Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Skillet Clubtail (*Gomphus ventricosus*) in Canada

Skillet Clubtail

2021

Government of Canada
Gouvernement du Canada

Canada

Recommended citation:

Environment and Climate Change Canada. 2021. Recovery Strategy for the Skillet Clubtail (*Gomphus ventricosus*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. vii + 29 pp.

Official version
The official version of the recovery documents is the one published in PDF. All hyperlinks were valid as of date of publication.

Non-official version
The non-official version of the recovery documents is published in HTML format and all hyperlinks were valid as of date of publication.

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

Cover illustration: Denis Doucet

Également disponible en français sous le titre
« Programme de rétablissement du gomphe ventru (*Gomphus ventricosus*) au Canada »

ISBN 978-0-660-40412-7
Catalogue no. En3-4/347-2021E-PDF

[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Preface

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

The Minister of Environment and Climate Change is the competent minister under SARA for the Skillet Clubtail and has prepared this recovery strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the provinces of Quebec and New Brunswick, as per section 39(1) of SARA.

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

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

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

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area[3] be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

[3] These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

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

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

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

Acknowledgments

This recovery strategy was finalized by Julie McKnight and Kathy St. Laurent (Environment and Climate Change Canada, Canadian Wildlife Service (ECCC-CWS) – Atlantic Region) with significant input from staff of the New Brunswick Department of Energy and Resource Development. An initial draft was developed by Mark McGarrigle in collaboration with Samara Eaton (ECCC-CWS). Others, including Paul Brunelle, Nathalie Desrosiers Denis Doucet, John Klymko, Wendy Monk, Zoe O'Malley, Jessica Orlofske, Dwayne Sabine, Michel Saint-Germain, Ken Tuininga, Marie-Claude Archambault and Michel Savard provided valuable input and/or comments towards the finalization of the recovery strategy. Thanks are extended to Matt Mahoney and Rebekah Persad (ECCC-CWS – Atlantic Region) for developing the critical habitat maps.

Executive Summary

Skillet Clubtail (*Gomphus ventricosus*[4]) is a dark dragonfly, with a swelled posterior (the "club"), green eyes, and clear wings.

Skillet Clubtail only occurs in eastern North America and approximately 3% of the North American population occurs in Canada (Abbott 2016). The Saint John River population (New Brunswick), known since 1933, extends from Fredericton to around Gagetown. A new population was discovered on the Batiscan River in Quebec in 2011. A single adult has been recently reported from the Saugeen River in Ontario, and the species has been reported on the United States side of the Rainy River in northwestern Ontario. There is high potential the species may be present in Ontario and further investigation is needed to confirm population status. Prior to this, the species was only documented sporadically outside New Brunswick's Saint John River watershed (i.e., historical occurrences from Ontario, Quebec, and Nova Scotia). The Canadian population where breeding has been confirmed is restricted to a small section of the Saint John River and to the Batiscan River watershed in Quebec.

Skillet Clubtail is likely intolerant of changes in habitat including degradation of water quality (e.g., due to siltation or low oxygen). The primary threats to the species are likely due to anthropogenic changes to the species' habitat. However, many knowledge gaps remain regarding threats to the species.

The population and distribution objectives for Skillet Clubtail are to maintain a stable population within the species' range in Canada, including any new sites that may be identified in the future.

The broad strategies and general approaches to be taken to meet population and distribution objectives and address threats to Skillet Clubtail are presented in the strategic direction for recovery section (section 6.2). As key knowledge gaps are addressed, conservation efforts may be refined and amended.

Section 41(1)(c) of SARA requires that the recovery strategy include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. Critical habitat is partially identified for Skillet Clubtail in this document to the extent possible given the best available information.

A schedule of studies is included to identify the studies required to complete the identification of critical habitat for Skillet Clubtail. One or more action plans will be completed within five years of the final version of this recovery strategy being posted on the Species at Risk Public Registry.

[4] Based on revised classification, a new genera name was proposed for this species: *Gomphurus ventricosus*

Recovery Feasibility Summary

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

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

   Yes. Currently, populations have been documented on the Saint John River in New Brunswick and the Batiscan River in Quebec. The species may also occur along several other rivers in New Brunswick and Quebec, where exuviae and adults have been observed. It is also likely that additional populations exist in Ontario, and possibly Nova Scotia.

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

   Yes. Although information on habitat requirements is relatively limited, the continued presence of the species on the Saint John River system and the number of individuals and exuviae observed in the Batiscan River watershed suggest that sufficient suitable habitat is available to support the species.

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

   Unknown. The level of concern for presumed threats (annual and perennial non-timber crops, logging and wood harvesting, dams and water management/use, agricultural and forestry effluents, habitat shifting and alteration) is unknown and whether these threats are reversible is poorly understood.

   The loss of natural riparian habitat threatens the species but this can be reduced to some degree with the use of shoreline buffers. Even so, it may not be sufficient to maintain the habitat quality required by the Skillet Clubtail.

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

Unknown. Management and stewardship approaches exist that could address threats to the species and have the potential to prevent future habitat destruction or to allow for habitat recovery. In the case of threats that may be associated with dams, the impact may be irreversible. The ongoing documentation of the Saint John River population since 1933, the number of observations made in the Batiscan River basin every year

since 2011 and the possibility other populations exist in Quebec and Ontario, all suggest that achieving population and distribution objectives is feasible (i.e., maintain the species).

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1. COSEWIC* Species Assessment Information

Date of Assessment: November 2010

Common Name (population): Skillet Clubtail

Scientific Name: *Gomphus ventricosus*[5]

COSEWIC Status: Endangered

Reason for Designation: This rare dragonfly of large, clean, and medium to slow-running rivers with fine sand, silt, or clay bottoms is currently known from only 3 locations in Canada. It disappeared over 60 years ago from two other rivers. The largest population is subject to a number of threats that are cumulatively leading to a decline in the quality of habitat.

Canadian Occurrence: New Brunswick

COSEWIC Status History: Designated Endangered in November 2010

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

2. Species Status Information

Skillet Clubtail only occurs in North America and approximately 3% of the North American population occurs in Canada (Abbott 2016). Skillet Clubtail (*Gomphus ventricosus*) was assessed by COSEWIC as Endangered in 2010 and listed in Schedule 1 of the *Species at Risk Act* (SARA) in 2017. The species was listed under the New Brunswick *Species at Risk Act* in May 2013 (New Brunswick Species at Risk Public Registry 2019). It is also considered likely to be designated threatened or vulnerable under the Quebec *Act Respecting Threatened or Vulnerable Species*. It is considered Globally Vulnerable (G3). National and sub-national ranks are in Table 1. Since the species was last assessed by COSEWIC, a relatively large Skillet Clubtail population was discovered in Quebec in the Batiscan River watershed. However, its extent of occurrence in Quebec and New Brunswick remains limited. Evidence suggests the species may also be present in Ontario on the Saugeen River and Rainy River but further study is required to determine the population status. Other potential populations, generally known from just one to several adults or exuviae, have yet to be confirmed but may significantly increase the species' extent of occurrence (Figure 2).

[5] Based on revised classification, a new genera name was proposed for this species: *Gomphurus ventricosus*

Table 1. Conservation status ranks for Skillet Clubtail (NatureServe 2017, CDPNQ 2019)

Global (G) Rank[a]	**National (N) Rank[b]**	**Subnational (S) Rank[c]**
G3	Canada N1	NB (S1), NS (S1), ON (SH), QC (S1)
	USA N3	Connecticut (S2), Indiana (S1S2), Iowa (SNR), Kentucky (SH), Maryland (SH), Massachusetts (S2), Michigan (SNR), Minnesota (SNR), Missouri (SU), New Hampshire (S3), New Jersey (SNR), New York (S1), North Carolina (S1S2), Ohio (S2), Pennsylvania (SX), Tennessee (S3), Vermont (S1), Virginia (S1), Wisconsin (S3S4)

[a] Conservation Status Rank: 1– critically imperiled; 2– imperiled; 3– vulnerable to extirpation or extinction; 4– apparently secure; 5– secure; X – presumed extirpated; H – historical/possibly extirpated; NR – status not ranked; U – unrankable

3. Species Information

3.1 Species Description

Clubtails are distinguishable from other dragonfly species by the lateral swelling of the posterior end of the abdomen (Massachusetts Division of Fisheries and Wildlife 2008). Skillet Clubtails have a lateral swelling that is almost circular in appearance. The sexes exhibit different characteristics, with females having thicker abdomens and smaller posterior swelling (COSEWIC 2010). Adults are dark brown and black, with a distinguishable pale marking on the abdomen, lateral yellow markings on the club, green eyes, and clear wings (Massachusetts Division of Fisheries and Wildlife 2008).

3.2 Species Population and Distribution

Globally, Skillet Clubtail distribution is restricted to eastern North America, east of the Mississippi River, south to Tennessee and as far north as Minnesota, the north shore of the St. Lawrence River in Quebec, and the Maritime provinces (COSEWIC 2010) (Figure 1).

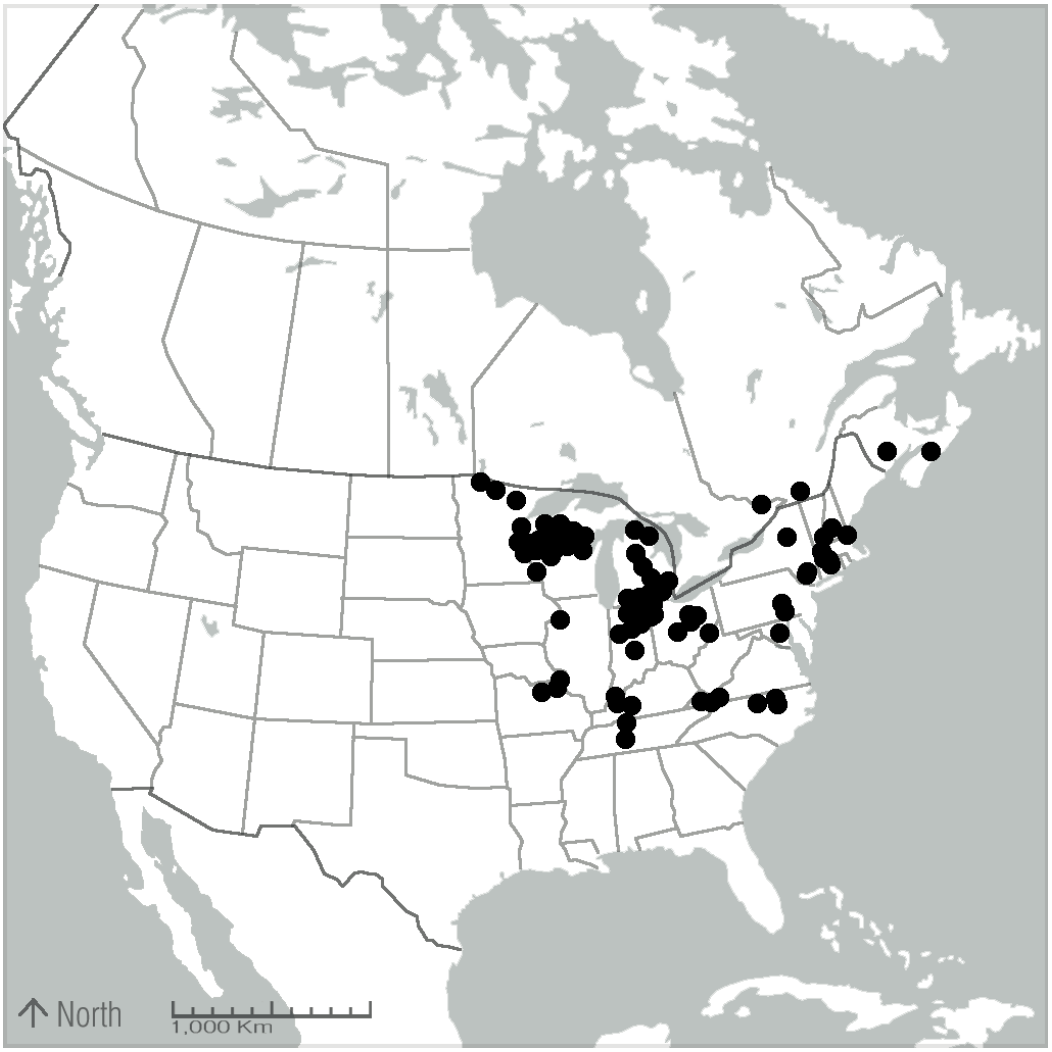

Figure 1. Global distribution of Skillet Clubtail, including historical occurrences for Ontario and Quebec and both a historical and an unconfirmed record for Nova Scotia (from COSEWIC 2010).

In Canada, Skillet Clubtail was documented historically in Ontario, Quebec, New Brunswick, and Nova Scotia. There are two confirmed breeding populations (New Brunswick and Quebec), and additional sites for which the population size and breeding status have not been determined (Ontario, New Brunswick and Quebec, and possibly Nova Scotia).

The Saint John River population (New Brunswick), known since 1933, extends from Fredericton to around Gagetown (Figure 2). Adults were also observed on two tributaries of the Saint John River (Salmon and Canaan Rivers). However, with only adult records from these rivers, it is currently unknown whether breeding populations exist.

In Quebec, a new population was discovered on the Batiscan River in 2011. Between 2011 and 2018, several adults and at least 192 exuviae were documented (Savard 2011; Charest in prep.) between Saint-Adelphe and Saint-Stanislas. Adults have

recently been reported on other rivers in Quebec. Additional efforts will be required to determine the size of these populations and to identify the sections used for egg-laying and adult emergence. The records are from the Chaudière River in the Beauce region (2015, 2 males) and the Godefroy River near Bécancour (2016, 1 male). In addition, there are two specimens in the collection of the Montreal Insectarium labelled as coming from Mont-Bellevue, in the Sherbrooke area, in 2005. Given the distance between these records and the currently known breeding populations, it is highly likely that these locations support separate breeding populations. Three historical records exist for Quebec from the Ottawa River (1924), Farnham (1940), and Saint-Cuthbert (1984) (Figure 2).

A historical record of an adult exists for Nova Scotia from Mount Uniacke, Hants County collected far from appropriate larval habitat. A second, more recent, record of an exuvia from the Shubenacadie River in 1992 was lost and cannot be confirmed (P. Brunelle pers. comm., Oct. 30 2011) (Figure 2). An intensive exuvia survey specifically targeting Skillet Clubtail was conducted on the Shubenacadie River in 2012 with no records of the species (Klymko and Robinson 2013).

In Ontario, historical records of this species exist for the Ottawa and Rideau rivers in Ontario from 1924 (COSEWIC 2010). An exuvia was collected on the Minnesota side of Rainy River near northwestern Ontario in 1998. No confirmed records on the Canadian side have been documented, though suitable habitat is believed to exist. Targeted surveys on this river are planned for 2021. A 2012 record of an adult on the Saugeen River in southern Ontario has recently been reported, though exuviae have not been found (C. Jones, pers. comm.). The discovery of the Batiscan River population in Quebec, and other potential populations, suggests that the species' range remains poorly understood and that additional populations could be verified or discovered in the future.

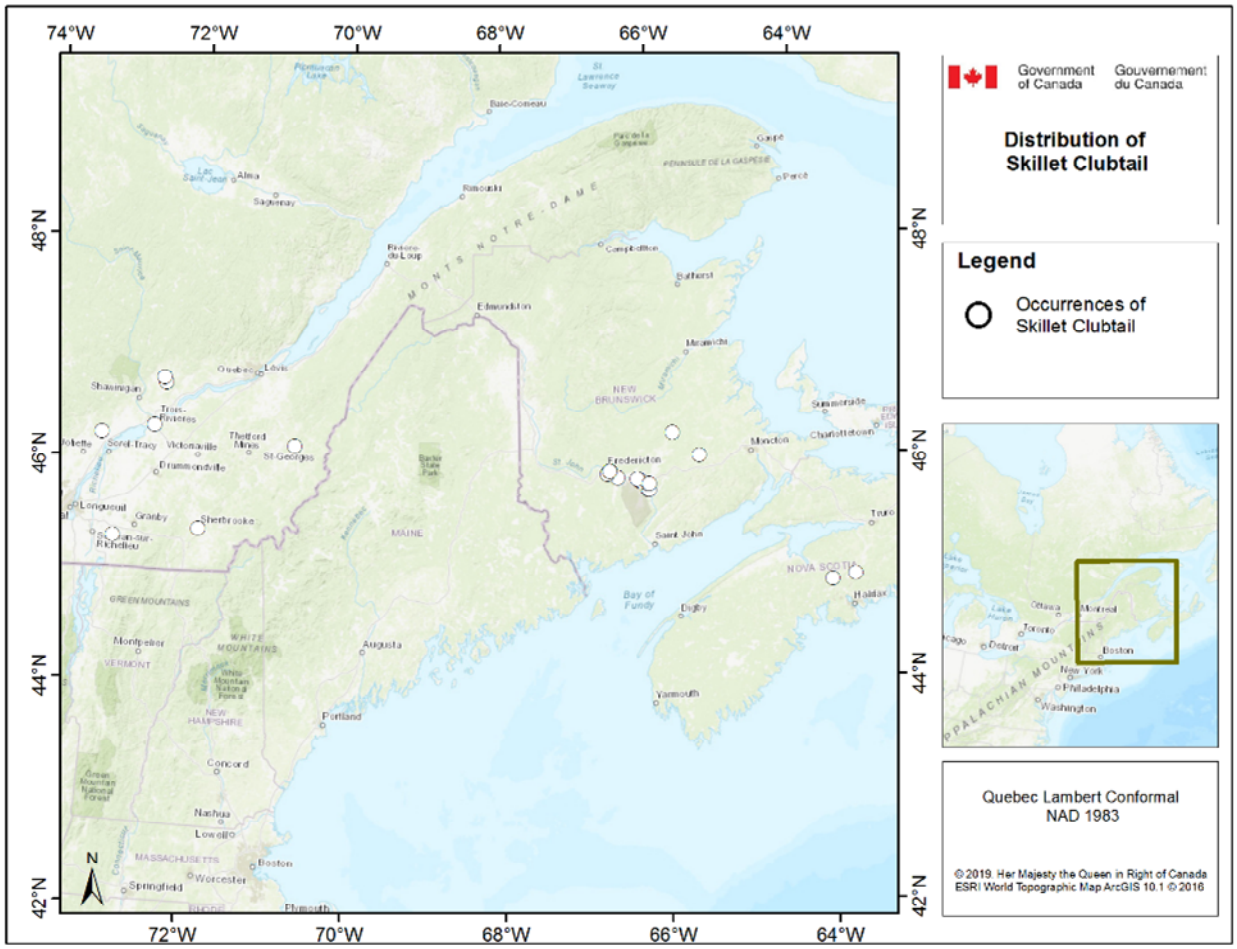

Figure 2. Current distribution (last 30 years) of Skillet Clubtail in Canada. Adult records are included but breeding populations are not confirmed outside the Saint John River in New Brunswick and the Batiscan River in Quebec.

3.3 Needs of Skillet Clubtail

The habitat requirements and preferences of Skillet Clubtail larvae and adults are poorly understood.

Skillet Clubtail requires clear or naturally turbid unpolluted running waters. Eggs are deposited on the surface of running waters and larvae likely drift a considerable distance from where eggs were deposited. Larvae likely burrow shallowly in the bottom of rivers and require appropriate substrates such as fine sand, silt, and/or clay. Larvae absorb oxygen from the water and are likely intolerant of degradation of water quality (e.g., extreme siltation or low oxygen) (COSEWIC 2010).

Skillet Clubtail larvae spend two or more years in the river before emerging. Larvae leaving the water to emerge may be concentrated in areas by the action of currents. COSEWIC (2010) mentions synchronous emergence around late June for the Saint John River population and recent observations in Quebec suggest emergence occurs

from early June to mid-July (Charest in prep.). Emergent larvae use appropriate substrates to moult into adults and these may be located both near the water (less than 30 cm, N. Desrosiers pers. comm.) and at a considerable distance from the shoreline in the riparian zone (D. Sabine, pers. comm. in COSEWIC 2010).

Adult Skillet Clubtails have been found in forests, bogs, and field habitats relatively close to suitable rivers for larvae (COSEWIC 2010). Adults may require forest canopy up to 10 km from their natal waters for mating (Dragonfly Society of America [Catling, Daigle, Donnelly, Dunkle, etc.] pers. comm. in COSEWIC 2010) and may spend the majority of their adult life in surrounding forests. The proximity of adjacent forest habitat may be a requirement for long-term persistence at a site (M. Savard pers. comm. 2018).

4. Threats

Direct threats to Skillet Clubtail and its habitat are assessed in Table 2.

The threat assessment for the species is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system.

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky et al. 2008). For the purposes of threat assessment, only present and future threats are considered. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section.

4.1 Threat Assessment

Table 2. Threat Assessment Table

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Comments
1	Residential & commercial development	Low	Restricted	Slight	High	
1.1	Housing & urban areas	Low	Restricted	Slight	High	Increasing development pressure along the Saint John River. Low along the Batiscan River.
4	Transportation & service corridors	Low	Large - Restricted	Slight	High	
4.1	Roads & railroads	Low	Large - Restricted	Slight	High	Vehicular traffic causes teneral and possibly adult mortality. Threat exposure occurs during a short window.
5	Biological resource use	Unknown	Restricted	Unknown	High - Moderate	
5.3	Logging & wood harvesting	Unknown	Restricted	Unknown	High - Moderate	Forest harvesting and agriculture along watercourses may cause sedimentation and may alter emergence habitat.
6	Human intrusions & disturbance	Unknown	Small	Unknown	High	
6.1	Recreational activities	Unknown	Small	Unknown	High	Wake from boats/vehicles may interfere with emergence (and potentially cause mortality) but this threat has not been evaluated.
7	Natural system modifications	Unknown	Pervasive	Unknown	High	
7.2	Dams & water management/ use	Unknown	Pervasive	Unknown	High	200+ dams and water control structures in the St. John River Basin. 103 water impoundments in the Batiscan River watershed. Alters natural hydrology of river systems and may encourage colonization by introduced species.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Comments
8	Invasive & other problematic species, genes & diseases	Low	Restricted	Moderate	High	
8.1	Invasive non-native/alien species/ diseases	Low	Restricted	Moderate	High	e.g., in New Brunswick: Crayfish, Chain Pickerel, Smallmouth Bass, Muskellunge. May alter the species habitat (including food resources) and feed on larvae. Invasive non-native/alien aquatic plants may alter habitat characteristics.
8.2	Problematic native species/diseases	Unknown	Restricted	Unknown	High	e.g., in Quebec: Chain Pickerel, Smallmouth Bass, Muskellunge. May alter the species habitat (including food resources) and feed on larvae.
9	Pollution	Unknown	Pervasive	Unknown	High	
9.1	Household Sewage & Urban Waste Water	Unknown	Pervasive	Unknown	High	(e.g., nutrient loads, soil erosion, sedimentation, herbicides and pesticides) Dragonflies are indicators of ecosystem health. Eutrophication from sewage input and agricultural and forestry effluents. Water quality of Saint John River continuously showing improvements since the 1960s and tributaries of the Batiscan River has somewhat improved (2003-2015)
9.3	Agricultural & forestry effluents	Unknown	Restricted	Unknown	High	
11	Climate change & severe weather	Unknown	Pervasive	Unknown	High	
11.1	Habitat shifting & alteration (sea-level rise and salt water intrusion)	Unknown	Pervasive	Unknown	High	Rising sea levels may push salt water further up the Saint John River. The species will not be able to move upstream to avoid saltwater influence (because of the Mactaquac dam).

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

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

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71%–100%; Serious = 31%–70%; Moderate = 11%–30%; Slight = 1%–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

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

4.2 Description of Threats

1.1 Housing & Urban Areas
Residential development along riparian areas has the potential to affect the habitat of both adults and larvae through clearing of vegetation and sedimentation, pollution, and increased access to the watercourse. The Saint John River locations are limited to an area of increasing development pressure and this threat is likely to increase over time (COSEWIC 2010). Development pressure is relatively low along the Batiscan River, but could be more significant along the Godefroy and Chaudière rivers and at the Mont-Bellevue site, depending on the exact location of the egg-laying and larval emergence sites. Additional surveys will be required to more precisely define these locations and thus better address the threats.

4.1 Roads & Railroads
Vehicle traffic on riverside roads can cause mortality (road kill) of tenerals and possibly adults. Dispersal distance of the species is thought to be up to 10km from larval waters (Dragonfly Society of America [Catling, Daigle, Donnelly, Dunkle, etc.] pers. comm. *in* COSEWIC 2010), increasing the risk for dispersing adults in urban areas such as Fredericton. The likelihood that this threat will occur is low for the Saint John River locations since there are relatively few roadways occurring near most larval emergence sites. However, there are roads very close to certain sectors along the Batiscan, Godefroy and Chaudière rivers. The impact of this threat at the population level is unclear.

5.3 Logging & Wood Harvesting and 9.3 Agricultural and Forestry Effluents
Forest harvesting and agricultural land use along watercourses supporting Skillet Clubtail has the potential to affect habitat through sedimentation from surface runoff, clearing of vegetation near the watercourse, as well as alteration of adult habitat through harvesting of forests surrounding the rivers. However, the extent to which this threat is influencing habitat is currently unknown and warrants further investigation. There is little agricultural activity upstream from known sites on the Batiscan River.

6.1 Recreational Activities (boats)
Wakes from boats and vehicles can result in mortality during emergence. Although most larval emergence in the Saint John River locations was observed quite a distance from the shoreline (D. Sabine pers. comm. *in* COSEWIC (2010), and Jessica Orlofske and Wendy Monk pers. comm.), that was not the case in Quebec, where emergence was observed less than 1 metre from the shore (N. Desrosiers pers. comm.). This threat was identified in the COSEWIC status report; however, its impact at the population level is unknown.

7.2 Dams & Water Management/Use
There are over 200 dams and water control structures in the St. John River Basin (Canadian Rivers Institute 2011). The largest barrier is the Mactaquac Dam upstream of Fredericton, which is both a power generation and flood control system. There are 103 water impoundments in the Batiscan River watershed (SAMBBA, 2015), most of

which are small and are intended for wildlife and resort purposes. A detailed assessment of the effects of potential aquatic barriers on Skillet Clubtail has not been conducted. Dams affect freshwater ecosystems on an ongoing basis by altering the natural hydrology of river systems, including changes to flow regimes, water temperatures, sediment transport, and nutrient loads (Bednarek et al. 2001; Saunders et al. 2002; Nilsson and Berggren 2000). Upstream of dams, the creation of reservoirs from water that once flowed downstream can lead to permanent terrestrial and riparian habitat loss (Nilsson and Berggren 2000), and lasting changes to species diversity (Nilsson et al. 1997). Reservoirs created from damming activities can also cause changes to water temperatures, resulting in habitat favouring warm water fishes and encouraging further colonization by introduced species (Canadian Rivers Institute 2011).

In the case of the Mactaquac dam, habitat suitable for larvae is found downstream of the dam and the current severity of this threat is thus considered unknown.

8.1 Invasive Non-native/Alien Species/ Diseases and 8.2 Problematic native species/diseases (e.g., Crayfish, Chain Pickerel, Smallmouth Bass, Muskellunge)
Invasive species have the potential to affect Skillet Clubtail directly and indirectly (COSEWIC 2010). The introduction of non-native predatory species could alter the naturally occurring ecological processes in the watercourse. Many species have the potential to feed on larvae that disperse in the water column or burrow into the substrate. Invasive aquatic plant species can result in the alteration of habitat characteristics, making a site unsuitable (COSEWIC 2010). The impact of the introduction of these species on Skillet Clubtail is unknown at present.

There are several introduced species in New Brunswick river systems containing Skillet Clubtail that may be a threat for the species. These include three species of fish: Muskellunge (*Esox masquinongy*), Chain Pickerel (*Esox niger*), and Smallmouth Bass (*Micropterus dolomieu*) and two species of crayfish: Spinycheek Crayfish, (*Orconectes limosus* (Rafinesque)), and Virile Crayfish (*Orconectes virilis* (Hagen)) (McAlpine 2007). The potential impact of problematic native species or introduced species on the Batiscan River population was not analyzed.

9.1 Household Sewage & Urban Waste Water and 9.3 Agricultural & Forestry Effluents (e.g., nutrient loads, soil erosion, sedimentation, herbicide and pesticides)
Damselflies and dragonflies are used throughout the world as indicators of ecosystem health (Lavilla et al. 2010, Kalkman et al. 2008, Stone et al. 2005, Hornung and Rice 2003). Skillet Clubtail is thought to be intolerant of eutrophication (COSEWIC 2010); however, the threat of eutrophication from sewage input along the Saint John River is low. It should be noted that the water quality of the Saint John River has continued to show improvement since the 1960s (Currie et al. 2011). The Batiscan River watershed is large (4,688 km^2). Tributaries located upstream of Saint-Adelphe drain an area occupied primarily by forest and have a very high level of ecological integrity. However, the Pierre-Paul River, which flows into the Batiscan River at Saint-Adelphe, has a very low level of ecological integrity due to the eutrophic waters from Lake Pierre-Paul

(SAMBBA 2015). Most tributaries of the Batiscan River located downstream from Saint-Adelphe have very poor water quality, but the situation in some of them improved between 2003 and 2015 (SAMBBA 2015). The impact of the Batiscan River water quality on the Skillet Clubtail population has not been quantified.

11.1 Habitat Shifting & Alteration (sea-level rise and salt water intrusion)
Over time, rising sea levels associated with climate change would push salt water further up the Saint John River. This extension of the salt water influence would reduce the habitat available to Skillet Clubtail. The species would not be able to migrate upstream because the Mactaquac dam and its headpond are unsuitable habitats extending 35 km (COSEWIC 2010).

5. Population and Distribution Objectives

The population and distribution objectives for Skillet Clubtail are to maintain a stable population within the species' range in Canada, including any new sites that may be identified in the future.

Skillet Clubtail was assessed as Endangered because the population is severely fragmented and subject to a number of threats that are cumulatively leading to a decline in the quality of habitat (COSEWIC 2010). As such, the population and distribution objectives to maintain a stable population and prevent loss of range and occupied habitat are considered appropriate.

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

The primary actions already completed for this species have been regarding surveys and monitoring.

Ontario

Surveys have been conducted at the following sites:

- Rainy River in 1998 (Steffens and Smith 1999). Exuviae collected on the Minnesota side of the river, and presumed suitable habitat on the Canadian side; no confirmed observations or records on the Canadian side. Emergence surveys are planned in 2021 (C. Jones, pers. comm.).
- Saugeen River in 2012, incidental observation of an adult. Searches for exuviae in 2019 but none found (C. Jones, pers. comm.).
- Ottawa and Rideau rivers from 2005-2010. Nine surveys totaling over 700 hours failed to find the species.

New Brunswick

- A five-year study (2002-2006) on dragonfly emergence was completed by D. Sabine in Fredericton, NB.
- Additional survey work was conducted by the Atlantic Canada Conservation Data Centre on portions of the following rivers:
  - Miramichi Watershed in 2007, no discoveries. Opportunistic surveying on other rivers, an adult was found on the Canaan River (Doucet and Edsall 2008)
  - Saint John River and its tributaries (Tobique, Canaan, Meduxnekeag, Jemseg, St-François) in 2008, no additional discoveries (D. Doucet, pers. comm., Oct. 21 2011)
  - Restigouche River and its tributaries in 2008, no discoveries (D. Doucet, pers. comm., Oct. 21 2011)
  - Magaguadivic River in 2008, no discoveries (D. Doucet, pers. comm., Oct. 21 2011)
  - Restigouche River in 2011 was surveyed for dragonfly exuviae (not specifically Skillet Clubtail), no new occurrences found (Klymko and Robinson 2011)
  - The New, Lepreau, Magaguadavic, Didgeguash, Petiticodiac River, Oromocto, and Canaan rivers were surveyed for exuviae in 2016, no discoveries (Klymko and Robinson 2017).
- Emergence surveys were carried out by Jessica Orlofske, Zoe O'Malley, and Wendy Monk at Saint John River locations from 2014 to 2016.

Although not targeted directly for the conservation of Skillet Clubtail, there are active watershed-based environmental non-government organizations working on conservation initiatives on the Saint John River. Water quality and the impact of anthropogenic activities were assessed in the 2011 the Saint John River State of the Environment report (Canadian Rivers Institute 2011).

Nova Scotia

- Survey work was conducted by the Atlantic Canada Conservation Data Centre on portions of the following rivers:
  - Tusket River, Medway River, Lahave River, and St. Mary's River in 2010-2011. These were surveyed for dragonfly exuviae (not specifically Skillet Clubtail) but no new occurrences found (Klymko 2010; Klymko and Robinson 2011).
  - Shubenacadie River in 2012. An intensive exuvia survey specifically targeting Skillet Clubtail. The entire river from Grand Lake Shubenacadie was sampled. 1,275 exuviae were collected at 32 sites; no Skillet Clubtails were found (Klymko and Robinson 2013).

Quebec

- Batiscan River in 2011[6]. A photo of the species was taken during inventories to produce an atlas of Quebec odonates.
- Batiscan River from 2012-2013. Exuviae surveys were conducted by the Centre de données sur le patrimoine naturel du Québec (N. Desrosiers, MFFP) with the collaboration of the Société d'aménagement et de mise en valeur du bassin de la Batiscan (C. Demers, SAMBBA) on sections of the Batiscan River in 2012 and 2013. In 2012, no exuviae or specimens were found. In 2013, one specimen in the process of emerging was discovered on the bank of the river.
- Batiscan River from 2012-2018. Annual inventories for exuviae and/or adults conducted by P. Charest (M. Savard, pers. comm.).
- Godefroy River in 2017. No discoveries.
- Suitable habitats near the historical Farnham location (1940) were visited several times in recent years by Alain Mochon. An exuvia was found, but given its condition, it was impossible to confirm that it was of the Skillet Clubtail (M. Savard, pers. comm.).

For most rivers listed above, there are large stretches that have been subject to little or no sampling.

[6] http://entomofaune.qc.ca/entomofaune/odonates/Atlas.html

6.2 Strategic Direction for Recovery

Table 3. Recovery Planning Table

Threat or limitation	Broad Strategy to Recovery[a]	Priority[b]	General Description of Research and Management Approaches[c]
All	Awareness Raising: Outreach & Communications	High	Raise awareness of Skillet Clubtail (e.g., species' needs, occurrences, direct threats) with relevant government agencies, land owners and managers, agriculture and forestry industry, recreational users (boaters, shoreline users)
	Conservation Designation & Planning: Conservation Planning	High	Plan for conserving and managing the species at occupied sites
Knowledge Gaps	Research & Monitoring: Basic Research & Status Monitoring	High	Develop and implement protocols and methods (including detailed study design) to monitor Skillet Clubtail (refer to Table 4 for priority rivers)
			Conduct research on Skillet Clubtail (to address knowledge gaps especially habitat requirements of larval and adult life stages)
			Compile and analyse information on known threats for occupied sites; Conduct research on threats to the species and its habitats (e.g., effects of sewage, run-off, agricultural & forestry effluents, invasive species, recreational activities, roads)
Household sewage & urban waste water; agricultural & forestry effluents (e.g., nutrient loads, soil erosion, sedimentation, herbicides and pesticides)	Law Enforcement & Prosecution: Detection & Arrest	Medium	Reduce or deter illegal behaviour through compliance promotion and enforcement of existing laws and policies that protect water resources
	Legal & Policy Frameworks: Laws, Regulations & Codes	Medium	Assess and amend, if necessary, existing water quality standards if it is determined that standards are insufficient to ensure the survival of Skillet Clubtail.

[a] Refer to the Conservation Measures Partnership (CMP) Conservation Actions Classification v 2.0 (classification levels 1 & 2) https://docs.google.com/spreadsheets/d/1i25GTaEA80HwMvsTiYkdOoXRPWiVPZ5l6KioWx9g2zM/edit#gid=1144804238

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

[c] These approaches are elaborated from the (CMP) Conservation Actions Classification v 2.0 (classification level 3)

6.3 Narrative to Support the Recovery Planning Table

The lack of basic information on Skillet Clubtail (e.g., its needs, fidelity to sites, and threats to its survival) is reflected in the high priority assigned to approaches that fill knowledge gaps. While knowledge gaps are being filled, the immediate focus of conservation efforts will be on the protection of natural riparian habitat and mitigation of presumed threats to this habitat. The Saint John and Batistican river populations are the only confirmed breeding populations at this time and conservation efforts will be prioritized to these areas.

Developing survey protocols and monitoring methods for the species is of “High” priority. Protocols and monitoring methods will be developed that increase the probability of detection and identify high priority areas for future work. Survey efforts should focus on locations in proximity to known occurrences (Table 4).

Table 4. Areas identified by expert opinion as high priority for additional surveys.

Province	**River**
Ontario	Rainy River
	Saugeen River
New Brunswick	Saint John River above the Mactaquac Dam[a]
	Petticodiac[b] River
	Canaan River[d]
	Salmon River[d]
Nova Scotia[a]	Annapolis River
Quebec[c]	Unsurveyed stretches of the Batiscan River
	Godefroy River (Bécancour)
	Chaudière River (Saint-Georges-de-Beauce)
	Confluence of the Magog and Saint-François rivers
	Yamaska River (Farnham section)

[a] P. Brunelle, pers. comm., Oct. 30 2011.
[b] D. Doucet, pers. comm., Oct. 21 2011.
[c] M. Savard, pers. comm. Dec. 6, 2018
[d] J. Klymko, pers. comm. Nov. 25, 2020

The impact of anthropogenic threats to the species (e.g., residential and commercial development, annual and perennial non-timber crops, logging and wood harvesting) is poorly known. Research on threats and a comprehensive threat assessment are required for effective conservation planning, and to assess and prioritize areas for management and conservation.

Necessary elements of habitat (biophysical attributes) for both adults and young are poorly known for this species. Information from observations of adults and of larvae at emergence covers only a small portion of the species’ life cycle requirements. The few records of adults do not provide definitive information on the behaviour and habitat requirements of adults. Quantifying needs of the species is key to the development and success of conservation measures.

7. Critical Habitat

Section 41(1)(c) of SARA requires that the recovery strategy include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction.

Critical habitat for Skillet Clubtail is based on habitat occupancy and habitat suitability and is partially identified in this document, to the extent possible, based on the best available information. Additional critical habitat may be added in the future if new information supports the inclusion of areas beyond what is currently identified (e.g., additional areas vital for larvae and/or adults).

A schedule of studies (Table 6) has been developed to provide the information necessary to complete the identification of critical habitat that will be sufficient to meet the population and distribution objectives. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

7.1 Identification of the Species' Critical Habitat

Critical habitat for Skillet Clubtail is identified as all areas with suitable habitat within the yellow polygons in Figures 3-6. Suitable habitat relates to the areas possessing a specific set of biophysical attributes required for Skillet Clubtail's life processes as summarized in Table 5. Note that not all attributes in Table 5 must be present in order for an area to be identified as critical habitat. If the area is capable of supporting synchronous emergence of Skillet Clubtail, it is considered critical habitat for the species, even though some of the associated attributes might be missing.

Areas within the polygons that clearly do not contain the biophysical attributes (e.g., bridges, roads, trails, human structures) are not identified as critical habitat under SARA.

Table 5. The area and associated biophysical attributes required for Skillet Clubtail to carry out the emergence phase of its life cycle.

Life Stage	Life Process	Area or Type of Site	Biophysical Attributes
Larvae (nymphs) → Tenerals	Emergence	Aquatic portion of rivers where currents may facilitate emergence and adjacent riverbank with structure (e.g., riparian[7] trees, rocks suitable for emergence)	• Clear, cool, relatively unpolluted rivers adjacent to riparian habitat with: o natural understory vegetation (i.e., relatively unaltered by development); o hardwood trees or other structures that provide emergence substrate; and o canopy cover within 30 m of the watercourse[8]

7.1.1 Information and methods used to identify critical habitat

Exuviae surveys conducted by D. Sabine yielded many emergence records and exuviae of the species between 2002 and 2006. Skillet Clubtail was also identified during exuviae surveys in 2014 and 2015 by the Canadian Rivers Institute (O'Malley and Monk 2016). For the Batiscan River site, P. Charest counted 192 Skillet Clubtail exuviae between 2011 and 2018 (N. Desrosiers pers. comm. 2018; P. Charest, in prep).

Sites with evidence of synchronous emergence (i.e., observations of at least three individual larvae, exuviae, and/ or tenerals) in at least two years between 2002 and 2018) were included in the dataset used to create the yellow polygons in figures 3-6. A 200 m critical function zone was drawn upstream and downstream of emergence sites because Skillet Clubtail larvae spend two or more years in the river and they concentrate in areas prior to emerging. This 200 m critical function zone, based on larval surveys and eDNA survey results by O'Malley and Monk (2016), is necessary to maintain water and river bottom characteristics for the larvae to survive prior to emerging. O'Malley and Monk (2016) also documented the distance exuvia travelled from water at each site along the Saint John River. A 30 m critical riparian zone extending landward of the river edge was drawn for each site. The intact critical riparian zone is necessary to maintain bank stability and macro- and micro-habitat characteristics required for Skillet Clubtail to survive.

More information on critical habitat to support protection of the species and its habitat may be requested by contacting Environment and Climate Change Canada's Recovery Planning section at: ec.planificationduretablissement-recoveryplanning.ec@canada.ca.

[7] relating to, or situated on, the banks of a river.

[8] as defined by the New Brunswick Clean Water Act: a watercourse means the full width and length, including the bed, banks, sides and shoreline, or any part, of a river, creek, stream, spring, brook, lake, pond, reservoir, canal, ditch or other natural or artificial channel open to the atmosphere, the primary function of which is the conveyance or containment of water whether the flow be continuous or not.

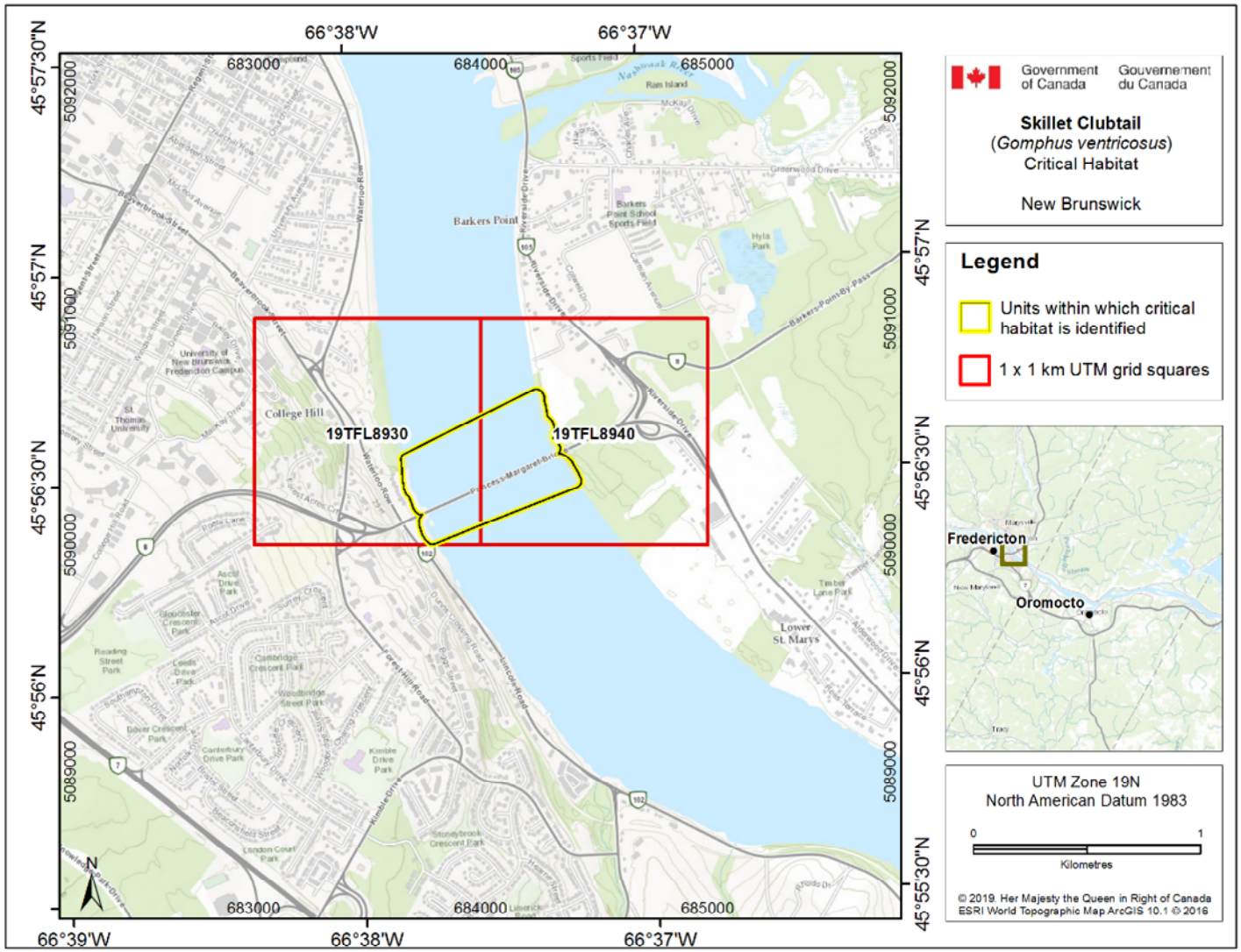

Figure 3. Critical habitat for Skillet Clubtail in Fredericton, NB is represented by the yellow shaded polygon where the criteria and methodology set out in section 7.1 of the recovery strategy are met. The 1 km × 1 km UTM grid overlay shown in this figure is a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the shaded polygon do not contain critical habitat.

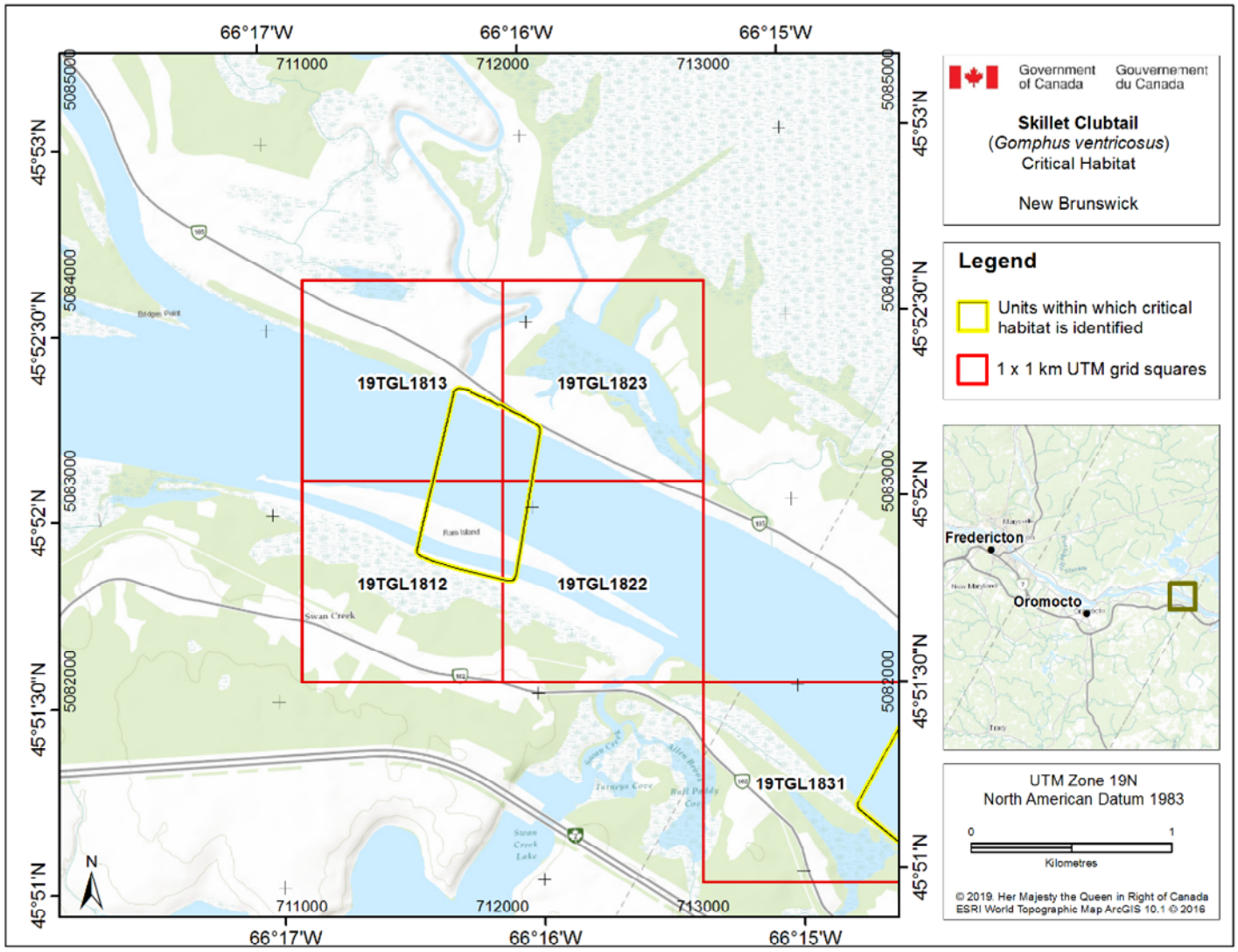

Figure 4. Critical habitat for Skillet Clubtail in McGowans Corner, NB is represented by the yellow shaded polygon where the criteria and methodology set out in section 7.1 of the recovery strategy are met. The 1 km × 1 km UTM grid overlay shown in this figure is a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the shaded polygon do not contain critical habitat.

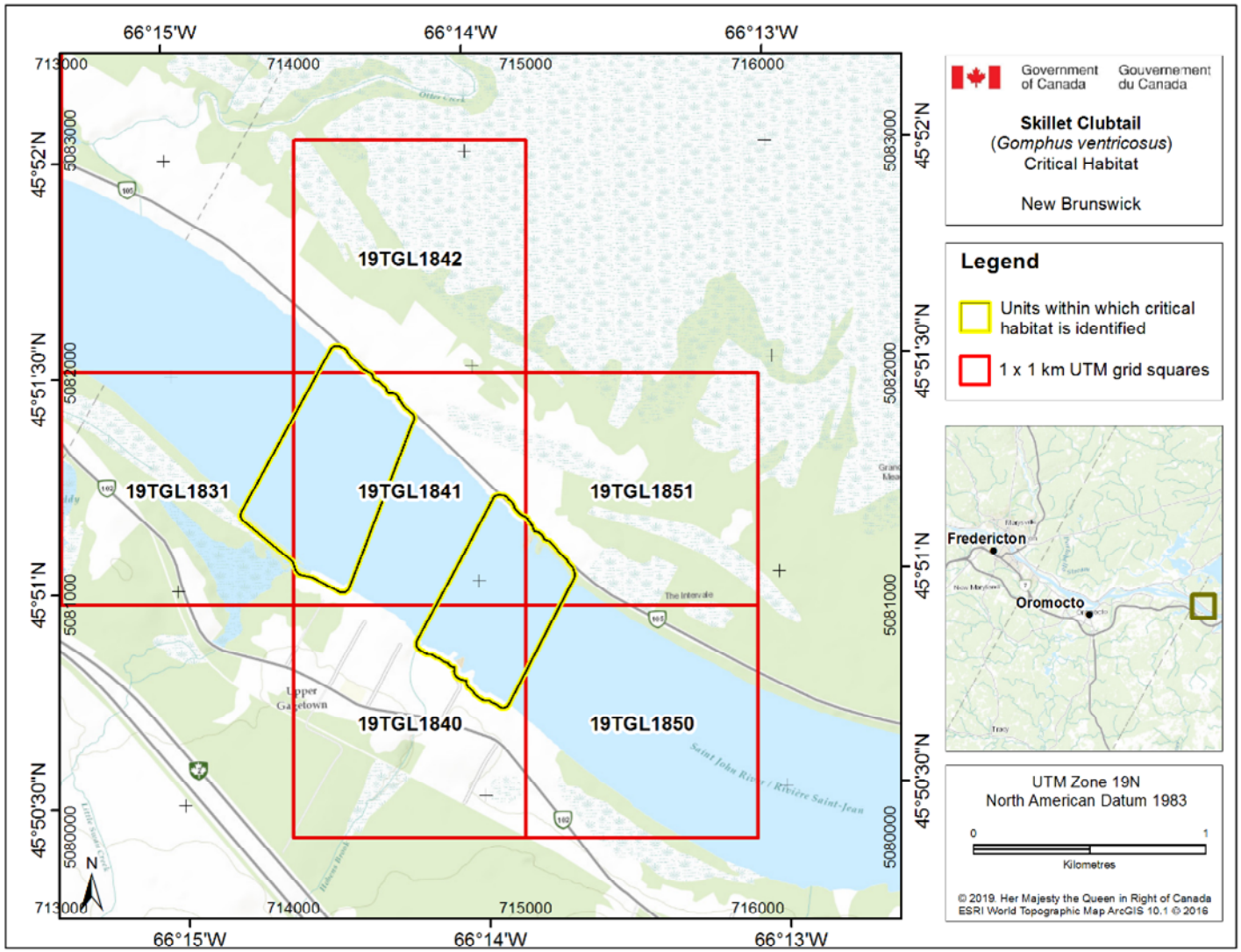

Figure 5. Critical habitat for Skillet Clubtail in Upper Gagetown, NB is represented by the yellow shaded polygons where the criteria and methodology set out in section 7.1 of the recovery strategy are met. The 1 km × 1 km UTM grid overlay shown in this figure is a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the shaded polygons do not contain critical habitat.

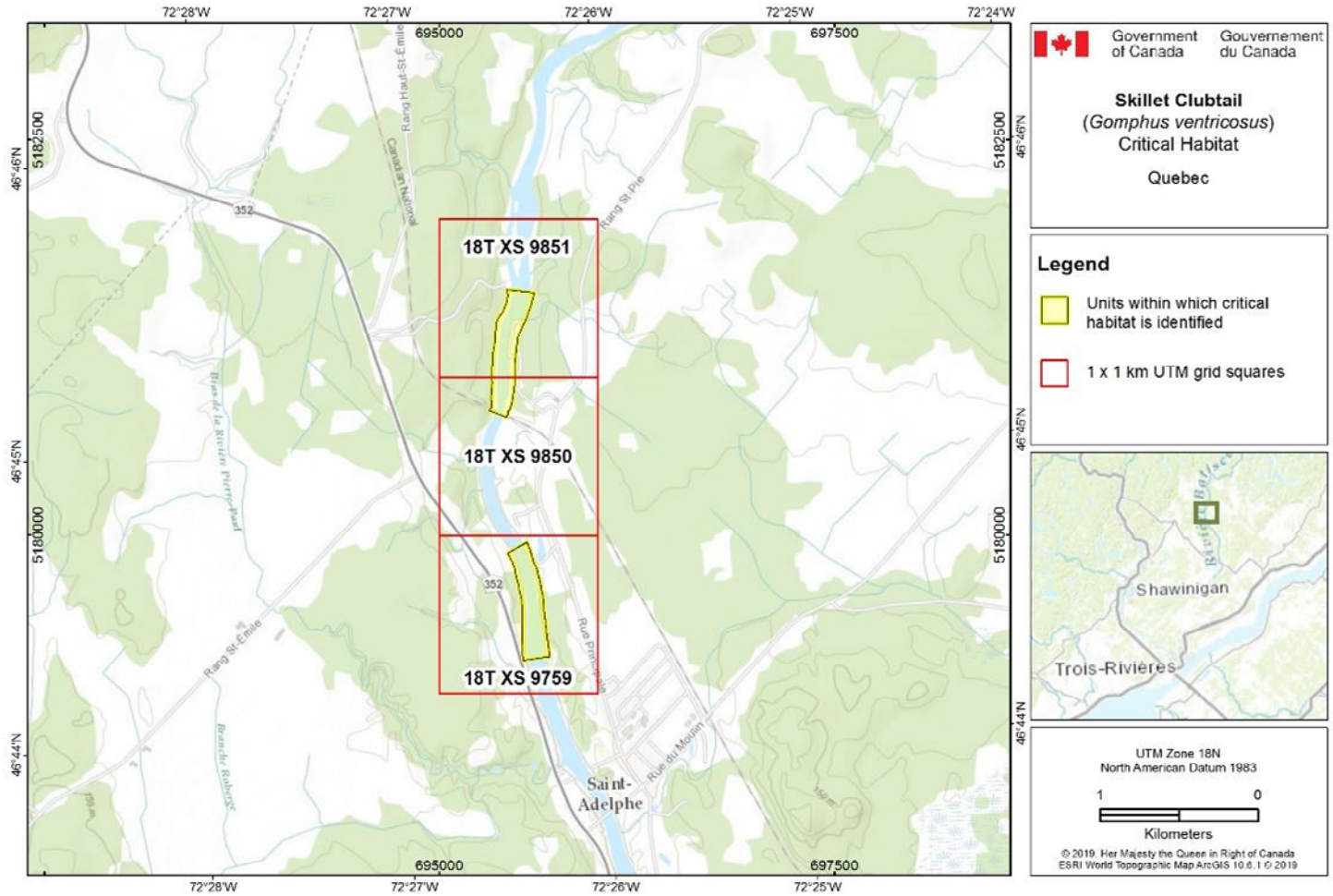

Figure 6. Critical habitat for Skillet Clubtail on the Batiscan River, Quebec, is represented by the yellow shaded polygons where the criteria and methodology set out in section 7.1 of the recovery strategy are met. The 1 km x 1 km UTM grid overlay shown in this figure is a standardized national grid system that indicates the general geographic area within which critical habitat is found. Areas outside of the yellow shaded polygons do not contain critical habitat.

7.2 Schedule of Studies to Identify Critical Habitat

Table 6. Schedule of Studies

Description of Activity	Rationale	Timeline
Life Stages: Larvae (nymphs), Tenerals (leaving behind exuviae), Adults • Conduct surveys to document emergence sites at rivers with potential to have breeding populations	• Suitable habitat exists on rivers where adults have been observed but, due to survey effort, emergence (i.e., breeding) has not been documented. Refer to Table 4 for priority rivers to survey in Ontario, Quebec, New Brunswick and Nova Scotia.	2021-2024
Life Stages: Eggs → Larvae (nymphs) (2 +years of development) • Document site use by larval stages over multiple years • If fidelity to sites is confirmed, identify biophysical attributes necessary for the survival of eggs and nymphs	• There is currently limited information on biophysical attributes and availability of larval habitat for Skillet Clubtail in Canada.	2022-2026
Life Stages: Larvae (nymphs) → Tenerals (leaving behind exuviae) • Document emergence over multiple years • Investigate whether emergence events can be reliably predicted (e.g., by date/ time, air, and/or water temperature) • If fidelity to sites is confirmed, identify biophysical attributes associated with emergence	• There is limited information on biophysical attributes and availability of emergence sites.	2021-2026
Life Stage: Adults • Track adult movement • Identify biophysical attributes necessary for the survival of adults (e.g., forest cover)	• There is limited information on biophysical attributes and availability of adult habitat for Skillet Clubtail in Canada.	When tags suitable for the species become available.

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case-by-case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Activities described in Table 7 include those likely to cause destruction of critical habitat for the species; however, destructive activities are not limited to those listed.

Table 7. Examples of activities likely to result in the destruction of critical habitat

Description of Activity	Description of Effect	Details of Effect
Development or land conversion (e.g., Housing and Urban areas, Annual & Perennial Non-timber Crops, Logging & Wood Harvesting)	• May modify the slope of the bank such that Skillet Clubtails are not able to emerge successfully • May alter understory vegetation which stabilizes the bank structure, provides shade and protection from predators • May remove hardwood trees that stabilize the bank structure, provide shade, temperature regulation, and a safe substrate for emergence.	This activity would only be likely to result in the destruction of critical habitat if it occurred within the bounds of critical habitat. This activity could cause destruction all times of the year.
Dams & Water Management/Use	• May alter specific habitats required by the species for emergence • May alter natural hydrology (e.g., flow regimes, water temperatures, sediment and nutrient loads) such that aquatic habitat becomes unsuitable due, for example, to low dissolved oxygen levels.	This activity may occur within or outside the bounds of critical habitat to cause its destruction. This activity could cause destruction all times of the year.
Agricultural & Forestry Effluents (e.g., nutrient loads, soil erosion, sedimentation, herbicides and pesticides) Development or land conversion (e.g., Housing and Urban areas, Annual & Perennial Non-timber Crops, Logging & Wood Harvesting)	• May alter water quality (e.g., through increased run-off, and sediments and nutrient loads) such that aquatic habitat becomes unsuitable due to low dissolved oxygen rates.	This activity may occur within or outside the bounds of critical habitat to cause its destruction. This activity could cause destruction all times of the year.

8. Measuring Progress

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

- No observed, estimated, inferred, or suspected reduction in the total number of mature individuals of Skillet Clubtail in Canada;
- No observed or inferred decline in the species' range (extent of occurrence), its occupied habitat (area of occupancy), and/or the quality of that habitat.

9. Statement on Action Plans

One or more action plans will be completed within five years of the final version of this recovery strategy being posted on the Species at Risk Public Registry.

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[9]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[10] (FSDS) goals and targets.

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

This recovery strategy will clearly benefit the environment by promoting the conservation of Skillet Clubtail which may also benefit co-occurring species. Federally listed co-occurring species may include Wood Turtle (*Glyptemys insculpta*), Cobblestone Tiger Beetle (*Cicindela marginipennis*), and Pygmy Snaketail (*Ophiogomphus howei*). The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the following sections of the document in particular: Section 3 which contains a description of the species' habitat and biological needs as well as Section 6 which includes the recovery planning table.

This recovery strategy directly contributes to the goals and targets of the Federal Sustainability Development Strategy for Canada. Specifically, it contributes to Goal 5: Wildlife Conservation – Maintain or restore populations of wildlife to healthy levels, and to Goal 6: Ecosystem/Habitat Conservation and Protection: Maintain productive and resilient ecosystems with the capacity to recover and adapt.

[9] www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[10] www.fsds-sfdd.ca/index.html#/en/goals/