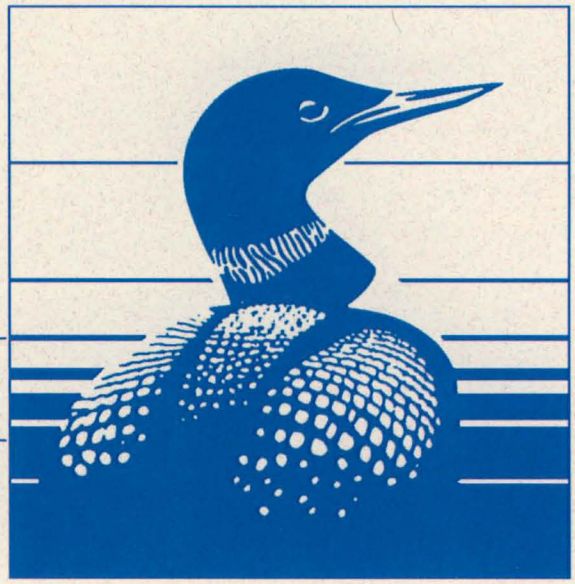
Unobtrusive methodology to obtain estimates of colony size of the Double-crested Cormorant *Phalacrocorax auritus* breeding on Pokeshaw Rock, Chaleur Bay, New Brunswick, 2006.

Colin M. MacKinnon and Andrew C. Kennedy

Canadian Wildlife Service – Atlantic Region



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Unobtrusive methodology to obtain estimates of colony size of the Double-crested Cormorant *Phalacrocorax auritus* breeding on Pokeshaw Rock, Chaleur Bay, New Brunswick, 2006.

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FRONTISPIECE

POKESHAW ROCK
1920

Dr. William Francis Ganong
photograph: Saw Mill,(double exposure with Camp Gear) Pokeshaw,
Gloucester County, New Brunswick, July 1920
silver print on paper
overall: 8.3 x 14 cm
William Francis Ganong Collection
1987.17.1225.34

Courtesy the New Brunswick Museum, Saint John, N.B.
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Note: The photo shows evidence of a double exposure (authors)

ABSTRACT

Pokeshaw Rock (47° 47' N 65° 15' W) is an inaccessible "sea stack" located along the south shore of Chaleur Bay about 20 km west of the town of Caraquet, New Brunswick, Canada. The Double-crested Cormorant *Phalacrocorax auritus* colony appears to have developed sometime after 1928; being first recorded in 1966. Seven surveys and/or estimates conducted from 1966 to 2006 have reported from 100 to 619 nests (mean 358, S.D. 219). The cormorant colony situated at the top of Pokeshaw Rock was remotely surveyed using an unobtrusive methodology on 6 June 2006. The maximum number of nests of Double-crested Cormorant in the colony was 577 (95% CI, range from 246 to 874). The ratio of observed adult birds versus nests (on both the long and narrow axis of the island) were both significantly correlated ($R^2 = 0.853$, n=11, $P<0.01$ and $R^2 = 0.696$, n=11, $P<0.01$ respectively). This unobtrusive census methodology provides both a safe and cost effective way to survey highly visible but inaccessible seabird colonies.

RÉSUMÉ

Le rocher Pokeshaw (47° 47' N 65° 15' W) est un « éperon d'érosion marine » inaccessible situé près de la côte sud de la baie des Chaleurs, à environ 20 km à l'ouest de Caraquet, au Nouveau-Brunswick, au Canada. La colonie de Cormorans à aigrettes (*Phalacrocorax auritus*) semble s'y être établie après 1928; on l'a rapportée pour la première fois en 1966. Selon 7 estimations et/ou relevés menés de 1966 à 2006, il y aurait entre 100 et 619 nids (moyenne = 358; écart-type = 219). La colonie de Cormorans à aigrettes établie au sommet du rocher Pokeshaw a fait l'objet d'un relevé à distance utilisant une méthode non invasive le 6 juin 2006. Le nombre maximal de nids dans la colonie était de 577 (intervalle de confiance à 95 % = 246-874). On a établi une corrélation significative entre le nombre d'oiseaux adultes observés et le nombre de nids tant sur la longueur de l'île ($R^2 = 0,853$; n = 11; $P < 0,01$) que sur sa largeur ($R^2 = 0,696$; n = 11; $P < 0,01$). Cette méthode non invasive constitue un moyen sûr et rentable d'étudier des colonies d'oiseaux de mer bien visibles mais inaccessibles.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure 8. Comparison of photograph resolution and ability to delineate individual birds. Top photo: Pentax K1000 using a Vivitar Series 1, 70-210 mm telephoto lens (photos taken using the 210 mm setting) with Kodak ASA 64 slide film. Bottom photo: Digital - Cannon Powershot G6 (7.1 megapixels)……...20

INTRODUCTION

The North American population of Double-crested Cormorant (DcC) *Phalacrocorax auritus* is estimated to be greater than 740,000 breeding birds; 30–50% (roughly 220,000 to 370,000) are in Canada (Milko *et. al.*, 2003). The DcC is a common breeder in Atlantic Canada with numerous colonies found in a variety of habitats. As with most colonial waterbirds, cormorant colonies are often found in isolated locations such as remote islands or peninsulas. Most of these sites, however, are more or less accessible and a number of researchers have documented the sizes and locations of most colonies in the Maritime Provinces.

Most of the early work on censusing colonial nesting birds in the Maritime Provinces, in an organized approach, traces back to A. R (Tony) Lock in 1971. Lock (1971) and Lock and Ross (1973) reported on the sizes and distributions of thirty DcC colonies in Nova Scotia, noting that only ten of these had been previously censused, although some information was available on at least twenty five sites. Lock (1982) also surveyed and reported on seven DcC colonies on the northwestern coast of the Bay of Fundy (southern New Brunswick) with the number of active nests per colony ranging between 2 to 2023. In 1983, he then reported on colonies along the Atlantic Coast of mainland Nova Scotia (excluding the Bay of Fundy, Northumberland Strait and Cape Breton) where 6,900 pair were recorded in 37 colonies (Lock *et al.*, 1983). Around this same time, Milton and Austin-Smith (1983) conducted a thorough census and evaluation of DcC colonies throughout Nova Scotia and reported an overall increase of 147% from 4,135 pair in 1971 (as recorded by Lock and Ross, 1973) to 10,227 pair in 1980. More recently, Boyne and Hudson (2002) reported ten DcC colonies ranging from 14 to 974 occupied nests (total of 3704 nests) along the Gulf of St. Lawrence coast of New Brunswick

With some exceptions, few individual DcC colonies appear to have been followed in the Maritime Provinces with any regular schedule. For example, the DcC colony on Boot Island National Wildlife Area, Nova Scotia, has been surveyed thirteen times from 1976 to 2006 (MacKinnon *et al.*, 2006). Most surveys have been opportunistic, where researchers have had the time, opportunity or interest to look more closely at a single or small number of colonies (MacKinnon, 1991). This census of the DcC colony on Pokeshaw rock was just such an opportunistic survey.

This paper is based on a chance survey of Pokeshaw Rock that was included as part of a larger evaluation of active Great Blue Heron and Black-crowned Night Heron colonies along the north-east and eastern coast of New Brunswick (MacKinnon and Kennedy, 2007). This picturesque rock, the top covered with highly visible but quite inaccessible breeding cormorants, is a noted ecotourism draw for northern New Brunswick. On our arrival, the authors new little of the history of the island but felt that a "quick" estimate of the colony size was warranted. The objectives of this paper are to: i) estimate the size of the DcC colony on Pokeshaw Rock ii) compare the colony estimate with other site surveys iii) evaluate the survey results based on the methodology and iv) suggest a remote (and safe) surveying method that could be utilized on an annual basis by interested residents or local naturalists.

With a New Brunswick Provincial Park immediately adjacent to Pokeshaw Rock, the cormorant colony is a very noticeable feature of the local landscape. We hope that, with guidance, this highly visible colony can be monitored more closely by local enthusiasts without undue disturbance to the birds and low risk of injury to the surveyor.

STUDY AREA

Pokeshaw Rock (47° 47' N 65° 15' W) is a dramatic rock, or "sea stack", located along the south shore of Chaleur Bay about 20km west of the town of Caraquet (Figure 1). The stack is approximately 16m high with shear cliffs around the circumference. The top of the oval shaped islands is relatively small, approximately 100 m (north to south) and 50 m (east to west) or ~4075 m^2. What once was a forested summit is now a jumble of dead snags and fallen trees undoubtedly killed by guano and/or regurgitation by the Double-crested Cormorants. Pokeshaw Rock is recognized as an Important Bird Area (IBA) by Bird Studies Canada (BSC) although the site reference incorrectly records 1371 pair of DcC in 1986 (Bird Studies Canada, 2007). This should read 137 pair of nesting DcC as recorded by A. R. Lock (MNRS, 1986) (Table 1).

METHODS

Pokeshaw Rock was surveyed on 6 June, 2006. Weather conditions were clear, warm and sunny (no haze) and observation conditions were excellent. Due to the extremely hazardous nature of trying to access the summit of Pokeshaw Rock, all observations were conducted remotely from the mainland. Two vantage points were used to take a series of photographs (Figure 2). The first viewing location (Observation Point No. 1) was at the top of an access road to the beach (about 400 m from the island). The second observation site (Observation Point No. 2) was at a small picnic park adjacent to, and at the same elevation as Pokeshaw Rock (Figure 2). This second location was about 100 m from the southern tip of Pokeshaw Rock.

Photographs were taken from each of the vantage points using two recording systems. Photographs were taken with a Pentax K1000 using a Vivitar Series 1, 70-210 mm telephoto lens (photos taken using the 210 mm setting) and Kodak ASA 64 slide film. Digital photographs were also taken using a 7.1 megapixel Cannon Powershot G6 (35-140 mm optical zoom). Analysis consisted of counting birds from enlarged photographs of the island taken with both cameras. Best results were obtained by taking high resolution scans of the 35mm slide film and then printing the scanned image onto paper. The resulting series of printed images (on 8.5" x 11" paper) formed a photo-mosaic 2.4m wide (Observation Point No. 1) and 2.6 m wide (Observation Point No. 2). From the two vantage points, we estimated that about 25% of the island could be seen from Observation Point No. 1 and about 20% of the island was in view from Observation Point No. 2.

Nests and adult DcC (breeders and non-breeders) were separated between those observed on the ground and those in trees. Even though only 20-25% of the island could be seen from the two vantage points, all the trees could be seen from both locations. The problem with combining the ground and tree nest counts was that the tree observations biased any attempt at extrapolation. For example, when Pokeshaw rock is viewed from Observation Point No. 2, visibility and depth perception is such that one can only see about 20% of the ground area, but all of the trees. This is best shown in Figure 3 where five trees have been "matched' from photographs taken from the two vantage points. Whereas the trees seen from Observation Point No. 2 look to be on nearly the same view plane, they are in fact quite spread out across the island.

The actual nest and bird counts were conducted by comparing the printed image with the same image on the computer screen. We used colored markers to delineate each nest and adult DcC on the paper image of the colony, and used the enlarging abilities of the computer generated image where additional detail was necessary for identification (Figure 4). In most cases, nests and adult birds were easy to identify. However, in the shaded areas caused by over-hanging vegetation, the highly visible adult DcC orange throat patch was used to delineate individual birds.

RESULTS AND DISCUSSION

We estimated the breeding population of DcC on Pokeshaw Rock to be 577 active nests in 2006 (560 nests on the ground and 17 nests in trees). This estimate remained the same when the extrapolation was based on the two independent surveys from two different observation points (Table 2). Counts of adult birds (both immature and mature) revealed 264 birds from Observation Point Number 1 (long axis of colony) while 226 DcC were observed along the short axis of the island from Observation Point Number 2 (Table 3).

A comparison of the numbers of nests versus the numbers of adult DcC (as observed on the ground) from each observation point is presented in Figures 5 and 6. The numbers of observed adult birds versus nests of DcC (on both the long and narrow axis of the island) were both significantly correlated ($R^2 = 0.853$, n=11, $P<0.01$ and $R^2 = 0.696$, n=11, $P<0.01$ respectively). As noted, however, we could not always distinguish between breeding and non-breeding DcC. Thus all adult birds were used for the calculation.

As expected, the colony estimate of 560 ground nests of DcC would have a range of error. The estimate of 560 nests, from the long axis of the colony, has a range of 246 to 874 nests (95% CI). The same nest estimate, as calculated from the narrow axis of the colony, has a range from 256 to 864 nests (95% CI). Note, that for the long axis calculation of SD, and thus the 95% CI, three of the eleven transects (all from the extreme periphery of the colony and essentially unsuitable habitat) with only "0" or "1" nest were not included in the analysis.

From the Saint John Museum (William Francis Ganong Collection) we were fortunate to obtain photographs of Pokeshaw Rock taken in 1920 and 1928. The 1928 photograph by H. W. Beecher Smith is quite detailed and there is no evidence of breeding by DcC

(Figure 7). The earliest breeding record was reported by H. Chiasson in 1966 (Table 1). Mr. Chiasson reportedly ascended the island, using a series of ladders, and surveyed the entire colony. His ground survey reported 100 nests of DcC. In 1970, P. A. Pearce (Canadian Wildlife Service) repeated the same feat and in four years the colony had expanded to 400 nests. Since 1970, an additional five surveys have been conducted ranging from a low of 137 nests reported in 1986 to a high of 619 nests in 2000 (Table 1). Our 2006 colony estimate of 577 DcC nests approximates the 2000 aerial survey estimate of 619 nests reported by Boyne and Hudson (2002). The 2006 estimate is also only slightly larger than the 500 estimated nests, again from aerial surveys, reported by A. D. Smith (Canadian Wildlife Service) in 1979 (Table 1).

Due to the hazardous nature of gaining access to Pokeshaw Rock, actual surveys within the colony are not recommended. The safest and viable survey options are via aerial estimates (aerial photography) or partial surveys from the mainland. Aerial surveys incur an additional cost, and are not usually done on a frequent basis. Remote observations and nest counts, as taken from the vantage points on the mainland, provide a safe and alternative means of monitoring. Photographs, and subsequent nest counts, can be taken by a local enthusiast with no personal risk or disturbance hazard to the birds. In hindsight, observations from a third vantage point with a view of the east side of the island, as seen in the H. W. Beecher Smith photo (Figure 7), would have increased the coverage of the island. The important point is having photographs with a high enough resolution to be able to count the individual nests. This paper is not a debate on the merits of digital versus conventional slide film as there are too many variables to consider. Also, the authors profess no specialized expertise in photography. Suffice to say that for our requirements, the 7.1 mega pixel digital camera did not provide enough resolution, on enlargement, to delineate individual birds or nests. The best resolution, and ability to count birds and nests, was provided by the Kodak ASA 64 slide film (Figure 8) using a 210 mm lens. Observers duplicating this survey should strive for the highest resolution available.

CONCLUSION

Pokeshaw Rock provides a unique opportunity for the general public to observe a seabird colony at a comparatively close distance without undue disturbance to the birds. Possibly local naturalists or enthusiasts may be encouraged to conduct monitoring of this colony, from a distance, and to better track fluctuations in numbers of breeding DcC. The research opportunity provided by the juxtaposition of the colony and adjacent mainland cannot be overstated. We can think of few other readily accessible viewing points where such a phenomenon can be seen and the birds remain unharmed. Our remote census compares favourably with past aerial surveys and should be a viable and cost effective alternative should local enthusiasts wish to monitor the Pokeshaw Rock Double-crested Cormorant colony.

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Table 1. Census of the Double-crested Cormorant colony undertaken on Pokeshaw Rock, Chaleur Bay, New Brunswick, from 1966 and 2006.

YEAR (date)	**Number of Pair**	**Observer/Source**
1966 (15 May)	100	H. Chiasson, ground survey on island, MNRS
1970	400	P. A. Pearce, believed to have conducted a ground survey on the island, MNRS
1979 (21 June)	500	A.D. Smith (aerial survey)
1985 (9 June)	175	L. Lemieux, MNRS
1986 (25 May)	137	A. R Lock, MNRS
2000 (1 June)	619	Boyne and Hudson (2002) (aerial survey)
2006 (6 June)	577*	MacKinnon/Kennedy (count/estimate from the mainland)

*Extrapolated (560 nests on ground plus 17 in trees)

Table 2. Double-crested Cormorant colony survey on 6 June 2006, Pokeshaw Rock, Chaleur Bay, New Brunswick. Nest count from photographs and colony size extrapolation.

Double-crested Cormorant count (nests), Long Axis of Pokeshaw Rock (~25% of island)	
Actual number of nests counted	Extrapolated Number of nests [Actual count (x 4) plus nests in trees[1]]
140	573
Double-crested Cormorant count (nests), Narrow Axis of Pokeshaw Rock (~20% of island)	
Actual number of nests counted	Extrapolated Number of nests [Actual Count (x 5) plus nests in trees[2]]
112	577

[1] 13 nest were observed in the trees
[2] 17 nest were observed in the trees

Table 3. Double-crested Cormorant colony survey on 6 June 2006, Pokeshaw Rock, Chaleur Bay, New Brunswick. Count of adult birds (breeders and non-breeders) from the Long and Narrow Axis of the island.

Double-crested Cormorant count (adult birds on ground), Long Axis of Pokeshaw Rock	224[1]
Double-crested Cormorant count (adult birds on ground), Narrow Axis of Pokeshaw Rock	179[2]

[1] An additional 40 adult birds were observed in the trees.
[2] An additional 47 adult birds were observed in the trees.

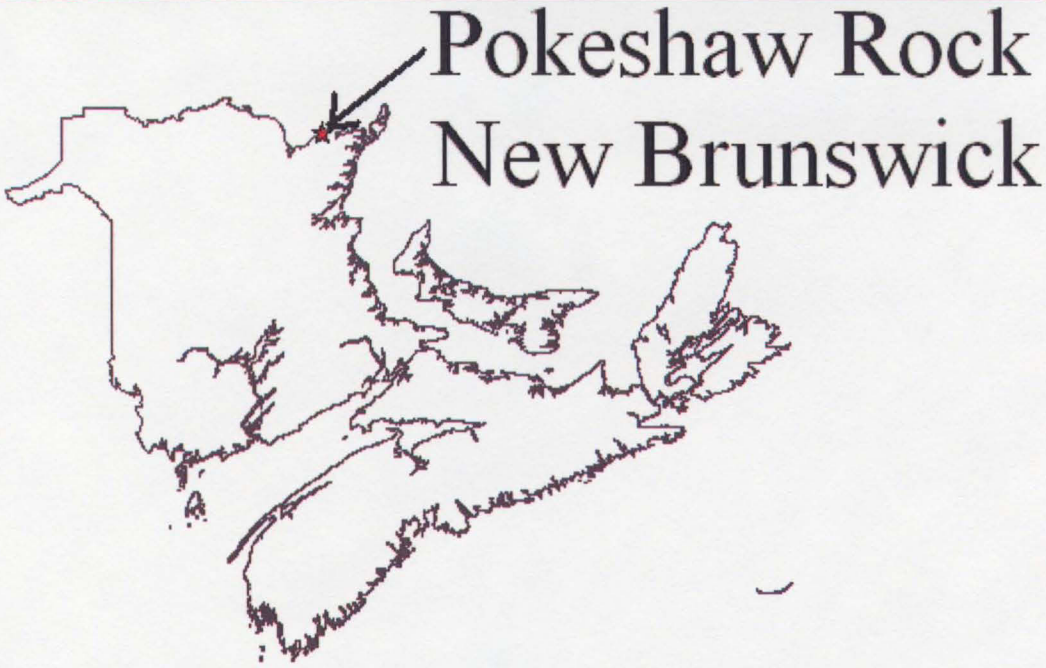

Figure 1. Pokeshaw Rock, Chaleur Bay, New Brunswick (47° 47' N 65° 15' W) as seen from the beach access road off Route No. 11.

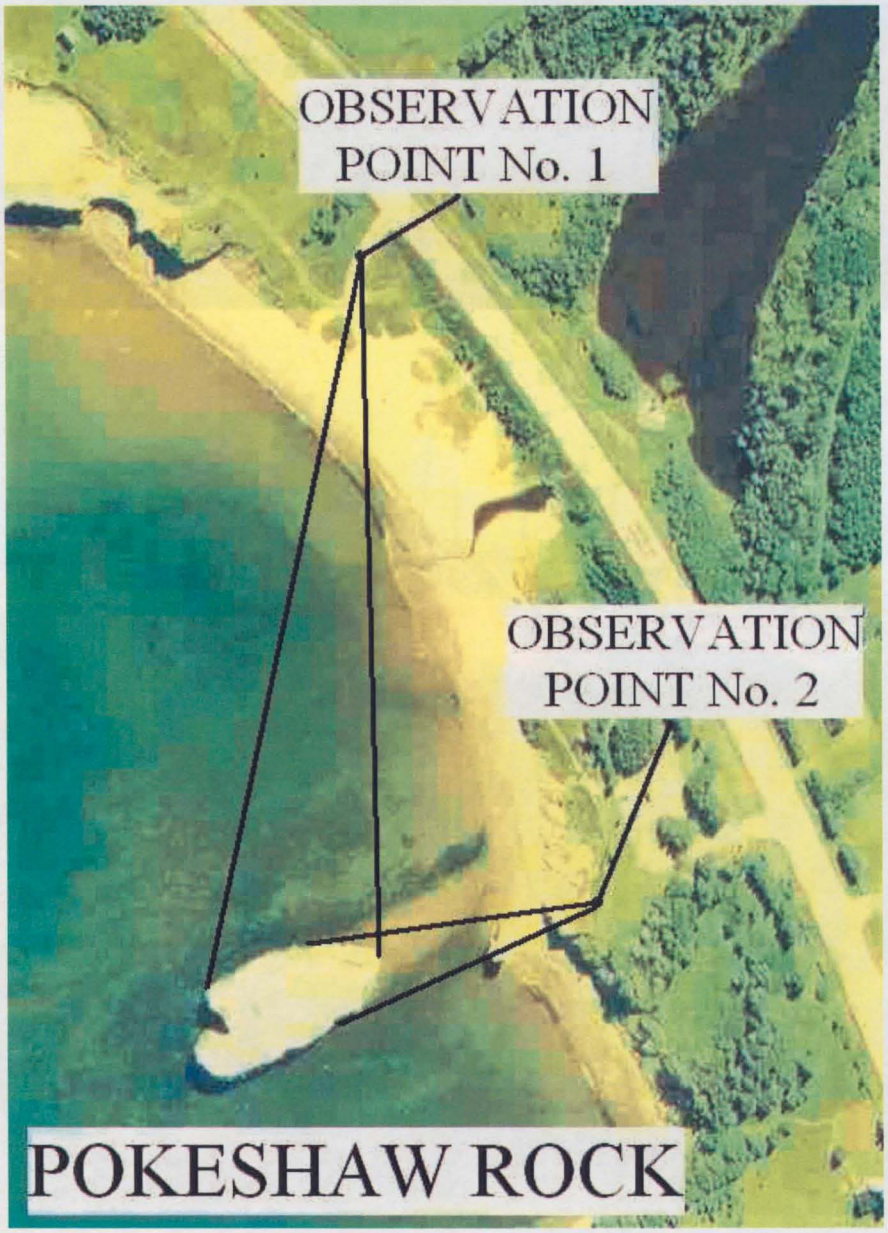

Figure 2. Pokeshaw Rock, Chaleur Bay, New Brunswick. Observation points and viewing angle. The entirety of the top of the island cannot be seen from the mainland. Observation Point No. 1 provides a view of the long axis of the island, Observation Point No. 2 provides a view of the narrow axis of the island.

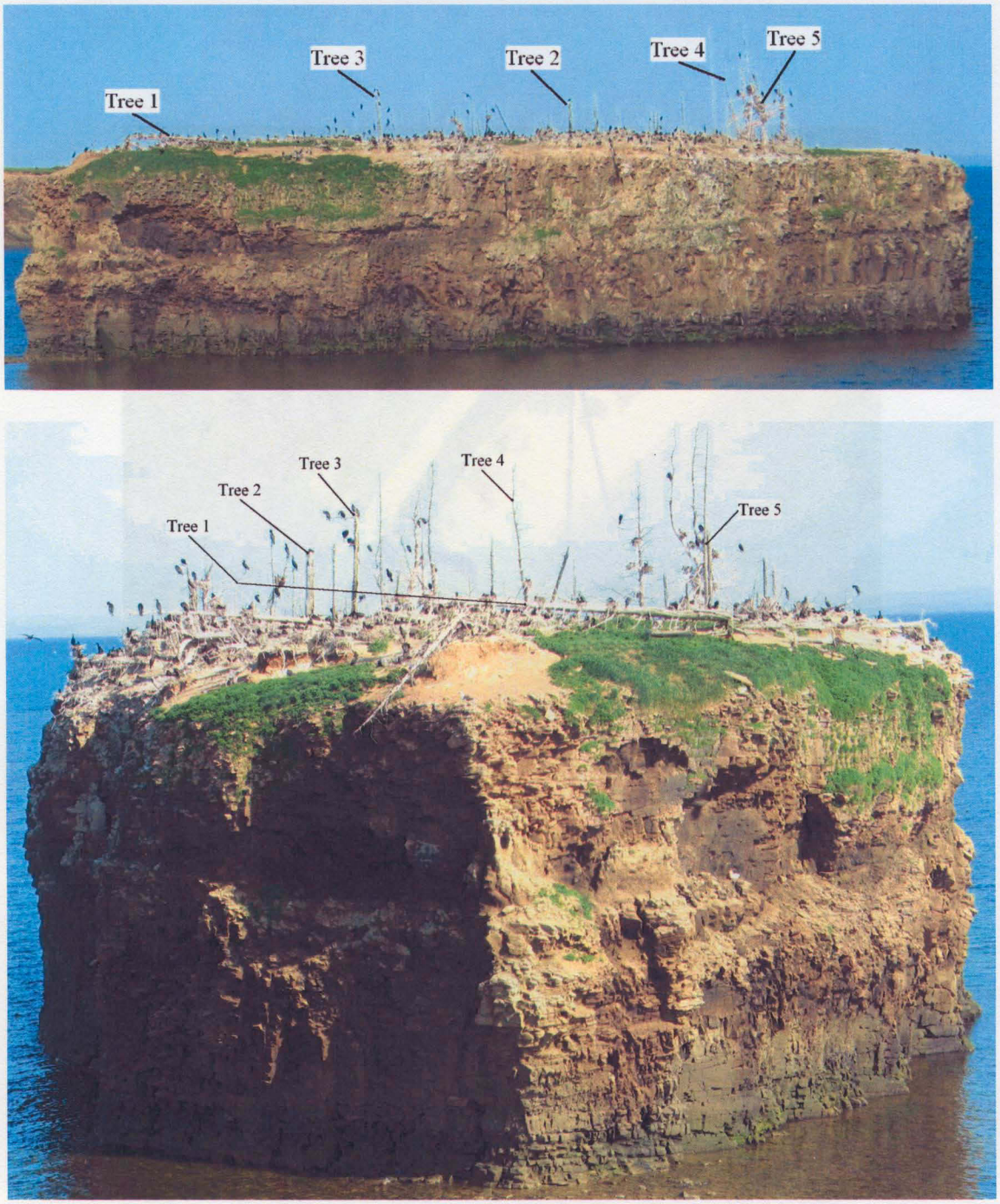

Figure 3. Double-crested Cormorant colony at Pokeshaw Rock, Chaleur Bay, New Brunswick. Top - view from road to the beach (looking west off Route No. 11), Bottom - view looking north from the Pokeshaw Picnic Park. In each photo a few trees have been "matched" (numbers 1 – 5) to show the problem with "depth perception" when censusing using photographs.

Figure 4. Photograph of a portion of Pokeshaw Rock (top) as taken from the Picnic Park using 210 mm telephoto lens. Inset (below) shows enlargement of area in dark outline; resolution is such that adult Double-crested Cormorant and young can be seen on the nests.

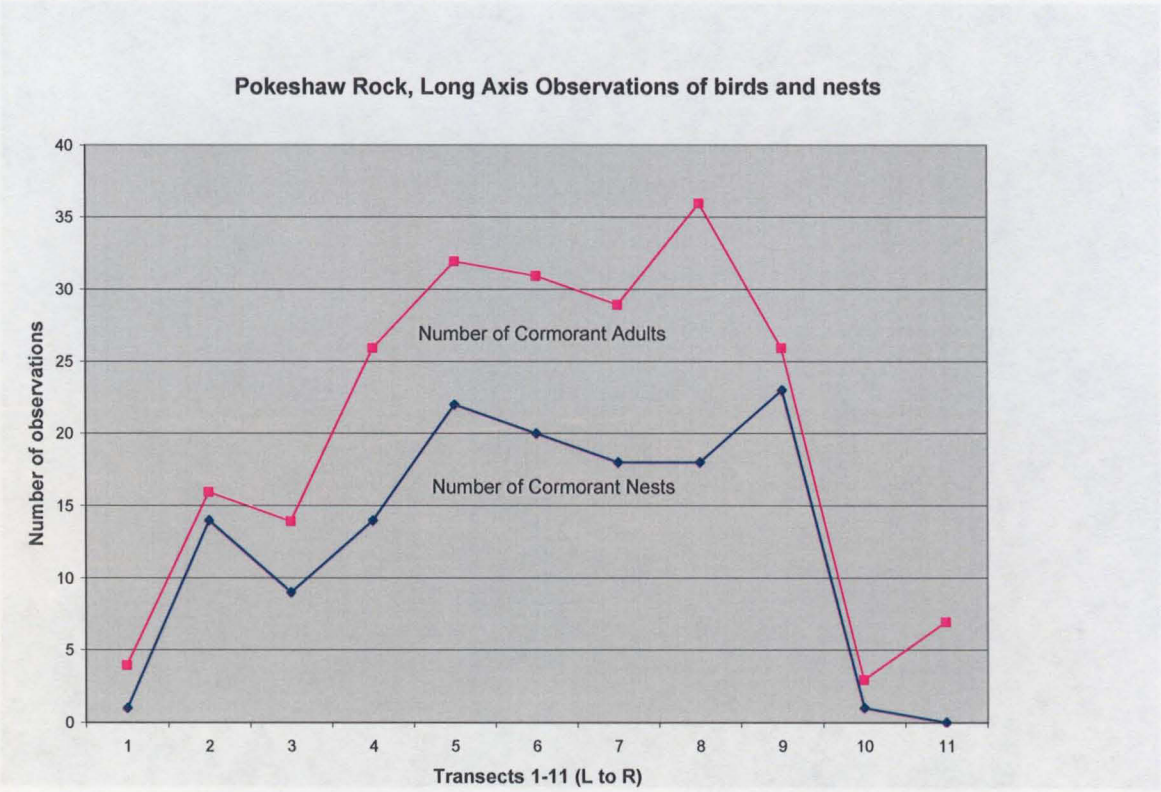

Figure 5. Distribution of Double-crested Cormorant nests and birds along eleven "photograph" transects (long axis of colony as viewed from left to right), 6 June 2006, Pokeshaw Rock, New Brunswick.

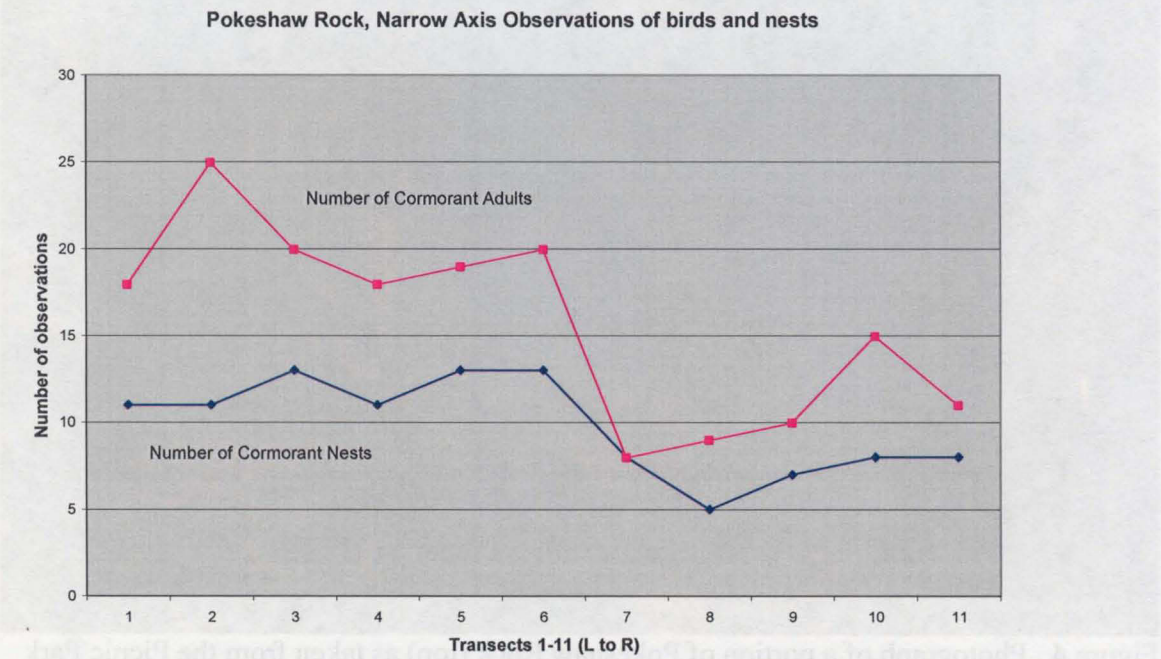

Figure 6. Distribution of Double-crested Cormorant nests and birds along eleven "photograph" transects (narrow axis of colony as viewed from left to right), 6 June 2006, Pokeshaw Rock, New Brunswick.

Figure 7. Pokeshaw Rock, New Brunswick in 1928 (H. W. Beecher Smith photo). No evidence of use by colonial nesting Double-crested Cormorant.

H. W. Beecher Smith
photograph: Pokeshaw Island, Looking East, Gloucester County,
New Brunswick, 1928
silver print
overall: 13.1 x 18 cm
William Francis Ganong Collection
1987.17.991

Courtesy the New Brunswick Museum, Saint John., N.B.
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Figure 8. Comparison of photograph resolution and ability to delineate individual birds. Top photo: Pentax K1000 using a Vivitar Series 1, 70-210 mm telephoto lens (photos taken using the 210 mm setting) with Kodak ASA 64 slide film. Bottom photo: Digital - Cannon Powershot G6 (7.1 megapixels).