint should be addressed to:

Information Commissioner
Tower B, Place de Ville
112 Kent Street, 22nd Floor
Ottawa, Ontario
KlA 1H3

If you have any questions regarding this request, please do not hesitate to contact Michael Bogues at (819) 953-5689.

Yours sincerely,

for Pierre Bernier
Access to Information and
Privacy Coordinator

Enclosure

16(2) SECURITY

16. (2) The head of a government institution may refuse to disclose any record requested under this Act that contains information that could reasonably be expected to facilitate the commission of an offence

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21(1)(a) ADVICE OR RECOMMENDATIONS

(a) advice or recommendations developed by or for a government institution or a minister of the Crown,

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21(1)(b) CONSULTATIONS OR DELIBERATIONS

(b) an account of consultations or deliberations involving officers or employees of a government institution, a minister of the Crown or the staff of a minister of the Crown,

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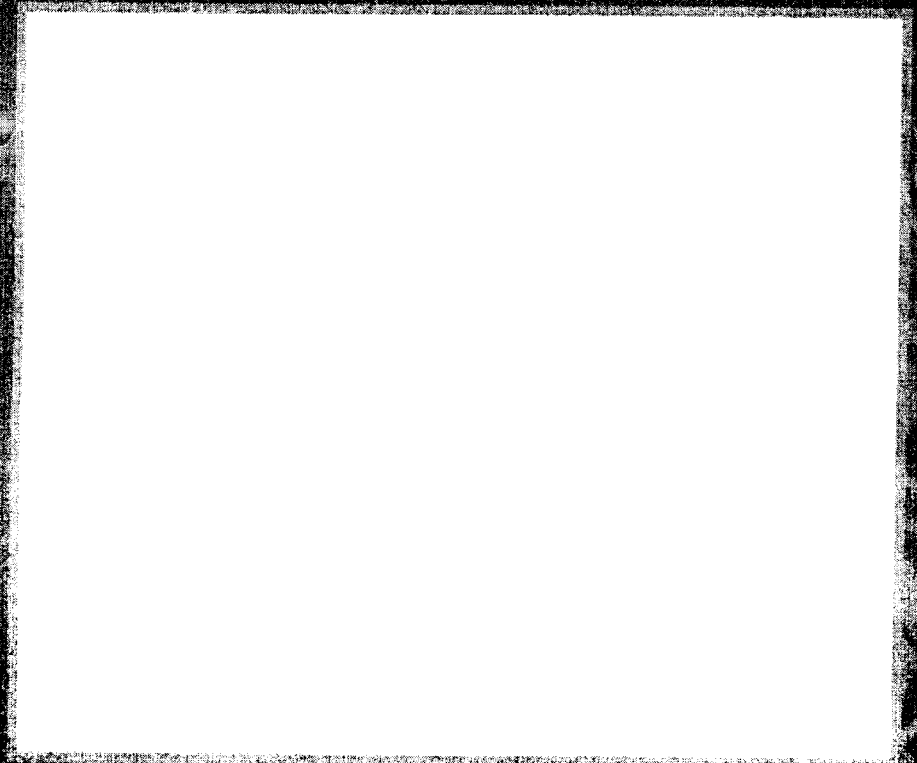
DRAFT VERSION

Species at Risk Act
Recovery Strategy Series

Canadian Multi-turtle Recovery Strategy (Ontario and Quebec): Northern Map Turtle (*Graptemys geographica*), Spiny Softshell (*Apalone spinifera*), Blanding's Turtle (*Emydoidea blandingii*), Stinkpot (*Sternotherus odoratus*), and Spotted Turtle (*Clemmys guttata*)

Species Name



March 2008

Environnement Canada Environment Canada

Canada

RECOVERY TEAM AND ADVISORY COMMITTEE MEMBERS

Christian Friis (Canadian Wildlife Service – Ontario), Benoît Jobin (Canadian Wildlife Service – Quebec) and Paul Goossen (Canadian Wildlife Service – Prarie and Northern); Rob Rempel, Chris Robinson and Fred Pinto (Ontario Ministry of Natural Resources); Ken De Smet (Manitoba Conservation); Christian Artuso (Bird Studies Canada); and Rachel Vallender (Consultant).

APPENDICES

A) EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

(optional)

Vegetation management to create Golden-winged Warbler habitat could benefit other species dependant on young shrubby habitat. Cowbird and Blue-winged Warbler population control, if implemented, will reduce numbers of those species.

<< see Askins 2001 and Hunter *et al.* 2001 (cited in Buehler *et al.* 2007)>>

B) RECORD OF COOPERATION AND CONSULTATION

(discretionary)

About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is *"to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."*

What is recovery?

In the context of species at risk conservation, **recovery** 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 the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (www.sararegistry.gc.ca/the_act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. A period of three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the Species at Risk (SAR) Public Registry (www.sararegistry.gc.ca).

Canadian Multi-turtle Recovery Strategy (Ontario and Quebec): Northern Map Turtle (*Graptemys geographica*), Spiny Softshell (*Apalone spinifera*), Blanding's Turtle (*Emydoidea blandingii*), Stinkpot (*Sternotherus odoratus*), and Spotted Turtle (*Clemmys guttata*)

[Draft, preliminary version]

March 2008

Recommended citation:

SARA Responsible Agency. 20YY. Canadian Multi-turtle recovery strategy (Ontario and Quebec): Northern Map Turtle (*Graptemys geographica*), Spiny Softshell (*Apalone spinifera*), Blanding's Turtle (*Emydoidea blandingii*), Stinkpot (*Sternotherus odoratus*) and Spotted Turtle (*Clemmys guttata*). [Draft]. *Species at Risk Act* Recovery Strategy Series. SARA Responsible Agency, Ottawa. xx + XX p.

Additional copies:

Additional copies can be downloaded from the SAR Public Registry (www.sararegistry.gc.ca).

Cover illustration: include credit

Également disponible en français sous le titre
« Programme de rétablissement multi-tortues au Canada (Ontario et Québec) : tortue géographique (*Graptemys geographica*), tortue-molle à épines (*Apalone spinifera*), tortue mouchetée (*Emydoidea blandingii*), tortue musquée (*Sternotherus odoratus*) et tortue ponctuée (*Clemmys guttata*) [Ébauche] »

ISBN ISBN to be included by SARA Responsible Agency
Catalogue no. Catalogue no. to be included by SARA Responsible Agency

DECLARATION

This recovery strategy has been prepared in cooperation with the jurisdictions responsible for the Northern Map Turtle, the Spiny Softshell, the Blanding's Turtle (excluding Nova Scotia population), the Stinkpot, and the Spotted Turtle. Environment Canada has reviewed and accepts this document as its recovery strategy for the Northern Map Turtle, the Spiny Softshell, the Blanding's Turtle (excluding Nova Scotia population), the Stinkpot, and the Spotted Turtle, as required under the *Species at Risk Act* (SARA). This recovery strategy also constitutes advice to other jurisdictions and organizations that may be involved in recovering the species.

The goals, objectives, and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide details on specific recovery measures to be taken to support conservation and recovery of the species. The Minister of the Environment will report on progress within five years, as required under 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 Canada or any other jurisdiction alone. In the spirit of the Accord for the Protection of Species at Risk, the Minister of the Environment invites all responsible jurisdictions and Canadians to join Environment Canada in supporting and implementing this strategy for the benefit of the Northern Map Turtle, the Spiny Softshell, the Blanding's Turtle, the Stinkpot and the Spotted Turtle and Canadian society as a whole.

RESPONSIBLE JURISDICTIONS

Environment Canada
Ontario Ministry of Natural Resources
Ministère des Ressources naturelles et de la Faune du Québec

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- Marie-André Carrière, biologist
- Jean-François Desroches, Cégep de Sherbrooke
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- Scott Gillingwater, Upper Thames River Conservation Authority
- William Kilpatrick, University of Vermont
- Sébastien Rioux, Consersol Vert Cher
- Raymond Saumure, The Springs Preserve
- Nathalie Tessier, ConservAction ACGT Inc.

STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

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*. 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.

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.

EITHER (+)
This recovery strategy will clearly benefit the environment by promoting the recovery of the Northern map turtle, the Spiny Softshell, the Blanding's Turtle, the Stinkpot, and the Spotted Turtle. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the following sections of the document in particular: description of the species' habitat and biological needs, ecological role, and limiting factors; effects on other species; and the recommended approaches for recovery.

OR (-)
While this recovery strategy will clearly benefit the environment by promoting the recovery of the Species Common Name, several potentially adverse effects were also considered. The strategy calls for identifying any issues that could lead to adverse effects, such as culling predators, some habitat control measures, etc. It was concluded that these effects could be mitigated and the following measures have been incorporated into the strategy: identify any measures or techniques, such as scaring rather than killing predators, avoiding activities in certain locations, etc. Further information is presented in refer to relevant sections of document. Taking these mitigation measures into account, it was concluded that the strategy will not entail any significant adverse effects OR that the benefits of the strategy far outweigh the adverse effects that may result.

RESIDENCE

SARA defines residence as: *a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating* **[Subsection 2(1)]**.

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SAR Public Registry:
www.sararegistry.gc.ca/sar/recovery/residence_e.cfm

PREFACE

EXECUTIVE SUMMARY

Begin this section on a new page.

TABLE OF CONTENTS

1. BACKGROUND

Federal Decision

This recovery strategy targets five freshwater turtle species that occur only in Ontario and Quebec. This strategy does not cover the Nova Scotia population of Blanding's Turtle (*Emydoidea blandingii*).

Multi-turtle teams were established in Ontario and Quebec, and each of these teams developed a recovery plan. The Quebec plan covers the wood turtle (*Glyptemys insculpta*), the Northern Map Turtle (*Graptemys geographica*), the Blanding's Turtle, the Stinkpot (*Sternotherus odoratus*), and the Spotted Turtle (*Clemmys guttata*) (Équipe de rétablissement de cinq espèces de tortues au Québec [ÉRCETQ] 2005). The existing Spiny Softshell (*Apalone spinifera*) recovery plan for Quebec (Ministère de l'Environnement et de la Faune 1997) was updated recently (Galois 2007). A national plan was developed for the Spiny Softshell (Eastern Spiny Softshell Recovery Team 1996)). The Ontario strategy covers the six previously mentioned species (Seburn 2007). The information in this document is taken mainly from these documents and the various provincial and federal status reports.

1.1 COSEWIC Species Assessments

Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports for these species were produced at various times (Campbell and Donaldson 1991; Oldham 1991; Herman et al. 1993; Edmonds 2002; Fletcher 2002; Roche 2002). Most of these have been updated, and the information contained in the following tables is based on the most recent versions (COSEWIC 2002 a, b, c, 2004, 2005).

Assessment Date: May 2002

Common Name (population): Northern Map Turtle

Scientific Name: *Graptemys geographica*

COSEWIC Status: Special Concern

Reason for Designation: There have been no quantitative or long-term studies of this species in Canada. Consequently, there is little evidence of recent range contraction or local extirpation of the species. However, this species' long life cycle, in conjunction with its delayed age of maturity and the numerous threats to the species and its habitats, suggests a significant susceptibility to population decline. This species should be the focus of population monitoring in order to identify demographic trends and establish population size estimates.

Occurrence in Canada: Ontario and Quebec

COSEWIC Status History: Designated a species of Special Concern in May 2002. Assessment based on a new status report.

Assessment Date: May 2002

Common Name (population): Spiny Softshell

Scientific Name: *Apalone spinifera*

COSEWIC Status: Threatened

Reason for Designation: Substantial habitat loss in the past has restricted the distribution of this species to a small part of its former range. Habitat degradation caused by development and recreational activities may be blocking access to nesting, hibernation, feeding, and basking sites. Other potential threats include the partial or complete isolation of population segments caused by dams and other structures, the reduction of juvenile recruitment associated with high predation rates on nests, and high mortality rates associated with motorboat collisions, trapping, and incidental mortality from fisheries.

Occurrence in Canada: Ontario and Quebec

COSEWIC Status History: Designated Threatened in April 1991. The status was re-examined and confirmed in May 2002. Last assessment based on an updated status report.

Assessment Date: May 2005

Common Name (population): Blanding's Turtle (Great Lakes/St. Lawrence population)

Scientific Name: *Emydoidea blandingii*

COSEWIC Status: Threatened

Reason for Designation: The Great Lakes/St. Lawrence population of this species is declining despite the fact that it is widespread and fairly numerous. Subpopulations are becoming increasingly fragmented due to the extensive road network that criss-crosses this turtle's entire habitat. This species is extremely vulnerable to increases in adult mortality rates due to its delayed age of maturity, its low reproductive output, and its extreme longevity. Nesting females are especially susceptible to being killed on the road because they often attempt to nest on gravel roads or on the shoulders of paved roads. The loss of mature females in such a long-lived species greatly reduces recruitment and the long-term viability of subpopulations. The species is also threatened by the habitat degradation caused by development and the alteration of wetlands. The pet trade represents another serious ongoing threat because nesting females are most vulnerable to collecting.

Occurrence in Canada: Ontario and Quebec

COSEWIC Status History: Designated Threatened in May 2005. Last assessment based on an updated status report.

Assessment Date: May 2002

Common Name (population): Stinkpot

Scientific Name: *Sternotherus odoratus*

COSEWIC Status: Threatened

Reason for Designation: This species has disappeared from most of the southern half of its range and is vulnerable to shoreline development and increased mortality associated with the use of outboard motors. The specific causes of this species' decline are unclear, but it does not appear to fare well in conjunction with increased anthropogenic activity.

Occurrence in Canada: Ontario and Quebec

COSEWIC Status History: Designated Threatened in May 2002. Assessment based on a new status report.

Assessment Date: May 2004

Common Name (population): Spotted Turtle

Scientific Name: *Clemmys guttata*

COSEWIC Status: Endangered

Reason for Designation: This species, which has low population densities, an exceptionally low reproductive potential, and a long life cycle, occurs in small numbers in fragmented ombrotrophic bogs and in marshes, which are disappearing. While some populations occur in protected areas, their probability of persistence may be quite low, particularly in light of the fact that their small numbers and isolation reduce the viability of the population. The low frequency of juveniles in most studied populations suggests these populations are composed largely of remnant, aged cohorts with low reproductive success. Collecting for the pet trade constitutes another clear threat. There is no immigration from external sources.

Occurrence in Canada: Ontario and Quebec

COSEWIC Status History: Designated a species of Special Concern in April 1991. Status re-examined and designated as Endangered in May 2004. Last assessment based on an updated status report.

1.2 Description of the Species

Northern Map Turtle

The Northern Map Turtle (*Graptemys geographica*) is a highly aquatic species that shows clear sexual dimorphism. The female carapace (upper part of shell) may exceed 25 cm in length, whereas the male carapace length is on average 14 cm. The carapace is olive to brownish in colour with a reticulate pattern of light yellow lines that fade with age. The relatively rounded carapace has a medial keel, and the plastron (lower part of shell) is yellow. When first described, the markings on its carapace were thought to resemble a geographical map, which gave rise to the turtle's common and scientific names.

Spiny Softshell

The Spiny Softshell is the only member of the family Trionychidae in Canada. These freshwater turtles can be recognized by their flat bodies and carapaces that have the consistency of thick leather rather than a shell. The carapace is brown to olive in colour and has short spines along its anterior edge. Males retain their circular spots (ocelli), whereas the females' ocelli become marbled over time. In addition, the surface of their carapace is rougher than in males. With four deeply webbed feet, the Spiny Softshell is well adapted for swimming. The neck is long and the snout is elongated (pointed). Sexual dimorphism is clearly present, as females (whose carapace can reach a length of 54 cm) are nearly twice as big as males.

Blanding's Turtle

The Blanding's Turtle has a smooth, highly arched, dark carapace with small yellowish spots. Total carapace length ranges between 15.2 cm and 27.4 cm. The throat and the underside of the neck are bright yellow. The snout is rounded and the eyes are prominent. The plastron, which is yellow with black spots, is hinged, allowing the turtle to close the anterior portion of its carapace. In males, the plastron is slightly concave.

Stinkpot

The Stinkpot has a highly arched carapace that is brownish or greyish in colour. The skin is grey. This is a small turtle (rarely exceeds 13 cm in length) that looks like a rock. It has tiny barbs on the throat and chin. It has two pairs of musk glands on the margins of its plastron. The latter is generally beige and has a hinge that allows the turtle to partially close the anterior portion of its carapace. The male has a thick spine at the tip of his tail.

Spotted Turtle

The Spotted Turtle is a relatively small freshwater turtle species, with adult carapace length typically less than 13 cm. The smooth and arched carapace of the Spotted Turtle is black with small, scattered yellow spots. The head and legs are also black with yellow spots. There is a larger yellow spot behind the eye. The plastron is yellowish with a black spot on each scute. In males, the plastron is slightly concave.

1.3 Populations and Distribution

The five species covered by this strategy occur in North America. Their range, which is mainly located in the eastern part of the continent, extends through the United States and Canada (Cook 1984; Ernst et al. 1994). Canada, therefore, constitutes the northern limit of their range. In addition, with the exception of the Blanding's Turtle, these turtles occur only in Ontario and Quebec.

Tables X and X list the global, Canadian, and provincial status of these species. Additional information, particularly regarding the definitions of the various status designations, can be found on the following sites:
www.sararegistry.gc.ca
www.cosewic.gc.ca
www3.mrnf.gouv.qc.ca/faune/especes/menacees/liste.asp
www.mnr.gov.on.ca/STEL02_163859.pdf
www.natureserve.org

The population trends are based on the Ontario and Quebec multi-turtle plans (ÉRCETQ 2005; Seburn 2007). Some of the information was supplemented by discussions with specialists and updated.

Table x – Federal and provincial status of the species, including the year of designation or the last assessment date

Specieswil	**Federal Designation (SARA)**	**Ontario Status**[a]	**Quebec Status**[b]
Apalone spinifera	Threatened (Schedule 1)	Threatened (2006)	Threatened (1999)
Clemmys guttata	Endangered (Schedule 1) [B2ab(i, ii, iii, iv, v); C1+2a(i)]	Endangered (not regulated) (2006)	Susceptible d'être désigné espèce menacée ou vulnérable [Likely to be designated threatened or vulnerable]
Emydoidea blandingii	Threatened (Schedule 1) C2a(i)	Threatened (2006)	Susceptible d'être désigné espèce menacée ou vulnérable [Likely to be designated threatened or vulnerable]
Graptemys geographica	Special concern (Schedule 1)	Special concern (2006)	Vulnérable [Vulnerable] (2005)
Sternotherus odoratus	Threatened (Schedule 1)	Threatened (2006)	Susceptible d'être désigné espèce menacée ou vulnérable [Likely to be designated threatened or vulnerable]

[a]Species at Risk in Ontario (SARO) list (Government of Ontario 2008).
[b]Liste des espèces faunique menacées ou vulnérables au Québec (Gouvernement du Québec 2008).

Table x – NatureServe global, Canadian, Ontario, and Quebec status (with the year of the last assessment)

Species	Global[a]	Canada[b]	Ontario[c]	Quebec[c]
Apalone spinifera	G5 (1996)	N2 (1998)	S3	S1 (2000)
Clemmys guttata	G5 (1996)	N3	S3	S1
Emydoidea blandingii	G4 (2001)	N4	S3	S1 (2003)
Graptemys geographica	G5 (1996)	N4	S3	S2 (2002)
Sternotherus odoratus	G5 (1996)	N4	S3	S1

[a] Global NatureServe status: G4 = Apparently Secure; G5 = Secure
[b] NatureServe status for Canada: N2 = Imperiled; N3 = Vulnerable; N4 = Apparently Secure
[c] NatureServe status for Ontario & Quebec: S1 = Critically Imperiled; S2 = Imperiled; S3 = Vulnerable

Northern Map Turtle

This species' North American range extends through the eastern United States (Ernst et al. 1994), southeastern Ontario (Cook 1984), and southwestern Quebec (Bonin 1998) (Figures x and x). In Canada, the range extends into the Great Lakes/St. Lawrence basin—from Lake St. Clair in Ontario to eastern Montréal in Quebec—and currently represents approximately 10% of this species' global range. The Northern Map Turtle population in Ontario is scattered along the shores of Georgian Bay, Lake St. Clair (western limit), the Detroit River, Lake Erie, and Lake Ontario. It also occurs along major rivers such as the Thames, Ausable, Sydenham, Grand, and Ottawa, as well as in some of the larger lakes along the southern edge of the Canadian Shield (COSEWIC 2002a). In Quebec, this species occurs along the Ottawa River, in the Montréal archipelago, in Lake St. Francis, in Lake Champlain, and its presence has recently been confirmed in the Richelieu River, an area associated with some historical records (Bonin 1998; Giguère 2006; Bernier et al. 2008). While a number of studies have been conducted and local estimates have been submitted (Chabot et al. 1993; Daigle et al. 1994; Desrosiers et al. Giguère 2008), population trends have yet to be documented. The situation is similar in Ontario, where the species has never been subjected to any particular monitoring initiative (since it was considered to be relatively common). However, a population decline is believed to have occurred in Point Pelee National Park of Canada (Browne and Hecnar 2007).

Spiny Softshell

This species' range extends through the eastern half of North America. The Spiny Softshell occurs mainly in the Mississippi River and Ohio River basins (Ernst et al. 1994) (Figure x). This species can be found from the Great Lakes to the north, southward to the Gulf of Mexico. Historically, the Canadian populations were more widespread in the lower Great Lakes/St. Lawrence River basin, which currently represents approximately 1% of the species' global range. However, the species now occurs in only a few isolated areas across this historic range. The Canadian population can be divided into two subpopulations: the historic range in Quebec including the Ottawa River, the St. Lawrence River (to Lake St. Pierre in the east), and the Richelieu River–Lake Champlain system (Bonin 1997) (Figure X). Currently, there is only one transboundary population (Quebec and Vermont), which can be found in Lake Champlain, although observations of individual specimens have been reported in the Richelieu River and Ottawa River (the Outaouais) areas (Galois et al. 2002; Daigle et al. 2002a; Rioux and Desroches 2007). While there are no reliable quantitative data for this population, the threats it faces have grown over the decades, and there is cause for concern for its future. The second subpopulation, which is considerably more abundant, occurs in Lake St. Clair, in Lake Erie (and a few of its major tributaries such as the Thames and Sydenham rivers), and in the western portion of Lake Ontario. The majority of individuals can be found in the Thames and Sydenham rivers, and at two sites on Lake Erie—Rondeau and Long Point provincial parks (COSEWIC 2002b) (Figure x). Based on the number of nests, the combined population in the Thames River, Rondeau Provincial Park, and Long Point Provincial Park areas exceeds 1200 adult females (Seburn 2007). Habitat loss and, more recently, changes to the rivers, as well as increased recreational activities in nesting sites, are a source of concern for the species' long-term viability.

Blanding's Turtle

This species' current range is restricted to the northeastern United States from the southern part of the Great Lakes to Missouri, and from Nebraska to western New York State (Ernst et al. 1994). There are also a few isolated populations in New England, an indication that Blanding's Turtles were more widespread in the past (Figure x). In Canada, this species occurs in three provinces, representing approximately 20–25% of its global range (Figure x). The species occurs around the Great Lakes in southern and south-central Ontario and extends towards the northwest to the Chippewa River and eastward to the far southwestern portion of Quebec (Herman et al. 1993; COSEWIC 2005) (Figure x). The species does not occur on the Bruce Peninsula, the surrounding areas to the south and southwest, the far southeastern portion of the province, or certain areas north of Lake Ontario. The Quebec population is concentrated along the north shore of the Ottawa River from the Gatineau Park region (south) through the locality of Bryson (North) (St-Hilaire 2003; Dubois unpublished data). There is a population in Nova Scotia at the northeastern boundary of this species' range, which seems to have been isolated in this area in the wake of the last glacial retreat. It is confined to two basins in the centre of the southwestern sector of the province (COSEWIC 2005).

There are limited data on population trends, but habitat loss and fragmentation within its range, particularly in southern Ontario, point to a population decline (Seburn 2007). Capture surveys made it possible to mark more than 500 individuals in the Big Creek National Wildlife Area (Seburn 2007) and more than 170 individuals in Rondeau Provincial Park (Gillingwater 2001). The majority of populations are likely less abundant. In Quebec, more than 50 individuals have been marked in the Outaouais (St-Hilaire 2003).

Stinkpot

The range of the Stinkpot extends throughout eastern North America from Florida to southern Ontario and Quebec (Ernst et al. 1994) (Figure x). Towards the west, the range follows an irregular line from Wisconsin to central Texas. In Canada, the species' range is limited to the area south of latitude 46°N (Figure x) and represents approximately 5% of the species' global range (Seburn 2007). Most Stinkpot sightings in Ontario have occurred along the southern edge of the Canadian Precambrian Shield (Figure x). The species has also been recorded in various areas along the shores of Lakes Huron, Erie, and Ontario. The known range in Quebec is restricted to the north shore of the Ottawa River in the Hull and Pontiac areas (Saumure 2008) (Figure x). Recent sightings have shed light on new sectors west of the known sites (Chabot and St-Hilaire 1991; Desrosiers and Giguère 2008). The full range of this elusive species has yet to be identified in Quebec.

Gaps in the knowledge of the range remain to be filled. There are virtually no data on population sizes and trends. A study conducted in a bay in Georgian Bay resulted in 575 individuals being marked (Edmonds 1998). Through studies and captures, the number of individuals in a southwestern Ontario site was estimated at 84 (± 76.8) (Browne 2003). In Quebec, 109 individuals have been found and marked in one site of the Ottawa River. This population, which is presently the only one known in Quebec, is estimated to have between 206 and 467 individuals with a density of 4.1 individuals/ha (Belleau 2008). Habitat loss and fragmentation in the Stinkpot's range, particularly in southern Ontario, suggest a population decline (Edmonds 2002; COSEWIC 2002c).

Spotted Turtle

The range of the Spotted Turtle is limited to portions of eastern North America (Ernst et al. 1994) (Figure x). In Canada, this species occurs in southern Ontario (COSEWIC 2004), which represents approximately 6% of the global range for this species (Seburn 2007). Although there have been a number

of inventories targeting this species and others (e.g., Armellin and Galois 2005; Desrosiers and Giguère 2008) and sightings from the public have been solicited (Desroches and Picard 2006), there are no valid recent records for this species in Quebec. Consequently, its presence in the province has yet to be confirmed. Two historical records place it in southwestern Quebec (Figure x). The species does, however, occur in eastern Ontario near the Quebec boundary between the Ottawa River and Lake Saint-François (Cook et al. 1980). It rarely basks, and its activity levels drop during the summer (aestivation). This, combined with its preference for bog habitat and elusive behaviour (Seburn 2003), may explain why its presence is so difficult to detect. The number of Spotted Turtles in southern Ontario has declined, and the species may even have disappeared from certain areas. The species can be found on the north shore of Lake Erie, in the Georgian Bay area, and on small islands in southern Ontario (Figure x).

Available data indicate that the total population numbers no more than 2000 individuals (COSEWIC 2004). Several remaining populations are not viable, since they include only a small number of individuals (Seburn 2007).

1.4 Species' Needs

1.4.1 Habitat and Biological Needs

Northern Map Turtle

In Canada, the Northern Map Turtle occurs in the large water bodies of the Great Lakes/St. Lawrence basin. During the summer, it may also frequent closed environments, such as streams, marshes, and swamps, that are linked to these large water bodies. The species favours shallow environments relatively close to shore (Pluto and Bellis 1986; Carrière 2007). It often basks in groups and prefers sites such as rocks, partially exposed tree trunks, and floating wood debris surrounded by deep open water, away from aquatic vegetation and the shore (Gordon and MacCulloch 1980; Flaherty and Bider 1984). As a result, the Northern Map Turtle favours natural environments, and is sensitive to disturbances and changes in the shoreline (Carrière 2007). The species seems to seek deep, oxygen-rich hibernation sites sheltered from ice (Bonin, unpublished data; Tessier, unpublished data; Ultsch 2006). To lay their eggs, the species also seeks areas near water, where the vegetation density and the slope are low (< 30°) and the substrate is mainly composed of gravel or sand (Flaherty and Bider 1984; Chabot and al. 1993; Giguère and al. 2005)

Spiny Softshell

In Canada, the Spiny Softshell occurs in the large water bodies of the Great Lakes/St. Lawrence basin. During the summer, it may also frequent closed environments, such as streams, marshes, and swamps, that are linked to these large water bodies. As this species cannot tolerate anoxic conditions, it seems to seek deep, oxygen-rich hibernation sites that provide shelter from the ice (Fletcher 2002; Galois et al. 2002; Reese et al. 2003; Ultsch 2006). To lay their eggs, the species also seeks areas near water, where the vegetation density and the slope are low (< 30°) and the substrate is mainly composed of gravel or sand (Graham and Graham 1997; Gillingwater 2001; Daigle and al. 2002).

Blanding's Turtle

This is a mainly aquatic species that frequents a variety of wetlands, including marshes, swamps, and peat bogs. It seems to favour relatively eutrophic environments. It is not reluctant to cover long distances overland to travel from one wetland to another, particularly to lay eggs or to hibernate (Chabot and St-Hilaire, unpublished data). It may hibernate in groups or alone (Herman et al. 2003; St-Hilaire 2003; Seburn 2008). Based on their microenvironments while hibernating, the Blanding's turtle is suspected to

be anoxia tolerant (Ultsch 2006). This species' habitat provides a number of basking sites. However, the mean critical thermal maximum for this species of around 39.5°C (Hutchinson et al. 1966) could explain its northerly distribution.

Stinkpot

This is a highly aquatic species that limits its overland travel because it moves slowly on the ground and is prone to rapid dehydration (Ernst 1986). It favours stagnant or slow-moving shallow wetlands (COSEWIC 2002c; Carrière 2007; Belleau 2008). The species appears to prefer the soft-bottomed sites frequented by beavers with considerable wood debris and submerged aquatic vegetation (Carrière 2007; Belleau 2008). Nesting sites are near water and sunny. Females typically lay or bury their eggs in decaying vegetation such as rotting logs, although they occasionally use beaver lodges and muskrat burrows (Edmonds 2002). Availability of suitable nesting sites with sufficient exposure may constitute a limiting factor for this species (COSEWIC 2002c). As this species cannot tolerate anoxic conditions, it seeks oxygen-rich hibernation sites (Ultsch 2006).

Spotted Turtle

The Spotted Turtle occurs in a variety of wetlands that are typically shallow and rich in organic matter, such as marshes, swamps, and peat bogs. These turtles may congregate in various areas to hibernate (Litzgus et al. 1999). Based on their microenvironments while hibernating, the Spotted turtle is suspected to be anoxia tolerant (Ultsch 2006). Nests may be dug in the ground, moss, muskrat burrows, or beaver lodges. This species prefers cooler temperatures and may become less active in mid-summer, when the temperatures are at their highest, and nestle in leaf litter (Litzgus and Brooks 2000).

1.4.2 Ecological Role

It should be noted that each of the species targeted by this strategy is the only representative of its genus, or even its family (Spiny Softshell, Stinkpot), in Canada. This makes them unique elements of biodiversity. Turtles may also constitute a significant ecosystem biomass (Congdon et al. 1986). The importance of turtles in the food web is probably underestimated due to the limited availability of quantitative data (Bulté and Blouin-Demers 2008). It should also be noted that these species are likely much less abundant now than they were before the arrival of European settlers and some may have already been declining (Brooks 2007b). Consequently, these turtles once played a much bigger role in the ecosystem than modern-day observations would indicate. A study conducted recently in Ontario shows that the Northern Map Turtle plays a significant trophic role in lake systems, as it is among the major consumers of the zebra mussel (*Dreissena polymorpha*), which is an invasive species (Bulté and Blouin-Demers 2008). The Blanding's Turtle is one of the long-lived species that originally formed the basis of demographic models developed to advance turtle conservation approaches and to demonstrate the importance of adult survival to long-term population maintenance (Congdon et al. 1993). It also serves as a useful model to study the evolution and persistence of small populations, such as the ones in Nova Scotia (Herman 2008).

1.4.3 Limiting Factors

Certain common biological traits help explain the precarious status of nearly two-thirds of the species within this group throughout the world (Gibbons et al. 2000; Turtle Conservation Fund 2002). Turtles evolved through a reproductive strategy that depends on high adult survival rates and longevity to counterbalance the low recruitment rates associated with the following factors:
1) late sexual maturity;

2) low recruitment due to the high rate of natural predation on eggs and juveniles under the age of two; and
3) dependence on meteorological conditions for the internal development of eggs and external incubation of eggs without parental care.

The short growing season associated with our northerly latitudes pushes these traits to the limit, making these species even more vulnerable to human activity (Brooks 2007b). For instance, several species do not reach sexual maturity until at least the age of 10 and, in some cases, not until the age of 15 or even 20 (Galbraith et al. 1989; St. Clair et al. 1994; Litzgus and Brooks 1998; Brooks 2007b).

Consequently, populations cannot adjust quickly (or even at all) to new sources of mortality nor any increase in mortality rates. Long-term studies also indicate that high survival rates among adult females are critical to the maintenance of turtle populations (adult mortality rate of no more than 5%). A 2–3% increase in the annual mortality rate would result in population declines (Congdon et al. 1993, 1994; Cunnington and Brooks 1996). A drop in the number of reproductive female adults below a certain threshold would doom the population to disappearance over the medium to long term. An adult mortality rate above 5% would lead to a decline of the Blanding's Turtle population (Congdon et al. 1993). Moreover, without some form of intervention, it would be very difficult, perhaps even impossible, for these populations to recover from a catastrophic event causing massive deaths.

Climate plays a vital role in recruitment, as these species rely on the external environment for incubation of eggs. Incubation time constitutes a major limitation for northern turtle populations (Brooks 2007b), as the short northern summer typically makes it possible to produce only one clutch per year. Certain species in the southern part of the range can produce multiple clutches each year, whereas this phenomenon is very uncommon in Canada (Ernst et al. 1994; Carrière 2007; Gillingwater 2008).

Consequently, recruitment can vary from one year to the next depending on meteorological conditions, particularly during the summer. Sex determination for four of the species (excluding the Spiny Softshell) is temperature-dependent and occurs during incubation (Ernst et al. 1994). It has been hypothesized that current climate changes and the anticipated increase in average temperatures could have an impact on the sex ratio of turtle populations (Janzen 1994) and on the development of embryos and hatchlings (Willette et al. 2005).

The temperature ranges within which these species can survive may also limit their range in northern areas and, in the case of the Blanding's Turtle, in southern areas as well (Hutchinson et al. 1966).

1.5 Threats

Generally speaking, any source of mortality that results in the loss of adults, particularly females, threatens the persistence of turtle populations. The main known threats are habitat loss, degradation, and fragmentation, road mortality, and increased predation rates from predators that are favoured by human activities (e.g. Northern Raccoon [*Procyon lotor*]). While some threats affect all of the species equally, other threats have a greater impact on one species in particular due to ecological and behavioural differences. For instance, road mortality is of greater concern for species such as the Blanding's Turtle, which frequently travels overland. Collecting threatens species that are popular for herpetological farming purposes, such as the Spotted Turtle. The Northern Map Turtle and the Spiny Softshell are more likely to be affected by contaminants because of their diets and the location of their habitats (St. Lawrence River and the Great Lakes). In addition, due to the lack of quantified information on overall threats, it is impossible to assess the full impact of these threats on population persistence for each species.

Table X – Threat Classification Table

1	Habitat loss	Threat Attributes		
Threat category	Habitat loss or degradation	**Scope**	Generalized	
			Local	**Entire range**
General threat	roads, urban development, expansion of intensive farming	**Occurrence**	Current	Current
		Frequency	Ongoing	Ongoing
Specific threat	Habitat loss	**Causal certainty**	High	High
		Severity	High	High
Stress	Increase the risk of death directly (e.g. wetland filling) or indirectely (e.g. essential habitats no longer avalaible)	**Level of concern**	High	

2	Isolation	Threat Attributes		
Threat category	Habitat loss or degradation	**Scope**	Generalized	
			Local	**Entire range**
General threat	Dams, roads, urban development, expansion of intensive farming	**Occurrence**	Historical (Spotted Turtle in QC), current	Current
		Frequency	Ongoing	Ongoing
Specific threat	Population fragmentation	**Causal certainty**	High	High
		Severity	High	High
Stress	Genetic drift, increased vulnerability to stochastic events and disease, poor adaptability, increased rate of deformities, decreased recruitment due to egg loss	**Level of concern**	High	

3	Changes to the water regime	Threat Attributes		
Threat category	Habitat loss or degradation	**Scope**	Localized	
			Local	**Entire range**
General threat	Dams	**Occurrence**	Current	Current
		Frequency	Ongoing	Ongoing
Specific threat	Artificial water levels, flooding of nesting sites, flood control (erosion and deposits, shore erosion caused by ice), loss of nesting sites	**Causal certainty**	Medium	Medium
		Severity	Medium	Medium
Stress	Decreased recruitment	**Level of concern**	Medium	

1.5.1 Threat Classification

Threat categories:

- Habitat Loss or Degradation
- Exotic, Invasive, or Introduced Species/Genome
- Changes to Ecological Dynamics or Natural Processes
- Pollution
- Accidental Mortality
- Biological Resource Use
- Disturbance or Harm
- Climate and Natural Disasters

	(egg loss due to flooding, invasive plants and roots, shade), loss of suitable habitat			

4	Red-eared slider	Threat Attributes		
Threat category	Exotic, invasive, or introduced species/genome	**Scope**	Localized	
			Local	**Entire range**
General threat	Red-eared slider	**Occurrence**	Anticipated	Anticipated
		Frequency	Seasonal	Seasonal
Specific threat	Competition for resources (basking sites, food), transmission of diseases	**Causal certainty**	Low	Low
		Severity	Unknown	Unknown
Stress	Indigenous species: delayed nesting (reduced basking) and decreased recruitment (late nesting, shortened incubation period), increased prevalence of certain diseases, epidemics	**Level of concern**	Low	

5	Exotic and invasive plants	Threat Attributes		
Threat category	Exotic, invasive, or introduced species/genome	**Scope**	Localized (expanding)	
			Local	**Entire range**
General threat	*Phragmites*, water milfoil, water chestnut	**Occurrence**	Current	Current
		Frequency	Ongoing	Ongoing
Specific threat	Habitat modification (reduced open wetlands)	**Causal certainty**	Medium	Medium
		Severity	Unknown	Unknown
Stress	Loss of aquatic habitats	**Level of concern**	In my opinion = low for Qc	

6	Predators favoured human activities	Threat Attributes		
Threat category	Changes to ecological dynamics or natural processes	**Scope**	Generalized	
			Local	**Entire range**
General threat	Predation on nests and individuals	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Predation by raccoons, striped skunks, red foxes, etc.	**Causal certainty**	High	High
		Severity	High	High
Stress	Reduced recruitment, increased rate of injuries (e.g., amputated limbs), increased mortality	**Level of concern**	High	

7	Nest parasitism	Threat Attributes		
Threat category	Changes to ecological dynamics or natural processes	Scope	Localized	
			Local	Entire range
General threat	Nest parasitism	Occurrence	Unknown/anticipated	Unknown/anticipated
		Frequency	Seasonal	Seasonal
Specific threat	Eggs infected by Sarcophagidae larvae	Causal certainty	Medium	Low
		Severity	Unknown	Unknown
Stress	Decreased recruitment	Level of concern	Low	

8	Disease	Threat Attributes		
Threat category	Changes to ecological dynamics or natural processes	Scope	Unknown	
			Local	Entire range
General threat	Spread of diseases, emerging diseases	Occurrence	Unknown/anticipated	Unknown/anticipated
		Frequency	Ongoing	Ongoing
Specific threat	Increased prevalence of certain diseases (release of infected individuals, climate change, increased vulnerability of isolated populations, fewer resistant genes due to genetic drift, increased vulnerability resulting from contaminant-induced weakening of the immune system, etc.)	Causal certainty	Low	Low
		Severity	Unknown	Unknown
Stress	Population declines, mass mortalities	Level of concern	Low	

9	Hypoxia	Threat Attributes		
Threat category	Changes to ecological dynamics or natural processes	Scope	Localized	
			Local	Entire range
General threat	Hypoxia during hibernation	Occurrence	Anticipated	Anticipated
		Frequency	Seasonal	Seasonal
Specific threat	Death by hypoxia due to invasion by aquatic plants and overabundance of sediments and particulates in the water resulting from human activity (high levels of biological activity that consumes dissolved oxygen)	Causal certainty	Low	Low
		Severity	Unknown	Unknown

Stress	Mass mortalities during hibernation; rapid decline of populations	**Level of concern**	Medium

10	**Contamination**	**Threat Attributes**		
Threat category	Pollution	**Scope**	Localized	
			Local	**Entire range**
General threat	Contamination of individuals and eggs through absorption	**Occurrence**	Current	Current
		Frequency	Ongoing	Ongoing
Specific threat	Ingestion of contaminated prey (i.e., zebra mussel) and accumulation of contaminants	**Causal certainty**	Low	Low
		Severity	Unknown	Unknown
Stress	Development of contaminant-related pathologies, decreased recruitment (lost embryos, deformities, feminization of males)	**Level of concern**	Medium	

11	**Blue-green algae**	**Threat Attributes**		
Threat category	Pollution	**Scope**	Localized	
			Local	**Entire range**
General threat	Blue-green algae blooms are associated with high levels of fertilizers	**Occurrence**	Current	Current
		Frequency	Ongoing	Ongoing
Specific threat	Accumulation of toxins through ingestion	**Causal certainty**	Low	Low
		Severity	Unknown	Unknown
Stress	Mortality and morbidity, potential toxin-related pathologies (e.g., liver functions)	**Level of concern**	Low	

12	Road mortality	Threat Attributes		
Threat category	Accidental Mortality	**Scope**	Generalized	
			Local	**Entire range**
General threat	Roads and roadwork	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Road mortality, injuries, destruction of nests in the shoulder of a road beside a ditch	**Causal certainty**	High	High
		Severity	High	High
Stress	Increasing rate of injuries, population decline through loss of individuals (especially adult females), decreased recruitment (loss of gravid females, hatchlings, and nests)	**Level of concern**	High	

13	Death and injuries associated with water sports	Threat Attributes		
Threat category	Accidental Mortality	**Scope**	Localized	
			Local	**Entire range**
General threat	Water sports	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Collisions with boats and injuries caused by propellers	**Causal certainty**	Medium	Medium
		Severity	Unknown	Unknown
Stress	Increasing rate of injuries, increased mortality, population decline	**Level of concern**	Medium	

14	Death and injuries associated with fishing	Threat Attributes		
Threat category	Accidental Mortality	**Scope**	Localized	
			Local	**Entire range**
General threat	Sport fishing (lines) and commercial fishing (hoop nets)	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Incidental catch, injuries caused by fishing-hooks and lines, lead poisoning, drowning	**Causal certainty**	medium	medium
		Severity	Unknown	Unknown
Stress	Increasing rate of injuries, increased mortality, population decline	**Level of concern**	Medium	

15	Off-road vehicles	Threat Attributes		
Threat category	Accidental Mortality	**Scope**	Localized	
			Local	**Entire range**
General threat	Public and illegal trails, unsupervised traffic	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Crushing of individuals (adults, young during hatching) and nests, injuries	**Causal certainty**	Low	Low
		Severity	Unknown	Unknown
Stress	Increasing rate of injuries, population decline due to increased mortality, decreased recruitment (destruction of nests)	**Level of concern**	Low	

16	Farming mortality	Threat Attributes		
Threat category	Accidental Mortality	**Scope**	Localized	
			Local	**Entire range**
General threat	Farming machinery and livestock	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Crushing of individuals (adults, young during hatching) and nests, injuries	**Causal certainty**	Medium	Medium
		Severity	Unknown	Unknown
Stress	Increasing rate of injuries, population decline due to increased mortality, decreased recruitment (destruction of nests)	**Level of concern**	Medium	

17	Illegal collecting for pet trade	Threat Attributes		
Threat category	Biological Resource Use	**Scope**	Generalized	
			Local	**Entire range**
General threat	Collecting and trade	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Illegal collecting for the pet trade	**Causal certainty**	medium	medium
		Severity	High	High
Stress	Population decline (removal of individuals), decreased recruitment (collecting of eggs and mature females)	**Level of concern**	Medium	

18	Illegal collecting for Consumption	Threat Attributes		
Threat category	Biological Resource Use	**Scope**	Generalized	
			Local	**Entire range**
General threat	Collecting and trade	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Illegal collecting for food for personal consumption	**Causal certainty**	medium	low
		Severity	medium	medium
Stress	Population decline (removal of individuals)	**Level of concern**	Low	

19	Disturbance	Threat Attributes		
Threat category	Disturbance or harm	**Scope**	Localized	
			Local	**Entire range**
General threat	Disturbance	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Disruption of essential activities such as basking	**Causal certainty**	Medium	Low to medium
		Severity	Unknown	Unknown
Stress	Delayed nesting (reduced basking) and decreased recruitment (late nesting, reduced number and size of eggs, shortened incubation period), slower growth and delayed maturity, impact on winter survival (poorer overall condition in the fall)	**Level of concern**	Medium	

20	Persecution	Threat Attributes		
Threat category	Disturbance or harm	**Scope**	Localized	
			Local	**Entire range**
General threat	Persecution	**Occurrence**	Current	Current
		Frequency	Seasonal	Seasonal
Specific threat	Harassment of individuals (death or injury caused by firearms, rocks, vehicles)	**Causal certainty**	Medium	Medium
		Severity	Medium	Unknown
Stress	Injuries, death, population declines (adults are most affected)	**Level of concern**	Medium	

1.5.2 Description of Threats

Habitat loss or degradation

At this point in time, there can be no doubt that habitat loss is the most significant threat. The loss of wetlands has been the most significant threat facing turtles in southern Ontario. It has been estimated that 68% of Ontario wetlands south of the Canadian Shield have disappeared since colonization (Snell 1987). Many turtle populations must have disappeared during this period. The loss of terrestrial habitats is significant because several species (e.g., Blanding's Turtle and Spotted Turtle) travel among multiple wetlands during a single season. Development of terrestrial habitats can hinder these seasonal movements and increase the risk of death.

In Quebec, agriculture and urbanization are the main causes of habitat loss. Agricultural, urban, and industrial development along the St. Lawrence River has resulted in the loss of numerous wetlands and the alteration of waterways (Bélanger and Grenier 2002; Jobin et al. 2003). Even the river itself has undergone several alterations, particularly as a result of dams and the creation of the seaway (La Violette 2004; Villeneuve 2001). The combined effect of human activity and ongoing climate change will have a profound impact on biodiversity (Intergovernmental Panel on Climate Change 2002), aquatic habitats, and riparian habitats (Hudon 2004).

Fragmentation leads to the isolation of populations and an increased risk of death during travel through inhospitable areas (e.g., roads, agricultural zones). In aquatic environments, dams can hinder turtle travel.

There are many facets to habitat degradation, including the decrease in water quality caused by the runoff of contaminated water from agricultural and industrial zones, roads (e.g., de-icing salt), industrial waste, and development of urban areas (Mitchell and Klemens 2000). Degradation may also be caused by the suppression of natural succession processes, such as the use of dams that control flooding. Historically, floods and ice stripped the shore of vegetation a lot more than today. Once stripped, these shores often served as nesting sites for turtles such as the Spiny Softshell. The reduction of flooding events in parts of the Thames River has led to a decrease in the number of nesting sites available. Dams also maintain artificially high water levels that result in the loss of potential terrestrial nesting sites.

Another example comes from the Spotted Turtle, a species that occurs primarily in peat bogs across Ontario. Under the suppression of the natural fire regime, the encroaching forests fill in these peat bogs, which then have less open water and less available habitat that is suitable for the Spotted Turtle (Seburn 2007).

A reduction in habitat quality can have an impact on reproductive success, basking, and thermoregulation potential; it can also lead to a reduction in the number of hibernation sites and to an increase in the number of predators.

The fact that the remaining habitat fragments are generally isolated from one another results in the creation of habitat "islands." Turtles tend to be less abundant in more isolated wetlands (Marchand and Litvaitis 2004). In addition, stochastic effects put species with several small isolated populations at greater risk of population decline, as smaller populations are inherently more vulnerable to factors that affect populations.

Another consequence of habitat loss and fragmentation is the loss of genetic variation. Small populations that are isolated from one another are at risk of losing genetic variation. Very little research has been conducted on the effects of reduced genetic variability within turtle populations. One study has shown that small populations of Blanding's Turtles may be genetically depauperate in comparison with larger populations (Rubin et al. 2001).
Small population sizes and isolation are among the factors that increase the risk of extinction through a loss of genetic diversity and loss of adaptability (Reed and Frankham 2003). Such populations are at

21	Sex ratio bias/altered biological cycle	Threat Attributes		
Threat category	Climate and natural disasters	**Scope**	Generalized	
			Local	**Entire range**
General threat	Increased average summer temperatures	**Occurrence**	Anticipated	Anticipated
		Frequency	Seasonal	Seasonal
Specific threat	Predominance of one sex in those species with temperature-dependant sex determination, impact on the developmental physiology of embryos and hatchlings	**Causal certainty**	Low	Low
		Severity	Unknown	Unknown
Stress	Population bias towards one sex, decreased recruitment	**Level of concern**	Low	

22	Dryout of wetlands	Threat Attributes		
Threat category	Climate and natural disasters	**Scope**	Generalized	
			Local	**Entire range**
General threat	Droughts caused by increased summer temperatures	**Occurrence**	Anticipated	Anticipated
		Frequency	Seasonal	Seasonal
Specific threat	Drying out of wetlands	**Causal certainty**	Low	Low
		Severity	Unknown	Unknown
Stress	Habitat loss, increased overland travel leading to an increased risk of death (dehydration, road mortality)	**Level of concern**	Low	

23 ?	Mortality associated with climate change	Threat Attributes		
Threat category	Climate and natural disasters	**Scope**	Generalized	
			Local	**Entire range**
General threat	Lower average temperatures (summer)	**Occurrence**	Anticipated	Anticipated
		Frequency	Seasonal	Seasonal
Specific threat	Reduced incubation period, physiological tolerance to winter (at the limit of the range)	**Causal certainty**	Low	Low
		Severity	Unknown	Unknown
Stress	Mortality (adults, eggs), altered egg development (decreased recruitment), modified range	**Level of concern**	Medium	

Nest parasitism

Turtle egg parasitism by dipteran larvae of the Sarcophagidae family has been documented relatively recently (Iverson and Perry 1994; Galois and Ouellet 2007a). The female flies lay their maggots beneath the surface of the soil, and the larvae make their way to the turtle eggs. In Ontario, these larvae have been confirmed as parasites of the embryos and hatchlings of the Northern Map Turtle, Spiny Softshell, Blanding's Turtle, and Wood Turtle. Nest parasitism has been reported in various Ontario sites, including Rondeau Provincial Park, Long Point Provincial Park, the Thames River, Point Pelee National Park of Canada, and Algonquin Provincial Park (Seburn 2007). Although it is still difficult to assess the scope of this threat, this type of parasitism could affect a high percentage of turtle nests in a number of sectors. In 2001 for instance, all of the Blanding's Turtle nests being monitored at Rondeau Provincial Park contained at least a few parasitized embryos (Gillingwater 2001). All of the infected embryos and hatchlings subsequently died. Additional research is required on the prevalence and scope of this threat and on possible control methods.

Disease

Information on the diseases that affect reptile populations in the wild is rather limited (Galois and Ouellet 2007). Nonetheless, new diseases have the potential to affect a large number of species and to spread rapidly through international transportation modes (Daszak et al. 2000). Moribund Northern Map Turtles have been observed at Rondeau Provincial Park (Gillingwater 2001). These lethargic and emaciated individuals died the week after they were discovered. Although the cause of death was not determined, these turtles may have died of botulism. Botulism-related deaths occur regularly in Lake Erie, where Northern Map Turtles feed on zebra and quagga mussels (*Dreissena bugensis*), which are suspected vectors of this bacterium (de Solla, pers. comm. *in* Seburn 2007).

Hypoxia

In Canada, turtles overwinter under water. There are very little data available on the oxygen levels of the numerous watercourses, water body and wetlands where turtles hibernate. The augmentation in nutrient loads associated with human activity can lead to increased oxygen consumption by bacteria, which, in turn, can result in periods of low dissolved oxygen levels (hypoxia) or even a total absence of oxygen (anoxia) during winter. Spiny Softshell, Map Turtle, and Stinkpot are known to be intolerant to hypoxia during hibernation (Ultsch 2006).

Pollution

Pollution has a direct impact on these species. They absorb the contaminants in the environment and the food chain through various physiological processes (e.g., feeding, breathing, absorption through tissues or membranes such as eggs). Pollution can also have an indirect impact by changing turtle habitats (e.g., the growth of invasive aquatic plants as a result of the presence of fertilizers). Very little is known about the effects of chemical contaminants, which have been studied in only a few reptile species (Sparling et al. 2000; Galois and Ouellet 2007a, Paul and Simonin 2007). While Canadian studies focus primarily on the snapping turtle (*Chelydra serpentina*) (e.g., Bishop and Gendron 1998; Ashpole et al. 2004; de Solla et al. 2004, 2007), they occasionally cover other species such as the Spiny Softshell (de Solla et al. 2003). It has been shown that some contaminants can have an impact on embryo development (deformities, spontaneous abortion) and trigger the feminization of male morphology (de Solla et al. 1998). The Northern Map Turtle's ingestion of large numbers of zebra mussels (Bulté and Blouin-Demers 2008) could constitute a major source of exposure to contaminants. Since turtles are a long-lived species, they accumulate contaminants whose long-term impact remains poorly understood.

greater risk of disappearing in the wake of a catastrophic event or epidemic (Frankham 1995). Greater consideration must be given to these threats in Canada, since the majority of the populations are already at the northern limit of their range and therefore constitute peripheral populations (Chek et al. 2007). However, these populations are unique in that they have adapted to extreme conditions, and this makes it difficult to assess their potential for persistence despite the fact that some of the populations are quite small (Herman 2008).

Activities that can alter or destroy the habitat include:

- drainage and drying out of wetlands and hydrological complexes;
- road construction along the edges of wetlands;
- alteration of the shores of wetlands;
- planting of exotic plants;
- dredging and canalisation of riverbeds;
- alteration of water flow regime;
- forestry operations that affect shores and water quality;
- agricultural practices that do not include a buffer zone; and
- lowering of the water table in wetlands.

Exotic, invasive, or introduced species/genome

The introduction of non-native species can have a drastic effect on turtles. One example involves the release of exotic turtles in natural environments (e.g., release of red-eared sliders, *Trachemys scripta elegans*, following a period of captivity); releases can result in the transmission of diseases to indigenous populations and can create competition for basking and feeding sites (Cadi and Joly 2003, 2004). Another involves the introduction of invasive exotic plants that affect the makeup of wetland communities (e.g., common reed, *Phragmites australis*, and water chestnuts, *Trapa natans*) and the quality of turtle habitats.

Changes to ecological dynamics or natural processes

This category includes natural phenomena that are exacerbated by human activity **or habitat changes (fragmentation, pollution, etc.).**

Predators favoured by human activities

In many areas, the absence of top predators and an indirect "human helping hand" (e.g., leftovers, crops) have led to a greater abundance of turtle predators than natural conditions would normally support (Mitchell and Klemens 2000). The turtles' main predators include raccoons, skunks, opossums, foxes, domestic dogs and cats, coyotes, and birds such as crows and ravens. Raccoons, for instance, will eat turtle eggs, hatchlings, and even the adults of certain species. This omnivorous predator has benefitted from farming, particularly corn (Rivest and Bergeron 1988). Meanwhile, the poor value of skins for many of those species in the last decades resulted in a considerable reduction of harvesting by trapping. The abnormally high level of many predator populations can lead to untenable rates of predation on turtle eggs. For instance, 100% predation rates on unprotected Spiny Softshell nests have been recorded in Rondeau Provincial Park (Fletcher 1998) and along the roads in Point Pelee National Park of Canada (Browne 2003). A number of factors and methods to deal with predation rates have been identified and used with varying degrees of success (Seburn 2007).

Accidental mortality

This category includes road mortality, collisions with boats, and injuries from propellers, all-terrain vehicles, and fishing. These constantly increasing sources of mortality are a major cause of concern for the future of these species (Galois and Ouellet 2007b).

Road mortality

The direct and indirect effects of the constant expansion of the road network threaten many species (Trombulak and Frissell 2000; Forman et al. 2003). The road network has grown significantly over the last few decades, especially in the southern parts of Ontario and Quebec, where both population density and biodiversity are particularly high. Roads affect turtles in many ways: roads degrade, destroy, and fragment the habitats that the turtles use, and vehicular traffic constitutes a direct source of mortality. Turtles are poorly adapted to this threat because their defence mechanisms—camouflage and immobility—are of very little use against a vehicle (Wright 2007). The annual road mortality rate is far from negligible, particularly on roads located near wetlands. For instance, over a 716 day study period spanning 4 years, 716 dead turtles were observed along a 3.6 km long causeway in Long Point, Ontario (Ashley and Robinson 1996). Among the observed species were Blanding's Turtle, Northern Map Turtle, and Spotted Turtle.

Road mortality is a growing concern in herpetofauna studies (Andrews et al. 2006). In the case of turtles, these concerns stem from the predicted long-term impacts (Aresco 2005a,b; Gibbs and Shriver 2002; Steen and Gibbs 2004; Gibbs and Steen 2005), which are based on available quantitative studies (Ashley and Robinson 1996; Haxton 2000; Steen et al. 2006; Desroches and Picard 2005, 2007). In several areas with a dense road network, models have shown that the mortality rates of semi-terrestrial species, like Blanding's Turtle and the wood turtle, are above the maintenance threshold (Gibbs and Shriver 2002). In addition, the females of several species are at greater risk because they travel overland during the nesting season (Haxton 2000). In wetlands surrounded by a dense road network, the sex ratio of certain painted turtle and snapping turtle populations is male-biased (Marchand and Litvaitis 2004; Steen and Gibbs 2004; Gibbs and Steen 2005).

Even if it is of considerabily less concern, train and railway networks can also be a threat in some areas. For example, a few dead Blanding's turtles, apparently killed by a train strike, were observed in Quebec where a railway crosses a wetland highly used by this species (Giguère, pers. obs.).

Water sports

While in the water, turtles are at risk of being injured or killed by boats and/or propellers. Since very few quantitative data have been published (e.g., Garber and Burger 1995; Gibbons et al. 2001; Smith et al. 2006; Galois and Ouellet 2007b), the magnitude of this threat has yet to be documented. From 1992 to 2003, the decline of the Painted Turtle (*Chrysemys picta*) population in an Indiana lake coincided with an increased number of propeller injuries and increased human presence (Smith et al. 2006). Consequently, as water sports could represent a major source of death and injury for turtles, these sports could also constitute a major threat to the survival of these populations. In Ontario, deaths and injuries associated with water sports have been observed among Northern Map Turtles, Blanding's Turtles, Spiny Softshells (Gillingwater 2001, pers. comm. in Seburn 2007; Carrière 2007), and, in all probability, among Stinkpots (Edmonds 1998). In Quebec, injuries associated with water sports have been documented among Spiny Softshells (Galois and Ouellet 2007).

Off-road vehicles

Off-road vehicles can have a significant impact on turtles. In areas where trails are located on or near nesting sites, females are at greater risk of being disturbed, hit, or killed by these vehicles. In addition, the nests are in danger of being crushed; this would hinder recruitment success.

Fishing

Turtles can be accidentally hooked on recreational fishing lines or caught in commercial or scientific traps or nets and drown. As turtles that get caught in fishing lines are quite often released by cutting the line, the hook remains in the turtle (Galois and Ouellet 2007b; Gillingwater 2008). The hook and nylon line can lead to serious lacerations in the digestive tract, and lead weights can cause poisoning (Borkowski 1997). Stinkpots often get caught, and they are generally just killed (Ernst et al. 1994). In 2005 alone, three Spiny Softshells were found in southern Ontario with fishing line in their throats (Gillingwater 2008). A Northern Map Turtle that had been fitted with a tracking device was caught on a fishing line in the Toronto area (Seburn 2007).

A study conducted on the Mississippi River (USA) examined the impact of various types of underwater traps and the effect of placing the traps to increase success in capturing fish (tributary, shores of the main water body) on turtle death rates (Barko et al. 2004). In 2005, at least one Stinkpot and 15 Northern Map Turtles drowned in underwater hoop-nets used for commercial fishing in the area of St. Lawrence Islands National Park of Canada (Carrière 2007). Even when care is taken to ensure that a portion of the trap remains above water, turtles tend to travel to the last compartment, which is anchored to the bottom and therefore completely submerged (Thompson, pers. comm. *in* Seburn 2007). Fish monitoring studies conducted by government agencies (e.g., provincial natural resource ministries, Fisheries and Oceans Canada, conservation authorities) using underwater traps also constitute a threat to turtle populations.

Other sources

Agricultural activities and equipment (heavy machinery, mowers) and trampling by livestock are also a source of death and injury (Saumure and Bider 1998; Saumure et al. 2007).

Biological resource use

Collecting

Turtle populations are impacted by both casual collection for pet purposes and large-scale systematic collection for the pet trade (Daigle and al. 2007; Moll and Moll 2004). The global reptile market is immense, and turtles represent a significant portion of that market. However, the annual removal of just a few adults from a turtle population can have a significant impact. For instance and even if the cause wasn't clearly demonstrated, over a ten-year period in Connecticut, the Wood Turtle virtually disappeared from a protected area after it was opened to the public for hiking (Garber and Burger 1995). Certain turtle species, particularly the Wood Turtle and the Spotted Turtle, are collected for the pet trade industry. In fact, growth of the human population and of the popularity of turtles as pets has caused a sharp increase in the demand and the market value. The growth of the Internet also contributed to the expansion of this market by making it easier to publicize and sell (both legally and illegally) these reptiles, which are typically well perceived by the public. In the past, over-collection for scientific purposes may also have had an impact on certain recovering populations (Seburn 2007). The scope of this illegal organized harvest is poorly documented in Canada.

Collecting for consumption

Although it is unclear whether harvesting of turtles for food is a widespread practice in Canada, it is clear that humans consume a number of species, including Spiny Softshells and Northern Map Turtles (Thorbjarnarson et al. 2000; Moll and Moll 2004). Each year, thousands of turtles are sold in Asian markets or are exported from the United States to Asia. However, illegal harvesting of snapping turtles for food in Ontario has been documented, and all indications are that local populations are at risk of being severely depleted (Seburn 2007). Two cases of Northern Map Turtle harvesting were documented recently in Ontario (Cebek, pers. comm.; de Solla, pers. comm. *in* Seburn 2007). One case of illegal harvesting of Blanding's Turtle and Spotted Turtle was also documented (Chatham Daily News 2008) Imperilled species (such as the Northern Map Turtle, the Spiny Softshell, and the Stinkpot) are at risk of being captured accidentally in traps or fishing lines set for snapping turtles, which can still be hunted legally in Ontario under certain conditions.

Climate and natural disasters

Climate change

Climate is the main barrier that limits the distribution of turtles in the north. Given the effect of climate on recruitment rates, it seems likely that global climate change caused by atmospheric pollution will have an impact on our populations. However, it is still difficult to assess the positive and negative impacts of climate change on these species.

An increase in the average temperature could improve breeding success, as it would advance the nesting season and allow for longer incubation periods, which would improve hatching success. Hydrological effects could be marked by 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 could dry out wetlands that were once permanent.

Lower water levels (reduced precipitation, increased evaporation) (Lemmen et al. 2008) could increase the concentrations of contaminants and suspended sediments (greater turbidity), affect the turtles' food chain, and modify habitats such as hibernation sites.

Increased frequency of severe meteorological events such as storms is also anticipated. These would intensify agricultural runoff, particularly near large-scale farming operations characterized by bare soil, very few riparian zones, and intense drainage (such as corn fields), and the runoff would increase the sediment and contaminant loads in water bodies and lakes. Due to the disappearance of wetlands, which serve as buffer zones, these severe events could also increase the risk of flooding nesting sites during the summer. An increased proliferation of blue-green algae should also be expected. It is important to note as well that the direct effects of these algae on turtles (toxins) and indirect effects (food chain, oxygen levels in the water) remain unknown.

These changes will have to be taken into consideration, since it will be necessary to prioritize which sites (including the corridors that link them) should be subject to protective measures to ensure the survival of these species in a range that is itself evolving (Lee and Jetz 2008).

Disturbance or harm

Disturbance

Human activity can affect turtles in many ways. Simply approaching basking turtles can cause them to scurry back into the water. The resulting heat loss, should the disturbance become repetitive, can delay the development of eggs in females. Moreover, the presence of people and/or boats can delay or interrupt nesting (Horne et al. 2003; Moore and Seigel 2006). When this type of disturbance becomes

frequent, females are subject to a higher risk of predation as they repeatedly attempt to lay eggs or are forced to use lower quality nesting sites (Moore and Seigel 2006). In addition, delayed nesting and the use of lesser quality sites can slow incubation and reduce the hatching rate (Horne et al. 2003).

Persecution

Harassment is another, much more direct, form of disturbance. It includes throwing rocks at turtles, shooting at them with a firearm, or intentionally driving over them (e.g., Horne et al. 2003; Ashley et al. 2007). Observers have also witnessed the deliberate destruction of eggs (Horne et al. 2003; Gillingwater 2008).

1.6 Actions already completed or underway

A number of recovery strategies have been established in Ontario and Quebec for various turtle species. Projects have also been undertaken by various authorities in the absence of a recovery team. Current measures involve the following initiatives: acquisition of knowledge, raising awareness, protection under provincial and federal regulations, establishment of protected areas by various government, municipal, and private authorities, and stewardship of private lands.
At the national scale, the The Canadian Amphibian and Reptile Conservation Network (CARCNET) is the main non-profit organization devoted to the conservation of amphibians and reptiles. Their annual meeting is the exchange point for the organisms and people implicated in the conservation of turtles in Quebec, Ontario and elsewhere in Canada.

Ontario

Although the Ontario Multi-Species Turtles at Risk Recovery Team was established only recently (Seburn 2007), a number of conservation activities have been ongoing in Ontario for many years. The following examples illustrate the kinds of projects and programs, with emphasis on multi-species initiatives. The following information is taken in large part from Seburn (2007).

Research and monitoring

- The Ontario Ministry of Natural Resources Natural Heritage Information Centre (NHIC) manages a database of records for the various Ontario species. This database is updated regularly as new observations are reported.
- Turtle monitoring programs include the Ontario Turtle Tally (Toronto Zoo), Kawartha Turtle Watch (Joe Cebek, Trent University), and the Blanding's Turtle Watch in eastern Ontario (David Seburn, Seburn Ecological Services).
- Several graduate-level research projects, principally on the Spotted Turtle and Blanding's Turtle, have been completed at Sudbury Laurentian University with Dr. Jacquline Litzgus. Some Map Turtle projects have been ongoing for several years in Professor Gabriel Blouin-Demers' herpetology laboratory at the University of Ottawa. Several research projects, principally on the Wood Turtle, have been completed in Ronald Brooks' laboratory at Guelph University.
- Identification of major road mortality sites for turtles in Ontario (Seburn and Seburn 2002).
- Study of turtle habitats, home ranges, and population sizes in Rondeau Provincial Park (Gillingwater 2001; Dobbyn and Smith 2005; Dobbyn and Marchand 2007).
- The effects of raccoon predation on turtle populations in Point Pelee National Park of Canada.
- Studies have been conducted on the demographics of and habitat use by Blanding's Turtles in southern Ontario (e.g., Saumure 1997; Gillingwater 2001; Browne 2003; Gillingwater and Piraino 2004, 2005; Seburn 2008). The ecology of nesting at Long Point Provincial Park (MacCulloch and Weller 1988) and St. Lawrence Islands National Park of Canada (Petokas et al. 1982; Carrière and Blouin-Demers 2007) has been documented.
- Studies have been conducted on the demographics of and habitat use by Northern Map Turtles along

the Ottawa River (e.g., Trute and Coulson 2004) and the St. Lawrence River (e.g., Carrière 2007; Carrière and Blouin-Demers 2007), as well as in Rondeau Provincial Park (e.g., Gillingwater 2001), at Long Point Provincial Park (e.g., Gillingwater and Piraino 2004), and in Point Pelee National Park of Canada (Browne 2003).

- Spiny Softshell habitat use and ecology have been studied along the Thames and Sydenham rivers (e.g., Fletcher and Gillingwater 1994; Fletcher 1999), in Rondeau Provincial Park (e.g., Gillingwater 2001), and at Long Point Provincial Park (e.g. Gillingwater and Piraino 2004).
- Studies have been conducted on Spotted Turtle demographics and habitat use in Georgian Bay (e.g., Litzgus and Brooks 1998), central Ontario (e.g., Haxton and Berrill 1999), eastern Ontario (e.g., Seburn 2003), and southern Ontario (e.g., Saumure 1995, 1997; Gillingwater 2001; Gillingwater and Piraino 2004, 2005).
- Studies have been conducted on Stinkpot demographics and habitat use in Georgian Bay (Edmonds and Brooks 1996), Point Pelee National Park of Canada (Browne 2003), and St. Lawrence Islands National Park of Canada (Carrière 2007; Carrière and Blouin-Demers 2007).
- Ontario Parks (southeast zone) documented turtle distributions and made monitoring, protection, and education recommendations (Imrie and Brdar 2006).

Education

- The Georgian Bay Reptile Awareness Program (completed in 2005), which covered all reptile species at risk in the Georgian Bay area, reached a broad audience. In 2003 alone, a variety of programs made it possible for over 2000 students and over 2300 members of the public to see presentations. Programs were designed for school audiences (mainly grades 4 and 10) and resident associations. A poster and brochures on Georgian Bay reptiles were produced and widely distributed.
- In 2005, awareness programs were conducted along the Trent-Severn Waterway to educate boaters about turtle species at risk. Awareness activities included presentations at marinas and the distribution of brochures in French and English.
- Reptile education programs were conducted by various agencies and groups, including the Ontario Ministry of Natural Resources, Ontario Parks, the Parks Canada Agency, Sciensational Sssnakes!!, and the Kawartha Turtle Trauma Centre.
- The Toronto Zoo leads several conservation programs aimed at benefiting turtles (Adopt-A-Pond, Turtle Island, Ontario Turtle Tally). The Zoo also produced posters featuring Ontario turtles and laminated turtle ID cards. In addition, the zoo collaborated with the Kawartha Turtle Trauma Centre to produce a "Turtles in Trouble" poster and educational material on turtle conservation.
- The Upper Thames River Conservation Authority runs species at risk programs, including the production and distribution of colour posters featuring the Spiny Softshell and the Spotted Turtle. These educational programs reached more than 5000 people in 2005.
- A Spiny Softshell stewardship guide for landowners and land managers was published (Gillingwater 2004).
- Turtle SHELL (Safety, Habitat, Education and Long Life) produced an educational booklet on turtle biology and conservation and put up "Turtle Crossing" signs throughout Ontario.

Population management

- Protection of Northern Map Turtle, Spiny Softshell, and Blanding's Turtle nests in Rondeau Provincial Park in 2000 and 2001 (Gillingwater 2001).
- Protection of Spiny Softshell nests and restoration of nesting sites on the Thames River since 1996 (Gillingwater, pers. comm.)
- Protection of Northern Map Turtle, Blanding's Turtle, and Stinkpot nests in Point Pelee National Park of Canada since 2001 (Seburn 2007).
- The Kawartha Turtle Trauma Centre rehabilitated a large number of injured turtles of species at risk and subsequently released them into the wild.

Quebec

The Équipe de rétablissement de la tortue-molle à épines [Spiny Softshell Recovery Team], which was established in 1996, became the Équipe de mise en œuvre du plan de rétablissement de la tortue-molle à épines du Québec [Spiny Softshell Recovery Implementation Team of Quebec] following the development of the recovery plan by the Quebec Ministère de l'Environnement et de la Faune in 1997. An initial report for the period 1997 to 2004 has been submitted (Galois 2007). The Équipe de rétablissement de cinq espèces de tortues du Québec [Recovery Team for Five Turtle Species in Quebec] (ÉRCETQ 2005) was launched in 2004 with three implementation groups: Northern Map Turtle, wood turtle, and Blanding's Turtle/Stinkpot.

A number of programs covering the turtles at risk not covered by a specific team were implemented by government organizations and non-governmental organizations and through partnerships.

Research and monitoring

- Various inventories were conducted across the province targeting different species (e.g., Chabot et al. 1993; Bonin 2007; Daigle et al. 1994; Daigle and Lepage 1997; Daigle and St-Hilaire 2000; Armellin and Galois 2005; Desroches and Picard 2005, 2006; Giguère 2006; Desrosiers and Giguère 2008).
- Amphibian and reptile database: Atlas des amphibiens et des reptiles du Québec managed by the Société d'histoire naturelle de la vallée du Saint-Laurent (SHNVSL) (e.g., Bider and Matte 1991); Centre de données sur le patrimoine naturel du Québec (CDPNQ), Quebec Ministère du Développement durable, de l'Environnement et des Parcs; Quebec Ministère des Ressources naturelles et de la Faune (MRNF).
- A number of graduate-level studies were conducted under the supervision of Roger Bider and Rodger Titman of the Department of Natural Resource Sciences at McGill University.
- Studies of various aspects of the ecology of the Northern Map Turtle in the Ottawa and St. Lawrence rivers and Lake Champlain (e.g., Bonin, unpublished data; Daigle et al. 1994; Daigle and Lepage 1997; Galois 1997; Tessier, pers. comm.).
- Inventories and studies of the ecology and genetics of the Spiny Softshell in the Ottawa and St. Lawrence rivers and Lake Champlain (e.g., Bonin 1993; Galois 1999; Daigle and St-Hilaire 2000; Daigle et al. 2002; Galois et al. 2002; Galois et al. 2007; Galois and Ouellet 2007b; Kilpatrick, pers. comm.) and of the impact of disturbances associated with the construction of a bridge in a major hibernaculum (e.g., Galois et al. 2007).
- Study of road mortality of turtles (e.g., Desroches and Picard 2007; Ouellet and Galois, pers. comm.).
- Study of the genetics of the Northern Map Turtle (Tessier, pers. comm.).
- Study of the ecology of the Stinkpot in southwestern Quebec (Belleau 2008).
- Study of Blanding's Turtle habitat use and movements in the Outaouais (Chabot and St-Hilaire, unpublished data, Dubois, unpublished data).
- Radio-tracking study of the Northern Map Turtle in Lac des Deux Montagnes (Bonin, unpublished data) and the Rivière des Milles Îles (multi-partner initiative—SHNVSL, MRNF, Université de Montréal).
- A protocol on population monitoring and estimates of the Quebec's turtles at risk is currently under redaction (Dubois, comm. pers.)

Education and awareness

- A number of educational and awareness programs that deal with turtles have been conducted by zoological institutions (e.g., Montréal Biodôme, SHNVSL, Zoo de Granby), conservation organizations (e.g., Nature-Action Québec, Corporation Bassin Versant Baie Missisquoi [CBVBM], Héritage Saint-Laurent, Éco-Nature), and parks (e.g., Gatineau Park, Parc national de Plaisance, Parc national d'Oka, Parc de la Rivière-des-Mille-Îles, and the Nature Park of the Ville de Montréal).
- Many local conservation organizations and associations contribute to the protection of these turtles (e.g., CBVBM, Conservation Baie-Missisquoi - SOS-Tortues, Éco-Nature).
- Various brochures and posters on the Spiny Softshell have been distributed.
- An eco-nautical map and awareness signs have been posted at Lake Champlain (Nature Conservancy, CBVBM).

Our lack of knowledge of these turtle species hinders our ability to implement effective recovery measures. Therefore, to maintain these populations successfully over the long term, we must improve our knowledge of these species' distribution, biology, and ecology, focusing in particular on the following areas.

- Detailed distribution of these species.
- Population sizes and demographic trends.
- Habitat use, including the relationship between turtles and vegetation.

- Long-term monitoring is required to detect changes in population structure (Brooks 2007b; Belleau 2008).
- Virtually nothing is known about the behaviour of juveniles. Depending on the activity, habitat selection may differ from adults (e.g., McMaster and Herman 2000; Ultsch 2006; Carrière 2007).

- Threats to the health of these populations are poorly documented (diseases, parasites, mortality and injuries associated with human activity), and very little is known about the significance of these risks for the survival of populations (Galois and Ouellet 2007).

- The impact of exotic species: red-eared slider and other species that have a direct impact on individuals (predation, spread of diseases) or habitats (e.g., invasive aquatic plant species).

- Definition of the minimum parameters for a sustainable population and of the minimum gene flow requirements to support genetically viable populations (genetic diversity, adaptability).

- Genetic data on the various populations for introduction, relocation, and breeding programs (Seigel and Dodd 2000; Chek et al. 2007; Williams and Osentoski 2007). These data could be useful in resolving conservation issues and prioritizing measures to be taken (population priority, introduction of individuals, relocation). However, depending on the type of analysis (choice of markers, choice of DNA type, etc.), the resulting data must be interpreted with caution (e.g., Tessier et al. 2005; Amato et al. 2008).

- Document and determine whether nest parasitism, diseases, loss of genetic variation, hypoxia, and exotic species constitute a risk to specific turtle populations. Assess the potential magnitude of these risks.

2. RECOVERY

2.1 Recovery Feasibility

Ontario

The Ontario team published the following notice (Seburn 2007):
At this point in time, the recovery of the five turtle species covered by this document is considered technically and biologically feasible based on the following reasons.

- Populations and individuals capable of reproduction for all five species remain across many areas of Ontario.
- Although habitat loss has been significant in many areas, sufficient habitat remains for all species or could be made available through habitat management and restoration.
- Threats facing the species and their habitats are severe, but effective management can reduce these impacts in many areas.
- Lastly, recovery for these species does not rely upon highly experimental or unproven techniques. Recovery techniques exist that are demonstrated to be effective.

- "Mousquetaires de l'eau" educational program for schools includes the Spiny Softshell (CBVBM).
- SOS Tortue brochure developed by Parc national de Plaisance.
- A Web vignette on the biology and the ecology of the turtles is available on the ministère du Développement durable, de l'Environnement et des Parcs du Québec site (Le coin de Rafale).

Population management

- Multi-partner project to protect Spiny Softshell nests and to create and improve nesting sites on Lake Champlain (Équipe de rétablissement de la tortue-molle à épines du Québec).
- Study of the creation of nesting sites on the Ottawa River (Tessier et al. 2007).
- Acquisition, agreement, and stewardship programs to protect habitats used by turtles in various regions of Quebec (e.g., Nature Conservancy of Canada, Ducks Unlimited, MRNF).
- Multi-partner project to protect nesting sites of the Northern Map Turtle around the Île de Montréal (Éco-Nature/Parc de la Rivière-des-Mille-Îles, MRNF, SHNVSL, Université de Montréal, Ville de Montréal).
- Project to protect nests and to create and improve nesting sites of the Northern Map Turtle in Ville de Montréal parks (Fournier, pers. comm.).
- Organizations involved in the conservation of habitat target species at risk in their acquisition programs (e.g., Nature Conservancy of Canada, Ducks Unlimited).

For a complete list of projects and participating organizations, please see the websites of the funding organizations or the actual program sites:
- Habitat Stewardship Program for Species at Risk (HSP): http://www.cws-scf.ec.gc.ca/hsp-pih/default.asp?lang=En&n=59BF488F-1
- Interdepartmental Recovery Fund (IRF): http://www.sararegistry.gc.ca/involved/funding/irf_fir/default_e.cfm
- Aboriginal Funds for Species at Risk - Aboriginal Capacity Building Fund - Aboriginal Critical Habitat Protection Fund: http://www.sararegistry.gc.ca/involved/funding/asrp_e.cfm
- Endangered Species Recovery Fund (ESRF), WWF-Environment Canada: http://www.sararegistry.gc.ca/involved/funding/esrf_e.cfm
- Fondation de la faune du Québec : http://www.fondationdelafaune.qc.ca/

The programs for conferences and workshops organized by groups like the Canadian Amphibian and Reptiles Conservation Network/Réseau canadien de conservation des amphibiens et des reptiles (CARCNET/RÉCCAR) (http://www.carcnet.ca/english/past_meetings/pastmeeting.html) and the Toronto Zoo (http://www.torontozoo.com/adoptapond/Archives.asp) provide an overview of turtle research and conservation projects underway in Canada.

The impact of these measures in terms of improving the status of turtle populations has rarely been evaluated with any degree of precision. Increasing the size of the protected areas across these species' ranges has definitely proven useful for the maintenance of certain populations. The inventories and research projects conducted over the past several years have also helped us gain a better understanding of each species' distribution and ecology. Clearly, however, further quantitative studies of the various aspects of turtle biology and the threats they face will have to be conducted to guide future conservation efforts. Turtles are a long-lived species; consequently, it will not be possible to estimate the efficiency of measures implemented to counteract population declines properly until they have been in effect for many years (decades). Therefore, the current approach is a race to protect the remaining natural habitats and take action to limit specific threats.

1.7 Knowledge Gaps

Quebec

The Quebec team provided an opinion on the potential for the conservation of turtles covered by its multi-species plan (ÉRCETQ 2005).

Considering:

- the general decline of turtle populations at the global scale;
- the presence of eight freshwater turtle species in Quebec, including the following four: Northern Map Turtle (*Graptemys geographica*), Blanding's Turtle (*Emydoidea blandingii*), Stinkpot (*Sternotherus odoratus*), and Spotted turtle (*Clemmys guttata*);
- the rarity and the limited extent of the distribution of certain species in Quebec and Canada;
- the precarious situation of these turtles as a result of their biological and habitat requirements (wetlands, riparian sites, and forests) and the fact that these habitats are threatened by human activity;
- the anticipated loss or degradation of habitats to development (urban, agricultural, and tourism) and to resort and outdoor activities;
- the potential irreversibility of the loss of highly specific habitats.

Considering also:
- the broad range of methods that could be included in the recovery strategy;
- the potential of habitat conservation and protection measures, and of forest management and education initiatives that involve local communities, large corporations, non-governmental organizations, and relevant government departments and Crown corporations.

Given the current level of knowledge, the members of the recovery team are of the opinion that the long-term maintenance of the freshwater turtle species targeted by this plan and the sustainable conservation of their principal habitats are not only possible but also desirable.

To simplify the planning process, the Ontario team chose to establish a set of common goals for all of the turtle species covered by this recovery strategy. These goals are detailed in section 2.4.

Federal multi-turtle team

2.4 Recovery Objectives

To streamline the planning process, the Ontario team decided to prepare a single set of objectives for all species covered by this recovery strategy. As such, the objectives are more general in nature reflecting the multi-species approach, and the varying state of knowledge regarding the different species (see Seburn 2007 for details).

These are essentially areas for simultaneous action. The importance of each action and the order of priority will vary according to the needs of and the threats faced by the various populations and species.

Recovery actions undertaken over the next five years should address the following objectives towards achieving the recovery goals.

Inventory and Monitoring
Determine the current distribution of each species and improve knowledge of the status of populations.

Research
Encourage and conduct research to address specific ecological and/or management-related needs to contribute to effective recovery efforts.

Conservation and Management
Develop and implement conservation and management measures to protect populations and mitigate identified threats.

Communication
Enhance public awareness and understanding of issues facing turtle species at risk to encourage recovery involvement.

The Quebec team sorted the actions into seven categories that are quite similar to the common objectives of the Ontario team.

Categories:
A. Knowledge acquisition
B. Inventories and monitoring
C. Protection of populations
D. Protection of habitats
E. Awareness, education, and communication
F. Funding
G. Recovery strategies and status report

2.5 Recommended Approaches to Meet the Recovery Objectives

Ontario

Recovery must be implemented at the landscape scale, emphasizing the protection of areas that are large enough to maintain viable populations over the long term. The priority for conservation efforts should be those areas that are home to more than one turtle species at risk. Habitat protection should be integrated into other habitat conservation programs, like the Natural Spaces Program of the Ontario Ministry of Natural Resources.

One or more action plans will be developed within 5 years of the posting of the recovery strategy.

Quebec

The team's work on turtles led to the identification of actions that would contribute to the achievement of the strategy's goals and objectives. For more detailed information about these actions please refer to the Plan de rétablissement de cinq espèces de tortues au Québec pour les années 2005 à 2010 (ÉRCETQ 2005).

Recovery Planning

Table X – Recovery Planning Table

Priority	Threat	General strategy to address the threats	Recommended approaches to meet recovery objectives	Performance measures
Goal 1: Knowledge acquisition, inventories, and population monitoring				
Urgent	All	Improve the collection of valid records, generate standardized protocols, prioritize surveys, population inventories, population monitoring	• Encourage the submission of records for all species to the databases (Ontario Ministry of Natural Resources Natural Heritage Information Centre (NHIC), Centre de données sur le patrimoine naturel du Québec (CDPNQ)); validate the records. • Develop, publicize, and implement a program inviting the general public to report sightings, particularly from protected areas. • Develop and implement national standardized protocols and data collection forms for use in the field during various projects (e.g., population inventories, habitat classification, radio-tracking, DNA sampling, handling and marking of individuals, capture, etc.). • Identify populations to be inventoried and prioritize and conduct inventories of 1) poorly documented populations and 2) potential population locations. • Conduct inventories of each known population to determine the size of the area occupied and the quality of the available habitat. • Determine the minimum parameters for a sustainable population. • Implement a protocol to estimate population sizes.	• Number of validated records submitted by the public. • Standardized protocols. • Number of validated records from the users of the standardized data collection protocol. • Number of participants using the standardized protocol. • Number of completed inventories of known and potential populations. • More precise information on the distribution of the various species and on the status of the populations. • Number of completed population profiles (size, area occupied, habitat characteristics), contribution to the characterization of critical habitat. • Parameters for viable populations.
	All	Threat assessments, demographic studies	• Assess the severity of specific threats to these populations. • Conduct intensive demographic studies in selected sites across the range of each species to identify essential life cycle needs. • Establish a network of indicator populations.	• Threat quantification to guide adjustments to conservation initiatives. • Demographic models. • Population status (declining, stable, increasing).

	All	Research on habitat use	• Characterize and define the habitats (e.g. nesting, feeding, and hibernation sites) used at various stages in the life cycle, particularly by hatchlings and juveniles. • Improve our knowledge of habitat selection to develop predictive habitat models. • Study the microhabitat of nesting sites. • Study hypoxia in hibernation sites.	• Habitat usage patterns for each species at the various life stages. • Contribution to the characterization of habitat needs.
Goal 2: Habitat management to maintain the distribution of the Canadian population				
Urgent	Habitat loss or degradation	Habitat protection through acquisition and stewardship	• Prioritize the protection of private land based on the urgency and importance of conserving it. • Identify and contact landowners. • Identify and implement appropriate protection measures. • Determine the minimum areas to be protected for each habitat and each species. • Protect habitats on private land through stewardship. • Develop recommendations and beneficial management practices for landowners and land managers (forestry agencies, municipalities). • Identify the positive and negative effects of land use practices and land management methods. • Develop beneficial management practices.	• Priority-based mapping of sites requiring protection. • Number and area of additional protected sites. • Increased connectivity between protected areas (corridors) and reduced number of small isolated sites. • Number of stakeholders (forestry, agriculture, urban planners, etc.) who adopt and implement turtle-friendly management practices.

Urgency???	Habitat loss or degradation, changes to the water regime	Ensure the enforcement of regulations and laws, propose regulations that recognize the needs of turtles	• Protect these species through the enforcement of existing provincial laws on species at risk and habitats (e.g., protection of shorelines and flood zones) and the federal *Species at Risk Act* (SARA). • Inventory all relevant laws and regulations and make recommendations to improve their applicability to turtle ecology (e.g., change the Ontario *Fish and Wildlife Conservation Act* to allow private landowners to protect nests). • Establish habitat identification and protection directives to be used in conjunction with provincial laws and regulations (Provincial Policy Statements issued under the Ontario *Planning Act*, Fisheries Management Plans (Ontario), Ontario Conservation Land Tax Incentive Program, and significant habitats under the Ontario *Endangered Species Act, 2007*) and SARA (critical habitat). • Promote the implementation of these directives by government and public authorities (departments of natural resources, departments of transport, park planning directives and regulations, park management plans, etc.). • Create habitat protection agreements between government departments and municipalities (urban planning). • Strengthen and develop agreements; extend them to privately owned land. • Inventory habitats on public land and protect them through legal means.	• Length of protected/restored shorelines. • Number and area of protected wetlands. • List of laws and regulations that could be beneficial to turtles; list of recommendations to improve these laws and regulations; proposal of new, more relevant, laws and regulations. • Agreements between government departments and municipalities. • Inclusion of turtle directives in agreements with various organizations (forestry agencies, agricultural groups, watershed managers, etc.) • Mapping of critical habitats on public land; number of sites protected.
	Habitat loss or degradation	Protection of sites on privately owned land	• Inventory potential habitat on privately owned land, protect critical habitat by means of agreements, acquisition, and easements, and ensure the stewardship of these sites.	• Site list sorted by priority of conservation action. • Number and area of sites protected on privately owned land.
	Invasive species, exotic species	Research and application of control methods	• Conduct research on the impact of invasive or exotic species and assess the various control methods.	• Control methods for invasive species. • Number of sites where invasive species are declining or completely eradicated.

Goal 3: Protection of populations and habitats in existing sites					
Necessary	Lack of protection, excessive disturbance	Legal protection, law enforcement, critical habitat	• Regulate and protect the species through provincial legislation on species at risk and the federal *Species at Risk Act* (SARA). • Develop and implement directives based on scientific data to determine critical habitat under SARA. • Establish and implement habitat mapping guidelines to designate, describe, define the boundaries of, and manage critical habitat. • Enforce the *Canada National Parks Act.* • Expedite the species assessment process (Committee on the Status of Endangered Wildlife in Canada (COSEWIC)).	• Number of species assessed by COSEWIC/protected under SARA. • Documentation of critical habitat for all species. • Implementation and application of directives to provide adequate protection of species at risk on federal land.	

Goal 4: Promote the survival of individuals (adults) and improve recruitment (stabilization and growth of declining populations)

Urgent	Road mortality	Research, reduction, awareness, rehabilitation	• Identify areas with high mortality rates. • Assess techniques to reduce road mortality at sites with high mortality rates. • Develop and issue directives to improve management practices (new and existing roads, off-road vehicles). • Strengthen restrictions for off-road vehicles in protected areas. • Develop rehabilitation and surgical techniques and provide veterinarians with these techniques.	• List of identified sites sorted according to priority for action. • Number of priority sites where action has been taken to reduce deaths. • Number of roadwork projects (repairs or new roads) that integrate reduced turtle mortality. • Number of ATV clubs that adopt rules to reduce turtle mortality and avoid essential habitat (trail modifications, raising awareness among members, etc.). • Number of sites no longer affected by off-road vehicles. • Increased post-operative survival rate of turtles (improved techniques and treatments). • Number of rehabilitation centres.
Necessary	Deaths and injuries associated with water sports and with fishing	Reduction, awareness, rehabilitation	• Conduct quantified assessments of the impact of water sports and fishing on turtle mortality. • Develop techniques to reduce the death rate of turtles accidentally caught in fishing gear. • Reduce the speed of boats in sensitive areas (heads of bays, narrow channels). • Create aquatic protected areas closed to navigation. • Create aquatic protected areas closed to fishing. • Raise awareness among users (eco-nautical maps). • Provide information on the steps to be taken when a turtle is caught on a fishing line (techniques, phone numbers, etc.).	• Quantitative data on deaths and injuries associated with water sports. • New fishing gear that allows turtles to be released unharmed. • Number of aquatic protected areas. • Number of reduced speed zones.
Necessary	Excessive predation	Documentation, reduction	• Identify the factors that contribute significantly to the predation of eggs. • Develop techniques to protect nests and reduce predation.	• Increased knowledge of egg predation. • More efficient methods. • Number of protected nests.

Necessary	Illegal collecting and trade	Reduction	• Document the scope of illegal turtle collecting (opportunistic collecting by individuals and organized collecting) and trade. • Support marking of all turtles and genetic identification of populations to allow the source population to be traced in the event of a seizure. • Ensure that protection (wildlife enforcement officers) and Customs authorities are aware of the turtles' critical situation. • Regularly assess whether the current laws and regulations are adequate and recommend changes as needed. • Raise public awareness of the importance of leaving indigenous turtle species in their habitats. • Ensure pet stores, pet trade brokers, and veterinary clinics are aware of applicable regulations governing the trade and captive husbandry of turtles.	• Quantified estimate of collecting. • Number of marked turtles (databank). • Number of interventions against illegal trade networks. • Number of pet stores, veterinary clinics, etc., reached by awareness campaigns. • Severity of the sentences and fines for offenders convicted of illegally collecting or selling turtles.
	Habitat loss or degradation, predators favoured by conditions, road mortality, off-road vehicles	Improve recruitment	• Create and/or improve nesting sites as needed. Monitor site use and hatching success. • Implement nest protection in priority sites using specially adapted methods.	• Number of managed nesting sites. • Hatching success.
Necessary	All.	Captive breeding	• Develop husbandry protocols (incubating eggs, raising hatchlings) in order to release juveniles ("headstarting") into populations with low recruitment rates. • Assess the feasibility of increasing the number of captive breeding units.	• Number of identified populations that are benefiting from a captive breeding program.
Necessary	Nest parasitism	Research, reduction	• Assess the impact of nest parasitism on reproductive success. • Develop techniques to reduce parasitism.	• Quantified data on the level of the threat. • Success of the control methods (reduction in the rate of infected nests).

Goal 5: Monitor and maintain population health

Necessary	Disease	Document, raise awareness	• Increase knowledge of the diseases, their prevalence in the natural environment, and transmission routes. • Encourage the opportunistic collection of dead individuals for autopsies (cause of death, prevalence of diseases, monitoring program for emerging diseases). • Develop and distribute handling, captivity, and release protocols to minimize the transmission of diseases. • Raise awareness among organizations, institutions, and employees that handle indigenous turtles or keep them in captivity (universities, researchers, veterinarians, petting zoos, etc.). • Increase public awareness of the potential risk associated with releasing captive individuals into the wild (any animal species, particularly aquatic species, could potentially be a host or a carrier of a disease).	• Documentation on diseases (articles, reports, etc.). • Number of reported cases and autopsies. • Number of organizations that apply appropriate health protocols. • Number of turtles (and other captive species) returned to institutions (reduction of releases into the wild).
Necessary	Pollution	Research	• Increase knowledge of the impact of contaminants on the various stages of development and knowledge of turtle contamination rates. • Develop and distribute protocols for the opportunistic collection of samples from dead specimens in the field. • Encourage the opportunistic collection of samples from dead specimens in the field. • Develop and distribute protocols for the collection of samples to be followed when handling, releasing, or keeping specimens in captivity in order to minimize the transmission of diseases.	• Documentation on the effect of contaminants (articles, reports, etc.) and evaluation of the impact of contaminants on populations. • Number of samples collected opportunistically. • Protocols and number of users.
Necessary	Loss of genetic variation, genetic drift, illegal collecting	Research, genetic profiling	• Collect DNA samples from all turtles handled during the course of a research project. • Characterize the various populations and establish markers for each one. • Increase the knowledge of the minimum size parameters for viable populations. • Integrate population dynamic models into conservation decisions (priorities, introductions, breeding, etc.).	• Sample bank. • Number of genetically profiled populations. • Minimum viable population model(s). • Integration of the information into the decision-making process for conservation issues.

	Hypoxia	Research	• Conduct hypoxia studies on hibernation sites affected by invasive plant species or degradation of water quality (decreased dissolved oxygen levels).	• Documentation on the effect of hypoxia (articles, reports, etc.) and evaluation of its impact on populations. • List of sites at risk of hypoxia. • Number of projects that integrate this information into their conservation plans.
Goal 6: Increase the number of awareness and communication initiatives directed at Aboriginal communities, interest groups, and the public in order to rally support for required behavioural changes (e.g., compliance with shoreline regulations, elimination of poaching and collecting) and foster cooperation to achieve recovery goals.				
Necessary	All	Communication and awareness	• Develop and implement communication strategies for targeted audiences (municipalities, forest agencies, boat clubs, fishing clubs, ATV clubs, farming groups, marinas, etc.). • Distribute existing public awareness materials. Develop new public awareness materials (using appropriate language) dealing with specific threats (e.g., illegal collecting) or directed at a specific audience (e.g., young people). • Identify major turtle populations that could benefit from measures implemented by Aboriginal communities to protect habitats and turtles.	• Number of organizations, associations, managers, etc., whose practices take turtles into consideration. • Changes in the turtle trade (legal and illegal markets). • Changes in road mortality.

2.9 Effects on other species

Most of these measures will be beneficial to the other species that coexist with turtles, whether as a result of the protection of habitats, research on threats (which may also threaten other species), or efforts to eliminate pollution from aquatic environments. The implementation of these measures could also lead to a reduction of invasive species. In addition, the creation of a network of linked aquatic and terrestrial environments to ensure the persistence of certain species, such as Blanding's Turtle, will also benefit several terrestrial and aquatic organisms, not to mention entire ecosystems. Some of these measures are likely to be found in other recovery strategies, particularly strategies that deal with aquatic species.

However, while these measures could result in the growth of turtle populations, there remains some uncertainty as to the long-term impact of this growth. The current (and poorly documented) role played by turtles in the ecosystem is probably a pale reflection of the role they played when they were considerably more abundant prior to the increased level of human activity.

2.10 Statement on Action Plans [à être finalisée par les compétences responsables]

Actions to meet recovery objectives listed in this recovery strategy will be detailed in an action plan. An action plan will be completed within five years after the posting of the final recovery strategy on the SARA Public Registry.

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2.5.1 Narrative Supporting the Recovery Planning Table

Length: between one-half a one full page, as needed.

If required, elaborate on the information (as opposed to reiterating) in the Recovery Planning Table (i.e. describe the recommended strategies or approaches in greater detail). In addition, if the general strategies do not deal with some of the threats outlined above, explain why and provide further details on the threats.

Although the knowledge acquisition approach is included in several objectives, an objective focused solely on this approach was also established. Knowledge acquisition is considered a priority to ensure the effectiveness of the Quebec and Ontario teams' turtle conservation efforts.

The priority given to the various approaches may differ from one species to another based on each species' vulnerability to known threats. The degree of urgency may also vary depending on the species.

Niveau d'urgence des approches à réviser par l'équipe

2.6 Performance Measures

The performance measures are listed in Table XX – Recovery Planning Table.

2.7 Critical Habitat

2.7.1 Identification of the Species' Critical Habitat

2.7.2 Examples of Activities that are Likely to Result in the Destruction of the Critical Habitat

2.7.3 Schedule of Studies to Identify Critical Habitats

Table X – Schedule of Studies

Description of the activity	Result/justification	Deadline

2.8 Existing and Recommended Habitat Protection Methods

Optional