POINT PELEE

NATIONAL PARK OF CANADA

MIDDLE ISLAND CONSERVATION PLAN

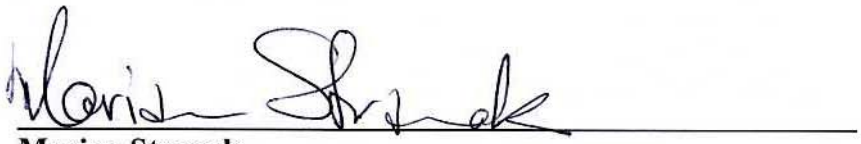
Parks Canada Parcs Canada

Canada

Prepared by:

Tammy Dobbie
Park Ecologist
Point Pelee National Park of Canada

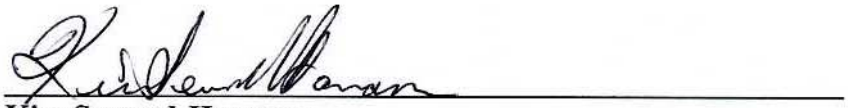
Recommended by:



Marian Stranak
Superintendent
Point Pelee National Park of Canada

Stephen Woodley
Chief Scientist
Ecological Integrity Branch

Approved by:



Kim Seward-Hannam
A/Field Unit Superintendent
Southwestern Ontario

Date: April 29, 2008

Point Pelee National Park of Canada

Middle Island Conservation Plan

Author
Tammy Dobbie

Special Thanks To
Josh Keitel, Rachel Thorndyke, Trevor McFadyen, Marian Stranak, Dan Reive and Nathalie McFadden

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Definitions

Source: Parks Canada Agency Management Directive 4.4.11: *Management of Hyperabundant Wildlife Populations in Canada's National Parks*, December 2007.

Active management: Any prescribed course of action directed towards maintaining or changing the condition of cultural, physical or biological resources to achieve Parks Canada objectives (Source: Terminology used by Parks Canada, No 236, 1997).

Adaptive Management: This is a common-sense approach to the management of ecological integrity that supports "learning while doing" and serves the dual goals of achieving management objectives and gaining reliable knowledge. It implies the development of a hypothesis (theory), and the implementation of monitoring, periodic review, and where required, changes in management actions. Where actions are changed, new predictions are formed, and the process is repeated. (Parks Canada National Parks Glossary http://pc.gc.ca/apprendre-learn/prof/itm3-guides/vraie-true/gloss_e.asp)

Ecological Integrity: "Ecological Integrity" means, with respect to a park, a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes.

Hyperabundant Population: A population of a hyperabundant species (see below)

Hyperabundant Species: Native species in a national park can be defined as hyperabundant when their numbers clearly exceed the upper range of natural variability that is characteristic of the ecosystem, and where there is a demonstrated long-term negative impact of ecological integrity.

Impair, Impairment: To change the structure or function of an ecosystem so that it is not within the natural variable range of ecological integrity.

Natural Processes: Ecological processes that support life, such as solar energy, climate processes, geological and geomorphologic processes, water cycles, fire cycles, wildlife population dynamics, and so on.

Population: All the individuals of one species occurring in a given area at a given time and existing as a breeding group generally isolated from other such groups.

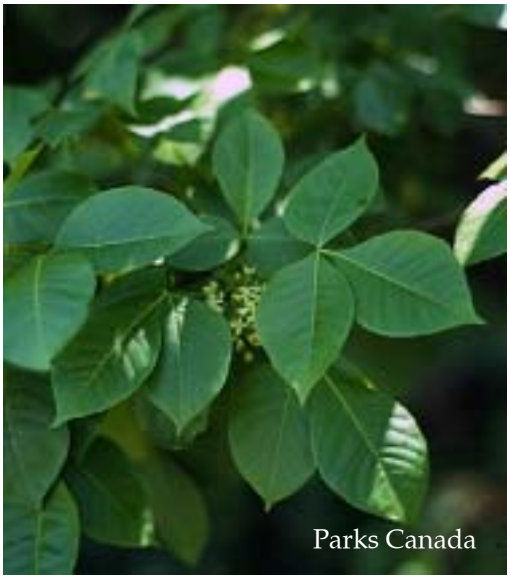
Background

Maintenance and restoration of ecological integrity has been legislated as the first priority for management of national parks in the *Canada National Park Act* (2000). Research and monitoring has concluded that Middle Island, part of Point Pelee National Park, is experiencing significant and potentially irreversible impairment of the island's rare Carolinian ecosystem, including nine species at risk protected by the federal *Species at Risk Act* (SARA) (Table 1) due to the high nesting population of the double-crested cormorant (*Phalocrocorax auritus*) colony.

> **Ecological Integrity** means, with respect to a park, a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes. (*Canada National Parks Act* 2000)

Miami Mist

Monarch



Common Hoptree

Carolina Wren

Table 1. Middle Island species at risk protected under the *Species at Risk Act* and their designations by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Plants	Reptiles	Insects
RED MULBERRY (Endangered) AMERICAN WATER-WILLOW (Threatened) WILD HYACINTH (Threatened) KENTUCKY COFFEE-TREE (Threatened) COMMON HOPTREE (Threatened) BLUE ASH (Special Concern)	LAKE ERIE WATERSNAKE (Endangered) EASTERN FOXSNAKE (Threatened)	MONARCH (Special Concern)

Middle Island is part of a unique group of islands, forming a twenty-one island chain in the western basin of Lake Erie (Fig. 1). These islands are found in the Carolinian ecozone of the St. Lawrence Lowlands, the southern most ecological region of Canada. The Carolinian ecozone represents only 1% of the landmass in Canada but today supports 25% of the Canadian population. Forest cover has been reduced from 80% to 11% in the Carolinian ecozone (Carolinian Canada 2008), and this number is approximately 5% in Essex County where Point Pelee National Park is located (Essex Region Conservation Authority 2007). The vegetation communities on these islands are significant because they are distinct from the mainland (Boerner 1984). As well, they are remnant examples of what much of southern Ontario looked like prior to European settlement. More importantly, they contain populations of rare and threatened flora, some of which do not occur anywhere else in Canada, and are also often rare or threatened in the northeastern United States (Kirk 2007).

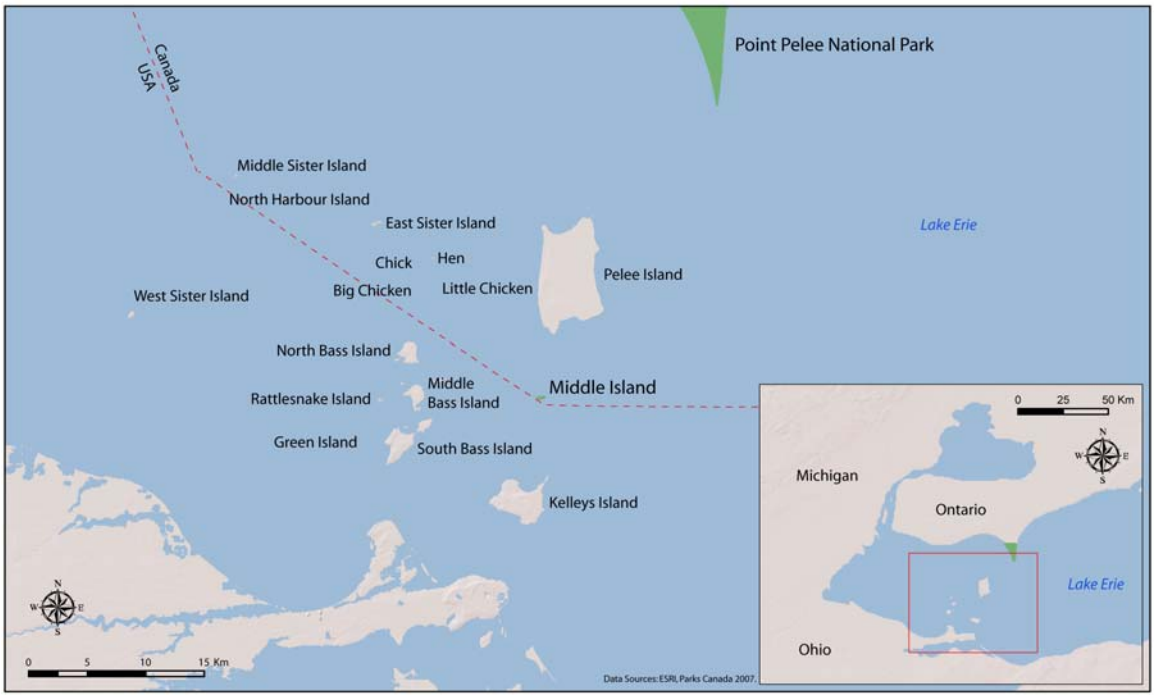


Figure 1. Location of Middle Island in Western Basin of Lake Erie.

The Nature Conservancy of Canada with the support of Parks Canada and other contributors acquired Middle Island at auction in July 1999. This 18.5 ha (48 acre) island is part of an archipelago in the western basin of Lake Erie. Acquisition of Middle Island was sought due to its significant native Carolinian vegetation communities and associated fauna, including rare and endangered species, as well as its high profile as the southernmost property in Canada. Ownership of Middle Island was transferred to Parks Canada and the island became part of Point Pelee National Park in 2000. The transfer was made with the understanding that the island be managed as a *Zone 1–Special Preservation* area. This zoning designates areas as deserving special preservation because they contain or support unique, rare or endangered features or the best examples of features (Parks Canada Guiding Principles and Operational Policies 1994).

The first plant survey of Middle Island was published in 1948 as part of an Ohio State University survey of the botany of the Lake Erie Islands. A complete list of the studies, inventories and surveys of the natural features of the island can be found in *Vegetation Communities and Significant Vascular Plant Species of Middle Island, Lake Erie* by North-South Environmental Inc.(2004). This 2002-2003 study is the eighth comprehensive vegetation survey of the island.

The double-crested cormorant is a relatively large, migratory waterbird and is the most abundant of the six cormorant species nesting in North America (Hatch and Weseloh 1999). Double-crested cormorants nest across the continent in

numbers estimated between one and two million birds (Hatch 1995). Their bodies are greenish-black with a golden throat patch and a cobalt-blue mouth during breeding season. These fish eating birds are colonial nesters, which require sites that are safe from ground predators and close to feeding areas (Wires *et al*. 2001). A summary of the biology of the double-crested cormorant, including range, nesting, diet and survival can be found in the recent *Review of the Status and Management of Double-crested Cormorants in Ontario* published by the Ontario Ministry of Natural Resources (OMNR 2006).

Double-crested Cormorant Nesting

Within the scientific community there is ongoing debate over when double-crested cormorants made their first appearance on the Great Lakes and how large that population was. There is some evidence to suggest that double-crested cormorants were present in more numerous numbers than current populations throughout much of their current North America range. (Fig. 2) However there are exceptions, one being on the Great Lakes (Wires and Cuthbert 2006). Wires and Cuthbert (2006) state the following concerning the North American Interior Zone of the double-crested cormorant population: "*In other areas of this zone (e.g., the Great Lakes), current numbers are much greater than they were in the late 1800s-early 1900s, and are the highest recorded in the history of the region.*"

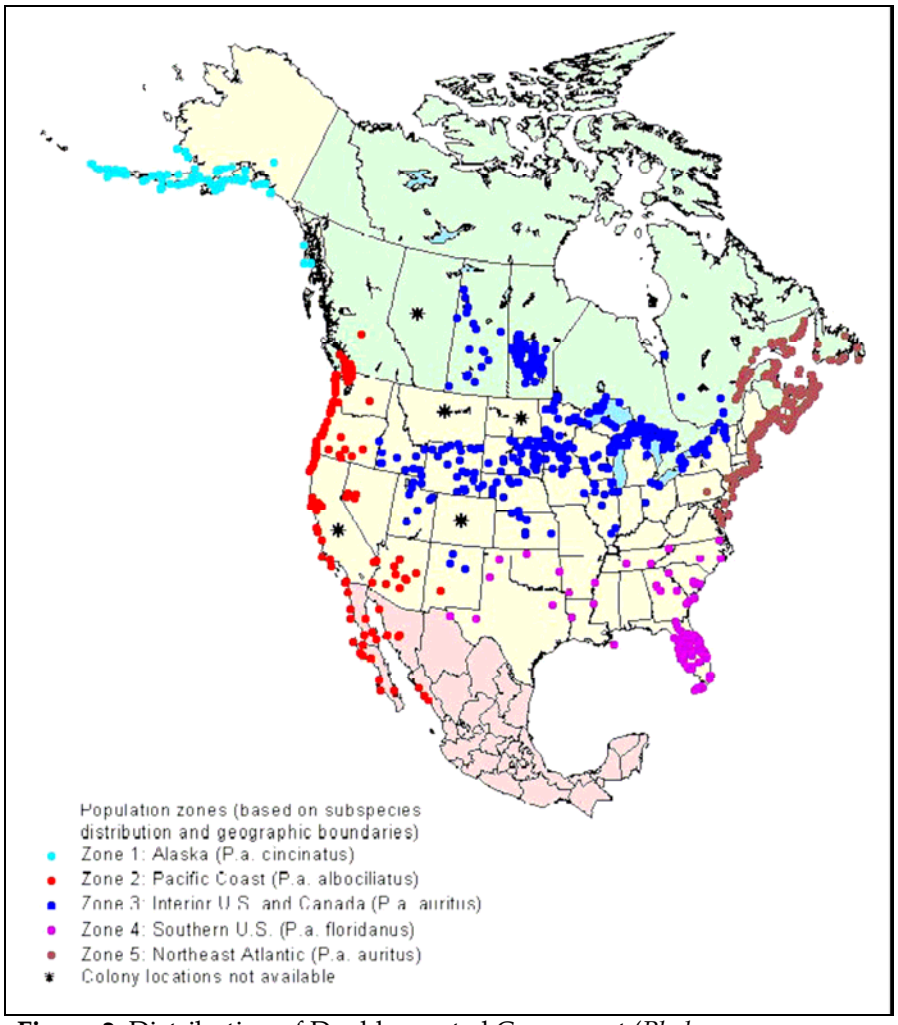


Figure 2. Distribution of Double-crested Cormorant (*Phalacrocorax auritus*) breeding colonies in North America 1970 – 2000 (Wires *et al.* 2001)

Double-crested cormorants were documented breeding in western Lake Superior in 1913 (Baillie 1947) and expanded eastward across the Great Lakes between 1913 and 1945 (Postupalsky 1978, Weseloh *et al*. 1995). In the 1950's the Great Lakes population was approximately 900 pairs (Postupalsky 1978), however by 1972 this number had decreased to 136 breeding pairs (Postupalsky 1978, Weseloh *et al*. 1995). The decline in numbers was largely due to the effects of pesticide (DDT) induced eggshell thinning and high reproductive failure (Ludwig and Tomoff 1966, Postupalsky 1978, Weseloh *et al*. 1983). Protective regulations, enhanced enforcement and public awareness led to a significant reduction (i.e. reduced by 80%) in the levels of toxic chemicals in the Great Lakes from 1971 to 1989 (Weseloh and Ewins 1994, Weseloh and Collier 1995, Weseloh and Pekarik 1999). From 1972 to 1993 double-crested cormorants began to make a comeback and increased by nearly 300 fold to 38,000 nesting pairs across the Great Lakes (Cadman *et al*. 1987, Weseloh and Collier 1995, Weseloh *et al*. 1995).

The dramatic increase in double-crested cormorant population can not exclusively be a result of a decrease in contaminants as the most recent increase has occurred more rapidly than when they made their way across the Great Lakes in the 1930s and 1940s. Four main events are believed to have contributed to the recovery of cormorant populations: 1) banning of the organochlorine pesticides (e.g. DDT); 2) reduced persecution when the species was included in the *Migratory Birds Treaty Act* amendment between the US and Mexico in 1972. In Canada, the double-crested cormorant is not protected under the federal *Migratory Bird Convention Act*, rather, it is protected under provincial wildlife legislation; 3) changes in fish populations in the Great Lakes advantageous to double-crested cormorants (Christie et al. 1987, Glahn and Stickley 1995, Weseloh and Collier 1995, Glahn *et al*. 1996); and 4) increased overwinter survival linked to abundant food resources, (primarily) catfish aquaculture in the southern United States (Aderman and Hill 1995, Hatch and Weseloh 1999,Wires et al. 2001). Of the five main double-crested cormorant populations in North America, the one that has increased most dramatically is the Interior Zone population, part of which is in the Canadian and United States Great Lakes region (Weseloh *et al*. 2006). The total population in the Canadian and U.S. Great Lakes was 113,000 pairs in 2005 (Weseloh *et al*. 2006).

In Lake Erie there were 14 nesting colonies of double-crested cormorants lake-wide in 2006 totalling 16,871 breeding pairs. Six of the nine colonies that occur in the western basin of Lake Erie are active and contain 14,879 breeding pairs, which is about 90% of the Lake Erie population.

Of the twenty-one islands in the Lake Erie western basin archipelago, few are undeveloped and still maintain the characteristic Carolinian ecozone vegetation. The large nesting colonies of double-crested cormorants are now found on these remaining uninhabited forested islands:

- Middle Island (18.5 ha), managed by Parks Canada as part of Point Pelee National Park;
- East Sister Island (15 ha), managed by the Ontario Ministry of Natural resources;
- Middle Sister Island (3.6 ha), a small privately owned island; and
- West Sister Island (31 ha) on the U.S. side of Lake Erie, managed by the U.S. Fish and Wildlife Service.
  (Note: the U.S. Fish and Wildlife Service also manages two smaller islands: Green Island and Turning Point Island, which had double-crested cormorant nesting colonies of 686 and 934 nests respectively in 2007).

Double-crested cormorant nest numbers for these four islands, since 2000, are found in figure 3. The graph shows nest numbers have increased on the more recently colonized islands, West Sister and Middle Sister, which have less

damage to their forest canopy. Middle and East Sister Islands, which were colonized much earlier and now have substantially altered nesting opportunities, are showing small declines or stabilization in nest numbers.

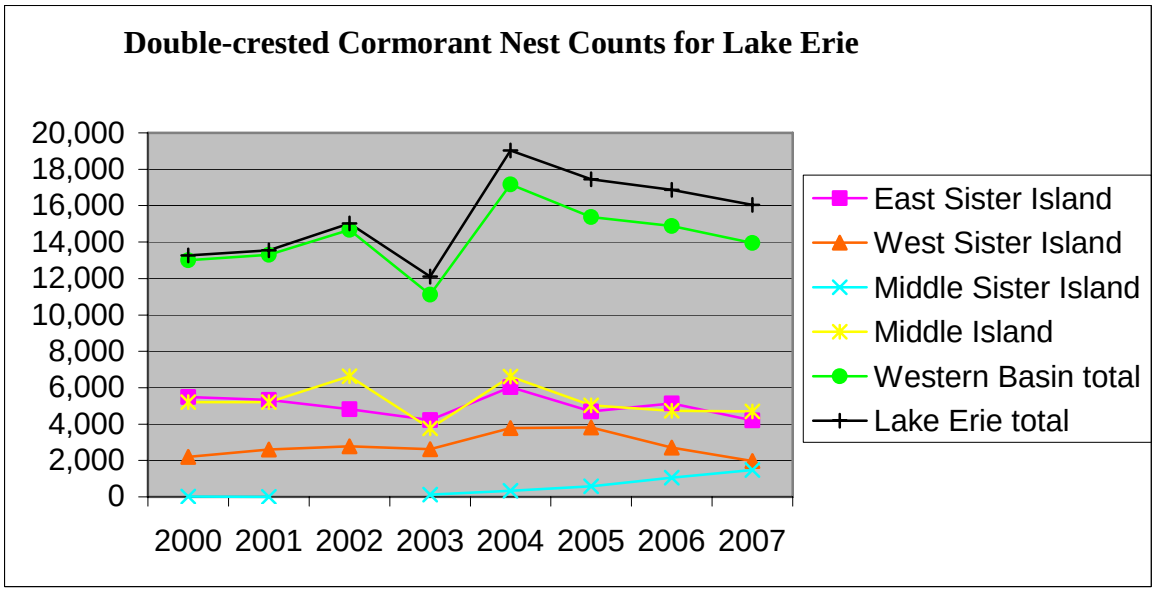


Figure 3. The number of double-crested cormorant nests on Lake Erie and four main nesting colony islands in the western basin of Lake Erie from 2000 to 2007.

Double-crested cormorant nesting was first recorded on Middle Island in 1987 and 1988 with 3 and 25 nests respectively. When the island was acquired by Parks Canada in 2000, it had 5,202 double-crested cormorant nests and the island was under ecological stress. Since then, double-crested cormorant nest count numbers have fluctuated slightly, but have averaged approximately 5,000 nests per year. Figure 4 shows annual nest counts on Middle Island between 1987 and 2007. There is some evidence that double-crested cormorant populations in the lower Great Lakes are not showing the same dramatic increase as in the previous 20 years (D.V.C. Weseloh, Canadian Wildlife Service, personal communication). However, nest numbers remain higher than they were in 2000 and twice what they were in 1995 (Canadian Wildlife Service, unpublished data).

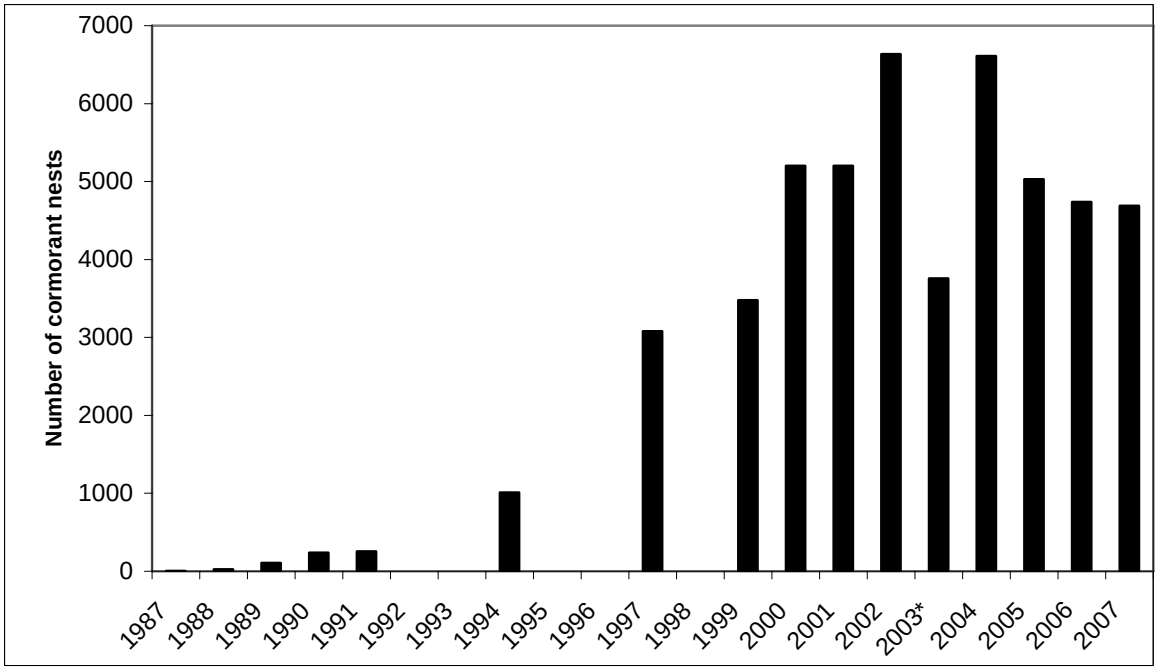


Figure 4. Double-crested cormorant nest count on Middle Island from 1987 to 2007.
Absent data indicate that no nest count was conducted on Middle Island that year. *Nest count in 2003 was incomplete (Source: Canadian Wildlife Service unpublished data and Parks Canada unpublished data).

The Need for Active Management

A tree with double-crested cormorant nests on Middle Island, May 6, 2006.

Research and monitoring provides clear evidence that the current nest density of the double-crested cormorant colony poses a significant and ongoing threat to the ecological integrity of Middle Island, including nine species at risk protected under the federal *Species at Risk Act*. Double-crested cormorants impact trees in their breeding colonies through physical breaking of branches and stripping foliage for nesting material and through the combined weight of birds and nests (Korfanty et al. 1999). Deposition of guano on trees, leaves and soil, can affect photosynthesis and soil chemistry (Hebert *et al*. 2005, Hobara *et al*. 2001). Roosting and loafing activities of double-crested cormorants can also cause impacts to vegetation, especially in the late summer and fall when the numbers of birds can increase dramatically with the arrival of migrants and

the addition of fledglings. To date, monitoring by Parks Canada personnel on Middle Island shows that although there are large numbers of double-crested cormorants loafing on the un-vegetated shorelines, there is no evidence of significant fall roosting or loafing behaviour in the trees.

Middle Island also provides nesting opportunities for colonies of five other colonial waterbird species, including two ground-nesting gull species and three tree-nesting species of heron. In 2007, the nest numbers of double-crested cormorants (4,688) were significantly higher than the great blue herons (304), great egrets (27), and black-crowned night herons (15). Physical impacts to vegetation are seen by other colonial waterbirds, however double-crested cormorant impacts seem to be more extensive and occur with greater intensity (Weseloh and Brown 1971, Dusi 1978, D.V.C. Weseloh, Canadian Wildlife Service, personal communication). Double-crested cormorants can adapt to the available nesting habitat in a colony by moving nests down the canopy and onto the ground as large then small trees are killed (Shieldcastle and Martin 1999, Koh and Carr 2003, Hebert et al. 2005, Koh 2005). Cormorant nesting trees are usually killed 3-10 years after nesting begins (Lemmon *et al*. 1994 and Wires *et al* 2001). This behaviour is typically not seen with other tree-nesting colonial waterbirds who will abandon a nesting area once the prime nesting trees are gone. This behaviour leaves an area to recover after only the large, upper-canopy trees have been damaged. Mid-canopy trees can then regenerate the upper canopy (Koh 2005).

Great Egret

Black-crowned Night Heron

Great Blue Heron

Ring-billed Gull

Herring Gulls

Research and monitoring conclude that the nesting population of double-crested cormorants on Middle Island is hyperabundant. Between 1995 and 2006, a 41% loss of dense (healthy) forest canopy has been recorded on Middle Island through a study to quantitatively assess the relationship between the distribution of double-crested cormorant nests and forest health (Hebert et al. 2005, Hebert 2006 unpublished data, Duffe 2006). (Fig. 5) In this study, two measures of forest cover were obtained using infrared aerial photography and ground-based measurements of leaf area index using Middle Island, Middle Sister Island and East Sister Island for data collection. Through cooperative work with the Canadian Wildlife Service, this study has continued with data collected in 2007 currently under analysis. A majority of the decline occurred between 2001 and 2003, (23%) when the number of nests peaked at 6,635 nests. This decrease

translates to a 6 ha loss in the total area of dense canopy of the original 16.8 ha total over 8 years (between 1995 and 2003) (Duffe 2006).

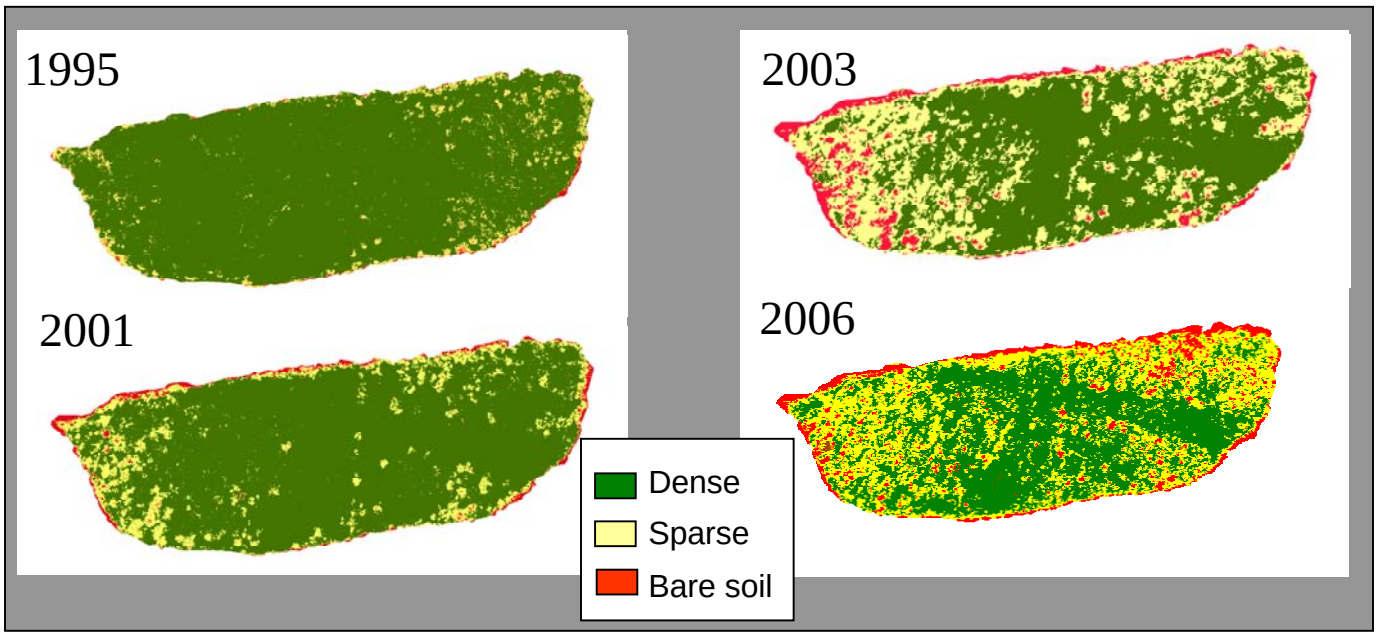


Figure 5. Analysis of infrared aerial photos to determine measures of forest canopy cover (dense or sparse forest canopy cover) on Middle Island (Hebert et al. 2005, Hebert 2006 unpublished data, Duffe 2006).

Further studies and inventories have shown that cascading effects of the nesting activities of the double-crested cormorant have changed the structure, composition and function of Middle Island's native Carolinian ecosystem. Documented impacts include the elimination or reduced diversity of understory vegetation assemblages; changes in the distribution and/or composition of native fauna species; and changes to soil chemistry[1].

Based on the decline in ecological integrity recorded to date and examples from other similar sites in the Great Lakes, the projection is that without an immediate and maintained decrease in nest numbers of the double-crested cormorant colony on Middle Island there would be an almost complete loss of ecological integrity of the rare Carolinian ecosystem on the island in less than a decade. This hypothesis is based on current double-crested cormorant nest numbers and trends on Middle Island, which have been showing a slight decline since a peak of 6,635 nests in 2002. Preliminary ecosystem modelling indicates that nest numbers are significantly greater than the island ecosystem can support. Therefore the slight reduction in the number of nests will not significantly slow

[1] For a thorough review of the history and ecological impacts of double-crested cormorant nesting on Middle Island refer to North-South Environmental 2004, Hebert et al. 2005, Duffe 2006, Kirk 2007, Koh et al. unpublished data.

the rate of ecological impairment. However, the declining trend in nest numbers does provide an increased opportunity for successful active management to affect a reduction in double-crested cormorant nest densities on Middle Island. Reducing an island's nesting population without significantly reducing the regional or larger population is possible because double-crested cormorants show site fidelity, meaning they return to the same site to breed year after year and young cormorants often return to the colony sites where they hatched or to nearby areas to breed (Sullivan *et al*. 2006).

These ecological impacts emphasize the need for an effective management program to manage the number of double-crested cormorant nests on Middle Island. The option of doing nothing is inconsistent with Parks Canada's legislative mandate to maintain and restore ecological integrity in national parks.

Figure 6. Aerial photograph Middle Island July 31, 2007

Goal and Objectives

The goal of the *Middle Island Conservation Plan* is:

- **To protect and to restore the ecological integrity of the Carolinian ecosystem on Middle Island, including the species at risk protected under the *Species at Risk Act*.**

A thorough investigation into the potential threats to significant species and vegetation communities on Middle Island was conducted in 2002-2003 (North-South Environmental 2004). Successional processes and non-native species were cited as possible threats, deserving of further investigation, but the double-crested cormorant nest numbers and associated nesting activities on the island were identified as the most serious threat in the short term. The conclusion of the study was that unless the number of cormorants nesting on Middle Island is reduced, either naturally or through human management, the native vegetation communities on the island would be largely eliminated. It is for this reason that the objectives of this 5-year conservation plan will be focused primarily on actions to address this most immediate threat to the island's ecological integrity. Subsequent iterations of the conservation plan will address the next stages in the maintenance and restoration of the Carolinian ecosystem of Middle Island.

The double-crested cormorant is considered a native species within the Great Lakes, and along with the other five species of colonial nesting waterbirds, is valued as a part of the biodiversity of Middle Island. It is not the goal of the conservation plan to eliminate the double-crested cormorant colony from the island or to manage toward attaining a fixed population or steady state, but rather to reduce nesting impacts so that the ecological integrity of the island is not impaired. Some vegetation damage is expected from any colonial waterbird colony, and will be considered a natural part of the Middle Island ecosystem. Vegetation monitoring and research will be used to ascertain the nest density level beyond which the vegetation communities are no longer able to regenerate and maintain their characteristic biodiversity. This conservation plan is specific to addressing Parks Canada's goal for Middle Island. However, Middle Island is part of a larger ecological landscape and the conservation plan has been developed working in collaboration with key partners and stakeholders so that active management activities are considered in the context of the larger ecosystem.

The objectives of the five year *Middle Island Conservation Plan* are:

1. **To significantly reduce the loss of dense (healthy) forest canopy cover on Middle Island due to the impacts of double-crested cormorant nesting;**
2. **To protect SARA-listed species at risk and areas of the island containing relatively intact examples of each Carolinian vegetation type;**
3. **To investigate the sustainable number of double-crested cormorant nests which can be supported by the island ecosystem; and**
4. **To continue monitoring and research to determine the need and means for restoration of ecological integrity on Middle Island.**

Management Approaches

The following management approaches will be used to achieve the ecological integrity goal and objectives for the *Middle Island Conservation Plan*:

Management Approach I: Reduction of double-crested cormorant nest densities in a management zone (split into two priority zones) comprising 14.6 ha of the island's total 18 ha forested area.

PURPOSE: Ecosystem protection through the significant reduction of the loss of healthy forest canopy cover on Middle Island due to the impacts of double-crested cormorant nesting. This approach will ensure protection of relatively intact examples of each vegetation community type and habitat protection for species at risk (Fig. 7).

RATIONALE: Impacts of double-crested cormorant nesting will be reduced on Middle Island enabling restoration of whole functioning ecosystem and the protection of species at risk. As nest reductions, logistically, can not be effected immediately over the entire island, active management activities will be focussed first in management zone- priority 1 and will then shift to management zone-priority 2 (Fig. 8).

CRITERIA FOR PRIORITY MANAGEMENT ZONE AREA SELECTION: The following criteria were considered when designating the priority management zones for nest reduction efforts:

- Presence of relatively undamaged vegetation communities – priority given to areas, which have sustained the least amount of damage and thus

have the greatest potential for restoration. This was evaluated using all remote and ground vegetation monitoring data currently available.

- Location of SARA-listed species at risk – priority given to areas with known populations or individuals of species at risk. In total, Middle Island harbours nine species at risk protected under the *Species at Risk Act*. A list of the SARA-listed species at risk and their COSEWIC (Committee on the Status of Endangered Wildlife in Canada) status are found in Table 1. A complete list of the species at risk (both federally designated by COSEWIC and provincially designated) documented on Middle Island since botanical surveys began in 1948 is found in the report *North-South Environmental Inc. 2004*. Figure 7 shows the most current locations of the SARA-listed plant species.
- Presence of forest types - priority given to areas such that each Carolinian vegetation community type found on the island receives adequate, timely protection from nesting impacts. The vegetation on Middle Island consists of variations of common hackberry (*Celtis occidentalis*) forests, which is considered provincially rare (S2) in Ontario (Bakowsky 1996). These are mapped in Figure 7 and include Hackberry, Hackberry-Sugar Maple, Hackberry-Blue Ash-Common Hoptree and Hackberry-Kentucky Coffee-tree (North-South Environmental 2004b). There is also an early successional forest that appears as an "X", in recent aerial photography, down the centre of the island. These areas were cleared in the 1970's for use as a taxiway and runway for a small plane.

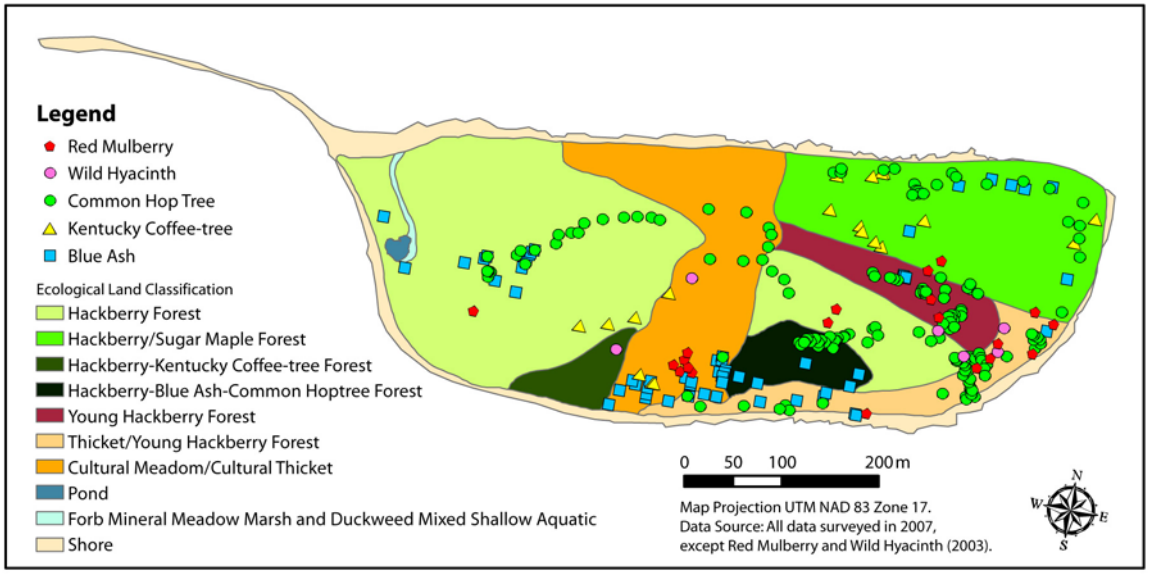


Figure 7. Ecological Land Classification (ELC) showing Carolinian vegetation communities and individual locations of plant species at risk (protected under SARA) for Middle Island.

METHOD: Qualified and experienced Parks Canada personnel will shoot (cull) adult double-crested cormorants associated with nests in trees, using highly accurate small calibre rifles. Flying double-crested cormorants and those with hatched young in nests will not be shot. This method immediately reduces double-crested cormorant nest numbers, allowing for the protection of remaining areas, which have yet to sustain major ecological damage. Field operations and techniques (e.g. use of sound suppressed weapons, using minimal personnel, not removing carcasses of culled birds, no use of motorized vehicles, etc.) will be designed and implemented to minimize impacts on the island's ecosystem (e.g. vegetation, species at risk, other colonial waterbirds). Specific techniques will be followed to minimize disturbance to the nesting colony during active management activities in order to prevent possible dispersal of double-crested cormorants to other island colonies or the establishment of new colonies elsewhere. An analysis of this active management approach and other active management approaches considered is found in Appendix 1.

DESIGN: An adaptive management approach will be used to ensure the number of double-crested cormorants culled results in a reduction in nest numbers to the target range of 30-60 nests/ha in the 14.6 ha management zones, as determined by June nest counts annually. The target range of 30-60 nests/ha has been chosen because preliminary ecosystem modelling has predicted that a nest density of 60 nests/ha may be sustainable for the island's Carolinian vegetation communities in the long term (See Design section of Approach II on page 23). However, these areas have already sustained significant impacts due to double-crested cormorant nesting and a lower nest density is recommended to allow for recovery and restoration and for further testing of the preliminary modelling. The lower end of the range (30 nests/ha) is hypothesized to be lowest nest density attainable using the low-impact methods and active management techniques chosen for this conservation plan. This active management approach is expected to reduce 4,026 nests (the number of double-crested cormorant nests counted in the management zones in 2007) to between 438 and 876 nests by 2012. The number of adult double-crested cormorants which can be taken through culling in any given year of the conservation plan will be limited by factors such as safety (employee and public), priority of animal care and priority of minimizing ecological disturbance. Examples of active management activities using culling at other sites have shown that the removal of adult double-crested cormorants from nesting colonies, especially early in the nesting season, does not yield a direct reduction in nest numbers. This is thought to be due primarily to the fact that although double-crested cormorants show high fidelity to colony sites, there can still be movement between colony sites due to factors such as adjacent colony dynamics, colony age or disturbance (Hatch and Weseloh 1999).

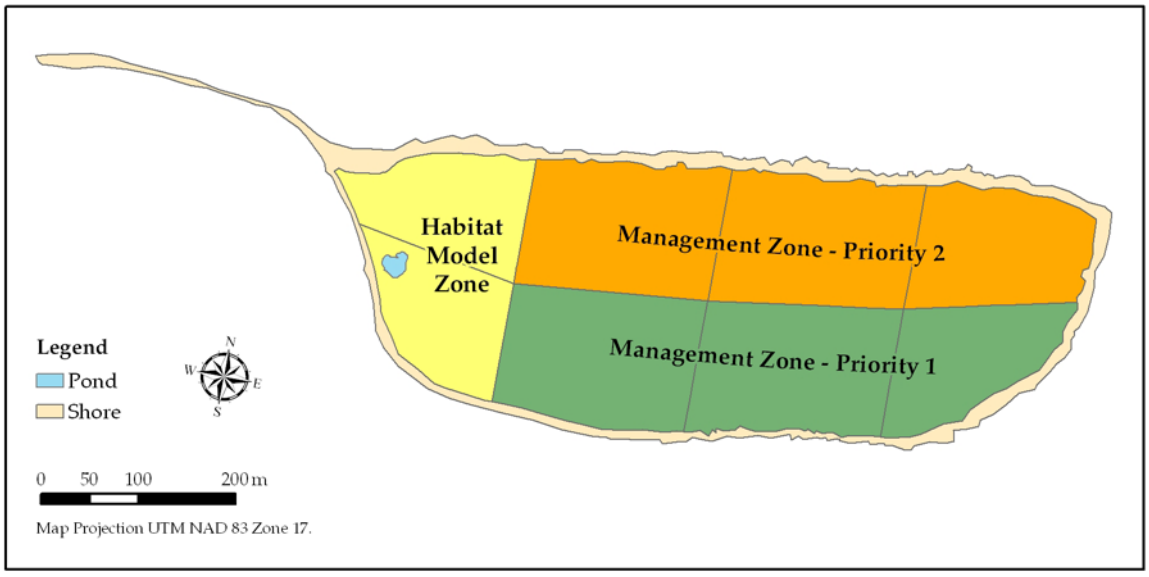


Figure 8. Middle Island showing priority management zones and the designated habitat model zone.

The early timing chosen in this conservation plan for culling activities (prior to chick hatching) must also be considered when predicting the results of this active management approach. This timing has been chosen because culling adult double-crested cormorants early in the nesting season before egg hatching prevents chicks from being abandoned. An early double-crested cormorant nest count conducted on Middle Island over two days in 2007 (April 30 and May 7) found 3,611 nests while the annual nest count held at the height of nesting season on June 20, 2007 yielded 4,688 nests. This indicates that 1,077 new nests were established on the island during this time interval. Based on this specific knowledge and on the results of similar active management activities at other sites, especially those at West Sister Island in 2006-2007, a reduction in nest numbers of approximately 20-30% per year of the conservation plan is predicted. However, there is some evidence that culling activities may become more effective as the colony becomes smaller, therefore an adaptive management approach must be taken and active management activities adjusted as necessary in order to attain the ecological integrity goals and objectives.

Effectiveness of culling will also vary depending on overall double-crested cormorant population numbers in Lake Erie and the Great Lakes. Nest counts of double-crested cormorants will take place on all other Lake Erie colonies in order to monitor the regional population trend. This information will be used to guide and refine the conservation plan implementation and to ensure that population viability for this species in Lake Erie is not put at risk.

MONITORING: The monitoring and research program is outlined in Appendix 2.

Management Approach II: Reduction of double-crested cormorant nest densities in the 3.4 ha habitat model zone

PURPOSE: To allow for the continuing investigation into the sustainable number of double-crested cormorant nests which can be supported by Middle Island's ecosystem. This will ensure the long-term protection and restoration of ecological integrity with double-crested cormorants as part of the island's diversity of nesting colonial waterbird species.

RATIONALE: To facilitate on-going research into the impacts of double-crested cormorant nesting on trees, herbaceous vegetation, and soils. To provide further monitoring information that contributes to the development of a carrying capacity model for the island and to assist in determining the sustainable number of double-crested cormorant nests the island's forests can support while maintaining their characteristic Carolinian ecozone biodiversity.

CRITERIA FOR MODEL ZONE AREA SELECTION: The following criteria were used when choosing the habitat model zone:

- the zone is large enough to provide a reasonable representation of island vegetation communities for testing of the model;
- according to forest damage monitoring conducted from 2004-2007 (Koh and Parks Canada unpublished data), the zone contains a range of sites from heavily damaged to low damage to allow for monitoring of a range of vegetation responses from progressive damage to re-generation; and
- the zone satisfies the first two criteria, yet does not contain significant amounts of the most intact and undamaged areas remaining on the island and does not contain significant numbers of species at risk protected under SARA.

METHOD: Qualified, experienced Parks Canada personnel will cull adult double-crested cormorants associated with nests in trees as described previously in, Management Approach I, in a 3.4 ha area termed the habitat model zone located on the west side of the island (Figure 8).

DESIGN: The habitat model zone contained 662 double-crested cormorant nests as determined by the June 2007 nest count. The targeted nest density will be 60 nests/ha, which will require a reduction to 204 nests in the 3.4 ha habitat model zone. This nest density is the best estimate for a long-term sustainable nest density based on all current scientific information available, including:

- analysis of monitoring data of tree damage indices from 2004-2007 on Middle Island related to double-crested cormorant nest densities (Koh et al. unpublished data);

- review of historical double-crested cormorant nest numbers on Middle Island (Hebert et al. 2005) and West Sister Island (USFWS 2003b) to assess nest densities over time compared to relative forest canopy health; and.
- preliminary work on a carrying capacity model for double-crested cormorant nest numbers in Carolinian forest island communities undertaken by Dr. Saewan Koh and James Hudson at the University of Alberta (unpublished data).

Reductions of double-crested cormorant nests in the habitat model zone will begin in year 1 of the conservation plan and based on predicted effectiveness rates, the goal nest numbers for the habitat model zone will be obtained by 2010.

MONITORING: The monitoring and research program is outlined in Appendix 2.

Management Approach III: Reduction of double-crested cormorant nest densities in very specific areas as necessary to protect SARA-listed species at risk.

PURPOSE: To protect SARA-listed species at risk from double-crested cormorant nest impacts to ensure their survival on Middle Island.

RATIONALE: To protect animal and plant SARA-listed species at risk on Middle Island, a general reduction in the number of double-crested cormorant nests as outlined in Management Approach I will protect the habitat needed for their long-term survival. However, the protection of individual SARA-listed species at risk plants (Table 1) may also be necessary if even a single double-crested cormorant nest threatens the species survival on the island. This approach will therefore be limited to specific situations to protect SARA-listed species at risk plants (trees or small populations of herbaceous plants) in specific areas from the impacts of double-crested cormorant nests.

CRITERIA FOR SITE SELECTION: Areas chosen for nest removal and the use of deterrents will be determined in collaboration with Parks Canada species at risk biologists and using the information for individual locations of plant SARA-listed species at risk. (Fig. 7)

METHOD: The removal of nest material and the use of deterrents will be used to prevent double-crested cormorants from nesting in or around specific areas critical to the survival of SARA-listed species at risk, regardless of location on the island. Nests will be removed with extendable forestry poles early in the nesting season, before hatching of eggs has taken place. Removal of new nests in these specific locations may be required throughout the breeding period, but will

always take place soon after nest establishment and before hatching of eggs has taken place. The use of "scare-crows" or other deterrents will be used as much as possible to impede the construction of new nests in these areas so that nest removal is not required. Priority will be given to the technique, which will cause the least disturbance to other colonial waterbird nesting.

DESIGN: An adaptive management approach will be used to ensure that these active management activities are monitored, evaluated and adjusted in response to their effectiveness.

MONITORING: Baseline data for species at risk locations have been collected in 2002-2003 and SARA-listed tree species at risk were inventoried again in fall 2007. An updated inventory of wild hyacinth is planned for spring/summer 2008. Monitoring for effectiveness of this active management approach will also include nest counts and vegetation monitoring as outlined in the research and monitoring program in Appendix 2.

Management Approach IV: Monitoring and research program to investigate ecological integrity restoration needs, methods and techniques for Middle Island.

PURPOSE: To ensure the long-term protection and conservation of the rare and nationally significant Carolinian ecosystem on Middle Island, including the associated SARA-listed species at risk.

RATIONALE: Areas of Middle Island already impacted by double-crested cormorant nesting may require restoration to recover and support the native, characteristic biodiversity of the Carolinian ecozone. Investigations into many aspects of restoration, including the effects of double-crested cormorant nesting on soils, seed viability, and invasive native and non-native plants are needed to provide information for future conservation planning needs.

METHOD: Cooperative work and partnerships have already been established with academic institutions (e.g. University of Windsor) and organizations (e.g. Canadian Wildlife Service) in order to investigate aspects of restoration such as soil chemistry and baseline forest canopy monitoring. Parks Canada personnel will continue to work with others to fill the remaining gaps in knowledge.

DESIGN: Research and monitoring needs will be developed in consultation with partners and stakeholders.

MONITORING: The monitoring and research program is outlined in Appendix 2.

Active Management Activities in the Western Basin of Lake Erie

The ultimate effectiveness of this conservation plan will be influenced, but not dependent on double-crested cormorant population reductions due to active management activities at the other major nesting colonies in the western basin of Lake Erie. In order to effect a reduction in double-crested cormorant nest numbers on Middle Island, there need not be a supplemental reduction at other nearby colonies or in the Great Lakes population or beyond. Nor is it required that the migratory population, which moves through the area in the fall, be reduced. This has been demonstrated by the management actions undertaken on West Sister Island in Ohio (Fig. 1) over the last two years as outlined below.

West Sister Island, Ottawa Wildlife Refuge Area, Ohio, USA

The rapid population increase of double-crested cormorants and its implications on colonial waterbird nesting habitat was the impetus for the Ohio Division of Wildlife to create a state-wide management plan for double-crested cormorants. The main goal of the management plan is to reduce double-crested cormorant populations to a level at which there is little to no negative impact to endangered plant species or colonial waterbird populations through either vegetation damage or direct competition for nest sites (ODNR 2007). The Environmental Assessment on Reducing Double-Crested Cormorant Damage in Ohio (USDA-APHIS-WS 2006) designated the management objective of 3,000-4,000 breeding birds or 1,500-2,000 double-crested cormorant nests for West Sister Island. The nest count of double-crested cormorants on West Sister Island was 3,813 nests in 2005. Culling of adult double-crested cormorants took place in spring 2006 and 2007. In spring 2006, 4,320 adult double-crested cormorants were culled on three days of shooting between April 11 and May 9. This resulted in a 29% decrease in nest numbers counted in June 2007, whereas there was a predicted increase of 20% in nest numbers based on previous population growth if no cull was undertaken. In spring 2007, a further 27% reduction in nest numbers was effected through the culling of 1,932 adult birds on two days of shooting, bringing nest numbers on the island down to 1,967 nests from 2,707 nests. These results have been affected in the absence of any additional active management activities on the major double-crested cormorant colonies in Lake Erie.

Future management in the western basin of Lake Erie

It is expected that nest reduction active management activities affecting double-crested cormorant nesting populations will take place by the Ohio Division of Wildlife on West Sister Island, Green Island and Turning Point Island in spring 2008. No other active management activities are known at this time.

Communications

As part of the development of the conservation plan, a program of communications/consultations focused within, but not limited to, the Greater Park Ecosystem of Point Pelee National Park was undertaken in 2007 between January and November with First Nations, partners, stakeholders, communities and the public. The purpose of the communications/consultations was to provide information, seek additional information and to gain an understanding of the values, opinions, perspectives and attitudes concerning the Middle Island ecological integrity challenge. The program of communications/consultations was guided by the Parks Canada Management Directive 4.4.11: *Management of Hyperabundant Wildlife Populations in Canada's National Parks (*December 2007). Each communications/consultation session included an information presentation delivered by the park ecologist and superintendent, an opportunity for discussion, questions and comments and participants were provided a comment form on which to provide their feedback in writing. Typically the meetings lasted from 90 minutes to two hours. A summary report, entitled *Middle Island Ecological Integrity Challenge: 2007 Public and Stakeholder Communications/Consultations Report* was prepared and is a companion document to the conservation plan.

Overall, the analysis indicates that participants from the First Nations, partner, stakeholder and public meetings demonstrated support for Parks Canada's mandate to protect ecological integrity and conservation of the biodiversity of Middle Island's Carolinian ecosystem, including the need to undertake active management. However, depending on the specific group and taking into consideration the mix of individuals who attended the public meetings, there was a wide range of divergent understandings, values, opinions and perspectives expressed, creating a polarized and somewhat advocacy-based environment. Further, a considerable volume of correspondence was received from groups and individuals that did not participate in a partner, stakeholder or public meeting. The vast majority of the responses from these groups and individuals focused on expressing values, perspectives and opinions on the ecological integrity challenge and most specifically with the management option, under consideration, of the culling of adult double-crested cormorants from the nesting colony on Middle Island.

When considering the purpose of the communications/consultations, the experience and the analysis of the feedback indicates that:

- Continued communication, with respect to Parks Canada's mandate for ecological integrity, the significance of Middle Island as part of Point Pelee National Park, the threat to the health of the ecosystem of Middle Island,

how Parks Canada will protect and restore the Middle Island ecosystem, is essential as part of the implementation of the conservation plan;
- Communications/consultations did produce a number of considerations with respect to additional information. These considerations are detailed in the summary report. The majority of these were already under consideration by Parks Canada. Those that were not were considered over the course of the development of the conservation plan; and
- The most significant volume of feedback provided Parks Canada with an opportunity to gain an understanding of the values, opinions, perspectives and attitudes concerning the Middle Island ecological integrity challenge. This body of feedback from the First Nations, stakeholders, partners and public meeting sessions, is captured in the summary report. To assist in guiding the details of the conservation plan and, further, to enable the development of additional communications, the feedback was synthesized into five themes. These are wilderness preservation, science of ecology, animal welfare, economic activities and Parks Canada's legislative mandate and policy.

In addition to guiding the development of the conservation plan, the results of the 2007 communications/consultation program will be used to develop a communications plan to accompany and to work in concert with the implementation of the conservation plan.

Implementation and Review of the Conservation Plan

This five-year conservation plan is based on the best available information at this point in time. Specific monitoring and research on Middle Island, as well as the broader scientific community will continue to add to the body of knowledge. As such, this conservation plan will be subject to ongoing review as part of the Point Pelee National Park ecological integrity monitoring program to assess success of management approaches outlined in the conservation plan to meet the ecological integrity goal and objectives for Middle Island. This will allow us to also identify modifications and/or changes as needed for the next iteration of the five year plan.

Implementation details of the conservation plan including methods to be used, operational procedures and guidelines, timetables, etc. will be incorporated into an operations plan prior to the implementation of the conservation plan.

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Appendix 1: Alternatives to Active Management and Alternative Active Management Approaches Considered

Alternatives to Active Management

There is no viable alternative to active management on Middle Island. Research and monitoring have demonstrated the current nest numbers of double-crested cormorants pose a significant and ongoing threat to the ecological integrity of Middle Island. Thus a reduction in nest numbers is deemed necessary as the *Canada National Parks Act* (2000) mandates the maintenance and restoration of ecological integrity as the first priority when considering all aspects of national park management.

Alternative Active Management Approaches Considered

Parks Canada considered six active management approaches to mitigate the adverse effects of the hyperabundant population of double-crested cormorants nesting on Middle Island. These included: nest destruction, displacement, artificial nesting platforms, predator introduction, egg oiling and culling of adult double-crested cormorants. These potential active management options were reviewed primarily on the basis of their ability to meet the ecological integrity goal and objectives for Middle Island. Other considerations included: the behavior of double-crested cormorants and the ecology of the island, availability of appropriate facilities and expertise, social considerations, cost effectiveness and humane treatment of individuals of the hyperabundant population. Public and stakeholder communications/consultation were undertaken in 2007 to share information, seek additional information and to gain an understanding of the different values, interests, concerns, attitudes and perspectives on this ecological integrity challenge facing Parks Canada.

Nest Destruction/Removal of Nest Material: This option has been shown to reduce nest densities in some situations, particularly in ground nesting colonies where nest material is scarce. However in tree nesting situations re-nesting can be rapid (1 to 3 days), usually resulting in additional destruction of vegetation for new nesting material. This method is extremely labour intensive and logistically difficult in tree nesting colonies. This method must also be repeated throughout the nesting season, causing continued disturbance to other nesting birds and vegetation. Disturbed double-crested cormorants could also move to other areas of the island or adjacent islands. Parks Canada's ecological integrity goal for Middle Island cannot be met using this technique alone. The negative impacts caused by island-wide implementation and the inability to reduce nest numbers in the time frame necessary render this method unacceptable for broad application on Middle Island. However, this method could be implemented in small areas at a fine scale to protect individual species at risk.

Displacement: For this option, birds attempting to nest or roost are discouraged from doing so by the use of harassment techniques such as noisemakers, propane exploders, pyrotechnics, distress call and sound producing devices, visual repellents and scaring tactics, lasers, and scarecrows. Disadvantages of harassment as an option for Middle Island are that: 1) this method has no effect on the total nesting population; 2) double-crested cormorants readily become habituated to many scaring devices; 3) the method could redistribute birds to areas where they had not previously nested and impact other landowners; and 4) the method is not species specific and would disturb other colonial nesting waterbirds. Documented effectiveness of this technique has only been proven in displacing roosting birds, not nesting birds.

Artificial Nesting Platforms: There has been little research or practical application to date on the effectiveness of this option. Theoretically, this method would involve providing nesting opportunities at another location, away from the natural resources to be protected. This technique would need to be combined with displacement techniques to move double-crested cormorants to the new nesting location. It is possible that additional structures may actually increase opportunities for the island population to nest. This method could prove practical with small nest numbers if further research advances application of the technique. Given the size of the double-crested cormorant population nesting on Middle Island and the proposed reduction in nest numbers, this option is not considered feasible as a primary means of reducing nest density and protecting sensitive ecosystem elements.

Predator Introduction: Raccoons are the only potentially significant predator of double-crested cormorant eggs found on Middle Island. There is evidence that people have been capturing and releasing raccoons into the double-crested cormorant colony for many years. Dead raccoons have been regularly documented in early spring. It is reasonable to assume the raccoons starve after the migratory colonial waterbirds leave in the fall, and there is no food source over the winter. There is no evidence that raccoon predation has any effect on the number of double-crested cormorant nests on Middle Island. However, raccoon predation of eggs is thought to have a negative effect on herring gull nesting success, as their eggs are found on the ground and are readily accessible. This management option is not seen to be viable for active management to reduce nest numbers due to the inability to control the effects and the disturbance to other colonial waterbirds.

Herring gulls in mixed colonial waterbird colonies have been documented to destroy double-crested cormorant eggs if the colony is disturbed. This behavior has not been observed on Middle Island.

Setting up nesting platforms to attract bald eagles, which predate and deter double-crested cormorants from their territory, has been suggested as a possible active management option. Although bald eagles are known to have nested on

Middle Island, there is a very low probability of a pair establishing a nest given the high double-crested cormorant nest densities currently found on Middle Island and the lack of suitable super-canopy trees. Even if successful, the level of predation/aversion by a bald eagle pair is not likely to have a significant effect on the double-crested cormorant nesting population at its current level. This option will be further investigated for application on Middle Island once a lower nest density has been achieved.

Egg Oiling: Applying inert mineral oil to eggs has been carried out for some ground nesting populations of double-crested cormorants. All of the double-crested cormorant nests on Middle Island are located in trees and as such, egg oiling is not considered feasible, particularly at the current nest numbers. One major advantage of oiling is that the birds would continue to incubate eggs until it is too late in the season to re-lay. However, this technique does not reduce the adult population. With a mean adult lifespan of 6.1 years (birds can live up to 17 years), double-crested cormorant nest densities could not be immediately reduced and reductions would only occur over a long period of repeated application. Given the impaired state of the Middle Island ecosystem, nest reductions are required immediately. Eggs must also be oiled multiple times throughout the breeding season and therefore this option could cause a moderate level of disturbance to ground vegetation and other colonial waterbirds.

Culling by Shooting: Both male and female breeding adults from a nest are shot to prevent re-nesting. Shooting is timed during nest establishment and prior to chick hatching, so that young are not left to starve or be preyed upon. The Canadian Council on Animal Care (CCAC) *Guidelines on: the Care and Use of Wildlife* (2003) considers shooting to be an effective means of humanely destroying animals in the field. The American Veterinary Medical Association (AMVA) *Report of the AVMA Panel on Euthanasia* considers a properly placed gunshot to be a quick and humane method of euthanasia and while other methods might be suitable for domestic animals or captive birds, the AMVA states that in some circumstances, a gunshot may be the only practical method of euthanasia. Culling of adult double-crested cormorants has proven to be an effective method to reduce double-crested cormorant nest densities by agencies striving to achieve similar ecological goals and objectives at other sites. This option reduces the nesting population immediately and can be applied in a variety of ways both temporally and spatially within the ecosystem. Research has shown that with the correct procedures, equipment and training, the effects of double-crested cormorant culling activities on surrounding nesting colonial waterbirds have been shown to be minimal, short-term and localized.

Appendix 2: Research and Monitoring Program

1) Previous Monitoring, Research and Inventories

Middle Island has been the focus of numerous natural history studies and inventories for many years. The first plant survey of Middle Island was published in 1948 as part of an Ohio State University survey of the botany of the Lake Erie Islands. A complete list of these recorded studies is found in the report *Vegetation communities and significant vascular plant species of Middle Island* (North-South Environmental Inc. 2004).

Since becoming part of Point Pelee National Park in 2000, the following monitoring and research activities have been put in place on Middle Island as part of the national park's ecological integrity monitoring program. This monitoring and research was implemented to establish changes in forest health to assess the state of the island ecosystem and was reported on in the *Point Pelee National Park: 2006 State of the Park Report* (Parks Canada 2007). These activities have been put in place prior to active management and will therefore serve as baseline studies for evaluation of the conservation plan.

a) Vegetation community types and species at risk monitoring

The North-South Environmental (2004) report was completed after field studies from 2000-2003 to document the Middle Island vegetation communities. The report also includes information collected about birds, herptiles, mammals, butterflies, and dragonflies and locations of vascular plant species at risk (both SARA-listed and provincially designated species). Additionally, the study documented double-crested cormorant nesting activity and its impact on the vegetation mosaic and significant species as well as assessing other threats, both general and specific.

In fall 2007, a follow-up survey was conducted for all of the SARA- listed plant species on Middle Island except for the spring blooming wild hyacinth. A study for wild hyacinth is planned for spring 2008.

b) Nest numbers of tree-nesting colonial waterbirds

Data regarding the number of breeding double-crested cormorants and other colonial waterbirds on islands in the western basin of Lake Erie have been collected since the 1970s through the efforts of the Canadian Wildlife Service. Since 2000, Parks Canada and the Canadian Wildlife Service have annually surveyed nest numbers of tree nesting colonial waterbirds on Middle Island cooperatively in late June. Signs of possible outbreaks of avian disease are monitored and if suspected, samples are sent for analysis to the Ontario Region Canadian Cooperative Wildlife Health Centre.

c) Aerial assessment of forest cover

In 2001, the Canadian Wildlife Service began a study on Middle Island, East Sister Island and Middle Sister Island where ground-based measurements of forest cover were compared to estimates inferred from aerial photographs. This technique was used to map and quantify forest canopy cover and provide an objective estimate of forest loss and subsequent habitat change associated with double-crested cormorant nesting on the islands (Hebert et al. 2005, Duffe 2006). A previous aerial photograph of Middle Island from 1995 was analysed using this technique and subsequent aerial photographs have been taken in 2003, 2005, 2006, and 2007. This data establishes a current baseline of the state of forest canopy health for Middle Island.

d) Ground assessment of forest health

Parks Canada personnel, working with Dr. Saewan Koh at the University of Alberta, established monitoring on Middle Island in 2004 to assess the impacts of double-crested cormorant nests on forest health at the individual tree level. Physical attributes or damage indices were assessed to measure the response of individual trees and poles (saplings) to varying nest densities of double-crested cormorants. Crown density, branch damage class, foliage transparency and decay class were measured annually at 52 sampling stations along 12 transects in June between 2004-2007. Herbaceous plant species and ground cover were also assessed in 1m x 1m plots at all 52 sampling stations in 2004 and 2007. Nest counts of all colonial waterbirds within a 10m radius circle from the centre of each plot began in 2006 and continued in 2007. This monitoring measures the health of trees on the island and any changes in the understory vegetation communities in relation to double-crested cormorant nest densities.

e) Soil sampling and analysis

In 2007 soil monitoring was established on Middle Island, in conjunction with reference sites on other Lake Erie Islands, to help establish how the guano from double-crested cormorants is changing the characteristics of the soils of Middle Island. This will help answer questions related to re-growth and regeneration, and is important for the further development of a carrying capacity model. Soil samples were taken in July and August 2007 with the assistance of the University of Windsor Great Lakes Institute from a range of double-crested cormorant nest density sites and are currently undergoing analysis.

2) Monitoring and Research during Conservation Plan implementation

The following research and monitoring program will be in place throughout the life of this conservation plan to assess whether the ecological integrity goal and objectives are being met.

a) Ecological integrity monitoring

Ecological integrity monitoring activities have been put in place prior to active management and will therefore serve as baseline studies for evaluation. These on-going monitoring projects will provide a measure of the effects of active management to attain the ecological integrity goal and objectives over the life of the conservation plan:

i. aerial assessment of forest canopy cover;
ii. ground assessment of forest health (tree damage indices and herbaceous vegetation) and forest regeneration;
iii. inventories of SARA-listed plant species at risk populations at a minimum twice during the course of the conservation plan;
iv. nest numbers of all colonial waterbirds and nest counts according to management zones for all tree-nesting colonial waterbirds; and
v. monitor for avian disease outbreaks in the Middle Island colonial waterbird colony in cooperation with other agencies.

b) Evaluation of active management approaches and techniques

i. annual monitoring of changes in nest densities of double-crested cormorants after active management activities in all delineated management zones and the habitat model zone;
ii. monitor disturbance during management approaches to other nesting colonial waterbirds;
iii. record the number of birds killed by culling;
iv. record wounding rate of culling activities;
v. record the location and extent of all active management activities taken under approach III (nest removal and deterrents) to protect SARA-listed species at risk;
vi. assess mercury levels of carcasses (using approx. 30 carcasses from year one of culling); and
vii. work with other agencies to monitor double-crested cormorant nest counts at other Lake Erie nesting colonies to monitor possible dispersal of double-crested cormorants to other colonies or establishment of new colonies.

3) Research and monitoring for long-term maintenance and restoration of ecological integrity of Middle Island

i. impacts of double-crested cormorant nesting on soil (short and long term) and implications for vegetation recovery (eg. seed germination and plant growth);

ii. detailed tree count and forest structure measurements (tree size and canopy placement) in the habitat model area on Middle Island to help determine model parameters. i.e. assess accurate number of suitable nesting trees;
iii. continue research into aspects of the preliminary carrying capacity model for double-crested cormorant nests and vegetation communities through sharing of data with other sites. Factors to be investigated include: rates of soil recovery from guano effects, relationship between nest densities and deterioration of trees, and spatial variability of rates of nesting and tree damage;
iv. investigate possibility of establishing control site for vegetation monitoring at a suitable location; and
v. fall roosting and loafing surveys of double-crested cormorants on Middle Island.

4) Companion science

Environment Canada will receive 200 whole double-crested cormorant carcasses for a number of scientific studies. All of these projects require tissues that can only be obtained through lethal sampling. These studies will involve:

- examination of gastrointestinal tract parasites for studies related to host contaminant dynamics;
- gut content analysis and stable isotope analysis of liver and muscle tissue. The influence of diet on contaminant levels and parasite burdens will be assessed;
- examination of flight feathers to improve understanding of moult;
- primary feathers will be used to examine changes in over-winter habitat use through time; and
- known-age, i.e. banded double-crested cormorants will be used in a project that is attempting to develop a molecular method for aging birds.

Appendix 3: Relevant Legislation and Policy

The development and implementation of the *Middle Island Conservation Plan* is governed by legislation, policies, plans and strategies as found in the following:

Canada National Parks Act (2000)
Section 8(2) Maintenance or restoration of ecological integrity, through the protection of natural resources and natural processes, shall be the first priority of the Minister when considering all aspects of the management of parks.
Section 16(1) The Governor in Council may make regulations respecting (c) the protection of fauna, the taking of specimens of fauna for scientific or propagation purposes, and the destruction or removal of dangerous or superabundant fauna.
National Parks Wildlife Regulations (2003)
Section 15(1) A superintendent may authorize (a) the removal, relocation or destruction of wildlife for scientific purposes or park management purposes.

Species at Risk Act (2002. C29)
The *Species at Risk Act* provides a framework for actions to ensure the survival of wildlife species and the protection of our natural heritage. It sets out how to decide which species are a priority for action and what to do to protect a species. It identifies ways governments, organizations and individuals can work together, and it establishes penalties for a failure to obey the law.
Under the *Species at Risk Act*, Parks Canada is responsible for the protection and recovery of listed species found in national parks, national marine conservation areas, national historic sites and other protected heritage areas administered by Parks Canada. Like the *Canada National Parks Act* and the *Canada National Marine Conservation* Areas Act, this legislation directs Parks Canada to:

- lead and participate in recovery teams;
- develop and support recovery strategies and priority actions;
- educate Canadians on species at risk;
- collect detailed information on species' distribution and population status; and
- assess how activities might affect species at risk within Parks Canada's protected heritage areas and monitoring these activities for their effects.

Parks Canada Guiding Principles and Operational Policies
Section 3.2.3
National park ecosystems will be managed with minimal interference to natural processes. However, active management may be allowed when the structure or function of an ecosystem has been seriously altered and manipulation is the only possible alternative available to restore ecological integrity.

Section 3.2.5

Where manipulation is necessary it will be based on scientific research, use techniques that duplicate natural processes as closely as possible, and be carefully monitored.

Parks Canada Agency Management Directive 4.4.11: Management of Hyperabundant Wildlife Populations in Canada's National Parks, December 2007 (replacing 4.4.11: Disposal of Surplus Wildlife dated September1999)

A recommendation to actively manage a hyperabundant wildlife population must be based on at least one of the following conditions:

4.1 The size of the hyperabundant wildlife population must have exceeded the upper range of natural variability that is characteristic of the ecosystem, and there must be demonstrated impact on ecological integrity. In the case of a naturalized species, a population may be regarded as hyperabundant if there is demonstrable evidence that its size is directly responsible for loss of ecological integrity in a park.

4.2 Hyperabundance is as a result of alteration of the natural population regulation mechanisms.

4.3 The survival or condition of one or more native species in the park, in particular, rare or endangered species, is threatened or likely to be threatened by the size of the hyperabundant wildlife population unless mitigation is undertaken.

4.4 There is clear evidence that the ecosystem is experiencing impacts outside the historical or modeled range of variation as a result of the presence of the hyperabundant population.

Parks Canada Management Bulletin 2.2.8 Management Bulletin on Animal Care Task Forces (2005)

Section 6.1 Whenever an environmental assessment (EA) is required for a wildlife research project, the Animal Care Task Force (ACTF) will operate in close conjunction with the EA process while recognizing that the focus of the EA process is the overall impact of the project on the species/or area from a ecological/biological perspective and that the animal care process addresses procedures during research or management that cause distress to wildlife and addresses the ethical and humane treatment of wildlife in these instances. Parks Canada ACTF approval or approval from another ACTF affiliated with a University or provincial or federal agency will be mandatory for protocols involving any handling and/or manipulation of wildlife.

Point Pelee National Park Management Plan (1995)
Section 2.2 Objectives: Protection and Management of Heritage Resources

Natural Heritage Resources

a) To provide the nationally and internationally significant natural resources and processes of Point Pelee National Park, in particular those physical and biotic resources and processes representative of the southern portion of the St. Lawrence Lowlands, with the highest degree of protection in order to maintain their natural qualities and prevent further human impact. In accordance with the National Parks Act and Parks Canada policy, the maintenance of the ecological integrity of the Carolinian forest and southern Great Lakes marsh ecosystems represented in the park, will be the prime considerations in the planning, operation and management of Point Pelee.
b) To provide the greatest possible protection to those features, processes, habitats or populations of species, which are unique, sensitive, rare or endangered in a park, regional, national or international context.
c) To emphasize the protection of habitats which are of limited distribution and extent, and without which adequate populations of many species could not survive.
d) To base the management of the natural resources of Point Pelee National Park on sound scientific knowledge, coordinating research and resource management with other agencies and landowners in the region.

Section 5 The Protection and Management of Park Heritage Resources

5.7 Wildlife Management

i) Wildlife in the park will be managed so that: management strategies are provided for species requiring active management.

Point Pelee National Park: 2006 State of the Park Report (2007)
Section 6, State of Ecosystems
Indicator: Forest Ecosystem; Measure: Hyper-abundant Double-crested Cormorants
The double-crested cormorant measure is assessed to be in poor condition and declining due to the current high number of nesting double-crested cormorants on Middle Island and the corresponding impacts on vegetation communities and island fauna.

Appendix 4: Planned budget for 5-year Middle Island Conservation Plan

The following table outlines the planned budget for the 5-year Middle Island Conservation Plan in dollars:

	2008/09	**2009/10**	**2010/11**	**2011/12**	**2012/13**
Salary	$40,000	$30,000	$30,000	$20,000	$20,000
Travel, transportation and equipment	$25,000	$30,000	$25,000	$25,000	$15,000
Monitoring and Research	$10,000	$15,000	$15,000	$15,000	$15,000
Communication	$20,000	$10,000	$5,000	$5,000	$10,000
Total	**$95,000**	**$85,000**	**$75,000**	**$65,000**	**$60,000**