

Management Plan for the
Channel Darter
(Percina copelandi)

St. Lawrence populations



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Management Plan for the Channel Darter (*Percina copelandi*), St. Lawrence populations in Canada

2026

Through the [Canada-Quebec agreement for the protection of species at risk in Quebec of 2012 to 2022](#), the Government of Quebec has given permission to the Government of Canada to adopt the "Recovery Plan for the Channel Darter (*Percina copelandi*) in Quebec, 2020 to 2030" (part 2), under section 69 of the *Species at Risk Act* (SARA). The Minister of Fisheries is the competent minister for the Channel Darter (*Percina copelandi*) under SARA and has included a federal addition (part 1), which fulfills all SARA requirements for this management plan.

The federal management plan for the Channel Darter (St. Lawrence populations) consists of 2 parts:

Part 1: Federal Addition to the "Recovery Plan for the Channel Darter (*Percina copelandi*) in Quebec, 2020 to 2030", prepared by Fisheries and Oceans Canada

Part 2: "Recovery Plan for the Channel Darter (*Percina copelandi*) in Quebec, 2020 to 2030", prepared by the Équipe de rétablissement des cyprinidés et petits percidés du Québec, produced for the Ministère des Forêts, de la Faune et des Parcs (now named Ministère de l'Environnement et de la Lutte contre les changements climatiques)

Acknowledgements

Fisheries and Oceans Canada (DFO) wishes to thank the Équipe de rétablissement des cyprinidés et petits percidés du Québec for leading the development of the provincial plan, and the Quebec Ministère de l'Environnement, de la Lutte aux changements climatiques, de la Faune et des Parcs (MELCCFP) for agreeing to have this document adopted at the federal level. DFO would also like to thank Arianne Savoie, Marie-Pierre Veilleux, Amy Boyko, Christine Lambert, Annabelle Mercier-Morache, Isadora Desmarais-Lacourse, Marie-Michèle Bourassa, Pierre-Jean Harnois and Andrew Geraghty, for the effort they invested in the federal addition.

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**Part 1 – Federal Addition to the "Recovery plan for the Channel Darter (*Percina copelandi*)
in Quebec, 2020 to 2030", prepared by Fisheries and Oceans Canada**

Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)¹ agreed to establish complementary legislation and programs that provide for the 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 a management plan for species listed as special concern and are required to report on progress 5 years after the publication of the final document on the [Species at Risk Public Registry](#), and every subsequent 5 years, until its objectives have been achieved.

The Minister of Fisheries is the competent minister under SARA for the Channel Darter (*Percina copelandi*) (St. Lawrence populations) and has prepared the federal addition (part 1) of this management plan, as per section 65 of SARA. The "Recovery Plan for the Channel Darter (*Percina copelandi*) in Quebec, 2020 to 2030" developed by the Quebec government is adopted as part 2 of this management plan pursuant to section 69 of SARA. This allows the competent minister to adopt all or part of an existing plan for the species if the minister is of the opinion that an existing plan relating to the wildlife species includes adequate measures for the conservation of the species. To the extent possible, this federal addition (part 1) of the management plan has been prepared in cooperation with other federal government departments, provinces, and indigenous organizations as per subsection 66(1) of SARA.

As stated in the preamble to SARA, success in the conservation of this species depends on the commitment and cooperation of many different groups that will be involved in implementing the directions and measures for the conservation of the species set out in this plan and will not be achieved by Fisheries and Oceans Canada or any other jurisdiction alone. The cost of conserving species at risk is shared among different contributors. All Canadians are invited to join in supporting and implementing this management plan for the benefit of the Channel Darter (St. Lawrence populations) and Canadian society as a whole.

A SARA management plan includes measures for the conservation of the species of special concern to prevent it from becoming threatened or endangered. The competent minister must prepare a management plan that includes measures for the conservation of the species that the minister considers appropriate. These measures for the conservation of the species are set out to achieve the management objectives identified in the management plan. Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

¹ The Quebec government has not signed the Accord for the Protection of Species at Risk of 1996. In addition, the Canada-Quebec Accord for the Protection of Species at Risk expired on March 31, 2022.

Additions and modifications to the adopted document

Fisheries and Oceans Canada (DFO) prepared the following additions to the "Recovery Plan for the Channel Darter (*Percina copelandi*) in Quebec, 2020 to 2030" (part 2 of this document, herein referred to as the Quebec Plan)², developed by the government of Quebec to meet the specific requirements of the *Species at Risk Act* (SARA) and to provide additional information. These additions and modifications are considered an integral part of the federal management plan for the Channel Darter (St. Lawrence populations; Channel Darter from this point forward).

Unless otherwise indicated in the federal addition (part 1) of this document, or when statements specifically concern Quebec rivers, the information regarding status, recovery strategy, management plan, and conclusion are also applicable to Channel Darter populations in Ontario.

The temporal scope of the federal management plan is not limited to the period 2020 to 2030. The measures identified will be the subject of a report on the progress of management plan implementation 5 years after the publication of the federal management plan, and these elements will remain valid until the objectives are achieved or new information becomes available that justifies their modification. Accordingly, any references to dates in the Quebec Plan in relation to recovery objectives or recovery measures and actions are not to be considered part of the federal management plan.

Under SARA, prohibitions regarding the protection of species and their habitat do not apply to species of special concern. Conservation measures in the Quebec Plan dealing with the protection of individuals and their habitat are still adopted to guide conservation efforts but would not result in federal legal protection.

The Quebec Plan addresses socio-economic considerations and the concept of critical habitat in several sections dealing directly with the recovery of the species. These components are not relevant to a management plan prepared under SARA; therefore, sections 2.6.2 (Critical habitats) and 5 (Socio-economic issues related to the implementation of the recovery plan) of the Quebec Plan are not adopted.

² The original version of this document is in French only. The version within this document was translated by the federal government.

1. Committee on the Status of Endangered Wildlife in Canada (COSEWIC) species assessment information

Assessment Summary – November 2016

Common name

Channel Darter - St. Lawrence populations

Scientific name

Percina copelandi

Status

Special concern

Reason for designation

This small-bodied species is broadly distributed, but there is evidence of extirpation at some localities within its range. The species is subjected to a variety of threats related to the impact of the invasive Round Goby and pollution. The species may become threatened if these threats are not effectively managed.

Occurrence

Ontario, Quebec

Status history

The species was considered a single unit and designated threatened in April 1993. Status re-examined and confirmed in May 2002. When the species was split into separate units in November 2016, the “St. Lawrence populations” unit was designated special concern.

2. Species status information

This section replaces the information on SARA legal designations and conservation status for Channel Darter in Canada in “Section 2: Species Status” of the Quebec Plan:

The legal designation of Channel Darter, St. Lawrence populations on SARA Schedule 1 is special concern (2019).

The Channel Darter was assessed by COSEWIC as a single designable unit (DU) and designated threatened in 1993; this status was confirmed in 2002. In April 2006, the species was listed on Schedule 1 of SARA as threatened. Following a review conducted by COSEWIC in November 2016, the single population was divided into 3 separate DUs. At that time, the St. Lawrence populations DU was designated special concern by COSEWIC. In August 2019, the St. Lawrence populations DU was added to Schedule 1 of SARA as special concern. Populations in the other 2 DUs have been listed on Schedule 1 as endangered and are subject to a separate recovery strategy and action plan.

SARA section 32 prohibitions do not apply upon listing Channel Darter as special concern and, therefore, no permits are required under section 73 of SARA. Further, the identification and protection of critical habitat and species’ residence is not required under SARA for species listed as special concern.

The *Fisheries Act* also provides for the protection of aquatic species at risk. The *Fisheries Act* provides a framework for (a) the proper management and control of fisheries; and, (b) the conservation and protection of fish and fish habitat, including by preventing pollution.

Section 2.9 of the Quebec Plan is descriptive in nature and is not intended as an evaluation of the effectiveness of legislative implementation. Such legislative audit processes already exist at federal level and in the Government of Quebec (Office of the Auditor General of Canada and

Vérificateur général du Québec [Lambert et al. 2023]). The following additions are made to section 2.9 "Protective measures" of the Quebec Plan:

The 4 laws of the Government of Quebec and the 2 federal laws named in the Quebec Plan aim, in various ways, directly or indirectly, to protect the Channel Darter or its habitat. Although these laws can potentially promote the conservation of the species, they are not the only means of achieving this objective.

Channel Darter has been listed under Ontario's *Endangered Species Act 2007* as a special concern species. Although the habitat of special concern species does not receive direct protection under the Act, the habitat of Channel Darter may receive indirect protection where it overlaps with the habitat of species listed as threatened or endangered. The following additions are made to section 2.9.1 of the Quebec Plan:

Channel Darter habitat could also receive legal habitat protection when the provisions of the *Provincial Policy Statement* are applied to protect the habitats of co-occurring threatened and endangered species. Policy 2.1.7 of the *Provincial Policy Statement*, issued under subsection 3(1) of the *Planning Act*, prohibits the development and site alteration in the significant habitat of provincially listed endangered and threatened species. This prohibition does not restrict or limit the ability of existing agricultural uses to continue, as mentioned in subsection 2.1.9 of the *Provincial Policy Statement*. The provincial government of Ontario is currently consulting on the *Provincial Planning Statement*, as such these references and policies may be subject to change.

Channel Darter is indirectly protected under the Ontario *Lakes and Rivers Improvement Act*, which addresses the construction and maintenance of dams, pipelines, channelization, and dredging activities, and the *Ontario Water Resources Act*, which prevents the deposition of harmful material into lakes and rivers as well as the removal of benthic or littoral material. The Ontario *Environmental Assessment Act* sets standards for the undertaking of environmental assessments in the province, and the application of decisions based on these assessments. Conservation authorities are also responsible for regulating and enforcing riparian development by the use of floodplain regulations under the *Conservation Authorities Act*.

The use of Channel Darter as baitfish is prohibited in Ontario (Ontario Ministry of Natural Resources and Forestry [OMNRF] 2021).

3. Population abundance and distribution

The Quebec Plan (part 2, section 2.3) describes the Channel Darter's range globally and within the province of Quebec. DFO adopts "Section 2.3: Channel Darter range" with the addition of the following to describe the Ontario range in Canada and update range maps in both Ontario and Quebec:

The range of the Channel Darter in Canada extends beyond the borders of Quebec and includes southern Ontario. All Channel Darter populations live within the Great Lakes – Upper St. Lawrence National Freshwater Biogeographic Zone, but because they have a discontinuous range, COSEWIC has divided the Channel Darter population in Canada into 3 DUs (COSEWIC, 2016): DU1 (Lake Erie populations), DU2 (Lake Ontario populations), and DU3 (St. Lawrence populations). These 3 DUs were identified by taking into account the distance between each population, which is at least 300 km. The

existence of 3 large, distinct populations was also confirmed through genetic studies (Kidd et al. 2011; Reid et al. 2013). This management plan was prepared for the St. Lawrence populations.

Figure 3 presents current occurrence data for Channel Darter in Quebec and replaces figure 3 in section 2.3.2 of the Quebec Plan. Note that figures 1 and 2 are to be found in Part 2: "Recovery Plan for the Channel Darter (*Percina copelandi*) in Quebec, 2020 to 2030".

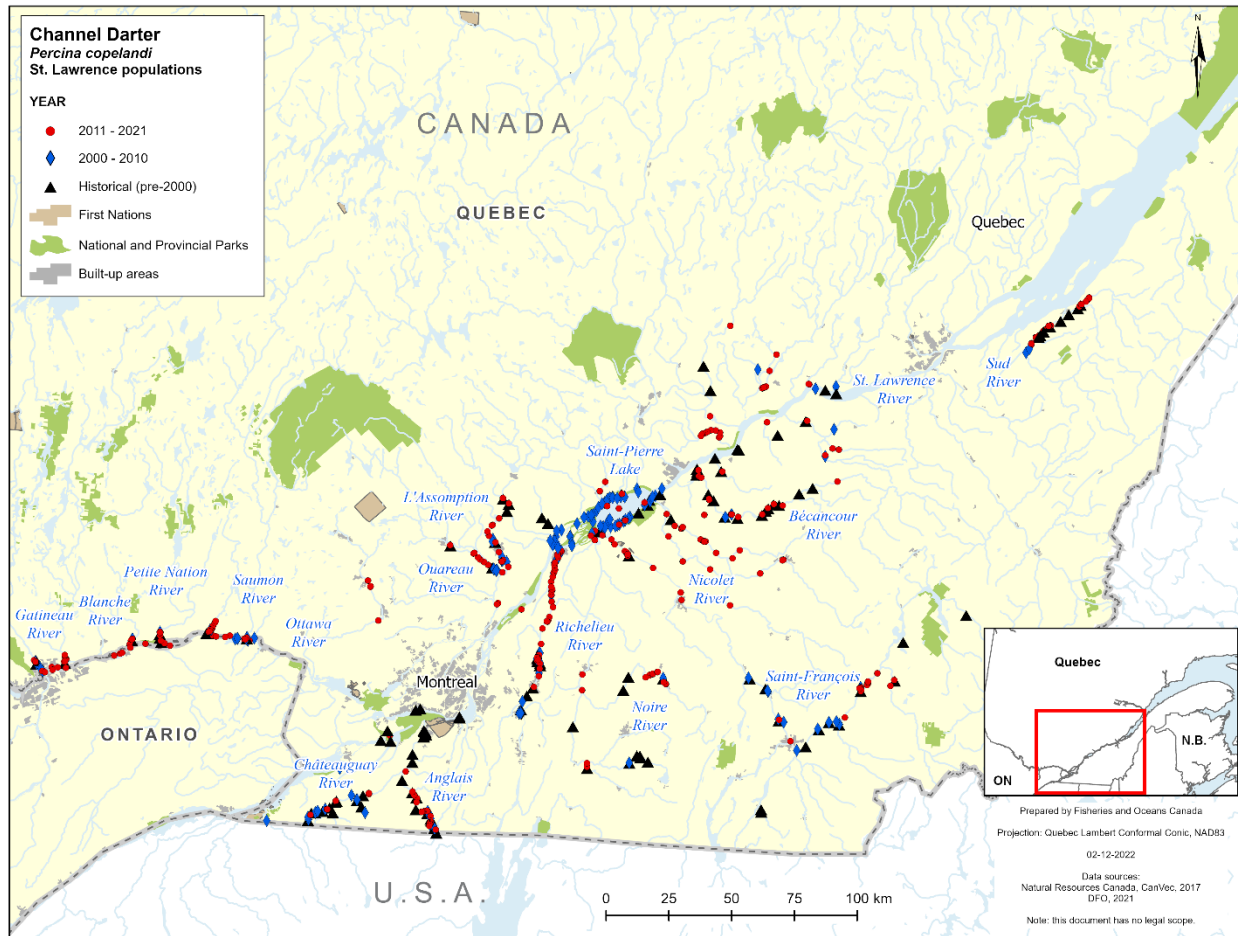


Figure 3. Range of Channel Darter (St. Lawrence populations) in Quebec.

Figure 4 is added to present the distribution of Channel Darter (St. Lawrence populations) in Ontario, which includes the Ontario part of the Ottawa River and Little Rideau Creek.

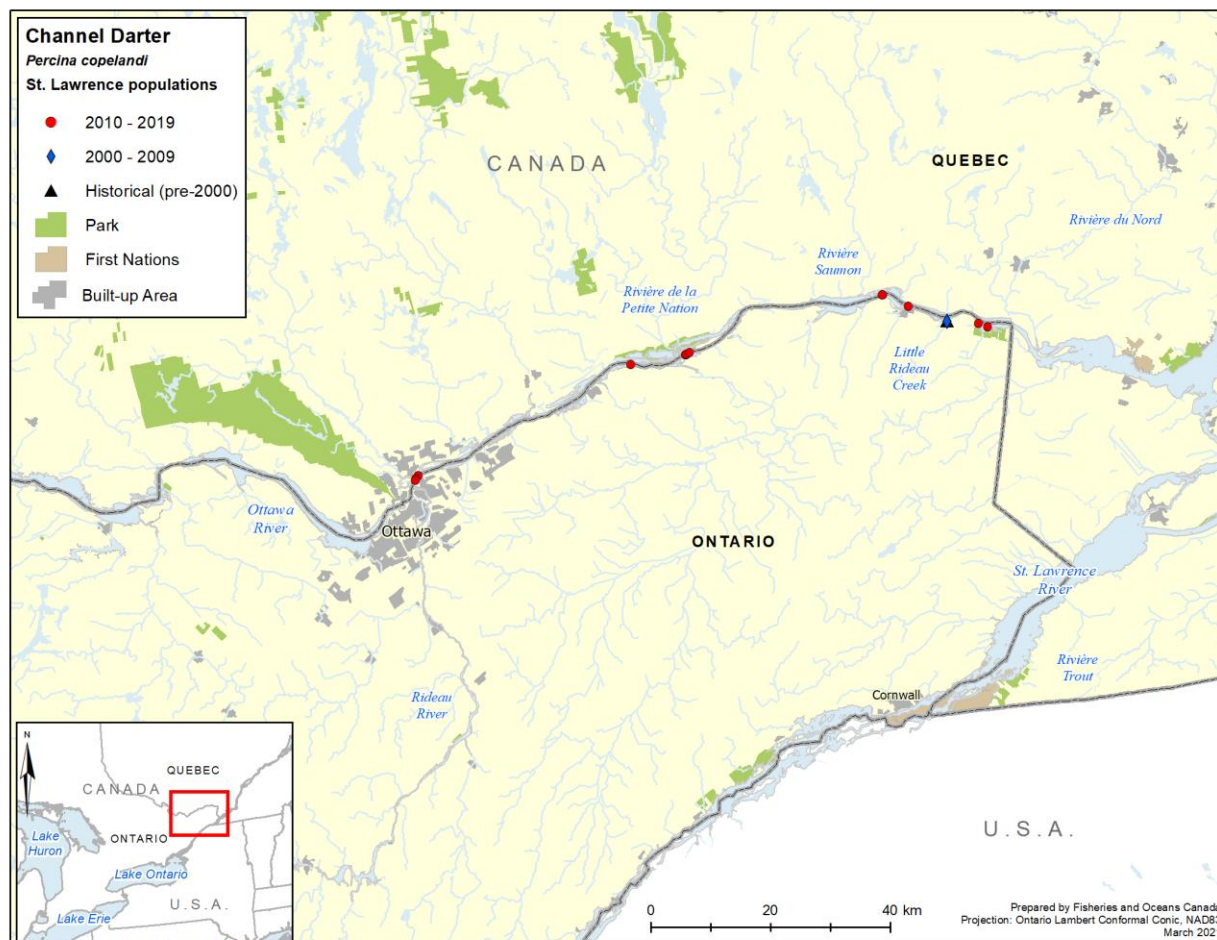


Figure 4. Range of Channel Darter (St. Lawrence populations) in Ontario.

4. Management objectives

DFO replaces the text of section 3.3 in the Quebec Plan by the following one:

The goal of the management plan for the Channel Darter is to improve the status of the St. Lawrence populations and the species habitat condition throughout its current and historical range in Quebec and Ontario.

Additionally, the management objectives 2 and 3 set out in the Quebec Plan (section 3.4) are replaced as follows:

- **Objective 2: Protect and improve Channel Darter habitats within its range**

To ensure the conservation of the Channel Darter in its range, habitat quality must be maintained and the quality of degraded habitats must be improved. Support from local partners and the mobilization of the municipal and agricultural communities are key collaboration to encouraging the adoption of practices and implementation of actions that will promote the maintenance and restoration of aquatic ecosystems. Various interventions to improve water quality in the watersheds occupied by the Channel Darter should be carried out. The use of administrative and private stewardship tools could help

protect habitats by ensuring that land use is compatible with the conservation objectives for the species. Best Management Practices are a valuable tool for improving water quality in agricultural landscapes. To be effective, such practices should be targeted to address threats in known Channel Darter habitat. Monitoring the application and effectiveness of habitat protection and enhancement measures will make it possible to assess the relevance of the actions taken.

- **Objective 3: Assess Channel Darter population distribution, abundance and trends**

Few data are available on Channel Darter abundance in Quebec and Ontario, making it difficult to identify trends or to assess the current state of the populations. Knowledge-building is therefore essential for identifying conservation targets for reassessing the species' status. This objective involves planning and implementing a survey program in order to update the species' distribution, document its abundance and monitor certain populations. It also involves the continuous updating of standardized protocols, such as that of Couillard et al. (2023) or Portt et al. (2008), in light of new information, including the development of detection methods (eDNA).

5. Measures for the conservation of the species

The measures for the conservation of the species are described in the Quebec Plan (part 2, section 4). DFO adopts "Section 4: Action plan" with the addition of the following to include the Ontario range and clarify DFO's role in these measures:

The purpose of the proposed actions and measures is to improve all populations of DU3. However, some actions may not apply in their entirety to each population, since the threats and local stakeholders may vary depending on the location.

For information on Channel Darter distribution in Ontario, refer to the online [Aquatic Species at Risk Map](#).

The following additions are made under the "Lead and Contributors" column for certain measures in table 4.1, table 4.2, and table 4.4 of the Quebec Plan, as in tables 1, 2, and 3 of this document.

Table 1. Addition of Fisheries and Oceans Canada (DFO) as a contributor in the last column of the table 4.1 “Measures to identify threats to the Channel Darter (Objective 1)” of the Quebec Plan for the Channel Darter, St. Lawrence populations.

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
1	Identify threats to the species and its habitat within its range.	b) Inform local organizations about the priority assigned to threats and protection issues.	Extracted data on threats and the level of protection of occurrences (actions 1a and 1c) will be shared with environmental organizations according to their respective areas of action. The distribution list will include watershed organizations, ZIP (Priority Intervention Area) committees, Indigenous organizations and other relevant partners (DFO, Regional County Municipalities [RCMs], Quebec Department of Municipal Affairs and Housing [MAMH] and Department of Energy and Natural Resources [MERN], conservation organizations, Hydro-Québec, etc.) on the extended distribution list that are located within the species' range.	1	List of stakeholders to be contacted has been prepared Prioritization of threats and protection issues has been disseminated to targeted partners On at least 5 occasions between 2020 and 2030, information is shared with the stakeholders identified in the previous indicator	Ministère des Forêts, de la Faune et des Parcs (MFFP) , Centre de données sur le patrimoine naturel du Québec (CDPNQ), DFO

Table 2. Addition of Fisheries and Oceans Canada (DFO) as a contributor in the last column of the table 4.2 “Measures to protect and improve Channel Darter habitats within its range (Objective 2)” of the Quebec Plan for the Channel Darter, St. Lawrence populations.

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
4	Mobilize municipal and agricultural communities to adopt practices that promote the protection and enhancement of the species' habitat.	a) Develop an intervention and communication strategy for targeted communities.	With the support of experts in communication and the development of innovative solutions, and in collaboration with local organizations, identify obstacles to the adoption by municipal and agricultural communities of practices conducive to protecting and enhancing the species' habitats. Establish an intervention strategy: 1. Identify the behaviour changes to be encouraged to mitigate threats to the species and its habitats 2. Identify target audiences and behaviours to be encouraged; 3. Set measurable objectives based on priorities in order to mitigate threats 4. Develop interventions to meet the targeted objectives 5. Establish a system for monitoring and evaluating interventions	1	Strategy established for one or more specific objectives Strategy shared with local organizations	Recovery Team , experts in communication and the development of innovative solutions, local organizations, DFO

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
4	Mobilize municipal and agricultural communities to adopt practices that promote the protection and enhancement of the species' habitat.	b) Implement the intervention and communication strategy.	Some of the interventions developed in the strategy (action 4a) will be implemented by local organizations, by Recovery Team members or by the Ministère des Forêts, de la Faune et des Parcs (MFFP).	1	At least one intervention developed under the strategy has been carried out and its success has been evaluated	Local organizations, recovery Team, MFFP, DFO

Table 3. Addition of Fisheries and Oceans Canada (DFO) as a contributor in the last column of the table 4.4 “Measures to identify habitats and key components required to maintain and ensure the recovery of Channel Darter populations (Objective 4)” of the Quebec Plan for the Channel Darter, St. Lawrence populations.

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
8	Define the species' habitat.	b) Analyze current habitat data.	The most recent analysis of habitat data covers the data collected from 1930 to 2016. An analysis incorporating habitat data collected after that period can be used to fine-tune the definition of habitat used by the species, since finer scale characterization data and data from a wider variety of habitats will be available.	2	A habitat data analysis report has been prepared	Ministère des Forêts, de la Faune et des Parcs (MFFP), DFO

6. Measuring progress

A successful management program will improve Channel Darter populations and their habitat throughout the current and historical range in Quebec and Ontario. Progress towards meeting the management objectives will be reported in the report on the progress of the management plan implementation, 5 years after the publication of the final document on the [Species at Risk Public Registry](#), and every subsequent 5 years.

The performance indicators presented below provide a way to define and measure progress toward achieving the management objectives. The performance indicators are as follows:

- more local analysis of threats have been made and concrete and realistic actions to reduce their effects have been implemented
- stewardship measures have been undertaken to maintain the quality of habitats or improve it where it has previously been degraded. Moreover, monitoring has been conducted to evaluate the efficacy of these projects
- a survey program has been implemented, and therefore, updated or new data are available on the species' distribution, its abundance and trends for certain populations. While the survey program has been conducted, standardized protocols have been improved with new information and methods
- a fine-scale habitat characterization has been completed and a variety of fishing gear has been used to expand and refine the knowledge of the habitats used by the Channel Darter. Therefore, the critical components of the species' habitat and the limiting factors that are likely to explain its absence are known, and monitoring has been conducted to evaluate the state of habitats where habitat restoration has occurred

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Part 2 – Recovery Plan for the Channel Darter (*Percina copelandi*) in Quebec, 2020 to 2030,
prepared by the Équipe de rétablissement des cyprinidés et petits percidés du Québec for the
Quebec Ministère des Forêts, de la Faune et des Parcs

Note : The original document, published only in French, has been translated into English by
DFO.

**Recovery Plan for the Channel Darter
(*Percina copelandi*)
in Quebec — 2020–2030**

by

The Équipe de rétablissement des cyprinidés et petits percidés du Québec



Prepared for the Quebec Ministère des Forêts, de la Faune et des Parcs

November 2019

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The full version of this document is available at the following addresses (in French only):

https://bibliotheque.cecile-rouleau.gouv.qc.ca/documents/archives/pgq/F7A1_A29_C96_2020_2030.pdf
<https://cdn-contenu.quebec.ca/cdn-contenu/faune/documents/animaux/fiche-synthese-retablissement-fouille-roche-gris.pdf>

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Disclaimer

The members of the Équipe de rétablissement des cyprinidés et petits percidés du Québec have agreed on the content of this document. They have used the most accurate information available to date and have developed a strategy and actions that, in their opinion, are conducive to the recovery of the Channel Darter in Quebec.

However, the members of the Équipe de rétablissement des cyprinidés et petits percidés du Québec are unable to guarantee that all of the proposed measures will be carried out, as this depends on the budget available for the recovery of threatened and vulnerable species, the priority assigned to each species, and the contributions of the many organizations involved over the entire duration of the recovery plan. Furthermore, the members' participation in the team in no way commits the organization they represent to implementing the measures and actions in the recovery strategy proposed in this document.

This recovery plan also constitutes advice to other departments and organizations that may be involved in the species' recovery.

Foreword

The first recovery plan for the Channel Darter was published and implemented in 2001. At that time, the Channel Darter was included on the list of species likely to be designated as threatened or vulnerable under Quebec's *Act respecting threatened or vulnerable Species*. The species was subsequently designated as vulnerable in 2005. The Équipe de rétablissement des cyprinidés et petits percidés du Québec prepared a report on the actions carried out from 2001 to 2016, in accordance with the Cadre de référence des équipes de rétablissement du Québec (terms of reference for Quebec recovery teams). The conclusions drawn from this analysis and the integration of new knowledge acquired on the species and its status have made it possible to develop this document, which is the first update of the recovery plan for the Channel Darter in Quebec.

Editorial Board

Current and former recovery team members who collaborated on the document:

- Marylène Ricard, Bureau d'écologie appliquée
- Marc-Antoine Couillard (Coordinator), Ministère des Forêts, de la Faune et des Parcs (MFFP), Direction de l'expertise sur la faune aquatique (DEFA)
- Chantal Côté, MFFP, Direction de la gestion de la faune de Lanaudière et des Laurentides (former team member)
- Steve Garceau, MFFP, Direction de la gestion de la faune de l'Estrie, de Montréal, de la Montérégie et de Laval
- Frédéric Lecomte, MFFP, DEFA (former team member)
- Anne-Marie Gosselin, MFFP, Direction de la gestion de la faune de l'Outaouais (former team member)
- Sylvain Roy, MFFP, Direction de la gestion de la faune de l'Estrie (former team member)
- Alain Kemp, Fisheries and Oceans Canada (DFO), Regional Ecosystems Management Branch (former Team member)
- Samuel Dufour-Pelletier, Abenaki Council of Odanak (former team member)
- Vanessa Fortin Castonguay, Abenaki Council of Odanak (former team member)
- Karine Richard, Abenaki Council of Odanak (former team member)
- Jean Caumartin, Hydro-Québec (former team member)

List of Quebec Recovery Team Members

Quebec Ministère des Forêts, de la Faune et des Parcs (MFFP)

- Carl Patenaude-Levasseur, (Chair), Direction de la gestion de la faune de l'Estrie, de Montréal, de la Montérégie et de Laval
- Marc-Antoine Couillard (Coordinator), DEFA
- Sébastien Auger, Direction de la gestion de la faune de Lanaudière et des Laurentides
- Steve Garceau, Direction de la gestion de la faune de l'Estrie, de Montréal, de la Montérégie et de Laval
- Carolane Riopel-Leduc, Direction de la gestion de la faune de l'Outaouais
- Mario Filion, Direction de la protection de la faune de la Mauricie, du Centre-du-Québec et de Lanaudière

Quebec Department of Agriculture, Fisheries and Food (MAPAQ)

- Mélanie Poirier, Direction régionale de la Montérégie-Ouest

Fisheries and Oceans Canada (DFO)

- Marie-Pierre Veilleux, Regional Ecosystems Management Branch

Ambioterra

- Priscilla Gareau

Société de conservation et d'aménagement des bassins versants de la Zone Châteauguay

- Geneviève Audet

Hydro-Québec

- René Dion

Comité de concertation et de valorisation de bassin de la rivière Richelieu

- Émilie Lapalme

Bureau d'écologie appliquée

- Marylène Ricard

Nature Conservancy of Canada

- Valérie Aubin

Executive summary

The Channel Darter (*Percina copelandi*) has a wide but disjunct distribution in central North America west of the Appalachian Mountains. In Quebec, the species is at the northern edge of its global range, and disjunct populations are located in the St. Lawrence River and several of its tributaries. The main threats to the species are agricultural pollution, domestic and urban wastewater pollution, shoreline modification, dams, culverts and water management structures, invasive alien species and climate change. Some limiting factors, such as the habitat requirements of the Channel Darter, may explain the species' vulnerability. Interspecific interactions with other darter species and the Round Goby (*Neogobius melanostomus*) may also limit populations.

To understand and improve the state of the populations within the species' range in Quebec, the Channel Darter recovery team published an initial recovery plan for the species in 2001. The team was renamed the Équipe de rétablissement des cyprinidés et petits percidés du Québec (Quebec Cyprinidae and Small Percidae Recovery Team) in 2006, notably because of the growing number of designated species and the issues common to some of them. Currently, in addition to the Channel Darter, the recovery team is working on the Eastern Sand Darter and the Bridle Shiner as well as the Northern Brook Lamprey and the Grass Pickerel, although the latter two species are not part of the Percidae family or the Cyprinidae family.

The 2001 plan included nine conservation strategies and 45 actions. In 2019, a progress report on the recovery plan for the Channel Darter was prepared; it describes the progress achieved in relation to knowledge acquired about the species and the actions set out in the Plan covering the period from 2001 to 2016.

Despite an increase in the records obtained from several Quebec watersheds since 2001, Channel Darter observations remain scarce and the species is not very abundant. Based on the results of point sampling undertaken to confirm historical observations, some populations have been extirpated, notably in the Rivière aux Bluets and the Niger, Maskinongé and Chicot Rivers. It is not possible to assess population trends at present, given the low number of observations reported annually.

The recovery team considers the recovery of the Channel Darter in Quebec to be both possible and feasible. The goal of the recovery plan is therefore to improve the state of Channel Darter populations and habitat throughout the species' current and historical range in Quebec. The status of the Channel Darter can be improved by implementing recovery measures aimed at protecting and increasing the number and quality of habitats used by the species. The goal of the recovery plan for the Channel Darter is to improve the status of the species' populations and its habitat throughout its current and historical range in Quebec. Four objectives were set in order to achieve this goal:

Objective 1: Identify threats to the Channel Darter.

Objective 2: Protect and enhance Channel Darter habitats within its range.

Objective 3: Assess Channel Darter population distribution, abundance and trends.

Objective 4: Identify habitats and key components required to maintain and ensure the recovery of Channel Darter populations.

To achieve the objectives set out in the recovery strategy, an action plan with 23 actions included in eight measures has been developed.

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Definitions

Agricultural water management structures: Structures that reduce soil erosion, improve surface water drainage and stabilize the banks of ditches or watercourses in an agricultural setting (drain riprap, berms, inlets).

Environmental DNA: Environmental DNA, or eDNA, is defined as DNA from various organisms that can be extracted from environmental samples, such as water, soil or feces (Taberlet et al. 2012). It is used to detect species without the need to isolate target organisms beforehand.

Land-use planning and development plan (LUPDP): Planning document that sets out the guidelines for the physical organization of the territory of a Regional County Municipality (RCM).

Occurrence: Occurrence is a term used by the Centre de données sur le patrimoine naturel du Québec (CDPNQ) to refer to a site that is necessary for the survival of a species (or of a natural community) within a limited area constituting a site that is likely used by this biodiversity component and that is justified by the presence of one or more (historical or recent) observations of the component.

Population: A demographic unit occupying a contiguous habitat. For the purposes of this Recovery Plan, the term population generally refers to a group of individuals occupying the same watercourse or watershed.

Private stewardship: Refers to the voluntary commitment to and co-operation of landowners in measures to preserve heritage or ecological features on their property that are of interest to the broader community.

Range: Area that encompasses the geographic distribution of all known populations of a species.

Species of special concern: Under Canada's *Species at Risk Act* (SARA) (S.C. 2002, c. 29), a species of special concern is a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Threatened species: Under Quebec's *Act respecting threatened or vulnerable Species* (CQLR, c. E-12.01), a species is considered threatened when it is at risk of becoming extirpated. Under SARA, a threatened species is a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Vulnerable species: Under Quebec's CQLR, a vulnerable species is a species whose survival is considered to be at risk, though it is not likely to become extirpated in the short or medium term.

1 Introduction

A report on the status of the Channel Darter in Quebec was produced in 1997 (Lapointe, 1997). The Channel Darter was designated as a vulnerable species in March 2005 under Quebec's *Act respecting threatened or vulnerable Species*³ (CQLR, c. E-12.01). This designation was based on the species' rarity in Quebec, its disjunct distribution in relation to other North American populations and the Quebec population's location at the northern limit of the species' range. The Channel Darter occurs mainly in watercourses on the agricultural plain of the St. Lawrence Lowlands, where the quality of the aquatic environment is threatened. The presumed extirpation of the species from some watercourses suggests a decline in some populations. Habitat loss and degradation are the main threats to the species.

In parallel with the assessment and designation process, an initial recovery plan was developed in 2001 (Équipe de rétablissement du fouille-roche gris, 2001). The nine conservation strategies adopted and the corresponding 45 actions were aimed at improving the situation of Channel Darter in its Quebec range. A progress report on the actions carried out from 2001 to 2016 for the recovery of the species was prepared (Équipe de rétablissement des cyprinidés et petits percidés du Québec, 2019) along with a report on the state of knowledge and the status of Channel Darter populations in Quebec (Couillard et al. 2013; Ricard et al. 2018). Numerous awareness, conservation and knowledge-building projects were carried out during this period. While knowledge has been acquired on the species' distribution and its habitat requirements, the populations are still under significant pressure and population trends are unknown.

This document, the first update of the recovery plan for the Channel Darter in Quebec, is aimed at consolidating the conservation efforts made since 2001. It presents the status of the species and the strategy and the action plan that will be implemented from 2020 to 2030 to support the species' recovery.

³ List of abbreviations presented in appendix 1.

2 Status

2.1 Species information

Scientific name: *Percina copelandi*

English common name: Channel Darter

French common name: *Fouille-roche gris*

Legal designation under the Quebec Act respecting threatened or vulnerable species: Vulnerable species status in 2005.

Reason for designation: The Channel Darter is a rare species in Quebec. It is located at the edge of its range and its populations are disjunct, being separated geographically from the other populations in North America. This species is mainly found in small streams in the agricultural plain of the upper St. Lawrence River, where the quality of the aquatic environment is threatened. The species has been extirpated from several watercourses, as confirmed by recent controlled surveys. The species' survival depends on access to healthy ecosystems and good water quality.

Canadian occurrence: Ontario and Quebec

Legal designation under Canada's Species at Risk Act: Previously considered a single unit, the Channel Darter was designated a threatened species in Canada in 2006. The species was divided into three separate units by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2016, and the "St. Lawrence populations" unit was assessed as special concern. This new status was changed on August 21, 2019.

Assessment of conservation status ranks⁴:

S rank: S2S3: Range from S2 (imperiled provincially) to S3 (vulnerable)

G rank: G4: Apparently secure, widely distributed, abundant and globally secure, but remains a concern in the long term.

2.2 Species description

The following description has been adapted from Scott and Crossman (1974), Trautman (1981) and Desroches and Picard (2013). The Channel Darter is a small fish in the Percidae family with a slender, elongated body (Figure 1). It is usually between 35 and 61 mm long (Goodchild, 1994) but can reach a length of 101 mm (Ricard et al. 2018). It has a light sand or olive-coloured body with brown speckles on its back and cross-shaped markings over its lateral line, and a whitish belly. It has alternating short or oblong brown spots on its sides. A dark spot or bar may be present beneath the eye and extend onto the snout. The fins are clear or lightly speckled and the tail is forked. The Channel Darter resembles the Johnny Darter (*Etheostoma nigrum*) and the Tessellated Darter (*E. olmstedii*) (Goodchild, 1994), both of which have distributions that overlap that of the Channel Darter. An identification key developed by Massé and Bilodeau (2003) can be used to distinguish the Channel Darter from these other darters. However, juvenile identification is still problematic and requires genetic analysis.

⁴ Definitions of NatureServe's Conservation Status Ranks are presented in appendix 2.



Figure 1. Channel Darter (source: Louis L'Hérault).

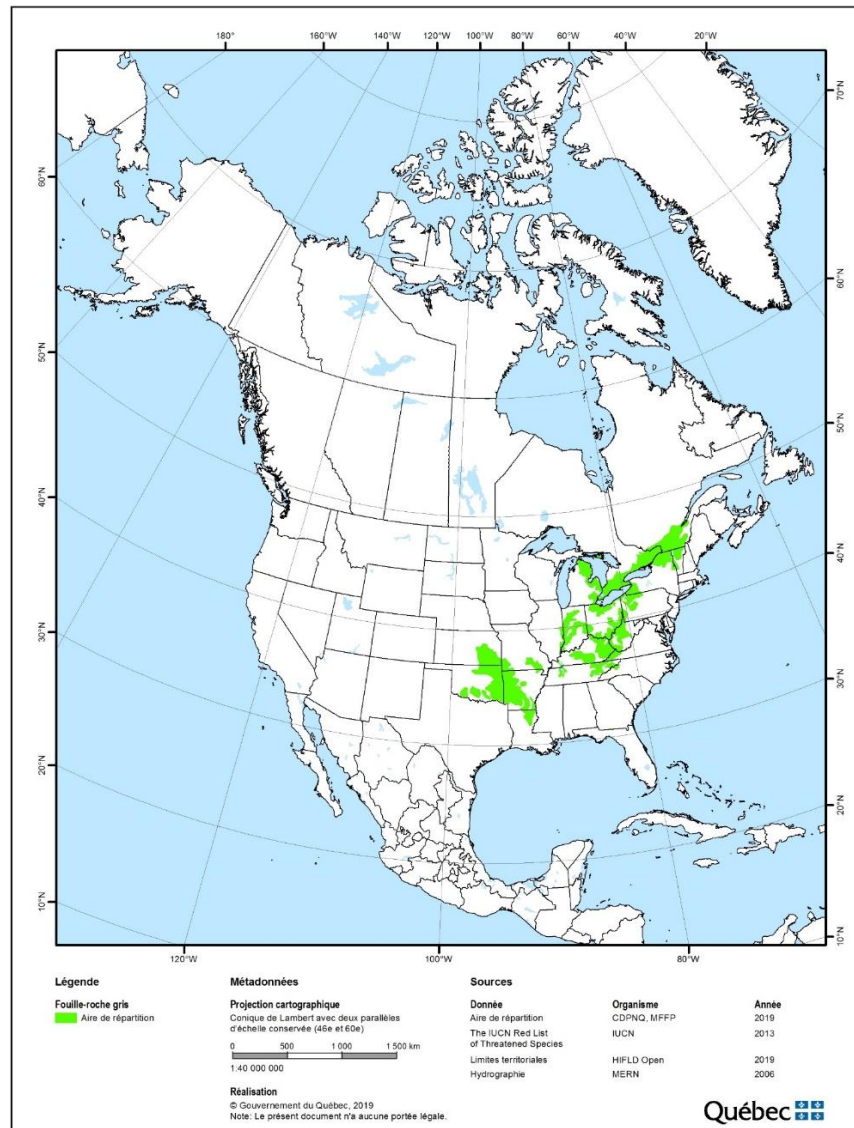
2.3 Channel Darter range

2.3.1 Global range

The Channel Darter has a wide but extremely disjunct distribution across much of central North America (figure 2) west of the Appalachian Mountains. It inhabits the Mississippi drainage (Tennessee, Ohio, and Arkansas rivers) and the southern Great Lakes basin (Lake Huron, Lake St. Clair, Lake Erie, Lake Ontario and St. Lawrence River drainages) (Goodchild, 1994). In the United States, it is found in the following states (listed from south to north): Louisiana, Oklahoma, Arkansas, Tennessee, Kansas, Missouri, Kentucky, Virginia, West Virginia, Indiana, Ohio, Pennsylvania, Michigan, New York and Vermont. In Ontario and Quebec, it is at the northern edge of its range (NatureServe, 2017).

2.3.2 Quebec range

In Quebec, the Channel Darter is at the northernmost limit of its global distribution. Whereas the species' distribution was previously thought to be limited to a few rivers (Couillard et al. 2013; Lapointe, 1997), it is now much better understood and the number of rivers where these fish are known to be present has increased as a result of intensified sampling efforts in recent years (Ricard et al. 2018). Disjunct populations are located in the St. Lawrence River and several of its tributaries, from the Ottawa River in the west to the Rivière du Sud watershed in the east (figure 3). The species is scattered throughout most of southern Quebec (Montreal, Montérégie, Eastern Townships, Centre-du-Québec, Chaudière-Appalaches, Outaouais, Laurentians, Lanaudière, Mauricie, Capitale-Nationale), but remains largely confined to the St. Lawrence Lowlands. There are a few records from the Appalachian Mountains in the Eastern Townships. A complete and detailed description of the distribution of the species in Quebec is presented in Ricard et al. (2018).



See the English translation below:

Legend

Channel Darter

Range

Metadata

Map Projection

Lambert conic with two parallels of scale preserved (46th and 60th)

Author

© Quebec Government, 2019

Note: This document has no legal significance.

Sources

Data

Range
The IUCN Red List of Threatened Species
Territorial limits
Hydrography

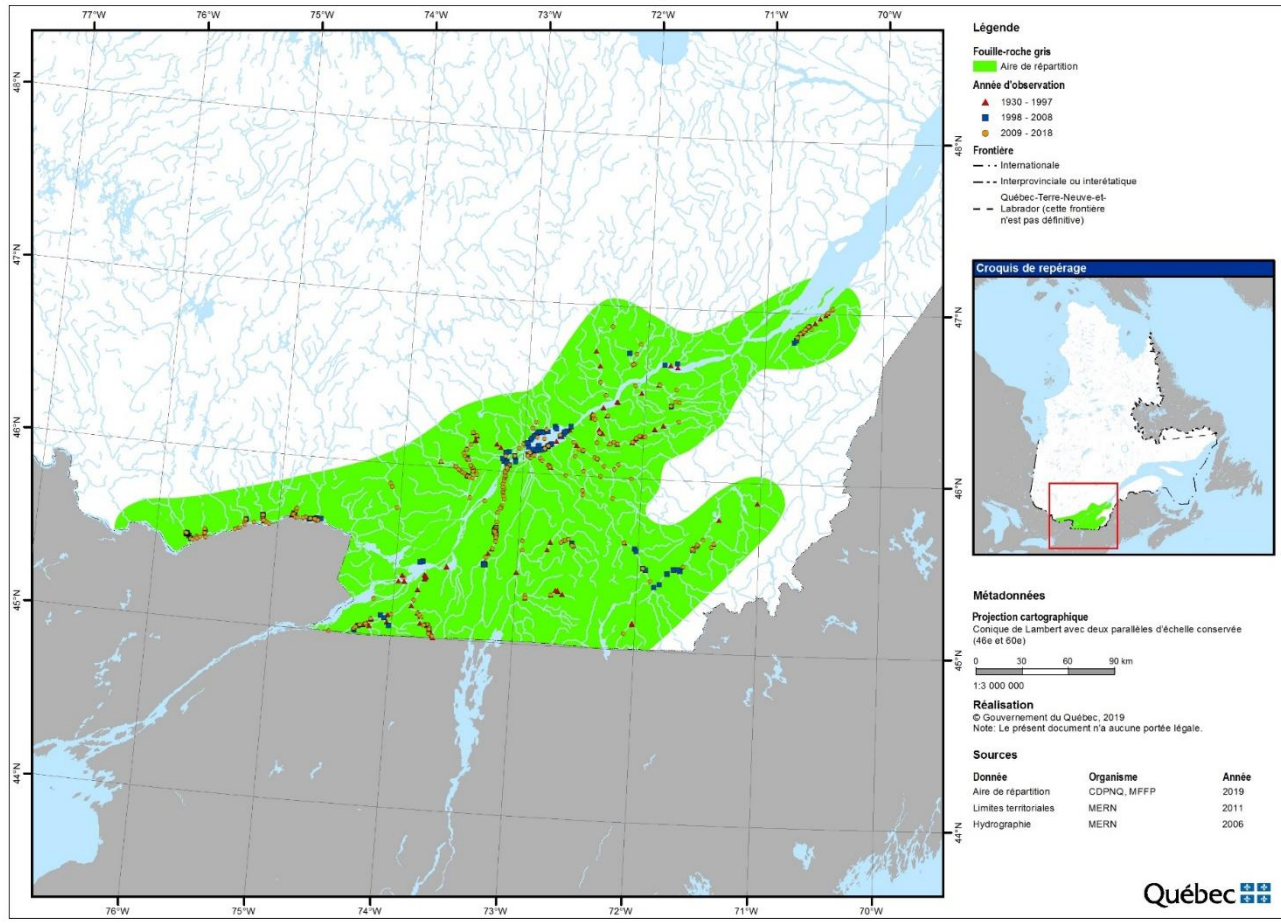
Organization

CDPNQ, MFFP
IUCN
HIFLD Open
MERN

Year

2019
2013
2019
2006

Figure 2. Range of the Channel Darter in North America.



See the English translation below:

Legend

Channel Darter

Range

Year of observation

▲ 1930 to 1997

■ 1998 to 2008

● 2009 to 2018

Border

- - - International

- . - Interprovincial or interstate

- - - Quebec-Newfoundland and Labrador (this border is not definitive)

MAP

Metadata

Map projection

Lambert conic with two parallels of scale preserved (46th and 60th)

Author

© Quebec Government, 2019

Note: This document has no legal significance.

Sources

Data	Organization	Year
Range	CDPNQ, MFFP	2019
Territorial limits	MERN	2011
Hydrography	MERN	2006

Figure 3. Range of the Channel Darter in Quebec.

2.4 Species' biology

The following section presents specific aspects of the biology of the Channel Darter that are key to understanding the limiting factors and to selecting appropriate conservation measures and actions. New data that have become available since the publication of the status report on the species are also presented (Lapointe, 1997). Please refer to that report for a more comprehensive description of the species' biology.

2.4.1 Diet

The Channel Darter's diet consists mainly of benthic invertebrates (mayfly, chironomid and caddisfly larvae) and, occasionally, ostracods, cladocerans and pupae (Strange, 1997; Winn, 1953).

2.4.2 Lifespan

Little information is available on the Channel Darter's lifespan. The age of most individuals collected from the Trent River in Ontario has been estimated at 2 to 3 years, with the oldest recorded specimen being 5 years old (Reid, 2004). Since it is a forage species, the majority of individuals are likely no more than 3 years old.

2.4.3 Spawning

In Quebec, spawning is thought to occur from May to July on substrates composed of rock and gravel and, to a lesser extent, sand and boulders (Comtois et al. 2004; Lemieux et al. 2005; Levert, 2013). Water temperatures measured during spawning ranged from 14 to 24°C (Comtois et al. 2004; Lemieux et al. 2005; Levert, 2013). Reid also reported temperatures ranging from 14.5 to 25°C during spawning in the Trent River in Ontario, and substrates dominated by rocks and gravel (2005). Adults seek out moderate to fast currents in which to spawn (0.24 to 0.60 m/s, Comtois et al. 2004; 0.076 to 3.5 m/s, Levert, 2013). Observations in the United States indicate that males defend a territory of just under one square metre, usually around a large rock in the current (Winn, 1953). Females move between territories, spawning successively with many males and depositing about 4 to 10 eggs in the gravel substrate after each mating (Winn, 1953). It appears that females between 1 and 2 years of age can produce between 350 and over 700 eggs, suggesting that a large number of males must be available to enable a female to lay all her eggs (Goodchild, 1994).

2.4.4 Parasites and disease

Trematodes, cestodes and nematodes have been observed on specimens from Lake Erie, Ontario (Goodchild, 1994). To our knowledge, no information is available on the parasites or diseases that affect the Channel Darter in Quebec.

2.4.5 Dispersal and migration

Observations on the species' movements are rare and often poorly understood. Nevertheless, some seasonal movements have been observed (Levert, 2013; Reid, 2004; Reid and Mandrak, 2008), including migration to deeper waters in the fall (Levert, 2013). It is assumed that the species has limited dispersal ability and that sites where populations are presumed to be extirpated are unlikely to be recolonized through natural population movements (DFO, 2013).

2.5 Population status and trends

Despite an increase in reports of the Channel Darter's presence in several Quebec watersheds since 2001, the species is still rarely observed and not very abundant. Point sampling undertaken to verify historical records indicates that some populations have been extirpated, notably in the Rivière aux Bluets and the Niger, Maskinongé and Chicot rivers (COSEPAC, 2016). Population trends cannot be assessed at present owing to the small number of observations submitted annually (Équipe de rétablissement des cyprinidés et petits percidés du Québec, 2019). This recovery plan identifies a number of actions specifically aimed at addressing this knowledge gap.

2.6 Habitat description

The following description is based on the document titled “État des connaissances sur quatre espèces de poissons en situation précaire au Québec : fouille-roche gris, dard de sable, méné d'herbe et brochet vermiculé” (Ricard et al. 2018), which summarizes the information acquired on the species based on all occurrence data gathered in Quebec from 1930 to 2016, and presents a review of the literature from 1943 to 2016.

Channel Darter habitat is associated with heterogeneous substrates composed mainly of sand, rock and gravel as well as silt, clay and boulders. The heterogeneity of the substrate provides optimal conditions in terms of refuge areas (Couillard et al. 2013). Water flow is an important factor in limiting siltation. Recorded current speeds range from 0.25 to 1 m/s, but are generally under 0.48 m/s. The depth of the water varies between 0.1 and 18 m, depending on the type of fishing gear used (electrofishing gear or trawl). The habitat is generally characterized by little aquatic vegetation and physico-chemical characteristics similar to those found in relatively undisturbed watercourses (low turbidity and relatively high dissolved oxygen concentrations). However, some observations of the Channel Darter come from highly disturbed environments, such as in the Richelieu, Châteauguay, L'Assomption, and Bayonne rivers and the Rivière du Loup.

2.6.1 Habitat availability

A large proportion of Quebec's watercourses have segments that have characteristics that are conducive to the presence of Channel Darter habitat. Companion species are frequently captured in these habitats (for example, Johnny Darter [*Etheostoma nigrum*], Fantail Darter [*Etheostoma flabellare*] and Logperch [*Percina caprodes*]). Despite the apparent widespread availability of these habitats, observations of the Channel Darter remain rare.

2.6.2 Critical habitats

As previously mentioned, the Channel Darter was designated as threatened under Canada's *Species at Risk Act* (SARA) (S.C. 2002, c. 29) and a recovery strategy was prepared in which critical habitat was identified. Critical habitat for the Channel Darter in Quebec has been identified under SARA in the following sectors: the Gatineau, L'Assomption, Ouareau, Richelieu, Saint-François, Rivière des Anglais, Rivière aux Outardes (East) and Trout/Châteauguay rivers. For the precise location of these critical habitats and a description of the methods used to identify the habitat, readers should refer to the Recovery Strategy for the Channel Darter (*Percina copelandi*) in Canada (DFO, 2013). In 2016, COSEWIC reassessed the status of the Channel Darter designatable units (DUs). The Channel Darter populations in the St. Lawrence were designated as special concern. When the status of the Channel Darter (St. Lawrence populations) was changed from threatened to special concern under Schedule 1 of SARA on August 21, 2019, the prohibitions and other protections (that is, the identification and protection of critical habitat) afforded by SARA were removed, because these prohibitions apply only to

listed threatened and extirpated species. The federal government will take steps to update the recovery strategy and transform it into a management plan for the conservation of the species.

2.7 Limiting factors

2.7.1 Habitat quality

The Channel Darter's requirements in terms of substrate and current speed are significant limiting factors (Goodchild, 1994). Some of the small streams it occupies are very dynamic environments with variable conditions, and the characteristics that make for optimal spawning habitat may only be present at intervals, leading to a variation in reproductive success and thus changes in abundance from year to year (Starnes et al. 1977). Siltation of the substrates may hinder the ability of this individuals to forage and may affect the availability of benthic prey (Goodchild, 1994). Sediment accumulation can also reduce the availability of spawning sites and threaten egg survival (Lapointe, 1997). Access to areas with moderate to fast current velocities is also essential for spawning, and any barriers that may reduce this access are likely to reduce spawning success (Goodchild, 1994). Spawning may be inhibited below a minimum current velocity (Winn, 1953).

Water temperature probably limits the species' expansion in Quebec, which is at the northern limit of its range (Lapointe, 1997). For example, temperatures that are too cold could reduce reproductive success (Goodchild, 1994).

2.7.2 Spawning behaviour

The communal spawning behaviour of the Channel Darter, whereby females spawn repeatedly with many males and deposit only a few eggs each time, may prevent females from attaining their full reproductive potential if there are not enough males (Goodchild, 1994).

2.8 Description of threats

The main known and suspected threats to the Channel Darter are presented here. They are described according to the classification system developed by Salafsky et al. (2008) and adopted by the International Union for Conservation of Nature (IUCN). It should be noted that the respective significance of these threats is reflected in the measures, actions and priorities of the action plan presented in section 4.

2.8.1 Agricultural pollution

In Quebec, the Channel Darter lives mainly in areas where intensive agriculture has led to habitat degradation, which poses a threat to the species' survival (Lapointe, 1997; DFO, 2013). Shoreline hardening and alteration as well as channel straightening associated with agricultural activities, along with leaching from soil, have resulted in increased levels of turbidity and siltation in watercourses. Elevated turbidity can negatively affect the ability of the Channel Darter to find food and locate spawning sites. Excessive siltation reduces the quality of the spawning substrate and can smother eggs and have an adverse effect on the Channel Darter's benthic invertebrate prey (Goodchild, 1994). When sediment loads increase in habitats with low to moderate current velocities, water flows may be insufficient to prevent sediment deposition.

Forest clearing and the destruction of riparian strips to increase cropland area contribute to increased surface runoff, sedimentation and nutrient loading in watercourses (Société de la faune et des parcs du Québec, 2002; Vachon, 2003). In predominantly agricultural regions where intensive monocropping is carried out on large expanses of land, riparian strips are often non-

existent. This is particularly true in regions where the topography is fairly flat, such as in Montérégie (Pépin, 2016). In Quebec, municipalities are responsible for implementing the measures set out in the “Protection policy for lakeshores, riverbanks, littoral zones and floodplains”. An investigation commissioned by the provincial government, however, revealed in 2004 there was very little enforcement of the regulations in the agricultural sector (Sager, 2004). The situation has changed little in recent years, and the state of riparian strips in agricultural areas is still cause for concern (Boucher and Garceau, 2010; Pépin, 2016). Despite the conservation efforts of watershed organizations and shoreline associations, there are still a number of obstacles that are hindering the revegetation of riparian strips, and the environmental effectiveness of the current Quebec policy remains to be proven (Choquette et al. 2008; Pépin, 2016).

Intensive agricultural practices have had a particularly severe impact in the watersheds of the Yamaska, Châteauguay, Richelieu, Saint-François, Nicolet, L’Assomption, and Bayonne rivers and the Rivière du Sud (DFO, 2013; Ricard et al. 2018).

2.8.2 Domestic and urban wastewater

In Quebec, most municipalities have wastewater treatment plants that provide primary treatment of wastewater. However, in the event of heavy precipitation or system failure, in some municipalities wastewater is released into the natural environment. Climate change can lead to an increase in the frequency of extreme weather events and thus to more of these releases. Wastewater discharges, overflows from municipal sewer systems, and faulty septic systems can result in excessive nutrient loading and releases of various contaminants from domestic and urban sources in watercourses (DFO, 2013). The water quality of certain Quebec rivers occupied by the Channel Darter is worrisome (for example, Richelieu, Yamaska, Bayonne, L’Assomption and Châteauguay rivers) (Côté et al. 2006; Giroux, 2007; DFO, 2010), and various contaminants and toxic substances in these waters could pose a threat to the species (DFO, 2010).

2.8.3 Shoreline modification

Stream channel straightening and the construction of infrastructure such as walls and riprap modify natural flow, erosion and sedimentation processes and could potentially alter aquatic habitats (DFO, 2013). For example, shoreline alteration may increase water flow sufficiently to limit habitat use by the Channel Darter or alter the abundance or composition of the benthic communities on which it preys. An increase in impervious surfaces near watercourses also increases runoff and exacerbates threats from agricultural and urban pollution.

Healthy riparian strips play an important role in conserving Channel Darter habitat (DFO, 2013). By naturally reducing soil erosion, filtering runoff and regulating water temperature, these areas help maintain good water quality. Although concrete efforts are currently being made, regulations pertaining to riparian areas remain poorly enforced in Quebec (Boucher and Garceau, 2010; Sager, 2004). For example, in urbanized municipalities, the distance between infrastructure and watercourses is sometimes too small (Pépin, 2016). The effects of shoreline modification are particularly severe in the watersheds of the Châteauguay, Richelieu, Saint-François, Nicolet, L’Assomption, Bayonne and Bécancour rivers and the Rivière du Sud (DFO, 2013; Ricard et al. 2018).

2.8.4 Dams, culverts and water management

Culverts, including their construction and maintenance, can affect the quality of fish habitat. Some of the watercourses occupied by the Channel Darter in Quebec feature dams that have a variety of effects on this species and its habitats.

In general, dams with no fishways and poorly designed culverts are barriers that can restrict access to important habitats for the Channel Darter. For example, barriers that block access to spawning sites can compromise the species' reproductive success (Phelps and Francis, 2002). They can also fragment fish populations and limit the potential for rescue effect from neighbouring populations (DFO, 2013). A number of dams and culverts, however, allow some downstream movement. In addition, dams (especially hydroelectric dams) are generally placed on natural obstacles which in many cases are impassable (J. Caumartin, pers. comm., 2017). The obstructions to the free passage of the Channel Darter in the Saint-François, Ottawa and Châteauguay river basins are considered to be especially problematic (DFO, 2013).

Hydroelectric dams have submerged rotating parts that can injure or kill fish that pass through them. The physical characteristics of these structures (number of blades, rotational speeds, etc.) determine the extent of the damage to the fish. The size and shape of the fish also play a role; for example, the smaller the size of the fish, the greater the probability of passing through the structure unharmed.

Dams with flow alteration mechanisms can negatively affect downstream populations by causing physiological stress, disrupting spawning or causing mortality (DFO, 2013). The severity of these negative effects depends on how these dams are managed. Certain types of dams can also stabilize flow and reduce the occurrence of severe flooding, which is likely to be beneficial for the Channel Darter. The lacustrine conditions that are observed immediately upstream of dams do not provide suitable habitat for the Channel Darter. Altered flow has been identified as a significant threat in the Ottawa, Saint-François, Yamaska and Rivière du Sud drainages (DFO, 2013).

In some situations, however, barriers may afford protection for the species from competitors, predators or invasive species (EERT, 2008). This is likely the case in the Rivière du Sud, which has a dam at its mouth that probably prevents the Round Goby from invading the river (Couillard, pers. comm., 2017).

2.8.5 Invasive alien species

Non-native fish species can adversely affect the Channel Darter by preying on these fish or competing with them for habitat, food, and spawning sites, by restructuring aquatic food webs, or by introducing new parasites. In areas where their habitats overlap (for example, Lakes Saint-Louis and Saint-François), the Round Goby competes with the species for habitat and food sources (Baker, 2005, Reid and Mandrak, 2008). It is also a potential predator of Channel Darter eggs and juveniles (Boucher and Garceau, 2010; Bouvier and Mandrak, 2010; French and Jude, 2001). Since its introduction, the Round Goby has been implicated in the declines of several darter species that inhabit the Great Lakes and it may have direct impacts on the Channel Darter (DFO, 2013). In Quebec, the Round Goby has been found to coexist with the Channel Darter in the Richelieu River, at the mouth of the Yamaska River and in the St. Lawrence River near Contrecoeur (Garceau et al. 2016). However, fish surveys suggest that the species has been expanding its range since the 1990s and now occupies most of the nearshore freshwater habitats of the St. Lawrence River between Lake Saint-François and Bécancour (Paradis, 2018), as well as the area downstream from Quebec City and extending as far as Montmagny (Couillard, 2009). The species appears to be less parasitized than native species such as the Logperch (*Percina caprodes*) (Gendron et al. 2012), which could make it an important competitor since it is able to establish more easily. This is a potentially significant threat to the Richelieu, Yamaska and St. Lawrence rivers (DFO, 2013; Ricard et al. 2018).

Certain other species introduced into natural environments are also likely to have indirect effects on the Channel Darter. This is true for the bacterium *Bacillus thuringiensis israelensis* (Bti), which

has been used as an insecticide in Quebec for a number of years where it has been sprayed in lotic environments to reduce black fly populations. Some studies have shown that this selective insecticide apparently harms the larvae of non-target species such as chironomids (Boisvert and Lacoursière, 2004), which are an important part of the Channel Darter's diet. However, the indirect effects of Bti on the Channel Darter have not been studied.

2.8.6 Climate change

Climate change is likely to have significant impacts on aquatic communities. Some of the anticipated changes, such as higher evapotranspiration, lower water levels in rivers in summer, an increase in the intensity and frequency of extreme weather events (Warren, 2004), and the consequent changes in plant communities, are likely to have adverse effects on Channel Darter populations. For example, an increase in the frequency of extreme weather events is likely to increase erosion and alter the quality of habitats available for the Channel Darter. On the other hand, the warmer temperatures could be beneficial to the Channel Darter, since its distribution appears to be limited by cool water temperatures (DFO, 2013), provided that dispersal corridors with suitable habitat are available. Nonetheless, the species dispersal ability is limited (DFO, 2013) and uncertainty exists with regard to its migration between habitats.

Other threats besides those mentioned above may affect the maintenance and recovery of the species in the future. They include the introduction of pathogens such as viral haemorrhagic septicaemia (VHS), a contagious disease that affects more than 65 fish species and has been linked to mass mortalities. To date, however, no cases of VHS have been detected in Quebec (C. Brisson-Bonenfant, pers. comm., 2017), but the disease is common in Ontario waters.

2.9 Protective measures

The description of the protection measures that apply to the Channel Darter and its habitat is adapted from the progress report on the species' recovery (Équipe de rétablissement des cyprinidés et petits percidés du Québec, 2019).

2.9.1 Legal measures

In Quebec, there are four pieces of provincial legislation that provide legal protection for the Channel Darter or its habitat. The *Act respecting the conservation and development of wildlife* (CQLR, c. C-61.1) is the main legal tool available for wildlife management in Quebec. Section 128.6 of the Act prohibits any activity that may alter a biological, physical or chemical attribute of the habitat of wildlife species. The *Regulation respecting wildlife habitats* (CQLR, c. C-61.1, r. 18) describes the wildlife habitats that are covered by this prohibition which includes all fish habitat on Crown land. This protection is particularly effective given the public area covered by the watercourses where the species lives. However, the beds of several streams and rivers in southern Quebec are privately owned. In these cases, section 128.6 of the *Act respecting the conservation and development of wildlife* does not apply.

The *Regulation respecting threatened or vulnerable wildlife species and their habitats* (CQLR, c. E-12.01, s. 10), made under the *Act respecting threatened and vulnerable species*, designates the Channel Darter as a vulnerable species. Channel Darter habitat could be the subject of a plan established by the Minister under paragraph 6 of section 1 of the *Regulation respecting wildlife habitats*, either as the habitat of a threatened or vulnerable wildlife species. This could provide additional legal protection for Channel Darter habitat on Crown land (in the event that the fish habitat protection described in section 1 of the *Regulation respecting wildlife habitats* is not sufficient).

The *Environment Quality Act* (CQLR, c. Q-2) aims to protect the environment and the species that live in it. Under this Act, the presence of threatened or vulnerable species must be taken into account in the analysis of the environmental impacts of projects submitted for authorization. In addition, the Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains promotes the sustainability of aquatic habitats by preventing shoreline degradation and erosion and by promoting the restoration of degraded riparian environments. This policy can also provide legal protection for the Channel Darter when it is integrated into the land-use planning and development plans of the Regional County Municipalities (RCMs), as this allows it to be applied to activities carried out on private properties.

In 2017, the Government of Quebec adopted a new law, the *Act respecting the conservation of wetlands and bodies of water* (CQLR, c. Q-2, s. 22). This legislation makes it possible to conserve, restore or create new environments to compensate for unavoidable losses of wetlands and other hydric environments, and to adopt a watershed-based approach to land-use planning by taking into consideration the functions of these critical habitats. In the event that a project is likely to alter a water body, a potentially important area for the Channel Darter could be targeted and restored to offset the loss.

Finally, the Quebec Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) can also protect Channel Darter habitat through the creation of protected areas under the *Natural Heritage Conservation Act* (NHCA) (CQLR, c. C-61.01). This legislation applies to both public and private lands.

At the federal level, there are two pieces of legislation that protect the Channel Darter and its habitat: SARA and the *Fisheries Act* (FA) (R.S.C. 1985, c. F-14). SARA provides general prohibitions (section 32) that apply to individuals and, under certain conditions, to the habitats of threatened, endangered or extirpated aquatic species wherever they are found in Canada, including on private land and land under provincial jurisdiction (for further details, see SARA and the Species at Risk Public Registry). The Channel Darter has been protected as a threatened species under SARA since 2006. It should be noted, however, that in 2016 COSEWIC reassessed the status of the Channel Darter in Canada and concluded that the status of the populations of the St. Lawrence River and its tributaries was of concern. When the status of the Channel Darter (St. Lawrence populations) was changed from threatened to special concern under Schedule 1 of SARA on August 21, 2019, the prohibitions and other protections (that is, the identification and protection of critical habitat) afforded by SARA were removed, because these prohibitions apply only to listed threatened, endangered and extirpated species.

The *Fisheries Act* protects all fish in areas covered by federal or provincial fishing regulations. Since all freshwater fish species in Quebec, including the Channel Darter, are covered by provincial fishing regulations, they are all covered by the Act. Protection under the FA includes a prohibition on using the species as bait fish. In addition, when analyzing development projects, DFO ensures that it has relevant data to assess the impact of projects on aquatic species at risk and that the project complies with the requirements of the FA and SARA.

2.9.2 Administrative measures

Protection on private land can be ensured at the municipal level. RCMs have the power to make zoning changes in their region in order to include conservation areas in municipal land-use plans. The zoning change could, for example, help to identify Channel Darter habitat. After instituting this change, the RCM can define which activities are permitted in the conservation area to ensure that they are compatible with conservation objectives, for example by placing restrictions on urban, industrial, commercial or agricultural development.

By reaching an agreement with its partners, the regional branches of the MFFP may also designate wildlife sites of interest (WSIs). WSIs are designated where no other protection exists and can be created on both public and private lands. In an aquatic environment, a WSI may, for example, protect a lake, a portion of a watercourse or a habitat component (spawning area) that has unusual characteristics or is home to economically valuable fish species with high productivity, or that protects sensitive populations. In such a case, the specific intervention methods likely to ensure the sustainability of the ecological functions of the site in question are defined.

2.9.3 Voluntary measures

Habitat protection on private land relies largely on the involvement of local organizations, such as watershed and conservation organizations. These organizations are actively working to raise awareness among waterfront populations, particularly farmers and municipal governments. Voluntary conservation agreements with landowners in watersheds where Channel Darter occurs are an essential element for the protection of habitat on private land in the current legal context. While some voluntary conservation approaches may lead to legal protection for habitat (for example, conservation easements), most, if not all, conservation agreements for the protection of Channel Darter habitat take the form of statements of intent that are not legally enforceable. It is difficult at present to know the real impact of these agreements on the practices adopted by signatory landowners, and even more difficult to assess their impact on the quality of Channel Darter habitats. In addition, there are no documents that can be used to assess the extent of occurrences or habitats benefiting from such agreements.

2.10 Special significance

Because of its rarity and small size, there is little interest in the Channel Darter among the general public. The species has no direct economic importance, and little is known about its role in aquatic ecosystems (Lapointe, 1997). According to Karr et al. (1986), the number and type of darter species that are present could serve as an index of the quality of the aquatic environment. However, the Channel Darter is of little interest as a bioindicator, given its rarity and low abundance (Lapointe, 1997).

The Channel Darter is a native species that enriches the biodiversity of aquatic environments and is part of Quebec's wildlife heritage. The establishment of a recovery team and the status designation of the species in the early 2000s generated a certain amount of interest among wildlife managers, researchers and environmental protection organizations, which led to increased knowledge and habitat protection efforts (Ricard et al. 2018).

3 Recovery strategy

A recovery strategy for the Channel Darter in Quebec was established based on an analysis of the elements presented above. It consists of one overarching goal and four objectives, which are described in this section. These objectives will be achieved by implementing eight measures and 23 actions and will be evaluated on the basis of achievement indicators during plan monitoring.

3.1 Potential for recovery

The Channel Darter's widespread distribution in Quebec and the recent discovery of several new sites where it occurs, notably in the Ottawa, Saint-François, Nicolet, Gentilly, Batiscan and Saint-Anne river basins (Ricard et al. 2018), suggest that suitable habitats for the species are available in many regions of southern Quebec. In addition, the capture of several individuals in deep-water habitats in 2015 and 2016 suggests that the species uses a greater diversity of habitats than previously known. The existence of well-established populations in some rivers (for example, the Ottawa, Richelieu, Saint-François and L'Assomption rivers) indicates that spawning has occurred in recent years. Although suitable habitat is available in many watersheds, the Channel Darter is still rare and found only at low abundances.

The Channel Darter's range in Quebec is located mainly in regions where aquatic habitats have been transformed by intensive agriculture and urbanization. Improvements in water quality and habitat management, including stewardship and cultural practices that can reduce loadings of sediment, nutrient and contaminants in watercourses, could enhance habitat quality and reduce human pressure on the species.

3.2 Feasibility of recovery

Based on current data, the recovery of the Channel Darter in Quebec is possible and feasible. The species, although not very abundant, inhabits a number of rivers, and suitable habitat is available in most parts of southern Quebec. The Channel Darter's situation can be improved by implementing recovery measures to protect and increase the number and quality of habitats used by the species. Similarly, an overall improvement in environmental quality in the affected watersheds will have a positive impact on water quality in the tributaries where the Channel Darter occurs.

3.3 Goal

The goal of the recovery plan for the Channel Darter is to improve the state of the species' populations and its habitat throughout its current and historical range in Quebec.

3.4 Objectives

In Quebec, the available data on historical and current Channel Darter populations are very limited, and it is difficult at present to set quantitative objectives for the number of individuals. Consequently, the objectives set out in this recovery plan are qualitative.

The objectives to be pursued over the next 10 years (2020 to 2030) in order to achieve the goal set out in the recovery plan are as follows:

Objective 1: Identify threats to the Channel Darter.

The threats to the Channel Darter are relatively well known. However, an analysis performed at too broad a scale makes it difficult to detect local problems and to implement concrete and realistic

actions to reduce their effects. In addition, the emergence of new threats underscores the need to continue to increase knowledge of the factors that may affect the Channel Darter. For example, the current expansion of the Round Goby into the Channel Darter's range poses a threat to the species whose scope is poorly understood. The impact of this invasive alien species on the Channel Darter needs to be documented as part of this recovery plan. In addition, the characterization of riparian areas in the watersheds occupied by the species and the identification of the main threats associated with each reported observation will make it possible to identify the most significant threats in each watershed, and to guide actions likely to reduce local pressure on the species. Assessing the level of protection for each reported observation will aid in establishing a profile of the level of habitat protection in the species' range and in prioritizing issues.

Objective 2: Protect and improve Channel Darter habitats within its range.

To ensure the recovery of the Channel Darter in its range, habitat quality must be maintained and the quality of degraded habitats must be improved. Support from local partners and the mobilization of the municipal and agricultural communities are key to encouraging the adoption of practices and implementation of actions that will promote the maintenance and restoration of aquatic ecosystems. Various interventions to improve water quality in the watersheds occupied by the Channel Darter will be carried out. The use of administrative and private stewardship tools will help protect habitats by ensuring that land use is compatible with the conservation objectives for the species. Monitoring the application and effectiveness of habitat protection and enhancement measures will make it possible to assess the relevance of the actions taken.

Objective 3: Assess Channel Darter population distribution, abundance and trends.

Few data are available on Channel Darter abundance in Quebec, making it difficult to identify trends or to assess the current state of the populations. Knowledge-building is therefore essential for identifying recovery targets for reassessing the species' status. This objective involves planning and implementing a survey program in order to update the species' distribution, document its abundance and monitor certain populations. It also involves updating the survey protocol developed by Couillard et al. (2011) by taking into account new knowledge and the development of detection methods (eDNA) as well as methods for estimating population size and trends.

Objective 4: Identify habitats and key components required to maintain and ensure the recovery of Channel Darter populations.

The analysis of habitat data collected from 1930 to 2016 (Couillard et al. 2013; Ricard et al. 2018) helped to clarify the definition of the species' habitat, particularly by revealing the use of deep-water habitats. However, it also highlighted the wide range of variations in the habitat data collected at capture sites. This variability makes it difficult to determine the critical components of Channel Darter habitat and the limiting factors that are likely to explain its absence. The use of a fine-scale habitat characterization method and a variety of fishing gear will make it possible to expand and refine our knowledge of the habitats used by the Channel Darter. The state of managed habitats will also be assessed to determine the effectiveness of the interventions carried out to maintain the components necessary for the maintenance and recovery of the Channel Darter.

4 Action plan

To achieve the objectives set out in the recovery strategy, 23 actions grouped under eight measures have been defined for the next 10 years (2020 to 2030). These measures and actions are detailed in sections 4.1 to 4.4. It was also agreed that the recovery team would prepare an annual schedule of activities to be carried out. This schedule will make it possible to plan activities according to the order of priority of the measures set out in this action plan, to monitor selected actions using indicators and to estimate the approximate cost of implementing them.

Each action is assigned a priority according to need. Priority level 1 is for an action deemed essential for achieving the objectives. Failure to complete this action will jeopardize the achievement of the recovery plan objectives. Priority level 2 is for an action that is important for achieving the recovery plan objectives. Priority level 3 is for actions that would help ensure the full achievement of the objectives. The level of priority assigned to each action may be reviewed during the implementation of the recovery plan, depending on the changes in the situation of the Channel Darter in Quebec.

The organizations responsible for implementing the measures and the contributing organizations are listed. Specifically, in the “Lead & Contributors” column, the name in bold type designates the organization responsible for coordinating this measure. This may not be the organization that is in charge of implementing the measure. This coordinating organization is responsible for securing the involvement of the other partners concerned. The list of contributing organizations, whose names are written in normal type, is provided for information purposes only and is not exclusive. It is important to note that not all the organizations identified have been consulted regarding their responsibility in relation to these measures and their agreement will be sought in due course.

Several of the proposed actions relate to the Channel Darter occurrences recorded by the Centre de données sur le patrimoine naturel du Québec (CDPNQ). Occurrences denote areas (map unit polygons) occupied by a local population of the target species. Occurrence information of this type can be requested from the CDPNQ.

4.1 Measures to identify threats to the Channel Darter (Objective 1)

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
1	Identify threats to the species and its habitat within its range.	a) Identify priority threats.	In collaboration with local organizations, document the Centre de données sur le patrimoine naturel du Québec (CDPNQ) occurrences in relation to priority threats (based on the IUCN classification) to the Channel Darter to prioritize actions for each watershed.	1	Prioritization of threats added for 50% of known CDPNQ occurrences as of March 31, 2030	- Quebec Ministère des Forêts, de la Faune et des Parcs (MFFP) - CDPNQ - Local organizations - Indigenous organizations - Fisheries and Oceans Canada (DFO)
1	Identify threats to the species and its habitat within its range.	b) Inform local organizations about the priority assigned to threats and protection issues.	Extracted data on threats and the level of protection of occurrences (actions 1a and 1c) will be shared with environmental organizations according to their respective areas of action. The distribution list will include watershed organizations, ZIP (Priority Intervention Area) committees, Indigenous organizations and other relevant partners (DFO, Regional County Municipalities [RCMs], Quebec Department of Municipal Affairs and Housing [MAMH] and Department of ,	1	List of stakeholders to be contacted has been prepared Prioritization of threats and protection issues has been disseminated to targeted partners	- MFFP - CDPNQ

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
			Energy and Natural Resources [MERN], conservation organizations, etc.) on the extended distribution list that are located within the species' range.		On at least five occasions between 2020 and 2030, information is shared with the stakeholders identified in the previous indicator	
1	Identify threats to the species and its habitat within its range.	c) Assess the condition of riparian strips in watersheds occupied by the species.	The purpose of this action is to assess the state of riparian areas in monitored rivers (action 7g), for example, through LiDAR interpretation and the MELCC's riparian strip quality index (IQBR) protocol. In special cases, the assessment may be carried out in other basins where the species occurs.	2	Report on the assessment of the state of riparian areas in monitored watersheds.	- Recovery Team - Watershed organizations - Local organizations - MFFP - MELCC
1	Identify threats to the species and its habitat within its range.	d) Evaluate the level of protection for CDPNQ occurrences.	Determine the tenure (private or public) as well as the level of protection (occurrence protected by voluntary conservation agreements, no specific protection, etc.) for each of the CDPNQ Channel Darter occurrences, in order to establish a profile of habitat protection in the species' range. This action will make it possible	2	Tenure and level of protection identified for 50% of the known CDPNQ occurrences as of	- MFFP - CDPNQ - Local organizations - Indigenous organizations

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
			to target and prioritize protection issues. Its implementation will require the support of the CDPNQ team to integrate this information into the database, and the participation of local organizations with information on the protection status of occurrences.		March 31, 2030	- Fondation de la Faune du Québec
2	Assess the threat associated with the Round Goby.	a) Study the expansion of the Round Goby range.	Assess the expansion of the Round Goby's range and its impact on the Channel Darter's distribution in streams where the two species coexist.	1	At least one report produced	- MFFP - DFO - Local organizations - Universities
2	Assess the threat associated with the Round Goby.	b) Study the extent of interspecific interactions with the Round Goby.	The consequences of competition for food sources, spawning sites and space should be documented, along with potential Round Goby predation on the Channel Darter or the potential decrease in overall predation pressure resulting from reduced prey supply.	2	At least one study or literature review is published	- Universities - MFFP - DFO

4.2 Measures to protect and improve Channel Darter habitats within its range (Objective 2)

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
3	Support partners and local organizations in the implementation of actions to protect or improve habitat.	a) Share useful knowledge and tools for the species' recovery.	This action has two components: 1. Send an annual newsletter to all partners. The distribution list will include watershed organizations, ZIP committees, Indigenous governments and other groups that request a copy (RCMs, conservation organizations, etc.); 2. Disseminate knowledge, documents produced and tools developed on a new or already operational sharing platform (for example, the Fondation de la faune du Québec's directory of biodiversity and endangered species). Both the MFFP and partners will be able to contribute to the platform. This information sharing will support the partners involved in implementing the recovery plan.	3	At least five newsletters distributed annually Sharing platform developed or updated At least five documents uploaded to the platform per year during the implementation of the plan	- MFFP - Fondation de la Faune du Québec - Local organizations - Indigenous organizations - DFO

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
3	Support partners and local organizations in the implementation of actions to protect or improve habitat.	b) Ensure that RCMs are able to integrate sensitive habitats into their development plans.	The species' habitats can be found in RCMs' land-use planning and development plans and zoning and the areas concerned are the subject of a designation intended to make land use compatible with Channel Darter conservation. The purpose of this action is to ensure that municipal land managers wanting to adopt this approach to protect sensitive aquatic habitats are given the means to do so. This guide will detail the types of zoning to be prioritized, the designation of areas of interest and the normative framework.	2	Guide on integrating sensitive habitats published for the benefit of RCMs Confirmation that the guide has been provided to the RCMs and organizations concerned	- MFFP - MAMH - MELCC

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
4	Mobilize municipal and agricultural communities to adopt practices that promote the protection and enhancement of the species' habitat.	a) Develop an intervention and communication strategy for targeted communities.	With the support of experts in communication and the development of innovative solutions, and in collaboration with local organizations, identify obstacles to the adoption by municipal and agricultural communities of practices conducive to protecting and enhancing the species' habitats. Establish an intervention strategy: 1. Identify the behaviour changes to be encouraged to mitigate threats to the species and its habitats; 2. Identify target audiences and behaviours to be encouraged; 3. Set measurable objectives based on priorities in order to mitigate threats; 4. Develop interventions to meet the targeted objectives; 5. Establish a system for monitoring and evaluating interventions.	1	Strategy established for one or more specific objectives Strategy shared with local organizations	- Recovery Team - Experts in communication and the development of innovative solutions - Local organizations

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
4	Mobilize municipal and agricultural communities to adopt practices that promote the protection and enhancement of the species' habitat.	b) Implement the intervention and communication strategy.	Some of the interventions developed in the strategy (action 4a) will be implemented by local organizations, by Recovery Team members or by the MFFP.	1	At least one intervention developed under the strategy has been carried out and its success has been evaluated	- Local organizations - Recovery Team - MFFP
5	Protect habitats, including watercourses and riparian strips, through administrative and private stewardship tools.	a) Protect riparian habitats on private lands through voluntary conservation options that are legally enforceable.	Legal conservation agreements make it possible to protect habitat on private land in perpetuity. The assessment of threats and of the level of protection for occurrences allow priority sectors to be targeted (actions items 1a and 1d). The implementation and effectiveness of these conservation agreements will be monitored. Integration of the intervention strategy (action 4a) will make it easier to carry out this action.	1	Two legal conservation agreements related to Channel Darter habitat have been signed The implementation and effectiveness of at least 50% of the signed agreements have been monitored, as per the previous indicator	- Local organizations - Waterfront property owners

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
5	Protect habitats, including watercourses and riparian strips, through administrative and private stewardship tools.	b) Protect riparian habitats on private land through voluntary conservation options that are not legally enforceable.	Voluntary conservation agreements that are not legally enforceable (for example, statements of intent) could make it possible to protect habitats in areas where there is strong pressure from agricultural and urban development and where human activities can continue while ensuring the maintenance of habitats and the species. The assessment of threats and of the level of protection for occurrences will allow priority sectors to be targeted (actions 1a and 1d). The implementation and effectiveness of these agreements will be monitored after they are signed. The integration of the intervention strategy (action 4a) will make it easier to carry out this action.	2	50 conservation agreements for the protection of Channel Darter habitat have been signed. The implementation and effectiveness of at least 50% of the signed agreements have been monitored, as per the previous indicator	- Local organizations - Waterfront property owners

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
5	Protect habitats, including watercourses and riparian strips, through administrative and private stewardship tools.	c) Protect habitat through regional planning documents.	This action aims to: 1. Integrate these habitats into development plans; 2. Establish land-use designations that are compatible with the conservation of these habitats; 3. Establish a normative framework that is compatible with the protection of these habitats. Local organizations will be able to begin the process with RCMs. The intervention strategy (action 4a) and use of the guide (action 3b) will help ensure this action is completed successfully.	1	Land protection and normative framework established for Channel Darter conservation in the development plan of at least two RCMs	- RCMs - Local organizations - Quebec Department of Municipal Affairs and Housing (MAMH) - MAPAQ - MELCC

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
6	Improve water quality in the watersheds where the Channel Darter occurs.	a) Improve the condition of riparian strips and implement agricultural practices that are likely to improve water quality.	A series of interventions will be carried out in the watersheds occupied by the species: development of wider or value-added riparian strips, integration of cover crops or perennial crops in rotations, along with conservation tillage practices, optimal fertilizer management, agricultural water management structures, etc. The conclusions drawn from the characterization of the state of riparian strips (1c) will help guide efforts. The intervention strategies (4a) will also be used.	1	A report is produced that provides a profile of the projects carried out in the basins subject to population monitoring (action 7g) during the implementation of the plan.	- Local organizations - Agri-environmental advisory clubs - Waterfront property owners and farmers - Municipal managers - MAPAQ - DFO - MFFP

4.3 Measures to assess Channel Darter population distribution, abundance and trends (Objective 3)

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
7	Plan and carry out long-term monitoring of population distribution and status.	a) Prepare a five-year survey plan.	A five-year plan (schedule of priority sectors to be surveyed over five years) will be developed to plan survey needs based on changes in knowledge and the species' situation. This plan will make it possible to update CDPNQ occurrences, assess the species' presence at sites of historical occurrence, monitor certain populations and detect the species in new areas.	1	Two five-year survey plans are produced	- MFFP - DFO - Recovery Team

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
7	Plan and carry out long-term monitoring of population distribution and status.	b) Carry out surveys of known CDPNQ occurrences to update them.	Occurrences more than 20 years old are considered "historical" and cannot be used to define the species' current range. Through strategic planning of sampling efforts, surveys will be carried out to confirm the species' presence at sites where it has been reported and to prevent them from becoming historical occurrences without field validation. At the time of publication, 14 occurrences were already considered historical, and nine more will become historical occurrences by the end of the plan.	1	No occurrences have become historical without field validation during the implementation of the recovery plan. Register of targeted surveys for the Channel Darter has been established and is updated annually	- MFFP - DFO - Local organizations - Indigenous governments

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
7	Plan and carry out long-term monitoring of population distribution and status.	c) Carry out targeted surveys at suspected extirpation sites.	Recent surveys have not made it possible to confirm the presence of the species at the following historical sites: the Niger and Maskinongé rivers and the Rivière aux Bluets in the Eastern Townships, the Chicot River in the Lanaudière region and the Bécancour-Batiscan section of the St. Lawrence River. Further surveys will be conducted in these areas to assess the presence or absence of the species.	3	A targeted survey has been carried out in each of the five target areas	- MFFP - DFO - Local organizations - Indigenous governments
7	Plan and carry out long-term monitoring of population distribution and status.	d) Conduct targeted surveys in the watersheds of the Chaudière-Appalaches and Capitale-Nationale regions where no occurrences have been reported.	The absence of reported occurrences in the Chaudière and Etchemin river basins in the Chaudière-Appalaches region and in the Portneuf and Jacques-Cartier river basins in the Capitale-Nationale region could be due to the lack of targeted surveys in these areas. Targeted sampling in these basins could improve our knowledge of the species' range in Quebec.	1	A targeted survey has been carried out in each of the identified watersheds	- MFFP - DFO - Local organizations

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
7	Plan and carry out long-term monitoring of population distribution and status.	e) Update the survey protocol.	This survey protocol will be an update of the protocol developed by Couillard et al. (2011). It will take into account previously undocumented fishing methods, including captures in deep-water habitats. The use of eDNA techniques will also be presented. Methods to support the acquisition of abundance data will be developed, and habitat characterization methods will be updated. Wide distribution of the protocol is planned.	1	A new survey protocol is published The protocol has been shared with all relevant MFFP partners	- MFFP - DFO - Recovery Team
7	Plan and carry out long-term monitoring of population distribution and status.	f) Develop a provincial monitoring program.	The monitoring program will be used to (1) assess the presence of the species in various watercourses throughout its range and (2) estimate population size and trends for selected populations in watercourses where the species appears to be abundant and well established. Presence and abundance indicators adapted to the selected watercourses will be developed. The monitoring program will also (3) create a register of targeted surveys.	1	Monitoring program established	- MFFP - DFO - Recovery Team - Local organizations

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
7	Plan and carry out long-term monitoring of population distribution and status.	g) Monitor a few control populations.	Monitoring will be initiated in a few selected watercourses. Repeat surveys will make it possible to confirm the presence of the species in various watercourses throughout its range. Abundance surveys will be conducted to determine population size and trends for certain well-established populations (for example, Richelieu, Saint-François, Gatineau, L'Assomption and Rivière du Sud).	1	At least one monitoring survey has been carried out for each target population	- MFFP - DFO - Local organizations - Indigenous governments

4.4 Measures to identify habitats and key components required to maintain and ensure the recovery of Channel Darter populations (Objective 4)

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
8	Define the species' habitat.	a) Inventory and characterize various habitats.	Various fishing techniques will be used to survey more varied habitats (for example, electrofishing for shallow depths and trawls designed for small bodied fish for greater depths) and ultimately identify the different habitats used by the species over the seasons.	2	At least two survey reports have been prepared based on the use of a method other than the use of a portable electrofisher or a seine	- MFFP - DFO - Local organizations - Indigenous governments - Universities

#	Measures	Actions to be carried out	Description	Priority	Achievement Indicator	Lead & Contributors
8	Define the species' habitat.	b) Analyze current habitat data.	The most recent analysis of habitat data covers the data collected from 1930 to 2016. An analysis incorporating habitat data collected after that period can be used to fine-tune the definition of habitat used by the species, since finer scale characterization data and data from a wider variety of habitats will be available.	2	A habitat data analysis report has been prepared	- MFFP

5 Socio-economic issues related to the implementation of the recovery plan

The conservation of species at risk is an important aspect of the Government of Quebec's commitment to the International Convention on Biological Diversity. To ensure the maintenance of biological diversity, the ecosystems with which species are associated must be healthy and whole. These conditions are also important for the provision of ecosystem services. Although it is difficult to assign a value to ecosystem services, studies conducted around the world have demonstrated that they make a significant contribution to the economy (Filion, 1993; Barbier and Heal, 2006; Almack and Wilson, 2010). Considering the contribution that biological diversity makes to the ecological services that support Quebec's current and future economic and environmental health, applying the precautionary principle in order to maintain and ensure the recovery of species at risk is justified.

Since the Channel Darter is not a species that is associated with a particular economic activity, its conservation has no direct socio-economic repercussions on such an activity (for example, fishing or consumption). However, the application of certain measures to protect and enhance the quality of the species' habitats could have an indirect socio-economic impact. For example, the changes in agricultural practices that need to be made to improve water quality in some watersheds are likely to affect agricultural yields. These potential impacts have not been quantified in this document. It should be noted, however, that the watercourses the species inhabits should theoretically be spared the negative effects of development, since they should have protection under the *Act respecting the conservation of wetlands and bodies of water*. In addition, maintaining a riparian buffer of a minimum width is rooted in the Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains, which is described in the *Environment Quality Act*.

A number of social and economic benefits are also associated with the planned actions, including the benefits associated with natural environments. The ecological services provided by aquatic environments must also be taken into consideration. Aquatic habitats, including the riparian buffer strip, help to promote the abundance of predators of harmful insects (fish, birds, insects, amphibians and reptiles), filter nutrients and fertilizers used on the agricultural plain and limit sediment leaching from the soil (Société de la faune et des parcs du Québec, 2002; Vachon, 2003; Association des gestionnaires régionaux des cours d'eau du Québec, 2017).

Finally, it should be kept in mind that, under the *Act respecting threatened and vulnerable species* and the *Act respecting the conservation and development of wildlife*, the Government of Quebec has certain responsibilities for protecting Quebec's biological diversity as a whole. The implementation of this recovery plan will make a significant contribution to maintaining Quebec's biodiversity.

6 Conclusion

According to the Recovery Team, the recovery of the Channel Darter in Quebec is feasible, despite ever-present threats to the species. The goal over the next 10 years will therefore be to improve the state of Channel Darter populations and their habitats throughout the species' current and historical range in Quebec. The Channel Darter's situation could be improved by implementing measures that include reducing agricultural and urban pollution, which is detrimental to the species and its habitats.

Although substantial work has been carried out in recent years to improve our knowledge of the species, further efforts are needed to assess its abundance and population trends, and to identify the habitats and habitat components that are required to maintain the populations and ensure the species' recovery. Nevertheless, the threats to Channel Darter habitats will have to be identified at a finer spatial (for example, CDPNQ occurrences) in order to implement realistic and effective actions to reduce the associated impacts. For example, once local point sources and non-point sources of pollution have been identified, appropriate actions can be implemented. The Recovery Team considers that range-wide habitat protection and enhancement is critical to the species' recovery and its long-term maintenance.

The efforts that are made to support the recovery of the Channel Darter will bring about an overall improvement in environmental quality in the affected watersheds. The measures that are implemented will benefit a wide variety of native fish (including species at risk) that inhabit the same river basins as the Channel Darter.

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List of personal communications

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Direction de l'expertise sur la faune aquatique
- Caumartin, Jean:** Biologist, Hydro-Québec.
- Couillard, Marc-Antoine:** Biologist, Ministère des Forêts, de la Faune et des Parcs,
Direction de l'expertise sur la faune aquatique

Appendix 1

List of Abbreviations Used in This Document

DNA:	Deoxyribonucleic acid
eDNA:	Environmental DNA
Bti:	<i>Bacillus thuringiensis israelensis</i>
CDPNQ:	Centre de données sur le patrimoine naturel du Québec
COSEWIC:	Committee on the Status of Endangered Wildlife in Canada
EERT:	Essex-Erie Recovery Team
IQBR:	Indice de la qualité de la bande riveraine
SARA:	<i>Species at Risk Act</i>
FA:	<i>Fisheries Act</i>
EQA:	<i>Environment Quality Act</i>
MAMH:	Ministère des Affaires municipales et de l'Habitation
MAPAQ:	Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec
MELCC:	Ministère de l'Environnement et de la Lutte contre les changements climatiques
MFFP:	Ministère des Forêts, de la Faune et des Parcs
DFO:	Fisheries and Oceans Canada
RCM:	Regional County Municipality
CQLR:	Compilation of Quebec Laws and Regulations
FMN:	Fish Monitoring Network of St. Lawrence River freshwater
LUPDP:	Land-use planning and development plan
SCABRIC:	Société de conservation et d'aménagement des bassins versants de la zone Châteauguay
WSI:	Wildlife site of interest
VHS:	Viral haemorrhagic septicaemia
IUCN:	International Union for Conservation of Nature
ZIP:	Priority Intervention Area

Appendix 2

Definitions of NatureServe's Conservation Status Ranks

Global (G) conservation status ranks represent the species' status globally, national (N) ranks represent the species' status nationally, and subnational (S) ranks represent the species' status provincially, territorially and by U.S. state. This table presents the definitions of the ranks discussed in this report. Several other rank qualifiers for ranks G, N and S can be found at <http://www.natureserve.org/>. The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank (e.g. G4T3 or G5T1).

Rank/Qualifier	Conservation status definition
1	Critically Imperiled, e.g. S1
2	Imperiled, e.g. G2
3	Vulnerable, e.g. S3
4	Apparently Secure – abundant, extensive range and fairly low risk, but possible cause for some concern in the long term, e.g. S4
5	Secure – very extensive range, abundant populations and proven stability, e.g. G5
NR	Unranked, e.g. SNR
U	Unrankable, e.g. SU
H	Possibly Extirpated – known only from historical records, not observed in the past 20 years (southern Quebec) or 40 years (northern Quebec), e.g. SH
?	Inexact Numeric Rank, e.g. S1?
NA	Not Applicable – Synonyms; hybrids; non-native species; accidental or irregular presence; reported but not characterized, reported but questionable; reported by accident; existing taxon without reported occurrence or undefined occurrences, e.g. SNA
S#S# or G#G#	Range Rank – Numeric range rank (between two specific categories), e.g. S1S2
X	Presumed Extirpated, e.g. SX
#B	Breeding – Breeding population, e.g. S1B
#M	Migrant – Migrant species, e.g. S1M
#N	Non-breeding – Non-breeding population, e.g. S2N
#Q	Questionable taxonomy that may reduce conservation priority, e.g. S2Q