The Effects of Egg Oiling on Fish Consumption by Double-Crested Cormorants On Little Galloo Island, Lake Ontario in 2005

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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 5,450 per year reaching a high of 8,400 in 1996. Since 1992 Johnson et al. (2005) estimate that cormorants from LGI alone have consumed 365 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. Here we report on the effectiveness of the seventh year of control measures that were carried out in 2005 with regard to fish consumption.

Methods

NYSDEC staff began treating accessible double-crested cormorant nests on LGI with corn oil beginning on May 10 and ending July 7, 2005. 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 or 0.2 oz/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 2005 was examined during the chick feeding (June 15 to July 19) and post-chick feeding (August 19 to October 2) 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. We adjusted the number of cormorant feeding days and total number of fish consumed to account for 686 cormorants (666 adults, 20 immatures) culled at LGI (5/27/05 and 6/15/05) as part of NYSDEC management programs. To account for the absence of these birds in determining the effects of egg oiling on fish consumption we subtracted 333 nests (50% of the number of adult birds that were culled) from the total nest count. 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, 1,043 pellets were examined to describe the diet composition of double-crested cormorants on LGI during the chick and post-chick feeding periods in 2005 (Table 1). Round goby was the major prey species followed in contribution by alewife, yellow perch, rock bass, cyprinids, smallmouth bass, pumpkinseed, and slimy sculpin. The contribution of round goby in the diet was substantially higher during the post-chick feeding period. Mean daily fish consumption (i.e. number of fish per pellet) was lower during the chick feeding period (9.5) than during the post-chick feeding period (13.5).

The removal of 686 mostly adult cormorants from the LGI population reduced the number of cormorant feeding days by about 65,000 and reduced total fish consumption by 800,000. Consequently, these feeding days and number of fish were not considered in estimating the effects of egg oiling.

In 2005, double-crested cormorant peak nest count on Little Galloo Island was 3,401. 300 cormorant chicks were fed by adults and fledged on LGI from 3,068 nests in 2005, a productivity of 0.10 chicks per nest. Chicks accounted for 27,600 cormorant feeding days from early June to mid October (Table 2). The total number of cormorant feeding days by the LGI colony in 2005 was estimated at 1.11 million (Table 2). We estimated the number of chicks that would have been produced on LGI from 3,068 nests in 2005 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 2005. If egg oiling was not undertaken, we estimate that 5,523 cormorant chicks would have been produced on LGI in 2005, a reduction of 95 percent. The number of chick feeding days by the LGI colony was also reduced by 95 percent (508,116 to 27,600). For the entire LGI colony in 2005 reproductive suppression reduced the total number of cormorant feeding days from 1.65 million to 1.11 million (33.0%) and the number of fish consumed from 20.0 million to 14.6 million (27%) (Table 2). The relative magnitude of the reduction in fish consumption caused by reproductive suppression at LGI in 2005 was consistent with what was achieved in the previous three years (Figure 1).

We estimate that the 300 cormorant chicks produced on LGI in 2005 consumed about 325,000 fish (Table 3). If egg oiling was not carried out and 5,523 cormorant chicks were produced on LGI in 2005 we estimate that these chicks would have consumed 5.73 million fish (Table 3). Consequently, egg oiling reduced fish consumption by 5.4 million fish in 2005. Using diet composition information for the chick and post-chick feeding periods, the reduced fish consumption represented 2.74 million round goby, 1.36 million alewife, 0.57 million yellow perch, 0.22 million cyprinids, 0.18 million rock bass, 0.12 million slimy sculpin and 0.10 million smallmouth bass (Table 3).

Discussion

Since the egg oiling program was initiated in 1999 the number of cormorant nests at LGI has decreased from 5,681 to 3,401. 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 0.07 chicks per nest (1999-2005), a 97% reduction. Since initiated in 1999, egg oiling has resulted in: (1) a 96.0% (range 93.3% to 98.0%) reduction in cormorant chick production, (2) a 29.3% (range 23.9% to 32.7%) reduction in cormorant feeding days, and (3) a 25.1% (range 19.1% to 28.6%) reduction in total fish consumption (Johnson et al. 2000, 2001, 2002, 2003, 2004, 2005).

We estimate that the cormorant reproductive suppression program on LGI has reduced fish consumption by the colony by 40.6 million fish since it was initiated in 1999. Included in this estimate are approximately 8 million yellow perch and 2.1 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).

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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. 2002. 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 28:202-211.

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 in 1999. Section 15 *in* 1999 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee.

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 *in* 2000 NYSDEC Annual Report0, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to

the Great Lakes Fishery Commission's Lake Ontario Committee.

Johnson, J.H., R.M. Ross, and J. Farquhar. 2002. The effects of egg oiling on fish consumption by double-crested cormorants on Little Galloo Island, Lake Ontario in 2001. Section 15 *in* 2001 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee.

Johnson, J.H., R.M. Ross, and J. Farquhar. 2003. The effects of egg oiling on fish consumption by double-crested cormorants on Little Galloo Island, Lake Ontario in 2002. Section 15 *in* 2002 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee.

Johnson, J.H., R.M. Ross, and J. Farquhar. 2004. The effects of egg oiling on fish consumption by double-crested cormorants on Little Galloo Island, Lake Ontario in 2003. Section 15 *in* 2003 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee.

Johnson, J.H., R.M. Ross, and J. Farquhar. 2005. The effects of egg oiling on fish consumption by double-crested cormorants on Little Galloo Island, Lake Ontario in 2004. Section 15 *in* 2004 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee.

Lantry, B.F., T.H. Eckert, C.P. Schneider, and J.R. Chrisman. 2002. The relationship between the abundance of smallmouth bass and double-crested cormorants in the eastern basin of Lake Ontario. Journal of Great Lakes Research 28:193-201.

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 (6/15/05 to 7/19/05) and post-chick (8/19/05 to 10/2/05) feeding periods in 2005.

	Chick	Post-chick
No. of pellets	557	486
Fish/pellet (adjusted)	9.7	13.5
Round goby	5.0	78.2
Alewife	62.4	2.5
Yellow perch	13.6	9.3
Rock bass	7.7	0.6
Cyprinids	1.1	5.8
Slimy sculpin	3.9	1.1
Smallmouth bass	4.1	0.4
Pumpkinseed	1.0	0.6
Catostomid	0.4	0.1
Ictalurid	0.1	0.3
Esocid	0.1	0.1
Other	0.6	1.0
	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 0.10 (control = egg oiling) and 1.8 chicks per nest (no control) on Little Galloo Island in 2005.

Action	No. of chicks	No. of chick feeding days	Total cormorant feeding days	No. of fish eaten
No control	5,523	508,116	1.65 million	20.0 million
Control (egg oiling)	300	27,600	1.11 million	14.6 million
Difference	5,223	480,516	0.54 million	5.4 million

Table 3: Fish consumption estimates for double-crested cormorant chicks based on chick productivities of 0.10 (control = egg oiling) and 1.8 chicks per nest (no control) on Little Galloo Island in 2005.

	Number of fish consumed		
Species	Control	No control	Difference
Round goby	165,000	2,908,000	2,743,000
Alewife	82,000	1,443,000	1,361,000
Yellow perch	34,000	601,000	567,000
Cyprinids	13,000	229,000	216,000
Rock bass	11,000	195,000	184,000
Slimy sculpin	7,000	126,000	119,000
Smallmouth bass	6,000	103,000	97,000
Other	5,000	86,000	81,000
Pumpkinseed	2,000	34,000	32,000
	325,000	5,725,000	5,400,000

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.