Wildlife Services

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Reducing Avian Predation in Aquaculture Systems

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Groups Affected by These Problems:

- aquaculture producers, distributors and retailers
- Catfish Farmers
- Consumers
- Sportfish guides and outfitters
- Wildlife managers

Major Cooperators:

- Canadian Wildlife Service
- Catfish Farmers of America
- Cornell University
- Delta Research and Extension Center, Thad Cochran National Warmwater Aquaculture Center
- Idaho Department of Fish and Game
- Michigan Department of Natural Resources
- Mississippi Agricultural and Forestry Experiment Station
- Mississippi State University, College of Veterinary Medicine
- Mississippi State University, Department of Wildlife, Fisheries, and Aquaculture
- Ontario Ministry of Natural Resources
- Ontario Parks
- Southern Regional Aquaculture Center
- U.S. Environmental Protection Agency-Great Lakes Restoration Initiative
- Vermont Fish and Game Department
- Wildlife Services Operations
- Wisconsin Department of Natural Resources

National Wildlife Research Center Scientists Address Aquaculture Losses

Wildlife Services' (WS) National Wildlife Research Center (NWRC) is the only Federal research facility devoted exclusively to resolving conflicts between people and wildlife through the development of effective, selective and socially responsible methods, tools, and techniques. The NWRC's field station in Starkville, MS, is located in the heart of the primary aquaculture producing area of the southeastern United States and was established to develop methods to reduce the impacts of fish-eating birds, such as double-crested cormorants, pelicans, egrets, and herons, on aquaculture stocks.

In the past several decades, populations of fish-eating birds have increased dramatically and caused substantial economic impacts on aquaculture production. Aquaculture industry costs associated with bird damage and damage prevention are estimated at approximately $25 million annually. NWRC's research goal is to determine the economic impact of fish-eating birds on aquaculture production and natural resources and to develop methods to reduce depredation impacts on southeastern catfish, baitfish, and crawfish industries. Current research aims to gain information about the abundance, distribution, and foraging behavior of fish-eating birds; economic impacts associated with their foraging activities; and diseases they transmit at aquaculture facilities. Information gathered as a consequence of this research provides a basis for developing new strategies, techniques, and tools for reducing damage.

Applying Science and Expertise to Wildlife Challenges

Differences in Two Double-Crested Cormorant Populations. — Because of rapid population expansion, conflicts between double-crested cormorants and humans have increased, particularly at fish farms in the Lower Mississippi River Valley. Although key demographic information on interior cormorant populations is sparse, management decisions for population reduction are already in place across their breeding range. NWRC researchers studied the population dynamics of two geographically distinct interior cormorant breeding areas located on either side of the migration divide in Ontario, Canada: one west of the Great Lakes in Lake of the Woods (LOW) and one in eastern Lake Ontario (ELO). From 2000-2008, researchers gathered data from color-banded cormorants on age, sex, survival rates, reproductive rates, and breeding site fidelity. Adult survival estimates (83-84 percent) did not differ between LOW and ELO; however, population growth models indicated a stable population in LOW and a slightly declining population in ELO. Although ELO produced almost 50 percent more female offspring each year, only 20 percent of those offspring survived their first year. LOW produced only a fraction of the amount of female offspring, but 45 percent of those offspring survived their first year. The potential interacting influences of survival and the number of fledglings may explain the slight differences in growth rates between the two populations. Considering these regional demographic differences, NWRC researchers recommend that future management efforts be based on migratory flyways within the interior population.

Optimizing Cormorant Management. — The double-crested cormorant, a native North American waterbird, has rapidly expanded its populations in some areas. Population control efforts in the United States and Canada attempt to mitigate cormorant damage to natural resources and aquaculture. However, there is currently no coordination among the various stakeholders involved in management activities as well as no attempt to optimize population control efficiency. For the first time ever, NWRC scientists modeled how individual management strategies combined with demographic and ecological factors might affect cormorant populations at various spatial scales and over time. The majority of current management operations are undertaken when colonies are near or at carrying capacity. In contrast, NWRC's models predict that management is most efficient when it is applied to colonies earlier (below carrying capacity) and to more central colonies. Management appears less efficient when colonies are closer to or at carrying capacity. These NWRC-developed simulation tools provide insights into the efficiency gain that can be expected from the coordinated planning of management activities.

Pentosidine-Based Age Prediction Models for Cormorants. — In some areas of North America, double

-crested cormorant populations have doubled every five years for the past three decades. These increases have resulted in both perceived and documented negative impacts to recreational fisheries, sensitive vegetation, other colonial-nesting birds, and channel catfish aquaculture. Determining the age demographics of animal populations, such as the cormorant's, helps resource managers predict population growth rates and responses to various management actions. NWRC scientists and collaborators at West Virginia University have identified a biomarker in the skin of double-crested cormorants, called pentosidine, which predicts their age. To improve models that predict cormorant population demographics, researchers developed and evaluated eight models using pentosidine data from cormorants with known ages and bird banding data. All of the models were able to produce estimated ages within three to four years of the birds' actual age for most samples. However, only the model for predicting the age of young cormorants was able to estimate the birds' age within one year of their actual age. Researchers discovered a high degree of variability in the amount of pentosidine that accumulated in the tissue of older birds, apparently reflecting different environmental and physiological factors. Because of this variability, researchers recommend the use of two different models: one for birds with pentosidine concentrations of eight picomoles per milligram of collagen or less (typically found in young birds) and one for all other samples. Researchers acknowledge there is still room for improving the models as more becomes known about pentosidine accumulation in birds. Knowing which age classes have the highest reproductive success, and knowing which percentage of the breeding colony consists of those age classes, will give managers a better idea of appropriate management actions to regulate regional populations.

Pond-Level Risk Factors Associated With Columnaris Disease at Catfish Farms. — Columnaris is the second most prevalent bacterial disease in farm-raised catfish, usually causing an infection of the fish's skin, fins, and gills. To help identify pond-level risk factors associated with the disease, NWRC researchers gathered data from a large commercial catfish enterprise encompassing over 500 food-fish ponds from five Mississippi Delta farms. To identify the risk factors affecting the susceptibility of farm-raised channel catfish to columnaris disease, a catfish management database was developed and data analyzed using several models. In one model, pond depth and reduced feed consumption by fish for a 14-day period prior to disease outbreaks were associated with columnaris disease. In a second model, which also considered water quality variables, pond depth, reduced feed consumption, shorter intervals from stocking to disease outbreaks, and levels of ammonia nitrogen were all associated with the appearance of columnaris. Identifying risk factors will aid producers in managing this disease before outbreaks occur.

Egret Impacts on Aquaculture. — It is important to document the impacts of wildlife on commodity production to determine the damage magnitude and patterns. This information is critical to efficiently allocate resources when developing mitigation measures. NWRC scientists analyzed the diets of great egrets foraging in catfish farms in the Mississippi Delta. The biomass of great egrets' stomach contents consisted of catfish (86.44 percent), shad (13.26 percent), bream (0.16 percent), and mosquito fish (0.14 percent). NWRC is conducting additional research to determine if the catfish consumed by great egrets were healthy or sick. Great egrets readily consume catfish and potentially warrant the use of wildlife damage management actions.

Impacts of colonial waterbirds on vegetation and potential restoration of island habitats. — Colonial waterbirds, such as double-crested cormorants, gulls and American white pelicans, have impacted forested island ecosystems throughout their breeding range by changing vegetation and soil characteristics with their fecal matter and physical destruction of vegetation. NWRC researchers studied how excluding colonial waterbirds impacts plant diversity and growth, soil chemistry, and the survival of black elderberry-a woody perennial that provides forage and cover for many wildlife species on island habitats in Lake Michigan. Results showed the exclusion of waterbirds increased non-woody plant growth, but failed to increase the regeneration of woody plants, possibly due to poor soil conditions or a lack of viable propagules. Soil from islands with nesting waterbirds was more acidic and had greater nutrient concentrations than those without nesting waterbirds. Exclusion or removal of nesting waterbirds from islands may improve overall vegetation growth, but successful restoration of woody vegetation, such as black elderberry, may require significant soil manipulation and planting.

Selected Publications:

Chastant, J.E., D.T. King, D.V.C.Weseloh, D.J. Moore. 2014. Population dynamics of Double-crested Cormorants in two interior breeding areas. Journal of Wildlife Management 78(1):3-11. doi:10.1002/jwmg.628.

Cunningham, F., S. Jack, D. Hardin and R. Wills 2014. Pond level risk factors associated with Enteric Septicemia of Catfish disease on Mississippi commercial catfish farms. Journal of Aquatic Animal Health 26:84-90.

Dorr, Brian S., Jeremy J. Hatch and D. V. Weseloh. 2014. Double-crested Cormorant (Phalacrocorax auritus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/441 doi:10.2173/bna.441

Guillaumet, A., B.S. Dorr, G. Wang, and T.J. Doyle. 2014. The cumulative effects of management on the population dynamics of the Double-crested Cormorant Phalacrocorax auritus in the Great Lakes. Ibis 156(1):141-152. doi:10.1111/ibi.12109.

O'Hear, M., L.Pote, M.Yost, C. Doffitt, T. King, and C.Panuska. 2014. Morphologic and molecular identifications of digenetic trematodes in Double-crested Cormorants (Phalacrocorax auritus) from the Mississippi Delta. USA. Journal of Wildlife Disease 50(1):42-49. doi:10.7589/2012-10-249.

Major Research Accomplishments:

- WS researchers developed population growth models to study the population dynamics of two geographically distinct interior cormorant breeding areas. Results showed one breeding population to be stable while the other showed a slight decline. Researchers recommend that future management efforts be based on migratory flyways within the interior population.
- WS scientists modeled how individual management strategies combined with demographic and ecological factors might affect cormorant populations at various spatial scales and over time. The models predict that management is most efficient when applied to cormorant colonies currently below carrying capacity.
- To improve models that predict cormorant population demographics, WS researchers developed and evaluated eight models using pentosidine data from cormorants with known ages and bird banding data.
- WS research identified the risk factors affecting the susceptibility of farm-raised channel catfish to columnaris disease, such as pond depth, reduced feed consumption, shorter intervals from stocking to disease outbreaks, and levels of ammonia nitrogen.
- WS experts analyzed the diets of great egrets foraging in catfish farms in the Mississippi Delta and found their stomach contents consisted of catfish (86.44 percent), shad (13.26 percent), bream (0.16 percent), and mosquito fish (0.14 percent).