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Should cormorants be controlled to enhance yellow perch in Les Cheneaux Islands? A comment on Fielder (2008)

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Management of Double-crested Cormorant (*Phalacrocorax auritus*; henceforth termed cormorant) populations in the Great Lakes is a controversial issue. One only needs to do a Google search to determine how many websites have been developed in favor of or against cormorant control. Control of nuisance wildlife populations, including cormorants, is a perfect example of a wicked problem, which defies simple solutions because people disagree on the definition of the problem as well as its solution (Warburton and Norton, 2009). Cormorant populations have expanded greatly since 1980. Their consumption of fish as prey as well as damages done by cormorants to the breeding islands have made their impact an area of concern. In response to a recently published paper by Fielder (2008), I will clarify points relating to cormorant issues in Les Cheneaux Islands area of Lake Huron, and the question of whether sufficient evidence is available to initiate large-scale control measures to reduce cormorant populations in order to restore the yellow perch (*Perca flavescens*) fishery in the region.

Fielder (2008) evaluated population trends in cormorants and yellow perch in Les Cheneaux Islands area and concluded that cormorants have been largely responsible for the collapse of the perch fishery there. This contrasted with an earlier study conducted in the same area (Diana et al., 2006), which concluded that cormorant consumption of perch had little effect on the perch population or recreational harvest in 1995. It is entirely possible that the relationship between cormorants and perch could have changed over the past decade and that conclusions of both of these studies are correct. A number of changes have occurred in Lake Huron during the 10 years, including collapse of alewife (*Alosa pseudoharengus*) populations in 2004, the expansion of round gobies (*Neogobius melanostomus*) to the upper lakes, massive declines in Pacific salmon and *Diporeia* in Lake Huron, changes in zebra (*Dreissena polymorpha*) and quagga mussel (*D. rostriformis)* populations, and changes in temperature conditions and water levels as a result of evolving climate. Given the large number of factors that could have caused a decline in the perch population, I do not believe the analysis done by Fielder (2008) proves the case for cormorants as the major source of mortality to yellow perch in the region. This rebuttal focuses on the analysis and conclusions of the Fielder (2008) paper, and then on the general issue of cormorant control.

In my view, Fielder's (2008) analysis of perch and cormorant trends has three main flaws: variable population trends, uneven data analysis, and limited data collection. In addition, cormorant control is philosophically wrong, except in locations with very clear indications of overwhelming damage from the birds. Each of these issues is addressed below.

Variable population trends

My first comments focus on how to best study cormorant–perch interactions. In approaching any evaluation, direct evidence collected to answer a specific problem is always preferred. This is particularly true in fisheries where fish populations and the effects on their

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harvest can be very site specific. Some previous studies (reviewed in Diana et al., 2006) developed methods to use direct estimates of characteristics like cormorant population numbers (from aerial counts and nest counts), perch population estimates (from mark-recapture experiments), food habits of cormorants (from stomach content analysis), energetic cost of nesting (from other work on cormorant physiology), and evaluations of alternative sources of perch mortality (from creel census and estimation of fishing mortality using angler recaptures of tagged fish) to model the consumption pattern by cormorants and the effects of this mortality on the perch population. For Les Cheneaux Islands, these analyses showed that in 1995, the overall perch consumption by cormorants was most likely 470,000 fish and that the mortality caused by this consumption was <7% for every age class, far less than the total mortality estimate of 45% and similar to the mortality caused by fishing of about 3% for fish older than 2 years. Cormorants largely ate small fish, with 73% of consumption targeted at fish <200 mm in length and 2 years of age.

Fielder (2008) used indirect evidence to evaluate the cormorant–perch interaction. In part, this is necessary for historic reconstructions, as consistent, targeted, and effectively collected data are seldom available. Therefore, a weight-of-evidence approach is often necessary in supporting historical reconstruction. As for evidence, perch population trends from Fielder (2008) were taken from gillnet catches in the area, as well as angler harvest and catch per effort from creel censuses, with no direct estimation of population numbers for any year. Cormorant population trends were taken from nest counts on local islands. Relative abundance and nest count data were then used to derive correlations between the abundance of perch and cormorants. Specifically, nest counts indicated that cormorant numbers had stabilized from 1995 to 2004. Perch recruitment (numbers at age 2 in the gillnet catch) was extremely variable and had not changed dramatically during the same time period, while adult perch populations had plummeted and mortality rate increased significantly. This led to the conclusion that increased mortality on adult perch was due to cormorant consumption of large adult perch. However, the only direct evidence we have for the region indicates that cormorants mainly consumed other species, and when they did consume perch, they ate mostly small individuals. Rudstam et al. (2004) found similar trends in Oneida Lake with cormorants consuming age 0–3 perch most commonly, but perch as old as 4 and larger than 200 mm were eaten as well (about 25–30% of the time).

If cormorant predation caused the perch collapse in Les Cheneaux Islands, the first evidence should be a decline in abundance of young fish (which they eat), rather than older fish (which they usually ignore). Of course, it may be possible that cormorant consumption changed to include larger fish as well as small ones, but if that were true, the best evidence would be direct (seeing larger perch in cormorant diets). Fielder (2008) did not provide any direct evidence for an increase in size or number of perch eaten. In absence of that, it is difficult to provide a logical explanation of the mechanisms causing increased mortality on adult perch by cormorant populations. Even if cormorants did expand their diet to eat larger perch, one would still expect them to continue to consume smaller fish, too; therefore, the collapse of a perch population would result from both increased adult mortality and reduced recruitment due to higher consumption rates on small perch. Indeed, this was exactly what happened in Oneida Lake (Rudstam et al., 2004), where direct evidence indicated a decline in perch recruitment due to cormorant predation. This did not happen in Les Cheneaux Islands, and, as a result, one cannot clearly conclude that cormorants were the cause of this collapse.

Data collection

Rudstam et al. (2004) studied perch–cormorant interactions in Oneida Lake using methods similar to Diana et al. (2006). In the end, they concluded that cormorants had a significant effect on perch recruitment in Oneida Lake. They also concluded that one could only analyze these effects when high quality data on fish population dynamics and cormorant consumption were available; unfortunately, there are few examples of such data availability. The latter is true in Les Cheneaux Islands, so for most analyses, Fielder (2008) had to use whatever data were available. For example, his gillnet catch data were based on two nets set in three bays for one night each. This is an extremely low level of effort to evaluate population status of fish within the Great Lakes. At times, the data were even further limited to catches only in Hessel Bay (with two nets set for one night). It is impossible to assess statistical significance on Hessel Bay based on a sample size of two nets per year, because a minimum of three sets would be required to calculate a standard error. Additionally, a switch was made to sampling in a different bay in 1985, and the result was a significant decline in the catch of yellow perch. However, Fig. 4 still included the early data from these different bays to define trends. If one observes the data trends for all catch-per-unit effort values since 1985 (when the same bays were used), the decreasing trend actually appears to occur between 2000 and 2003, although it does not appear to be significant. The CPUE during the fishery collapse in 2000 was not obviously different from data during the previous 4 years.

Another issue related to the gillnet catch data in Fielder (2008) centers on statistical methods to estimate trends and variability. Fielder provided no evidence that gillnet catches could be repeated over time or space, which should be important if they are to serve as reliable indicators of perch abundance. In fact, he demonstrated they were not consistent over different bays. Additionally, there were inconsistencies in the interpretation of the same data set between Fielder's paper in 2008 and an earlier publication (Fielder, 2004). Fig. 3 from Fielder (2004) demonstrated trends in catch-per-unit effort from gillnet data for age 2 yellow perch (his recruitment data), and the maximum CPUE achieved was 28 fish in 2000. The same data (Fig. 6) showed a completely different pattern based on the use of geometric means in Fielder (2008), with CPUE in 2000 of 15. The same situation was shown in Fig. 2 from Fielder (2004), which depicted mean CPUE for all ages of fish. This figure showed an obvious upward trend in catch rates from 1984 through 2002. Compare this to Fig. 4 from Fielder (2008), where the use of geometric means indicated relatively stable catch rates from 1984 through 2004. One should be suspect of any claim of significance from data that are so inconsistent.

Finally, there is a major question about how to determine age distribution or mortality rates from these data. The catches in 2000–2004 visually estimated from Fig. 4 in Fielder (2008) would be from 10–20 fish per net night. With 6 net nights in the survey, this would equate to a total sample of 60–120 fish of ages ranging from 2–10. In some years, this sample appears to be as low as 30 fish collected. These numbers seem far too low to assess age distribution or mortality rate using catch curves, which are typically based on many more fish (for example, the minimum sample size was set at 1000 fish in Rudstam et al., 2004).

To support his use of gillnet data, Fielder stated that these same gillnet data were used by Diana et al. (1987), Lucchesi (1988), and Diana et al. (1997) to calculate mortality rate. This is a large oversimplification. The latter studies used mark-and-recapture experiments to estimate fish vital statistics, and thousands of perch were marked, released, and recaptured. Data from these fish were used for creating catch curves and mortality rates. Mortality rates were also verified directly using return of marked fish in recreational catch. These were then compared to data from the gillnet survey, and the reported values came from the larger data set based on the more robust samples of fish.

Data analysis

After reading this paper carefully, I have questions related to the data analysis in Fielder (2008). A few direct statements from the