Species at Risk Act
Recovery Strategy Series
Adopted under Section 44 of SARA

Recovery Strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Canada

Jefferson Salamander

2016

Government of Canada
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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

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[1] http://www.registrelep-sararegistry.gc.ca

RECOVERY STRATEGY FOR THE JEFFERSON SALAMANDER (*Ambystoma jeffersonianum*) IN CANADA

2016

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

In the spirit of cooperation of the Accord, the Government of Ontario has given permission to the Government of Canada to adopt the *Recovery Strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario* (Part 2) under Section 44 of the *Species at Risk Act* (SARA). Environment Canada has included an addition (Part 1) which completes the SARA requirements for this recovery strategy.

Environment Canada is adopting the provincial recovery strategy with the exception of section 2, Recovery. In place of section 2, Environment Canada is establishing a population and distribution objective and performance indicators, is adopting the government-led and government-supported actions of the *Jefferson Salamander Ontario Government Response Statement*[2] (Part 3) as broad strategies and general approaches to meet the population and distribution objective, and is adopting the habitat regulated under Ontario's *Endangered Species Act, 2007* as critical habitat for the Jefferson Salamander.

The federal recovery strategy for the Jefferson Salamander in Canada consists of three parts:

Part 1 – *Federal Addition to the Recovery Strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario*, prepared by Environment Canada.

Part 2 – *Recovery Strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario*, prepared by the Jefferson Salamander Recovery Team for the Ontario Ministry of Natural Resources[3].

Part 3 – *Jefferson Salamander Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources.

[2] The Government Response Statement is the Ontario Government's policy response to the recovery strategy and summarizes the prioritized actions that the Ontario Government intends to take and support.
[3] On June 26, 2014, the Ontario Ministry of Natural Resources became the Ontario Ministry of Natural Resources and Forestry.

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PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[4] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress five years after the publication of the final document on the SAR Public Registry.

The Minister of the Environment is the competent minister for the recovery of the Jefferson Salamander and has prepared the federal component of this recovery strategy (Part 1), as per section 37 of SARA. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)). The Ontario Ministry of Natural Resources (now the Ontario Ministry of Natural Resources and Forestry) led the development of the attached recovery strategy for the Jefferson Salamander (Part 2) in cooperation with Environment Canada.

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. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Jefferson Salamander and Canadian society as a whole.

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

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When the recovery strategy identifies critical habitat, there may be future regulatory implications, depending on where the critical habitat is identified. SARA requires that critical habitat identified within federal protected areas be described in the *Canada Gazette*, after which prohibitions against its destruction will apply. For critical habitat located on federal lands outside of federal protected areas, the Minister of the Environment must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies. For critical habitat located on non-federal lands, if the Minister of the Environment forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of

[4] http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2

Parliament, and not effectively protected by the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to extend the prohibition against destruction of critical habitat to that portion. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

ACKNOWLEDGMENTS

The federal addition was prepared by Jennie Pearce (Pearce & Associates Ecological Research). Additional preparation and review of the document was completed by Rachel deCatanzaro, Angela McConnell, and Allison Foran (Environment Canada, Canadian Wildlife Service – Ontario). This federal addition benefited from input, review, and suggestions from the following individuals and organizations: Krista Holmes, Madeline Austen, Lesley Dunn, and Elizabeth Rezek (Environment Canada, Canadian Wildlife Service – Ontario); Paul Johanson (Environment Canada – Canadian Wildlife Service – National Capital Region) and Joe Crowley and Jay Fitzsimmons (Ontario Ministry of Natural Resources and Forestry). Information contributed by Talena Kraus (Artemis Eco-works), Kari Van Allen and Angela Darwin (Environment Canada, Canadian Wildlife Service – Ontario) and Barbara Slezak (formerly Environment Canada, Canadian Wildlife Service-Ontario) is also gratefully acknowledged.

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

ADDITIONS AND MODIFICATIONS TO THE ADOPTED DOCUMENT

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the Province of Ontario's *Recovery Strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario* (Part 2) and to provide updated or additional information.

Under SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Therefore, statements in the provincial recovery strategy referring to protection of the species' habitat may not directly correspond to federal requirements, and are not being adopted by Environment Canada as part of the federal recovery strategy. Whether particular measures or actions will result in protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

1. Species Status Information

The Jefferson Salamander is listed as Endangered[5] under the Ontario *Endangered Species Act, 2007* (ESA), and is currently listed as Threatened[6] on Schedule 1 of the federal SARA.

Globally, the Jefferson Salamander is ranked Apparently Secure[7] (G4) (NatureServe 2012a). At the national scale, it is ranked as Imperiled[8] (N2) in Canada and Apparently Secure (N4) in the United States. At the sub-national level, it is ranked as Imperiled (S2) in Ontario, and Imperiled to Apparently Secure across its range in the United States (Appendix A).

In Canada, the species only occurs in Ontario. The Ontario population of the Jefferson Salamander occurs at the northern limit of the species' range in North America. As of October 2008, there were an estimated 328 known breeding ponds representing approximately 27 geographically discrete populations within the province. The Canadian population of the Jefferson Salamander probably constitutes between one and three percent of the species' global distribution (Jefferson Salamander Recovery Team 2010).

[5] A species that is native to the wild in Ontario but is facing imminent extinction or extirpation.
[6] A wildlife species likely to become an Endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.
[7] Apparently Secure (G4/N4/S4): At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
[8] Imperiled (G2/N2/S2): At high risk of extirpation in the jurisdiction due to very restricted range, few populations or occurrences, very steep decline, severe threats, or other factors.

The area of occupancy[9] of the Jefferson Salamander in Canada has been estimated to be around 196 km^2 (COSEWIC 2010).

2. Recovery Feasibility

Based on the following four criteria outlined in the draft SARA Policies (Government of Canada 2009), there are unknowns regarding the feasibility of recovery of the Jefferson Salamander. In keeping with the precautionary principle, a full recovery strategy has been prepared as would be done when recovery is determined to be feasible.

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

   Yes. As of October 2008, Jefferson Salamanders had been confirmed breeding (in at least one year since 1998) at approximately 328 breeding ponds in Ontario, representing approximately 27 geographically discrete populations (Jefferson Salamander Recovery Team 2010). The total number of Jefferson Salamanders in Ontario is unknown, but COSEWIC (2010) estimated that there may be fewer than 2,500 adults.

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

   Unknown. Within the species' current range, suitable habitat exists, but is highly fragmented and nearby development activities may be causing habitat degradation. The availability of suitable habitat (both terrestrial and breeding ponds) is recognized as a major limiting factor for the species (COSEWIC 2010; Jefferson Salamander Recovery Team 2010). Although little information on population trends is available, annual observations for several extant populations have documented a severe decline in the number of egg masses observed, possibly due to habitat degradation at these extant populations.

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

   Unknown. Activities associated with urbanization, aggregate extraction and other resource developments pose the most significant threat to the Jefferson Salamander. These activities can result in the direct loss, degradation or fragmentation of habitat (e.g., through loss of natural cover), as well as indirect degradation or loss of breeding habitat through alterations to the hydrologic regime (water table, groundwater and surface water flows, wetland hydroperiod,

[9] A biological measure of the occupied habitat within a wildlife species' range, determined by COSEWIC using an Index of Area of Occupancy (IAO).

etc.). In addition, roads may threaten Jefferson Salamanders as some roads present a barrier to dispersal and may result in mortality of individuals from vehicles. The effects of these threats may be cumulative. Threats to each extant population have not been quantified or monitored, and the effectiveness of mitigation efforts is currently unknown (Jefferson Salamander Recovery Team 2010). While it may not be possible to reverse some of the effects of existing or past developments, it is expected that with further investigation into both direct and indirect threats to Jefferson Salamander habitat posed by development (including an examination of cause-effect relationships) and the relative severity of threats to populations, threats from development activities and roads can be reduced to some degree through land management and stewardship actions.

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

   Yes. The population and distribution objective consists of maintaining or increasing the species' area of occupancy within its existing Ontario range. Research is required to investigate the relative severity of direct and indirect threats to individual populations of Jefferson Salamander (Jefferson Salamander Recovery Team 2010) and identify actions to recover populations. While there may be challenges associated with their implementation, land management and stewardship techniques to achieve recovery of the species – such as land use planning, wetland creation/ restoration, and techniques to mitigate road mortality – do exist.

3. Population and Distribution Objectives

The provincial *Recovery Strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario* contains the following recovery goal:

- The recovery goal is to ensure that existing threats to populations and habitat of the Jefferson Salamander are sufficiently removed to allow for the long-term persistence and expansion of the species within its existing Canadian range.

The Government Response Statement for the Government of Ontario lists the following goal for the recovery of the Jefferson Salamander in Ontario:

- The government's goal for the recovery of the Jefferson Salamander is to ensure that threats to populations and habitat are addressed, in order to allow for the long-term persistence and expansion of the species within its existing Ontario range.

Environment Canada supports the provincial recovery goal to allow for the long-term persistence and expansion of the Jefferson Salamander in Ontario. To meet the requirements and processes set out in SARA, Environment Canada has refined this recovery goal into a population and distribution objective for the species. The population

and distribution objective established by Environment Canada for the Jefferson Salamander is to:

- Maintain, and to the extent that it is biologically and technically feasible, increase the species' area of occupancy within its existing Ontario range.

Estimates of population size for the Jefferson Salamander are difficult to obtain because of the presence of unisexual salamanders[10] which are morphologically similar to the Jefferson Salamander, and comprise approximately 90% of local populations (Bogart 2003; Bogart and Klemens 1997, 2008; Bi and Bogart 2010). Adults are also difficult to observe or capture except at breeding ponds, where they may be present for only a few days. Furthermore, breeding may not occur at a pond every year (Weller 1980). For these reasons, the population and distribution objective is based on area of occupancy rather than on population abundance. Population abundance, though difficult to measure, will also likely increase along with increases to the area of occupancy.

In order to achieve the population and distribution objective, addressing threats to the Jefferson Salamander and its habitat will be important. Suitable habitat for the Jefferson Salamander is limited in Ontario, severely fragmented and occurs within an urban and rural landscape with increasing development pressures, ongoing aggregate extraction activities and/or other development activities. These development activities can directly or indirectly lead to habitat loss or degradation (i.e. through pollution, changes in the water regime, etc.). Many historical breeding sites may no longer support Jefferson Salamanders, and the number of Jefferson Salamanders in extant populations may be declining (COSEWIC 2010). Jefferson Salamanders appear to have strong site and pond fidelity, and are long-lived (up to 30 years) (Weller 1980; Thompson et al. 1980; Jefferson Salamander Recovery Team 2010). Provided other threats to Jefferson Salamander individuals (e.g., road mortality, unauthorized collection) are managed and mitigated, viable populations would be expected to persist over long time frames where sufficient suitable habitat exists, and expansion of populations may be encouraged through maintaining currently unoccupied adjacent suitable habitat.

4. Broad Strategies and General Approaches to Meet Objectives

The government-led and government-supported action tables from the *Jefferson Salamander: Ontario Government Response Statement* (Part 3) are adopted as the broad strategies and general approaches to meet the population and distribution objective. Environment Canada is not adopting the approaches identified in section 2 of

[10] A unisexual salamander is a female member of the *Ambystoma laterale–jeffersonianum* complex that uses a form of reproduction whereby sperm is required to stimulate egg development but the male's genes are not incorporated into the genome of the offspring. See Jefferson Salamander Recovery Team (2010) and COSEWIC (2010) for a more detailed account of the biology and genetics of the *Ambystoma laterale–jeffersonianum* complex.

the *Recovery Strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario* (Part 2).

5. Critical Habitat

5.1 Identification of the Species' Critical Habitat

Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. Under SARA, critical habitat is "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species".

Identification of critical habitat is not a component of the provincial recovery strategy under the Province of Ontario's ESA. However, following the completion of the provincial recovery strategy for the Jefferson Salamander, a provincial habitat regulation was developed and came into force February 18, 2010. A habitat regulation is a legal instrument that prescribes an area that will be protected[11] as the habitat of this species by the Province of Ontario. The habitat regulation identifies the geographic area within which the habitat for the species is prescribed and the regulation may apply and explains how the boundaries of regulated habitat are determined (based on biophysical and other attributes). The regulation is dynamic and automatically in effect whenever the description(s) of the regulation are met within a specified geographic area.

Environment Canada adopts the description of the Jefferson Salamander habitat under section 28 of Ontario Regulation 242/08[12] made under the provincial ESA as the critical habitat in this federal recovery strategy. The area defined under Ontario's habitat regulation contains the biophysical attributes required by the Jefferson Salamander to carry out its life processes. To meet specific requirements of SARA, the biophysical attributes of critical habitat are provided below.

The areas prescribed under **Ontario regulation 242/08 – Jefferson Salamander habitat** are described as follows:

> *28. For the purpose of clause (a) of the definition of "habitat" in subsection 2 (1) of the Act, the following areas are prescribed as the habitat of the Jefferson Salamander:*

[11] Under the federal SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.
[12] http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_080242_e.htm#s28

1. In the City of Hamilton, the counties of Brant, Dufferin, Elgin, Grey, Haldimand, Norfolk and Wellington and the regional municipalities of Halton, Niagara, Peel, Waterloo and York,

i. a wetland, pond or vernal or other temporary pool that is being used by a Jefferson Salamander or Jefferson dominated polyploid[13] or was used by a Jefferson Salamander or Jefferson dominated polyploid at any time during the previous five years,

ii. an area that is within 300 metres of a wetland, pond or vernal or other temporary pool described in subparagraph i and that provides suitable foraging, dispersal, migration or hibernation conditions for Jefferson Salamanders or Jefferson dominated polyploids,

iii. a wetland, pond or vernal or other temporary pool that,

A. would provide suitable breeding conditions for Jefferson Salamanders or Jefferson dominated polyploids,

B. is within one kilometre of an area described in subparagraph i, and

C. is connected to the area described in subparagraph i by an area described in subparagraph iv, and

iv. an area that provides suitable conditions for Jefferson Salamanders or Jefferson dominated polyploids to disperse and is within one kilometre of an area described in subparagraph i. O. Reg. 436/09, s. 1.

The habitat for the Jefferson Salamander is protected under the ESA until it has been demonstrated that Jefferson Salamander and *jeffersonianum*-dominated polyploids have been absent for a period of at least five years. Terrestrial habitat includes all of the areas and features described above that extend radially 300 m from the edge of the breeding pond. The 300 m distance is based on data from telemetry studies (OMNR 2008 unpublished data) as the habitat area required to support 95% of the adult population for each breeding location. The 1 km distance used to identify dispersal corridors is based on the maximum migratory distance of adults from the breeding pond into surrounding habitat (Faccio 2003; Semlitsch 1998; OMNR 2008 unpublished data).

While *jeffersonianum*-dominated polyploids will not be protected under the ESA or SARA, they are included in the regulation as surrogates for pure Jefferson Salamanders. The presence of *jeffersonianum*-dominated polyploids indicates that a pure breeding Jefferson Salamander is present to act as a sperm donor (Bogart and

[13] A Jefferson dominated polyploid is a unisexual salamander having more than two sets of chromosomes, with a predominance of Jefferson Salamander chromosomes. See Jefferson Salamander Recovery Team (2010) and COSEWIC (2010) for a more detailed account of the biology and genetics of the *Ambystoma laterale–jeffersonianum* complex. Jefferson dominated polyploids are referred to elsewhere in this addition (Part 1), and in the provincial recovery strategy (Part 2) as *jeffersonianum*-dominated polyploids

Klemens 1997, 2008). Furthermore, *jeffersonianum*-dominated polyploids use the same habitats as pure Jefferson Salamanders and, therefore, a *jeffersonianum*-dominated polyploid associated with a specific habitat (e.g., breeding pond) provides a good indication that pure Jefferson Salamanders (which are very rare and difficult to find) also use that habitat.

The biophysical attributes of critical habitat include the characteristics described below.

For breeding:

- Wetlands, ponds or pools that possess the following characteristics:
    - exist either temporarily, semi-permanently, or permanently and contain ponded water for the duration of egg and larval development[14]; and
    - do not contain predatory fish; and
    - contain substrate(s), such as shrubs, tree branches, twigs, or vegetation to which egg masses may be attached; and
    - contain suitable aquatic prey items such as small aquatic invertebrates or amphibian larvae or tadpoles

For hibernation, foraging, seasonal migration, and dispersal:

- Woodlands, upland forests, swamps, successional areas, meadows, old fields or other vegetated areas that possess the following characteristics:
    - *for hibernation*, contain vertical burrows such as rock fissures or rodent burrows that extend below the frost line; or
    - *for foraging*, contain suitable terrestrial prey items such as insects, earthworms, or other invertebrates; or
    - *for seasonal migration and/or dispersal*, are not interrupted by barriers to movement (e.g., major roads)

- Open, non-vegetated areas (including agricultural fields) connecting breeding ponds and forested areas that possess the following characteristics:
    - *for seasonal migration*, are not interrupted by barriers to movement (e.g., major roads)

Through this recovery strategy, the areas prescribed as habitat for the Jefferson Salamander under section 28 of Ontario Regulation 242/08 become critical habitat identified under SARA. Since the regulation is dynamic and automatically in effect whenever the conditions described in the regulation are met, if any new locations of the Jefferson Salamander (or *jeffersonianum*-dominated polyploids) are confirmed within the geographic areas listed under subsection (1) of the regulation (see Figure 1), the habitat regulation under the ESA applies. Should new occurrences of Jefferson Salamander be identified that meet the criteria above, the additional crtical habitat will be identified in an updated recovery strategy or a subsequent action plan.

[14] As conditions may vary year-to-year, breeding ponds that are temporary in nature may only contain ponded water for a sufficient duration in some years.

Because several or many breeding ponds within an area may support a discrete population, critical habitat for the Jefferson Salamander is made up of core areas and dispersal corridors. Critical habitat core areas are comprised of the breeding ponds (i.e., the areas described in 28(1)(i) and 28(1)(iii) of the Ontario Regulation 242/08), as well as the areas within 300 m of occupied breeding ponds that provide suitable conditions for foraging, dispersal, migration or hibernation (i.e., the areas described in 28(1)(ii) of the Ontario Regulation 242/08). Critical habitat dispersal corridors consist of the habitats that connect core areas and provide suitable conditions for dispersal (i.e., the areas described in 28(1)(iv) of the Ontario Regulation 242/08).

At this time, breeding ponds that provide the basis for delineating critical habitat are represented using available wetland habitat mapping. Where breeding ponds that support Jefferson Salamander are not known (or not available in existing wetland habitat mapping), a generalized area (represented by a radial distance around an observation record (300 m, and 1 km where appropriate; see habitat regulation)) is used to represent the habitat and direct recovery and protection activities until information allowing identification of more detailed critical habitat boundaries is obtained. Because small, temporal or ephemeral features are not well captured through existing land classification mapping, especially where field verification has not taken place, precaution should be taken when biophysical attributes of suitable habitat are represented by available thematic data.

Application of the critical habitat criteria above to the best available data[15], identifies critical habitat of Jefferson Salamander (or *jeffersonianum*-dominated polyploids) in Canada. The total area within which critical habitat for Jefferson Salamander is found is 56,540 ha[16] (Figure 2; see also Table 1). The critical habitat identified is considered a partial identification of critical habitat, and is insufficient to meet the population and distribution objective for the Jefferson Salamander. Additional surveys are required to confirm habitat occupancy at locations where Jefferson Salamader records are older than thirty years or are spatially imprecise. A schedule of studies has been developed to provide the information necessary to complete the identification of critical habitat (see section 5.2).

Human-created features (e.g., old farm ponds and dug ponds) are included in the identification of critical habitat unless there is evidence that Jefferson Salamander or *jeffersonianum*-dominated polyploids have been absent for a period of at least five years. Newly created artificial habitat (i.e., created breeding ponds) will not be included in the identification of critical habitat until there is evidence of use. In addition, the following features are not considered suitable (do not meet the biophysical attributes

[15] The identification of critical habitat is based on available observations as of April 2015 for Jefferson Salamander from the past 30 years.

[16] The area estimate is derived from available land cover information and/or generalized areas and not specific critical habitat mapping for the species. Actual critical habitat within this area occurs only in those areas described in subsection 1(i-iv) of the provincial habitat regulation for Jefferson Salamander habitat and therefore the actual area could be less than reported and may require field verification.

described above) and are not part of critical habitat: existing houses, buildings, structures, quarries, and other pre-existing industrial land uses; major roads; and open areas which do not directly separate breeding ponds from forested areas.

Critical habitat for the Jefferson Salamander is presented using 10 x 10 km UTM grid squares. The UTM grid squares presented in Figure 2 are part of a standardized grid system that indicates the general geographic areas containing critical habitat, which can be used for land use planning and/or environmental assessment purposes, and is a scale appropriate to reduce risks to the Jefferson Salamander and its habitat (e.g., to human disturbance). The areas of critical habitat within each grid square occur where the description of critical habitat is met. More detailed information on the regulated habitat may be requested on a need-to-know-basis from the Ontario Ministry of Natural Resources and Forestry. More detailed information on critical habitat to support protection of the species and its habitat may be requested on a need-to-know basis by contacting Environment Canada – Canadian Wildlife Service at ec.planificationduretablissement-recoveryplanning.ec@canada.ca.

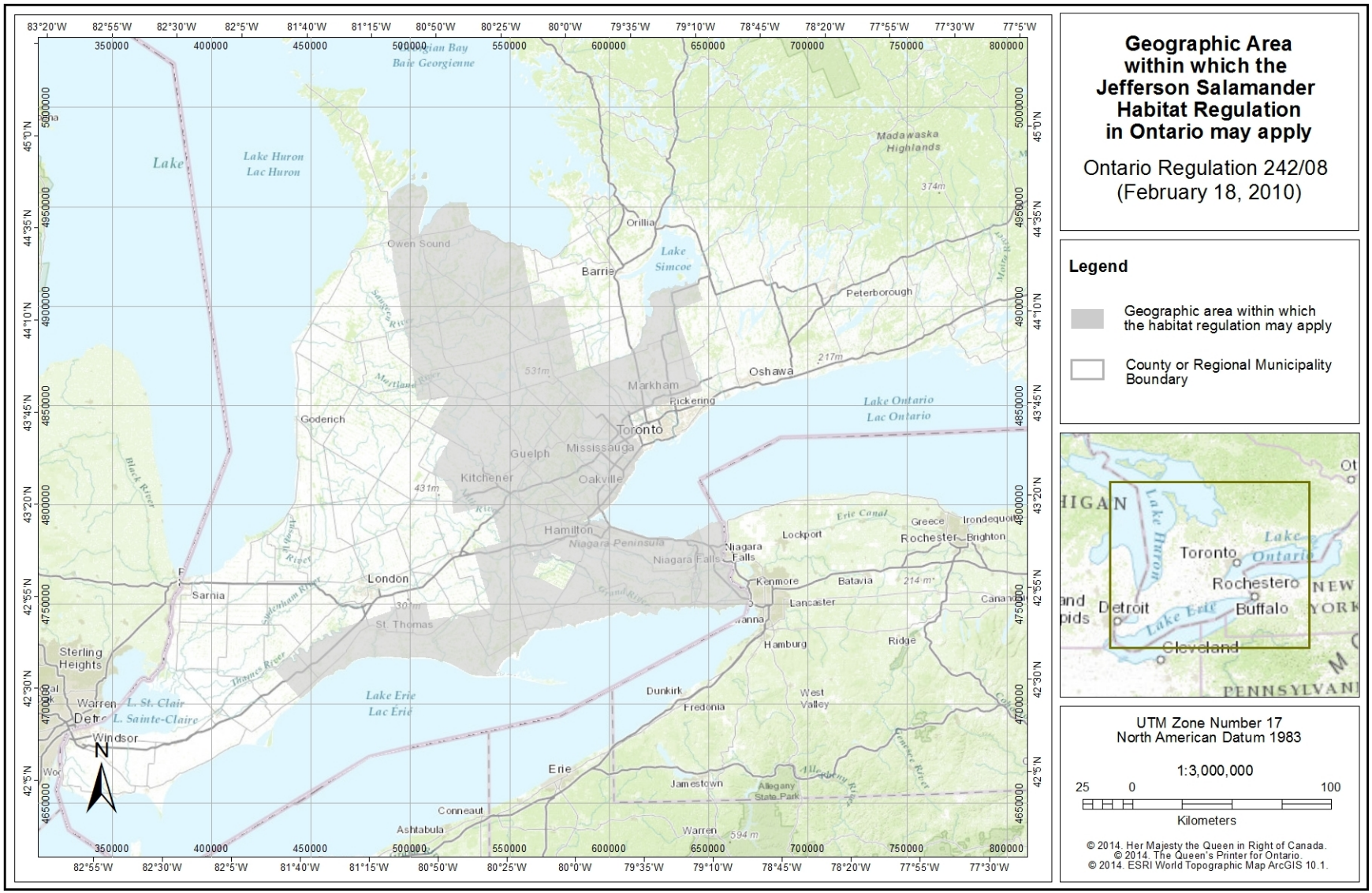

Figure 1. The geographic areas within which the habitat regulation for the Jefferson Salamander may apply, if the habitat meets the criteria described in section 28 of Ontario Regulation 242/08 under the provincial ESA.

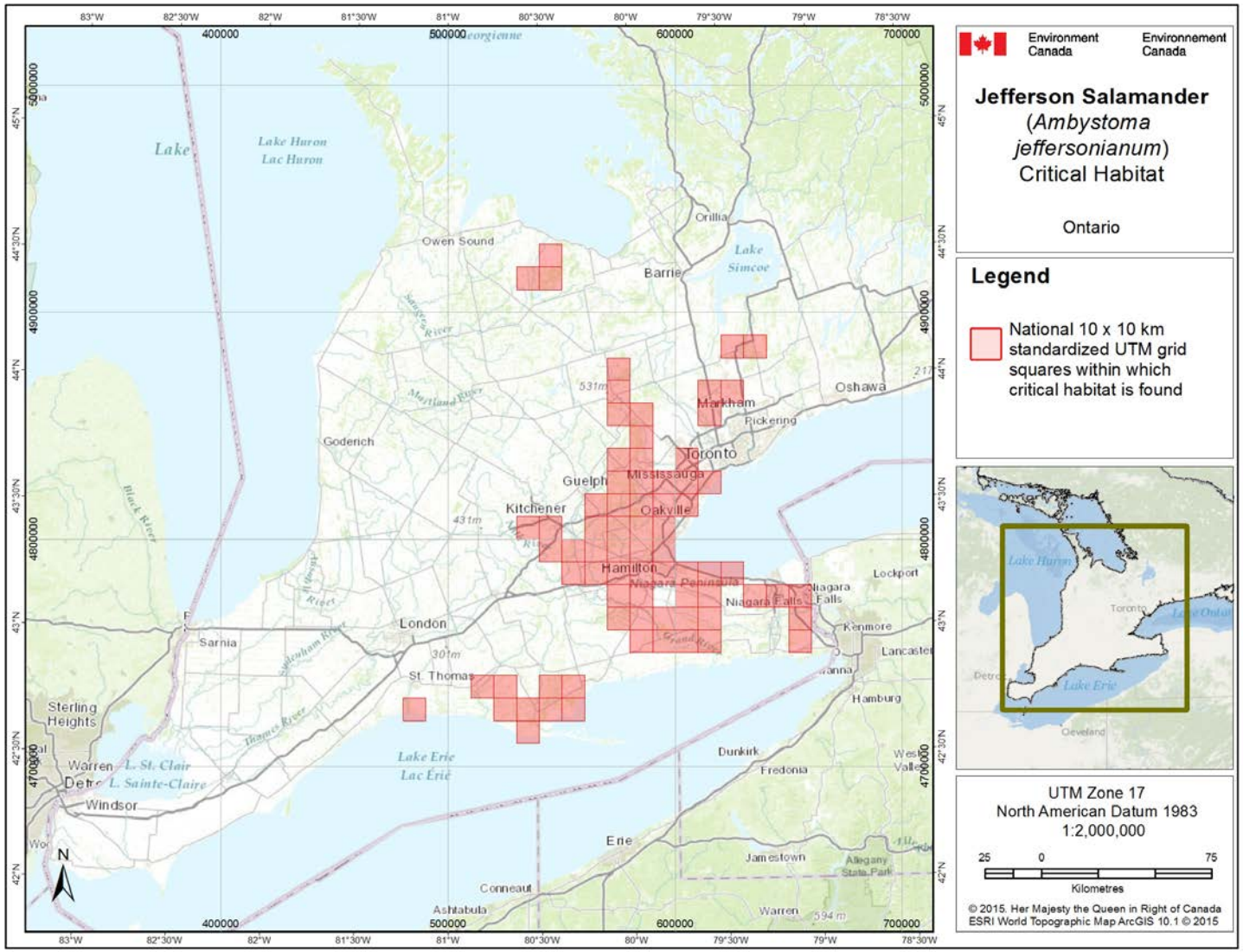

Figure 2. Grid squares that contain critical habitat for the Jefferson Salamander in Canada. Critical habitat for the Jefferson Salamander occurs within these 10 x 10 km UTM grid squares (red shaded squares), where the description of critical habitat is met.

Table 1. Grid squares that contain critical habitat for the Jefferson Salamander in Canada. Critical habitat for the Jefferson Salamander occurs within these 10 x 10 km UTM grid squares where the description of critical habitat is met.

10 x 10 km Standardized UTM Grid Square ID[a]	UTM Grid Square Coordinates[b]		Land Tenure[c]
	Easting	Northing	
17TMH82	480000	4720000	Non-federal Land
17TNH13	510000	4730000	Non-federal Land
17TNH22	520000	4720000	Non-federal Land
17TNH23	520000	4730000	Non-federal Land
17TNH31	530000	4710000	Non-federal Land
17TNH32	530000	4720000	Non-federal Land
17TNH42	540000	4720000	Non-federal Land
17TNH43	540000	4730000	Non-federal Land
17TNH49	540000	4790000	Other Federal Land and Non-federal Land
17TNH52	550000	4720000	Non-federal Land
17TNH53	550000	4730000	Non-federal Land
17TNH58	550000	4780000	Non-federal Land
17TNH59	550000	4790000	Non-federal Land
17TNH68	560000	4780000	Non-federal Land
17TNH69	560000	4790000	Non-federal Land
17TNH76	570000	4760000	Other Federal Land and Non-federal Land
17TNH77	570000	4770000	Other Federal Land and Non-federal Land
17TNH78	570000	4780000	Non-federal Land
17TNH79	570000	4790000	Non-federal Land
17TNH85	580000	4750000	Non-federal Land
17TNH86	580000	4760000	Other Federal Land and Non-federal Land
17TNH87	580000	4770000	Other Federal Land and Non-federal Land
17TNH88	580000	4780000	Non-federal Land
17TNH89	580000	4790000	Non-federal Land
17TNH95	590000	4750000	Non-federal Land
17TNH96	590000	4760000	Non-federal Land
17TNH98	590000	4780000	Non-federal Land
17TNH99	590000	4790000	Non-federal Land
17TNJ30	530000	4800000	Non-federal Land
17TNJ40	540000	4800000	Non-federal Land
17TNJ60	560000	4800000	Non-federal Land
17TNJ61	560000	4810000	Non-federal Land
17TNJ70	570000	4800000	Non-federal Land
17TNJ71	570000	4810000	Non-federal Land
17TNJ72	570000	4820000	Non-federal Land
17TNJ73	570000	4830000	Non-federal Land
17TNJ75	570000	4850000	Non-federal Land
17TNJ76	570000	4860000	Non-federal Land
17TNJ77	570000	4870000	Non-federal Land
17TNJ80	580000	4800000	Non-federal Land
17TNJ81	580000	4810000	Other Federal Land and Non-federal Land
17TNJ82	580000	4820000	Non-federal Land
17TNJ83	580000	4830000	Non-federal Land
17TNJ84	580000	4840000	Non-federal Land
17TNJ85	580000	4850000	Non-federal Land
17TNJ90	590000	4800000	Other Federal Land and Non-federal Land
17TNJ91	590000	4810000	Non-federal Land
17TNJ92	590000	4820000	Non-federal Land

17TNK31	530000	4910000	Non-federal Land
17TNK41	540000	4910000	Non-federal Land
17TNK42	540000	4920000	Non-federal Land
17TPH05	600000	4750000	Non-federal Land
17TPH06	600000	4760000	Non-federal Land
17TPH07	600000	4770000	Non-federal Land
17TPH08	600000	4780000	Non-federal Land
17TPH15	610000	4750000	Non-federal Land
17TPH16	610000	4760000	Non-federal Land
17TPH17	610000	4770000	Non-federal Land
17TPH18	610000	4780000	Non-federal Land
17TPH28	620000	4780000	Non-federal Land
17TPH37	630000	4770000	Non-federal Land
17TPH55	650000	4750000	Non-federal Land
17TPH56	650000	4760000	Non-federal Land
17TPH57	650000	4770000	Non-federal Land
17TPJ01	600000	4810000	Non-federal Land
17TPJ02	600000	4820000	Non-federal Land
17TPJ03	600000	4830000	Non-federal Land
17TPJ12	610000	4820000	Non-federal Land
17TPJ15	610000	4850000	Non-federal Land
17TPJ16	610000	4860000	Non-federal Land
17TPJ26	620000	4860000	Non-federal Land
17TPJ28	620000	4880000	Non-federal Land
17TPJ38	630000	4880000	Non-federal Land

[a]Based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098), where the first two digits and first letter represent the UTM Zone, the following two letters indicate the 100 x 100 km standardized UTM grid followed by two digits to represent the 10 x 10 km standardized UTM grid containing all or a portion of the critical habitat. This unique alphanumeric code is based on the methodology produced from the Breeding Bird Atlases of Canada (See http://www.bsc-eoc.org/ for more information on breeding bird atlases).

[b]The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 10 x 10 km standardized UTM grid square containing all or a portion of the critical habitat. The coordinates may not fall within critical habitat and are provided as a general location only.

[c]Land tenure is provided as an approximation of the types of land ownership that exist where critical habitat has been identified and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.

5.2 Schedule of Studies to Identify Critical Habitat

Table 2. Schedule of Studies

Description of Activity	Rationale	Timeline
Confirm habitat occupancy in locations where Jefferson Salamander records are older than thirty years, spatially imprecise, or cannot be associated to specific locations.	This activity is needed to complete critical habitat identification.	2016 - 2026

5.3 Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by

case basis. Destruction would result if part of the critical habitat was degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single activity or multiple activities at one point in time or from the cumulative effects of one or more activities over time (Government of Canada 2009).

Destruction of critical habitat for the Jefferson Salamander can occur at a variety of scales and in both aquatic and terrestrial habitats. It may occur from an activity taking place either within or outside of the critical habitat boundary and it may occur in any season of the year. Within the critical habitat boundary, activities may affect core habitat areas which include breeding ponds and the areas within 300 m of occupied breeding ponds that provide suitable conditions for foraging, dispersal, migration or hibernation (i.e., the areas described in 28 (1) (i-iii) of the Ontario Regulation 242/08). Activities may also affect dispersal corridors that connect core areas (i.e., the areas described in 28 (1) (iv) of the Ontario Regulation 242/08). Within dispersal corridors it is most important to maintain habitat permeability (movement through connective habitat to access adjacent core areas) and, as a result, certain activities that are likely to cause destruction in core areas may not cause destruction in corridors so long as sufficient habitat permeability is maintained. Activities taking place outside of the critical habitat boundary are also less likely to cause destruction of critical habitat than those taking place within the critical habitat boundary.

Activities described in Table 3 are examples of those likely to cause destruction of critical habitat for the species; however, destructive activities are not necessarily limited to those listed**.**

Table 3. Activities likely to destroy the critical habitat of the Jefferson Salamander.

Description of activity	Description of effect in relation to function loss	Where activity may cause destruction of critical habitat			Details of effect
		Within critical habitat boundary		Outside critical habitat boundary	
		Core	Dispersal corridor		
Development activities (e.g., tree harvesting, site clearing and grading, stormwater management, surface paving, etc.) or other activities that alter site cover and/or hydrology	Tree harvesting, site clearing (e.g., for urban development, aggregate extraction, or resource development) and other activities that result in the net removal, disturbance or destruction of cover objects (e.g., rocks, logs or debris) may result in the direct loss of suitable terrestrial microhabitat characteristics which the species relies on for foraging, for maintaining hydration, for protective cover, and for overwintering. Site clearing and grading may alter the topography and the hydrology (drainage patterns, water table, groundwater flow) of the site. Stormwater management and increases in impervious surfaces may also alter site hydrology. These hydrologic changes may destroy or degrade breeding and/or foraging habitat by modifying or disrupting water flow, water balance, wetland hydroperiods[17], wetland function or soil moisture. Large-scale developments (e.g., urbanization), may remove canopy, alter watercourses for snowmelt and runoff, and/or draw down the water table and therefore may result in the reduction of vernal pond “envelopes” and buffer zones or premature drying of ponds, and thereby destroy, damage or fragment habitat.	X	X	X	Activities within critical habitat core areas that alter cover or the hydrologic regime are highly likely to result in direct destruction at any time of the year because they would degrade habitat required by all life stages for survival. If grading or other activities that alter water flows occur outside of critical habitat or in corridors, it could result in the indirect destruction of critical habitat by altering water regimes within critical habitat thereby reducing or eliminating breeding habitat. Large-scale developments within or adjacent to critical habitat may cause destruction of critical habitat at any time of year. If it occurs within critical habitat core areas, it is highly likely to cause destruction; if it occurs in corridors or adjacent to critical habitat, effects would most likely be cumulative and whether or not they result in destruction would likely depend on the extent and location of the development.

[17] The period during which a wetland holds ponded water.

Description of activity	Description of effect in relation to function loss	Where activity may cause destruction of critical habitat			Details of effect
		Within critical habitat boundary		Outside critical habitat boundary	
		Core	Dispersal corridor		
Erecting barriers (e.g. silt fences or drainage ditches)	Temporary and permanent structures including silt fences erected during construction, or drainage ditches, create physical barriers within the habitat that may hinder or prevent migration of salamanders, thereby preventing them from accessing habitats required to carry out life processes (e.g., breeding, foraging, overwintering) or to migrate among sites.	X	X		This activity must occur within the bounds of critical habitat to cause its destruction, and the likelihood of it causing destruction would depend in large part on the configuration of the barrier and the time of year that it is in place. If this activity occurs within critical habitat core areas, it could cause destruction if it prevents access to areas required by the Jefferson Salamander at one or more life stages. If this activity were to occur in early spring (typically late March to early April) it could prevent or impair breeding, or prevent or impair adults from returning to foraging habitat. If this activity were to occur in late summer/early fall (typically mid-July to mid-September), this activity could prevent or impede dispersal by juveniles from breeding habitat to foraging and overwintering habitat. If this activity occurs within critical habitat corridors, it may cause destruction if it eliminates the function of the corridor.
Building or upgrading roads	If it occurs within critical habitat, this activity could result in the loss or degradation of suitable habitat for all life stages through removal of vegetative cover and conversion to impermeable surfaces (see above). The construction or upgrading of roads can also lead to fragmentation of critical habitat by forming physical barriers that impede dispersal (e.g., steep roadside slopes, large roads with concrete lane dividers), thereby preventing	X	X	X	The effects of this activity can be both direct (e.g., loss of cover, creation of a barrier that fragments habitat) and indirect or cumulative (e.g., pollution). If the effects of the activity are permanent (e.g., paving natural habitat), the activity is likely to cause destruction of habitat if undertaken at any time of the year. However, if activities do not have lasting effects (e.g., upgrading of a road that does not result in further reducing habitat permeability

Description of activity	Description of effect in relation to function loss	Where activity may cause destruction of critical habitat			Details of effect
		Within critical habitat boundary		Outside critical habitat boundary	
		Core	Dispersal corridor		
	Jefferson Salamander from accessing habitats required to carry out life processes or to migrate among sites, and by increasing mortality (e.g., greater risk of desiccation, vehicle collision and predation). In addition, if this activity occurs within or near critical habitat, chemicals and pollutants from roads (e.g., salt, metals, products of combustion) can enter breeding ponds, degrade habitat and cause toxic effects.				or increasing pollution), it may only cause destruction if conducted when the species is undertaking terrestrial movements (typically late March to early April; and mid-July to mid-September). This activity is highly likely to cause destruction if it occurs within critical habitat core areas, because it would reduce access to areas required by the Jefferson Salamander at one or more life stages. If this activity occurs within critical habitat corridors, it is also highly likely to cause destruction by eliminating the function of the corridor. If this activity occurs outside of critical habitat, it may result in the indirect destruction of critical habitat through the introduction of chemical pollution (e.g., salt) into wetlands within critical habitat.
Operation of heavy equipment (e.g., forestry equipment) or heavy use by ATVs	The operation of heavy equipment and heavy use of ATVs (e.g., repeated travel along a path) to the extent that the activity results in the loss of vegetation or microhabitat features, alteration of vernal pool hydrology, or filling, sedimentation or pollution of vernal pools, could destroy, damage or isolate/fragment breeding or terrestrial habitat.	X			If this activity occurs within critical habitat core areas at any time of the year, with the exception of winter months when the ground is snow covered and frozen, it is highly likely to have direct effects on critical habitat.
Addition of carnivorous fish to breeding ponds	Addition of carnivorous fish to ponds would destroy breeding habitat because fish prey upon all life stages of salamanders and would therefore reduce the survival and reproductive success of Jefferson Salamander individuals.	X			If this activity occurs within critical habitat core areas, at any time of the year, it is highly likely to result in its destruction because it would directly eliminate breeding habitat.

6. Measuring Progress

The performance indicator presented below provides a way to define and measure progress toward achieving the population and distribution objective. Every five years, success of recovery strategy implementation will be measured against the following performance indicator:

- The area of occupancy of the Jefferson Salamander in Ontario has been maintained or increased.

7. Statement on Action Plans

One or more action plans will be completed and posted on the Species at Risk Public Registry for the Jefferson Salamander by December 2022.

8. Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[18]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[19] (FSDS) goals and targets.

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

This federal recovery strategy will clearly benefit the environment by promoting the recovery of the Jefferson Salamander and by protecting and enhancing breeding habitat for other co-occurring amphibian species. Government-supported strategies presented in the Government Response Statement will have a positive impact on other wildlife species occupying Carolinian forest, as well as protecting the remnant forest itself. Efforts to protect habitat, to identify potential approaches to mitigate environmental and cultural stressors, and to understand the sensitivity of ponds and vernal pools to changes in the quantity and quality of water will inevitably benefit species found in

[18] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[19] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

association with the Jefferson Salamander. The potential for the strategy to inadvertently lead to adverse effects on other species was considered and no adverse effects from potential mitigation activities were identified.

The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects.

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APPENDIX A: SUBNATIONAL CONSERVATION RANKS OF THE JEFFERSON SALAMANDER (*AMBYSTOMA JEFFERSONIANUM*) IN CANADA AND THE UNITED STATES

Jefferson Salamander (*Ambystoma jeffersonianum*)	
S-rank	**State/Province**
S2 (Imperiled)	Ontario, Illinois, Vermont
S2S3 (Imperiled-Vulnerable)	Massachusetts, New Hampshire
S3 (Vulnerable)	Connecticut, Maryland, New Jersey, West Virginia
S3S4 (Vulnerable-Apparently Secure)	Pennsylvania
S4 (Apparently Secure)	Indiana, Kentucky, New York, Virginia
SNR (Unranked)	Ohio

Rank Definitions (NatureServe 2012b)

S2: Imperiled - At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

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

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

SNR: Unranked - National or subnational conservation status not yet assessed.

PART 2 – *Recovery Strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario*, prepared by the Jefferson Salamander Recovery Team for the Ontario Ministry of Natural Resources

Photo: Leo Kenney

Jefferson Salamander

(Ambystoma jeffersonianum) in Ontario

Ontario Recovery Strategy Series

Recovery strategy prepared under the *Endangered Species Act, 2007*

February 2010

Natural. Valued. Protected.

Ministry of Natural Resources

Ontario

About the Ontario Recovery Strategy Series

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

What is recovery?

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

What is a recovery strategy?

Under the ESA, 2007, a recovery strategy provides the best available scientific knowledge onwhat is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA, 2007 outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. There is a transition period of five years (until June 30, 2013) to develop recovery strategies for those species listed as endangered or threatened in the schedules of the ESA, 2007. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

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

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Natural Resources Species at Risk webpage at: www.ontario.ca/speciesatrisk

RECOMMENDED CITATION

Jefferson Salamander Recovery Team. 2010. Recovery strategy for the Jefferson Salamander (*Ambystoma jeffersonianum*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 29 pp.

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AUTHORS

The recovery strategy was developed by the Jefferson Salamander Recovery Team.

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DECLARATION

The Ontario Ministry of Natural Resources has led the development of this recovery strategy for the Jefferson Salamander in accordance with the requirements of the *Endangered Species Act, 2007* (ESA 2007). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

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

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

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

RESPONSIBLE JURISDICTIONS

Ontario Ministry of Natural Resources
Environment Canada, Canadian Wildlife Service – Ontario

EXECUTIVE SUMMARY

This recovery strategy outlines the objectives and strategies necessary for the protection and recovery of Canadian populations of the Jefferson Salamander (*Ambystoma jeffersonianum*). The strategy was developed with the goal of ensuring that existing threats to populations and habitat of this species are sufficiently removed to allow for long-term persistence and expansion of the Jefferson Salamander within its existing Canadian range. The strategy is based on a comprehensive review of current and historical population census data and research, in addition to genetic analyses that provide accurate identifications of this salamander species and members of the *Ambystoma laterale* (Blue-Spotted Salamander)–*jeffersonianum* complex.

Jefferson Salamander populations have a distinctive genetic evolutionary history. Ontario populations coexist with unisexual individuals that are mostly polyploids with a predominance of Jefferson Salamander chromosomes, and which together are referred to as members of the *A. laterale–jeffersonianium* complex. Jefferson Salamander and polyploids use the same habitat, and the polyploids are reproductively dependant on the Jefferson Salamander. That is, the presence of *jeffersonianum*-dominated polyploid eggs necessarily means that Jefferson Salamander is present as a sperm donor for those unisexual polyploids. For these reasons, the recommendations in this recovery strategy relating to the identification, mapping and protection of habitat apply to both Jefferson Salamander and *jeffersonianum*-dominated polyploids. The apparent absence or lack of documentation of a Jefferson Salamander individual is often the result of naturally low relative abundance and/or limited search effort (Bogart and Klemens 2008).

Major threats to the Jefferson Salamander in Ontario include habitat loss, habitat fragmentation and degradation/alteration, road mortality, impairment of wetland/hydrologic function and the introduction of fish to breeding ponds.

The conservation biology of the Jefferson Salamander is well known in comparison to that of other species at risk in Ontario. This recovery strategy provides the scientific basis with which to establish habitat protection guidelines and make recommendations to protect this species in Ontario. Toward this end, this recovery strategy also outlines and prioritizes recovery approaches and programs. Because known Jefferson Salamander populations exist in areas that are presently under development pressure, there is an urgent need to implement the recovery approaches and to communicate the recovery goals to municipalities, developers and other stakeholders where conflicts exist or are anticipated.

It is recommended that the habitat regulation for the Jefferson Salamander include:

- all wetlands or wetland features that provide suitable breeding conditions where the Jefferson Salamander and *jeffersonianum*-dominated polyploids occur;
- terrestrial habitat areas within 300 metres of the edge of breeding ponds that provide conditions required for foraging, dispersal, migration and hibernation; and

- corridors that provide contiguous connections between breeding locations (up to a maximum distance of 1 kilometre).

Any newly discovered breeding locations and associated terrestrial habitat, as well as extirpated and historical locations where suitable habitat remains, should also be included within the regulation.

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1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Jefferson Salamander
SCIENTIFIC NAME: *Ambystoma jeffersonianum*
SARO List Classification: Threatened
SARO List History: Threatened (2004)
COSEWIC Assessment History: Threatened (2000)
SARA Schedule 1: Threatened (June 5, 2003)
CONSERVATION STATUS RANKINGS: GRANK: G4 NRANK: N2 SRANK: S2

The glossary provides definitions for the abbreviations above.

1.2 Species Description and Biology

Species Description

The Jefferson Salamander (*Ambystoma jeffersonianum*) is a relatively large grey to brownish grey salamander (snout to vent length: 65–96 millimetres [mm]). Bishop (1947) described egg masses of this species. The eggs are incorporated in gelatinous masses that are attached to sticks and plant stems. Each egg mass contains 16 to 40 large (2.0–2.5 mm) eggs, which contain a black or dark brown embryo enclosed in a distinct envelope. A loose, watery layer of protective gel surrounds the eggs. The dark melanin pigment and the gel covering (and any algae in it), along with dissolved organic matter in the water, protect the developing embryos from damage through exposure to ultraviolet B radiation (Licht 2003). Individual females lay several such egg masses, which contain more than 200 eggs, depending on the size of the female.

Breeding success varies from year to year, depending on spring weather and water-level conditions. However, because Jefferson Salamanders are long lived (up to 30 years) populations can be resilient to such variable reproductive output. Eggs complete their development in two to four weeks (depending primarily on water temperature). Hatchlings are 10 to 14 millimetres in total length. The transformation from larvae to adults normally occurs in July and August, when juveniles move out of the pond and seek shelter in the forest litter. The larval stage varies in duration and can extend into early September.

Species Biology – Genetics

The unusual reproductive biology and genetics of the Jefferson Salamander have presented a number of challenges in formulating recovery recommendations. The summary below is intended to explain the main aspects of the *A. laterale* (Blue-Spotted Salamander)–*jeffersonianum* complex.

Jefferson Salamander populations normally coexist with unisexual individuals that are mostly polyploid with a predominance of Jefferson Salamander chromosomes; together they constitute the *A. laterale–jeffersonianum* complex. The presence of eggs of *jeffersonianum*-dominated polyploids necessarily and absolutely indicates the presence of a breeding pure Jefferson Salamander, which is required as a sperm donor to initiate egg development of *jeffersonianum*-dominated polyploids (Bogart and Klemens 1997, 2008, Rye and Weller 2000, OMNR 2008 unpublished data). In Ontario, the correspondence between pure Jefferson Salamanders and *jeffersonianum*-dominated polyploids is absolute, as is the case in New England and New York (Bogart and Klemens 1997, 2008). Pure Jefferson Salamanders and *jeffersonianum*-dominated polyploids cannot be separated by habitat or in many cases by morphology. Therefore, genetic analysis is often required to distinguish pure Jefferson Salamanders from polyploids, and particularly to distinguish pure female Jefferson Salamanders. Blue-spotted Salamanders (*Ambystoma laterale)* and *laterale*-dominated polyploids are the other members of the complex. Polyploids dominated by the Blue-spotted Salamander are not indicative of Jefferson Salamanders. Polyploid members of the complex are generally triploid, but tetraploid and pentaploid individuals have also been documented (Bogart 2003).

Contrary to earlier theories, there is no evidence of past or present hybridization among the members of the *A. laterale–jeffersonianium* complex (Bogart 2003). Mitochondrial DNA from polyploid females predates that of the Jefferson Salamander and Blue-spotted Salamander (Bogart et al. 2007) and has been matched with that of a Kentucky population of the Streamside Salamander (*Ambystoma barbouri*) (Bogart 2003). The genetic mixing that occurs within the polyploid component of the complex is attributed to an unusual reproductive strategy (gynogenesis) whereby polyploid females lay mostly unreduced eggs (eggs whose number of sets of chromosomes is equivalent to that of the parent's somatic cells), and where sperm from a diploid male is required solely to initiate egg development (Elinson et al. 1992). Occasionally, reduced eggs (eggs with only one set of chromosomes) will be present in an egg mass, and genetic material from sperm can be incorporated into the embryos (Bogart 2003).

Jeffersonianum-dominated polyploids demonstrate the same ecology and use of habitat as pure Jefferson Salamanders (Bériault 2005, OMNR 2008). However, *jeffersonianum*-dominated polyploids are much more abundant, normally comprising 90 to 95 percent of local populations (Bogart and Klemens 2008, 1997, OMNR 2008 unpublished data). Therefore, many search efforts focused on finding Jefferson Salamanders using a random sampling of the population would probably encounter only *jeffersonianum*-dominated polyploids.

Because the Jefferson Salamander and *jeffersonianum*-dominated polyploids cannot be separated by habitat, and because the perpetuation of the polyploid component of the complex is dependent on the presence of the Jefferson Salamander, the recommendations in this recovery strategy relating to the identification, description, mapping and protection of habitat apply to both the Jefferson Salamander and *jeffersonianum*-dominated polyploids. The state of Connecticut has gone one step further and has afforded equal protection to polyploids (Bogart and Klemens 2008*)*.

Ecological Role

The presence of the Jefferson Salamander is critical to the survival and existence of unisexuals that make up the majority of the population complex and use Jefferson Salamander males as sperm donors.

Jefferson Salamander larvae are voracious aquatic predators that feed on moving prey such as insect larvae, small crustaceans and amphibian larvae. Adults probably are prey for wetland predators, such as snakes, rodents and birds, for example, the Red-shouldered Hawk (*Buteo lineatus*). The Jefferson Salamander plays an important role in channeling nutrients between the aquatic environment and the upland wooded environment and is an indicator species of high-quality vernal pools.

1.3 Distribution, Abundance and Population Trends

Global Range

The Canadian range of the Jefferson Salamander is restricted to southern Ontario, particularly along the Niagara Escarpment World Biosphere Reserve. In the United States, the species ranges from New York and New England south and southwestward to Indiana, Kentucky, West Virginia and Virginia. An ecological isolate occurs in east-central Illinois (Petranka 1998) (figure 1). For much of this range, genetic data are unavailable, so the continental distribution of pure Jefferson Salamanders and *jeffersonianum*-dominated polyploids is uncertain (Bogart and Klemens 1997).

The current global conservation status rank for the Jefferson Salamander was assigned by the Association for Biodiversity Information (ABI) (NatureServe 2008). Its ranking for the Jefferson Salamander is G4, a level of ranking assigned to species with greater than 100 site occurrences and greater than 10,000 individuals, giving the species an apparently secure ranking globally. NatureServe also applies conservation status ranks at the national (N) and subnational (S) (i.e., provinces or states) levels. Table 1 summarizes the NatureServe rankings for the Canadian and U.S. populations. The species has been designated as imperilled (S2) in Ontario, Illinois and Vermont and is considered to be apparently secure (S4) in only 5 of the 14 states where it is found. Notably, the species is also listed as threatened in Ontario under the *Endangered Species Act, 2007* (ESA 2007) and in Canada under the federal *Species at Risk Act* (SARA).

Table 1. Summary of NatureServe (2008) Conservation Status Ranks for the Jefferson Salamander

Jurisdiction	Conservation Status Rank
Global	G4
Canada	N2
Ontario	S2
United States	N4
Connecticut	S3
Illinois	S2
Indiana	S4
Kentucky	S4
Maryland	S3
Massachusetts	S2S3
New Hampshire	S2S3
New Jersey	S3
New York	S4
Ohio	SNR
Pennsylvania	S4
Vermont	S2
Virginia	S4
West Virginia	S3

Legend:

N2/S2 – Imperilled (i.e., extremely rare or especially vulnerable)

S3 – Vulnerable to extirpation or extinction (i.e., rare and uncommon)

G4/N4/S4 – Apparently Secure (i.e., uncommon but not rare)

SNR – Unranked

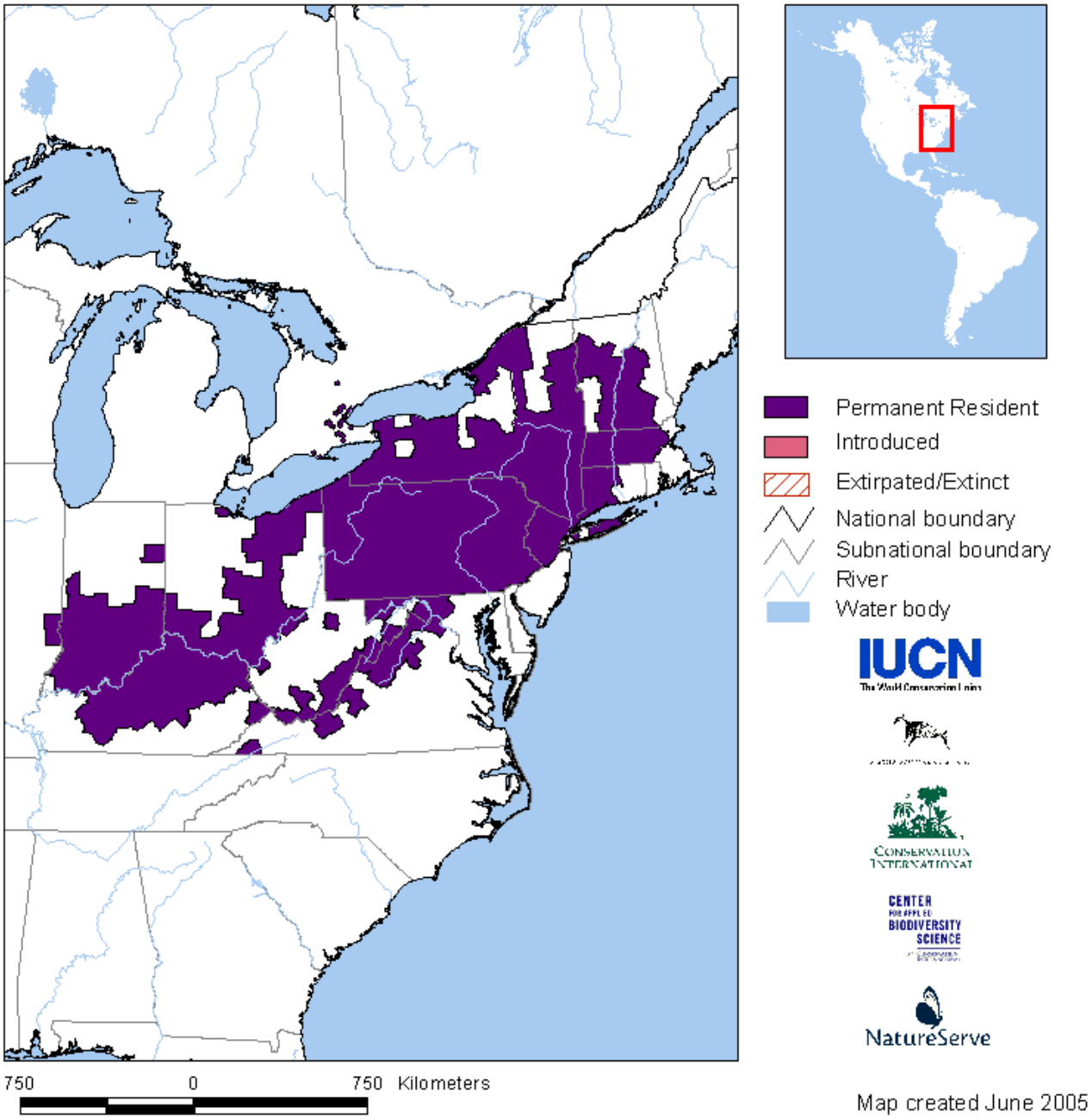

Figure 1. Global range for the Jefferson Salamander (NatureServe 2005)
Note: This map is based on Element Occurrence (EO) records, which represent specific locality data that are developed and maintained by individual provincial and state natural heritage programs. The Canadian distribution is shown as individual occurrences and the U.S. distribution is shown as the watersheds where the occurrences are found.

Canadian Range

The distribution of the Jefferson Salamander in Canada as of October 2008 is based on approximately 328 known breeding ponds representing approximately 27 geographically discrete populations. A geographically discrete population is one that is separated or isolated from other populations by gaps in habitat that limit or prevent gene flow. Distribution data reflect both extant and historic occurrences.

Figure 2 provides the most current locality information for the species. The information is based on a database of all Ontario locations that were compiled by the recovery team and housed at the Natural Heritage Information Centre (NHIC).

The NHIC (2003) has assigned the species a rank of S2 (i.e., very rare in Ontario; usually between 5 and 20 element occurrences in the province, or few remaining hectares, or with many individuals in fewer occurrences; often susceptible to extirpation). The S-rank applies only to pure Jefferson Salamanders, which, by virtue of their very low relative abundance within the complex, means they are exceedingly rare.

In Ontario, known extant populations of the Jefferson Salamander occur in:

- Haldimand, Norfolk, Wellington, Brant, Grey and Elgin counties;
- forested habitat along the Niagara Escarpment from the Hamilton area to Orangeville;
- isolated localities in Halton, Peel, Waterloo, York and Niagara regions;
- Dufferin County east of the Niagara Escarpment.

A population in Wellington County, south of Guelph, is probably extirpated. Jefferson Salamanders were last observed at that site in April 1989 (Bogart unpublished data) and the breeding pond was dry in successive years (1990–93). Historically, the Jefferson Salamander was probably much more widely distributed throughout southwestern and south-central Ontario before the clearing of forests for agriculture.

Percentage of the Global Distribution in Canada

Populations of the Jefferson Salamander in Canada are situated at the northern limit of the species' North American range. The Canadian populations probably represent a maximum of 1 to 3 percent of the estimated North American population, based on relative ranges (Rye and Weller 2000) (figure 1).

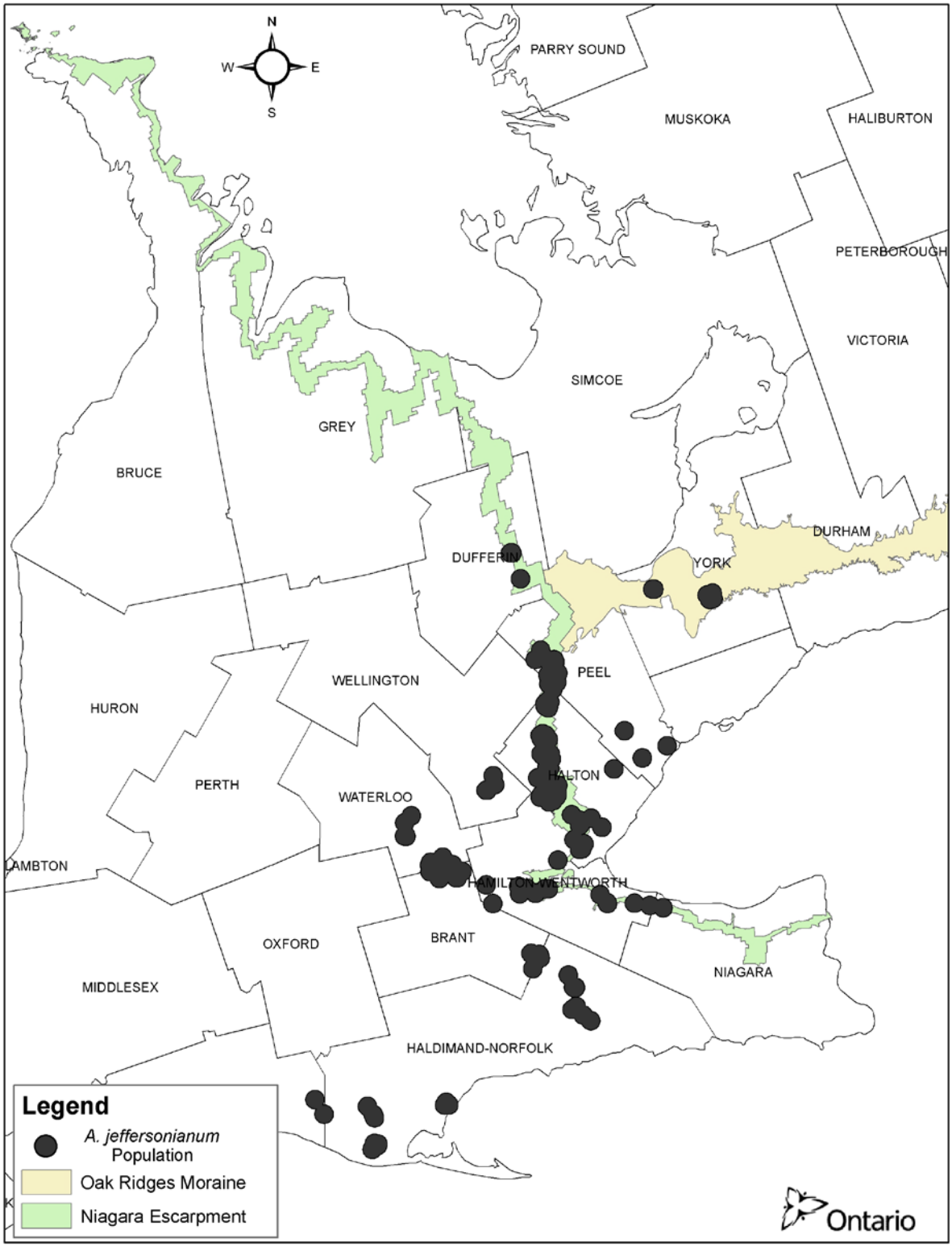

Figure 2. Documented locations of the Jefferson Salamander in Ontario

Population Sizes and Trends

The Jefferson Salamander was first recognized to occur in Canada by Weller and Sprules in 1976. The present knowledge of this species indicates that the current isolated populations are remnants of what was once a more extensive (i.e., continuous) range throughout southern Ontario. Fragmentation and loss of habitat have led to the isolation of these populations. In the part of the province located south and east of the Canadian Shield, over 70 percent of the original woodlands have been lost since European settlement (Riley and Mohr 1994). Habitats have been further lost and fragmented as a result of large-scale agriculture, urbanization, road networks and resource development activities, such as aggregate extraction.

As noted above, the Canadian range of this species comprises approximately 27 known populations in Ontario. One breeding pond does not necessarily represent a population; several or many breeding ponds within an area may support a discrete population. Populations are represented by one or more breeding ponds within an area of contiguous suitable habitat.

Available population census information does not permit an assessment of global abundance trends for this species. Its current global conservation status rank is G4 (NatureServe 2008), which indicates that the species is apparently secure within its range. In Ontario, however, threats to the Jefferson Salamander (see section 1.6) are well known, and cumulative loss and impairment of habitat continue.

Temporal trends for this species are not readily available because of the challenges in identifying the Jefferson Salamander and the unisexuals. As stated earlier, *jeffersonianum*-dominated polyploids occur at much greater relative abundance and normally comprise 90 to 95 percent of local populations (Bogart and Klemens 1997, 2008, OMNR 2008 unpublished data). This means that pure Jefferson Salamanders represent only 5 to 10 percent of the relative abundance of the population (Bogart and Klemens 2008).

Normally, estimations of distribution of vertebrate species may be obtained from museum records and voucher specimens. Such historical identifications of the Jefferson Salamander, as well as available museum records, are, however, not necessarily accurate. Bishop (1947), in his classic book on North American salamanders, lumped all presently recognized members of the complex (Blue-spotted Salamander, Jefferson Salamander and all unisexuals) in a single species, the Jefferson Salamander. Until 1964, most museum curators adhered to Bishop's nomenclature without the benefit of genetic confirmation. It is now understood that distinguishing between most individuals of the complex that are catalogued in major museum collections is not possible.

Uzzell (1964) tried to establish ranges for the Jefferson Salamander by sorting the males into Blue-spotted Salamander and Jefferson Salamander and by using blood-cell size to distinguish diploid and triploid females. Uzzell's ranges for the Jefferson

Salamander were based on very few individuals (8 from Massachusetts, 1 from New Jersey, 37 from New York and 1 from Vermont). Bogart and Klemens (1997) provided a more accurate range of the Jefferson Salamander in New York and New England through the isozyme screening of 1,006 individuals from 106 sites. That large sample identified only 66 pure Jefferson Salamander individuals (6.59%). The global range (figure 1) is based on limited data, and occurrences in many regions still require genetic confirmation.

Jefferson Salamander individuals occur in all of the populations shown in figure 2 (Bogart 1982, Bogart and Cook 1991, Lamond 1994, Bogart unpublished information), but some of these localities have not been revisited for more than 10 years.

Despite difficulties in genetic identification, the available population data show a declining trend (Rye and Weller 2000).

1.4 Habitat Needs

Breeding Ponds

During the first spring rains in March and April, adult Jefferson Salamanders migrate overland at night to breeding ponds (e.g., vernal pools) where mating and oviposition take place. The species uses a range of wetland types for breeding. Breeding ponds are generally vernal pools that are fed by either groundwater (e.g., springs), snowmelt or surfacewater. These types of ponds normally dry in mid to late summer. Other types of wetlands used for breeding may have permanent or semi-permanent water. The ponds are generally located within a woodland or in proximity to a woodland. Jefferson Salamander individuals demonstrate strong pond fidelity, returning to the same pond each year to breed.

Within breeding ponds the Jefferson Salamander requires low shrubs, twigs, fallen tree branches, submerged riparian vegetation or emergent vegetation to which to attach egg masses.

Research has shown that the depth of the water, water temperature, pH, and other water-chemistry and water-quality parameters are not good predictors of the species' use of breeding ponds (Bériault 2005). In central Pennsylvania, one of the few regions in which unisexuals do not coexist with the Jefferson Salamander, embryonic (larval) mortality was high in ponds with a pH below 4.5. Because the Jefferson Salamander larvae are not particularly susceptible to relatively low pH (K. Beriault pers. comm.), mortality was probably affected by the availability of prey (Sadinski and Dunson 1992).

Food must be present in the breeding ponds. Known aquatic prey includes small aquatic invertebrates and amphibian larvae.

For egg masses and juvenile and adult Jefferson Salamanders to survive, breeding ponds must not contain fish that can prey on them.

The hydrologic and hydrogeologic integrity of breeding habitat must be maintained. This requires that both surfacewater hydrology and groundwater contributions are not disrupted, altered or diminished. Hydrologic assessments are required for any adjacent land use that may impact groundwater or surfacewater supporting the breeding pond.

Terrestrial Habitat

Jefferson Salamanders use a number of terrestrial habitats during all parts of their life cycle, including during migration to and from breeding ponds, summer and fall movement and foraging, and overwintering. Most often, these salamanders are associated with deciduous or mixed woodlands. Terrestrial habitat must contain microhabitat, such as rodent burrows, rock fissures, downed woody debris, tree stumps and buttresses, leaf litter, logs, and so on. Other than during migration and breeding, Jefferson Salamanders reside in this microhabitat, overwintering in deep rock fissures and rodent burrows below the frost line. Summer burrows are horizontal and winter burrows are vertical (Faccio 2003). Jefferson Salamanders are also known to show fidelity to their terrestrial habitat (Thompson et al. 1980, OMNR 2008 unpublished data).

Prey in the terrestrial habitat includes insects, earthworms and other invertebrates.

Migratory movements occur in a variety of habitats, including woodlands, plantations, agricultural fields and early successional areas, and across roads. Radio-telemetry studies have documented that the migratory distance of adults of the *jeffersonianum* complex can range from hundreds of metres up to 1 kilometre from the breeding pond into surrounding habitat (Bériault 2005, Faccio 2003, Semlitsch 1998, OMNR 2008 unpublished data). Radio-telemetry studies in Ontario, however, also found that 90 percent of adults reside in suitable habitat within 300 metres of their breeding pond (Bériault 2005, OMNR 2008 unpublished data).

1.5 Limiting Factors

Factors affecting the Jefferson Salamander include the limited availability of the habitats required by the species, namely, vernal pools or fishless wetlands in woodlands for breeding, and loose, moist soils in deciduous or mixed woodlands in terrestrial sites for burrowing.

Climate change may also have an effect on the timing and success of the breeding season and on habitat.

Limiting Factors in Breeding Ponds

For breeding to be successful, suitable egg attachment sites must be available, and the pond must contain an adequate amount of food. At all life stages, the Jefferson

Salamander is vulnerable to predation by fish; therefore, ponds containing fish capable of preying on this species are not suitable as habitat. Many forested wetlands are connected by stream systems that provide access for fish. The lack of vernal pools and fishless wetlands in woodlands is a limiting factor.

Egg and larval mortality have been observed to be high in ponds used by most populations of the Jefferson Salamander, but dead eggs are usually attributed to the polyploids. It is believed that this is a genetic viability issue in some polyploids. Larval mortality is also high among polyploid individuals (Bogart and Licht 1986). In some years, populations can be negatively affected by ponds drying or freezing completely when adult salamanders are breeding or prior to larval transformation.

Limiting Factors in the Terrestrial Habitat

The terrestrial habitat must have an adequate humus layer, leaf litter, stumps, logs, root holes, rock fissures, an appropriate soil type and mammal burrows to support feeding, moisture retention and the avoidance of predators.

1.6 Threats to Survival and Recovery

The following threats to the Jefferson Salamander are presented in order of priority.

Habitat Loss or Degradation

Anthropogenic threats include development activities that result in the cumulative loss and degradation of habitat and fragmentation of breeding ponds and woodlands. Activities associated with urbanization, aggregate extraction and other resource development are the most significant threats to Jefferson Salamanders in southern Ontario. The range of this species is concentrated along the Niagara Escarpment, which is a significant aggregate extraction area.

Impacts from development include site clearing and grading that alter cover, topography and drainage patterns; stormwater management and increases in impervious cover that alter natural hydroperiod regimes; alteration of the water balance of adjacent wetlands and the moisture content of soils; and silt fencing that prevents and/or hinders migration of salamanders. Urbanization, aggregate extraction and roads can result in the loss, impairment and fragmentation of habitat. In addition to direct habitat loss and fragmentation, any resource development activity that may alter the water table or cause a disruption or modification to groundwater flow has the potential to alter wetland hydroperiods and breeding habitat, water balance, wetland function and soil moisture regimes in adjacent Jefferson Salamander habitat.

Roads

Some roads (and urbanization) can create barriers that limit salamander dispersal and abundance and fragment habitat. Vehicles frequently kill Jefferson Salamanders as

they cross roads, and curbs may act as barriers and catch basins as traps. Roads also are a source of chemicals and pollutants (e.g., salt) that degrade adjacent aquatic and terrestrial habitat. Roads create zones of disturbance characterized by noise and light pollution, and contribute to the desiccation of migrating adult salamanders and their increased vulnerability to predators.

Changes in Ecological Dynamics

Relevant to this discussion is an examination of why Jefferson Salamanders were not found in some sites in recent years. Perhaps the species is extirpated in these populations. Again, data are limited, but the species' absence is probably due to habitat changes associated with anthropogenic disturbance. Premature drying of ponds can result from the removal of a part of the protective canopy, drawing down the water table in developed areas, or altering watercourses for snowmelt and runoff. The reduction of vernal pond "envelopes" and buffer zones also has been suggested as contributing to the reduction and possible elimination of species of *Ambystoma* salamanders (Calhoun and Klemens 2002).

Forestry Activities

As Jefferson Salamanders are generally associated with deciduous woodlands, the terrestrial habitat of the species is vulnerable to forestry activities. Forestry activities and the equipment used in them may result in the filling of vernal pools, alteration of vernal pool hydrology, sedimentation, removal or alteration of associated upland habitat (removal of canopy cover, stumps, logs and leaf litter, and alteration of nutrient inputs by leaves), pollution and fragmentation or isolation of vernal pools from the terrestrial habitat.

Recreation and Trails

Heavy use by hikers, cyclists and all-terrain vehicle users of recreational trails near breeding pools and terrestrial habitat may also result in salamander mortality or habitat degradation.

Unauthorized Collection and Introduced Species

Collection of amphibians and reptiles for the pet trade is a growing concern and may be a threat to the Jefferson Salamander. Knowledge of the species' whereabouts is not widespread in the general public since adult Jefferson salamanders migrate and breed during very few rainy nights early in spring, and juveniles migrate in late summer or early fall. A bigger human-related threat is the addition to breeding ponds of carnivorous fish, which prey on all life stages of the salamander.

1.7 Knowledge Gaps

Key knowledge gaps relating to the Jefferson salamander include (but are not limited to) the following:

- the effectiveness of mitigation efforts to address threats and means of reducing road mortality
- the refinement of the species' distribution and range, particularly in portions of the Oak Ridges Moraine Plan Area and the Greenbelt Plan Area
- juvenile dispersal patterns, timing and distances
- fall migration
- overwintering sites

These knowledge gaps have been grouped below in terms of the research requirements for clarifying threats and increasing biological/ecological information.

Threat Clarification Research Requirements

To date, little research has focused directly on natural and human threats to this species. Direct threats, such as habitat loss and degradation associated with resource development and urbanization, need to be quantified and evaluated within the context of cumulative impacts on the distribution and abundance of the Jefferson Salamander. Indirect threats (e.g., development activities that cause changes to wetland hydrology on adjacent lands) require detailed investigation and monitoring to determine cause-and-effect relationships and to evaluate the effectiveness of proposed mitigation. All potential threats to the Jefferson Salamander should be investigated empirically and weighted against other threats. Threats are often difficult to manage; therefore, it is important to amass empirical data to support recovery planning in consultation with planning authorities, developers and stakeholders.

Biological/Ecological Research Requirements

Little is known about the dispersal patterns of juvenile Jefferson Salamanders. It is theorized that juveniles probably disperse farther than adults to establish new breeding ponds and/or populations when the carrying capacity has been reached in existing breeding ponds (J. Bogart pers. comm.).

All radio-telemetry studies completed to date have focused on the spring/summer migration of adults. Future radio-telemetry studies are required to learn more about fall migration. They would help in obtaining more information on Jefferson Salamander overwintering sites, use of terrestrial habitat and microhabitats, communal or individual use of sites, and so on.

1.8 Recovery Actions Completed or Under Way

Work on several of the recovery objectives (see table 2) has begun, and a number of studies on the species have been completed.

Research on Habitat Use and Spatial Requirements (Recovery Objective 2)

In 2004, the University of Guelph initiated radio-telemetry studies of a southern Ontario Jefferson Salamander population (K. Bériault 2005). These studies focused on the movement and habitat use of LJJ[1] polyploids (sample size of 16). To increase the sample size of radio-tagged salamanders and to investigate additional questions relating to habitat use, movements and population demographics, the Ontario Ministry of Natural Resources (OMNR) continued and expanded the study in 2005. Radio transmitters were implanted in 17 additional polyploids from the same location and in 9 and 10 individuals, respectively, at two different sites in Peel Region. In 2007 and 2008, OMNR conducted additional radio-telemetry monitoring of both polyploids and pure Jefferson Salamanders at a site in Halton Region. With an additional 59 salamanders monitored, for a total sample size of 111, these studies have generated extensive data on the movements and terrestrial habitat use of the Jefferson Salamander and *jeffersonianum*-dominated polyploids. These findings, in addition to other studies cited in this document, provide the basis for the recommendations for habitat regulations in section 2.5.

Monitoring Extant Occurrences and Searching for New Breeding Ponds (Recovery Objectives 1 and 5)

In 2002 and 2003, the recovery team worked with the Regional Municipality of York to determine whether Jefferson Salamander populations existed in York Region. Field investigations revealed four populations of Jefferson Salamander. They are the only ones known in York Region and represent the easternmost population of this species in Ontario.

In 2003, the recovery team formed a partnership with the University of Guelph to update the database of all known Jefferson Salamander and polyploid occurrences. Since 2003, more than 100 wetlands with the potential to support *Ambystoma* species have been searched to determine whether the Jefferson Salamander is present. Fifteen new breeding sites have been documented, while at some of the historical breeding locations the species has been confirmed to be extirpated because of habitat disturbance or loss. Because of the elusive nature of this species, the limited window of time in which to find them and the fact that they may not breed every year if conditions are not appropriate, it is difficult to determine with certainty that a breeding location is extirpated. These findings highlight the rarity of the Jefferson Salamander, particularly in areas that are not located on the Niagara Escarpment.

[1] LJJ: a member of the *A. laterale–jeffersonianum* complex with a predominance of *A. jeffersonianum* chromosomes.

Also in 2003/04, the Niagara Escarpment Biosphere Reserve, in partnership with Ontario's Niagara Escarpment (ONE) Monitoring Program staff and the University of Guelph, and under the direction of the recovery team, undertook a study to examine the location and habitat conditions of Jefferson Salamander breeding sites along the Niagara Escarpment. The study focused on historically known breeding locations that the University of Guelph had documented in 1990 and 1991. One historic breeding pond could not be located; whether this was due to inaccurate location information or whether the pond was no longer present could not be determined. Eleven historic breeding ponds (at four geographically discrete locations) were located and searched for egg masses. The presence of the Jefferson Salamander was confirmed at one of the sites. At two sites, egg masses were collected but did not survive genotyping. At one historic site, none of the ponds that were searched contained Jefferson Salamander or polyploid egg masses. The presence of the Jefferson Salamander was confirmed at one new location in Halton Region where the species was not previously documented. In accordance with the recommendations in this recovery strategy, the seven sites where the Jefferson Salamander was not found should be revisited to confirm the presence or absence of the species.

In 2004, also under the direction of the recovery team, a number of conservation authorities (including Grand River Conservation Authority, Hamilton Conservation Authority, Conservation Halton, Credit Valley Conservation, and Toronto and Region Conservation Authority) continued to contribute to the recovery process and recovery planning by allocating staff time and resources to revisiting vernal pools previously known to support the Jefferson Salamander, and to investigating other potential habitats within their watersheds.

In 2006, and continuing in 2007, the University of Toronto at Mississauga, Evergreen, EcoSource Mississauga and Credit Valley Conservation have, under the direction of the recovery team, partnered to assess both habitat conditions and potential human-related impacts on a Jefferson Salamander breeding pond in Peel Region. Information gathered through this project will contribute to the understanding of groundwater contributions to the breeding pond, and of habitat impacts associated with use of recreational trails.

Species and Ploidy Identification

At the University of Guelph, microsatellite molecular markers for the Jefferson Salamander (Julian et al. 2003) have been and continue to be used effectively to identify diploid Jefferson Salamanders and distinguish polyploid members of the complex. These markers may also address other questions regarding population dynamics and genetics that involve the unisexual part of the complex.

Public Contact and Education (Recovery Objective 4)

Many members of the recovery team are associated with or work for regional conservation groups or authorities. In May 2003, OMNR ran workshops in Halton

Region and Waterloo Region that provided instruction on egg mass identification and outlined the protocol for obtaining samples for genetic analyses. Recovery team members attended these workshops.

Aurora District OMNR has produced *Guideline for Applicants for Wildlife Scientific Collectors Authorizations* (2007). This guideline includes detailed direction on collection methodologies and study design requirements that are directly applicable to the Jefferson Salamander. OMNR and the recovery team have worked extensively with a number of consultants, the aggregates industry and conservation authorities in providing direction on collection methodologies and protocols.

2.0 RECOVERY

2.1 Recovery Goal

The recovery goal is to ensure that existing threats to populations and habitat of the Jefferson Salamander are sufficiently removed to allow for the long-term persistence and expansion of the species within its existing Canadian range.

2.2 Protection and Recovery Objectives

The priority of the short-term recovery objectives, and the overall recovery goal, is the protection of existing populations of the Jefferson Salamander by ensuring that no further loss or degradation of known habitat or potentially suitable habitat (recovery habitat) occur. **Habitat protection is critical to the survival of the species.** Protection of existing habitat should have priority over compensation for lost habitat (i.e., the creation of habitat). Consistent with general principles of conservation biology for species at risk, compensatory measures such as habitat creation and species relocation efforts should be undertaken only as a last resort and when other measures (e.g., mitigation) have proved unsuccessful.

Protection, restoration and enhancement of existing Jefferson Salamander habitat are the priority recovery planning recommendations. Habitat alterations that would adversely affect the species should be discouraged.

At present, there is no basis for protecting newly created features (e.g., breeding ponds) because colonization and use of such features has not been sufficiently documented. Created habitat cannot immediately replace existing habitat that Jefferson Salamanders use.

In addition, long-term (i.e., potentially decades) forest and wetland restoration or remediation proposals intended to compensate for losses of existing habitat are not in keeping with recovery planning for the Jefferson Salamander and other species at risk.

Table 2. Protection and recovery objectives

No.	Protection or Recovery Objective
1.	Identify and monitor extant populations of the Jefferson Salamander in Canada
2.	Apply research findings on the species' movements and habitat use to ensure protection of habitat
3.	Identify historic populations/sites with the potential for enhancement or restoration (e.g., recovery habitat)
4.	Develop a communication strategy to inform municipalities, planners, the development industry, property managers and other stakeholders of the habitat mapping and protection requirements for the Jefferson Salamander under the *ESA 2007* and other recovery planning initiatives
5.	Develop and evaluate mitigation and restoration techniques employed to address threats

2.3 Approaches to Recovery

Table 3. Approaches to recovery of the Jefferson Salamander in Ontario

Priority	Objective Number	Broad Approach/ Strategy	Specific Steps	Measurable Outcomes
Urgent	1, 3	Identification of populations	• Verify and document extant, historic and potential populations	• Provision of accurate data for subsequent research, monitoring and mapping

Urgent	1	Population and habitat monitoring	• Develop and implement a standardized monitoring protocol and a five-year monitoring schedule that will focus on:
			  • the presence/absence of salamanders
			  • site-specific and cumulative impacts
			  • range expansion/retraction
			  • assessment of trends in habitat condition
				• Site-specific information for each population in Canada
				• A measure of the success of the species' recovery
				• A central repository and data custodian for information collected

Urgent	1	Population and habitat monitoring/ research	• Select at least one long-term control site and conduct annual monitoring • Prioritize monitoring frequency of locations on the basis of current and potential threats	• Consistent baseline information to compare against effects noted at other sites
Urgent	2, 3	Description of habitat recommended for regulation under the ESA 2007	• Describe and identify aquatic and terrestrial habitat for extant populations • Identify and describe recovery habitat (historic locations and presently unoccupied areas with suitable habitat)	• Provision of advice to government to inform the habitat regulation process under the ESA 2007
Urgent	4	Habitat protection	• Work with planning authorities to encourage integration of the habitat regulation into official plans and other relevant planning processes	• Percentage of the reviewed official plans that integrate protection of the areas prescribed in the habitat regulation
Urgent	4	Communications	• Identify communication needs and products that will provide information and resources to landowners, property managers, the aggregate industry, local stewardship councils, local conservation authorities and other stakeholders to assist in the recovery effort and promote land stewardship • Support monitoring by stakeholders	• Early inclusion/consideration of recovery plan recommendations in higher order planning documents • Production of a list of stakeholders involved in active stewardship and monitoring projects

Priority	Objective Number	Broad Approach/ Strategy	Specific Steps	Measurable Outcomes
High	5	Restoration and enhancement of historic sites	• At historic sites, identify factors that probably caused the loss of the population (e.g., water-level fluctuations, addition of fish, loss of egg attachment sites) • Prioritize potential sites for restoration activity • Evaluate restoration and mitigation techniques	• A number of re-established populations and/or resumption of breeding and successful recruitment • Demonstrated effectiveness and subsequent assessment of mitigation techniques
High	2	Research	• Continue research on species ecology, juvenile dispersion, population biology and parameters consistent with conservation biology planning, using control sites to provide benchmark data for comparison with other locations	• Research providing additional data and products that will assist in the refinement of the recovery strategy and contribute to improved understanding of the ecology/biology of this species
High	5	Research	• Investigate the species' tolerance to environmental and cultural stressors (e.g., environmental contaminants, agricultural activities, urban development, resource extraction)	• Detailed information regarding stressors that negatively affect populations, which will be used in addressing and mitigating threats and in assessing impacts
High	5	Research	• Conduct research on the hydrology of breeding habitat	• Improved understanding of hydrological characteristics (specifically the hydroperiod) and sensitivity of breeding habitat to changes in the quantity and quality of water • Identification methods to study, assess and characterize the hydroperiod of breeding habitat

2.4 Performance Measures

Performance measures have been identified that will evaluate the success and progress of the recovery approaches set out in this strategy. These performance measures will also indicate the extent to which the objectives have been met. They include:

- population trends (increase/decrease) and confirmation of breeding activity;
- quantification of new/extirpated populations;
- consistent baseline information generated from the long-term control site;
- the number and participation of stakeholders involved in related stewardship and monitoring;
- the number of locations for which identified threats have been reduced, mitigated or eliminated;
- the assessment of mitigation techniques (e.g., culverts, silt fencing, artificial recharge);
- increased knowledge of aquatic and terrestrial habitat (e.g., radio-telemetry research);
- the number of municipalities that incorporate the habitat regulation and protection policies into their official plans;
- recommendations used to inform the habitat regulation process under the ESA 2007;
- identification of methods to study, assess and characterize the hydrology of breeding habitat.

2.5 Area for Consideration in Developing a Habitat Regulation

Under the ESA 2007, a recovery strategy must include a recommendation to the Minister of Natural Resources on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below by the author will be one of many sources considered by the Minister when developing the habitat regulation for this species.

The following is a description of the area that is recommended to be prescribed in the regulation as habitat for the Jefferson Salamander.

Breeding Habitat

All wetlands or wetland features that provide suitable breeding conditions for the Jefferson Salamander and *jeffersonianum*-dominated polyploids, such as vernal pools, woodland pools, deciduous swamps, spring-fed pools, groundwater-supported wetlands, sloughs, old deepened or created ponds or ditches where breeding Jefferson Salamanders occur should be included within the habitat regulation.

All such wetlands and features have sites for egg attachment and a sufficient combination of hydroperiod, temperature and productivity to support the deposition and development of eggs and larvae. However, breeding habitat can be dynamic and conditions variable from year to year, depending on precipitation and water levels. This can result in variable breeding activity and success from one year to next. For this reason, surveys intended to determine the presence of Jefferson Salamanders in new locations may need to be conducted for up to three years to ensure that adequate effort has gone into investigating the species' presence. In the case of historic locations, a minimum of three consecutive years of surveys that fail to indicate the presence of the Jefferson Salamander must be conducted to confirm the extirpation of the species from that specific historic site. All life stages of the Jefferson Salamander are vulnerable to predation by fish; therefore, ponds containing fish that can prey on Jefferson Salamanders are not suitable breeding habitat.

Terrestrial Habitat

The terrestrial component of Jefferson Salamander habitat consists of woodlands, upland forests, swamps, successional areas, meadows, old fields, agricultural fields and other vegetated areas that provide conditions required for foraging, dispersal, migration, growth and hibernation. Terrestrial habitat includes all of the areas and features described above that extend radially 300 metres from the edge of the breeding pond. The 300 metre distance is based on the findings of telemetry studies (Bériault 2005, OMNR 2008 unpublished data) and is calculated as the habitat area used by 90 percent of the adult population for each breeding location, identified on the basis of movements of tracked individuals. Terrestrial habitat that meets these requirements should be included within the habitat regulation.

Corridors that provide contiguous connections between breeding locations can extend up to a maximum of 1 kilometre and should also be included within the habitat regulation. Non-vegetated open areas such as agricultural fields may be used as migratory corridors between the breeding pond and forested areas.

Exclusions

The following features should not be included within the habitat regulation:

- existing houses, buildings, structures and quarries (and other pre-existing industrial land uses) that are within 300 metres of a breeding pond
- major roads within 300 metres of a breeding pond that present barriers to migration and dispersion (e.g., highways, major arterial roads)
- open areas such as agricultural fields that are within 300 metres of a breeding pond but that do not directly separate it from forested areas and therefore do not serve as corridors between habitats and/or breeding areas

Newly Discovered Occurrences

New occurrences of the Jefferson Salamander are expected to be discovered. For the purposes of investigating the presence of this species at previously unsurveyed locations, appropriate surveys for up to three consecutive years may be required to document its presence. This is because breeding success may be intermittent due to variable conditions.

Any newly discovered breeding locations and associated terrestrial habitat, as well as extirpated and historical locations where suitable habitat remains, should also be included within the regulation.

Human-Created Features

Jefferson Salamanders occasionally breed in old farm ponds and human-created depressions that have reached a substantial state of wetland succession (probably after decades) and that occur within or close to existing forested or other naturally vegetated areas. Most of these ponds/depressions occur in locations where wetlands had originally existed or where portions of wetlands have been deepened. The vast majority of wetlands on the landscape that existed before agricultural conversion have been eliminated, and therefore the Jefferson Salamander uses some naturalized human-created depressions as breeding habitat, which should be included within the habitat regulation.

Artificial Habitat Creation/Rehabilitation

At present there is no basis for protecting newly created features (e.g., breeding ponds) within a habitat regulation because colonization and use of such features has not been sufficiently documented. Created habitat cannot immediately replace existing habitat that the Jefferson Salamander uses.

GLOSSARY

Extant population: A population that has been confirmed in the last 20 years.

Historic population: A population that has not been confirmed in the last 20 years but is not yet confirmed as extirpated.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee responsible for assessing and classifying species at risk in Canada.

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

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

1 = critically imperilled
2 = imperilled
3 = vulnerable
4 = apparently secure
5 = secure

Control site: A study site against which all other study sites will be compared. In the case of the Jefferson Salamander, a control site is one where conditions are known to be typical for the species and where there is a lack of disturbance.

Element occurrence: As used by NatureServe conservation data centres, an occurrence of an element of biodiversity (e.g., species or ecological community) on the landscape; an area of land and/or water on/in which an element is or was present. The NHIC uses a 1 kilometre radius to define element occurrences of the Jefferson Salamander in Ontario.

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

Hydroperiod: The duration of time in which water is present in a vernal pool or other wetland.

Polyploid: [Of] An organism that contains more than two sets of chromosomes (e.g., triploid – three sets of chromosomes, tetraploid – four sets of

chromosomes). Examples within the *Ambystoma laterale–jeffersonianum* complex include LJJ, LLJ, LJJJ, and so on.

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

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

Snout to vent length (SVL): A standard measurement of an animal's body length. The measurement is from the tip of the nose (snout) to the cloaca (vent), and excludes the tail.

Unisexual: A female member of the *Ambystoma laterale–jeffersonianum* complex that uses a form of reproduction whereby sperm is required to stimulate egg development but the male's genes are not incorporated. The offspring are genetically identical to their mothers.

Vernal pool: Also known as an "ephemeral wetland," a landform depression that temporarily fills with water following snowmelt in the spring and heavy rainfall or as a result of a high water table. Vernal pools vary in their size, shape, depth, timing and duration of flooding, and the types of species that are able to use them. A defining feature of vernal pools is that they usually dry by the middle of the summer; some vernal pools, however, may dry only every couple of years.

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RECOVERY STRATEGY DEVELOPMENT TEAM MEMBERS

NAME	AFFILIATION and LOCATION
Dr. Jim Bogart (Team Chair)	Department of Zoology University of Guelph
Emma Followes (Team Coordinator)	District Ecologist Ministry of Natural Resources Aurora District
Heather Lynn	Natural Heritage Ecologist Credit Valley Conservation
Kim Barrett	Senior Ecologist Conservation Halton
John Pisapio	Wildlife Biologist Ministry of Natural Resources Aurora District
Ron Gould	Species at Risk Biologist Ministry of Natural Resources Aylmer District
Dr. Bob Murphy	Senior Curator Centre for Biodiversity and Conservation Biology Royal Ontario Museum
Anne Marie Laurence	Ecological Monitoring Specialist Ontario's Niagara Escarpment (ONE) Monitoring Program Niagara Escarpment Commission
Lisa Grbinicek	Environmental Planner Ontario's Niagara Escarpment (ONE) Monitoring Program Niagara Escarpment Commission
Tony Zammit	Ecologist Grand River Conservation Authority
Scott Sampson	Natural Heritage Ecologist Credit Valley Conservation
Sue Hayes	Project Coordinator, Terrestrial Field Inventories Toronto and Region Conservation Authority
Karine Bériault	Species at Risk Biologist Ministry of Natural Resources Vineland Area Office

PART 3 – *Jefferson Salamander Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources

Ministry of Natural Resources

Natural. Valued. Protected.

Jefferson Salamander

Ontario Government Response Statement

Photo: Leo Kenney

PROTECTING AND RECOVERING SPECIES AT RISK IN ONTARIO

Species at risk recovery is a key part of protecting Ontario's biodiversity. Biodiversity – the variety of living organisms on Earth – provides us with clean air and water, food, fibre, medicine and other resources that we need to survive.

The *Endangered Species Act*, 2007 (ESA) is the Government of Ontario's legislative commitment to protecting and recovering species at risk and their habitats. As soon as a species is listed as extirpated, endangered or threatened under the ESA, it is automatically protected from harm or harassment. Also, immediately upon listing, the habitats of endangered and threatened species are protected from damage or destruction.

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

GOVERNMENT RESPONSE STATEMENTS

Within nine months after a recovery strategy is prepared, the ESA requires the Ministry to publish a statement summarizing the government's intended actions and priorities in response to the recovery strategy. The recovery strategy for Jefferson Salamander was completed on February 18, 2010.
(http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/286968.pdf)

The response statement is the government's policy response to the scientific advice provided in the recovery strategy. In addition to the strategy, the response statement is based on input from stakeholders, other jurisdictions, Aboriginal communities and members of the public. It reflects the best available traditional, local and scientific knowledge at this time and may be adapted if new information becomes available. In implementing the actions in the response statement, the ESA allows the Ministry to determine what is feasible, taking into account social and economic factors.

Jefferson Salamanders have grey or brown backs, with lighter undersides. Adults are 12-20 cm long with the tail making up half this length. In Canada, the species is found only in southern Ontario, mainly along the Niagara Escarpment. Major threats to the Jefferson Salamander include habitat loss, degradation and fragmentation, road-related threats, and introduction of carnivorous fish to breeding ponds.

Ontario

MOVING FORWARD TO PROTECT AND RECOVER JEFFERSON SALAMANDER

The Jefferson Salamander is listed as a threatened species under the ESA which protects both the species and its habitat. The Government of Ontario has demonstrated its commitment to protecting the Jefferson Salamander by prescribing its specific habitat in regulation. The Act prohibits any damage or destruction of that habitat without authorization. Such authorization would require that conditions established by the Ministry be met.

The government's goal for the recovery of the Jefferson Salamander is to ensure that threats to populations and habitat are addressed, in order to allow for the long-term persistence and expansion of the species within its existing Ontario range.

Protecting and recovering species at risk is a shared responsibility. No single agency or organization has the knowledge, authority, or financial resources to protect and recover all of Ontario's species at risk. Successful recovery requires inter-governmental co-operation and the involvement of many individuals, organizations and communities.

In developing the government response statement, the Ministry considered what actions are feasible for the government to lead directly, and what actions are feasible for the government to support its conservation partners to undertake.

GOVERNMENT-LED ACTIONS

To help protect and recover the Jefferson Salamander, the government will directly undertake the following actions:

- Ensure appropriate timing windows for activities undertaken in and around Jefferson Salamander habitat are considered in the application of the ESA.
- Educate other agencies and planning authorities on the requirement to consider the protection of the Jefferson Salamander and its habitat in planning activities and environmental assessment processes.
- Encourage the submission of Jefferson Salamander data to the Ministry of Natural Resources' central repository at the Natural Heritage Information Centre.
- Undertake communications and outreach to increase public awareness of species at risk in Ontario.
- Protect the Jefferson Salamander through the ESA and enforce the regulation protecting the specific habitat of the species.
- Support conservation, agency, municipal and industry partners to undertake activities to protect and recover the Jefferson Salamander. Support will be provided through funding, agreements, permits (including conditions) and advisory services.
- Establish and communicate annual priority actions for government support in order to encourage collaboration and reduce duplication of efforts.

GOVERNMENT-SUPPORTED ACTIONS

The government endorses the following actions as being necessary for the protection and recovery of the Jefferson Salamander. Actions which are noted as "high" will be given priority consideration for funding or for authorizations under the ESA. The government will focus its support on these high priority actions over the next five years.

Focus Area: Monitoring
Objective: Identify and monitor populations of the Jefferson Salamander in Ontario.

Actions:

1. **(HIGH)** Verify and document the locations of historic, existing and potential populations and the characteristics of their habitat.
2. **(HIGH)** Implement a standardized monitoring protocol to measure the presence or absence of salamanders, the site-specific and cumulative impacts at the locations, and trends in habitat condition. The monitoring frequency of the locations should be prioritized on the basis of current and potential threats. Each year, monitoring should include both unaltered sites and sites under threat, in order to allow for comparison of impacts.

Focus Area: Threat Management
Objective: Evaluate and implement threat mitigation and habitat restoration techniques.

Actions:

3. **(HIGH)** Investigate the tolerance of the species to environmental and cultural stressors (e.g., environmental contaminants, agricultural activities, urban development and resource extraction) and potential approaches to mitigate these threats.
4. At sites where Jefferson Salamander used to occur, identify factors that likely caused the loss of the population (e.g., water-level fluctuations, addition of fish, or loss of egg attachment sites).
5. Identify currently unoccupied sites where the species used to occur and where the habitat has the potential to be enhanced or restored.
6. Where appropriate, implement habitat restoration and threat mitigation techniques at priority sites.
7. As opportunities arise, support the securement of habitat of the Jefferson Salamander through existing land securement and stewardship programs.

Focus Area: Habitat Research
Objective: Address knowledge gaps on the species' movements and habitat use to inform protection of habitat.

Actions:

8. Continue research on the species' use of habitat with a focus on gaining information about fall movements, overwintering areas and juvenile dispersal.
9. Conduct research on the hydrology of breeding habitat to determine the sensitivity of breeding habitat to changes in the quantity and quality of water.

Focus Area:	**Awareness**
Objective:	Raise awareness and promote stewardship of Jefferson Salamanders and their habitat in Ontario.

Actions:

10. Develop communication products and tools to provide information to landowners, property managers, industry, local stewardship councils, conservation authorities and other stakeholders to assist in the recovery of the species and promote land stewardship.

IMPLEMENTING ACTIONS

Financial support for the implementation of actions may be available through the Species at Risk Stewardship Fund, Species at Risk Farm Incentive Program, or Community Fisheries and Wildlife Involvement Program. Conservation partners are encouraged to discuss project proposals related to the actions in this response statement with the Ministry of Natural Resources. The Ministry can also advise whether any authorizations under the ESA or other legislation may be required for undertaking the project.

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

REVIEWING PROGRESS

The ESA requires the Ministry to conduct a review of progress towards protecting and recovering a species not later than five years from the publication of this response statement. The review will help identify whether adjustments are needed to achieve the protection and recovery of the Jefferson Salamander.

ACKNOWLEDGEMENT

We would like to thank everyone who participated in the development of the "Recovery Strategy for the Jefferson Salamander in Ontario" for their dedication to protecting and recovering species at risk.

For additional information:
Visit the species at risk website at
ontario.ca/speciesatrisk
Contact your MNR district office
Contact the Natural Resources Information Centre
1-800-667-1940
TTY 1-866-686-6072
mnr.nric.mnr@ontario.ca
ontario.ca/mnr