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08-01 Introduction to the Symposium On Double-crested Cormorants: Population Status and Management Issues in the Midwest

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Populations of double-crested cormorants (Phalacrocorax auritus) have increased dramatically in the last 2 decades, particularly in the Great Lakes and the southeastern United States. Cormorants are impacting, or perceived to be impacting, sport fishing, aquaculture operations, vegetation, and other colonial waterbirds. Anglers, aquaculturists, resort operators, lake-home owners, politicians, and others are calling for a solution to these problems. This symposium will address the status and biology of double-crested cormorants (with special reference to the Midwest), problems the birds are causing or perceived to be causing, options available for resolution of cormorant-human conflicts, and information needs related to cormorant management.

08-02 Keynote Address: Advances and Retreats in Our Knowledge of the Biology and Management of the Double-crested Cormorant since the 1992 Cormorant Symposium

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Cormorants (Phalacrocorax auritus) are universally considered as pests and, like many fish-eating birds, can be considerable predators of mariculture and aquaculture activities. The group which has shown the greatest potential for deleterious cormorant/human interactions are the continental cormorants (e. g., double-crested and olivaceous cormorants) and macrocormorants (e. g., European cormorant). The other North American species (Brandt s, pelagic, red-faced, etc.) are rarely implicated as serious pests. I will discuss the ecological and behavioral aspects of cormorants which are the cause of their negative impacts on human activities, and I offer some possible mitigating approaches based on these facts. I will contrast the European approaches to managing cormorant populations and controlling fisheries impacts with that proposed in 1992 and its consequences. I also will discuss the present state of knowledge concerning the biology and management of double-crested cormorants in North America, and contrast the present state of affairs with the depressing history of past attempts at understanding the role and impacts of cormorants on human activities.

08-03 Population Status of Nesting Double-crested Cormorants in the United States and Canada

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We obtained recent (about 1994) population estimates for double-crested cormorants (Phalacrocorax auritus) in the United States from published references and by conducting telephone interviews with biologists from each state (excluding Hawaii). In addition, field surveys were conducted of cormorant breeding colonies in the Canadian and United States Great Lakes in 1997. We compared these estimates to those obtained by Hatch (1995) to determine changes in regional populations since about 1991. Overall, the population of nesting cormorants in the United States has remained relatively stable (-0.6% mean annual change), from 109,719 nesting pairs in 1991 to >107,865 pairs in 1994. Cormorants in the Atlantic and West Coast and Alaska populations declined 6.9% and 7.3%, respectively. In contrast, the Southeast and Interior populations increased 2.6% and 8.3%, respectively. The increase in the Interior population was a consequence primarily of an 18% increase (from 25,370 pairs in 1992 to 32,686 pairs in 1995) in nesting cormorants in states bordering

the Great Lakes. With the exception of Minnesota, populations of nesting cormorants in Great Lakes states have remained stable or increased during the 1990s. The number of nesting pairs of cormorants in Great Lakes states include: Minnesota (ò6,439 pairs), Wisconsin (8,000), Illinois (675), Indiana (0), Michigan (7,975), Ohio (1,500), Pennsylvania (0), and New York (ò8,097, excluding cormorants nesting on the Atlantic coast). Suggested causes for population increases in the Great Lakes include reduced human persecution, reduced contaminant levels, high reproductive success, and increased availability of forage fish. Cormorants in the Great Lakes have been associated with numerous conflicts including competition with sport and commercial fisheries, displacement of other avian species at nesting colonies, destruction of insular habitat, and depredations at aquaculture facilities. Continued monitoring of nesting populations of cormorants is necessary for effective management and to ensure population viability.

08-04 Status and Management of Double-crested Cormorants in Wisconsin

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We review changes in Wisconsin's populations of double-crested cormorants (Phalacrocorax auritus) over the past century, discuss factors contributing to a population decline during the 1950s through the early 1970s, as well as factors contributing to a resurgence in population growth during the past 25 years, when the number of nesting pairs increased from a low of 66 in 1973 to over 8,000 pairs today. Specific management actions to enhance the states' nesting population, such as the installation of cormorant nesting platforms in the 1970s and early 1980s, as well as later management actions to deter cormorants at pound nets on Lake Superior, are reviewed and summarized. Current fishery concerns are reviewed and management and research recommendations proposed.

08-05 Impact of Double-crested Cormorant Predation on the Yellow Perch Population of the Les Cheneaux Islands of Michigan

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In 1995, in response to concerns that double-crested cormorants (Phalacrocorax auritus) were severely impacting the yellow perch population in the Les Cheneax Islands area of northern Lake Huron, the Michigan Department of Natural Resources, in conjunction with the University of Michigan and the United States Fish and Wildlife Service, conducted a research study to determine possible impact. Aerial flight counts, nesting colony counts, and creel census counts were utilized. Nearly 10,000 perch were jaw tagged and 373 cormorants were collected for stomach analysis. Study conclusions were: (1) cormorants fed heavily on yellow perch in early spring (47% of diet by weight), but over the entire season only 10% of their diet was perch, (2) alewife and sticklebacks comprised the major portion of cormorant's diet (62%), (3) cormorants removed only 2.3% of the available perch biomass vs. 1.8% by anglers over the same period, (4) most fish taken by cormorants were <150 mm in size, (5) total annual mortality of perch was about 45%, of which <9% (one-fifth) was due to cormorants, and (6) cormorants accounted for only 0.8% of the mortality of legal size perch (178 mm) while summer sport fishing accounted for 2.5%. Thus, while the impact of cormorants on the perch population may vary slightly from year-to-year, depending on the birds migration chronology relative to the time of perch spawning, we concluded that cormorant predation is having minimal impact on the local perch population.

08-06 Total and Sport Fish Losses to Double-crested Cormorant Predation in the Eastern Basin of Lake Ontario, 1993-1996

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We examined regurgitated digestive pellets of double-crested cormorants (Phalacrocorax auritus) over a four-year period, as well as a limited sample of concurrent fecal material, to estimate annual losses of sport fish and total fish in the eastern basin of Lake Ontario. Using a model that incorporates annual colony nest counts; fledgling production rates; adult, immature, and young-of-year residence times (seasonal); estimates of mean number of fish per pellet and mean fish size; and a fecal pathway correction factor (4.0%), we estimate total annual losses due to cormorants in the eastern basin of Lake Ontario to range from 37 to 91 million fish for 1993-1996. This fish loss equates to an estimated 2.05 to 5.01 million pounds of fish consumed per year, principally alewife (Alosa pseudoharengus, 34.1%) and yellow perch (Perca flavescens, 18.6%). Game fish losses were minor components, with an average estimated annual consumption of 870,000 smallmouth bass (Micropterus dolomieu, 1.4%) and 168,000 salmonines (mostly lake trout, Salvelinus namaycush, 0.2%). Cormorant predation on lake trout fingerlings stocked in May 1993 and June 1994 was estimated through the use of coded wire tag recoveries from pellets collected on Little Galloo Island one and four days after stocking events. We estimated losses of 7.1 and 8.8% of the fish stocked for the two events, an average of 8.0%. These estimates were based on a regression of the number of tag recoveries per 40,000 fish stocked versus the day post-stocking, with seven cormorant pellet collections contributing data to the regression.

08-07 Diet of the Double-crested Cormorant in Western Lake Erie

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Sport and commercial fishing factions are concerned about the potential impact the double-crested cormorant (Phalacrocorax auritus) may have on fish species of interest. There have been no previous diet studies of cormorants on Lake Erie. Our objectives of this study were to determine the diet of double-crested cormorants in western Lake Erie and to compare fish consumption of double-crested cormorants with that of piscivorous fish such as walleye and yellow perch to determine diet overlap. Food of double-crested cormorants was determined from stomach contents and regurgitated material from birds collected at or near nesting colonies and foraging areas in 1997. The diet of double-crested cormorants is expected to vary both with sex and seasonally. In the spring, cormorants may feed on various fish species which may include yellow perch (Perca flavescens), emerald shiners (Notropis atherinoides), spottail shiners (Notropis hudsonius), gizzard shad (Dorosoma cepedianum), alewife (Alosa psuedoharengus), trout-perch (Percopsis omiscomaycus), and white perch (Morone americana). During summer, species such as yellow perch and white perch may not be as available because their distribution will change after spawning. We anticipate that double-crested cormorants will not be serious competitors with predatory fish, such as walleye (Stizostedion vitreum), and yellow perch, for prey fish resources.

08-08 United States Fish and Wildlife Service and State Agency Positions on the Effects of Double-crested Cormorants on Sport Fish

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In response to concerns expressed by anglers, the United States Fish and Wildlife Service (Service) conducted an extensive review of published studies done throughout the United States and Canada on the impacts of double-crested cormorants (Phalacrocorax auritus) on sport fish populations in open waters. The literature review indicated that fish species valued by sport and commercial anglers make up a very small proportion of the cormorant's diet. Scientific evidence does not support the contention that cormorants significantly impact sport fish populations or angler catch; research to date suggests that cormorants have a minor effect on fish populations relative to sport and commercial fishing, natural predation, and other mortality factors. The Service sent a questionnaire to state agencies, soliciting their biological information and professional opinions on the role of cormorants in regulating wild fish populations, affecting sport angler catch, and causing adverse impacts on tourism and other fish-related economies. Agency attitudes towards cormorant population control were also assessed. Results of this survey will be presented. Based on the literature review and the survey responses, it does not appear that a strategy of reducing cormorant populations to benefit sport fish is biologically warranted at this time.

08-09 The United States Department of Agriculture Animal Damage Control Program's Integrated Wildlife Damage Management for Aquaculture Facilities: Policies and Procedures

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A comprehensive double-crested cormorant (Phalacrocorax auritus) integrated damage management program has been developed by the United States Department of Agriculture Animal Damage Control (ADC) program to address the needs of the aquaculture industry. This management program includes physical exclusion from aquaculture facilities, cormorant management at facilities, cormorant management at roost sites, and cormorant management at breeding colonies. In association with these operational activities, is compliance by ADC with the regulatory procedures developed by the United States Fish and Wildlife Service (Service). Regulations developed by the Service contain procedures for issuing permits to ADC for wildlife damage control. ADC, as a permittee, is responsible for complying with these procedures and the restrictions imposed by the permit when implementing wildlife damage management programs. In addition, ADC serves as an advisor to the Service on depredation permits issued to the private sector. Statistics on cormorant take under depredation permits will be summarized and possible implications of that take discussed. The ongoing interaction between ADC and the Service has evolved into the development of a cormorant depredation order to simplify and standardize the cormorant depredation permit process.

08-10 The Possible Effects of Mississippi Catfish Production on Overwinter Survival of Double-crested Cormorants

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Concurrent with the rapid growth of the Mississippi catfish industry during the 1980s, there was a dramatic increase of cormorant (Phalacrocorax auritus) populations wintering in the Delta Region of Mississippi. Observational and food habits studies suggest that this expansive industry, incorporating over 100,000 acres of ponds, provides an enormous food base for overwintering populations estimated in recent years to exceed 50,000 individuals. As much as 75% of the diet of cormorants in certain roosting areas of the Mississippi Delta

consisted of catfish. Bioenergetic models predict that cormorant populations are exploiting a biomass of up to 938.9 metric tons of catfish per winter. Despite these data, there has been little attempt to demonstrate how exploitation of this food base has increased survival of wintering cormorants that ultimately return primarily to the Great Lakes region to breed. To examine this possible effect, we used data on body mass of wintering cormorants collected during food habits studies in the Delta region of Mississippi and compared these masses over the wintering season and to body mass data of wintering cormorants from other areas without extensive aquaculture production. Our assumption was that body mass and body fat was an index to survival. Body mass of cormorants following arrival in Mississippi was found to average only 2,098 grams compared to 2,442 grams for cormorants in April prior to spring migration. Although body mass data on other wintering cormorants are scanty, body mass of cormorants wintering in Mississippi are higher than that reported elsewhere. Although further data, including those currently being collected, are needed to fully understand this issue, we speculate that cormorant exploitation of catfish and other aquaculture production on their wintering grounds has contributed to the population explosion of cormorants observed over the past decade.

08-11 Colonial Waterbird Nesting on West Sister Island National Wildlife Refuge and the Arrival of Double-crested Cormorants

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Recent survey data have shown the importance of West Sister Island, Lake Erie, to nesting waders; approximately 40% of all herons and egrets nesting in the United States Great Lakes occur there, including the largest colonies of great blue heron (GBHE; Ardea herodius), great egret (Casmerodius albus), and black-crowned night-heron (BCNH; Nycticorax nycticorax), and the largest of two snowy egret (Egretta thula) colonies, in the Great Lakes. The island's importance to Ohio has grown in recent decades with the loss of smaller mainland colonies of waders, especially the BCNH. The double-crested cormorant (Phalacrocorax auritus) returned to Ohio as a successful nester in 1992 for the first time in more than a century. The effects of this species on wading bird colonies have been well-documented in Canadian Lake Erie; cormorants have successfully competed against GBHEs for nesting space and eliminated BCNHs through habitat destruction. Breeding pair estimates made at West Sister Island since 1991 indicate that the BCNH has fallen to less than half its historic numbers on the island and is dropping dramatically in the region. The BCNH has been affected negatively as canopy height has increased with vegetative succession. A second concern is the cormorant, which has increase from zero to approximately 1,500 nests in 5 years. This rate of increase mirrors that of East Sister Island. To date, competition has not been a significant problem, but habitat degradation has been documented, with major leaf loss noted in 1995 on trees having cormorant nests and along the perimeter of the island. The Ohio Division of Wildlife and the United States Fish and Wildlife Service are concerned, both biologically and aesthetically, about the future status of the West Sister Island colonies in light of habitat succession and the addition of the cormorant.

08-12 The Use of a Geographic Information System to Monitor Competition for Nest Trees Between Double-crested Cormorants and Black-crowned Night-herons at Colonies near Toronto, Canada

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In the early 1990s, it became apparent that the rapid colonization of Tommy Thompson Park (on Lake Ontario near Toronto) by double-crested cormorants (Phalacrocorax auritus) might impact the existing colonies of black-crowned night-herons (Nycticorax nycticorax) due to displacement and destruction of nest trees. As a result, monitoring of these two species was expanded in 1992 by individually marking all nest trees (using permanent metal tree tags) and by recording for all nest trees the numbers of heron and/or cormorant nests. In 1996, the exact locations of nest trees were determined by professional surveyors. We developed a Geographic Information System (GIS) to plot the changes in the nesting distributions of cormorants and night-herons during 1992-1996 on the peninsulas at Tommy Thompson Park. We have also begun to determine the health of nest trees (and of control trees) to evaluate the impact of cormorants on their nest trees. The GIS will provide the basis for the development of a predictive model for evaluating impacts of the expanding cormorant colonies on the night-herons and on the nest trees.

08-13 Doubled-crested Cormorant Culling in the St. Lawrence River Estuary: Results of a Five-year Program

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Modeling indicated that lowering the double-crested cormorant (Phalacrocorax auritus) population from 17,000 to 10,000 pairs in the St. Lawrence River estuary could only be attained by a combination of techniques: egg-spraying in accessible ground nests to lower recruitment and culling breeding birds in arboreal colonies to lower breeding stock. The five-year program was launched in 1989 and was halted four years later as the population had fallen below the 10,000 breeding-pair threshold. A much greater vulnerability of the males to shooting (203:100) most likely accounts for the faster than predicted drop in numbers. Culling should be considered as a last resort form of intervention whenever softer techniques (egg-spraying, mechanical nest-destruction and carefully planned disturbances to the nesting colonies to enhance predation and abandonment) are not practical to attain population control. It should be based upon careful censuses and detailed modeling and be conducted under scientific supervision.
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