Double-Crested Cormorant Predation on Smallmouth Bass and Other Fishes of the Eastern Basin of Lake Ontario: Overview and Summary

C. P. Schneider[1], A. Schiavone, Jr[2]., T. H. Eckert[1], R. D. McCullough[2],
B. F. Lantry[1], D. W. Einhouse[3], J. R. Chrisman[4] and C. M. Adams[5]
New York State Department of Environmental Conservation

and

J. H. Johnson[6] and R. M. Ross[7]
United States Geological Survey

This compilation of reports is the culmination of an intense field effort during 1998 by the New York Department of Environmental Conservation (NYSDEC) and United States Geological Survey (USGS) to evaluate the impact of double-crested cormorant predation on smallmouth bass and other fishes of the eastern basin of Lake Ontario. For the purpose of this evaluation, the eastern basin includes New York waters of Lake Ontario from 7 km south of Little Galloo Island to Cape Vincent (see coverpage map). This evaluation was precipitated by the concern of resource managers for the long-term health of the eastern basin fishery, and by a strongly held public perception that smallmouth bass fishing was poor and double-crested cormorant predation was excessive.

Along with public concerns, NYSDEC and USGS had collected information that confirmed warm water fish stocks in the eastern basin had declined, and cormorants were consuming large numbers of fish. There was no conclusive evidence, however, to directly link double-crested cormorants to the decline in smallmouth bass. Furthermore, there were other ecological changes (phosphorus, alewife, dreissinid mussels, and water clarity) that occurred during the same period that may have contributed to the decline in smallmouth bass.

The main focus of the 1998 studies was to: 1) assess trends in the quality of the eastern basin warm water fishery, 2) describe the sizes, ages and numbers of smallmouth bass and yellow perch consumed by cormorants, 3) evaluate the influence of ecosystem changes on smallmouth bass fisheries, 4) determine if walleye are a major predator on smallmouth bass and 5) establish if cormorant predation represented a significant factor in the decline of the smallmouth bass population and fishery of the eastern basin. The following synopsis provides a brief highlight of the findings included in each of the attached reports.

Overview of Attached Reports:

Population Trends Among Smallmouth Bass in the Eastern Basin: Chrisman and Eckert (1998) examined the abundance, age, growth and mortality of smallmouth bass from the eastern basin from 1976 to 1997. Their report documented a precipitous decline in relative abundance beginning in 1991, along with a modest decline in survival for ages 6 to 12. Over the course of the study, growth increased for ages 6 to 10, suggesting that the eastern basin smallmouth bass were not resource limited, despite declines in lake productivity. Chrisman and Eckert (1998) also believed

[1] Cape Vincent Fisheries Station, Cape Vincent, NY 13618
[2] Region 6 Fisheries Office, Washington St., Watertown, NY 13601
[3] Dunkirk Fisheries Station, Dunkirk, NY 14048
[4] College of Environmental Science and Forestry, Syracuse University, Syracuse, NY
[5] McMurdo Station, Project S-031, PSC 469, Box 800, APO AP 96599-5800
[6] Tunison Laboratory of Aquatic Science, Cortland, NY 13045
[7] Leetown Science Center, Wellsboro, PA 16901

mortality of younger smallmouth bass increased, because of a shift in the modal age group in catch curves toward younger fish, and because the otherwise strong 1987-88 year classes never made a significant contribution to the fishery once they reached age-6.

Summary of 1976-98 Warm Water Assessment: Since 1976, NYSDEC has undertaken a warm water fish stock monitoring program for the eastern basin of Lake Ontario. Eckert (1998a) describes a pattern of overall decline in the warm water fish community from 200-250 fish per net gang in 1976-79 to approximately 20 fish per net gang in 1997-98. This has involved significant declines among most species that were abundant at the start of the assessment program. Smallmouth bass have always been an important component of the eastern basin fish community. In the last four years, however, the bass CPUE (catch per unit effort) was lower than any previously recorded year. In 1998, the CPUE for smallmouth bass increased 55.2% compared to 1997, but the error bounds of this estimate overlap the 1996-97 estimates. Yellow perch stocks remain low, despite recent improvements in reproductive success. Other panfish populations are also near the lowest recorded levels.

Lake Ontario – Eastern Basin Creel Survey, 1998: A survey was undertaken in the eastern basin of Lake Ontario in 1998 to validate concerns by resource managers and the public that the quality of the smallmouth bass fishery in the eastern basin had deteriorated to one of the lowest levels on record. McCullough and Einhouse (1998) reported that 36,000 smallmouth bass were harvested by anglers in 1998, which was substantially lower than the 183,000 and 90,000 smallmouth bass harvested in the eastern basin during 1978 and 1984, respectively. Angling quality (CPUE, catch per unit of effort), was approximately one-half or less than that measured in previous studies, supporting the view that recent smallmouth bass fishing in the eastern basin was poor. Furthermore, the low CPUE measured in the fishery was comparable to the very low relative abundance of smallmouth bass observed by Eckert (1998a) in a summer gillnet survey of the eastern basin. Although angling quality diminished, McCullough and Einhouse (1998) also reported there was no detectable decline in participation in the fishery (angling trips) compared to previous surveys, even though anecdotal accounts by anglers suggested fewer participants in the fishery than in other years. McCullough and Einhouse (1998) indicated that different methods were employed in each of the surveys to estimate fishing effort, suggesting comparisons with previous estimates of fishing effort should be done cautiously. Also, they indicate that the recent expansion of the walleye fishery in the eastern basin has undoubtedly created additional angling opportunities that were not available during previous creel surveys.

Diet Composition and Fish Consumption of Double-crested Cormorants in Eastern Lake Ontario, 1998: Johnson and Ross (1998) describe a comprehensive study of the diet of double-crested cormorants that was undertaken in 1998 to quantify predation on the fish community of eastern Lake Ontario. They examined over 3,000 cormorant pellets collected between April 22 and September 23 from Little Galloo Island. Alewife (27.0%), threespine stickleback (21.6%), yellow perch (18.1%), and cyprinids (minnows) (13.1%) were the major fish species consumed by cormorants. Gamefish, mainly smallmouth bass (1.5%), made up 1.6% of the diet. They estimated that double-crested cormorants consumed 87.5 million fish in eastern Lake Ontario in 1998 including 60.3 million forage fish, 25.8 million panfish, and 1.4 million gamefish. Alewife (23.6 million), threespine stickleback (18.9 million), and cyprinids (11.5 million) were the primary forage species eaten whereas yellow perch (15.8 million), pumpkinseed (6 million), and rock bass (2.6 million) were the major panfish consumed. About 1.3 million smallmouth bass were eaten by cormorants. Because of seasonal variation in both diet composition and the number of fish per pellet, the extended sampling period in 1998 provided a better representation of cormorant diet and fish consumption than earlier studies on Little Galloo Island.

Size and Ages of Smallmouth Bass Consumed by Double-crested Cormorants: Two studies conducted in 1998 filled an important information gap concerning the size and ages of smallmouth bass and yellow perch consumed by double-crested cormorants. Adams et al (1998) examined archived smallmouth bass otoliths collected in 1993-94. They estimated the total length of smallmouth bass from the length of each otolith using a total length-to-otolith length regression, and they estimated age by applying an age-length key derived from gillnetted fish. In 1993-94, estimated average total length of smallmouth bass consumed by double-crested cormorants was 256 mm (10.1 in) with an average age of 4.4 years. Adams et al (1998) also estimated that 14% of smallmouth bass consumed by double-crested cormorants in 1993-94 were legal-size fish (above the 12 in minimum size).

In 1998, Schneider and Adams (1998) reported that smallmouth bass consumed by double-crested cormorants were smaller and younger than that observed in 1993-94. They estimated the size and age of smallmouth bass consumed by double-crested cormorants using samples collected from cormorant stomachs, chick regurgitate, and pellets. The average size and age of smallmouth bass were 199 mm (7.9 in) and 3.3 years; few smallmouth bass were legal-size. The smaller sizes and younger ages of smallmouth bass consumed by double-crested cormorants in 1998 compared to 1993-94 were attributed to what was available in the population, i.e., a greater proportion of smaller, younger smallmouth bass in 1998. Schneider and Adams (1998) also noted that the size of smallmouth bass declined by 55% from April to September. They also found in 1998 that double-crested cormorants preyed upon ages 2 to 4 yellow perch.

Trends in Lake Ontario Smallmouth Bass Sport Fisheries: Declines in phosphorus and alewife abundance along with increases in dreissenid mussels and water clarity are important ecosystem changes that have occurred in Lake Ontario during the last two decades. Eckert (1998b) examined trends in the smallmouth bass fishery of Lake Ontario from 1985 to 1998 to see if these ecosystem changes may have reduced the angling quality of lakewide smallmouth bass fisheries. He found a significant decline in the harvest rate ratio at the Henderson site (Eastern Basin), beginning in the early 1990s. He was unable to demonstrate, however, any significant lakewide trend in smallmouth bass harvest rate at other sites, despite rather profound changes in nutrients, alewife abundance and dreissenid densities. These findings were similar to that observed in Lake Erie, where smallmouth bass populations seem to have benefited from nutrient reductions, dreissenid expansion, and improved water clarity.

Predation on Smallmouth Bass by Walleye in the Eastern Basin of Lake Ontario, 1998: The diet of eastern basin walleye was examined in 1998 because walleye were the only species in the eastern basin to increase in abundance in the last two decades and because walleye could prey on smallmouth bass. Schneider et al (1998) examined 167 walleye stomachs collected from the eastern basin during spring, summer and fall. No smallmouth bass were eaten by walleye, although few fish were identified and most walleye stomachs were empty. From 1992 through 1997, 276 stomachs were examined from walleye captured incidentally in chinook salmon nets set near Henderson Harbor. Again, most stomachs were empty; the principal prey was alewife and no smallmouth bass were identified. Likewise, the Ontario Ministry of Natural Resources examined over 5,000 walleye stomachs from the eastern basin and Bay of Quinte from 1958 to 1998. Alewives were the major prey item and no smallmouth bass were found in any of the walleye stomachs. Although walleye stomach data collected in 1998 were limited, the other observations tend to support the view that walleye are not a major predator on smallmouth bass in the eastern basin.

Population Trends Among Yellow Perch in the Eastern Basin of Lake Ontario, 1976-98: Yellow perch are an important component of the warm water fish community of Lake Ontario's eastern basin, harvested by both sport and commercial fisheries. Fishermen have complained of reductions in perch sizes and

catch. Based on catch per unit effort data from gillnet surveys, Eckert (1998c) found a significant decline in yellow perch abundance since the mid 1980's. Further analysis of the assessment data showed no apparent increase in mortality of perch age-4 and older, and no major changes in growth rates. However, recruitment to the adult population since the 1978 year class has been poor, and there has been a gradual reduction in mean age and percent contribution of fish age 6 and older. Bottom trawl data collected in the fall from 1978-95 by the Oswego Biological Field Station, USGS, show high abundance of young-of-year (YOY) in 1977 and 1978, generally poor production from 1979-90, and then good production from 1991-95. These changes in YOY production are believed linked to changes in predation on larval yellow perch by alewife, and were expected to increase adult abundance. Failure of improved YOY production to increase the adult population is believed to be related to increased mortality of juvenile perch. Bottom trawl data showed increased mortality of age 1-3 yellow perch from the strong 1991 year class compared to the strong 1977 and 1978 year classes.

Cormorant Predation on Recently Stocked Salmonids at Stony Point, Lake Ontario: The initial controversy surrounding the double-crested cormorants in eastern Lake Ontario was concern for intensive predation on recently stocked salmonines. Ross and Johnson (1998) evaluated the 21 May 1998 stocking of 37,000 yearling brown trout and 92,700 yearling lake trout stocked at Stony Point, Lake Ontario. These fish were stocked from a barge in daylight hours and in close proximity to Little Galloo Island (8 km for lake trout and 9 km for brown trout). No other stocking events took place within 5 days of the 21 May stocking date. Approximately 150 cormorant pellets were sampled each day on the 1st, 2nd and 4th days after the stocking, similar to that done previously to assess lake trout stocking loss (Ross and Johnson 1995). Only two brown trout were recovered from the sample on the 4th day; no lake trout were recovered from any of the samples. By calculating the proportion of brown trout in the sample and using the relative predation rates found for lake trout, Ross and Johnson (1998) estimated that 189 brown trout were consumed by double-crested cormorants, or 0.5% of the stocking lost to double-crested cormorant predation. The low percentage of loss for brown trout and zero loss for lake trout suggests the effectiveness of barge stocking has improved, compared to 1993 and 1994 when 13.6% and 8.8%, respectively, of the stocked lake trout were consumed by double-crested cormorants (Ross and Johnson 1995).

The Relationship Between the Abundance of Smallmouth Bass and Double-Crested Cormroants in the Eastern Basin of Lake Ontario: Although previous work established that smallmouth bass stocks had declined to new lows and double-crested cormorants were consuming large numbers of bass, Chrisman and Eckert (1998) were only able to estimate mortality of older, larger smallmouth bass (ages 6-12), ages that were too old to be targeted by double-crested cormorants. Lantry et al (1998) used the ratio of CPUE at age-3 to CPUE at age-6 smallmouth bass as an index of relative mortality, to look for trends in mortality in younger fish. They found a significant difference in relative mortality of smallmouth bass between ages 3 and 6 for two time stanzas, 1975 to 1988 and 1989 to 1996. Mortality increased substantially after 1989, near the end of a four year period of time when double-crested cormorants on Little Galloo Island increased from 1,419 to 4,072 nesting pairs. Further, from 1976 to 1994, there was a highly significant relationship between age-3 to 6 relative mortality of smallmouth bass and numbers of nesting pairs on Little Galloo Island. Using diet composition of smallmouth bass consumed by cormorants, the 1992-96 smallmouth bass consumption mean (600,000), and estimates of smallmouth bass standing stock for the U.S. waters of the eastern basin, Lantry et al (1998) calculated cormorants had the potential to remove a major proportion of each year class. Moreover, if current levels of double-crested cormorant predation continue, the strong 1995 year class of smallmouth bass could be virtually eliminated by the time these fish enter the fishery at age-6.

Summary:

Cormorant impacts on smallmouth bass and other warm water fish are the result of two interconnected factors. First, the number of double-crested cormorants expanded dramatically, increasing the number and biomass of fish consumed. The question of whether cormorants are having an impact on smallmouth bass population is a difficult question to answer conclusively. Our approach has been to develop enough evidence to enable a reasonable conclusion to be made regarding cormorant impacts.

We believe the information presented in the following reports provide reasonable evidence to conclude that double-crested cormorant predation on smallmouth bass in New York waters of the eastern basin of Lake Ontario is excessive. We were able to demonstrate that angling quality for smallmouth bass had deteriorated in the eastern basin, while it remained unchanged or improved in other areas of Lake Ontario that were outside the feeding range of eastern basin double-crested cormorants. This suggested that ecosystem changes, e.g., low phosphorus, declining zooplankton and expanding dreissenid mussels, were not the principal factors responsible for the decline in the smallmouth bass stocks in the eastern basin, because these same ecosystem changes occurred throughout Lake Ontario

We also learned that double-crested cormorants were preying on larger sizes and older ages of smallmouth bass than we had initially thought. The fact that near 1 million, age-3 to 5 smallmouth bass were consumed by double-crested cormorants annually, just a year or two prior to the age when they entered the fishery, suggested that mortality of these young fish must have increased substantially. The subsequent evaluation of relative mortality of young smallmouth bass showed a significant increase in mortality beginning about 1989, when double-crested cormorant numbers grew to 4,000 nesting pairs. Furthermore, the changes in relative mortality of young smallmouth bass were significantly associated with the growth of the double-crested cormorant population on Little Galloo Island. Finally, the 1995 year class of smallmouth bass is the most important cohort produced since 1988. Double-crested cormorants removed a major portion of the 1995 year class as age-3 fish in 1998, and if predation is unchecked, we anticipate two more years of intense predation on age-4 and age-5 fish will likely remove the remainder of the year class, prior to the time they become available to eastern basin bass anglers.

Acknowledgments:

We would like to thank NYSDEC conservation officers Gerald Spaziani and Chris Handley for their help with the cormorant collections. We would like to acknowledge the special efforts of Laura Brown and Brian Edmonds, whose dedication and diligence allowed us to gather the most extensive sample of pellets to date. We also want to acknowledge the help and support of NYSDEC Albany staff, Doug Stang and Bob Lange in particular. We also want to thank Lars Rudstam, Ed Mills, John Post and Pat Sullivan for their support and advice. Finally, many thanks to Ellen Hinckley and Beverly Grant for their help in preparing the pellet database, and to Robert Werner for his review of these reports.

Literature Cited

Adams, C. M., C. P. Schneider and J. H. Johnson. 1998. Predicting the Size and Age of Smallmouth Bass Consumed by Double-Crested Cormorants in Eastern Lake Ontario, 1993-94. NYSDEC Special Report, December 15, 1998.

Chrisman, J. R. and T.H. Eckert. 1998. Population Trends Among Smallmouth Bass in the Eastern Basin. NYSDEC Special Report, December 15, 1998.

Eckert, T. H. 1998a. Summary of 1976-98 Warm Water Assessment. NYSDEC Special Report, December 15, 1998

Eckert, T. H. 1998b. Trends in Lake Ontario Smallmouth Bass Sport Fisheries. NYSDEC Special Report, December 15, 1998.

Eckert, T. H. 1998c. Population Trends Among Yellow Perch in the Eastern Basin of Lake Ontario, 1976-98. NYSDEC Special Report, December 15, 1998.

Johnson, J. H., R. M. Ross and C. M. Adams. 1998. Diet Composition and Fish Consumption of Double-Crested Cormorants in Eastern Lake Ontario, 1998. NYSDEC Special Report, December 15, 1998.

Lantry, B. F., T. H. Eckert and C. P. Schneider. 1998. The Relationship Between the Abundance of Smallmouth Bass and Double-Crested Cormorants in the Eastern Basin of Lake Ontario. NYSDEC Special Report, December 15, 1998.

McCullough, R. D. and D. W. Einhouse. 1998. Lake Ontario – Eastern Basin Creel Survey, 1998. NYSDEC Special Report, December 15, 1998.

Ross, R. M and J. H. Johnson. 1998. Cormorant Predation on Recently Stocked Salmonids at Stony Point, Lake Ontario. NYSDEC Special Report, December 15, 1998.

Schneider, C. P. and C. M. Adams. 1998. Estimating the Size and Age of Smallmouth Bass and Yellow Perch Consumed by Double-Crested Cormorants in the Eastern Basin of Lake Ontario, 1998. NYSDEC Special Report, December 15, 1998.

Schneider, C. P., T. H. Eckert and R. D. McCullough 1998. Predation on Smallmouth Bass by Walleye in the Eastern Basin of Lake Ontario, 1998. NYSDEC Special Report, December 15, 1998.