Intercolony and Regional Movements of Double-crested Cormorants Breeding In Eastern Lake Ontario-Research Report for Calendar Year 2000

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This report summarizes the research activities associated with a cooperative research study between USDA's National Wildlife Research Center and the New York State Department of Environmental Conservation (Cooperative Service Agreement Number 00-7407-0399 [RA]).

Abstract: Migratory paths of North American waterbirds have been traditionally evaluated by relocating birds banded as nestlings. Although over 8,000 banded Double-crested Cormorants (*Phalacrocorax auritus*) have been recovered in North America since 1923, the movements of wintering and breeding cormorants remain poorly understood. In addition to impacts to southeastern aquacultural production, Double-crested Cormorants may also negatively impact other fisheries, including those in the Great Lakes region of the United States. Localized breeding-colony control activities were implemented in eastern Lake Ontario in 1999 to reduce such impacts. We initiated a two-year satellite telemetry study (n = 25 per year) in May 2000 to determine cormorant emigration, reproductive success, nest-site fidelity, and site-specific foraging distribution following control activities at Little Galloo Island in western New York. Preliminary data suggest that cormorants remained near the breeding colony from May- September 2000. Two groups did, however, emigrate from Little Galloo Island in July and were observed near Montreal, Quebec and Oneida Lake, NY. When completed, these studies will collectively provide a biological basis for the management of cormorant impacts to commercial and recreational fisheries.

Background and Justification

Double-crested cormorants (DCCO) have been observed to breed in nearly each state and province east of Texas and Manitoba. Cormorants traditionally (late 19th and early 20th centuries) bred in northern United States, including the Great Lakes region of the U.S. and Canada, and wintered in the Gulf Coast region (Lewis 1929). Several fish-eating birds (including cormorants) and other colonial waterbirds were negatively affected by compromised environmental quality throughout their ranges in the 1960's and 1970's.

Excessive phosphorus in the Great Lakes region in the 1960's resulted from sewage treatment effluents, urban and agricultural runoff, and popular use of organophosphate chemicals. Available phosphorus declined in the 1970's and early 1980's, thus creating moderate phosphorus available for aquatic productivity. Thus, opportunities were great for fish-eating birds and recreational fisherman in the Great Lakes region through the 1980's. The recent invasion of zebra and quagga mussels has caused a dramatic decrease in nutrient availability in the Great Lakes region. Given myriad factors, all-time low abundance of some fish species was observed in Lake Ontario by 1995. Recreational fisherman and fisheries managers in the Great Lakes region are thus concerned presently.

Land use and environmental policy changes have also affected the quality of wintering habitat and subsequent migratory behaviors of DCCOs. Given all-time low prices for cotton and soybeans in southern states, many farmers converted to catfish aquaculture in Mississippi, Arkansas, and surrounding states in the 1980's. By the mid 1980's, fewer cormorants migrated completely southward to the Gulf of Mexico each year, and cormorant abundance progressively increased in the upper delta region of the Mississippi River. Today, Great Cormorants (*Phalacrocorax carbo*) in northern Europe and Asia, and DCCOs in North America are most abundant. Double-crested cormorant populations have increased since the mid-1970s, following several years of serious reproductive failure associated with organochlorine contaminants (Hatch 1995, Hatch and Weseloh 1999). A conservative estimate of the total population of DCCOs

in the United States and Canada is greater than 1 million birds, including breeding and non-breeding individuals, but is probably closer to 2 million (Hatch and Weseloh 1999, Tyson et al. 1999). While the overall rate of growth in the United States and Canadian populations slowed during the early 1990s (Tyson et al. 1999), there are still significant population increases occurring in some areas. For example, in the Great Lakes, where DCCOs probably reached a low of around 200 nesting pairs sometime between 1968 and 1973 (Ludwig 1984), there were approximately 115,000 DCCO nests in the 2000 breeding season (D.V. Weseloh, unpublished data), up from an estimated 38,000 in 1991 (Weseloh et al. 1995) and 93,000 in 1997 (Tyson et al. 1999).

The abundance of DCCOs wintering in the delta region of Mississippi has nearly tripled in the last decade (Glahn et al. 2000a), and cormorants have been found to consume an average of 1.0 to 1.5 pounds of catfish per day (Glahn and Brugger 1995). Double-crested Cormorants have also been reported to negatively impact populations of smallmouth bass and other fishes in the Great Lakes region of the United States (Schneider et al. 1999).

The New York State Department of Environmental Conservation (NYSDEC) has been controlling cormorant breeding at two colonies in eastern Lake Ontario (i.e., Gull andBass Islands, New York) since 1994. The NYSDEC also began control activities at Little Galloo Island in May 1999 and plans to continue these activities in 2000 and 2001. To supplement the NYSDEC efficacy assessment for these management actions, we proposed to monitor the movements of cormorants following colony control activities at Little Galloo Island, NY.

The purpose of the present study is to determine (1) the emigration and reproductive success of cormorants on Little Galloo Island, NY following May-July (2000 and 2001) control activities; and (2) the nest-site fidelity and (3) the site-specific foraging distribution of cormorants dispersed from Little Galloo Island in years following breeding control activities. In supplement to flyway patterns elucidated by banding nestlings in the Great Lakes region since 1923, modern technology (e.g., satellite telemetry) enables wildlife researchers to evaluate the daily and annual movements of waterbirds over large spatial scales. Thus, we installed satellite transmitters (platform transmitter terminals; PTT) on DCCOs to enable our observation of their movements following control activities at Little Galloo Island.

The present report provides preliminary insight regarding the breeding and wintering distributions of DCCOs captured at a traditional breeding colony in eastern Lake Ontario. The understanding of cormorant movements will enable the development of various alternatives for managing cormorant impacts to commercial and recreational fisheries based on subsequent analyses of these spatial data.

This study is part of the Research Project of the National Wildlife Research Center entitled “Economic Impact and Management of Bird Predation at Aquaculture Facilities in the Southeastern United States.”

Methods

In May 2000, we initiated a cormorant satellite telemetry study in eastern Lake Ontario. We captured twenty-six DCCOs by using modified leghold traps (King et al. 1998; 2000). We recorded the relative age (adult, immature), mass (0.1 kg precision), and culmen, tarsus, and wing cord lengths (1 mm precision) for each captured cormorant for ongoing morphometric studies (see Glahn and McCoy 1995). The number of nests, eggs per nest, and chicks per nest were recorded as part of the ongoing (since May 1999) breeding population monitoring at Little Galloo Island, NY. The number of nests at Gull and Bass Islands were also recorded as part of NYSDEC’s population monitoring at these islands since 1994.

We installed PTTs and released all cormorants at their breeding colony on Little Galloo Island, New York. An aluminum leg band was attached to the left tarsus, and an orange (plastic) band with a black, alpha-numeric code was attached to the right tarsus of all captured cormorants prior to release. A backpack harness (adapted from Dunstan 1972; King et al. 2000) was used to attach PTTs on all cormorants. We used a 45 g PTT (< 1.8% bird weight) manufactured by Microwave Telemetry, Inc. (Columbia, MD). The body of the transmitter measured 48x17x7 mm (1.90x0.65x0.28 inches), with a 216 mm (8.5 inch) flexible antenna protruding from the back edge of the transmitter, 45 degrees from the bottom face. The PTTs were

programmed to transmit approximately 8 hr each 48 hr from May-September 2000, and 8 hr each 10 days from October 2000 to September 2001. Using this programming, the expected longevity (battery life) of these PTTs is approximately twelve months.

Spatial data were received (and transmitted) by Service Argos, Inc. equipment aboard two National Oceanographic and Atmospheric Administration (NOAA), polar-orbiting satellites. The data temporarily stored on satellites were sent to ground telemetry stations and were subsequently forwarded to us via electronic mail. A Geographic Information Systems (GIS) model is being developed to illustrate cormorant locations, regional and continental movements, breeding and foraging distributions, winter range, habitat selection, migration corridors, and the rate and timing of migrations. Twenty-five DCCOs will again be captured in May 2001 at Little Galloo Island, NY and outfitted with satellite telemetry transmitters such that this cooperative study will involve the monitored movements of fifty DCCOs.

Study Design

The primary objective of this study is to determine the emigration and nest-site fidelity of double-crested cormorants on Little Galloo Island, NY following control activities at this traditional breeding colony. Thus, descriptive statistics (e.g., measures of spatial and temporal variability, frequency of cormorant locations, average movements, and average migratory corridors per each study year) will be used to illustrate effectiveness of breeding colony control activities, emigration and fidelity, habitat utilization, and cormorant migration rates. Spatial data analyses will be used to correlate cormorant habitat selection and traditional fisheries habitat, adjacent breeding colonies, and conventional migratory paths in North America.

The mixed model procedure (PROC MIXED) of the Statistical Analysis System (SAS) will be used to evaluate the randomized block design of the proposed study. Treatment blocks will be DCCOs (n = 25 in each of 2000 and 2001) live-captured for attachment of PTTs. This design will enable investigators to address each objective of this study. Student-Newman-Keuls (SNK) post-hoc contrasts will be used to separate the means of significant ($P < 0.1$) ANOVA effects.

Results

Based on a preliminary analysis, cormorants observed from May through September 2000 generally remained in the east basin of Lake Ontario, near the breeding colony (Fig. 1). Six cormorants, however, emigrated from Little Galloo Island, NY during the early summer (Figs. 2-7). Two cormorants emigrated approximately 260 km (160 mi) from eastern Lake Ontario before July 14, and were observed near the St. Lawrence River Seaway (southwest of Montreal) through September 17 (Fig. 4, 7). Two other cormorants left Little Galloo Island (July 4 and August 27) and flew (approximately 85 km, or 53 mi) to Oneida Lake in central New York (east of Syracuse). These birds remained near Oneida Lake through September 17. The last two cormorants that did not remain near Little Galloo Island during the summer of 2000 left eastern Lake Ontario (May 10 and June 1) and migrated to Oneida Lake. These individuals remained on Oneida Lake until they returned to eastern Lake Ontario on May 17 and June 13, respectively.

A comparison of the summer distributions of the cormorants captured and marked in 2000 and 2001 will enable us to determine the annual site fidelity of these birds. Subsequent analyses of individual summer distributions will enable us to determine seasonal fidelity associated with the Little Galloo Island breeding colony.

We were able to evaluate cormorant movements prior to and following breeding colony control activities at Little Galloo Island to determine if cormorants associated with egg-oiling emigrated from the east basin of Lake Ontario. Although the NYSDEC oiled cormorant eggs on Little Galloo Island from 16 May through 28 June 2000, cormorants associated with this study remained in the east basin of Lake Ontario following this treatment period (Fig. 8). Subsequent analyses will enable a more precise evaluation of the effects of colony control on cormorant summer distributions.

Further analyses will enable us to determine the daily movements and inferred activities (e.g., roosting, foraging, loafing) of cormorants marked in May 2000 and May 2001. For example, much spatial data have been collected for individual cormorants for extended periods (Fig. 9). By stratifying these data by time of day (e.g., 0601-1100, 1101-1400, 1401-1900, 1901-0600 hrs), we can determine the night roosting, morning, mid-day, and evening locations of individual cormorants

while they remain near their breeding colonies (Fig. 10). These analyses will further enable us to determine the site-specific foraging distribution of cormorants captured at Little Galloo Island in 2000 and 2001.

Most of the cormorants captured at Little Galloo Island in May 2000 migrated east of the Appalachian Mountains toward their winter range beginning in October 2000 (Fig. 11). Of the cormorants still transmitting satellite data, one cormorant migrated west of the Appalachians toward its wintering area in the central portion of the Gulf of Mexico coast. A second cormorant associated with this study was also observed in southwestern AL on 22 November 2000. A recreational fisherman found cormorant #23 (captured on Little Galloo Island on May 2, 2000) beneath the water surface while fishing in a creek near Mobile, AL. The last satellite telemetry data (near Oneida Lake, NY) from cormorant #23 was received on May 13, 2000.

The winter distribution of cormorants captured in eastern Lake Ontario, NY in May 2000 extends from southeastern LA, along the coast of the Gulf of Mexico, and the southern portion of the Atlantic coast (Fig. 11). On December 27, 2000, a wildlife biologist at the Big Cypress National Preserve in southwestern FL reported that a DCCO with a satellite transmitter and two leg bands was observed at the Preserve. These uniquely-coded leg bands identified this bird as one associated with this study. Another cormorant from this study was found dead at a person's residence in Franklin, PA on 29 January 2001. Subsequent analyses of spring and winter data will enable us to determine the migratory paths of cormorants fitted with satellite transmitters in eastern Lake Ontario in spring (this study) and near southeastern aquaculture facilities in winter (Werner et al. In Press).

Discussion

The preliminary insight provided herein suggests that DCCOs predominantly remained near their capture location in eastern Lake Ontario. If the ultimate results of the present studies indicate that breeding colony control efforts are effective, the distribution and abundance of breeding cormorants could be managed using colony controls (e.g., culling of breeding adults, nest destruction, egg oiling, culling of nestlings) and/or culling of adults at breeding colonies throughout the United States. Considering the need to reduce cormorant impacts to aquacultural production in southeastern states, Glahn et al. (2000b) suggested that lethal control strategies under the present cormorant depredation order may need to include take at roosting sites to supplement the temporary effectiveness of non-lethal dispersal techniques adjacent to aquaculture facilities. Indeed, the fundamental biology of this species indicates that populations of DCCOs could be most efficiently reduced by lethal take of adults rather than reproductive control (Dolbeer 1998).

As of February 2001, we are presently receiving quality spatial data from nine of the twenty-six cormorants that we fitted with PTTs in May 2000. An understanding of the failure of the remaining seventeen PTTs will improve our effectiveness in 2001. By June 1, 2000, nineteen of the twenty-six satellite transmitters were providing data. By July, fourteen transmitters were active. Ten transmitters provided data by August 2000, and we have received satellite telemetry data from nine cormorants since September. The satellite transmitter recovered from the dead cormorant near Mobile, AL on 22 November 2000 was returned to the manufacturer for inspection. Examination of the external and internal portions of the transmitter indicated that the plastic box containing the electronics was cracked, thus causing the failure of the transmitter. The manufacturer suggested that the structural integrity of PTTs is compromised at water depths greater than 20 m.

Although DCCO have been previously reported to dive a maximum of 7.9 m during one study in Nova Scotia (Ross 1977), Great Cormorants have been observed to dive 25 m while foraging in The Netherlands (Voslamber et al. 1995). Thus, we regard increased pressure at depth to be a contributing factor to the failure of seventeen transmitters during the first year of this collaborative research. The 45 g PTTs that we installed in 2000 were the smallest available transmitters with a battery life needed for our study objectives. We will install 30 g PTTs in May 30 with the same expected longevity and greater structural integrity as the 45 g model. Furthermore, the manufacturer has agreed to reinforce the area surrounding the twenty-five transmitters that we will install on Little Galloo Island in May 2001.

When completed, the present satellite telemetry study will facilitate the development of biologically realistic alternatives for managing DCCO impacts to commercial and recreational fisheries. The timing and location of effective cormorant management remain unknown.

Based on further analyses of these spatial data, an understanding of the annual distribution of cormorants associated with commercial and recreational fishery impacts may facilitate the development of plans to minimize such impacts.

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Figure Legends

(Color versions of figures available on DEC's website at www.dec.state.ny.us)

Figure 1. Satellite telemetry location data for Double-crested Cormorants (n = 26) captured on Little Galloo Island, NY (eastern Lake Ontario). Locations represent cormorant movements from May 10 through September 15, 2000.

Figure 2. Individual home range (95% kernel) for cormorant #1 (May- Oct. 2000).

Figure 3. Individual home range (95% kernel) for cormorant #8 (May- Oct. 2000).

Figure 4. Individual home range (95% kernel) for cormorant #15 (May- Sept. 2000).

Figure 5. Individual home range (95% kernel) for cormorant #16 (May- Oct. 2000).

Figure 6. Individual home range (95% kernel) for cormorant #17 (May- July 2000).

Figure 7. Individual home range (95% kernel) for cormorant #21 (May- Oct. 2000).

Figure 8. Satellite telemetry location data from 28 June through 10 October 2000.

Figure 9. Satellite telemetry location data for cormorant #1 (May through October 2000),stratified by time of day.

Figure 10. Daily activities of cormorant #1 (May through October 2000), stratified by time of day.

Figure 11. Satellite telemetry location data for Double-crested Cormorants (n = 26) captured on Little Galloo Island, NY (eastern Lake Ontario). Locations representcormorant movements from 10 May 2000 through 5 January 2001.