

Recovery Strategy for the Northern Barrens Tiger Beetle (*Cicindela patruela*) in Canada

Northern Barrens Tiger Beetle



2016



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¹ <http://www.registrelep-sararegistry.gc.ca>

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* (SARA; SC 2002, c. 29), 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 of the final version of this recovery strategy being posted on the Species at Risk Public Registry.

The Minister of the Environment is the competent minister under SARA for the Northern Barrens Tiger Beetle and has prepared this recovery strategy per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the governments of Quebec (Department of Forests, Wildlife and Parks) and Ontario (Ministry of Natural Resources and Forestry).

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

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to the 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 a recovery strategy identifies critical habitat, there may be future regulatory implications, depending on where the critical habitat is identified. SARA requires that critical habitat identified within federal protected areas be described in the *Canada Gazette*, after which prohibitions against its destruction will apply. For critical habitat located on federal lands outside federal protected areas, the Minister of the Environment must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies. For critical habitat located on non-federal lands, if the Minister of the Environment forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament and is not effectively protected by the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to extend the

² <http://registrelep-sararegistry.gc.ca/default.asp?lang=En&n=6B319869-1%20>

prohibition against destruction of critical habitat to that portion. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

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Thanks are extended to all individuals and organizations that provided input or comments to improve this recovery strategy, including various Aboriginal organizations, landowners, citizens and other stakeholders, either during the drafting of the strategy or in subsequent consultations.

Executive Summary

The Northern Barrens Tiger Beetle (*Cicindela patruela*) is a medium-sized (12 to 14.5 mm), dull metallic green beetle that lives in semi-open sandy pine- or oak-dominated savanna and barrens habitat. This tiger beetle is naturally rare throughout its range, probably owing to its specific habitat requirements. The only location where individuals have recently been observed in Canada is Pinery Provincial Park in southern Ontario. No individuals have been observed at the Constance Bay location in Ontario since 1950. In Quebec, one specimen was observed on Île aux Allumettes in the Ottawa River in 1980. Although its exact provenance on the island remains unknown and its presence has yet to be reconfirmed, this local population is still considered extant. The species was assessed as Endangered by the Committee on the Status of Endangered Wildlife Species in Canada (COSEWIC) in 2009 and was listed as such on Schedule 1 of the *Species at Risk Act* (SARA) since 2012.

The species has never been very widespread in Canada. However, it has probably suffered from the conversion of savanna habitats in southern Ontario, which had historically been maintained by frequent ground fires. Owing to human suppression of the natural fire regime, vast areas of habitat have become unsuitable for the species. Urban development, forestry, agriculture and industrial activities in its range have also contributed to the conversion of a large part of its habitat. The current threats to the species in its area of occupancy in Canada are susceptibility to stochastic events, compaction and trampling of occupied sites, forestry (planting, logging and wood harvesting), illegal collection, suppression of the natural fire regime, and broad-spectrum pesticide use.

There are unknowns regarding the feasibility of recovery of the Northern Barrens Tiger Beetle. Nevertheless, in keeping with the precautionary principle, this recovery strategy has been prepared per section 41(1) of SARA, as is done when recovery is determined to be feasible. The population and distribution objectives for the Northern Barrens Tiger Beetle are to maintain the local populations in Pinery Provincial Park and on Île aux Allumettes, if that local population still exists, and to increase, to the extent possible, the number of local populations and the size of the species' current area of occupancy in Canada. The broad strategies and general approaches for meeting these objectives are presented in section 6.2 – *Strategic Direction for Recovery*.

Northern Barrens Tiger Beetle critical habitat is partially identified in this recovery strategy. It includes all suitable habitats comprised within a 250-m radius of any valid record meeting the occupancy criterion. The identification of critical habitat currently applies only to the habitat of the Pinery Provincial Park population. A schedule of studies outlines the activities necessary to complete the identification of critical habitat.

One or more action plans will follow this recovery strategy and will be posted on the Species at Risk Public Registry by January 2021.

Recovery Feasibility Summary

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

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

Yes. There is a small extant local population estimated at 400 to 1,000 individuals capable of reproduction in Pinery Provincial Park in southern Ontario. In order to more precisely assess the abundance of individuals capable of reproduction in Canada, however, additional survey efforts would be required in the rest of the species' Canadian range, including Île aux Allumettes in Quebec.

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

Yes. Although the typical habitat of the Northern Barrens Tiger Beetle has been adversely affected by various factors, including suppression of the natural fire regime, urban development, and forestry, agricultural and industrial activities, quality habitats remain particularly in certain shoreline areas of Lake Erie and Lake Huron. Furthermore, certain habitats could be restored with the reintroduction of a fire regime.

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

Unknown. The mitigation or prevention of mortality and habitat loss and degradation is possible through legal measures, best management practices and habitat conservation or restoration measures. However, the availability of quality habitat is not sufficient in itself to explain the presence or absence of the species, and the factors explaining its habitat use patterns continue to be poorly understood. In addition, the growing isolation of the remaining suitable habitats could hamper recovery by natural colonization.

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

Yes. First, the Northern Barrens Tiger Beetle has been successfully raised in captivity, and captive breeding for the purpose of introduction could therefore contribute to the achievement of the population and distribution objectives of increasing, to the extent possible, the number of local populations and the size of the species' current area of occupancy in Canada. Second, various land management techniques aimed at restoring savanna habitats or other types of semi-open habitat (including the use of fire) are well documented.

Table of Contents

| | |
|---|-----|
| Preface..... | i |
| Acknowledgements | iii |
| Executive Summary | iv |
| Recovery Feasibility Summary..... | v |
| 1. COSEWIC Species Assessment..... | 1 |
| 2. Species Status Information | 1 |
| 3. Species Information | 2 |
| 3.1 Species Description | 2 |
| 3.2 Population and Distribution | 3 |
| 3.3 Needs of the Northern Barrens Tiger Beetle | 4 |
| 4. Threats..... | 6 |
| 4.1 Threat Assessment | 6 |
| 4.2 Description of Threats | 7 |
| 5. Population and Distribution Objectives..... | 10 |
| 6. Broad Strategies and General Approaches to Meet Objectives | 11 |
| 6.1 Actions Already Completed or Underway..... | 11 |
| 6.2 Strategic Direction for Recovery..... | 13 |
| 6.3 Narrative to Support the Recovery Planning Table | 15 |
| 7. Critical Habitat..... | 16 |
| 7.1 Identification of the Species' Critical Habitat | 16 |
| 7.2 Schedule of Studies to Identify Critical Habitat..... | 20 |
| 7.3 Activities Likely to Result in the Destruction of Critical Habitat..... | 21 |
| 8. Measuring Progress..... | 22 |
| 9. Statement of Action Plans..... | 22 |
| 10. References..... | 23 |
| Appendix A: Effects on the Environment and on Other Species | 27 |

1. COSEWIC* Species Assessment

Date of Assessment: November 2009

Common Name: Northern Barrens Tiger Beetle

Scientific Name: *Cicindela patruela*

COSEWIC Status: Endangered

Reason for Designation: This showy metallic-green beetle inhabits sandy, open forest habitat dominated by pine and/or oak trees. Found in northeastern and north-central North America, it is globally imperiled, reaching its northern limit in southern Ontario, where it is currently found at only two localities. The species has disappeared from one well-known historical site. Habitat loss resulting from natural succession and increased pedestrian traffic are significant threats.

Canadian Occurrence: Ontario, Quebec

COSEWIC Status History: Species Designated Endangered in November 2009.

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

Note: The wording of the COSEWIC assessment summary for the Northern Barrens Tiger Beetle could leave the impression that the two localities where the species is found in Canada are in Ontario. However, one of them is in Quebec (Île aux Allumettes). See section 3.2 – *Population and Distribution* of this document for more details.

2. Species Status Information

The Northern Barrens Tiger Beetle is listed in Schedule 1 of the *Species at Risk Act* (SARA) as an endangered species³ in Canada since 2012. It is also listed as endangered⁴ under the Ontario *Endangered Species Act* (ESA; SO 2007, c. 6). In Quebec, it is on the list of species likely to be designated threatened or vulnerable under the *Act Respecting Threatened or Vulnerable Species* (CQLR, c. E-12.01). It is given a global rank of G3 (vulnerable) by NatureServe (2015). Although the species' range, which covers a large part of eastern North America, is relatively large, its populations are sparsely distributed. The Canadian portion of its range represents less than 10% of the total range. The species is ranked as critically imperiled in Canada (N1) and in Ontario (S1) and as potentially extirpated in Quebec (SH; NatureServe 2015), where the last confirmed observation was in 1980. Table 1 summarizes the conservation status rankings of the Northern Barrens Tiger Beetle in various jurisdictions, including the bordering U.S. states. The status rankings of this species in

³ Endangered species (SARA): a wildlife species facing imminent extirpation or extinction.

⁴ Endangered species (ESA): a species that lives in the wild in Ontario but is facing imminent extinction or extirpation.

all the jurisdictions where it has been reported can be found in the COSEWIC status report (COSEWIC 2009) and on NatureServe.org.

Table 1. List of the various conservation status rankings of the Northern Barrens Tiger Beetle (NatureServe 2015)

| | Global (G) Rank | National (N) Rank | Subnational (S) Rank | COSEWIC Designation |
|---|-----------------|-------------------|--|---------------------|
| Northern Barrens Tiger Beetle (<i>Cicindela patruela</i>) | G3 | Canada (N1) | Quebec (SH) Ontario (S1) ----- Michigan (S3) Minnesota (S3) New Hampshire (SH) New York (S1) Vermont (S1) Wisconsin (S3) | Endangered |

1: Critically Imperiled; 2: Imperiled; 3: Vulnerable; 4: Apparently Secure; 5: Secure; H: Possibly Extirpated.

3. Species Information

3.1 Species Description

The Northern Barrens Tiger Beetle is a beetle of the family Cicindelidae (included by some experts in the family Carabidae). Adults generally measure 12 to 14.5 mm long and have a morphology typical of the family, i.e., wide head with large, bulging eyes and well-developed mandibles, sides of abdomen nearly parallel, and long, slender legs (COSEWIC 2009; Pearson et al. 2015). The elytra (i.e., first pair of wings that cover the membranous wings and the abdomen) are a dull metallic green. Each elytron has three distinct, unconnected white markings (called “lunules”). The marking on the anterior tip of the elytron (humeral lunule) consists of two interrupted or connected dots; the middle marking (middle lunule) is a continuous band and reaches to the outer edge of the elytron; the marking on the posterior tip of the elytron (apical lunule) consists of two distinct or narrowly joined markings. The Six-spotted Tiger Beetle (*C. sexguttata*) is a relatively common species that is quite similar in appearance to the Northern Barrens Tiger Beetle. It can be distinguished from the Northern Barrens Tiger Beetle by its middle lunule, which is broken into two separate spots (Kaulbars and Freitag 1993, in COSEWIC 2009; Pearson et al. 2015).

Northern Barrens Tiger Beetles have white, grub-like larvae, up to 25 mm long, that live in vertical larval burrows, lying in wait for prey passing along the surface near the opening. The various species of tiger beetles are difficult to differentiate in the larval stage. Willis (1980) provides criteria that can be used to identify the larvae of *C. patruela*.

More detailed information on the morphology of the adult and larval stages can be found in various works (Willis 1980; COSEWIC 2009; Pearson et al. 2015).

3.2 Population and Distribution

The global range of the Northern Barrens Tiger Beetle covers a large part of eastern North America, extending from Minnesota in the west to Massachusetts in the east, and from Georgia in the south to Quebec in the north. The species has been documented in Quebec, Ontario and 24 U.S. states (NatureServe 2015). However, because of the species' specific habitat requirements, its occurrence is discontinuous and localized. In 1994, the estimated number of local populations in the world was between 33 and 56 (NatureServe 2015), and, more recently, Knisley et al. (2014) estimated that the species was present at over 40 sites. However, new local populations are discovered from time to time, including in some areas from which the species was believed to be extirpated (e.g., New York and New Jersey; NYSDEC 2005; Schlesinger and Novak 2011).

In Canada, the Northern Barrens Tiger Beetle has been formally documented at three locations: two in Ontario (Pinery Provincial Park and Constance Bay) and one in Quebec (Île aux Allumettes; COSEWIC 2009).

The only recently documented extant local population in Ontario is located in Pinery Provincial Park, on the southeastern shores of Lake Huron. The abundance of this local population is estimated at roughly 400 to 1,000 individuals, including both larvae and adults (COSEWIC 2009). The occurrence of the species at this location is restricted to three sectors, despite the relative abundance of habitat that appears to be suitable for it. The overall trend of the local population in Pinery Provincial Park is unknown, although the species appears to be less abundant than was previously the case in one of the three sectors (Foster and Harris 2007a, in COSEWIC 2009). Despite hundreds of hours of suitable habitat surveys at locations considered accessible, no other sectors containing the species have been discovered. Entomologists have also made site visits to other habitats of interest in the immediate area of Pinery Provincial Park numerous times without detecting this species considered extremely rare (COSEWIC 2009). The other location where the presence of the Northern Barrens Tiger Beetle has been documented in Ontario is in the Constance Bay area, along the Ottawa River, approximately 20 km east of Arnprior. Despite repeated visits by entomologists, the Northern Barrens Tiger Beetle has not been observed there since 1950 (Foster and Harris 2007b, in COSEWIC 2009). Furthermore, the habitat at this site has been significantly modified by silvicultural interventions aimed at forest stand densification and by the planting of pine (*Pinus* spp.) trees in open savanna areas (Catling and Kostiuik 2010; Catling et al. 2010). The species is likely extirpated from this site (Catling and Brunton 2010), which is now considered "historical." However, habitat restoration efforts at Constance Bay in the late 1980s and early 1990s re-established open savanna habitats in areas that had been converted to pine plantations (Catling and Kostiuik 2010).

In Quebec, *C. patruela* was observed on Île aux Allumettes (regional county municipality [RCM] of Pontiac), on the Ottawa River, on May 24, 1980 (H. Goulet, pers. comm., in COSEWIC 2009). This is the only specimen documented as observed at this location,

and its exact provenance on the 264-km² island is unknown. However, its identification was confirmed by specialists and is considered valid by COSEWIC (2009). Despite the relative abundance of suitable habitat for the species, seemingly little effort has since been made to find other specimens in this sector. It is therefore impossible to confirm, based on current knowledge, whether this local population is still extant. Consequently, despite the uncertainty surrounding the current occurrence of the species at this locality, the Île aux Allumettes site is still included in the calculation of the species' extent of occurrence and area of occupancy by COSEWIC (2009), and this recovery strategy considers the local population at this site to be extant.

Several other locations that appear to offer interesting habitat for the species have been surveyed by qualified entomologists, particularly in Ontario (e.g., Pinery Provincial Park area, Norfolk area, Ottawa Valley), as well as in Quebec (Ottawa Valley). These locations are listed in the COSEWIC status report (2009) and in the Ontario provincial recovery strategy (Farrell et al. 2011). However, no new local populations have been discovered. Farrell et al. (2011) list several other sectors in Ontario where potential habitat could be found (Lambton, Norfolk, Northumberland, Prince Edward and Simcoe counties) and where surveys should be conducted.

Note that, at present, the calculation of the species' extent of occurrence (290 km²) and area of occupancy (12 km²) by COSEWIC (2009) is based solely on the Pinery Provincial Park and Île aux Allumettes sites, since the Constance Bay site is considered "historical."

3.3 Needs of the Northern Barrens Tiger Beetle

Throughout its range, the Northern Barrens Tiger Beetle is almost always found in open savannas or forests dominated by pine (*Pinus* spp.) and oak (*Quercus* spp.), occurring on sandy soils (Mawdsley 2007; Pearson et al. 2015). Adults and larvae essentially use the same habitat, although the highly mobile adults can be found several tens of metres from the larval colonies, in more open habitats (Mawdsley 2007).

Adult females lay roughly 50 eggs singly in 3- to 5-mm holes (Shelford 1908, in COSEWIC 2009) on a sandy substrate in relatively shaded areas (COSEWIC 2009). The larvae are sedentary; they hunt from the shelter of their vertical burrows, which they enlarge as required as they develop (Pearson 1988, in COSEWIC 2009). Hibernation takes place at the adult stage in the pupal chamber, which is no more than an additional enlargement of the larval burrow (Willis 2000). The adults are generalist predators and hunt on a wider variety of substrates. To maintain an optimal body temperature via thermoregulation, they need sun-exposed areas, with access to shaded areas or structural objects (e.g., leaves, twigs, branches) under which to take shelter (Knisley et al. 1990, in COSEWIC 2009).

The Northern Barrens Tiger Beetle is believed to have a narrow range of tolerance for soil conditions. It appears to prefer dry, coarse-grained sandy soils (Kaulbars and Freitag 1993; Knisley and Shultz 1997, in COSEWIC 2009). Oviposition and the

excavation of larval burrows occur in moderately compacted soil with good stability (Mawdsley 2007; Pearson et al. 2015). These burrows are thus often found on the edge of sandy habitats, e.g., adjacent to trails, sand quarries or dune fields. In addition to these edaphic⁵ parameters, the females appear to prefer shadier areas, as well as bare areas with no accumulation of forest litter. Larval burrows are often found among lichens and mosses, signs that the local accumulation of forest litter is minimal, but the soil is rarely disturbed in the medium term (Lawton 1974; Knisley et al. 1990; Willis 2000; Keeney 2007, in COSEWIC 2009). This probably means better hunting conditions for the larvae, which are less likely to have the opening to their burrow obstructed by forest litter.

Schlesinger and Novak (2011) classify tiger beetle species into three groups based on their habitat association: beach species, species associated with riparian/sandbank environments, and barren/savanna species, to which the Northern Barrens Tiger Beetle belongs. These different associations reflect different needs in terms of both soil characteristics and canopy cover for thermoregulation. *C. patruela* generally lays its eggs in the shadier areas of its habitat (Lawton 1974; Knisley et al. 1990; Willis 2000, in COSEWIC 2009). However, the species does not occur under dense canopies. The thermoregulation needs of this active hunter are high. For this species, the optimal internal temperature for hunting is 34 °C, and the adults do not emerge from their pupal chamber in the spring until the ground surface temperature has reached 19 °C (Knisley et al. 1990, in COSEWIC 2009).

It is frequently the case with the Northern Barrens Tiger Beetle that seemingly suitable habitats are not used, despite the proximity of local populations that could likely colonize them. Based on current knowledge, it is impossible to determine whether the sparse distribution of the local populations is linked to finer-scale habitat requirements that remain unknown or to dispersal constraints of physiological or behavioural origin (Farrell et al. 2011).

The local population in Pinery Provincial Park is found in savanna dominated by Black Oak (*Quercus velutina*) and White Pine (*Pinus strobus*), with a certain proportion of Red Pine (*Pinus resinosa*). At this locality, it is found in an understory of Bracken Fern (*Pteridium aquilinum*), blueberry (*Vaccinium* spp.), Witch Hazel (*Hamamelis virginiana*), sunflowers (*Helianthus* spp.) and graminoids, particularly *Carex pensylvanica* (Farrell et al. 2011). The Constance Bay local population was found in open forests of Jack Pine (*Pinus banksiana*) and Red Oak (*Quercus rubra*) on sand dunes (post-glacial relicts) (Boyd and Cuddy 1984; Brunton 1992, in COSEWIC 2009). The exact habitat from which the Île aux Allumettes specimen originated is unknown, but the island contains sandy dunes and barrens, as well as sandy areas that are bare or dominated by oak (*Quercus* spp.) and pine (*Pinus* spp.; NCC 2013).

⁵ Edaphic: of or pertaining to the soil; resulting from, or influenced by, factors inherent in the soil or other substrate rather than by climatic factors (Agriculture Canada 1976).

4. Threats

The Northern Barrens Tiger Beetle has probably never been very abundant in Canada (COSEWIC 2009). Since this species is associated to some extent with recently disturbed environments, it can be assumed that, historically, its distribution at the local scale has varied over time in response to disturbance regimes and plant succession. The destruction and isolation of potential habitats has probably hampered and continues to hamper the dynamics that influence the colonization of new habitats.

One of the extant local populations of the Northern Barrens Tiger Beetle is located in an Ontario provincial park (Pinery Provincial Park), where it receives some level of conservation protection. However, certain park management practices and approaches can be considered threats to this local population (e.g., intensive use of trails, use of pesticides). Since the exact location of the other local population considered extant in Canada (Île aux Allumettes) is unknown, it is not possible at this time to describe in greater detail the threats it is facing.

4.1 Threat Assessment

Threats are presented in Table 2 by category. When a given threat applies to more than one category, further information is provided in section 4.2 – *Threat Description*. Most of the threats listed here have resulted and continue to result in the loss or degradation of potential habitats throughout the species' range. The threat assessment covered the entire area of occupancy and took into account the impact of current and future threats but not the causes of past declines.

Table 2. Threat Assessment Table

| Threat | Level of Concern ¹ | Extent | Occurrence | Frequency | Severity ² | Causal Certainty ³ |
|---|-------------------------------|------------|------------|------------|-----------------------|-------------------------------|
| Natural processes or activities | | | | | | |
| Susceptibility to stochastic events | High | Widespread | Imminent | Continuous | High | High |
| Habitat loss or degradation | | | | | | |
| Compaction and trampling of occupied sites | Medium | Localized | Current | Seasonal | Moderate | Medium |
| Forestry (planting, logging and wood harvesting) | Medium | Localized | Unknown | Continuous | High | High |

| Threat | Level of Concern ¹ | Extent | Occurrence | Frequency | Severity ² | Causal Certainty ³ |
|--|-------------------------------|------------|-------------|------------|-----------------------|-------------------------------|
| Biological resource use | | | | | | |
| Illegal collection | Medium | Widespread | Anticipated | Seasonal | Unknown | Low |
| Changes in ecological dynamics or natural processes | | | | | | |
| Fire regime suppression | Medium | Widespread | Current | Continuous | High | High |
| Pollution | | | | | | |
| Use of broad-spectrum pesticides | Low | Localized | Unknown | Seasonal | Low | Low |

¹Level of concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table.

²Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).

³Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability, e.g., expert opinion; Low: the threat is assumed or plausible).

4.2 Description of Threats

Threats are listed in decreasing order of level of concern for the local population in Pinery Provincial Park only, as there are too many unknowns surrounding the status of the local population on Île aux Allumettes.

Susceptibility to stochastic events

In Canada, the Northern Barrens Tiger Beetle is adequately documented at only one location, i.e., Pinery Provincial Park in Ontario. The species could therefore, in theory, be extirpated from Canada by a single catastrophic stochastic event affecting this local population (e.g., uncontrolled high-intensity fire, severe windstorm). Natural recolonization would be unlikely, given the distance separating these habitats from the closest local populations located in the United States. In order to mitigate this threat, it would be necessary to ensure the presence of the species at at least one other location, i.e., confirming the species' occurrence on Île aux Allumettes, discovering a new local population, or introducing the species at a location considered suitable.

Compaction and trampling of occupied sites

Given the species' use of trails, larval burrows can be trampled by hikers, which can result in mortality of individuals or seriously disturb their activities. Erosion caused by mountain bikes can also seriously degrade the habitat (Peach 2006). Furthermore, the local Northern Barrens Tiger Beetle population in Pinery Provincial Park is found in a high-use area of this park, which receives over 600,000 visitors annually

(MacKenzie 2007, in COSEWIC 2009). In addition, the use of gravel to stabilize the trails can make part of this habitat unusable. Heavy use also disturbs the adults and causes them to flush more often, thus increasing their exposure to predators, mainly robber flies (Diptera: Asilidae; Knisley and Schultz 1997). A study conducted in the United States on a different tiger beetle species (*C. ohlone*) suggested that an awareness campaign may be able to mitigate the impact of certain activities (e.g., cycling) on tiger beetles by encouraging the target group (e.g., cyclists) to modify its behaviour (e.g., slowing down in tiger beetle habitat) in order to reduce the threat (Cornelisse and Duane 2013).

All-terrain vehicles also represent a prevalent threat to the type of sandy habitat preferred by the Northern Barrens Tiger Beetle (Schultz 1988; Keeney 2007; McCann 2007, in COSEWIC 2009). However, all-terrain vehicles are prohibited in Pinery Provincial Park.

Illegal collection

Tiger beetles are among a group of insects particularly sought after by collectors, and rarer species such as *C. patruela* are increasingly being targeted for observation and potentially for illegal trade (COSEWIC 2009). The frequency of collecting for illegal trade is unknown, but its impact can be significant when local populations are small. Note that insect collection is prohibited by Pinery Provincial Park regulations.

Fire regime suppression

A number of natural barren or savanna habitats in southeastern Ontario were historically maintained by ground fires, either of natural origin or set by local Aboriginal populations to manage these habitats (Willis 2001). These periodic disturbances helped maintain optimal habitat for the Northern Barrens Tiger Beetle (i.e., exposed mineral soil habitats with open vegetation cover, from the herbaceous layer to the canopy) and increase connectivity between potential suitable habitats for colonization at the landscape scale. The elimination of fire as an agent of disturbance of these ecosystems has resulted in an accumulation of forest litter, promoting stand densification (increased canopy cover) and eventually leading to a change in species composition of the tree stratum. Taken together, these changes tend to make these habitats unusable for *C. patruela*. It is estimated that, historically, southern Ontario had over 800 km² (perhaps even over 2,000 km²) of prairie and savanna managed mainly by fire. Fewer than 21 km² of this type of habitat, or approximately 3% of the historical area, remain (Bakowsky, pers. comm.; Woodliffe, pers. comm.; Bakowsky and Riley 1994, in Rodger 1998). It is assumed that the Canadian range of the Northern Barrens Tiger Beetle may have been larger prior to the loss of its habitats.

However, in the current context where metapopulation dynamics between local populations of the species in Canada may no longer occur, fire could also pose a threat if it were to break out in habitats currently used by the Northern Barrens Tiger Beetle, by causing some degree of mortality and harmful habitat alteration (see also the threat “Susceptibility to stochastic events”). Fire could also cause a decline in the abundance of the invertebrate species on which the Northern Barrens Tiger Beetle feeds (including

ants). Ants living in sand dunes or barrens may be relatively resilient to fire, however, meaning that the decline in prey abundance could be only temporary (Glasier et al. 2015). The risk associated with fires in the species' habitat can also be mitigated by the use of prescribed fire management practices designed specifically for invertebrates that use savannas or prairies (e.g., MDNR 2013).

Forestry (planting, logging and wood harvesting)

In addition to suppression of the fire regime, other factors have led to the modification or destruction of habitats preferred by *C. patruela*. For example, on the Constance Bay site, silvicultural work was carried out in order to increase stand density or to convert open savanna habitats to pine plantations, making these habitats unsuitable for the Northern Barrens Tiger Beetle (Catling and Kostiuk 2010). A number of other former dune systems have been significantly altered by stand planting (Catling et al. 2008). Any type of intervention in Northern Barrens Tiger Beetle habitat that could lead to a change in the openness of the tree stratum is thought to be likely to adversely affect the species. Restoration measures have been successfully carried out in Constance Bay and have re-established open savanna habitats at sites that had been converted to pine plantations in the 1950s (Catling and Kostiuk 2010).

Use of broad-spectrum pesticides

The Northern Barrens Tiger Beetle is sensitive to broad-spectrum insecticides. The Constance Bay site was sprayed with DDT in the 1950s to control pine insect pests, and this may have played a role in the suspected disappearance of the Northern Barrens Tiger Beetle from this location (Goulet 2005, in COSEWIC 2009). In addition, certain products may be used in Pinery Provincial Park for pest management or silvicultural purposes (Willis 2001; McCann 2007, in COSEWIC 2009). The specific impact of the various pest control products on the Northern Barrens Tiger Beetle and its prey has not been documented. However, broader trends suggest a worldwide decline in the abundance of insects (Collen et al. 2012; Dirzo et al. 2014), as well as a regional decline, including in Ontario (Cooper et al. 2014), that is likely influenced by the use of pesticides.

Potential threats

The presence of non-indigenous species could pose a threat to local populations of the Northern Barrens Tiger Beetle. The invasion of the species' habitat by a number of exotic plants (e.g., some species of the genus *Centaurea*) or by exotic insects (e.g., European Oak Borer [*Agrilus sulcicollis*], first detected in Ontario in 2008 [Haack et al. 2009]) could potentially alter these habitats and make them unsuitable for the species (Farrell et al. 2011). Invasive non-indigenous plant species are associated with a decline in the abundance and diversity of herbivorous or predaceous arthropods (Litt et al. 2014). Invasive non-indigenous predatory insect species could also pose a direct threat (i.e., predation on Northern Barrens Tiger Beetles) or indirect threat (i.e., competition for the same prey sought by Northern Barrens Tiger Beetles) to the species. For example, the European Fire Ant (*Myrmica rubra*), an invasive species from Europe that is present in Ontario, can have significant adverse effects on indigenous arthropod communities (Naumann and Higgins 2015), especially on other ant species

(on which the Northern Barrens Tiger Beetle feeds). Certain management measures taken to control invasive alien species could also potentially pose a threat to local populations of the Northern Barrens Tiger Beetle.

In addition, there could be incompatibility between the habitat needs of the Northern Barrens Tiger Beetle and those of other rare species and plant communities that are also present in Pinery Provincial Park or at other locations where local populations of Northern Barrens Tiger Beetle may occur (COSEWIC 2009). Certain habitat management measures taken for other rare species could be detrimental to Northern Barrens Tiger Beetle habitat and could therefore constitute a threat.

5. Population and Distribution Objectives

The population and distribution objectives for the Northern Barrens Tiger Beetle are as follows:

- 1) to maintain the local population in Pinery Provincial Park and, if still extant, the local population on Île aux Allumettes;
- 2) to increase, to the extent possible, the number of local populations and the current area of occupancy of the species in Canada.

The Northern Barrens Tiger Beetle has always been rare in Canada and has never been considered a common species throughout its global range. This is likely attributable, in part, to the fact that the species is dependent on recently disturbed habitat and on the continual recolonization dynamics necessary to sustain it at the regional scale. A number of unsuccessful surveys have been conducted in other sectors of Pinery Provincial Park and more widely elsewhere in Ontario and Quebec in an effort to discover new local populations. However, these survey efforts were limited and did not cover all potential locations (COSEWIC 2009). It is therefore possible that one or more as yet unknown local populations exist. In addition, it has been shown that tiger beetles can successfully reproduce in captivity (Gwiazdowski et al. 2011), including the Northern Barrens Tiger Beetle (Wills 1980, in COSEWIC 2009), which means that potential introduction to an unoccupied suitable habitat might be possible, if the natural colonization process is not sufficient.

The local Northern Barrens Tiger Beetle population in Pinery Provincial Park (including larvae and adults) is estimated between 400 and 1,000 individuals (COSEWIC 2009). Depending on the number of additional locations at which the species occurs in Canada, the total population could be higher. The population trend is not known, but in one of the sectors of Pinery Provincial Park where the species occurs, numbers appear to have declined over the past 15 years (COSEWIC 2009). The size of the area of occupancy in Canada has been estimated at only 12 km² (including the sites in

Pinery Provincial Park and on Île aux Allumettes), using a 2 x 2 km grid overlay in which there are records of the species (COSEWIC 2009).⁶

In this context, recovery efforts must seek to maintain the species' presence at the known sites (including Pinery Provincial Park) and to determine whether it is present on Île aux Allumettes. Additional survey efforts may also be required in order to more precisely assess the species' abundance and area of occupancy in Canada and ideally to discover, re-establish or introduce additional local populations to enhance the species' presence in Canada and to improve its long-term conservation prospects. It is necessary to increase both the size of the Canadian population of the species and the number of adequately documented local populations to more than one, if only to offset any possible loss of the species in Canada following a stochastic event that could affect the local population in Pinery Provincial Park.

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Underway

In Canada, the only currently confirmed extant local population of the Northern Barrens Tiger Beetle is located in a provincial park classified as a Natural Environment Park by the Government of Ontario, whose mandate includes the protection of natural heritage. Pinery Provincial Park has developed a long-term strategy aimed at rehabilitating the savanna habitats within the park. The actions taken include prescribed burns, some of which were carried out between 1986 and 1994 (Rodger 1998) and again in 2001. Farrell et al. (2011) report that prescribed burns are now carried out annually in the park to re-establish and manage savanna habitat, which will have a positive impact on the availability and quality of habitat for the Northern Barrens Tiger Beetle. These actions could potentially benefit from the results of research initiated by the Minnesota Prairie Plan Working Group on prairie habitat restoration (e.g., through prescribed burns and browsing; MPPWG 2013).

Furthermore, although the Northern Barrens Tiger Beetle is believed to no longer occur at the Constance Bay location, it is worth noting that restoration work has re-established a certain amount of suitable habitat for the species (Catling and Kostiuk 2010) and that Constance Bay sand dunes are considered an "Area of Natural and Scientific Interest" by the Government of Ontario (City of Ottawa 2012) and therefore receive a certain level of conservation protection.

In addition, several locations in Ontario and Quebec with potential habitat for this species have been surveyed in order to locate another local population. Targeted visual

⁶ Two 2 x 2 km squares (total of 8 km²) were calculated in Pinery Provincial Park. On Île aux Allumettes, since only one report of an unspecified location had been documented (see section 3.2 – *Population and Distribution*), only one 2 x 2 km square (total of 4 km²) was calculated (COSEWIC 2009).

searches were carried out at some locations, while others were surveyed using pitfall trapping. The sites that were specifically surveyed for *C. patruela* are listed in the COSEWIC status report (2009), as well as in the Ontario provincial recovery strategy (Farrell et al. 2011).

The Northern Barrens Tiger Beetle is listed as endangered in Ontario under the *Endangered Species Act, 2007*. The recovery strategy was prepared by Farrell et al. (2011) for the Ontario Ministry of Natural Resources.⁷ Following the completion of the recovery strategy, the Government of Ontario developed a response statement and a regulation on the species' habitat (Ontario Regulation 242/08 - www.e-laws.gov.on.ca/index.html), which came into effect on July 1, 2012. A regulation on habitat is a legal tool defining the habitat of the species to be protected and can describe its characteristics. It also identifies the geographic area in which the habitat is located and explains how the actual habitat boundaries are determined (on the basis of biophysical or other characteristics). This regulation is dynamic and is automatically in effect when the conditions described in the regulation are met within the identified geographic area.

A field guide to tiger beetles has recently been published (i.e., field guide to tiger beetles of the United States and Canada by Pearson et al. [2015]) and another is currently being developed by the Minnesota Department of Natural Resources [C.E. Smith, pers. comm.]. These guides may facilitate identification of Northern Barrens Tiger Beetles during surveying and monitoring activities and may generate public interest in the species.

⁷ On June 26, 2014, the Ontario Ministry of Natural Resources was renamed the Ministry of Natural Resources and Forestry.

6.2 Strategic Direction for Recovery

Table 3. Recovery Planning Table

| Threat or Limiting Factor | Priority ⁸ | Broad Recovery Strategy | General Description of Research and Management Approaches |
|---------------------------|-----------------------|---|---|
| All threats | High | Conservation of individuals and habitat | <ul style="list-style-type: none"> • By means of appropriate legislation, management and stewardship, restore and maintain a regional metapopulation⁹ dynamic centered on the occupied site in Pinery Provincial Park • Continue to develop, implement and document reduction and mitigation techniques (e.g., best management practices) aimed at addressing threats to individuals and habitat • Develop and implement, as necessary, habitat management or restoration techniques specific to the species in order to restore historical habitats or create new habitats • Ensure the presence of the species at sites other than Pinery Provincial Park (e.g., confirmation of the local population on Île aux Allumettes, discovery of new local populations, introduction) |
| Lack of knowledge | High | Survey and monitoring | <ul style="list-style-type: none"> • Identify the knowledge on the Pinery Provincial Park population (e.g., identify the area of the habitat used, identify the size of the local population) • Initiate monitoring of the local population and its distribution in Pinery Provincial Park in order to determine trends • Determine whether the species is present on Île aux Allumettes • Conduct surveys of potential habitat throughout the species' range |

⁸ "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.

⁹ A metapopulation is made up of a group of populations of the same species that are spatially separated from one another, between which occasional exchanges increase the likelihood of persistence of local populations.

| | | | |
|---------------------------------------|---------------|--|--|
| <p>All threats; lack of knowledge</p> | <p>Medium</p> | <p>Research</p> | <ul style="list-style-type: none"> • Improve knowledge of the species' ecology (e.g., diet, habitat selection, movement) • Fill knowledge gaps regarding the unknown effects of threats (e.g., use of broad-spectrum pesticides, illegal collection, invasive alien species) |
| <p>All threats; lack of knowledge</p> | <p>Medium</p> | <p>Communication, awareness and partnerships</p> | <ul style="list-style-type: none"> • Make available the results of research on the Northern Barrens Tiger Beetle and the conservation techniques developed • Promote collaboration with the key groups involved in the recovery of the Northern Barrens Tiger Beetle (e.g., governments, Aboriginal peoples, land managers responsible for areas containing the species' habitat, amateur entomologists) in order to reduce the impact of the threats to the species • Encourage surveys and reporting of species sightings by volunteers |

6.3 Narrative to Support the Recovery Planning Table

Two main factors explain the precarious status of the Northern Barrens Tiger Beetle in Canada. First, it is a highly specialized species in terms of habitat. The pine or oak savanna habitat preferred by the species was historically maintained by frequent ground fires, which have been largely eliminated in its range. The urban, forestry, agricultural and industrial development of this region has also led to the conversion of a large part of its habitats. Since this species is associated to some extent with relatively frequent disturbances, its maintenance at the landscape scale depends on the availability of habitat patches colonized or abandoned in response to disturbances and vegetation succession. Currently, this species is considered to be present at two locations in Canada, only one of which is well documented. This makes the Canadian population highly susceptible to stochastic events. This also means that interventions must be carried out in the occupied habitat in order to prevent degradation as a result of succession of the plant community and that it is important to determine whether the species is present outside the adequately documented site. Conservation efforts must also be aimed at creating metapopulation dynamics between the various sites, in order to permit movement of the local populations in response to the cycle of appearance and degradation of the optimal habitat. Furthermore, habitat management efforts aimed at recreating habitats and promoting natural colonization by or introduction of Northern Barrens Tiger Beetles in those habitats may be necessary.

The second factor complicating the recovery of this species is the lack of knowledge based on observations in several respects. First, there are few specialists who are able to formally identify the species. It is therefore conceivable that the species is present but not detected at certain locations with suitable habitat. As a result, the current picture of its distribution in Canada may be incomplete. Second, there is limited knowledge of the more specific parameters of its preferred habitat. With the current level of knowledge, it is not possible to determine the reasons for which many seemingly suitable locations for the Northern Barrens Tiger Beetle are unoccupied. It may be because the habitat is in fact unsuitable or because of dispersal constraints. In addition, little or nothing is known about certain aspects of the ecology of the Northern Barrens Tiger Beetle, such as its movements and the composition of its diet. Prey availability may be a limiting factor for populations, particularly in the context of broad-spectrum pesticide use. These knowledge gaps explain the need for research and management strategies aimed at improving knowledge.

In order to improve the effectiveness of conservation, research, surveying and monitoring strategies, various groups, including federal, provincial and local governments, researchers, Aboriginal communities and volunteers, should be asked to coordinate the implementation of the conservation measures (e.g., threat mitigation measures), to share the techniques developed (e.g., make the species' DNA "barcode" available for use in monitoring programs), to encourage voluntary surveys, and to effectively communicate the results of research and surveys (e.g., observations by amateur entomologists). A communication and outreach approach for various target audiences would also be highly useful, since the Northern Barrens Tiger Beetle may meet a number of the criteria required to be considered a flagship for invertebrate conservation (Barua et al. 2012).

7. Critical Habitat

Subsection 2(1) of SARA defines critical habitat as “the habitat that is necessary for the survival or recovery of a listed wildlife species (...).” Paragraph 41(1)(c) states that the recovery strategy must include an identification of the species’ critical habitat, to the extent possible, based on the best available information, and examples of activities that are likely to result in its destruction. This recovery strategy contains a partial identification of the critical habitat of the Northern Barrens Tiger Beetle. At the time of writing, a single local population, located in Pinery Provincial Park in Ontario, is sufficiently well documented to be confirmed as currently extant. Paragraph 41(1)(c.1) also states that the recovery strategy must contain a schedule of studies to identify critical habitat, when available information is insufficient. The status of the Northern Barrens Tiger Beetle on Île aux Allumettes has yet to be confirmed; targeted surveys will be necessary in order to determine whether the species is still extant there and whether certain sectors should be included in the identification of critical habitat. Surveys will also have to be conducted at other locations where adequate habitat may be present. This information is reported in a schedule of studies in section 7.2 of this recovery strategy. Given that the Pinery Provincial Park population is the only critical habitat identified, it will not be possible to meet the population and distribution objectives, and the status of the species in Canada remains extremely precarious, particularly because it occurs at only one site.

7.1 Identification of the Species’ Critical Habitat

The only confirmed occurrence of Northern Barrens Tiger Beetle in Canada at this time is in Pinery Provincial Park in Ontario. The critical habitat is therefore identified only for this population in this document. Critical habitat is identified on the basis of two criteria: habitat occupancy and habitat suitability. The identification of critical habitat will be updated as new information becomes available, either in a revised recovery strategy or in one or more action plans.

(1) Habitat occupancy

This criterion refers to sites for which there is a degree of certainty as to the presence of the species. The sites for which the presence of the species has been confirmed and that have not been subject to significant habitat alteration (see “Habitat suitability”) are considered occupied. The Constance Bay location does not meet this criterion because the species has not been recorded there since 1950 and the habitat has since been significantly altered (see section 3.2 – *Population and Distribution*). The Île aux Allumettes population does not meet this criterion at this time given that the exact location of the specimen observed there has never been reported.

At all sites considered occupied by the Northern Barrens Tiger Beetle, critical habitat corresponds to suitable habitat (see “Habitat suitability”) located within a 250-m radius of any valid record of an individual. A mark-recapture study conducted in Michigan showed that movements between captures could range from 60 m to over 200 m

(Fry 1981). Since mark-recapture studies may be biased due to various factors, such as sample size (Franzén and Nilsson 2007), recapture sampling effort and area (Schneider 2003), and the characteristics of the study site (Dover and Settele 2009), the species' movement distances may be underestimated. At this time, in the absence of a more precise assessment, the 250-m radius is considered sufficient to encompass the home range and seasonal movements of individuals (OMNR 2012). However, a research approach has been included in Table 3 (section 6.2 – *Strategic Direction for Recovery*) to improve knowledge about the species' movements.

(2) Habitat suitability

Habitat suitability refers to sites having the biophysical characteristics suitable for the species to complete its life cycle.

In Canada, the Northern Barrens Tiger Beetle is closely associated with sites on dune or alluvial sand deposits (dry, sandy, coarse-grained soils) and with the plant communities typically associated with these types of deposits. Woodlands or barrens that develop on these types of xeric/xeric-mesic (very dry to dry) soils generally remain open and are dominated by species that tolerate these conditions, such as oak and pine. Shrub and herbaceous cover, although present, remains sparse. This type of community offers a range of conditions suitable for the Northern Barrens Tiger Beetle, which vary depending on life-cycle stage. Some habitats created by human activity, such as the sides of trails or dirt roads, the edges of sand quarries and rights of way (e.g., power line corridors), reproduce some of these characteristics and can also be used by the species.

Oviposition and subsequent larval development occur on relatively bare, shaded sites on consolidated sand. Some degree of lichen and moss cover is often present, but needle or leaf litter is generally non-existent. The larvae are sedentary and remain in their burrow until the complete metamorphosis. The adults generally hunt and mate on bare soils but are more tolerant in terms of the level of soil compaction, using either unconsolidated or consolidated sand. Their needs in terms of thermoregulation are more specific. They need bare, sunny sites to raise their body temperature, but they also need some degree of vegetation or litter cover (pebbles, twigs, etc.) for taking shelter from the sun when they must lower their body temperature. Hibernation occurs at the adult stage in pupal chambers, which is simply an extension of the burrow dug by the larvae. At this stage, therefore, the adult occupies the same habitat as the larva.

The biophysical characteristics of critical habitat for the Northern Barrens Tiger Beetle in open oak or pine woodlands or barrens on sand substrates can be summarized as follows:

- bare, sandy sites, which may include all levels of compaction;
- partially bare sandy sites, with some cover of litter, lichen or nonvascular vegetation;

- sites with shrub or herbaceous cover, located along the edges of bare or partially bare sandy sites;
- at a larger spatial scale, low to moderate tree cover density creating shaded and sunny areas.

Application of critical habitat identification criteria for Northern Barrens Tiger Beetle

The critical habitat for the Northern Barrens Tiger Beetle is identified as habitat corresponding to the biophysical characteristics described for each life-cycle stage of the species (habitat suitability) located within a 250-m radius of any valid record (habitat occupancy).

The application of these identification criteria to the most recent data (March 2015) identifies critical habitat for the only confirmed persistent local population of Northern Barrens Tiger Beetle in Canada. The exact location of the critical habitat is not provided in this document; to avoid disclosing this sensitive information. Figure 1 shows the location on a 10 x 10 km UTM grid scale (Figure 1; Table 4). This identification is considered partial and is deemed to be insufficient to achieve the population and distribution objectives. A standard 10 x 10 km UTM grid was used to present the critical habitat of the Northern Barrens Tiger Beetle (Figure 1; Table 4). This grid is part of a standardized system of grids that show the general location of sectors containing critical habitat and that can be used for land-use planning and development or for environmental assessment purposes.

Trails/dirt roads or other suitable open spaces, such as rights of way, are identified as critical habitat. However, anthropogenic structures (e.g., houses, paved surfaces) and zones (e.g., open water) that lack the characteristics of suitable Northern Barrens Tiger Beetle habitat are not part of the identified critical habitat. If required, more detailed information on critical habitat can be requested by contacting Environment Canada – Canadian Wildlife Service (ec.planificationduretablissement-recoveryplanning.ec@canada.ca).

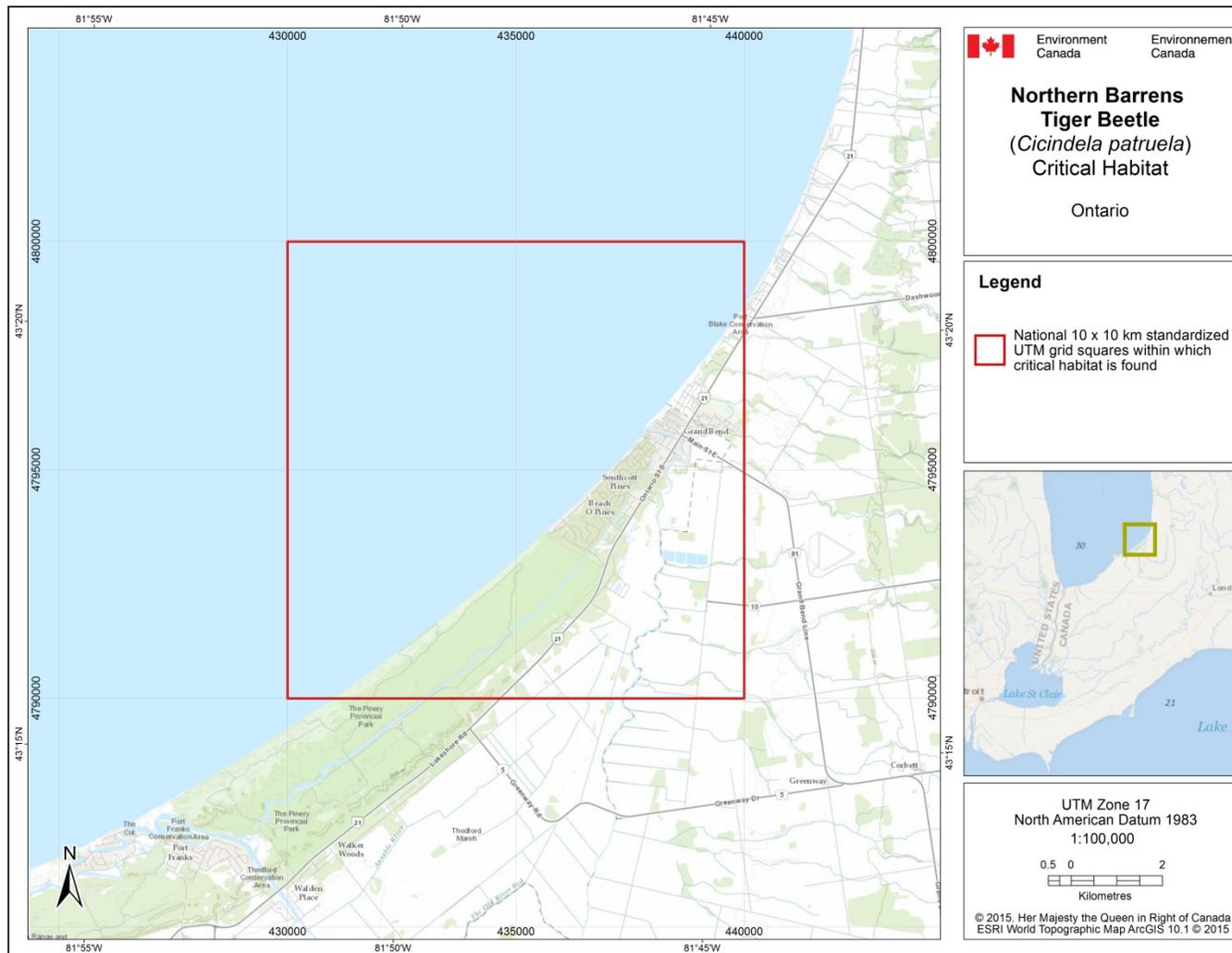


Figure 1. Square containing critical habitat for the Northern Barrens Tiger Beetle in Canada. Habitat that is contained in the 10 x 10 km standardized UTM grid square (in red) and that corresponds to the biophysical characteristics identified in this recovery strategy constitutes critical habitat.

Table 4. Grid square containing critical habitat for the Northern Barrens Tiger Beetle.

| Local population | Province / territory | 10 x 10 km standardized UTM grid square code ¹ | Province/territory | Coordinates ² of UTM grid square | | Land tenure ³ |
|------------------------|----------------------|---|--------------------|---|----------|--------------------------|
| | | | | Easting | Northing | |
| Pinery Provincial Park | Ontario | 17MH39 | Ontario | 430000 | 4790000 | Non-federal land |

¹Based on the standard UTM Military Grid Reference System (see <http://www.nrcan.gc.ca/earth-sciences/geography/topographic-information/maps/9789>), where the first two digits and letters represent the UTM zone, the following two letters represent the 100 x 100 km UTM grid, and the following two digits indicate the 10 x 10 km UTM grid containing critical habitat. This alphanumeric code is based on the methodology produced from the Atlas of Breeding Birds of Canada.

²The reported coordinates consist of a cartographic representation of locations where critical habitat can be found, more specifically in the southwest corner of the 10 x 10 km UTM grid square in question. These coordinates are provided as a general location only.

³Land tenure is provided as an approximation of the types of land ownership that exist within the sectors identified. The exact identification of land tenure where critical habitat occurs requires cross-referencing of geographic data for critical habitat parcels with data from the land registry.

7.2 Schedule of Studies to Identify Critical Habitat

Table 5. Schedule of Studies to Identify Critical Habitat

| Description of Activity | Rationale | Timeline |
|---|---|----------|
| Confirm whether or not the species is present on Île aux Allumettes. | One specimen was observed on Île aux Allumettes in 1980, the location of this record is imprecise, and subsequent surveys have not been conducted at this site to locate the local population. This activity is required in order to determine whether it is necessary to identify critical habitat on Île aux Allumettes. | 2018 |
| Identify the locations with suitable habitat for the species in its Canadian range. | This study is required prior to the implementation of surveys aimed at determining whether local populations are present in areas where no critical habitat has been identified. This study could also help determine where additional local populations could be introduced (and where additional critical habitat could be identified). This study is also required in order to achieve the objective of increasing the number of local populations and the size of the species' area of occupancy in Canada. | 2018 |
| Carry out surveys in the pre-identified locations to determine if the species is present. | This study is required in order to determine whether additional local populations currently exist in areas where no critical habitat has been identified. Certain sites with suitable habitat have not been surveyed by specialists capable of recognizing the species (see Farrell et al. 2011). If that is the case, additional critical habitat will have to be identified. | 2021 |

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Destruction of critical habitat will result if any part of the critical habitat is either permanently or temporarily damaged or modified. Destruction may result from a single activity or multiple activities at one point in time or from the cumulative effects of one or more activities over time. The activities described in Table 6 are examples of activities likely to result in the destruction of critical habitat of the Northern Barrens Tiger Beetle; this list of activities is not exhaustive. The activities causing excessive compaction or erosion of the sandy soils used by this tiger beetle are particularly likely to result in the destruction of critical habitat.

Table 6. Examples of Activities Likely to Result in the Destruction of Critical Habitat

| Description of Activity | Description of Effects | Details of Effects |
|--|---|---|
| Motorized vehicles (e.g., all-terrain vehicles), excessive use by hikers or mountain bikes | Increased soil compaction; in certain cases, increased susceptibility of soils to erosion | The Northern Barrens Tiger Beetle looks for moderately compacted soils in which to build its larval burrows. This level of compaction appears to be very important and distinguishes the ecological niches of several species of tiger beetles. |
| Elimination or reduction of the tree layer below a critical threshold | Elimination of shaded areas sought for oviposition and thermoregulation | The Northern Barrens Tiger Beetle depends on some degree of balance between shaded and sunny areas to complete its life cycle. Depending on the density of tree cover, a decline in this balance can have positive effects to a certain threshold and negative effects below this threshold. The elimination or reduction of the tree layer below this threshold could cause significant physiological stresses and render the site unsuitable for the species. |
| Elimination or reduction of the shrub/herbaceous cover | Reduction in understory cover | The Northern Barrens Tiger Beetle uses shrub or herbaceous cover for thermoregulation when its body temperature is high. Here again, habitat suitability depends on a balance between the bare areas and the availability of understory cover along the edges of these areas. As in the case of tree cover, a decline in understory cover could be beneficial up to a certain threshold and could have adverse effects beyond that threshold. |
| Excavation or compaction work or the addition of aggregates | Serious alteration in soil structure | Any work that changes the soil structure or covers the soil with aggregates would have the effect of irreversibly destroying critical habitat. |

8. Measuring Progress

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

- The Pinery Provincial Park local population is maintained.
- The status (extant or historical) of the local population on Île aux Allumettes is determined.
- To the extent possible, the number of local populations and the area of occupancy of the Northern Barrens Tiger Beetle in Canada are increased.

9. Statement of Action Plans

One or more action plans for the Northern Barrens Tiger Beetle will be posted on the Species at Risk Public Registry by January 2021.

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Appendix A: Effects on the Environment and on 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](#)¹⁰. 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 determine whether the outcomes of a recovery planning document could affect any component of the environment or any of the goals or targets in the [Federal Sustainable Development Strategy](#)¹¹ (FSDS).

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.

Oak and pine savanna habitats were once relatively common in southern Ontario. However, since the 1950s, they have gradually declined, often due to conifer planting or vegetation succession promoted by the elimination of the natural fire regime. As a result, these habitats are now marginal, and the large plant and animal communities associated with them have been severely diminished. Several species associated with these habitats are now endangered or extirpated, including the eastern subspecies of the Persius Duskywing (*Erynnis persius persius*), Frosted Elfin (*Callophrys irus*) and the Karner Blue butterfly (*Lycaeides melissa samuelis*). All management efforts designed to maintain or recreate these now extremely rare habitats could have significant benefits for the Northern Barrens Tiger Beetle and for these other species. For now, the sites targeted for potential recovery measures are limited in size and are concentrated in human-altered habitats. The anticipated adverse effects of such measures would be extremely limited, if not non-existent. It should be noted, however, that the Rusty-patched Bumble Bee (*Bombus affinis*), a species at risk, also occurs in Pinery Provincial Park and that potential measures to maintain or restore Northern Barrens Tiger Beetle habitat (such as prescribed burning) should also take into account the needs of the Rusty-patched Bumble Bee.

¹⁰ <http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1>

¹¹ <http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1>