

## The Effects of Egg Oiling on Fish Consumption by Double-Crested Cormorants On Little Galloo Island, Lake Ontario in 2001<sup>1</sup>

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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 6,000 per year reaching a high of 8,400 in 1996. Since 1992 Johnson et al. (2002) estimate that cormorants from LGI have consumed 316 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. (In press) and Burnett et al. (In press) provide convincing evidence linking cormorants 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 vegetable oil. We report on the effectiveness of the third year of control measures that were carried out in 2001.

### Methods

NYSDEC staff began treating all accessible double-crested cormorant nests on Little Galloo Island with pure food grade vegetable oil beginning on May 15, 2001. The oiling process was conducted four times at 2 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 2001 was examined during the chick feeding (June 12 to July 18) and post-chick feeding (August 1 to October 10) 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 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, 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 2001, double-crested cormorant peak nest count on Little Galloo Island was 5,440. Fledgling productivity was estimated at 0.074 fledglings per nest on Little Galloo Island in 2001 based on counts during the field surveys. Fledgling productivity on nearby Pigeon and Snake Islands in 2001 was estimated at 1.3 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**

In all 1,368 pellets were examined to describe the diet composition of double-crested cormorants on LGI during the chick and post-chick feeding periods in 2001 (Table 1). Alewife was the major prey species followed in contribution by yellow perch, cyprinids, rock bass,

smallmouth bass, pumpkinseed and slimy sculpin. The contribution of alewife in the diet declined from the chick (63.0%) to the post-chick (44.5%) feeding period whereas most other important species (except slimy sculpin) increased. Mean daily fish consumption (i.e. number of fish per pellet) was similar (10.9 versus 11.1) between feeding periods (Table 1).

Almost 400 cormorant chicks were fledged on LGI from 5,440 nests in 2001, a productivity of 0.074 chicks per nest. Chicks accounted for 36,800 cormorant feeding days from early June to late September (Table 2). The total number of cormorant feeding days by the LGI colony in 2001 was estimated at 1.88 million (Table 2). We estimated the number of chicks that would of been produced on LGI from 5,440 nests in 2001 in the absence of reproductive suppression (i.e. egg oiling) by using a chick productivity estimate of 1.3 chicks per nest that was observed at nearby Pigeon and Snake Islands in 2001. If reproductive suppression was not attempted we estimate that 7,072 cormorant chicks would have been produced on LGI in 2001, a reduction of 94 percent. The number of chick feeding days by the LGI colony was also reduced by 94 percent (650,624 to 36,800). For the entire LGI colony in 2001 reproductive suppression reduced the total number of cormorant feeding days from 2.49 million to 1.88 million (24.5%) and the number of fish consumed from 28.22 million to 21.46 million (24.0%) (Table 2). The relative magnitude of the reduction in fish consumption caused by reproductive suppression at LGI in 2001 was consistent with what was achieved in the previous two years (Figure 1).

We estimate that the 400 cormorant chicks produced on LGI in 2001 consumed about 405,000 fish (Table 3). If reproductive suppression was not carried out and 7,072 cormorant chicks were produced on LGI in 2001 we estimate that these chicks would have consumed 7.16 million fish (Table 3). Consequently, reproductive suppression reduced fish consumption by 6.76 million fish in 2001. Using diet composition information for the chick and post-chick feeding periods the reduced fish consumption represented 3.57 million alewife, 1.33 million yellow perch, 0.44 million cyprinids, 0.44 million rock bass, 0.33 million smallmouth bass, 0.27 million pumpkinseed, and 0.23 million slimy sculpin (Table 3).

## Discussion

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 (0.04) chicks per nest (1999-2001), a 98 percent reduction (Johnson et al. In press). Reproductive success of cormorants on LGI in 2001 (0.074 chicks per nest) was higher than in the previous two years of the reproductive suppression program (0.036 in 1999 and 0.039 in 2000) and was likely attributable to either late nesting or tree nestings. Since initiated in 1999 egg oiling has resulted, on average, in a 96.2% (range 94.3% to 97.7%) reduction in cormorant chick production, a 25.6% (range 23.9% to 28.3%) reduction in cormorant feeding days, and a 22.4% (range 19.1% to 24.1%) reduction in total fish consumption (Johnson et al. 2000, 2001).

We estimate that the cormorant reproductive suppression program on LGI has reduced fish consumption by the colony by 17.26 million fish since it was initiated in 1999. Included in this estimate are approximately 3.97 million fewer yellow perch and 1.10 million fewer 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 has been associated with cormorant population increases (Burnett et al. In press, Lantry et al. 1999, Lantry et al. In press).

Johnson et al. 2000, 2001 speculated that because of temporal variation in the diet composition by the LGI double-crested cormorant colony two species, alewife and smallmouth bass, benefitted the most from the reproductive suppression program. Compared to the previous two years of the program (i.e. 1999, 2000) limited temporal variation in the diet composition by LGI cormorants in 2001 occurred (Johnson et al. 2002). This change in temporal feeding pattern in 2001 had little impact on potential consumption of smallmouth bass since the temporal trend in consumption (i.e. increased bass consumption over the season) did not change from previous years. However, there were probably fewer benefits to alewife in 2001 (versus previous years) since there was no dramatic increase by this species in the diet following the pre-chick feeding period.

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## References

- Birt, V.L. T.B. Birt, D. Goulet, D.K. Cairns, and W.A. Montevecchi. 1987. Ashmole's halo: direct evidence for prey depletion by a seabird. *Marine Ecology Progress Series* 40:205-208.
- Burnett, J.A.D., N.H. Ringer, B.F. Lantry and J.H. Johnson. In press. Impact of double-crested cormorant (*Phalacrocorax auritus*) piscivory on the yellow perch (*Perca flavescens*) populations in the eastern basin of Lake Ontario. *Journal of Great Lakes Research*.
- Craven, S.R. and E. Lev. 1987. Double-crested cormorants in the Apostle Islands, Wisconsin, USA: population trends, food habits, and fishery depredations. *Colonial Waterbirds* 10:64-71.
- Derby, C.E. and J.R. Lovvorn. 1997. Comparison of pellets versus collected birds for sampling diets of double-crested cormorants. *Condor* 99:549-553.
- Johnson, J.H. and R.M. Ross. 1996. Pellets versus feces: their relative importance in describing the food habits of double-crested cormorants. *Journal of Great Lakes Research* 22:795-798.
- Johnson, J.H., R.M. Ross, and J. Farquhar. 2000. The effects of egg oiling on fish consumption by double-crested cormorants on Little Galloo Island, Lake Ontario. Report to Lake Ontario Committee of the Great Lakes Fishery Commission, Section 15, pages 1-7.
- Johnson, J.H., R.M. Ross, and J. Farquhar. 2001. The effects of egg oiling on fish consumption by double-crested cormorants on Little Galloo Island, Lake Ontario in 2000. Section 15, Pages 1-7. Report to Lake Ontario Committee of the Great Lakes Fishery Commission. New York State Department of Environmental Conservation. Albany, NY
- Johnson, J.H., R.M. Ross, R.D. McCullough, and B. Edmonds. 2002. Diet composition and fish consumption

of double-crested cormorants from the Little Galloo Island colony of eastern Lake Ontario in 2001. This volume.

Johnson, J.H., R.M. Ross, and R. McCullough. In Press. Little Galloo Island, Lake Ontario: a review of nine years of double-crested cormorant diet and fish consumption information. *Journal of Great Lakes Research*.

Lantry, B.F., T.H. Eckert and C.P. Schneider. 1999. The relationship between the abundance of smallmouth bass and double-crested cormorants in the eastern basin of Lake Ontario. Section 12-1 to 12-10 in Final Report: To assess the impact of double-crested cormorant predation on smallmouth bass and other fishes of the eastern basin of Lake Ontario. New York State Department of Environmental Conservation, Albany, NY.

Lantry, B.F., T.H. Eckert, C.P. Schnieder, A.S. Schiavone, R.D. McCullough, and J.H. Johnson. In Press. The relationship between the abundance of smallmouth bass and double-crested cormoants in the eastern basin of Lake Ontario. *Journal of Great Lakes Research*.

Orta, J. 1992. Family Phalacrocoracide (Cormorants). Pages 326-353 in J. Del Hoyo. A. Elliot, and J. Sargatal (eds.), *Handbook of the Birds of the World, Vol. 1*. Lynx Editions. Barcelona. 696 pp.

Schramm, H.L., B. French, and M. Ednoff. 1984. Predation of channel catfish (*Ictalurus punctatus*) by Florida double-crested cormorants, (*Phalacrocorax auritus floridanus*). *Progressive Fish Culturist* 46:41-43.

Schramm, H.L., M.W. Callopy, and E. A. Okrah. 1987. Potential problems of bird predation for fish culture in Florida. *Progressive Fish Culturist* 49:44-49.

Weseloh, D.V. and J. Casselman. 1992. Calculated fish consumption by double-crested cormorants in eastern Lake Ontario. *Colonial Waterbird Society Bulletin* 16(2):63-64.

**Table 1:** Percent diet composition of double-crested cormorants on Little Galloo Island during the chick (6/12/01 to 7/18/01) and post-chick (8/1/01 to 10/10/01) feeding periods in 2001.

	<u>Chick</u>	<u>Post-chick</u>
No. of pellets	739	629
Fish/pellet (adjusted)	10.9	11.1
Alewife	63.0	44.5
Yellow perch	14.7	23.8
Cyprinids	4.0	8.6
Rock bass	4.9	7.9
Smallmouth bass	4.3	5.9
Pumpkinseed	1.9	5.6
Slimy sculpin	5.2	1.7
Ictalurid	0.1	0.8
Three-spine stickleback	0.3	0.5
Catostomid	0.3	0.5
Esocid	<0.1	<0.1
Trout-perch	1.2	<0.1
Other	0.1	0.1
	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 0.074 (control = egg oiling) and 1.3 chicks per nest (no control) on Little Galloo Island in 2001.

Action	No. of chicks	No. of chick feeding days	Total cormorant feeding days	No. of fish eaten
No control	7,072	650,624	2.49 million	28.22 million
Control (egg oiling)	400	36,800	1.88 million	21.46 million
Difference	6,672	613,824	0.61 million	6.76 million

**Table 3:** Fish consumption estimates for double-crested cormorant chicks based on chick productivities of 0.055 (control = egg oiling) and 1.3 chicks per nest (no control) on Little Galloo Island in 2001.

Species	Number of fish consumed		
	Control	No control	Difference
Alewife	214,000	3,787,000	3,573,000
Yellow perch	80,000	1,410,000	1,330,000
Cyprinids	27,000	467,000	440,000
Rock bass	27,000	469,000	442,000
Smallmouth bass	21,000	351,000	330,000
Pumpkinseed	16,000	281,000	265,000
Slimy sculpin	13,000	238,000	222,000
Other	7,000	161,000	154,000
	405,000	7,163,000	6,759,000

**Figure 1.** Estimated numbers of fish consumed by double-crested cormorants from 1992 to 2001 and estimated number of fish “saved” by cormorant reproductive suppression since 1999 on Little Galloo Island.

