Photo: Michael Runtz

Northern Barrens Tiger Beetle

(Cicindela patruela) in Ontario

Ontario Recovery Strategy Series

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

February 2011

Natural. Valued. Protected.

Ministry of Natural Resources

Ontario

About the Ontario Recovery Strategy Series

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

What is recovery?

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

What is a recovery strategy?

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

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

What's next?

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

For more information

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

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Cette publication hautement spécialisée Recovery strategies prepared under the *Endangered Species Act, 2007*, *n'est disponible qu'en anglais en vertu du Règlement 411/97 qui en exempte l'application de la Loi sur les services en français. Pour obtenir de l'aide en français, veuillez communiquer avec Pamela Wesley au ministère des Richesses naturelles au 705-755-5217.*

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DECLARATION

The recovery strategy for the Northern Barrens Tiger Beetle has been developed in accordance with the requirements of the *Endangered Species Act,* 2007 (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

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

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

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

RESPONSIBLE JURISDICTIONS

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

EXECUTIVE SUMMARY

The Northern Barrens Tiger Beetle (*Cicindela patruela*) is a dull metallic green beetle that lives in sandy openings in pine and pine-oak woodlands. Larvae live in burrows within these sandy openings. Adults forage in the same habitat and have a two-year life cycle.

This species is a globally rare insect found in eastern North America, with its native range extending from West Virginia north to southern Ontario and southern Quebec. In Ontario, only two populations have been observed: Constance Bay, along the Ottawa River, near Ottawa, and Pinery Provincial Park near Grand Bend on southern Lake Huron. The Constance Bay population is likely extirpated given that it was last confirmed extant in 1965. The species is listed as endangered on the Species at Risk in Ontario (SARO) List under the *Endangered Species Act, 2007* (ESA).

Threats to the survival and recovery of the existing population are primarily associated with factors affecting the succession of vegetation into the beetles' open to semi-open habitat, including trail use and development, habitat and trail modification, fire suppression and subsequent ecological succession and increased fire intensity, pesticide use, non native plant and animal species and their management. Recovery potential for the species is limited by its very specific habitat requirements and limited dispersal capabilities. A greater understanding of the reasons for the limited distribution of the species and for its habitat specificity would aid in protection and recovery.

The recovery goal is to ensure the long-term survival of the Northern Barrens Tiger Beetle in Ontario, including the exploration of the feasibility of re-introduction.

The protection and recovery objectives are to:

- Determine the Northern Barrens Tiger Beetle distribution, abundance and population trends in Ontario;
- Document micro and macrohabitat information throughout the species range;
- Initiate research on biological needs and threats; and
- Develop and implement conservation, management and protection methods.

These objectives should be addressed through surveys of existing and potentially suitable habitat, analysis of site characteristics for all known populations, and appropriate protection management and monitoring of habitats and populations.

The area prescribed as habitat in a regulation should include Pinery Provincial Park ski trails (excluding sections on paved and unpaved roads and parking lots), hydro cut lines, sandy access roads, fire breaks, The Wilderness Trail and the trail (old waterline installation route) on the east side of the Old Ausable Channel, which runs north of North Bridge to the northern boundary of the park. At each site, the area prescribed as habitat should include the trail and the surrounding area extending ten metres beyond the outer edges of the trail. If the ecological community that exists adjacent to the trail

extends beyond 10 metres then the area of regulated habitat should encompass this entire ecological community.

In addition, if new locations for the Northern Barrens Tiger Beetle are discovered or the species is re-introduced, then these areas should also be prescribed as habitat in the regulation.

TABLE OF CONTENTS

RECOMMENDED CITATION i
AUTHORS ii
ACKNOWLEDGMENTS ii
DECLARATION iii
RESPONSIBLE JURISDICTIONS iii
EXECUTIVE SUMMARY iv
1.0 BACKGROUND INFORMATION 1
1.1 Species Assessment and Classification 1
1.2 Species Description and Biology 1
1.3 Distribution, Abundance and Population Trends 2
1.4 Habitat Needs 5
1.5 Limiting Factors 5
1.6 Threats to Survival and Recovery 6
1.7 Knowledge Gaps 7
1.8 Recovery Actions Completed or Underway 8
2.0 RECOVERY 10
2.1 Recovery Goal 10
2.2 Protection and Recovery Objectives 10
2.3 Approaches to Recovery 11
2.4 Area for Consideration in Developing a Habitat Regulation 14
GLOSSARY 15
REFERENCES 17

LIST OF FIGURES
Figure 1. Range of Northern Barrens Tiger Beetle in North America 3
Figure 2. Historical and current distribution of Northern Barrens Tiger Beetle in Ontario 4

LIST OF TABLES
Table 1. Protection and recovery objectives 10
Table 2. Approaches to recovery of the Northern Tiger Beetle in Ontario 11

1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Northern Barrens Tiger Beetle
SCIENTIFIC NAME: *Cicindela patruela*
SARO List Classification: Endangered
SARO List History: Endangered (November 2009)
COSEWIC Assessment History: Endangered (November 2009)
SARA Schedule 1: N/A
CONSERVATION STATUS RANKINGS: GRANK: G3 NRANK: NNR SRANK: S1

The glossary provides definitions for the abbreviations above and other terms in the document.

1.2 Species Description and Biology

Species Description

Northern Barrens Tiger Beetle (*Cicindela patruela*) belongs to the family Carabidae (ground beetles) and the subfamily Cicindelinae (tiger beetles). There are three subspecies, only one of which is found in Ontario: *Cicindela patruela patruela. The* Northern Barrens Tiger Beetle is most easily identified in the adult life stage. Adults are a dull metallic green measuring 12 to 14 mm in length. Each elytron (wing cover) has three distinct, unconnected, white maculations (markings). The upper maculation (humeral lunule) is reduced to two slightly connected or interrupted dots, the middle maculation bends and reaches to the outer edge of the elytron and the maculation at the base of the elytron (apical lunule) consists of two distinct or narrowly joined markings.

Other green tiger beetles that occur in Ontario are the Six-spotted Tiger Beetle (*C. sexguttata*), Laurentian Tiger Beetle (*C. denikei*), Festive Tiger Beetle (C. scutellaris), Cow Path Tiger Beetle (*C. purpurea*), and the Common Claybank Tiger Beetle (*C. limbalis*). The middle maculation in Six-spotted Tiger Beetles is broken into two small spots unlike the bent complete band of the Northern Barrens Tiger Beetle. The maculations of the Laurentian Tiger Beetle are even smaller and are usually reduced to only two or three small white spots. In addition, in Ontario, the Laurentian Tiger Beetle is confined to alvar habitats on Manitoulin Island and similar habitats in northwestern Ontario. The Festive Tiger Beetle ranges from dark brown

to green and the markings are limited to the side. The Cow Path Tiger Beetle has middle maculations that are less curved and thinner than on the Northern Barrens Tiger Beetle and markings don't reach the edge of the elytron. The wing colour in the Cow Path Tiger Beetle can vary from purplish bronze to greenish but there are no upper maculations. Common Claybank Tiger Beetle has very similar markings to Northern Barrens Tiger Beetle but is found on bare sloping clay banks and road cuts, and it has a purple to greenish elytron.

The body of the white, grub-like larva of the Northern Barrens Tiger Beetle is predominantly membranous except for the head and the top of the thorax, which are covered in a hard, darkened capsule (Pearson et al. 2006). The lower dorsal abdomen of the larva has a prominent hump with two hooks that aid in anchoring (Leonard and Bell 1999).

Species Biology

The Northern Barrens Tiger Beetle has a two year spring – fall life cycle (Leonard and Bell 1999, Pearson et al. 2006). Pupae occur in a chamber beneath the ground and beetles emerge from chambers as adults in August to September. The tiger beetle adult overwinters in an underground burrow. Adults re-emerge from burrows in April through June, when they mate, lay eggs and die. Eggs hatch and the larvae live a year or more before pupating and emerging as adults, completing the life cycle. Larvae are found in the same habitat as adults.

Both adults and larvae are carnivorous, preying on ants, spiders, flies and other invertebrates. Adults run down their prey in short, fast bursts and use large mandibles to chew prey into fragments, which are dissolved by digestive enzymes (Leonard and Bell 1999). Adults engage in short-distance flights (5-10m) in response to disturbances and will land within the open area or in the vegetation immediately adjacent to it (Mawdsley 2007).

Larvae are less evident than adults as they live in burrows and keep their heads level with the ground. When larvae sense nearby prey, they extend their bodies and capture and pull prey into the burrow (Pearson and Vogler 2001). Hooks on the dorsal hump anchor the larva vertically to the wall of the burrow and help to prevent it from being pulled out of its burrow when struggling with its prey.

1.3 Distribution, Abundance and Population Trends

The Northern Barrens Tiger Beetle is ranked globally as vulnerable (G3). Global abundance for *C. patruela* is estimated at 1,000 to 100,000 individuals and for *C.patruela patruela* numbers are estimated at 1,000 to 2,500 individuals (NatureServe 2009). The Northern Barrens Tiger Beetle is a globally rare insect found in eastern North America, ranging from Georgia, South Carolina and Tennessee north to southern Ontario and southwestern Quebec and west to Minnesota (Sutherland 1999,

NatureServe 2009, COSEWIC in press, Figure 1). It occurs in small, isolated populations in suitable habitat patches throughout its range (Mawdsley 2007).

Figure 1. Range of Northern Barrens Tiger Beetle in North America (COSEWIC in press)

Three geographically isolated subspecies of this beetle are known in North America: *C. p. huberi,* which occurs only in central Wisconsin*, C. p. consentanea*, which occurs in the Atlantic coastal plain and New Jersey Pine Barrens, and *C. p. patruela*, which occurs in the central portion of the range (Mawdsley 2007) including Ontario and Quebec. Within Canada and Ontario, it is ranked as critically imperilled (N1 and S1).

In Ontario, only two populations of Northern Barrens Tiger Beetle have been documented (Figure 2):

- Constance Bay, along the Ottawa River near Ottawa, where its presence was last documented in 1965 (Wallis 1961, NHIC 2010); and
- Pinery Provincial Park, a Natural Environment class park (Ontario Parks 2010) near Grand Bend on Lake Huron. Its presence in the park was first documented in 1991, and specimen collections and observations have been made periodically or nearly annually to the present. These include The Wilderness Trail, the trail (old waterline installation route) near the North Bridge, and a new population was recorded in 2009 on The Huron Ski Trail (A. MacKenzie pers. comm. 2010).

The Constance Bay population is likely extirpated given that, despite repeated searches, the species has not been observed in over 45 years.

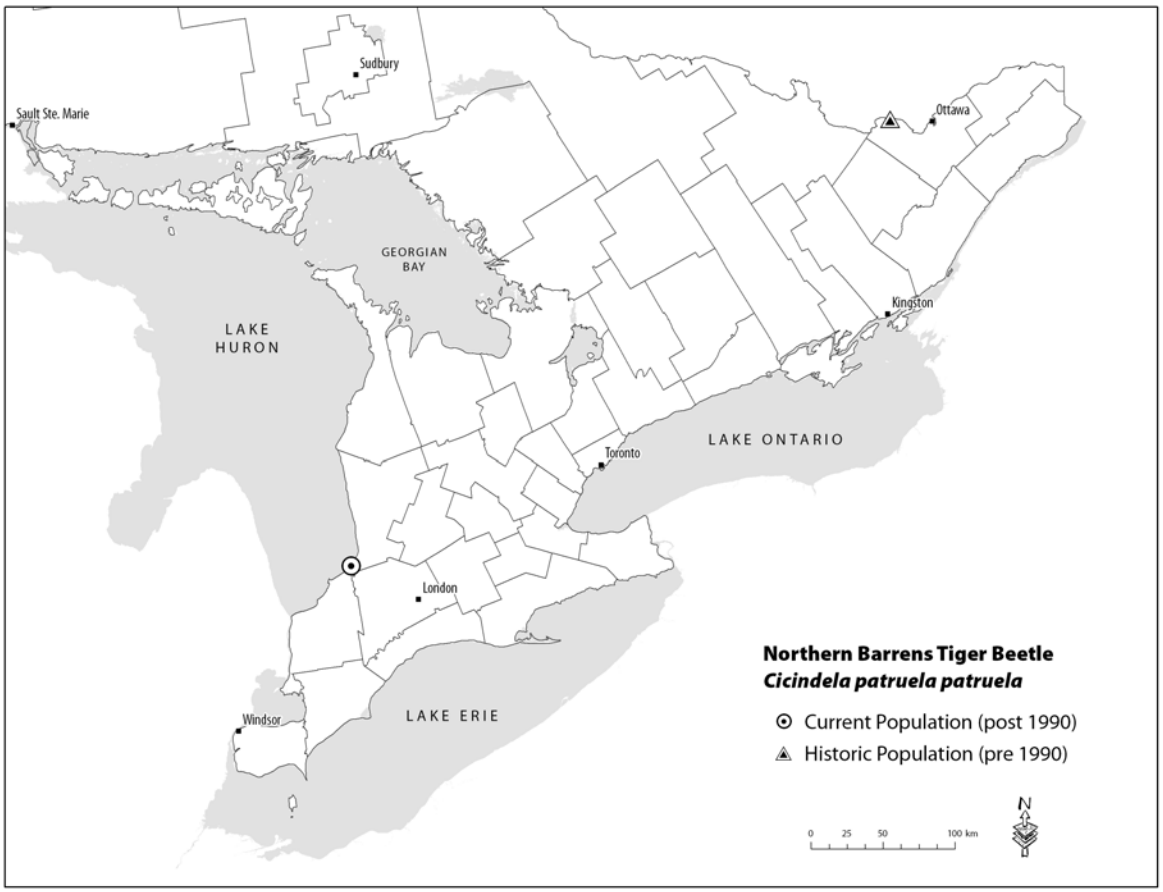

Figure 2. Historical and current distribution of Northern Barrens Tiger Beetle in Ontario

Searches by qualified entomologists have taken place in suitable habitats in Ontario (COSEWIC in press). The majority of searches have taken place before 2007 and in the months of May, June and August. To date, no new populations have been found outside the current distribution. The Pinery Provincial Park population has been roughly estimated at 400 to 1000 individuals, including both larvae and adults (COSEWIC in press).

1.4 Habitat Needs

The Northern Barrens Tiger Beetle requires openings in Pine (*Pinus* spp.) or Pine-Oak (*Quercus* spp.) ecosystems occurring on sandy soils (Mawdsley 2007). Adults are most often found in open, sandy barrens bordered by woodlands and forests of pines or deciduous trees (mainly oak) (Mawdsley 2005) and are often observed on sandy roads, hydro cut lines, logging access roads or laneways occurring within these habitats (Wallis 1961, Graves and Brzoska 1991, Pearson et al. 2006). Vegetation surrounding known locations of Northern Barrens Tiger Beetle includes pine, oak, blueberry (*Vaccinium* spp.) and Sweet-fern (*Comptonia peregrina*) (Leonard and Bell 1999). Larvae occur near adult habitat, scattered in burrows in more compacted sandy soils closer to, or amongst vegetation (Pearson et al 2006, Mawdsley 2007).

The habitat of the extant Ontario population is noted as Black Oak (*Quercus velutina*) - Eastern White Pine (*Pinus strobus*) savannah and woodland with Bracken Fern (*Pteridium aquilinum*), blueberry, American Witch-hazel (*Hamamelis virginiana*), sunflower (*Helianthus* spp.), graminoid, Eastern Poison-ivy (*Toxicodendron radicans*) and Pennsylvania Sedge (*Carex pensylvanica*) (COSEWIC in press).

In 2004, a new population was discovered in Ulster County, New York State (NYNHP 2009) in habitats similar to those in southeastern Ontario. This habitat consisted of woodland habitats on rocky hilltops with quartzite, sandstone or schist bedrock and sandy sites dominated by pine and scrub oak. Pitch Pine (*Pinus rigida*) ridgetops similar to those in Ulster County, New York, are known to exist in southeastern Ontario on the Frontenac Arch in Leeds and Grenville County.

Adults achieve thermoregulation through a series of behaviours, and use warm, sun-exposed microhabitats to reach body temperatures required to maintain a high activity level for foraging (around 34°C), but also require access to shady or damp areas when body temperatures exceed 36°C (Knisley et al. 1990). Adults may take cover under sticks and stones, or dig temporary burrows during higher daytime temperatures and at night during cooler temperatures (Pearson and Vogler 2001).

Northern Barrens Tiger Beetle favours habitats with moderate natural disturbance levels. The disturbance should be sufficient to maintain open patches for sunning and foraging but should also be adjacent to cooler shaded areas. Locations with open patches and nearby early successional native plant communities (including mosses, lichens and sedges for oviposition sites) are considered optimal (Mawdsley 2005).

1.5 Limiting Factors

Northern Barrens Tiger Beetle is prone to extirpation because of its very specific habitat requirements, need for moderate disturbance and limited dispersal behaviour. The lack of understanding of the reasons for the limited distribution and/or habitat sensitivity of

the Northern Barrens Tiger Beetle is a serious limiting factor to protection and management.

1.6 Threats to Survival and Recovery

Human activities which alter the pine or oak barrens habitat required by this species are a threat to its survival. Such activities could include:

- Development and habitat modification including changes to the trail surface (paving, wood chips, limestone screenings or gravel);
- High levels of human disturbance through the use of off-road vehicles such as bicycles and all-terrain vehicles, and heavy pedestrian traffic, which compacts the soil, threatening larval habitat and disturbing the adults. The degree of disturbance that this species can tolerate has yet to be established (NatureServe 2009;
- Lack of natural fires and prescribed burns, which prevents the creation and maintenance of habitat openings, and the subsequent ecological succession (Mawdsley 2005, NatureServe 2009, NYNHP 2009);
- Increased fire intensity (because of fuel loading due to fire suppression), which some researchers speculate could threaten localized populations (COSEWIC in press);
- Pesticide use which can threaten the habitat, the species and its prey; and
- Non-native plant and animal species and their management, which could change vegetation cover, introduce competition, or be subject to management practices which are incompatible with Northern Barrens Tiger Beetle preservation (e.g.: pesticide use, increased traffic for monitoring).

The Pinery Provincial Park conducts prescribed burns on an annual basis as part of the management regime for Oak Savannah habitat (A. MacKenzie, pers. comm. 2010). However, lack of standardized monitoring of populations and restoration efforts may have the consequence that negative impacts of management are going undetected. Individuals of the species have been observed on a well-used recreational trail within the park, which presents a management challenge (A. MacKenzie, pers. comm. 2010).

Recovery of the Constance Bay population poses a greater challenge due to residential development that surrounds the area. The Constance Bay site was sprayed with DDT in the 1950s, which may have been a major contributor to decline of that population of Northern Barrens Tiger Beetle (COSEWIC in press). Current management of the Torbolton Forest in the Village of Constance Bay includes fire suppression and the development and maintenance of a recreational trail system (City of Ottawa 2006). While presence of the trails themselves may be beneficial in terms of apparently suitable habitat, the potential for trampling and soil compaction due to a high volume of traffic may be a threat to recovery.

1.7 Knowledge Gaps

Up to date research on preferred habitat and current information on the species current distribution in Ontario is required to help guide monitoring, restoration and habitat protection. Areas with high quality potential habitat should continue to be searched for adult and larval activity.

No detailed studies of the ecology and biology of the Northern Barrens Tiger Beetle have been conducted in Canada. Previous studies of this species have all been conducted on populations elsewhere in the species' range. While such studies are informative, detailed information on the extant population would provide insight into the size and extent of subpopulations, habitat preference at different scales and other aspects of the species' biology within Pinery Provincial Park. Specific habitat information on the extent, frequency and intensity of restoration activities (including prescribed burns) required to sustain the population, as well as information on habitat preference (sand, light, trail conditions) and the required disturbance regime would also be useful.

There is a lack of detailed information in the literature on the specific effects of prescribed burns on the tiger beetle adults and larvae. Information collected at the Pinery Provincial Park and in other parts of the tiger beetles range should be used to further the scientific literature on tiger beetles and prescribed burns.

Moderate disturbance is required to maintain the open habitat of the trail, but the exact amount of disturbance is not known. Too much can harm the adults and larvae, too little and vegetation will cover over the path. More in-depth research and information on disturbance in other parts of the Northern Tiger Beetle range where the species is present is required.

Non-native species populations and their management could have an effect on the Northern Barrens Tiger Beetle population. These include management of areas to control insects such as European Oak Borer (*Agrilus sulcicollis*) and non-native, invasive plants like knapweed (*Centaurea spp*). Changes in numbers of these species and their control could have effects on the Northern Barrens Tiger Beetle and its prey. The amount of predation on the Northern Barrens Tiger Beetle larvae and adults by both native and non-native insect predators in the Pinery Provincial Park is unknown and warrants investigation.

Reintroduction efforts may be necessary for Northern Barrens Tiger beetle to colonize suitable unoccupied sites or re-establish extirpated populations (Mawdsley 2005). Additionally, reintroduction efforts may be hampered by the tendency of adult tiger beetles to disperse greater distances when handled, so relocation of larvae may be necessary to establish populations in recovered habitats (Mawdsley 2005).

It is unlikely that areas restored to ideal habitat will become naturally repopulated if no existing populations occur in the vicinity because adults are not typically observed in

flight outside their habitat and dispersal beyond 5 to10 m from established habitats is rare. As such, reintroduction efforts may be necessary for Northern Barrens Tiger Beetle to colonize suitable unoccupied sites.

1.8 Recovery Actions Completed or Underway

Searches have taken place for Northern Barrens Tiger Beetle in Pinery Provincial Park, surrounding locations and numerous other similar habitats across the province (A. MacKenzie, pers. comm. 2010, COSEWIC in press, P. Catling, pers. comm. 2010).

Areas that have been searched in the past include:

- Bruce County – Inverhuron Provinicial Park, Hepworth Dunes (COSEWIC in press);
- Lambton County – Pinery Provicinal Park, Karner Blue Sanctuary, Attawandaron Scout Camp, Port Franks Forested Dunes (COSEWIC in press);
- Manitoulin Island – Misery Bay and Area (COSEWIC in press);
- Norfolk County – St Williams Forest Station, Normandale Fish Hatchery Areas, Turkey Point Provincial Park (COSEWIC in press);
- Northumberland County – Presqu'ile Provincial Park; (COSEWIC in press);
- Ottawa area – Constance Bay (COSEWIC in press);
- Prince Edward County – Sandbanks Provinical Park;
- Renfrew County – Petawawa Area (COSEWIC in press);
- Sault Ste. Marie – Goulais River Area (COSEWIC in press); and
- Simcoe County – Wasaga Beach Provincial Park (COSEWIC in press).

Additional areas of high quality habitats that require searches include:

- Counties of Northumberland, Peterborough, Victoria and the Region of Durham – Ganaraska Forest and area;
- Lambton County – Ipperwash Park and conservation lands [Nature Conservancy of Canada (NCC)], conservation authorities, land trusts, federal and provincial lands, naturalists' clubs, county, municipal and regional forests);
- Leeds and Grenville – Frontenac Arch;
- Norfolk County – conservation lands;
- Northumberland County – conservation lands;
- Prince Edward County – Sandbanks Provincial Park;
- Simcoe County – Base Borden.

The use of prescribed burns as a technique to restore and maintain oak savannah and woodland habitat within the Pinery Provincial Park has been ongoing since 1990 (A. MacKenzie, pers. comm. 2010). Prescribed burns have been undertaken in 45 to 50 percent of oak savannah habitat within the park and all of the areas adjacent to the Northern Barrens Tiger Beetle locations have been burned at least once since 1990 (A. MacKenzie, pers. comm. 2010). Prescribed burns conducted in known areas for

Northern Barrens Tiger Beetle have only occurred on one side of the trail in order to leave unburned habitat on the other side. (A. MacKenzie, pers. comm. 2010).

Pinery Provincial Park has attempted to restrict off season use of ski trails by cyclists and hikers, while mowing the habitat once in late fall to maintain vegetation levels. Efforts to restrict heavy pedestrian use of these habitats have been met with only limited success as many cyclists and hikers continue to use these paths (A. MacKenzie, pers. comm. 2010). Further measures to control the use of ski trails during the growing season are required as these facilities bisect nature reserve zones.

2.0 RECOVERY

2.1 Recovery Goal

The recovery goal is to ensure the long-term survival of the Northern Barrens Tiger Beetle in Ontario, including the exploration of the feasibility of re-introduction.

2.2 Protection and Recovery Objectives

Table 1. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Determine the Northern Barrens Tiger Beetle distribution, abundance and population trends in Ontario.
2	Document micro and macrohabitat information throughout the species range.
3	Initiate research on biological needs and threats.
4	Develop and implement conservation, management and protection methods.

2.3 Approaches to Recovery

Table 2. Approaches to recovery of the Northern Tiger Beetle in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1. Determine the Northern Barrens Tiger Beetle distribution, abundance and population trends in Ontario.				
Necessary	Short-term	Communication	**1.1** Develop a one page fact sheet to aid in the identification of this species and raise awareness to land stewards and staff working at extant and potential suitable tiger beetle habitats. In addition, this information should be given to all Pinery Provincial Park staff including current and new staff in the spring of the year.	• Lack of understanding of the current distribution and abundance
Necessary	Ongoing	Inventory, Education and Outreach	**1.2** .Engage experts, local naturalists, land stewards and staff working at the potential suitable tiger beetle habitats in the search for this species. All permanent and seasonal Pinery Provincial Park outreach and education, natural heritage and maintenance staff should be aware of the species and its habitat and biology.	• Lack of understanding of the current distribution
Necessary	Ongoing	Inventory	**1.3** Determine current population numbers and trends and fluctuations in populations based on standardized inventory and monitoring protocols.	• Detailed baseline data on the population numbers are lacking.
Necessary	Ongoing	Inventory	**1.4** Develop a prioritized list of sites where apparently suitable habitat exists and complete standardized ground searches for the species.	• Lack of understanding of the current distribution

2. Document micro and macrohabitat information throughout the species range				
Critical	Short-term	Monitoring and Assessment	**2.1** Document habitats and site conditions – Complete Ecological Land Classification (ELC) of areas adjacent to existing populations. – Document substrate, vegetation, light levels, trail conditions, vegetation structure and amount of open sand at existing population locations.	• Lack of detailed site specific information on habitat and how much habitat is required to maintain a metapopulation
Critical	Short-term	Monitoring and Assessment	**2.2** Document all restoration activities at locations of existing populations including timing and intensity of prescribed burns, burn effectiveness and conditions, and adult and larvae responses to burns.	• Lack of detailed baseline site specific information on habitat and tiger beetle response to prescribed burns
Critical	Short-term	Monitoring and Assessment	**2.3** Document existing uses and frequency and duration of use of habitats by Northern Barrens Tiger Beetle.	• Lack of site-specific detailed information on habitat and habitat use
3. Initiate research on biological needs and threats				
Critical	Ongoing	Research, Monitoring and Assessment	**3.1** Document information on Northern Barrens Tiger Beetle biology and behaviour – Collect site specific baseline data on timing of adult emergence, exact location of larvae, adult and larval feeding habits and prey and predators.	• Lack of understanding of biology and behaviour in southern Ontario
Necessary	Ongoing	Research, Monitoring and Assessment	**3.2** Initiate research into predator effects.	• Lack of understanding of predators and predator effects in southern Ontario
Necessary	Ongoing	Research, Monitoring and Assessment	**3.3** Determine whether non-native invasive species impact the persistence of Northern Barrens Tiger Beetle in Ontario, and if necessary, mitigate the impact.	• Lack of understanding of non-native species and their effect on the population of Northern Barrens Tiger Beetle

Necessary	Ongoing	Research	**3.4** Determine why Northern Barrens Tiger Beetle does not occur at apparently suitable sites across Ontario.	• Lack of understanding of the current distribution
Beneficial	Long-term	Research	**3.5** Explore research and requirements to re-introduce Northern Barrens Tiger Beetle.	• Lack of information on the feasibility of this option in the long term recovery of this species
4. Develop and implement conservation, management and protection methods				
Critical	Short-term	Protection	**4.1** Ensure Northern Barrens Tiger Beetle habitat is accurately described and protected through habitat regulation.	• Habitat protection
Critical	Ongoing	Management	**4.2** Maintain the amount of habitat for the Northern Barrens Tiger Beetle at known locations.	• Habitat protection and enhancement
Critical	Short-term	Protection	**4.3** Identify and implement approaches to control non-natural disturbances in areas of suitable habitat and the areas prescribed in a habitat regulation.	• Habitat protection
Critical	Ongoing	Management	**4.4** Maintain the use of prescribed burning as a management tool to prevent succession of and to restore and maintain occupied and potential habitats.	• Habitat protection and enhancement

2.4 Area for Consideration in Developing a Habitat Regulation

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

It is recommended that the area prescribed as habitat for this species include all occupied habitat. For the single extant Ontario population of Northern Barrens Tiger Beetle, this includes several specific areas within Pinery Provincial Park:

- Ski trails (excluding sections on paved and unpaved roads and parking lots)
- The Wilderness Trail
- The trail (old waterline installation route) on the east side of the Old Ausable channel, which runs north of north bridge to the northern boundary of the Park
- hydro cut lines, sandy access roads and fire breaks

At each of the specific areas described above, the area prescribed as habitat should include the trail and the surrounding area extending ten metres beyond the edge of the trail. Mawdley 2007 states that flights of the beetle rarely exceed five to ten metres. If the ecological community that exists adjacent to the trail extends beyond ten metres then the area of regulated habitat should encompass this entire ecological community.

In addition, if new locations for the Northern Barrens Tiger Beetle are discovered or the species is re-introduced, then these areas should also be prescribed as habitat in the regulation.

GLOSSARY

Apical lunule: Markings on the posterior tip of the elytron of tiger beetles.

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

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

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

1 = critically imperilled
2 = imperilled
3 = vulnerable
4 = apparently secure
5 = secure
NNR = not yet assessed

Diapause: A period of delayed development or growth accompanied by reduced metabolism and inactivity.

Elytron (plural = elytra): The hard wing covers on the back of beetles.

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

Humeral lunule: Markings on the anterior tip of the elytron of tiger beetles.

Maculations: Markings (apical, middle and humeral lunules) on the elytra of tiger beetles.

Mandibles: The chewing structures of the insect mouth.

Membranous: Covered in a thin, pliable layer of tissue.

Pupation: The non-feeding life cycle stage during which the insect transforms from larva to adult.

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

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

Thorax: The middle region of the body of an insect, between the head and the abdomen.

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