

**The Effects of Egg Oiling on Fish Consumption by Double-Crested Cormorants
On Little Galloo Island, Lake Ontario, in 2004**

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For over a decade Little Galloo Island (LGI) has supported the largest colony of double-crested cormorants (*Phalacrocorax auritus*) in the eastern basin of Lake Ontario. Cormorant nest counts on the island since the early 1990's have averaged about 5,600 per year reaching a high of 8,400 in 1996. Since 1992 Johnson et al. (2004) estimate that cormorants from LGI have consumed 349 million fish. The proliferation of cormorants in the eastern basin of Lake Ontario has coincided with declines in two important recreational fish species, smallmouth bass and yellow perch. Lantry et al. (2002) and Burnett et al. (2002) provide convincing evidence linking cormorant population increases to declining eastern basin smallmouth bass and yellow perch stocks. Decline of these fish stocks is evident only in the eastern basin, suggesting a localized problem which is consistent with the halo effect where large piscivorous waterbird colonies may deplete local fish stocks (Birt et al. 1987).

In 1999 the New York State Department of Environmental Conservation (NYSDEC) initiated an experimental program to control the reproductive success of cormorants nesting on LGI. The program consists of spraying cormorant eggs with corn oil. We report on the effectiveness of the sixth

year of control measures that were carried out in 2004 with regard to fish consumption.

Methods

NYSDEC staff began treating accessible double-crested cormorant nests on Little Galloo Island with corn oil beginning on May 4, and ending July 7, 2004. The oiling process was conducted five times on each nest with eggs. 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 2004 was examined during the chick feeding (June 16 to July 21) and post-chick feeding (August 4 to October 12) 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-year (YOY) 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 straightforward 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, 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 2004, double-crested cormorant peak nest count on Little Galloo Island was 3,967. Fledgling productivity was estimated at 0.05 fledglings per nest on Little Galloo Island in 2004 based on counts during the field surveys. Fledgling productivity on nearby Snake Island in 2004 was estimated at 1.8 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, the period specific percent diet composition by number, and daily fish consumption estimates.

Results

In all, 1,350 pellets were examined to describe the diet composition of double-crested cormorants on LGI during the chick and post-chick feeding periods in 2004 (Table 1). Alewife was the major prey species followed in contribution by yellow perch, rock bass, cyprinids, smallmouth bass, pumpkinseed, and slimy sculpin. The contribution of alewife in the diet declined from the chick (52.6%) to the post-chick (41.2%) feeding period, whereas most other important species increased. Mean daily fish consumption (i.e. number of fish per pellet) was consistent during the chick feeding period (9.2) and the post-chick feeding periods (9.1).

About 200 cormorant chicks were fed by adults and fledged on LGI from 3,967 nests in 2004, a productivity of 0.05 chicks per nest. Chicks accounted for 18,400 cormorant feeding days from early June to mid October (Table 2). The total number of cormorant feeding days by the LGI colony in 2004 was estimated at 1.36 million (Table 2). We estimated the number of chicks that would have been produced on LGI from 3,967 nests in 2004 in the absence of reproductive suppression (i.e. egg oiling) by using a chick productivity estimate of 1.8 chicks per nest that was observed at nearby Snake Island in 2004. If reproductive suppression had not been attempted, we estimate that 7,141 cormorant chicks would have been produced on LGI in 2004, a reduction of 97 percent. The number of chick feeding days by the LGI colony was also reduced by 97 percent (656,972 to 18,400). For the entire LGI colony in 2004 reproductive suppression reduced the total number of cormorant feeding days from 2.0 million to 1.36 million (32.0%) and the number of fish consumed

from 21.50 million to 15.66 million (27.2%) (Table 2). The relative magnitude of the reduction in fish consumption caused by reproductive suppression at LGI in 2004 was consistent with what was achieved in the previous three years (Figure 1).

We estimate that the 200 cormorant chicks produced on LGI in 2004 consumed about 168,000 fish (Table 3). If reproductive suppression was not carried out and 7,141 cormorant chicks were produced on LGI in 2004 we estimate that these chicks would have consumed 6.01 million fish (Table 3). Consequently, reproductive suppression reduced fish consumption by 5.84 million fish in 2004. Using diet composition information for the chick and post-chick feeding periods, the reduced fish consumption represented 2.71 million alewife, 1.62 million yellow perch, 0.47 million rock bass, 0.33 cyprinids, 0.30 million smallmouth bass, 0.17 million pumpkinseed, 0.11 million round goby and 0.09 million slimy sculpin (Table 3).

Discussion

Since the egg oiling program was initiated in 1999 the number of cormorant nests has decreased from 5,681 to 3,967. This report deals only with the direct effects of oiling in terms of reducing consumption by chicks. A substantial indirect effect involves the general reduction in cormorant population abundance due to reduced recruitment.

Results achieved by the double-crested cormorant reproductive suppression program on LGI since 1999 have been remarkably consistent. Chick productivity has been reduced from an average of about 2.00 chicks per nest (1992-1998) to 0.06 chicks per nest (1999-2003), a 97 percent reduction. Since initiated in 1999, egg oiling has resulted, on average, in a 96.2% (range 93.3% to 98.0%) reduction in cormorant chick production, a 28.7% (range 23.9% to 32.2%) reduction in cormorant feeding days, and a 24.8% (range 19.1% to 28.6%) reduction in total fish consumption (Johnson et al. 2000, 2001, 2002, 2003, 2004).

We estimate that the cormorant reproductive

suppression program on LGI has reduced fish consumption by the colony by 35.2 million fish since it was initiated in 1999. Included in this estimate are approximately 14.1 million yellow perch and 2.0 million smallmouth bass that were not consumed by cormorants. These two species are especially important since declines in their abundance in the eastern basin of Lake Ontario have been associated with cormorant population increases (Burnett et al. 2002, Lantry et al. 2002).

Acknowledgments

We thank Brian Boyer, Nicole Bearup, Russ McCullough, Irene Mazzocchi, Jennifer Scofield and Brian Edmonds for their efforts in collecting and processing samples and Jerry Spaziani for boat transport.

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Table 1. Percent diet composition of double-crested cormorants on Little Galloo Island during the chick (6/16/04 to 7/21/04) and post-chick (8/4/04 to 10/12/04) feeding periods in 2004.

| | <u>Chick</u> | <u>Post-chick</u> |
|------------------------|--------------|-------------------|
| No. of pellets | 450 | 900 |
| Fish/pellet (adjusted) | 9.2 | 9.1 |
| <hr/> | | |
| Alewife | 52.6 | 41.2 |
| Yellow perch | 24.7 | 29.8 |
| Rock bass | 8.6 | 7.6 |
| Cyprinids | 4.3 | 6.8 |
| Smallmouth bass | 4.8 | 5.3 |
| Pumpkinseed | 1.9 | 3.7 |
| Slimy sculpin | 1.5 | 1.5 |
| Ictalurid | 0.1 | 0.9 |
| Catostomid | 0.2 | 0.3 |
| Esocid | 0.1 | 0.1 |
| Round goby | 1.0 | 2.6 |
| Other | 0.2 | 0.2 |
| <hr/> | | |
| | 100.0 | 100.0 |

Table 2. Estimated number of chicks produced, chick feeding days, total cormorant feeding days, and the number of fish eaten based on chick productivities of 0.05 (control = egg oiling) and 1.8 chicks per nest (no control) on Little Galloo Island in 2004.

| Action | No. of chicks | No. of chick feeding days | Total cormorant feeding days | No. of fish eaten |
|----------------------|---------------|---------------------------|------------------------------|-------------------|
| No control | 7,141 | 656,972 | 2.00 million | 21.50 million |
| Control (egg oiling) | 200 | 18,400 | 1.36 million | 15.66 million |
| Difference | 6,941 | 638,572 | 0.64 million | 5.84 million |

Table 3. Fish consumption estimates for double-crested cormorant chicks based on chick productivities of 0.05 (control = egg oiling) and 1.8 chicks per nest (no control) on Little Galloo Island in 2004.

| Species | Number of fish consumed | | |
|-----------------|-------------------------|---------------|---------------|
| | Control | No control | Difference |
| Alewife | 78,000 | 2,790,000 | 2,712,000 |
| Yellow perch | 46,000 | 1,668,000 | 1,622,000 |
| Rock bass | 14,000 | 484,000 | 470,000 |
| Cyprinids | 9,000 | 340,000 | 331,000 |
| Smallmouth bass | 9,000 | 305,000 | 296,000 |
| Pumpkinseed | 5,000 | 173,000 | 168,000 |
| Round goby | 3,000 | 112,000 | 109,000 |
| Slimy sculpin | 3,000 | 90,000 | 87,000 |
| Other | <u>1,000</u> | <u>48,000</u> | <u>47,000</u> |
| | 168,000 | 6,010,000 | 5,842,000 |

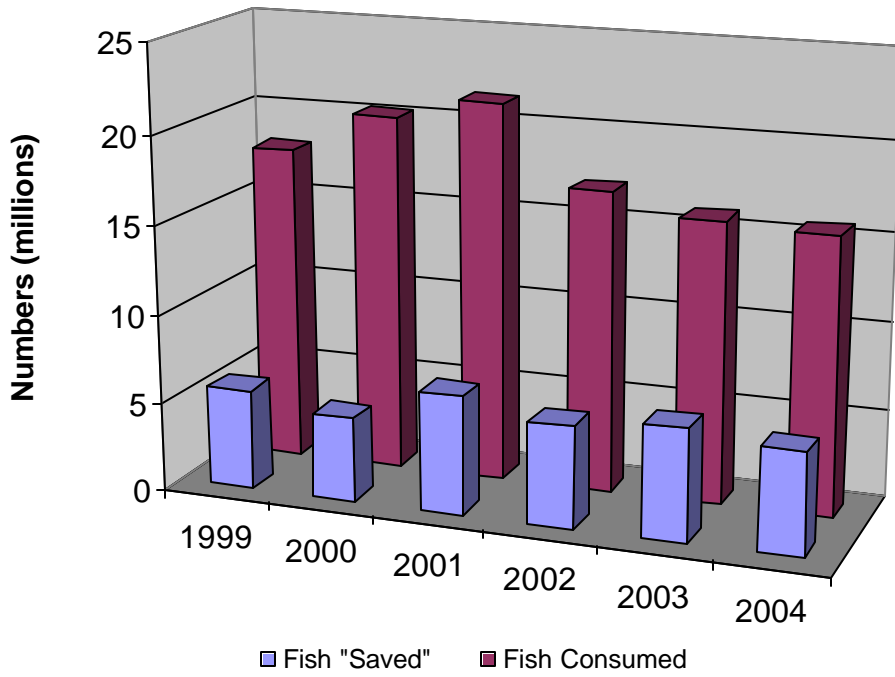


Figure 1. Estimated numbers of fish consumed by double-crested cormorants and estimated number of fish "saved" by cormorant reproductive suppression since 1999 on Little Galloo Island.