PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Eastern Prickly Pear Cactus (*Opuntia humifusa*) in Canada

Eastern Prickly Pear Cactus

May 2010

Parks Canada Parcs Canada

Canada

About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (*SARA*)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. *SARA* came into force in 2003 and one of its purposes is *"to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."*

What is recovery?

In the context of species at risk conservation, **recovery** 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 the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a Recovery Strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of the three federal *SARA* agencies — Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada — under the *Accord for the Protection of Species at Risk*. Sections 37–46 of *SARA* (www.sararegistry.gc.ca/approach/act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was last assessed, a recovery strategy has to be developed within one to two years after the species is added to the *List of Wildlife Species at Risk*. Three to four years is allowed for those species that were automatically listed when *SARA* came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The Series

This series presents the recovery strategies prepared or adopted by the federal government under *SARA*. New documents will be added regularly as species get listed and as strategies are updated.

To Learn More

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the Species at Risk Public Registry (http://www.sararegistry.gc.ca/).

Recovery Strategy for the Eastern Prickly Pear Cactus (*Opuntia humifusa*) in Canada

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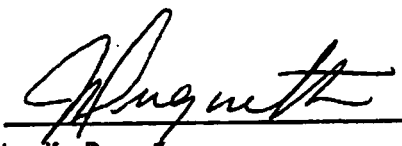
Recommendation and Approval Statement

Recovery Strategy for the Eastern Prickly Pear Cactus (*Opuntia humifusa*) in Canada

Recommended by:



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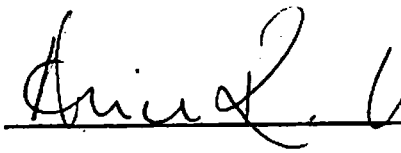

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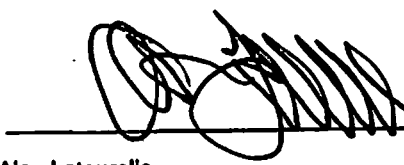

Alan Latourelle
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Date: 27/Apr/2010

DECLARATION

Under the *Accord for the Protection of Species at Risk* (1996), the federal, provincial and territorial governments agreed to work together on legislation, programs and policies to protect wildlife species at risk throughout Canada. The *Species at Risk Act* (S.C. 2002, c.29) (*SARA*) requires that federal competent ministers prepare recovery strategies for listed Extirpated, Endangered and Threatened species.

The Minister of the Environment presents this document as the recovery strategy for the Eastern Prickly Pear Cactus as required under *SARA*. It has been prepared in cooperation with the jurisdictions responsible for the species, as described in the Preface. The Minister invites other jurisdictions and organizations that may be involved in recovering the Eastern Prickly Pear Cactus to use this recovery strategy as advice to guide their actions.

The population and distribution objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide further details regarding measures to be taken to support protection and recovery of the Eastern Prickly Pear Cactus. Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the actions identified in this strategy. In the spirit of the *Accord for the Protection of Species at Risk*, all Canadians are invited to join in supporting and implementing this strategy for the benefit of the Eastern Prickly Pear Cactus, and of Canadian society as a whole. The Minister of the Environment will report on progress within five years.

AUTHORS

The information, concepts and recommendations presented in this recovery strategy were developed by the Eastern Prickly Pear Cactus – Lake Erie Sand Spit Savannas Recovery Team. The background, ecosystem-based document that was the basis of this recovery strategy was researched and prepared for the recovery team by Melinda Thompson, Sam Brinker and Ken Ursic of Dougan & Associates Ecological Consulting Services, with extensive reviews, revisions and contributions by Vicki M^{c}Kay, Recovery Team Chair and Species at Risk Recovery Specialist, Point Pelee National Park of Canada, Patrick Nantel, National Office, Parks Canada Agency (Parks Canada) and by Brian Hutchinson of the Ontario Service Center, Parks Canada.

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In addition to the authors, current recovery team members and their support staff, the following individuals and organizations are acknowledged for contributing their time, expertise or information to assist in the development of a comprehensive, ecosystem-based recovery strategy: Danielle Breault (Essex Region Conservation Authority), Tricia Radburn (Essex County Stewardship Network), Marc Allan (Ontario Nature), Lisa Solomon (Ontario Parks), Ron Tiessen (Pelee Island Heritage Centre), and Stéphane Bruneau, Geordan Harvey, Josh Keitel and Shawna Lee Currie (Parks Canada). Peer reviewers Anton A. Reznicek and Rose Klinkenberg are kindly thanked for their review of a draft as are Nikki May (Carolinian Woodlands Recovery Team), Karen Hartley and Julia Talotti (Ontario Ministry of Natural Resources), Christine Vance, Angela McConnell and Barbara Slezak (Canadian Wildlife Service, Ontario) and Marian Stranak, Dan Reive, Dan Dufour, Lindsay Rodger, Kara Vlasman,

Kent Prior, Marie-Josée Laberge and Richard Pither (Parks Canada). Appreciation is extended to Jane Bowles and Clint Jacobs (Walpole Island Heritage Centre, Walpole Island First Nation), for their reviews.

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STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

In accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals* (2004), a strategic environmental assessment (SEA) is conducted on all *SARA* recovery strategies. 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 (see also Appendix 1).

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 on non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, primarily within the Effect on the Environment and other Species section, but are also summarized below.

Most broad strategies and approaches to recover the Eastern Prickly Pear Cactus are expected to either have no significant adverse impacts or to have a positive environmental effect on the Lake Erie Sand Spit Savannas ecosystem, as well as other species occupying those habitats. Proposed approaches oriented towards research, monitoring, protection and public education are expected to result in the return of a mosaic of vegetation communities, particularly Lake Erie Sand Spit Savannas, as well as Eastern Prickly Pear Cactus. Monitoring work may include assessments of cactus habitat, thereby increasing knowledge relating to both the ecosystem and closely associated species. Public awareness initiatives may assist in raising awareness of other species at risk and shared threats.

Negative environmental effects arising from this strategy will likely be confined to the use of vegetation management techniques as a tool to restore open habitats and to minimize or prevent succession to closed canopy habitats. Particularly, there may be potential adverse effects associated with fire management techniques. Effects could include potential loss of individuals, including Eastern Prickly Pear Cactus and other species at risk; potential damage to archaeological resources; potential loss of mature forest habitat cover and thicket and woodland habitats; loss of downed woody debris that provides important microhabitat for many Lake Erie Sand Spit Savannas species; potential displacement of existing vegetation if Eastern Prickly Pear Cactus is repatriated to historic locations; the potential disturbance of soil contaminants and potential impacts to visitor experience due to the control of off-trail activities. The potential loss of individuals from trampling and disturbance due to monitoring activities could also occur.

Mitigation measures to reduce or eliminate these impacts will require research on vegetation management techniques and their impact on Eastern Prickly Pear Cactus. The maintenance of a mosaic of vegetation communities of different age classes will require minimizing vegetation management activities so as not to include the entire habitat at once. Managing the timing of those activities could reduce disturbance to other species and to allow for "refuge" areas. Similarly, consultation with Parks Canada Archaeologists, education and coordination of staff participating in management and monitoring activities and increasing visitor awareness of those activities and its reasoning would further mitigate the above impacts.

Potential negative impacts and corresponding mitigations may be addressed in greater detail in project level environmental assessments for any habitat modification projects, prescribed burns, invasive species removals or shoreline alterations at Point Pelee National Park under the Canadian Environmental Assessment Act (1992, c. 37) (CEAA) and at Fish Point Provincial Nature Reserve under *A Class Environmental Assessment for Provincial Parks and Conservation Reserves (2005)*. These environmental assessments would require follow-up to determine the success of the techniques implemented, and the accuracy of effects predicted for other species, ecosystem processes and the environment. This will allow for adaptive management at these sites, the mitigation of any environmental effects and continual adjustment and improvement of recovery efforts.

RESIDENCE

SARA defines residence as: *a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating* [Subsection 2(1)].

The concept of residence under *SARA* does not apply to this species. Individuals of the Eastern Prickly Pear Cactus do not inhabit and leave a dwelling place that has features or functions similar to a nest or den. Damaging or destroying the location of individuals of Eastern Prickly Pear Cactus will simultaneously damage or destroy those individuals. Therefore, there is no requirement to describe residences for Eastern Prickly Pear Cactus as a means of raising awareness and enforcing the general prohibitions of *SARA*. Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the Species at Risk Public Registry: http://www.sararegistry.gc.ca/sar/recovery/residence_e.cfm.

PREFACE

This recovery strategy addresses the recovery of the Eastern Prickly Pear Cactus. In Canada, native populations are only known to occur at two locations in southwestern Ontario – Point Pelee National Park and Fish Point Provincial Nature Reserve.

Parks Canada led the preparation of this recovery strategy in cooperation with the Ontario provincial government and Environment Canada. All responsible jurisdictions reviewed and supported posting of the strategy. The proposed strategy meets *SARA* requirements in terms of content and processes (Sections 39-41).

The proposed recovery strategy for the Eastern Prickly Pear Cactus in Canada was adapted from a more comprehensive draft document, prepared by the Eastern Prickly Pear Cactus – Lake Erie Sand Spit Savannas Recovery Team, describing a strategy for protecting and recovering Eastern Prickly Pear Cactus, the Lake Erie Sand Spit Savannas and other species found within that ecosystem in Canada (Dougan & Associates and M^{c}Kay 2009.). Additional scientific and technical details, as well as detailed references, can be found in either that supporting document, or in the most recent status report for the Eastern Prickly Pear Cactus.

EXECUTIVE SUMMARY

The Eastern Prickly Pear Cactus (*Opuntia humifusa*) is a perennial, low-spreading, succulent cactus with jointed, rounded, but flattened, green stems measuring 5 to 12 cm in length. Stem segments are fleshy or firm, and sparsely covered with clusters of barbed bristles and spines. It occurs in small patches or large, scattered colonies of thousands of stems.

An Endangered plant species in Canada, it reaches the northern edge of its range in the southern tip of Ontario. It occurs there in two protected areas: two native populations in Point Pelee National Park and one in Fish Point Provincial Nature Reserve on Pelee Island. These populations are threatened mainly by loss and degradation of suitable habitat and by collection. In Canada, the species is limited to dry, sandy substrates, typically dunes, that are in the early stages of succession in habitats known collectively as Lake Erie Sand Spit Savannas.

The population and distribution objectives for the recovery of Eastern Prickly Pear Cactus are as follows:

1. To maintain the current number of microsites (345) of the Eastern Prickly Pear Cactus in Point Pelee National Park over the next five years, and to increase the total number of microsites by 5% over the next 10 years.
2. To maintain the population size (five microsites) at Fish Point Provincial Nature Reserve on Pelee Island over the next five years.

The primary threats to the species, critical information requirements for recovery, and additional steps needed to attain these objectives are addressed within the Broad Strategies and Approaches to Recovery section.

Critical habitat for the Eastern Prickly Pear Cactus is identified in the recovery strategy for all three native populations. Where conditions appear to be suitable, critical habitat is identified by vegetation communities using the standardized Ecological Land Classification system. In degraded, secondary successional habitats and areas where the vegetation has succeeded beyond optimal growing conditions for Eastern Prickly Pear Cactus, the species' critical habitat is identified using an occupancy-based approach.

One or more action plans identifying specific actions in relation to this strategy will be completed within five years of the final posting of this recovery strategy.

RECOVERY FEASIBILITY SUMMARY

Recovery of Eastern Prickly Pear Cactus in Canada is considered biologically and technically feasible, as the species meets all four criteria presented in the draft Government of Canada Species at Risk policy, as described below.

1. **Individuals of Eastern Prickly Pear Cactus that are capable of reproduction are available now or in the foreseeable future to sustain or improve its abundance.**
   Existing native Eastern Prickly Pear Cactus populations demonstrate relatively good vigour and reproduction on the current suitable sites at Point Pelee National Park and Fish Point Provincial Nature Reserve (VanDerWal *et al.* 2007b). Flowering, fruiting and seedlings have all been observed at Point Pelee National Park, with recruitment of new clusters. At Fish Point Provincial Nature Reserve, clusters have been observed to fruit in recent years.

2. **Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.**
   Point Pelee National Park and Fish Point Provincial Nature Reserve currently provide suitable habitat to support the native Eastern Prickly Pear Cactus populations found there. However, Point Pelee National Park cactus populations are experiencing stress, possibly due to declining habitat suitability (VanDerWal *et al.* 2007a). At Fish Point Provincial Nature Reserve, the limited suitable habitat is highly susceptible to disturbance and may be unsuitable for seedling establishment due to the limitations vegetation overgrowth imposes on light availability (L. Lovett-Doust pers. comm. 2006). Habitat restoration, however, is believed to be possible.

3. **The primary threats to the species or its habitat can be avoided or mitigated.**
   All confirmed native, extant populations of Eastern Prickly Pear Cactus are contained within areas protected by legislation. Management of vegetation succession can be implemented to mitigate the threat of succession caused by human intervention with natural processes. Enforcing critical habitat protection and the prohibitions surrounding collection can be achieved through educational programs and regulations.

4. **Recovery techniques exist to achieve population and distribution objectives or can be expected to be developed within a reasonable timeframe.**
   Management of vegetation succession, using a variety of methods demonstrated to be technically feasible, can be implemented to mitigate the threat posed by natural succession. Individuals from genetically appropriate (native or transplanted native) populations can be used to enhance or add to populations.

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1. COSEWIC SPECIES ASSESSMENT INFORMATION

Common Name:	Eastern Prickly Pear Cactus
Scientific Name:	*Opuntia humifusa*
Assessment Summary:	May 2000
COSEWIC Status:	Endangered
Reason for designation:	Two existing natural populations with one near extirpation and continued threats from collection.
Canadian Occurrence:	Ontario
COSEWIC Status history:	Designated Endangered in April 1985. Status re-examined and confirmed Endangered in April 1998 and in May 2000. Last assessment based on an existing status report.

Source: COSEWIC 2000

2. EASTERN PRICKLY PEAR CACTUS STATUS INFORMATION

Considered an Endangered plant species in Canada, as well as Endangered in Ontario (*Endangered Species Act*, 2007), the Eastern Prickly Pear Cactus reaches the northern edge of its range in the southern tip of Ontario. The Canadian population represents much less than one percent of the global abundance of this species. The three extant native populations of the species are found at two locations (two at Point Pelee National Park and one at Fish Point Provincial Nature Reserve).

Conservation Status Ranks (Nature Serve, 2009):

Global:	G5	Secure - common, widespread and abundant
National (USA):	N5	Secure - common, widespread and abundant
National (Canada):	N1	Critically Imperiled
Sub-national (Ontario):	S1	Critically Imperiled

(see also Population and Distribution Context).

3. DESCRIPTION OF THE SPECIES AND ITS NEEDS

3.1. Eastern Prickly Pear Cactus Description

Eastern Prickly Pear Cactus is a perennial, low, spreading, succulent cactus with jointed, rounded, but flattened, green stems measuring 5 to 12 cm in length. Stem segments are fleshy or firm and become wrinkled under drought stress. Stems are sparsely covered with clusters of barbed bristles and spines. It has a shallow, efficient root system consisting of a central taproot and fleshy, lateral roots. Flowers appear in June. They are large, waxy and yellow with red centres. The fruits are oblong and turn red when mature. Eastern Prickly Pear Cactus occurs as small patches or large scattered colonies of thousands of stems. For more detailed information on this species' description please consult Benson (1982).

3.2. Eastern Prickly Pear Cactus Needs

Eastern Prickly Pear Cactus can survive across a wide range of environmental conditions as it is highly drought tolerant and has low nutrient requirements. In Canada, the species is limited to dry, sandy substrates, typically near shore dunes and sand barrens, that are in the early stages of succession (Reznicek 1982, Klinkenberg and Klinkenberg 1984, Chiarot 1992). The species is associated with the Lake Erie Sand Spit Savannas ecosystem. This ecosystem includes habitats along the shorelines of Lake Erie sand spits and in the dry interior areas of these sand spits (dry *Open* and *Shrub Shoreline*; *Open*, *Shrub* and *Treed Sand Dune*; *Tallgrass*, *Mixed Tallgrass* and *Coniferous Savanna* and some *Coniferous* and *Mixed Woodland* vegetation communities) that are characterized by the presence of semi-open, early successional vegetation situated on well-drained, nutrient-poor, sandy substrates (Geomatics International Inc. 1994). Together, these habitats share biophysical attributes and are subject to comparable geophysical processes. The more open of these habitats (*Little Bluestem–Switchgrass–Beachgrass Open Graminoid Sand Dunes*, *Hoptree Shrub Sand Dunes* and *Red Cedar Treed Sand Dunes*) support, or are capable of supporting, Eastern Prickly Pear Cactus. However, relict plants can be found in later successional stages of thicket, woodland and forest.

This species is limited by light exposure conditions. Optimal growth occurs with 50 to 70 percent lighting (VanDerWal *et al.* 2007b), while full light may result in rapid drying of the sandy soils, contributing to reduced vigour. Seedlings survive best in more open primary and secondary successional habitats.

Eastern Prickly Pear Cactus relies on bumblebees and other bee species for pollination (Kevan and Aiello 2002) and on birds and mammals for seed dispersal. It may be limited where pollinators and dispersers are in short supply or where unsuitable habitat (e.g. forests) acts as a barrier to pollinator movement (Kevan *et al.* 2003).

4. THREAT IDENTIFICATION

The three extant native populations of the species at two locations (two populations at Point Pelee National Park [PPNP] and one at Fish Point Provincial Nature Reserve [FPPNR]) face three significant threats: loss of habitat through succession, loss of suitable habitat through the alteration of natural disturbance regimes and collection (Table 1).

Table 1: Threat classification table.

Threat	Extent	Causal Certainty	Occurrence	Frequency	Severity	Overall Level of Concern
Vegetation succession	Widespread	High	Current	Continuous	High	**High**
Alteration of natural disturbance regimes	Widespread	High (shoreline populations	Current (shoreline populations	Continuous	High	**Medium**
Collection	Widespread	High (FPPNR), Medium (PPNP)	Current	Recurrent	Medium	**Medium**

4.1. Loss and Degradation of Suitable Habitat

The loss of suitable habitat detailed below places the few, small, Canadian Eastern Prickly Pear Cactus populations, already living in a dynamic and harsh environment, in danger of complete loss due to stochastic (random) events.

4.1.1. Vegetation Succession

Suitable habitat for Eastern Prickly Pear Cactus has been lost or degraded due to vegetation succession. Alteration of the natural disturbance regimes can result in direct competition with other plants as succession proceeds. Eastern Prickly Pear Cactus is intolerant of such competition. This is the most imminent threat posed to the species and of the highest concern. This threat is considered current and severe at all three extant, native populations.

4.1.2. Alteration of Natural Disturbance Regimes

Shoreline erosion is leading to the loss of individuals and habitat, caused in part by interference with Lake Erie sediment transport dynamics (COSEWIC 2000). Eastern Prickly Pear Cactus individuals have been relocated away from the shoreline at Point Pelee National Park in the past to prevent their loss from storm action (Klinkenberg and Klinkenberg 1984).

4.2. Collection

The collection of whole specimens representing genetically unique individuals, or their parts, for horticultural purposes has, and continues to pose a threat to native Canadian populations at both sites, particularly the small population at Fish Point Provincial Nature Reserve (Canadian Parks Service 1991, COSEWIC 2000). Two instances of collection or attempted collection were reported in 2009 at Point Pelee National Park (V. L. M^{c}Kay pers. obs., L. Ritchie pers. comm. 2009).

4.3. Other Threats

The following threats are considered to be potential or historical and are thought to be of low concern in terms of population-level effects to the Eastern Prickly Pear Cactus at this time.

- **Disease:** Monitoring of the Point Pelee National Park population demonstrated that clusters of cactus with more than 75 stems having 70 percent or more shading suffered from an unspecified blight that decreased the health and survival of the cactus (Chiarot 1992).
- **Non-Indigenous, invasive species:** Non-indigenous, invasive plants represent an important threat to the habitats in which Eastern Prickly Pear Cactus is found. Daylily (*Hemerocallis* species), Spotted Knapweed (*Centaurea maculosa*) and White Sweet-clover (*Melilotus alba*) have been noted to competitively exclude Eastern Prickly Pear Cactus (Canadian Park Service 1991). Other invasive, woody species advance rates of natural succession.
- **Loss of genetic integrity through the introduction of non-native genes:** Should cacti that are not of local provenance be planted in areas immediately adjacent to the native

populations, cross-pollination could potentially result in the alteration of the native genetic makeup.

- **Loss of genetic integrity through genetic isolation occurring in small populations:** Genetic isolation can lead to random fluctuations in the frequency of the appearance of a gene in a small population, presumably owing more to chance rather than natural selection. This can affect the genetic makeup of the population, leading to differences from the main population (founder effect). The effect of this genetic drift is more pronounced in small isolated populations and can result in reduced fitness.
- **Off-trail traffic:** Point Pelee National Park experiences high rates of visitor traffic during peak seasons. These visitors do not always remain on trails. Soil compaction, the introduction of exotic species and trampling of species at risk result (Geomatics International Inc. 1994). The effect of this perceived threat remains to be clarified and quantified. While increased pedestrian traffic may have its impacts, such disturbances may also contribute to the maintenance of the open nature of the Lake Erie Sand Spit Savannas ecosystem upon which Eastern Prickly Pear Cactus depends.
- **Introduction of non-indigenous, invasive species, including exotic pests and diseases:** This concern relates primarily to a potential, future invasion of the Cactus Moth (*Cactoblastis cactorum),* a South American species native to Argentina, Paraguay, Uruguay and southern Brazil. The larvae feed on *Opuntia* species' cactus pads and resulting wounds and secondary pathogens are often fatal to the plant (Zimmermann *et al.* 2000). Although it has recently appeared in Florida, the Canada Food Inspection Agency does not consider this tropically adapted species to be a risk as it is felt that it would be unable to survive the harsh Canadian winter. However, impacts could be catastrophic for Eastern Prickly Pear Cactus if this is not the case.

5. POPULATION AND DISTRIBUTION

5.1. Population and Distribution Context

The range of the Eastern Prickly Pear Cactus extends from Massachusetts through extreme southwestern Ontario, west to Minnesota and south to Oklahoma and Florida (Figure 1). The Canadian population represents much less than one percent of the global abundance of this species. The species is common throughout the southern and eastern parts of its United States range. However, the species' conservation status rank is S1 (Critically imperiled) in Wisconsin and S3 (Vulnerable) in Iowa, Ohio, Pennsylvania and Connecticut (NatureServe 2009).

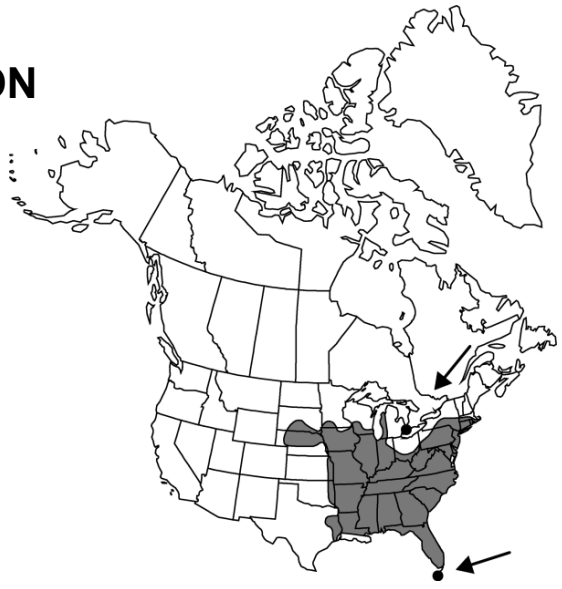

Figure 1: North American distribution of Eastern Prickly Pear Cactus. The arrows point to outliers in the species' range (Pinkava 1993).

In Canada, the Eastern Prickly Pear Cactus reaches the northern edge of its range in the southern tip of Ontario. Extant, native populations are only known to occur at two locations in southwestern Ontario: two populations in Point Pelee National Park in Essex County and one in Fish Point Provincial Nature Reserve on Pelee Island (Figure 2).

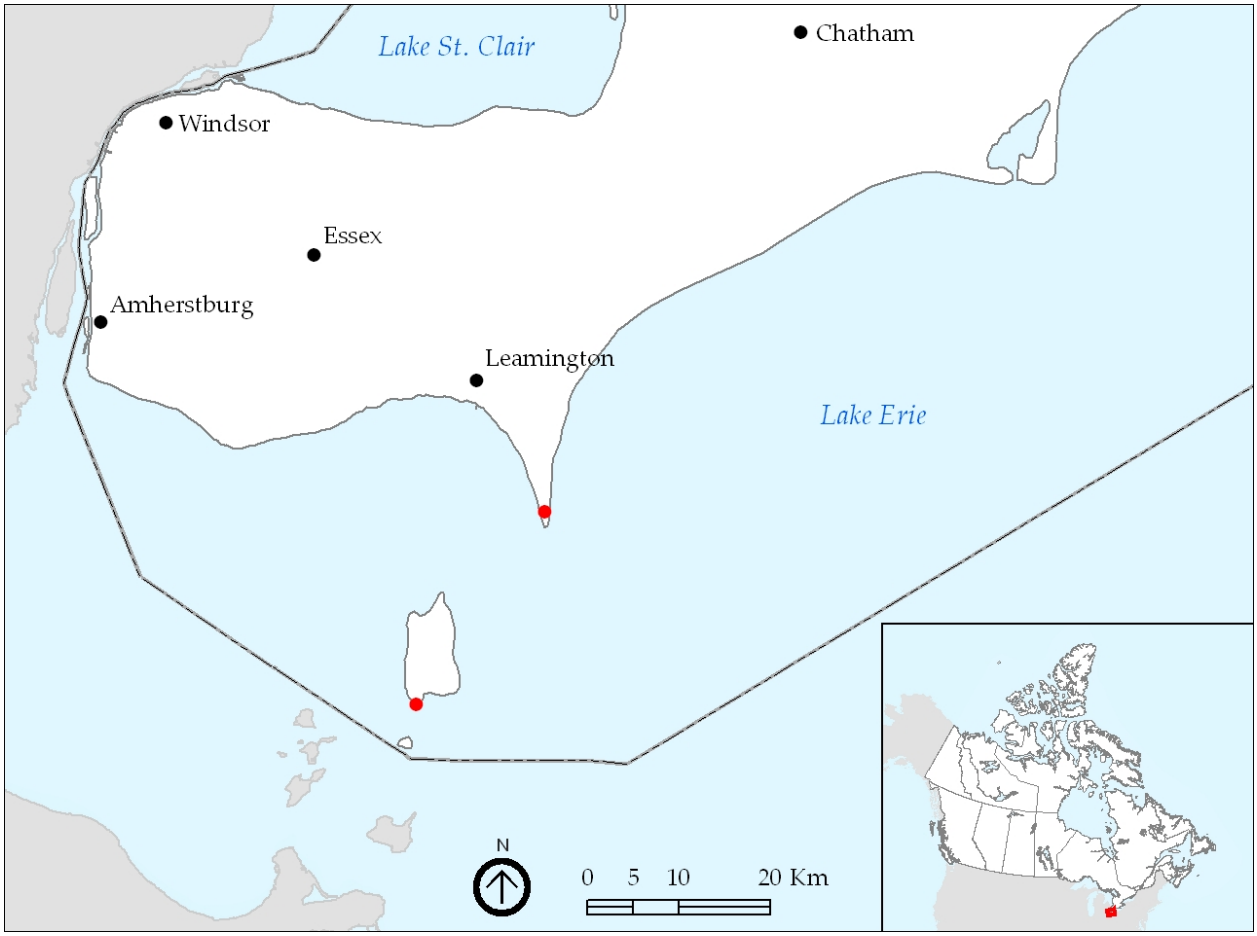

Figure 2: Distribution of extant, native populations of Eastern Prickly Pear Cactus in Canada.

The two distinct, native, Eastern Prickly Pear Cactus sites in Point Pelee National Park – one in primary successional shoreline areas and the other located in secondary successional, abandoned farm field sites, total 2 070 individuals (VanDerWal *et. al.* 2007a). A single site exists at Fish Point Provincial Nature Reserve on Pelee Island totaling 11 individuals (S. Dobbyn pers. comm. 2009). In addition to these native populations, there are five known populations of planted Eastern Prickly Pear Cactus in southwestern Ontario for which the origin is unknown, or suspected to be from one of the two native populations. Note that planted populations are not considered part of the Endangered Canadian population, but may potentially play a role in their recovery. The COSEWIC Reason for Designation considers only the two native populations (since determined to be three native populations at two locations) in its decision. There are also six populations of unconfirmed origin that are now extirpated (Table 2).

Table 2: List of extant and extirpated Canadian Eastern Prickly Pear Cactus populations.

Population - Site Name	Location	Origin	Status
Fish Point Provincial Nature Reserve (1 population)	Pelee Island, Essex County	Native	Extant
Point Pelee National Park (2 populations)	Point Pelee National Park, Essex County	Native	Extant
Chatham-Kent Roadside	Municipality of Chatham-Kent	Unknown (P.A. Woodliffe pers. comm. 2005)	Extant
Rondeau Provincial Park	Municipality of Chatham-Kent	Introduced presumably from Fish Point Provincial Nature Reserve (P.A. Woodliffe pers. comm. 2003)	Extant
Howard Township Cemetery	Howard Township, Municipality of Chatham-Kent	Introduced from Point Pelee National Park (White 1998)	Extant
Turkey Point	Norfolk County	Introduced from an unknown location (P. Carson pers. comm. 2003)	Extant
South barrier beach of Big Creek Marsh	Port Rowan, Norfolk County	Introduced (S. Brinker pers. comm. 2008, J. Robinson pers. comm. 2008)	Extant
Cedar Beach	Colchester South Township, Essex County	Unknown (no voucher)	Extirpated
Harwich Township Cemetery	Harwich Township, Municipality of Chatham-Kent	Introduced from Point Pelee National Park (White 1998)	Extirpated
Bradley's Marsh	Dover Township, Municipality of Chatham-Kent	Unknown (no voucher)	Extirpated
West of Port Stanley	Elgin County	Unknown (no voucher)	Extirpated
Long Point	Norfolk County	Unknown (Macoun 1883, no voucher)	Extirpated
Ruscom Shores Conservation Area	Essex County	Unknown (P.A. Woodliffe pers. comm. 2005)	Extirpated

The demographic record for Canadian populations is too inconsistent to accurately assess population trends, although some losses are known to have occurred. To more accurately estimate the size of the populations at Point Pelee National Park, population size was determined by using "microsites" as a surrogate. A microsite represents one or more groups of cacti less than 1.0 m from other groups (Lovett-Doust *et al.* 2004). It was estimated that each Point Pelee National Park microsite contains, on average, six individuals. Based on this, approximately 2 070 naturally established individuals occur in 345 microsites at Point Pelee National Park – 209 microsites along the west beach and 136 in the Park interior, approximately 250 m from the west beach (VanDerWal *et al.* 2007a). There are five microsites containing only 11 individuals at Fish Point Provincial Nature Reserve (S. Dobbyn pers. comm. 2009).

In Point Pelee National Park, the average age of microsites, the number of stems per microsite and the number of reproductive individuals in the population have declined (VanDerWal *et al.* 2007a). At the same time, the average number of fruits recorded per stem has increased, although this increased emphasis on sexual reproduction may be a stress response to declining habitat suitability. Based on the size, genetic variability and recruitment levels of Point Pelee National Park's existing populations, the populations are thought to be viable (L. Lovett-Doust pers. comm. 2005). In contrast, the viability of the Fish Point Provincial Nature Reserve population is questionable due to the small number of microsites and individuals and an apparent lack of recruitment (L. Lovett-Doust pers. comm. 2005).

5.2. Population and Distribution Objectives

Based on the information presented above, the population and distribution objectives for Eastern Prickly Pear Cactus are:

1. To maintain the current number of microsites (345) of the Eastern Prickly Pear Cactus in Point Pelee National Park over the next five years, and to increase the total number of microsites by 5% over the next 10 years.
2. To maintain the population size (five microsites) at Fish Point Provincial Nature Reserve on Pelee Island over the next five years.

6. ADDITIONAL INFORMATION REQUIREMENTS

There has been considerable research conducted on the biology and ecology of Eastern Prickly Pear Cactus in Canada, as well as in the United States, where it is more common and occurs in a diversity of ecosystems (e.g. http://www.fs.fed.us/database/feis/plants/cactus/opuhum/all.html). However, even though there is sufficient information to define broad recovery objectives, strategies and approaches, there are still a number of information requirements that need to be addressed in order to recover the species. These are summarized below.

- **Population monitoring:** A standardized protocol for assessing microsites and population size has been developed and tested at Point Pelee National Park. Continued, consistent implementation is required in all three populations.
- **Threat clarification:** Threats from collection, trampling and non-indigenous, invasive species (e.g. Cactus Moth) require further investigation. An assessment of the magnitude, severity and frequency of occurrence of these threats and their impacts is needed to focus protection and recovery efforts.
- **Spatial population structure and origin:** Genetic investigation of the three native Eastern Prickly Pear Cactus populations, as well as individuals at other sites in Ontario derived from stock of unknown or unconfirmed origin, is underway. While long-term maintenance and recovery of Eastern Prickly Pear Cactus at planted sites is not planned, should it be determined that planted individuals originate from the native populations they could assist in efforts to recover the species (for example, as a source for augmenting populations). It is also possible that, through this study, populations believed to have been planted will be determined to be native, which would effectively increase the number of known native populations in Canada.

7. BROAD STRATEGIES AND APPROACHES TO RECOVERY

In order to attain the Population and Distribution Objectives, the approaches to recover the species are summarized and ranked below by their degree of urgency. Threats to the populations and information requirements are addressed. These approaches will be planned with due regard for negative impacts on other species at risk that the Lake Erie Sand Spit Savannas ecosystem supports.

7.1. Manage critical habitat to maintain suitability – URGENT

Without vegetation management interventions to restore early successional stages of the Lake Erie Sand Spit Savannas ecosystem, the quality and quantity of critical habitat available is expected to decline. Based on monitoring information, plant communities need to be managed to maintain or restore early successional stages using locally developed and appropriate methods.

7.2. Identify habitat for restoration – URGENT

In order to meet the Population and Distribution Objectives, areas for habitat restoration in Point Pelee National Park need to be identified, prior to restoration efforts.

7.3. Monitor populations and habitats – NECESSARY

Monitoring of Eastern Prickly Pear Cactus individuals, microsites and populations will continue using the existing protocols in both Point Pelee National Park and Fish Point Provincial Nature Reserve. As well, monitoring protocols to measure vegetation succession and habitat quality will be developed and initiated. This will provide the data necessary for determining population trends and viability, and allow for the evaluation of progress toward achieving recovery (see Performance Measures section below). This will provide the baseline information needed to measure success in achieving the Population and Distribution Objectives.

7.4. Minimize collection and other human disturbances – NECCESSARY

Education and communication initiatives will be developed and implemented to reduce the behavior of collection of Eastern Prickly Pear Cactus. These may include targeted, effective communications to encourage compliance, as well as enforcement of existing legislation.

7.5. Assess feasibility of restoration – BENEFICIAL

Determine whether Eastern Prickly Pear Cactus patches of unknown origin have been transplanted from or are descended from transplanted individuals from the two native populations. Based on the findings, assess the appropriateness and feasibility of restoration in each case.

7.6. Address major knowledge gaps

7.6.1. Threat clarification – NECESSARY

Based on the threats identified earlier, characterize the type, magnitude and frequency of threats to populations of Eastern Prickly Pear Cactus using a standardized impact assessment protocol.

7.6.2. Spatial population structure and origin – BENEFICIAL

Research on population genetics of Eastern Prickly Pear Cactus should continue, specifically addressing genetic relationships and variability among naturally occurring, transplanted and introduced sites and sites of unknown origin, as well as potential or actual natural source sites. A systematic review of the species' records is also needed to confirm its historical range and assist in the identification of potential sites for restoration. Genetic studies will assist in the recovery of critically imperiled and degraded populations through the identification of appropriate source material for restoration to historic sites, supplementation of non-viable populations and increasing the genetic diversity of viable populations. It will also help identify the urgency of restoration and augmentation efforts for extirpated and native populations.

7.7. Protect and restore genetic integrity – BENEFICIAL

Out-crossing of introduced Eastern Prickly Pear Cactus populations with native populations can be prevented by encouraging removal of introduced genotypes and discouraging the sale of plants. Protection of native Eastern Prickly Pear Cactus genotypes and associated adaptations will help ensure long-term sustainability of the species' populations. Depending on whether restoration is feasible, plant material could be repatriated from transplanted sites to the appropriate native population to restore genetic material lost through past collection activities and storm events. This could also restore the size of degraded or imperilled species' populations to viable levels and increase genetic variability within populations.

7.8. Establish gene bank – BENEFICIAL

A protocol for collection, processing and storage of Eastern Prickly Pear Cactus seeds should be developed. Seeds would be collected and maintained live in a secure gene bank to preserve the native genotype to counteract a catastrophic event, if it occurs.

7.9. Build community support for recovery – BENEFICIAL

The content of existing educational tools for Eastern Prickly Pear Cactus (e.g. pamphlets, DVDs, lectures, education programs, exhibits) needs to be expanded to include the national and global significance of the Lake Erie Sand Spit Savannas ecosystem where the cactus and a large number of other species at risk are found. Support for the recommended approach for recovery of Eastern Prickly Pear Cactus needs to be developed. The ultimate goal is to increase community involvement in the development of an action plan and active participation in the implementation of ongoing recovery actions and present opportunities.

8. CRITICAL HABITAT IDENTIFICATION

Critical habitat for the Eastern Prickly Pear Cactus is identified for three extant, native populations of the species: two in Point Pelee National Park and one in Fish Point Provincial Nature Reserve on Pelee Island.

8.1. Approaches Used to Identify Critical Habitat

The Ecological Land Classification (ELC) vegetation types where Eastern Prickly Pear Cactus naturally occurs have been used to identify its critical habitat. However the spatial arrangement and the amount of each vegetation type are not fixed. This is because these vegetation types occur along a dynamic shoreline where natural disturbance regimes make them shift in space and time. In degraded, secondary successional habitats and areas where the vegetation has succeeded beyond optimal growing conditions for Eastern Prickly Pear Cactus, the species' critical habitat is identified using an occupancy-based approach. This provides an opportunity for recovery work to be undertaken to restore habitat conditions appropriate to the species rather than requiring the preservation of the habitat that is currently present and that may not continue to support cacti in the future.

Eastern Prickly Pear Cactus critical habitat descriptions and mapped delineations will be refined as new information or improved techniques for critical habitat identification become available.

8.2. Maps of Eastern Prickly Pear Cactus Critical Habitat

Precise geographic locations for Eastern Prickly Pear Cactus critical habitat are not presented in this recovery strategy, and will not be presented in any action plan, to protect the species from the threat of collection. As per Section 124 of the Species at Risk Act, the locations are being withheld on the advice of the COSEWIC chair (J. Hutchings pers. comm. 2008).

The Eastern Prickly Pear Cactus critical habitat map for Point Pelee National Park is housed at Point Pelee National Park, Leamington, Ontario, and in the Parks Canada Ontario Service Centre in Cornwall. ELC mapping and mapping of all Eastern Prickly Pear Cactus occurrences at Fish Point Provincial Nature Reserve are housed at the Ontario Parks, Southwest Zone office in London, Ontario.

8.3. Critical Habitat Within Point Pelee National Park

Within the boundaries of Point Pelee National Park, as identified on the National Topographic System (NTS) map 40G/15 (edition 7, printed 2001), part of the critical habitat for the Eastern Prickly Pear Cactus is identified as the three primary successional Lake Erie Sand Spit Savanna ELC vegetation types in which the cactus is currently found at this site (Lee *et al.* 1998, Lee 2004, Dougan & Associates 2007). These types are:

- *Little Bluestem–Switchgrass–Beachgrass Open Graminoid Sand Dunes,*
- *Hoptree Shrub Sand Dunes and*
- *Red Cedar Treed Sand Dunes.*

The remaining parts of the species' critical habitat are identified as a circle with a radius of 25 m from the centre point of each of these two groups of Eastern Prickly Pear Cactus microsites:

- those found in secondary successional ELC vegetation types that are degraded Lake Erie Sand Spit Savannas, and
- those found in sites that have succeeded beyond optimal conditions for Eastern Prickly Pear Cactus, such that the cactus is considered to be a relict of past conditions.

The 25 m radius used was chosen to minimize shading of Eastern Prickly Pear Cactus sites that might result from the placement of new infrastructure, as these cacti grow optimally with 50 to 70 percent light availability.

8.4. Critical Habitat Within Fish Point Provincial Nature Reserve

Within Fish Point Provincial Nature Reserve, as identified on the NTS map 40 G/15, critical habitat for the Eastern Prickly Pear Cactus is identified as the entire area within the *Red Cedar Treed Sand Dunes* ELC vegetation type, the primary successional Lake Erie Sand Spit Savanna ELC vegetation type in which Eastern Prickly Pear Cactus is currently found at this site (Lee *et al.* 1998, Lee 2004, Dobbyn 2006).

8.5. Parts of Occupied Habitat not Included in the Species' Critical Habitat

Existing anthropogenic features, including, but not limited to, parking lots, roads, trails, footpaths, cemeteries and septic fields, are excluded from the species' critical habitat because they are not suitable for supporting the species. Areas where all Eastern Prickly Pear Cactus microsites have been planted or transplanted, where records remain unverified or where its location or origin is uncertain, are not considered critical habitat. Two areas within Point Pelee National Park currently fit within this category. Complete geographical descriptions of these two areas are housed at Point Pelee National Park. Elsewhere, Eastern Prickly Pear Cactus that remains extant has been determined to be planted at:

- Rondeau Provincial Park, Municipality of Chatham-Kent
- Howard Township Cemetery, Municipality of Chatham-Kent
- Turkey Point, Norfolk County
- The south barrier beach of Big Creek Marsh, Port Rowan, Norfolk County
- Harwich Township Cemetery, Municipality of Chatam-Kent
- in various private gardens throughout the range

No areas at Long Point are identified as critical habitat, as records of the locations are not specific and cannot be verified.

9. ACTIVITIES LIKELY TO RESULT IN THE DESTRUCTION OF CRITICAL HABITAT

Examples of activities that are likely to result in the destruction of Eastern Prickly Pear Cactus critical habitat are listed here together with the effect they are likely to have on the critical habitat (Table 3).

Table 3: Examples of activities likely to result in the destruction of Eastern Prickly Pear Cactus critical habitat in Point Pelee National Park and Fish Point Provincial Nature Reserve.

Activity	Effects on Critical Habitat
Construction, expansion or maintenance of new or existing infrastructure (e.g. buildings).	Loss of habitat or excessive shading of habitat
Construction, expansion or maintenance of new or existing roads, trails or footpaths.	Loss of habitat
Use of motorized vehicles in the critical habitat without following Best Management Practices for this activity (BMPs).	Disturbance of sand preventing seedling establishment
Excessive impacts (e.g. trampling) from off-trail activities.	Disturbance of sand preventing seedling establishment
Deliberate introduction of non-indigenous, invasive species in or adjacent to critical habitat.	Loss of habitat through competition or by shading
Installation of any structure that interferes with the natural coastal processes that affect the critical habitat.	Interruption of natural processes that create or maintain critical habitat

Note that the *Canadian Environmental Assessment Act (1992, c. 37), A Class Environmental Assessment for Provincial Parks and Conservation Reserves (2005)* and the *Ontario Environmental Assessment Act (R.S.O. 1990 c. E.18)* are in place to ensure that projects do not cause significant adverse environmental effects on federal, Ontario provincial or Ontario private lands respectively and in doing so provide for protection, conservation and wise management of the environment.

10. HABITAT CONSERVATION

Native Canadian Eastern Prickly Pear Cactus populations are presently contained entirely within protected areas: Point Pelee National Park, managed by Parks Canada, and Fish Point Provincial Nature Reserve, managed by Ontario Parks. The critical habitat of the Eastern Prickly Pear Cactus in Point Pelee National Park will be protected by subsection 58(1) of *SARA*, 90 days after the description of critical habitat, as identified in the recovery strategy, is published in the *Canada Gazette*. The prohibition of this section provides additional protection to that already afforded and available under the *Canada National Parks Act (S.C. 2000, c. 32)* and its regulations. Eastern Prickly Pear Cactus and its habitat at Fish Point Provincial Nature Reserve on Pelee Island in the Township of Pelee receive protection from section 9 and 10 of Ontario's *Endangered Species Act, 2007* as well as the *Ontario Provincial Parks and Conservation Reserves Act* (S.O. 2006, c. 12). Land managers of these protected areas will identify and use the tools available to protect the habitat of this species.

The majority of potential habitat available for recovery is also located within these two protected areas. Rondeau Provincial Park, also managed by Ontario Parks, currently protects cactus transplanted from Fish Point Provincial Nature Reserve. This site is afforded the same legal protection under the *Ontario Provincial Parks and Conservation Reserves Act*, not the *Endangered Species Act, 2007*as this population is not listed.

11. MEASURING PROGRESS

Evaluation of the progress toward achieving Eastern Prickly Pear Cactus recovery will be undertaken five years following final posting of this recovery strategy on the Species at Risk Public Registry, and every five years following, as per *SARA* (s. 46). Success of the implementation of the recovery strategy will be evaluated against the Population and Distribution Objectives and approaches using a suite of performance measures (Table 4).

12. STATEMENT ON ACTION PLANS

One or more action plans identifying specific actions in relation to this strategy will be completed within five years of the final posting of this recovery strategy.

Table 4: Performance measures for the broad strategies and approaches to recovery.

Broad Approach	Goal for Recovery	Threats Addressed	Performance Measures
Manage critical habitat to maintain suitability	Protect Critical Habitat Effectively	Loss and degradation of suitable habitat	Activities likely to destroy the proposed critical habitat have been effectively managed. Mitigation efforts have been undertaken within five years of final posting of the recovery strategy in Point Pelee National Park. Operational guidelines for use of motorized vehicles (BMPs) are established to avoid damage to critical habitat. Requirements to mitigate vegetation succession and suppression of natural disturbance regimes have been identified within three years of posting of the recovery strategy.
Identify habitat for restoration	Find and identify areas for restoration	Suitable habitat is fragile, dynamic, and temporary	All potential habitat areas for restoration in Point Pelee National Park have been identified within five years of posting of the recovery strategy.
Monitor populations and habitats	Determine population trends	All	Monitoring has been carried out every two years and demonstrates the number of microsites at the two protected areas have been maintained over the five year period after posting; the number of microsites has increased by 5% within 10 years of posting in Point Pelee National Park.
Minimize collection and other human disturbances	Small population size and low recruitment rates	Collection	Monitoring shows no evidence of collection. Where evidence of collection has been observed, enhanced protection measures are designed and implemented.
Assess feasibility of restoration	Small population size and low recruitment rates	Catastrophic stochastic events leading to loss	Genetic studies on all populations are completed within two years of the final posting of the recovery strategy. Feasibility studies of restoration are completed within five years of the posting of the final recovery strategy.
Address major knowledge gaps a) Threat clarification b) Spatial population structure and origin	Determine the significance of threats Clarify origins of all populations	All	Progress has been made to acquire the information needed as outlined in the Additional Information Requirements section.

Broad Approach	Goal for Recovery	Threats Addressed	Performance Measures
Protect and restore genetic integrity	Small population size and low recruitment rates	Loss of genetic integrity	If warranted, based on the feasibility assessments, restoration plans have been completed for both native sites, with restoration underway at one native site within 10 years of posting of the final recovery strategy.
Establish Gene Bank	Provide access to additional genetic material if needed	Small population size and low recruitment rates leading to loss	A protocol has been established for development and management of a secure, off-site gene bank with collection initiated at Fish Point Provincial Nature Reserve and Point Pelee National Park within 10 years of final posting of the recovery strategy.
Build community support for recovery at the ecosystem level	Engage target audiences to assist in recovery	All	Develop and implement a communication plan targeted at the local communities and First Nations so as to ensure support for recovery efforts at the ecosystem level within five years of posting of the final recovery strategy.

13. REFERENCES

Benson, L. 1982. The Cacti of the United States and Canada. Stanford, California: Stanford University Press. 1044 pp.

Brinker, S. 2008. Natural Heritage Project Botanist, Natural Heritage Information Centre, Ontario Ministry of Natural Resources. Personal communication.

Carson, P. 2003. Private Consultant. Personal communication.

Canadian Parks Service. 1991. Eastern Prickly Pear Cactus Management Plan: Point Pelee National Park. Volume I – Text. Natural Resource Conservation, Point Pelee National Park. 20 pp.

COSEWIC. 2000. COSEWIC assessment and update status report on the Eastern Prickly Pear Cactus *Opuntia humifusa* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 7 pp.

COSEWIC. 2007. http://www.cosewic.gc.ca/eng/sct5/index_e.cfm.

Chiarot, R. 1992. Eastern Prickly Pear Cactus Monitoring Report 1992 at Point Pelee National Park. 42 pp.

Dobbyn, S. 2009. Ecologist, Ontario Parks, Southwest Zone. Personal communication.

Dobbyn, S. 2006. Ecological Land Classification of Fish Point Provincial Nature Reserve. Draft. Ontario Parks, Southwest Zone, London. 17 pp.

Dougan & Associates and V. L. M^{c}Kay. 2009. An Ecosystem-based Recovery Strategy for the Eastern Prickly Pear Cactus (*Opuntia humifusa*) – Lake Erie Sand Spit Savannas in Canada (Draft). *Species at Risk Act* Recovery Strategy Series. Parks Canada Agency, Ottawa. xiv + 36 pp. + Appendices.

Dougan & Associates. 2005a. Point Pelee National Park Ecological Land Classification and Plant Species at Risk Mapping and Status. Prepared for Parks Canada Agency, Point Pelee National Park. 421 pp. + 7 Appendices.

Hutchings, J. 2008. Chair, Committee on the Status of Endangered Wildlife in Canada. Personal communication.

Kevan, P. G. and R. Aiello. 2002. Pollination & seed set mechanisms of Eastern Prickly Pear Cactus, *Opuntia humifusa,* in Point Pelee National Park. Unpublished report. 10 pp.

Kevan, P. G., J. W. Boone, R. Aiello and T. Hisatomo. 2003. Fruit and Seed Dispersal biology of Eastern Prickly Pear Cactus, *Opuntia humifusa,* in Point Pelee National Park: Report for Field Seasons 2001, 2002 & 2003. 18 pp.

Klinkenberg, B and R. Klinkenberg. 1984. Status Report on Prickly Pear Cactus *Opuntia humifusa* (Raf.) A Threatened Species in Canada. 37 pp. + 6 p.

Lee, H. T. 2004. Provincial ELC Catalogue Version 8. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch.

Lee, H. T., W. D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and its Application. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02. 225 pp.

Lovett-Doust, L. 2005 and 2006. Professor. Formerly of the University of Windsor. Personal communications.

Macoun, J. 1883. Catalogue of Canadian Plants. Part I. – Polypetalae.
Geological Survey of Canada. Dawson Brothers, Montreal.

Geomatics International Inc. 1994. Red Cedar Savannah Restoration Plan Point Pelee National Park. Prepared for Resource Conservation Point Pelee National Park. Iii + 60 pp. + folded map.

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. http://www.natureserve.org/explorer.
(Accessed: February 28, 2007).

Pinkava, D. J. *Opuntia*. In: Flora of North America Editorial Committee, eds. 1993 +.
Flora of North America North of Mexico. 12+ vols. New York and Oxford. Vol. 4, p. 123.

Reznicek, S. A. 1982. Verification and Prioritization of Rare Species: Point Pelee National Park. Draft Report. Prepared for Parks Canada. 52 pp.

Ritchie, L. 2009. Eastern Mole Researcher, Ontario Ministry of Natural Resources. Personal communication.

Robinson, J. 2008. Wildlife Areas Manager, Ontario, Canadian Wildlife Service, Environment Canada. Personal communications.

White, D. J. 1998. Update COSEWIC Status Report on the Eastern Prickly Pear (*Opuntia humifusa*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-7pp.

Woodliffe, P. A. 2002–2007. District Ecologist, Ontario Ministry of Natural Resources, Aylmer District, Chatham Area. Personal communications.

VanDerWal, J., N. Evans, I. Wozniczka and L. Lovett-Doust. 2007a. Demography of *Opuntia humifusa* located within Point Pelee National Park. Prepared for Parks Canada Agency, Point Pelee National Park. 53 pp.

VanDerWal, J., M. S. Moeen, L. Lovett-Doust and C. L. Stewart. 2007b. Defining habitat requirements of *Opuntia humifusa* as determined by field and lab studies. Prepared for Parks Canada Agency, Point Pelee National Park. 142 pp.

Zimmermann, H. G., V. C. Moran and J. H. Hoffmann. 2000. The renowned cactus moth, *Cactoblastis cactorum*: Its natural history and threat to native *Opuntia* floras in Mexico and the United States of America. Diversity and Distributions, Vol. 6, No. 5 (Sept. 2000), p. 259-269.

APPENDIX 1: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

The ecosystem type within which Eastern Prickly Pear Cactus occurs, the Lake Erie Sand Spit Savannas, is among the rarest and most imperiled terrestrial ecosystems in North America. This ecosystem supports a large number of species, including 40 other species at risk at the provincial or national scale.

Broad approaches and strategies aimed at the recovery of the Eastern Prickly Pear Cactus are expected to either have no significant adverse impacts or to positively affect other species in the Lake Erie Sand Spit Savannas. Negative environmental effects arising from this strategy will likely be confined to the use of vegetation management techniques. Habitat modifications to enhance suitability for Eastern Prickly Pear Cactus may have adverse effects on other species but by applying appropriate mitigation measures these are not expected to be significant. Potential adverse effects associated with fire management techniques are not expected to be significant. Effects could include potential loss of individuals, including Eastern Prickly Pear Cactus and other species at risk, potential damage to archaeological resources, potential loss of mature forest habitat cover and thicket and woodland habitats, loss of downed woody debris that provides important microhabitat for many Lake Erie Sand Spit Savanna species, potential displacement of existing vegetation if Eastern Prickly Pear Cactus is repatriated to historic locations, the potential disturbance of soil contaminants and potential impacts to visitor experience due to the control of off-trail activities. The potential loss of individuals from trampling and disturbance due to monitoring activities could also occur.

The approaches currently outlined are mainly oriented towards research, monitoring, and protection. Threat assessments undertaken for Eastern Prickly Pear Cactus may benefit other species by clarifying threats that have impacts beyond just that species. Monitoring work may include assessments of cactus habitat, thereby increasing knowledge relating to both the ecosystem and closely associated species.

Similarly, education and communication activities relating to the Eastern Prickly Pear Cactus generally include information relating to both the ecosystem and other component species, thereby conferring benefits to these other species. Activities aimed at preventing the collection of Eastern Prickly Pear Cactus may help other species, like the Five-lined Skink (*Plestiodon fasciatus*), as well as some turtles and snakes, which are valued by collectors.

The implementation of any vegetation management program should involve follow-up to determine the success of the techniques implemented, in addition to the impacts on other species, ecosystem processes and the environment. This will allow for adaptive management at these sites, the mitigation of any environmental effects and continual adjustment and improvement of recovery efforts.