MANAGEMENT OF BREEDING AND FALL MIGRATING DOUBLE-CRESTED CORMORANTS IN NEW YORK AND VERMONT- EIGHT YEARS OF LESSONS LEARNED

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Abstract: Exponential growth of the Interior double-crested cormorant (*Phalacrocrax auritus*) breeding populations in the past 20 years has resulted in intensified conflicts with human interests. Increasing nesting populations and seasonal impacts of fall migrating cormorants in New York and Vermont have raised significant concern among fish and wildlife resource managers, stakeholders and the general public. Property damage, interspecific competition, decreased plant and animal species diversity, and predation on sport fish are the primary concerns. The need for cormorant management techniques that are effective, socially acceptable, and practical to implement at the local level remains a considerable challenge for wildlife managers in the Great Lakes Region. To address these concerns on Lake Ontario, Oneida Lake and Lake Champlain, cormorant damage management programs have been designed to limit nest numbers, colony locations and loafing / feeding sites. Habitat management and alteration, egg and nest removal, egg oiling, and an integrated harassment program using multiple scaring tools are used in combination to meet individual site objectives. We compared the techniques relative to cost, effectiveness, and desired outcome. On breeding colonies, removal of eggs and nest materials deterred cormorant nesting effectively, but required persistence. Egg oiling reduced hatching rates to less than 2%, resulting in lower breeding numbers over time. Habitat alteration in the form of overstory tree removal did not prevent nesting attempts by cormorants, but did facilitate nest removal. Scare devices and harassment were used effectively to eliminate nesting on a privately owned island on Lake Champlain, but less intensive harassment was not effective on Lake Ontario. Harassment using pyrotechnics, human effigies, Mylar tape, propane cannons, and chasing with boats used at loafing and feeding areas was very effective in moving migrating cormorants from Oneida Lake during the month of September over five consecutive years. Costs to implement a program ranged from less than $1,000 to $12,000 annually, depending on the site and the objectives. Our experiences with cormorant management on and near breeding colonies suggest that relatively inexpensive site-specific control can be used to reduce local impacts. Concurrent flyway-level cormorant population management remains desirable to lessen the incidence of local impacts and to address the broader scope of concerns occurring across their range.

Key words: cormorant, egg oiling, habitat, harassment, hazing, management

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INTRODUCTION

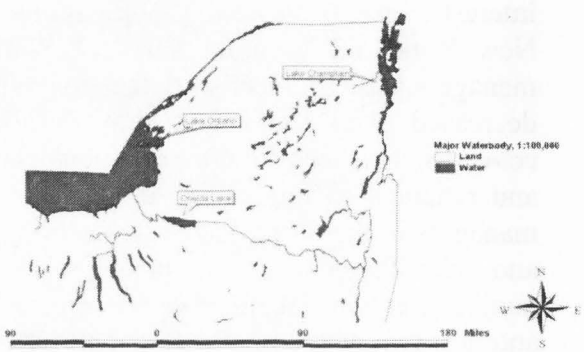
Recent increases in double-crested cormorant (*Phalacrocorax auritus*) populations are well-documented within the Great Lakes region (Tyson et al 1999, Weseloh et al. 1995). On Lake Ontario, the number of breeding cormorants increased from fewer than 25 pairs to over 28,000 pairs between 1974 and 2002 (C. Weseloh, personal communication). Concurrent with the Great Lakes increase, Lake Champlain in Vermont/ New York and Oneida Lake, New York were colonized by cormorants in 1981 and 1984, respectively. The Oneida lake cormorant nesting population increased over the last 15 years from a single nesting pair in 1984 to a peak of 365 pairs in 2000 (Coleman et al. 2002). Fall migration of cormorants to Oneida Lake results in a temporary influx of up to 2,000 birds during the month of September each year (Chipman et al. 2000). On Lake Champlain, cormorant nesting pairs increased from one pair to 4,459 pairs in 1999.

Throughout the period of rapid expansion in cormorant populations, concerns by area residents, anglers, and scientists emerged relative to impacts to private property, vegetative communities, fisheries impacts, and interspecific competition among waterbird species. Specific management strategies for each situation were formulated following research demonstrating cormorant damage (Schneider et al. 1999, USDA 1999, VanDeValk et al. 2002) and through public participation efforts designed to determine acceptable techniques (Gotcsik 1995, NYSDEC 1999).

STUDY AREA

Cormorant management activities in upstate New York and Vermont have been focused on three large lake systems (Figure 1).

Figure 1. Double-crested Cormorant Management Areas in Northern New York and Vermont, 1994-2002.



Lake Champlain is situated in northern New York and Vermont, and is 193 km in length encompassing 1127 sq. km. Maximum depth is 122 meters with an average depth of 19.5 meters. Cormorant management directed at population reduction and restoration of native vegetation and waterfowl nesting habitat takes place on Young and Bixby Islands in Vermont. Young Island is owned by the State. Six other islands in Vermont are also managed as necessary to prevent new colonies from being established. Cormorants also nest, but are not managed on Four Brothers Island, Crown Point, New York, and Missiquoi National Wildlife Refuge, Swanton, Vermont.

The eastern basin of Lake Ontario is a relatively shallow (<70 meters) area of roughly 2000 sq. km east of a line between Stony Point, New York and Prince Edward Point, Ontario. About half of the basin is within U.S. boundaries. Cormorant management activities have been conducted on four New York islands in the basin during the breeding season. Management objectives on Gull, Calf, and Bass Islands involve maintenance of vegetation on private property, and nesting habitat for black-crowned night heron (*Nictocorax nictocorax*). Management of cormorants nesting on state-owned Little Galloo Island supports both eastern basin fish community and waterbird diversity objectives (NYSDEC 2000).

Oneida Lake is located 40 km southeast of Lake Ontario. Oneida Lake is a shallow waterbody (maximum depth 16.8 m) with a surface area of about 207 sq. km. Since the 1940's, walleye (*Stizostedion vitreum*) and yellow perch (*Perca flavescens*) have dominated the lake and are the species most commonly sought by anglers (Mills et al. 1997). Cormorant management activities on Oneida Lake take place lake-wide during fall migration to reduce seasonal predation on perch and walleye. Management during the breeding season occurs on Long and Wantry Islands in support of common tern (*Sterna hirundo*) management objectives and private property interests.

METHODS

Field management is conducted by NYSDEC (Lake Ontario, Oneida Lake), Vermont Department of Fish and Wildlife (Lake Champlain), New York Cooperative Fish and Wildlife Research Unit (Oneida Lake nesting season), and USDA-APHIS-WS (Lake Champlain, Oneida Lake migration).

Egg and nest removal on Lake Ontario was initiated on three colonies in 1994 and has continued through the 2002 nesting season. Nest removal was also used on six Lake Champlain colonies between 1995 and 2000 and two Oneida Lake sites in 1991-92 and 1998-2000. The nest removal process begins in early May of each year and continues at 5-7 day intervals through June or until no active nests remain. Eggs are either "tossed" from nest structures or nest and contents are completely removed and scattered. Ground nests are removed by hand, tree nests are removed either by a climber, from the ground by telescopic pole, or by shotgun. Shotgunning is accomplished using 12 gauge shells loaded with steel 1, 2, BB or T size shot. On Lake Champlain, high pressure water spray was successfully used to remove tree nests. To confirm results in sprayed nests, a pole-mounted mirror was used to examine contents. Habitat modification in the form of overstory tree removal (chainsaw felling of woody stems over 20 cm dbh) was accomplished on Gull Island, Lake Ontario, in the fall of 1993 prior to the 1994 nesting season.

Beginning in 1999, egg oiling has been used to reduce cormorant reproductive success on Little Galloo Island in Lake Ontario and on Young Island in Lake Champlain. Egg oiling has also been used on Oneida Lake in 2001 and 2002. Pure food-grade corn oil is applied to eggs in accessible nests with a backpack sprayer in sufficient quantity to soak the exposed surface of each egg (approximately 6ml/egg). On Little Galloo Island, two teams of two to three persons consisting of a sprayer, a note-taker and a nest marker complete the oiling effort in three hours or less (Farquhar et al. 2000). Oiling treatments are conducted either two or three times (Young Island) or four to six times (Little Galloo, Long) each year beginning in early to mid-May and concluding by early July. Oil is applied at 10-14 day intervals to ensure each egg is treated at least twice during the incubation period.

USDA Wildlife Services employees in cooperation with NYSDEC and Cornell University have conducted the Oneida Lake hazing program using pyrotechnics and boat chasing during September in each year since 1998. Cormorants are harassed by 2 biologists on the lake five days per week. The hazing program is not conducted on the weekend to minimize conflict with human recreational use of the Lake. Hand-held pyrotechnics including "bird bangers" and "screamers" and cracker shells (fire crackers shot from a 12 gauge shotgun) are used to scare birds.

In addition to pyrotechnics, Mylar tape, propane cannons, predator eye balloons, human effigies and the USDA's Electronic Guards are placed on traditional day and night roosts and loafing islands on the Lake to discourage roosts by cormorants. Traditional roosting sites include Wantry Island, Long Island, Little Island, Willard Island, Grassy Shoal and Cleveland Bay. Mylar tape is strung 3 feet above the ground between stakes at 7-day roost sites as a visual deterrent.

To document the cost of each program, impacts to surrounding lakes, consequences of management, and effectiveness, detailed records were maintained throughout each project.

Costs for documenting all management activities were derived from expenses associated with total employee compensation added to equipment and travel expenses. These estimates are restricted to actual field effort and do not include costs associated with planning, reporting, or related research. On all sites, disturbance to other waterbirds is monitored in terms of response to human intrusion. Satellite (Dorr et al. 2003) and VHF telemetry (Coleman 2003, Mazzocchi 2002, Mazzocchi 2003), initiated in 2000 is providing information on cormorant movement resulting from management. Visual monitoring of 6 lakes in the vicinity of Oneida lake was conducted in 1998 and 1999 to measure impacts on surrounding lakes A DEC technician surveyed each lake twice a week for approximately 6 weeks. Effectiveness of management is determined through monitoring of birds and nests both pre- and post- treatment, breeding chronology, hatching rates, and population trends for each managed site.

RESULTS

Egg and nest removal, though labor intensive, has been a 100% effective technique for deterring nesting on all sites with a zero nest objective. The number of treatments necessary to ensure success has varied annually from 1-11 nest removal sessions. Hand removal of ground nests was accomplished at a rate of about 100/person/hour. Pole and climber removal of nests to a height of 10 meters averaged 30/person/hour. Overstory tree removal on Gull Island limited the vertical component of available nesting sites and permitted nest elimination by hand, pole, or climber. Nests constructed between 10 and 15 meters were effectively treated by shotgun or high-pressure water spray. Water spraying dislodged 80-90% of nests. A pole-mounted mirror was used to examine contents in some nests that were not dislodged. Above 15 meters, shotgunning was the only practical means we tried. Shotgunning did not completely dislodge nests from trees. When a minimum of two shots was applied to each nest, no reproduction was observed. We observed that complete removal of nest material appeared to discourage re-nesting more effectively than methods which left a residual nest structure intact.

Egg oiling took place 2-6 times per year from May- July in 1999-2002 on Little Galloo Island and Young Island, and during the same time period in 2001-2002 on Long Island. Hatching success (number of chicks hatched per egg) for oiled nests was less than 2% on treated colonies when the

number of treatments was three or more. Hatching success rose to 11% on the Young Island colony when only two treatments were applied in 2002. Overall, accounting for intentionally untreated and inaccessible nests, fledging rates for the treated colonies were estimated at 0.03 - 1.09 per nest compared to estimates of 1.3-1.8 young per nest in nearby untreated colonies. Observed variation in fledging rates may result more from management approach than efficacy of oiling. Estimated per-nest fledging peaked at 0.70 on Young Island (2001) when 547 of 1,156 nests were an un-treated control and at 1.09 on Long Island (2001) when 162 of 260 nests were left alone.

Since egg oiling began in 1999, annual peak nest numbers have shown a downward trend. Little Galloo Island and Young Island peak nest counts were 16% and 56% percent lower, respectively, in 2002 compared to 1999. The sharp decrease in the number of nesting pairs observed on Young Island in 2000 and 2001 may be due in part to egg predation by resident herring gulls (*Larus argentatus*) associated with human disturbance during control activities. On Long Island, no decreasing trend is apparent from two years of egg oiling. However, numbers of nests on Long Island were lower in 2001 and 2002 than they were when nest control was initiated in 1998 (Coleman 2003).

The numbers of fall migrating cormorants feeding and roosting on Oneida Lake were significantly reduced as the result of the integrated wildlife damage management program. The population of cormorants during the month of September on Oneida Lake has historically ranged from 1,000 to 2,800 birds, depending on the time of month. Lake-wide cormorant numbers during September 1998-2002 were 61-98% lower compared to September population estimates in the three years previous to program implementation. The majority of cormorants using traditional roosting sites was significantly reduced (less than 400 birds) after only the first few days of harassment. Mylar tape remained an effective tool for discouraging cormorants from roosting from 1998 to 2001, with habituation documented on two sites in 2002. One human effigy was placed on Little Island during the third week of the project in 1998 and appeared to discourage cormorants from loafing near the island, however, it appeared to negatively impact state threatened common terns and may have caused them to abandon the site. Predator Eye balloons were also used at a number of locations with varying success.

An integral component of the cormorant hazing program included the use of a boat and pyrotechnics. A combination of hazing birds with the boat and the use of pyrotechnics resulted in the dispersal of an estimated 86,041 individual cormorants. This estimate includes single individuals harassed multiple times and is not a population estimate. Despite extensive use of pyrotechnics throughout the lake, only one noise complaint was received by Wildlife Services during the entire operation. In addition, although we did not specifically monitor other bird populations on the lake, the impact of the hazing program on non-target species appeared minimal. Plans for 2003 include specific monitoring of the hazing program's impact on common terns.

Quantitative surveys have not yet been conducted on Young Island, Lake Champlain, to determine a response in vegetation. Observations of field staff involved in egg oiling indicate little change to date. Recovery of these impaired functions is expected to take many years. The rapid decline in Young Island nest numbers following initiation of management (3,053 in 1999 to 1,325 in 2002) has been offset by a fairly rapid increase in nest numbers on Four brothers Island, New York from 1,372 to 2,498 during the same period.

A complete evaluation of Lake Ontario cormorant management is planned for 2003 following completion of five years of egg oiling. This evaluation will include effects on cormorant movement rates as determined through telemetry studies, impacts on non-target nesting waterbirds, and progress towards restoring depressed smallmouth bass populations.

Preliminary results of the Lake Ontario studies provide some insights. Cormorant nest numbers on Little Galloo Island have declined at a slightly higher rate than projected by NYSDEC to 4,780 nests in 2002, versus a predicted number of 5,210 (NYSDEC 2000). Mazzocchi (2002, 2003) found that some effects on cormorant site fidelity can be attributed to the management program, but the relative importance of reproductive failure vs. human harassment is not yet known. Loss of non-target waterbird numbers or diversity has not been observed (Farquhar et al. 2002). Johnson et al. (2003) estimated an average 26.9% (range 23.9-30.7) reduction in Little Galloo Island cormorant feeding days, and a 23.2% (range 19.1-25.4) reduction in total fish consumption. Smallmouth bass abundance, measured during annual gill net surveys, remain at the lowest levels recorded in the 26 years of sampling (Eckert 2002).

Offsite impacts of the Oneida Lake migration harassment program were monitored in 1998 and 1999. No significant increases in cormorant numbers were documented on nearby Cazenovia Lake, Oneida River, Otisco Lake or Skaneateles Lake during the hazing operation. Cormorants (range 0-50) were observed on Cross Lake during the survey period. The survey could not determine if these birds were recent migrants or a result of a small population shift from Oneida Lake. Onondaga Lake had a pretreatment cormorant population that averaged approximately 196 birds (range 84-266). The average number of cormorants observed on Onondaga Lake during the Oneida Lake hazing program was 442 (range 12-1605). The pulse of birds seen during the week of September 8 and September 15 is likely the result of typical cormorant migration patterns, although some individuals from Oneida Lake did shift to Onondaga Lake.

DISCUSSION

The variety of cormorant management techniques being used on breeding colonies in New York and Vermont were designed to achieve site-specific objectives. Each has been operationally successful, but not without consequences. Long-term results, such as improvements to a fish community, re-establishment of nesting waterfowl or waterbirds, and vegetative response require a longer period of treatment and monitoring to fully evaluate the effects of management programs. Efforts to prevent the establishment of new colonies has been most successful requiring treatment periodically rather than annually.

Trends in nest and migration numbers on the managed sites are difficult to predict, due in part to continued increases in the lower Great Lakes cormorant population at un-managed colonies. Between-season variability in cormorant persistence, possibly related to weather, local forage availability, or other factors also appears to be a factor. Consequently, the effort required to complete annual cormorant management actions is somewhat variable and remains unpredictable year to year. Simple nest removal on Lake Ontario islands, for example, has required from 1 to 11 treatments per year, depending on the number of nests involved and the persistence of nesting cormorants. The cost of the program is directly related to the effort required. In the case above, nest removal costs ranged from about $500 - 3,500 in relationship to staff effort required. Although a $3000 differential in annual cost

may not appear significant in multi-million dollar agency budgets, such variation, particularly in relation to human resources needed (2 staff days versus 15), could become problematic as additional sites require similar management efforts.

It should be noted that additional cormorant management initiatives have recently commenced on the Niagara River in western New York, and agency-sponsored programs have been requested for the St. Lawrence River (private actions began on two sites in 2002) and on Long Island, New York. Each new site-specific management program to date has required substantial evaluation, public involvement, and planning effort prior to implementation. The Lake Ontario cormorant research program alone has required about $75K in annual funding to maintain baseline data necessary to evaluate the efficacy of management (D. Stang, personal communication). Though the programs we report on were not developed as an integrated "package", open cooperation, coordination, and communication among the involved agencies has served to synchronize effort and evaluation through time. We conclude that selection of appropriate management actions is situation-specific, often requiring a level of persistence exceeding that of the cormorant. It is apparent, however, that effective management of this abundant, mobile species cannot occur without consideration of conditions off site. In the future, a broader, well-coordinated regional approach to cormorant management including population goals may be beneficial if impacts at existing sites increase or when new sites require treatment.

MANAGEMENT IMPLICATIONS

- Site-specific management of cormorants is effective, but must consider immigration from the broader system, and emigration related to the action.
- Site and objectives dictate the appropriate techniques. Each technique has benefits and consequences that need to be fully considered prior to application.
- Techniques are best used in combination, and/or customized to the individual site and available resources.
- Habitat modification should be considered on sites where permitted.
- Lethal removal may have application to reinforce non lethal control or in situations requiring more rapid response.

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