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Presqu'ile

Annual Report on the Management of Double-crested Cormorants for 2007

Ontario

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Cover photo: Cormorants at High Bluff Island, Presq'uile Provincial Park
Photo taken by: Ontario Parks staff

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Executive Summary

Between April 24 and October 11, 2007, Presqu'ile Provincial Park implemented the fifth year of a management program to reduce the effects of Double-crested Cormorants *(Phalacrocorax auritus)* on woody vegetation. The goal of this program is *to protect representative woodland flora and fauna of High Bluff Island while retaining maximum diversity of nesting colonial bird species*.

From 2003 until 2007 management was carried out annually on ground-nesting and tree-nesting cormorants on both Gull and High Bluff Islands. This activity was in accordance with the amended Management Strategy for Double-crested Cormorants (Ontario Parks 2004 a). In 2003, management activities occurred only in the western woodland of High Bluff Island and the ground colonies on Gull and High Bluff Islands. From 2004 until 2007 all wooded areas on High Bluff Island were managed. In 2007 the Management Strategy for Double-crested Cormorants was extended for a single year with all management activities occurring with the exception of culling.

The following methods were employed to meet the objectives of the management strategy:

1) oiling eggs in ground nests (2003, 2004, 2005, 2006, 2007)
2) culling of adult cormorants from tree nests (2004, 2005, 2006)
3) composting of cormorant carcasses (2004, 2005, 2006, 2007)
4) nest removal from trees (2003, 2004, 2005, 2006, 2007)
5) disturbance of post-breeding season roosts (2004, 2005, 2006, 2007)
6) artificial ground colony habitat creation (2004, 2005)
7) habitat restoration (tree planting) (2004, 2005, 2006)
8) removal of dead roost trees (2005, 2006, 2007)
9) monitoring of wading-bird species (herons and egrets)(2003, 2004, 2005, 2006, 2007)

In 2007 a total of 3,006 nests was removed from trees using forestry poles. Mineral oil was applied to a cumulative total of 8,555 eggs (from a maximum total of 1562 ground nests). The 60 ground nests found on Gull Island in 2007 were not oiled due to the fact they were subjected to on-going predation by coyotes.

The carcasses of cormorants culled in 2006 continued composting throughout 2007. The site location, design and operations of this facility were determined by the Ontario Ministry of the Environment in accordance with a provisional Certificate of Approval to operate a waste disposal facility.

Cormorant roost disturbance was conducted during August and September, 2007. In some areas, dead trees used by roosting cormorants were cut down to provide protection to sub-canopy vegetation suffering from the effects of cormorant guano falling from above.

Wading-bird species (herons and egrets) living in proximity to the managed areas produced successful broods in 2007. Two species, black-crowned night-heron (*Nycticorax nycticorax)* and great blue heron *(Ardea herodias)* declined while the third, great egret (*Ardea alba*) reached the highest levels on record. The declines seen are likely attributed to the loss of woody vegetation formerly used by these species due to the effects of cormorants. The increase in great egret numbers is consistent with the pattern seen throughout the years cormorant management has occurred at Presqu'ile.

According to the late-June census period, the number of cormorant nests had declined 68.1% from 2002 (the last year in which management did not occur). However cormorant nest numbers increased 36.7% from 2006 levels. Most of this increase was in the ground nesting component of the population.

In 2002, the Presqu'ile cormorant colony represented 42.8% of the Lake Ontario population. In 2007, the Presqu'ile cormorant colony represented 16.6% of the Lake Ontario population.

2007 Nest Count (Count period in late-June)

Tree Nests	= 2,233	(1,432 in East Woodland, 801 in West Woodland)
Ground Nests	= 1,622	(1,562 on High Bluff Island, 60 on Gull Island)
Total Nests	= 3,855	

Background Information

Double-crested cormorants (*Phalacrocorax auritus;* hereafter referred to as cormorants) first colonized the Great Lakes in the early 1900s. The first known nesting colony was found in western Lake Superior in 1913. By 1945, cormorants had established colonies as far east as the St. Lawrence River in the Great Lakes Basin (Weseloh et al., 1995). Recently, cormorant populations have increased in Ontario from a low of about 120 nesting pairs in the early 1970s to 115,000 nesting pairs in 2001 (Ontario Parks, 2000 a). In 2002, the last year in which no management occurred at Presqu'ile, the Presqu'ile colony constituted approximately 43% of the Lake Ontario population. 12,082 of Lake Ontario's 28,180 nests were located at Presqu'ile in 2002. In 2007, after five years of management, the Presqu'ile colony constitutes 16.6% of the Lake Ontario population. In 2007, 3,855 of Lake Ontario's 23,179 cormorant nests were at Presqu'ile.

Cormorants first began nesting at Presqu'ile in 1982 with a single tree nest on Gull Island. Since then, cormorant nesting has spread to the adjacent High Bluff Island and numbers have risen steadily to a peak of 12,082 nests in 2002. As a result of the nesting activity of these birds, all trees on Gull Island have died, most super-canopy trees on High Bluff Island have died and the remaining mid and lower vegetation on both islands are threatened (Koh and Carr 2003).

To prevent further negative impacts on the existing island ecosystem, Ontario Parks implemented the 'Management Strategy for Double-crested Cormorants' (Ontario Parks 2002). The 2003 breeding season was the first year of the program and the results of that year's work are summarized in the annual report (Ontario Parks 2004 b; http://www.ontarioparks.com/english/pres_planning.html). In 2004, the Presqu'ile Cormorant Management Strategy was amended to allow nest removal in all remaining woody vegetation on both Gull and High Bluff Islands and to allow for the culling of adult tree-nesting cormorants.

The goal of cormorant management operations at Presqu'ile Provincial Park is:

- *to protect representative woodland flora and fauna of High Bluff Island, Presqu'ile Provincial Park, while retaining maximum diversity of nesting colonial bird species.*

There are four objectives associated with the goal:

- *to limit cormorant use of trees for nesting on High Bluff Island,*
- *to reduce cormorant use of trees for roosting on High Bluff Island,*
- *to reduce recruitment from ground nesting cormorants on Gull and High Bluff Islands, and*
- *to minimize impacts of cormorant management on other colonial bird species nesting on Gull and High Bluff Islands.*

This report summarizes the results of cormorant management activities at Presqu'ile Provincial Park in 2007.

Methods

Site description

Management activities were conducted on High Bluff Island and Gull Island at Presqu'ile Provincial Park (Figure 1). High Bluff Island is a low, essentially flat limestone outcrop that has a thin mantle of lacustrine sands and clays at its interior, shingle beach at its periphery, and remnant shingle beach at its interior. Gull Island is an exposed shingle and gravel bar expanding towards the peninsula.

High Bluff Island supports of two major woodlands; a 8.75 ha western woodland and a 2.88 ha eastern woodland. In the recent years, both woodlands have suffered serious degradation as a result of the cormorant population. In 2003, the focus of the management program was in the western woodland due to its significant species association. In this area, most super-canopy trees have died and many have fallen over but the mid-canopy and lower vegetation remains relatively intact. In 2004, 2005, 2006 and 2007 management activities were expanded to include the eastern woodland and other areas of woody vegetation.

Mature sugar maple (*Acer saccharum*), red oak (*Quercus rubra)* and black maple (*A. saccharum ssp. nigrum*) made up the dominant tree cover in the western woodland. The eastern woodland is dominated by white ash (*Fraxinus americana*), white cedar (*Thuja occidentalis*), crack willow (*Salix fragilis*) and white birch (*Betula papyrifera*). Trees are found scattered throughout much of the island's interior, as well in successional fields and thickets of choke cherry *(Prunus virginiana)* and Canada plum *(Prunus nigra)*. Provincially significant species on the islands include bushy cinquefoil *(Potentilla paradoxa*) and Smith's club-rush (*Schoenoplectus smithii*) and the regionally rare black maple. The woodland on the island was considered significant due to the age of the trees, the uncommon species association, and the rarity of mature forest on Lake Ontario islands (Blaney 1997).

At present, cormorants nest on the ground on Gull Island (they formerly nested here in trees which have since died and fallen). In recent years they have also nested in the remaining bush on Sebastopol Pt, Gull Island but these nests have been removed since 2004. On High Bluff Island cormorants nest in woody vegetation and on the ground.

Figure 1. Aerial photo of High Bluff Island in the foreground, Gull Island in the background (1997 photo).

Cormorant Management

Cormorant management activities that occurred from April 24, 2007 to October 11, 2007 included egg oiling, nest removal and disturbance of roosting birds. Egg oiling smothers the embryos within the eggs thereby reducing recruitment of young into the population. Adults continue to incubate the eggs and do not re-nest. Nest removal discourages nesting and reduces damage to vegetation from the guano of incubating adults and young. Disturbance of roosting birds in the post-breeding season reduces damage to vegetation from guano deposited while roosting.

Egg oiling. Eggs of ground-nesting cormorants were treated with white mineral oil (Daedol 50 Waterbird Control Oil), approved by Health Canada. Backpack-style agricultural sprayers were used to deliver the oil (Figure 2). Each sprayer carried 12 L of oil. Hearing protection was worn by all staff to reduce noise associated with the bird colony. All nests were identified and marked prior to oil spray application. One person followed the oil sprayer to document the number of treated eggs, number of treated nests and number of unoccupied nests (nests without eggs).

Predation of cormorant eggs by gull species causes cormorants to re-lay new eggs in the same nests. Due to these new clutches of eggs and late nesting cormorants, it was necessary to oil nests repeatedly. Ground nests containing eggs were treated on four separate sessions between May 18 and July 20, 2007. In order to minimize disturbance to ground-nesting cormorants and other colonial waterbird species visits to the ground colonies were kept to an absolute minimum.

Due to on-going predation of cormorant nests on Gull Island by coyotes, the ground-colony at this location failed to produce viable nests in 2007. As a result Gull Island cormorant nests were not oiled in 2007.

Figure 2. Oiling of ground-nests.

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Composting. The carcasses of cormorants culled in 2006 were given a second season of decomposition in 2007. The site location, design and operations of this facility were determined by the Ontario Ministry of the Environment in accordance with a provisional Certificate of Approval to operate a waste disposal facility (Figure 3). In 2007 composting activities included the turning of the compost pile and ongoing temperature monitoring of the compost.

In July, due to unseasonably hot weather, it was necessary to "open up" the pile in order to prevent it from over-heating. This was achieved using an all-terrain vehicle fitted with a snow-plow. Hand tools such as shovels and pitch forks were also used to manipulate smaller quantities of compost material. Once the compost material had cooled the pile was reassembled to maintain optimal composting temperatures.

Compost temperatures were monitored using thermal probes attached to two separate thermometers. These probes were driven into the pile to a depth of approximately one meter. Temperature readings were recorded on a daily basis.

Figure 3. 2006 Composting facility on High Bluff Island. A thermometer used to monitor compost temperatures is located in the mid, right-hand side of the compost material.

Nest removal. In 2007, 3,006 nests were removed from trees in all wooded areas of the Presqu'ile Islands using forestry poles. Forestry poles (square cross-sectioned fiberglass poles in 8-foot (2.46 m) sections) were used to knock nests down from trees (Figure 4a). As in previous years, high-level nests (Figure 4b) that required 8 or more sections of poles (22.5 m or higher from the ground) required significant amounts of time and effort to remove (up to 20 minutes for a single nest). Many nests were beyond the reach of forestry poles. For detailed information on nest removal techniques refer to the 2003 annual report (Ontario Parks 2004 b; http://www.ontarioparks.com/english/planning_pdf/pres_annual_report.pdf).

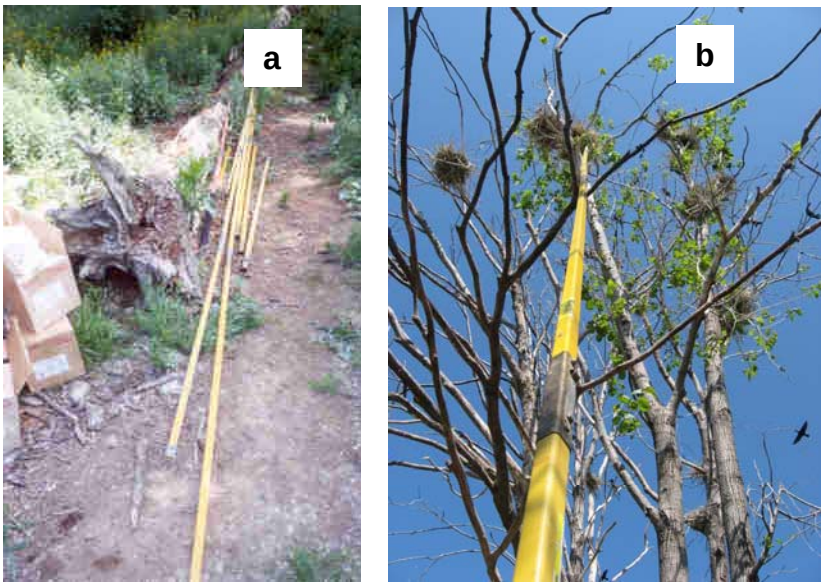


Figure 4a. Forestry pruning poles, in sections, used for knocking down nests
4b. Poles in use for nest removal on High Bluff Island.

Roost Disturbance. During August and September 2007 staff actively discouraged cormorants from roosting in areas containing living vegetation on High Bluff Island. Roost disturbance was initiated after the heron and egret nesting period. This was achieved through the presence of humans within these areas, and by discharging noise-making devices such as whistles, air-horns and blank shot-gun shells. Staff located at the island's lighthouse and stationed on the island's north shore observed cormorants to determine the reaction of roosting birds after disturbance activities. Roost disturbance typically occurred every third day.

Prior to roost disturbance activities cormorants arriving to roost on the island were tallied (Appendix 1). This was achieved by placing observers on the western and eastern tips of High Bluff Island. Looking in opposite directions the observers assessed numbers of birds as they arrived to roost. Only flocks flying from the horizon flying from open water towards the island were counted. Birds flying about in close vicinity to the island were excluded from totals.

Vegetation Management

In 2007 sites planted with trees in previous years were given the following treatments:

1) The thick grass and herb layer growing around the planted trees was mowed to prevent rodent damage (Figure 5a.)
2) Maintenance of fencing to prevent deer browsing and buck-rubbing (Figure 5a.)
3) Small seedlings were watered during drought periods. (Figure 5b.)

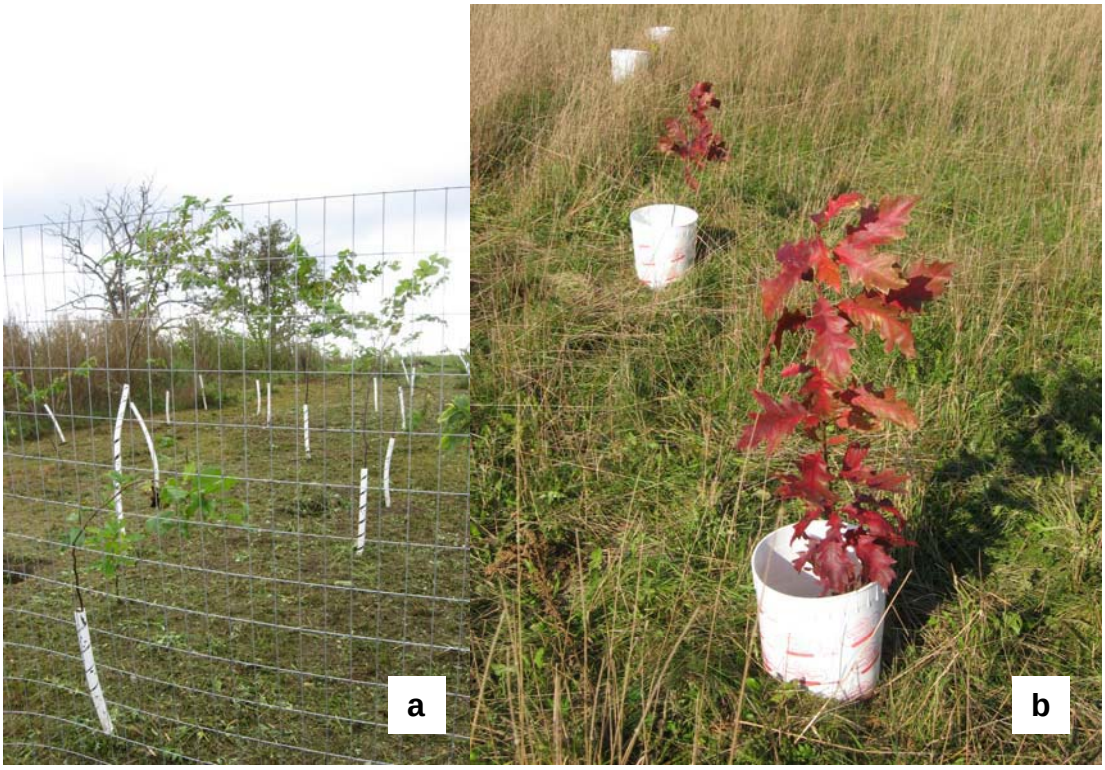


Figure 5a) Fencing to discourage browsing and "buck-rubbing" by deer. Rodent guards and cut ground level herbaceous layer discourages tree-girdling by rodents.

5b) A planted tree "collared" by a 11.4 liter pail with the bottom removed. Rodent protection and deep-root watering is provided by the pail

Roost Tree Cutting. In 2007 a limited number of dead roost trees were removed in areas where living vegetation was being affected by the guano produced by the roosting cormorants. The trees were cut with chain saws at waist level and the trunks were left where they fell.

Wading-bird (herons and egrets) Species Monitoring

The nesting status of the park's great egret (GREG), great blue heron *(*GBHE) and black-crowned night-heron (*Nycticorax nycticorax,* BCNH) populations were closely monitored prior to and during the management period of 2007 (as in 2003, 2004, 2005 and 2006) (Figure 6).

Figure 6. Monitoring of wading-bird species (herons and egrets) occurred before, during and after management activities.

Monitoring of the three heron species began on April 24, 2007 and concluded on August 03, 2007. Monitoring typically occurred from observation stations located in areas where nests could be seen but not disturbed by the observer (Figure 7). Species specific monitoring methods are listed below:

Great Egret. All GREG nests were observed, using binoculars and spotting scopes, between three and five days per week from April 24 until August 03, 2007. Six marked observation stations were arranged throughout the island (Figure 7) so that access to and use of these stations did not cause disturbance to breeding GREGs. Nest productivity data was determined from these observations since GREG young are large and easily seen. More invasive observations were not necessary.

Great Blue Heron. The monitoring schedule and routine for GBHEs was the same as that for GREGs with the exception of difficult to observe GBHE nests as discussed below.

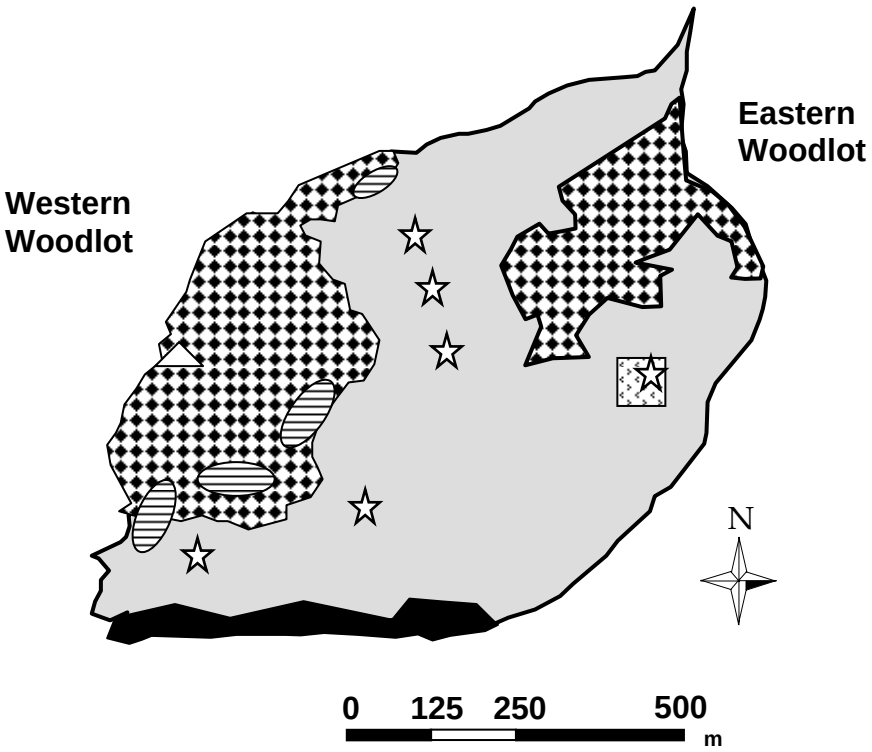
For GBHE nests that were difficult to observe from the observation stations it was necessary to approach more closely to determine the nest status or brood size (in some cases, this involved standing beneath the nesting tree). This colony-wide census was performed only on June 28/29 and July 09 to minimize disturbance to nesting herons.

Black-crowned Night-Heron. Several factors made the monitoring of BCNH nests a challenge. Of the three heron species nesting at Presqu'ile, BCNH adults are potentially the most sensitive to human disturbance and nestlings are prone to fleeing from the nest site when disturbed (much more so than the other heron species). However, the only option available to determine BCNH nest numbers was to enter their nesting areas. To minimize potential negative impacts on breeding BCNHs, nesting areas were only entered three times during the breeding season (May 28, June 28, and July 09, 2007)

Nest productivity data was not collected in 2007 due to concerns around disturbing the sensitive young.

Heron Roost Monitoring. The possible impact of cormorant roost disturbance activities on roosting herons was a concern. In an attempt to determine if a regional heron roosting site existed on or near High Bluff Island, observations of herons flying to and from High Bluff Island were made on 15 days between August 10 and September 24. Observation periods ranged in length from 45 minutes to 2 hr and 05 minutes. Sunrise or sunset occurred mid-way through the observation periods.

Two observers using 7 power binoculars with 42 mm objective lenses were placed at vantage points facing east and west where they could record herons moving to and from High Bluff Island. The observers were able to contact each other with two-way radios to ensure observation errors did not occur.



Observation Station

Wooded area utilized by cormorants and GBHE

GREG nesting areas

Cormorant ground nesting area

Compost facility

Base camp

Figure 7. Locations of GBHE and GREG Nesting and Monitoring Sites on High Bluff Island.

Companion Science.

Morphometric data from unbroken cormorant eggs picked up during nest-removal operations was recorded in 2007.

Egg length and widths were measured by vernier calipers and length to width ratios were calculated. Measurements were made to the nearest tenth of a millimeter. Egg weights were determined with an electronic scale capable of measuring to the nearest gram.

Results

Cormorant Management

On June 22, 2007 a total of 3,855 cormorant nests was counted at Presqu'ile, an increase of 36.7% since 2006. Since the last year in which management of cormorants did not occur (2002) the number of cormorant nests has declined by 68.1% (Table 1).

Table 1. Double-crested cormorant nesting at Presqu'ile, 2002 to 2007.
* Nest data is tallied the late-June count period.

Site	Nest Location	Number of Nests by Year*					
		2002	2003	2004	2005	2006	2007
High Bluff Island	tree	6893	4631	3656	1976	2108	2233
	Ground	3491	2948	1683	1305	498	1562
Gull Island	Ground	1698	1117	1601	1328	213	60
Total	tree	6893	4631	3656	1976	2108	2233
	Ground	5189	4065	3284	2633	711	1622
	all	12082	8696	6940	4609	2819	3855

As in other years, tree nests were found in both the eastern (1432 nests) and western (801 nests) woodlots of High Bluff Island in 2007.

Egg oiling. A total of 8,555 eggs from a maximum of 1562 nests were treated with mineral oil on High Bluff island (Table 2). Egg oiling successfully prevented all eggs from hatching in ground nests. Adults continued to incubate oiled eggs and did not re-nest.

The ground nest colony on High Bluff Island increased by 213.6 % from 498 nests in 2006 to 1562 nests in 2007. On Gull Island, the number of ground nests decreased by 71.8 % from 213 nests in 2006 to 60 nests in 2007.

Carcass Disposal. Compost temperatures from birds culled in 2006 remained within the required range for effective composting throughout the monitoring period (July, August and September)**.**

Nest removal. In 2007, 3,006 nests were removed from trees on High Bluff Island (Table 2). The success of removing a nest using forestry poles depended largely on nest height. Mid-level nests demanded the most attention due to their relative abundance. As in previous years cormorants appeared reluctant to return to areas that had been completely cleared of nests (trees, small trees and shrubs). Removal of high-level nests was an extremely slow process and required a high degree of effort.

Table 2. Double-crested cormorant management actions at Presqu'ile.

Activity	Year				
	2003	**2004**	**2005**	**2006**	**2007**
eggs oiled	28648	26311	23732	4,515	8,555
nests removed	3980	2098	1861	2,077	3,006
adults culled	0	6030	1867	2,927	0

Roost Disturbance. In 2007, roost disturbance activities commenced on August 24. The roost disturbance techniques employed (noise-makers and human presence) worked to varying degrees in encouraging roosting cormorants to vacate High Bluff Island. Noise-makers were most effective especially when backed up by human presence within the colony following the initial noise. The range of the noise's impact varied with the intensity of the noise, with the loudest sounds having the largest disturbance range.

Cormorants arriving to roost were also observed and counted in August and September. The results of these observations are listed in Appendix 1. The observations were commenced on August 10 and concluded on September 24. The maximum number of cormorants seen arriving to roost during the observation period was 836 on September 10. The smallest number seen was 166 on August 22.

Birds flushed by disturbance activities were watched by observers from several locations around the perimeter of the island. After taking off, the birds typically circled the island. Some birds simply flew to the adjacent woodlot. Most however landed on the adjacent waters of Lake Ontario and, after a period of five to fifteen minutes the majority of these birds flew to Sebastopol Point, Gull Island where they roosted on the ground. The Sebastopol point roosting flock was extremely dense, appearing as a solid covering of cormorants. These flocks were still present on Sebastopol Point the following morning before dispersing to feed.

The majority of the island's resident roosting cormorants were displaced by roost disturbance activities. However a group of around 200 cormorants refused to leave the island. Many of these birds were young cormorants remaining in the highest trees, the same trees that were not accessible to nest removal.

Vegetation Management

Tree-Planting. No tree-planting was conducted in 2007. Maintenance of stock planted in previous years was undertaken in 2007. The thick grass and herb layer growing around the planted trees was mowed to prevent rodent damage. At no time during the 2007 growing season did this grass and herb layer develop to a point where it provided cover to rodents.

Fencing installed in previous years prevented browsing and buck-rubbing in 2007.

Small seedlings were watered during drought periods. This was necessary due to the extreme drought which occurred in the mid and late in the summer of 2007. Around 10% of the youngest trees (planted in 2006) suffered desiccated foliage. Most of these were Red Oak seedlings. It is not known if these trees are dead or have gone dormant due to lack of moisture. Assessment will be completed in the 2008 growing season.

Roost Tree Cutting. In October of 2007, 3 dead trees were cut in areas where roosting cormorants were damaging nearby living vegetation. The trees were left where they fell. Details on the trees removed are in Appendix 2.

Monitoring of Herons and Egrets

All three wading-bird species had successful breeding seasons in 2007 (Tables 3 and 4).The number of successful great blue heron nests declined from the previous year, great egret nest numbers increased substantially, and the number of nesting black-crowned night-herons declined slightly (Table 4). Fledging rates for great blue heron were similar in 2006 and 2007; fledging rates for great egrets increased from 2.5 chicks per nest in 2006 to 3.0 chicks per nest in 2007; and black-crowned night-herons fledging rates were not measured in 2007.

Great Egret. A maximum of 23 great egret nests were counted on May 31, 2007. Twenty one of these nests were successful. In total, the twenty one successful nests produced 63 young - an average of 3.0 chicks fledged per successful nest.

Great Blue Heron. The maximum great blue heron nest count occurred on May 04, 2007 when there were 30 active nests (active nests were defined as a discernable collection of sticks of any size attended by accompanying herons). These nests were distributed between the eastern (10 nests) and western woodlands (20 nests). Twelve nests did not fledge chicks: cormorants replaced the original occupants in 11 cases, one nest was destroyed by cormorants. Eighteen great blue heron nests were successful, producing 42 young – 17 in the eastern woodlot and 25 in the western woodlot. An average of 2.33 chicks fledged per successful nest.

Black-crowned Night-Heron. Seventy-seven black-crowned night-heron nests were counted in 2007. All of these nests were located on High Bluff Island. Sebastopol Point, Gull Island, which supported seventeen night-heron nests in 2006 (and similar numbers of nests in previous years) did not have any night-herons in 2007. On High Bluff Island, black-crowned night-herons nested mainly at two sites: in a clump of cedar trees at the western tip of the island and in the choke cherry thicket along the northern shoreline. Smaller groupings of nests in non-traditional areas also developed in 2007. These were along the northern and western shorelines and eastern woodland of High Bluff Island.

Table 3. Maximum nest count data for the three heron species at Presqu'ile, 1998-2007

Species	Number of nests observed									
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
great blue heron	1	5	14	na	12	38	63	42	36	30
great egret	0	1	2	3	3	5	10	17	16	23
black-crowned night-heron	na**	nc***	nc***	na	73*	80*	59	71	84	77

* Canadian Wildlife Service data

** na – not available

*** nc – not counted to avoid disturbance to proximity to newly established egret nests

Table 4. Nesting success of heron species at Presqu'ile, 2003-2007.

		Year				
Measure of Nesting Success	**Species**	**2003**	**2004**	**2005**	**2006**	**2007**
Maximum nest count	GBHE	38	63	42	36	30
	GREG	5	10	17	16	23
	BCNH	80	59	71	84	77
Number of successful nests	GBHE	25	38	32	22	18
	GREG	4	10	16	14	21
	BCNH	?*	?	?	?	?
Number of fledged young	GBHE	37	75	75	51	42
	GREG	10	26	42	35	63
	BCNH	?	?	?	80*	?
Number of young fledged per nest	GBHE	1.48	1.97	2.34	2.27	2.33
	GREG	2.5	2.6	2.6	2.50	3.0
	BCNH	?	?	?	1.96*	?

? – unknown

- * - 51 nests were monitored in for productivity in 2006; 41 of these successfully fledged 80 young

Heron Roost Monitoring

A total of 37 observer hours of heron-roost observations were made during 15 surveys between August 10 and September 24, 2007. Numbers of herons roosting were low and variable, with a peak of 5 herons observed to be moving to the island on to roost August 15 (Appendix 3).

Companion Science

Morphometic measurements of unbroken eggs collected during nest removal operations are listed in Appendix 4.

Discussion

Cormorant Management

Cormorant management activities on Presqu'ile's islands have lead to a substantial decline in the number of cormorants nesting at Presqu'ile. Since 2002, the last year in which management did not occur, the park's cormorant nesting population has declined by 61.8%. This reduction in nest numbers has been achieved through the combined effects of egg oiling, nest removal and culling of adult birds. These activities have reduced the use of trees by nesting and roosting cormorants and have reduced recruitment from ground-nesting colonies, in accordance with the objectives of the project.

Egg-oiling. Egg oiling again proved to be an effective tool to reduce production of young from the ground-nesting colony, as eggs could be treated relatively quickly and the technique was successful in preventing hatching. Egg oiling also "fooled" adults into continuing to incubate eggs, thus pre-occupying their time for long periods. However, predation of cormorant eggs by gull species was apparent, and when predation occurred, cormorants would re-lay their eggs (in the same nests). Cormorant egg-laying also naturally occurs over a prolonged period of time. For these reasons it was necessary to continue oiling nests throughout the egg-laying period.

Experience elsewhere has shown that egg-oiling should be considered a long-term method of reducing avian populations (Bedard *et al.* 1999 and Blackwell *et al.* 2002). Egg-oiling only reduces recruitment of young into the population, and the adult birds remain within the population and continue to attempt breeding. The impact of these birds remains, since the guano produced by these unsuccessful breeders continues to affect vegetation used for nesting and roosting. Another factor to consider is the fact that a significant proportion of Presqu'ile's nesting cormorants do not nest on the ground. In 2007 more than half of the park's nesting cormorants were tree-nesters, inaccessible to oil-spraying equipment. For these reasons, egg-oiling can only be considered as a part of the overall cormorant management scenario for Presqu'ile.

In 2007 the cormorant colony on Gull Island dramatically changed. It declined from several hundred nests to a maximum of 60 nests, none of which produced young. Oiling activities were not carried out on Gull Island in 2007 since the ground colony was too transient, to warrant it.

Throughout the 2007 breeding season the Gull Island cormorant colony was disrupted by coyotes. Although direct predation was not witnessed, on many occasions coyotes were seen foraging in the vicinity of cormorant nests, presumably eating cormorant eggs. In addition to losses of cormorant eggs by coyotes, many eggs were taken by gulls which would opportunistically steal eggs while cormorants were displaced from their nests by coyotes.

The cormorant ground nest colony on High Bluff Island increased by 213.6 % from 498 nests in 2006 to 1562 nests in 2007. Most of this increase was found in an area of "artificial ground colony", an area where structural diversity on the ground was enhanced by the spreading of debris and pounding in of 1 meter tall wooden stakes. (Figure 8.) This technique had been experimented with since 2004 but did not see appreciable cormorant nesting until the 2007 breeding season.

Figure 8. Artificial cormorant ground colony utilized by cormorants in 2007. Note that cormorant nests are located near stakes driven in to the ground.

Numbers of both ground and tree nesting cormorants have been declining since management began in 2003 (Table 1). In the period from 2002 until 2005 the tree colony declined 71%. The ground colony declined by 49% in the same period. The larger decline in the tree-nesting component of the population is likely due to more focused management efforts to reduce numbers in this segment of the population. Ground-nesting birds have been managed only as a means to prevent the young from these nests from becoming future tree-nesters.

Aside from limited collection of nesting material from living woody vegetation, ground nesting cormorants have relatively little impact on woody vegetation and thus are not aggressively managed. However the eggs of ground nesting birds are oiled to prevent their young from nesting in the trees in future years. In effect, a ground colony that does not produce young acts as a "sink", attracting potential tree-nesting birds to areas where they will not produce young if oiling occurs. The reverse could also be true. If it is deemed appropriate to increase the number of cormorant young produced by the overall colony a specified portion of the ground nests could be left un-oiled and allowed to produce young.

Carcass Disposal. During abnormally hot weather conditions careful monitoring of compost temperatures is required. On one occasion, in mid-summer excessive heat within the compost pile threatened to kill the microbes responsible for the decomposition process. To cool the pile it was opened up, allowed to cool then reformed. Ongoing temperature measurements indicated that the compost's microbial community continued to flourish throughout the entire composting season in 2007.

Nest Removal. A total of 3,006 cormorant tree nests was counted in the third week of June. Many of these nests were too high for removal. Since management began in 2003, high level nests have remained beyond reach for removal. Low and medium level nests can be effectively removed and hence are the focus of nest removal efforts. A method of dealing with high-level nests is required to provide maximum protection to the ecosystem.

However, as large nesting trees that have died in previous years fall down, the relative numbers of high level nests will drop.

Between 2003 and 2006 the number of tree nesters has been declining by an average of 23.7% per year. In 2007 the number of tree nesters increased by 5.9% despite an increase of nest removal effort (44.7% more tree nests were removed in 2007 verses 2006). Concurrent with this tree-nest increase, no culling activities occurred in 2007. The increase in tree-nesting cormorants, despite significantly increased nest removal efforts, indicates that culling is an effective method to reduce the tree-nesting component of the overall population.

Roost Disturbance. Roost disturbance operations removed most of the park's roosting cormorants from High Bluff Island. However a group of cormorants refused to leave the island and either ignored the disturbance events or simply shifted locations within the island. Some of these birds were the young, flightless birds unable to flee the disturbance. The others which shifted about the island but did not depart may have been the parents of these young birds and thus reluctant to leave their offspring. Despite the reluctance of this group to leave the majority of the roosting population departed soon after the initiation of roost disturbance activities, thereby reducing further deposition of guano.

The entrenched 2007 group was approximately half as large as the persistent group seen in 2006. This is likely due to an especially prolonged cormorant breeding season in 2006 that resulted in a large group of young cormorants and their attending adults being present very late in the 2006 breeding season. This phenomena did not occur in 2007.

In 2007 the majorityof cormorants displaced by roost disturbance flew from the main body of High Bluff Island to Sebastopol Point, Gull Island. This pattern was also seen in 2006. In contrast to this, the majority of birds displaced in 2005 flew directly to Scotch Bonnet Island 25 kilometers to the southeast.

In 2007 observations of the numbers of cormorants arriving to roost were made during the peak roosting period (Appendix 6). It is important to note that the numbers listed in Appendix 6 are an underestimate of the overall number of roosting birds since the observers' field of view is limited. In previous years, judging the very large numbers of birds arriving to roost, it is thought that Presqu'ile was the recipient of roosting birds originating from other colonies. However the relatively low numbers of roosting cormorants in 2007 suggests that this phenomena may not happened to the same degree.

Vegetation Management

Tree-Planting. Two factors appear to significantly influence the survival rate of trees planted on High Bluff Island. These are: 1) weather conditions during the first growing season following the initial transplant of saplings and; 2) the degree of damage caused by herbivores during the winter season (rodent browsing is problematic only during the winter months).

In 2007 tree-girdling of planted trees by rodents was minimal. This was partly due to the use of tree-guards which prevented herbivore feeding. The meadow vole (*Microtus pennsylvanicus*) population was particularly high during the winter of 2006/2007 and caused substantial damage to unprotected trees. However survival of protected trees was over 90%.

Voles also favour areas containing a thick, ground level herbaceous plant community. The cutting and removal of this herbaceous "thatch" first implemented in 2006 also helped reduce rodent girdling of young trees. Feeding runways could be seen leading towards planted areas but changed course when the cut areas were encountered.

Male white-tailed deer using the young planted trees as "rubbing-posts" have caused structural damage to many trees in the past. In some cases they completely snapped off the upper parts of the planted trees. The fencing of planted areas prevented rubbing behaviour in the autumn of 2006 and winter of 2007.

Despite some losses to deer, drought and rodent damage the surviving trees are experiencing significant growth. In some cases tree height has doubled and planted trees are producing seed. This may accelerate the rate of forest recovery in the planted areas. Many of the deer and vole damaged trees are also suckering from lower sections and quickly recovering lost growth.

Roost Tree Cutting. The goal of roost tree cutting is to provide protection to living vegetation found beneath dead roost trees. However it should be noted that if a large number of roost trees are removed from High Bluff Island then it is likely that roosting cormorants will use living trees. To minimize the risk of this occurring, roost tree cutting has been kept to a minimum.

The three trees removed in the autumn of 2007 were found in areas where high-value living vegetation was being threatened by roosting cormorants.

Monitoring of Herons and Egrets

Wading bird species living in association with cormorant management activity at Presqu'ile successfully nested and reared young in 2007. Successful great egret nest numbers increased by 50 per cent while the number of black-crowned night-herons and great blue heron nests decreased slightly from the previous year.

In contrast to earlier years, very few of the initial great egret nesting attempts failed. Most nests for this species were successful from their initiation, possibly due to a growing percentage of older, more experienced great egrets within the Presqu'ile colony.

Great blue heron nest numbers continued to decline in 2007 (from a maximum of 36 nests in 2006 to 30 in 2007). The all-time maximum great blue heron nest number was 63 in 2003. This pattern of decline has occurred consistently since 2003. A number of factors is likely responsible for this decline. These include: competition for nesting sites and materials by cormorants; nest take-overs (herons displaced from established nests by cormorants); and the loss of super-canopy trees which formerly supported the nests of this species.

Of the factors listed above the one with the longest term implications is the loss of the large trees. These trees are preferentially used by cormorants and have been amongst the first vegetation to succumb to the effects of their guano. The loss great blue heron nesting habitat is likely to continue since the majority of the large trees favoured by this species are already dead and will continue falling. In addition, these large trees are so tall and have such sparse branch-structure that cormorant nests cannot be effectively removed from their canopies. It is important to note that while the canopy-nesting great blue herons have shown a steady decline in nest numbers, the sub-canopy nesting black-crowned night-herons and great egrets have shown stable or increasing numbers during the same period.

All of the 12 great blue heron nests which failed in 2007 were used by cormorants. Eleven were occupied by nesting cormorants and the twelfth was taken apart and used as nesting material by cormorants.

While the maximum number of great blue heron nests has decreased slightly, nesting productivity for great blue herons has steadily risen since the initiation of cormorant management. In 2003 an average of 1.48 young were fledged from each successful nest while in 2007 each successful nest fledged 2.3 young. One potential factor in the increase in heron productivity is reduced encounters with cormorants due to lower cormorant numbers within the Presqu'ile colony. In the five cormorant management years at Presqu'ile, the highest heron productivity occurs in the three years that the cormorant population was at its lowest levels.

The black-crowned night-heron nest count in 2007 was down from that of the previous year (84 nests in 2006, 77 nests in 2007). Despite this decline it is still near the all-time maximum nest count recorded in 2006.

It is important to note that the tree located on Sebastopol Point on Gull Island, an important nesting site for BCNH for many years, was lost as a BCNH nesting site in 2007. The most likely explanation for the loss of this site is its colonization by cormorants which had shifted from the main body of Gull Island where coyote predation had caused major disruption in the cormorant ground colony. Sebastopol Point was separated from the rest of the island by approximately 150 meters of open water through the erosion of the former

connecting spit. In effect this small tree is located on its own island which may have provided some protection from further predation by the coyote. From early-April onwards cormorant nests were established in this small tree and despite removing 328 cormorant nests, only one BCNH nest was established at this location and it was unsuccessful.

The BCNH displaced from Sebastopol Point appear to have shifted to sites on High Bluff Island. BCNH nested in greater than normal densities in their traditional nesting areas on High Bluff Island and several BCNH nests were located along the northern and western shores of the island in areas that had not been known to support this species in the past. These new sites typically consisted of only a few nests in a single tree. It is possible these sub-colonies were vulnerable to adverse weather and other threats due to the exposed nature of nests in isolated trees.

Despite the loss of Sebastopol Point and the colonization of new, possibly more vulnerable sites, the BCNH colony at Presqu'ile was maintained through the establishment of 77 nests on High Bluff Island in 2007.

As in previous years roost monitoring suggests that High Bluff Island is not an important night roosting location for herons and egrets in the region after the breeding season. Heron and egret activity was low throughout August and was likely limited to young resident birds.

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Appendix 1

Roosting Cormorant Arrivals seen from Western High Bluff Island

	AUGUST								SEPTEMBER					
	13	**15**	**20**	**22**	**24**	**27**	**29**	**31**	**4**	**6**	**10**	**17**	**21**	**24**
START	19:50	19:50	19:50	19:50	19:50	19:25	19:20	19:15	19:15	18:30	18:00	18:00	18:20	18:00
FINISH	20:45	20:45	20:40	20:35	20:35	20:35	20:30	20:25	20:20	20:15	20:05	19:55	19:40	19:35
SUNSET	20:20	20:17	20:09	20:06	20:03	19:58	19:54	19:51	19:44	19:40	19:33	19:20	19:13	19:07
18:00											20	73		25
18:05											53	64		26
18:10											42	60		12
18:15											43	62		20
18:20											34	46		35
18:25											40	23	42	7
18:30										26	36	35	34	14
18:35										25	29	41	48	12
18:40										29	48	32	25	53
18:45										29	35	23	17	21
18:50										23	21	31	30	16
18:55										34	20	24	32	8
19:00										41	24	18	23	5
19:05										33	14	21	41	7
19:10										29	17	23	25	4
19:15								7	22	35	11	17	6	6
19:20							9	3	16	17	10	16	1	5
19:25						19	24	15	20	23	10	9	1	1
19:30						51	14	11	23	14	7	7	12	0
19:35						52	20	3	28	13	17	2	11	
19:40						12	20	25	10	8	11	5		
19:45						17	13	2	15	13	3	0		
19:50	59	26	12	9	42	7	17	3	9	9	1	0		
19:55	29	15	8	26	37	6	13	1	9	7	2			
20:00	150	11	13	12	44	13	14	7	5	3	1			
20:05	7	64	7	11	38	44	3	4	0	0				
20:10	13	65	9	8	15	7	2	6	1	1				
20:15	13	32	23	7	7	3	1	2	0					
20:20	14	22	13	7	6	6	3	0						
20:25	5	12	8	2	3	3	0							
20:30	7	12	9	4	4	0								
20:35	4	12	2											
20:40	4	2												
TOTAL	**305**	**273**	**104**	**86**	**196**	**240**	**153**	**89**	**158**	**412**	**549**	**632**	**348**	**277**

Appendix 1

Roosting Cormorant Arrivals seen from Eastern High Bluff Island

	AUGUST								SEPTEMBER					
	13	**15**	**20**	**22**	**24**	**27**	**29**	**31**	**4**	**6**	**10**	**17**	**21**	**24**
START	19:50	19:50	19:50	19:50	19:50	19:25	19:20	19:15	19:15	18:30	18:00	18:00	18:20	18:00
FINISH	20:45	20:45	20:40	20:35	20:35	20:35	20:30	20:25	20:20	20:15	20:05	19:55	19:40	19:35
SUNSET	20:20	20:17	20:09	20:06	20:03	19:58	19:54	19:51	19:44	19:40	19:33	19:20	19:13	19:07
18:00											9	16		4
18:05											15	13		3
18:10											11	24		3
18:15											28	22		3
18:20											40	34	5	0
18:25											21	9	0	4
18:30										53	12	9	0	1
18:35										35	21	24	1	10
18:40										45	23	6	0	9
18:45										27	10	17	2	5
18:50										18	4	13	0	5
18:55										22	18	2	7	4
19:00										8	5	4	2	9
19:05										19	15	2	2	4
19:10										45	8	3	3	2
19:15								14		12	17	0	1	3
19:20							60	36	13	5	3	0	0	0
19:25						15	26	37	15	6	4	5	0	0
19:30						26	22	13	11	0	7	1	0	0
19:35						22	8	29	21	0	8	0	0	
19:40						46	15	18	9	10	0	0		
19:45						11	10	7	6	14	7	0		
19:50	0	33	1	14	25	9	5	8	2	7	1	0		
19:55	0	30	27	20	19	6	7	12	5	4	0			
20:00	4	31	169	12	15	3	2	6	0	0	0			
20:05	11	43	82	8	23	7	4	1	1	0				
20:10	11	27	117	14	39	5	2	4	0	0				
20:15	7	18	44	12	19	15	0	3	0	0				
20:20	10	21	41	0	4	1	0	3						
20:25	7	39	13	0	6	1	0							
20:30	13	19	11	0	2	0								
20:35	26	14	19											
20:40		9												
TOTAL	**89**	**284**	**524**	**80**	**152**	**167**	**161**	**191**	**83**	**330**	**287**	**204**	**23**	**69**

Appendix 2 Details of Roost Trees Cut in 2007

#	Date Cut	Species Cut	Details
1	October 11/07	Sugar Maple	30 cm DBH*- dead
2	October 11/07	Red Oak	25 cm DBH*- dead
3	October 11/07	Sugar Maple	35 cm DBH*- dead

*DBH – diameter at breast height – 1.3 m above the ground

Appendix 3

High Bluff Island Heron Roost Monitoring from August 13 to September 24, 2007

	August									September					
	10	**13**	**15**	**20**	**22**	**24**	**27**	**29**	**31**	**04**	**06**	**10**	**17**	**21**	**24**
Start	05:45	19:50	19:50	19:50	19:50	19:50	19:25	19:20	19:15	19:15	18:30	18:00	18:00	18:20	18:00
Finish	06:46	20:45	20:45	20:40	20:35	20:35	20:35	20:30	20:25	20:20	20:15	20:05	19:55	19:40	19:35
Sunset	06:08	20:20	20:17	20:09	20:06	20:03	19:58	19:54	19:51	19:44	19:40	19:33	19:20	19:13	19:07
Western Island Observations															
BCNH Ar.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BCNH Dep.	0	1	2	1	2	0	5	0	0	0	1	1	1	0	0
GBHE Ar.	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
GBHE Dep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREG Ar.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
GREG Dep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Island Observations															
BCNH Ar.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BCNH Dep.	0	0	1	0	4	8	2	0	0	0	0	0	0	3	0
GBHE Ar.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
GBHE Dep.	2	1	4	0	0	0	0	0	0	0	0	0	0	0	0
GREG Ar.	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0
GREG Dep.	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0
SUMMARY	2 GBHE departed, 2GREG departed	1 BCNH departed, 1 GBHE departed, 2 GREG arrived, 2 GREG departed	3BCNH depart, 1 GBHE arrive, 4 GBHE depart 4 GREG arrive	1 BCNH depart	6 BCNH depart 1 GBHE arrive	8 BCNH depart	7 BCNH depart 1GBHE arrive				1 BCNH depart	1 BCNH depart	1 BCNH depart	3 BCNH depart	

Appendix 4

Cormorant Egg Data (Length and width to nearest tenth millimeter, weights to the nearest gram)

*** = not weighed**

23-May	LENGTH	WIDTH	WEIGHT	length:width ratio
1	61.5	31.5	*	1.95
2	59.5	38.5	*	1.55
3	58.5	40	*	1.46
4	64	35	*	1.83
5	59	37	*	1.59
6	58.5	37.5	*	1.56
7	58	38	*	1.53
8	63.5	36	*	1.76
9	63.5	35	*	1.81
10	60	39.5	*	1.52
11	57.5	38	*	1.51
12	63.5	37.5	*	1.69
13	60	39	*	1.54
14	57	38.5	*	1.48
15	61.5	37.5	*	1.64
16	53.5	35.5	*	1.51
17	58.5	37.5	*	1.56
18	62	39.5	*	1.57
19	60	35.5	*	1.69
20	60.5	38	*	1.59
21	58.5	38	*	1.54
22	60.5	37.5	*	1.61
23	58.5	36.5	*	1.60
24	59.5	37	*	1.61
25	57.5	38.5	*	1.49
26	61.5	36.5	*	1.68
27	62.5	38.5	*	1.62
28	62	40	*	1.55
29	58.5	35	*	1.67
30	62	37	*	1.68
31	63	37	*	1.70
32	58	39	*	1.49
33	57	37	*	1.54
34	60	39	*	1.54
35	61	37	*	1.65
36	61	40	*	1.53
37	57	36	*	1.58
38	57	35	*	1.63
39	60	38	*	1.58
40	64	38	*	1.68
41	61	40	*	1.53
42	58	40	*	1.45
43	56	37	*	1.51
44	58	38	*	1.53
45	62	37	*	1.68
46	64	38	*	1.68

24-May	LENGTH	WIDTH	WEIGHT	length/width
47	64	37	*	1.73
48	52.5	36	*	1.46
49	62	37	*	1.68

25-May	LENGTH	WIDTH	WEIGHT	
50	59	36.5	*	1.62
51	67.5	40	*	1.69

28-May	LENGTH	WIDTH	WEIGHT	length/width
52	52	37	45	1.41
53	59	38	48	1.55
54	60	36	43	1.67
55	61	36	44	1.69
56	59	38	47	1.55
57	62	37	48	1.68
58	61	38	48	1.61
59	57	37	45	1.54
60	57.5	38	47	1.51
61	60	38	49	1.58
62	59	37.5	48	1.57
63	61	36	43	1.69
64	60	39	51	1.54
65	59	37	45	1.59
66	58	37	45	1.57
67	62	36	46	1.72
68	61	39	52	1.56
69	62	37	48	1.68
70	60	40	51	1.50
71	61	37	45	1.65
72	56	37	43	1.51
73	59	38	44	1.55
74	61	37	48	1.65
75	62	38	49	1.63
76	57	36	42	1.58
77	59	37	44	1.59
78	62	39	50	1.59
79	61	37	48	1.65
80	60	39	49	1.54
81	62	39	52	1.59
82	58	40	49	1.45
83	62	39	52	1.59
84	58	37	46	1.57
85	61	36	44	1.69
86	60	37	46	1.62
87	61	40	53	1.53
88	60	37	46	1.62
89	58	36	41	1.61
90	57	36	39	1.58
91	59	36	44	1.64

05-June	LENGTH	WIDTH	WEIGHT	length:width ratio
92	61	40	51	1.53
93	59	36	50	1.64
94	61	37	43	1.65
95	56	38	46	1.47
96	64	38	45	1.68
97	61	37	43	1.65
98	58	38	43	1.53
99	62	36	42	1.72
100	60	38	44	1.58

06-June	LENGTH	WIDTH	WEIGHT	length:width ratio
101	64.5	48.5	53	1.33
102	60	38.5	47	1.56
103	58	38.5	47	1.51
104	61.5	36.5	46	1.68

07-June	LENGTH	WIDTH	WEIGHT	length:width ratio
105	58	38	43	1.53
106	61	39	53	1.56
107	55	36	42	1.53

08-June	LENGTH	WIDTH	WEIGHT	length:width ratio
108	64	39	55	1.64
109	57	37	44	1.54
	58	37	46	1.57

11-June	LENGTH	WIDTH	WEIGHT	length:width ratio
110	57	35	41	1.63
111	63	38	53	1.66
112	61	38	50	1.61

12-June	LENGTH	WIDTH	WEIGHT	length:width ratio
113	57	37	48	1.54

13-June	LENGTH	WIDTH	WEIGHT	length:width ratio
114	56	37	44	1.51

20-June	LENGTH	WIDTH	WEIGHT	length:width ratio
115	57	38.5	47	1.48
116	57	38	48	1.50
117	59	36	43	1.64
118	59	38	48	1.55
119	57.5	36	39	1.60
120	61	38	48	1.60
121	61	39	51	1.56

25-June	LENGTH	WIDTH	WEIGHT	length:width ratio
122	63	37	48	1.70

26-June	LENGTH	WIDTH	WEIGHT	length:width ratio
123	59.5	38.5	49	1.55
124	58.5	37.5	47	1.56
125	59	38.5	50	1.53

06-July	LENGTH	WIDTH	WEIGHT	length:width ratio
126	59.5	36	45	1.65
127	59.5	36.5	45	1.63
128	60	35	42	1.71