

**The Effect of Bald Eagles and Boat Traffic on Nesting
Double-crested Cormorants (*Phalacrocorax auritus*)
In the Strait of Georgia**

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Abstract

It is suspected that boat traffic or Bald Eagle disturbance cause declines in Double-crested Cormorants in the Strait of Georgia. The purpose of this study was to determine the relative significance of disturbance to nesting Double-crested Cormorants from Bald Eagles and boat traffic. Double-crested Cormorants were observed from late May to late August at four sites in the Strait of Georgia: Chain Island, Mandarte Island, Crofton dolphins, and Five-fingers Island. Disturbance types included Bald Eagles, fishing boats, tourist boats, and kayaks. The total number of possible disturbances was summarized from the colony observations, as were flushing events caused by each category of disturbance. Eagles were found to disturb nesting cormorants when they came within ten metres of a nest, causing the cormorants to vacate the colony. Nesting cormorants were not observed to vacate their nests as a result of any category of boat traffic.

Introduction

Disturbance of marine fauna has become a major concern to wildlife managers. Eco-tourism in British Columbia is growing by about 10-30% annually, which means that every year there are more vessels on the water observing marine fauna. However, the effect of boat traffic on marine fauna is not known. If boat traffic is adversely affecting marine animals, then guidelines and regulations should be developed and implemented (Malcolm & Lochbaum, 1999).

Double-crested Cormorants (*Phalacrocorax auritus*) are of particular interest to wildlife managers because they are on the edge of their range in the Strait of Georgia. Furthermore, Double-crested Cormorants have not always

nested in the Strait of Georgia. In fact, it was not until 1927 that the first Double-crested Cormorant nesting record was reported (Campbell *et al.*, 1990). Moul (2000) found that along the south-east coast of Vancouver Island, the number of nesting pairs had dropped by 81% between 1987 and 1999. Moul (2000) suspected that this decline was related to human disturbance.

Anecdotal evidence from Ian Moul (2000) suggests that disturbance from boaters and Bald Eagles (*Haliaeetus leucocephalus*) are forcing cormorants off the nest, which leaves the eggs and nestlings vulnerable to predation by Glaucous-winged Gulls (*Larus glaucescens*) and Northwestern Crows (*Corvus caurinus*). Similar interactions have been documented when cormorants are forced to leave their nests by humans visiting a colony (Kury & Gochfeld, 1975).

Kury and Gochfeld (1975) described cormorant behaviour in response to human presence on the colony site. First the cormorants raised their heads; then they teetered forward; and finally they took flight. During the period of agitation, before actually vacating the nest, adult cormorants occasionally crushed eggs or pushed eggs from the nest. Sometimes cormorants regurgitated food before they took flight. This may act as a defense mechanism, because gulls and crows feed on the regurgitated fish before they prey on the eggs or young. However, by regurgitating fish there is less food for the cormorant's young (Kury and Gochfeld, 1975).

In this study I examined the effect of boats and Bald Eagles on the behaviour of Double-crested Cormorants nesting in the Strait of Georgia. Specifically, at what distance were Double-crested Cormorants flushed from their nest by boats and Bald Eagles?

Materials and Methods

Site Description

Double-crested Cormorants were observed using binoculars and a 20-45X telescope at four major breeding colonies within the Strait of Georgia: Chain Island, Mandarte Island, Crofton, and Five Fingers Island (Figure 1). The colonies were selected based on ease of observation and the presence of a

variety of boat traffic. There was also at least one active Bald Eagle nest in the vicinity of all four sites.

Chain Island is an Ecological Reserve in the Oak Bay area. Observations were made from the pullout by the Oak Bay marina, about one nautical mile from the site. Chain Island had 95 pairs of nesting Double-crested Cormorants in 2000 (Chatwin *et al.*, 2000). It is also an important nesting area for other bird species including Pelagic Cormorants (*Phalacrocorax pelagicus*), Glaucous-winged Gulls, and several passerines.

Mandarte Island is located near Sidney, BC. This large Double-crested Cormorant colony was observed from the South beach of Sidney Island, which is a distance of about one nautical mile. Mandarte Island had 215 breeding pairs of Double-crested Cormorants in 2000 (Chatwin *et al.*, 2001). It also has Glaucous-winged Gulls, Pelagic Cormorants, Pigeon Guillemots (*Cephus columba*) and many passerines nesting on it.

At the Crofton site, 104 pairs of Double-crested Cormorants nested on the pulp mill effluent dolphins in 2000 (Chatwin *et al.*, 2001). Observations were made from Shoal Island, about 200 metres from the colony. There are no other species nesting on the dolphins at this site.

Five-fingers Island, just outside Nanaimo harbour, had 15 nesting pairs of Double-crested Cormorants in 2000 (Chatwin *et al.*, 2001). The colony was observed by boat from a distance of about 50 metres. This small, rocky island also has nesting colonies of Glaucous-winged Gulls, Canada Geese (*Branta canadensis*), and Pelagic Cormorants.

Field Methodology

Double-crested Cormorant colonies were observed from late May to late August to determine the effect of disturbance by boats and other bird species. Each colony was observed for a minimum of 6 days, except for Five-fingers Island. Unfortunately the Double-crested Cormorants abandoned this colony during the course of this study (before July 7, 2000), resulting in limited data for this site. More vessel traffic was expected during weekends, as this is when

most people are enjoying their boats. To account for the extra traffic on weekends, half of the observation periods for each colony were on Saturdays or Sundays. Each observation period lasted for 6 hours between 0900 and 1600.

The number of cormorants in the nesting area was recorded at ten-minute intervals. This was done by counting the number of heads observed or the number of bodies, if the heads were tucked. The presence of eagles and boats were also recorded at this time. Boats and eagles were assigned distance codes where A was within 10 metres, B was between 11 and 50 metres, C was between 51 and 100 metres, and D was 101 metres or more. Boat traffic was further categorized as fishing, tourist, or kayaks. No distinction was made between commercial and recreational tourist boats, or between commercial and recreational fishing boats.

In addition, when a disturbance or flushing event occurred it was recorded. Since the colonies were being observed from a long distance, only the maximum response to disturbance was observed, that is, only when the cormorants vacated their nests. Furthermore, disturbance data were only recorded whenever more than the background level of birds flew away from the nesting area ($\geq 10\%$), as there were always a few birds coming and going. Data recorded included the approximate number of birds leaving the nesting area, the number of birds still at the nesting area, and the presence of boats or eagles.

Data Analysis

Each category of possible disturbance was summed to reflect the total number of potential disturbances at each colony. If more than one possible disturbance was present they were each added separately; thus if five kayaks were present at the start of a ten-minute interval, they would be considered five potential disturbances. At Five-fingers Island, the observation boat was not included as a potential disturbance, because the vessel was anchored for the duration of the observation period.

For each flushing event recorded, the possible disturbance categories that were present were noted. The total number of flushing incidents attributed to each category was totaled.

Results

The total observation time and the total number of each possible disturbance category for each colony are summarized in Table 1. Eagles were present at all four colonies. No boat traffic was observed during the one observation day at Five-fingers Island. At Chain Island, fishing boats, tourist boats and kayaks were observed, with tourist boats being the most common vessel observed. Mandarte Island had some fishing boats present, however tourist boats were the most common vessel. Tourist boats were the most abundant vessel observed at the Crofton dolphins, although fishing boats and tugboats were present. At Crofton dolphins and Chain Island, boats came within ten metres of the colonies on several occasions (Figures 2 & 3).

The total number of flushing incidents attributed to each disturbance category for each colony is summarized in Table 2. During the observation period, disturbances occurred at all of the sites except Mandarte Island. Eagles were the cause of all these disturbances; boats were not present during any of the recorded disturbances. Eagles did not disturb the cormorants until they were within ten metres of a nest. When the cormorants nearest the eagle took flight, the entire colony would flush, except during the one disturbance event at the Crofton site, where only 14% of the birds flushed. Eagles were observed eating two adult or juvenile Double-crested Cormorants at the Crofton site on July 15, 2000.

Discussion

Eagles are a major cause of disturbance at the Double-crested Cormorant colonies. When eagles came within ten metres of the cormorants, the cormorants flushed from the nest. While the cormorants are off their nests, the eggs and young are vulnerable to temperature extremes as well as predation by

crows and gulls. If a nest fails the parents may attempt to re-nest, however this is energetically costly to the parents. Moreover, young from re-nesting attempts late in the season (after August) are unlikely to survive (Campbell *et al.*, 1990).

It is interesting that Bald Eagles were observed preying on Double-crested Cormorants, as this is not mentioned in other literature. If eagles are eating cormorants or their young, it compounds the effect that they were originally thought to have on the cormorants. Not only are the eagles disturbing the cormorants and making the nests vulnerable to predation by gulls and crows, but the eagles themselves are also raiding nests.

Boat traffic was not a cause of major disturbance, as the cormorants did not leave the nest even when boat traffic came within ten metres of the colony. However, boats could be causing less observable disturbances. For example, before cormorants are frightened off their nests, they become agitated (Figure 2). During this period of agitation, cormorants could be damaging eggs or hurting young (Kury & Gochfeld, 1975).

It is a natural interaction for the eagles to disturb the cormorants, but it may be having a larger effect on the Double-crested Cormorant populations than it has historically. Breeding Bird Surveys have shown that Bald Eagle populations along BC's coast have been steadily increasing by 7.6% per year since the late 1960's (Campbell *et al.*, 2001). Furthermore, coastal BC's population of Northwestern Crows has increased by 1.8% per year (Campbell *et al.*, 2001) and gull populations have increased with increased urbanization (Mahaffy *et al.*, 1994). Populations of crows and gulls may be increasing as a result of increasing access to urban food sources, such as refuse.

We must consider why populations of cormorant predators are increasing before we can begin to understand how to manage this complex problem. Gill (1998) found that eagle nests near shrimp fisheries in the Strait of Georgia, like Crofton, have had increased nesting success. Thus, eagle populations may be increasing because they are able to prey on by catch from shrimp vessels (Gill, 1998). It is interesting that the Double-crested Cormorant population at the Crofton dolphins has also increased (Chatwin *et al.*, 2001). This suggests that

diversionary feeding may reduce the pressure of eagles preying on cormorant colonies. Diversionary feeding has been successful method of reducing Moose calf predation by Grizzly Bears, so it could work with Double-crested Cormorants and Bald Eagles (Savage, 1999).

The Five-fingers Island colony may have abandoned their nests because of disturbance by Bald Eagles or River Otters (*Lontra canadensis*). The Double-crested Cormorants at this colony were disturbed two times during six hours of observation. In contrast, the cormorants at the Chain Island site were disturbed four times in 36 hours of observation and cormorants at the Crofton site were only disturbed once during 48 hours of observation. It appears that the cormorants at Five-fingers Island were under more pressure from the eagles than cormorants at the other colonies. Furthermore several days after the birds abandoned their nests, four River Otters were observed on Five-fingers Island (Trudy Chatwin pers. comm.) River Otters are known to raid sea bird colonies (Vermeer & Rankin, 1984) and were observed raiding Pelagic Cormorant nests on Race Rocks during the breeding season of 2000 (Carol Slater pers. comm.).

This study focussed on the maximum effect that eagles and boats had on the cormorants. It can be concluded that eagles disturb cormorants, and may be responsible for the observed population declines. However, it cannot be concluded that boats did not disturb cormorants, since only the maximum response to disturbance was observed. Future studies of cormorant disturbance should examine the number of agitated cormorants on their nests before and while a boat is present. This may be a more accurate method of measuring cormorant disturbance; however, the cormorant colonies would have to be observed by boat or from blinds near the colonies. Future studies of boat disturbance may lead to management recommendations.

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Figure 1. Disturbance monitoring sites: Five Fingers Islands, Shoal Islands, Mandarte Island and Chain Islands.



Figure 2. Commercial tourist boat within ten metres of the Chain Island site (September 17, 2000). The Pelagic Cormorants appear to be agitated as they all have their heads raised.



Figure 3. Recreational fishing boat between 11 and 50 metres away from Crofton dolphins (May 31, 2000).

Table 1. Summary of total number of observation days and number of potential disturbances of Double-crested Cormorants at each colony: Chain Island, Mandarte Island, Crofton, and Five-fingers Island.

Site	Total Observation Days	Eagles	Fishing Boats	Tourist Boats	Kayaks	Tugboats
Chain	6	25	12	87	34	0
Mandarte	6	1	4	25	0	0
Crofton	8	23	41	163	0	60
Five-fingers*	1	2	0	0	0	0

* Five-fingers Island was only observed on June 17, 2000 because the birds abandoned this colony. The observation vessel was present the entire time.

Table 2. Summary of the number of flushing incidents of Double-crested Cormorants at Chain Island, Mandarte Island, Crofton, and Five-fingers Island.

Site	Eagles	Fishing Boats	Tourist Boats	Kayaks
Chain	4	0	0	0
Mandarte	0	0	0	0
Crofton	1	0	0	0
Five-fingers	2	0	0	0