

**The Effects of Egg Oiling on Fish Consumption by Double-Crested Cormorants
On Little Galloo Island, Lake Ontario**

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Introduction

Historically the eastern basin of Lake Ontario provided excellent warmwater sportfishing and is especially noted for its productive smallmouth bass fishery (Stone et al. 1951, Krester and Klatt 1981, Panek 1981, McCullough and Einhouse 1999). Recent declines in this sportfishery have coincided with rapid expansion of double-crested cormorant (*Phalacrocorax auritus*) populations in the eastern basin. Although numerous other lakewide changes have occurred in the Lake Ontario ecosystem including reduced nutrient loading, the proliferation of exotic species such as dreissenid mussels, and increases in water clarity, declines of smallmouth bass have only been identified in the eastern basin (Lantry et al. 1999). Because of the potential link between the decline of smallmouth bass in the eastern basin and increasing numbers of double-crested cormorants, a comprehensive study was conducted in 1998 to examine this relationship (Schneider et al. 1999). This study found linkages between the declining smallmouth bass populations and the increasing cormorant populations. Consequently, in 1999 the New York State

Department of Environmental Conservation (NYSDEC) initiated an experimental program to reduce the nesting success of cormorants on Little Galloo Island in the eastern basin of Lake Ontario. This effort consisted of applying corn oil to all accessible cormorant nests that contained eggs. This paper reports on the effectiveness of this approach in 1999 in reducing cormorant reproductive success and fish consumption.

Methods

NYSDEC staff began treating all accessible double-crested cormorant nests on Little Galloo Island with pure food grade corn oil beginning on 6 May 1999. The oiling process was conducted five times at 2 to 3 week intervals, ensuring each nest would be treated at least twice during the incubation period. Oil was applied from a backpack sprayer unit in sufficient volume to cover the exposed surface of each egg (approximately 6 ml/egg). The number of eggs treated per nest was recorded and each nest or group of nests were marked with spray paint to facilitate efficient movement throughout the colony as well as complete nest

coverage. Also recorded were the number of nests not treated and the number of chicks present per visit.

The diet composition of double-crested cormorants on Little Galloo Island in 1999 was examined during the chick feeding (June 17 to August 4) and post-chick feeding (August 5 to October 6) periods. Diagnostic fish remains recovered in regurgitated pellets were used to quantify diet composition. Cormorants regurgitate about one pellet per day (Craven and Lev 1987, Orta 1992, Derby and Lovvorn 1997). Consequently, the contents of a pellet approximate mean daily fish consumption. Diagnostic material and eye lenses were removed from the pellets and identified under magnification. Eye lenses were not used in species identification but were sometimes used to determine the number of fish eaten when lens numbers exceeded fish counts from otoliths and other diagnostic structures. Daily fish consumption was estimated as the mean number of fish per pellet multiplied by a fecal correction factor (1.042) (Johnson and Ross 1996).

To estimate cormorant feeding days and fish consumption by chicks from the Little Galloo colony, we used the model developed by Weseloh and Casselman (unpublished report: Fish consumption by double-crested cormorants on Lake Ontario, Burlington, Ontario). The number of cormorant feeding days is largely based on active-nest counts and estimates of reproductive success (i.e., number of fledglings/nest). Model assumptions include (1) the population of mature birds is twice that of the active-nest counts, (2) the number of immature cormorants is approximately 10% of the adult population, and (3) residence time for breeding adults, immatures, and young-of-the-year is approximately 158, 112, and 92 days, respectively. To estimate the biomass of fish consumed we assumed that cormorants consumed about 0.47 kg fish per day (Schramm et al. 1984, 1987; Weseloh and Casselman 1992). Since 0.47 kg is about 1 pound, a straight forward estimator of biomass consumed is the number of cormorant feeding days (i.e., 1 cormorant feeding day equals 1 pound of fish consumed). Because of seasonal variation in diet composition in 1999, to derive fish

consumption estimates, we apportioned the 92 chick feeding days from the Weseloh and Casselman model into 42 days when adult cormorants were actively feeding chicks (chick feeding period) and 50 days post-chick feeding. In 1999, double-crested cormorant peak nest count on Little Galloo Island was 5,681 on May 20. Fledgling productivity was estimated at 0.035 fledglings per nest on Little Galloo Island in 1999 based on counts during the field surveys. Fledgling productivity on nearby Pigeon and Snake Islands in 1999 was estimated at 1.5 chicks per nest. We estimated fish consumption for each feeding period using the number of chick feeding days (either 42 or 50), the total number of chicks present, and period specific percent diet composition and daily fish consumption estimates.

Results

A total of 1,173 pellets were examined to describe the diet composition of double-crested cormorants during the chick feeding and post-chick feeding periods (Table 1). Alewife, yellow perch, and cyprinids were the primary fish consumed by cormorants. Alewife were considerably more abundant in the diet of cormorants during the chick feeding period (64.5%) than in the post-chick feeding period (26.0%). Yellow perch and cyprinids both increased in importance in the diet during the post-chick feeding period. Mean daily fish consumption was about the same during each period (i.e., chick feeding = 7.5 fish/pellet, post-chick feeding = 7.3 fish/pellet) (Table 1).

A fledgling productivity of 0.035 chicks per nest equates to 199 cormorant chicks on Little Galloo Island in 1999. These chicks provided 18,000 cormorant feeding days. The number of feeding days for the entire cormorant colony on Little Galloo Island in 1999 was estimated to be 1.94 million. To determine the effect of a reduction in the number of chicks on cormorant feeding days, we also estimated cormorant feeding days based on a fledgling productivity of 1.5 chicks per nest (observed at nearby Pigeon and Snake Islands in 1999). Using a productivity of 1.5 chicks per nest, we estimated that 8,522 chicks would have been produced on Little Galloo Island if egg oiling had not

been done and these chicks would have provided 784,000 of the entire colony's 2.71 million cormorant feeding days. Consequently, the number of cormorant feeding days and the biomass of fish consumed by the Little Galloo colony was reduced by 766,000 days and 766,000 pounds, respectively, a 28.3% reduction for the entire colony.

Cormorant chicks on Little Galloo Island consumed an estimated 135,000 fish in 1999 (Table 2). If egg oiling had not occurred, we estimate, based on a fledgling productivity of 1.5 chicks per nest, that cormorant young-of-the-year would have consumed 5.80 million fish (Table 2). In 1999, cormorants from the Little Galloo colony consumed 17.94 million fish (Johnson et al. 2000) Consequently, egg oiling reduced consumption by an estimated 5.66 million fish including 3.39 million forage fish (mainly alewife - 2.39 million, cyprinids - 0.69 million, and slimy sculpin - 0.16 million), 1.85 million panfish (primarily yellow perch - 1.21 million, rock bass - 0.41 million, and pumpkinseed - 0.18 million), and 0.42 million gamefish (mostly smallmouth bass - 0.36 million and esocids - 0.04 million) (Table 2).

Discussion

Egg oiling appears to be an effective technique to reduce the reproductive success of double-crested cormorants on Little Galloo Island. Cormorants from the Little Galloo colony consumed 17.94 million fish in 1999 compared to 31.19 million fish in 1998 (Johnson et al. 2000). We estimate that 8,300 fewer cormorant chicks were produced on the island in 1999 because of oiling which reduced fish consumption by 766,000 lbs and 5,660,000 total fish. The reduction in biomass represented a 28.3% reduction for the Little Galloo colony and a 17.0% reduction for all eastern basin colonies. Similarly, fish consumption was reduced by 24.0% for the Little Galloo colony and 12.0% for all eastern basin colonies.

Because of seasonal variation in the diet of cormorants from the Little Galloo colony, the oiling of eggs may provide the greatest protection for those fish species that are proportionally more abundant in the diet during the chick feeding and

post-chick feeding periods than during the pre-chick feeding period. In this regard two species, alewife and smallmouth bass, may benefit the most since their contribution in the diet is substantially greater during this period than during the pre-chick feeding period. Although substantially fewer yellow perch (1.21 million) and cyprinids (0.69 million) were consumed because of egg oiling, the peak contribution in the diet of these species occurs during the pre-chick feeding period (i.e., yellow perch - 33.5%, cyprinids - 23.4%) (Johnson et al. 2000).

While the experimental program to reduce the reproductive success of double-crested cormorants on Little Galloo Island was effective in reducing fish consumption, it is too early to determine what, if any, effect that this will have on the fish community or individual species populations. A long term experimental control program coupled with cormorant population and diet studies and fish community studies is necessary to determine if reducing the reproductive success of cormorants is benefitting the fish communities in the eastern basin of Lake Ontario.

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Table 1: Percent diet composition of double-crested cormorants on Little Galloo Island during the chick and post-chick feeding periods in 1999.

	<u>Chick feeding</u>	<u>Post-chick feeding</u>
No. of pellets	598	575
Fish/pellet (adjusted)	7.5	7.3
	<u>% Composition</u>	
Yellow perch	15.5	26.5
Alewife	64.5	26.0
Cyprinid	4.7	18.7
Rock bass	5.5	8.8
Pumpkinseed	2.3	3.8
Stickelback (3-spine)	---	0.2
Slimy sculpin	1.9	3.6
Smallmouth bass	4.5	8.0
Trout perch	0.4	0.1
Ictalurid	0.1	0.7
Gizzard shad	---	2.0
Esocid	0.1	1.1
Catostomid	0.1	0.1
Darter	0.1	0.1
Walleye	0.1	0.1
Burbot	0.1	0.1
Rainbow smelt	0.1	---
White perch	---	<u>0.1</u>
Total	100.0	100.0

Table 2: Fish consumption estimates based on double-crested cormorant productivities of 0.035 (control=egg oiling) and 1.5 chicks per nest (no control) on Little Galloo Island in 1999.

<u>Species</u>	<u>No. of fish consumed</u>		
	<u>Control</u>	<u>No control</u>	<u>Difference</u>
Alewife	59,000	2,451,000	2,392,000
Yellow perch	29,000	1,240,000	1,211,000
Cyprinids	17,000	707,000	690,000
Rock bass	10,000	421,000	411,000
Smallmouth bass	9,000	370,000	361,000
Pumpkinseed	4,000	180,000	176,000
Slimy sculpin	4,000	163,000	159,000
Other	<u>3,000</u>	<u>263,000</u>	<u>260,000</u>
Total	135,000	5,795,000	5,660,000

