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Essay

Ontario's Double-crested Cormorant hunting season may be ineffective but that doesn't mean there are no conflict issues

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La saison de chasse au Cormoran à aigrettes de l'Ontario est peut-être inefficace, mais cela ne signifie pas pour autant qu'il n'y a pas de problèmes de conflit

Key Words: *cormorants; management; policy; Laurentian Great Lakes; Ontario*

INTRODUCTION

After reading Hobson (2021) and the follow-up editorial by Cooke (2021), we were compelled to clear up some misunderstandings regarding Double-crested Cormorant (*Nannopterum auritum*, hereafter "cormorant") management to address predation issues on fisheries resources. As researchers and managers who have been actively involved in cormorant-related research, management, and policy development for decades, we offer an alternative perspective on this controversial issue. This is not a rebuttal per se, because we agree with Hobson's and Cooke's principal opinion that management with a province-wide fall hunting season is a poor method of addressing cormorant conflicts. We do, however, take exception to some of the assertions they make as the reasoning for that opinion. This situation provides an opportunity to address misconceptions about cormorant and fishery interactions, summarize the current state of knowledge on the issue, and discuss a different approach based on collective experience in the United States.

A fundamental premise of Hobson's and Cooke's editorials was that there is no current scientific evidence that cormorants compete with anglers for fish, or affect fisheries or fish populations. Hobson (2021) wrote:

> *That highly questionable action (i.e., the Ontario hunting season) derives clearly from the attitude that cormorants are competing with anglers for sports fish as well as annoying those promoting nondisturbance of lakeshore vegetation. However, the scientific evidence is clearly against this notion, which seems deeply based in human psychology that every fish taken by a cormorant is one less to be taken by an angler or to be taken by a fish sought after by an angler, or that somehow, cormorants represent a new threat to island vegetation.*

Similarly, Cooke (2021) states that many fish species in Ontario are not doing well but cormorant effects are near the bottom of the list of reasons, if even a factor at all. Overall, the implication of both editorials is that cormorants rarely, if ever, are an issue for any reason, and that management is rarely warranted.

Contrary to Cooke's and Hobson's assertions of no current evidence of meaningful impact to fisheries, research has established that cormorants have negatively affected some economically important sport and commercial species, as well as threatened and endangered species in North America (O'Gorman and Burnett 2001, Burnett et al. 2002, Johnson et al. 2002, Lantry et al. 2002, VanDeValk et al. 2002, Casselman et al. 2003, Hebert and Morrison 2003, Seider 2003, Rudstam et al. 2004, Ridgway et al. 2006, Smith et al. 2007, Fielder 2008, 2010, Dorr et al. 2010, Johnson et al. 2010, Bacheler et al. 2011, DeVault et al. 2012, Dorr et al. 2012, Ridgway et al. 2012, Schultz et al. 2013, Johnson et al. 2015, McGregor et al. 2015, Coleman et al. 2016, Evans et al. 2019, Ovegård et al. 2021). There is also accumulating evidence that management to reduce cormorant predation has benefited some affected fisheries, confirming ascription of fisheries declines to cormorant predation (Dorr et al. 2010, Fielder 2010, Dorr et al. 2012, Schultz et al. 2013, Johnson et al. 2015, McGregor et al. 2015, Coleman et al. 2016). Taken together these studies provide substantial weight of evidence that cormorants do in fact affect fisheries and fish populations. To be clear, there are studies that suggest cormorants are not having an impact on fisheries in some locations (Diana et al. 2006, Kaemingk et al. 2012, Koenigs et al. 2020). These studies combined do not suggest cormorants are always or never an issue for fisheries, but that their potential impacts vary by location and conditions.

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We also found some research attributions misleading. Cooke (2021) cites Ovegård et al.'s (2021) meta-analyses of cormorant fisheries issues as stating cormorants have no statistically significant effect on marine or freshwater fish populations. Ovegård et al. (2021) specifically state that interactions vary by cormorant and fish species, and that Great Cormorants (*Phalacrocorax carbo*) and Double-crested Cormorants are significantly associated with negative impacts to cyprinid and percid fish species such as yellow perch (*Perca flavescens*) and walleye (*Sander vitreus*), species that are of fishery concern in Ontario. Hobson (2021) also cites Johnson et al.'s (2015) long-term study as evidence that cormorants consume primarily round gobies, but fails to acknowledge Johnson et al.'s findings that "There is evidence that the combination of management actions and round goby may have allowed some population recovery of yellow perch and smallmouth bass in eastern Lake Ontario" (2015:652). Whereas Hobson (2021) and Cooke (2021) make claims of no evidence of fishery impacts in Ontario, at least 15 of the above citations regard cormorant fisheries interactions in Ontario or in adjacent U.S. waters (e.g., U.S. waters of Lake Ontario), a substantive oversight. Although we agree with Cooke's (2021) assertion that cormorant impacts to fisheries do not compare in scope to issues of climate change, pollution, overfishing, and habitat degradation, they are hardly non-existent or even all that rare or isolated, and should not be simply ignored or dismissed.

HOW ARE IMPACTS DEFINED AND MEASURED?

Through our own experiences, we have observed the disagreement on the role of cormorant predation effects on fishery resources often stems from disagreement on how those effects should be measured. The temptation by many is to rely on cormorant-diet studies to draw conclusions on predation effects. Hobson (2021) and many others highlight diet studies in which the consumption of forage fish species or non-native species are commonly provided as evidence of no impact on fisheries. However, this recalls the common aphorism, "absence of evidence is not evidence of absence." Further discussion about cormorant-diet studies and impact to fisheries is clearly warranted.

Cormorant-diet studies are important, but relying on diet studies to evaluate cormorant effects on fisheries is problematic for a multitude of reasons. Cormorants are generalist, opportunistic predators, and their diets can vary substantially in space and time (Trapp et al. 1997, Dorr and Somers 2012, Johnson et al. 2015, Dorr and Fielder 2017). Because of these characteristics of cormorant-foraging ecology, many diet studies fail to reflect their diet accurately. Diet studies are often initiated after large declines in fish populations of management interest have already occurred; consequently, their results may not reflect diets prior to fish-population changes. On their breeding grounds, cormorants have often been found to consume the vast majority of centrarchid and percid sportfish early in the breeding season, when these fish species are spawning and vulnerable to predation (Belyea et al. 1999, Johnson et al. 2002, Dorr et al. 2010). Diet studies, particularly those using chick regurgitates, often under-sample or miss these time periods entirely. Cormorants also do not forage randomly from a fish population. Their foraging on sportfish can be focused on certain age classes of fish. Therefore, comparisons of biomass removed to biomass of all fish in a population can fail to measure actual predation impacts. If cormorants are consuming a large percentage of specific age classes, this predation can result in a recruitment bottleneck to a fishery (Lantry et al. 2002, Fielder 2010, Dorr and Fielder 2017), resulting in subsequent declines, particularly if cormorant-predation mortality is additive to other sources of mortality. Last, many diet studies have been done in the absence of data on the potentially affected fish populations, which greatly limits the ability to draw inference as to whether the amount of predation can be supported by the population. In Ovegård et al.'s (2021) meta-analyses of cormorant and fishery interactions, the authors reported over half of the 603 studies reviewed were diet studies that made conclusions unsupported by the data. Ovegård et al. (2021) concluded that reliance on diet studies to prove or disprove the impact of cormorant predation on fisheries has contributed to the misunderstanding of cormorant and fishery interactions.

Cormorant foraging ecology and potential impacts to fish populations are now better understood. For example, the cormorant's generalist diet (Trapp et al. 1997) and ability to prey switch (Johnson et al. 2010, DeBruyne et al. 2013) can result in what is described by Hilborn and Walters (1992) as a predator threshold phenomenon, meaning the functional response of a secondary prey species to predation results in a depensatory mortality effect. As such, a predator sustained at high density by an abundant primary prey (like alewife or round goby) can have a substantial negative predatory effect on a secondary prey form (like a game species), even if eaten only infrequently. Such predator thresholds can decouple predators and prey from the classic predatory-prey oscillations that many wildlife and fisheries students are taught early in their educations (Dorr and Fielder 2017).

To fully assess the status of a fish species in response to cormorant predation requires assessment of trends in fish-species total annual mortality rates (Fielder 2008, Fielder 2010, Dorr et al. 2012, Schultz et al. 2013). Because cormorants often tend to consume younger age groups of a sport-fish population than anglers (likely a result of abundance and preferred prey size) before moving on to older ages or switching to other prey species, their foraging can mimic recruitment failures and can be mistaken for reproductive declines in fish populations. Often observed where sufficient data exist is the emergence of abundant young fish only to disappear quickly in the presence of cormorant predation (Rudstam et al. 2004, Dorr et al. 2010, Fielder 2010). Although cormorants typically eat younger age classes of fish than anglers, that predation often comes too late for mortality to be compensatory to other sources of mortality (i.e., young fish eaten by cormorants may die from other causes like other predators or disease). Consequently, cormorant predation can be additive to other mortality sources, elevating mortality rates beyond what can be explained by angling or commercial harvest alone (Lantry et al. 2002, Rudstam et al. 2004, Fielder 2010, Ridgway et al. 2012). Growth rates of fish species affected by cormorant predation will often increase greatly, released from the limitations of density-dependent growth. Mean age of affected fish populations will rise initially, then plummet. Often, fish populations subjected to substantial cormorant predation will demonstrate these classic signals of over harvest (Dorr et al. 2010, Fielder 2010, Ridgway et al. 2012, Schultz 2013). To accurately assess the effects of cormorant predation on a fish community requires a variety of time-series data that often do not exist. This lack of information can contribute greatly to uncertainty and controversy surrounding cormorant-fishery conflicts. Last, as Johnson et al.'s (2015) long-term study highlights, these ecosystems are dynamic. Johnson et al. (2015) found evidence that cormorants were having an impact on fisheries in the eastern basin of Lake Ontario, but after the arrival of invasive round goby, cormorant predation on sportfish was reduced because round goby appear to serve as a buffer prey species. This change may allow for a reduced take level of cormorants than was originally prescribed. However, waiting a decade or more to deal with predation issues in hopes of an introduction of a damaging invasive species to serve as a buffer prey, is not a recommended management strategy. It should also be noted that ecosystem changes could result in greater cormorant impacts and need for management.

A QUESTION OF SCALE AND SCOPE

Cooke (2021) suggests that cormorant impacts to natural systems are inconsequential because they aren't global, national, or province-wide. We think this is a strawman argument because few management concerns would measure up to this criteria yet are still important. If not, why have, for example, local fish-harvest regulations for specific parks or lakes at all? Clearly these individual policies do not have global impacts, yet we cannot imagine an agency ignoring these issues simply because they are not large scale. However, the cumulative actions at local scales can have larger scale consequences. Cormorants are neither randomly distributed nor do they forage randomly in the systems they occupy (Dorr et al. 2021, Dorr and Fielder 2017). Inherently, the issues associated with these birds tend to be local, although potentially affected areas can be astonishingly large, for example Les Cheneaux Islands (Michigan), Columbia River, or Leech Lake (Minnesota; Collis et al. 2001, Collis et al. 2002, Fielder 2010, Schultz et al. 2013, Evans et al. 2019).

We assert and believe research supports finding that cormorants, in some locations and conditions, can and do have a deleterious effect on recreationally and commercially important fish species, and threatened or endangered fish species. The challenge then becomes to recognize when and where those situations exist and constitute an actionable level of concern, which is primarily a question of scale and scope. We appreciate that Hobson (2021) made some acknowledgment of this by saying:

> *In local cases where cormorant control is deemed necessary (and supported by scientific evidence), it should be carried out by skilled professionals and not by the general public. Even so, such control measures need to be continually justified within the spirit of adaptive resource management.*

We wholeheartedly agree with Hobson's assertion, although intensive adaptive management may not be possible or required in every application, but certainly follow-up monitoring is. Herein lies the problem with a region-wide fall hunting season: there is no effort to understand when and where cormorant predation is problematic and where it is not. It treats all cormorants the same whether from a large colony potentially affecting important recreational or commercial fisheries, or just a few birds on a remote lake. Further, imposing a fall hunting season while birds are migrating means a reduction of birds that has little likelihood of resulting in real relief in problem areas. Thus, the use of a hunting season is at best a feel-good illusion of management.

A DIFFERENT APPROACH

Many of the same questions regarding cormorant societal interactions that have played out in Ontario have also occurred through much of the United States, another partner to the Migratory Bird Treaty Act mentioned by Hobson (2021). The U. S. includes both over-wintering and breeding grounds for cormorants and their interstate management falls to the U.S. Fish and Wildlife Service (USFWS). Cormorant abundance throughout their range expanded exponentially in the 1970s to 2000s, to numbers not previously seen in decades, if ever for some areas. For example, in the Great Lakes alone, cormorants rebounded from around 200 nesting pairs in the early 1970s to 115,000 in 2000 (Taylor and Dorr 2003). This growth was likely because of laws reducing environmental contaminates like DDT (Weseloh et al. 2002) and legal protection from unregulated persecution (Dorr et al. 2021). Increases in cormorant abundance may also have been fueled by expanding aquaculture in the southern U.S. (Burr et al. 2020) and the availability of nonnative prey resources in the Great Lakes region, such as alewife (*Alosa pseudoharengus*) and later round goby (*Neogobius melanostomus*; Ridgway and Fielder 2013). The increase in cormorant abundance is unquestionably a wildlife-recovery success story. This success has, however, caused some stakeholders to view cormorants as overabundant, particularly in areas where they concentrate for nesting or foraging (e.g., aquaculture farms; Dorr and Fielder 2017, Dorr et al. 2021).

The history of cormorant management in the U.S. has had its own limitations and challenges. The most recent U.S. policy, the 2020 USFWS Permit System (Federal Registry 2020) for states and tribes in the U.S. is an evolution to, we think, a better framework for addressing cormorant concerns (see also USFWS 2020). The permit system was developed specifically to alleviate the conflict between cormorants and fisheries. For natural-resource managers, this has the effect of focusing actions on specific areas where the conflict exists. If there is no conflict, then no action is needed.

Management actions to reduce conflict under this new policy should be more focused in approach with considerable responsibility for establishing that there is a problem. If a problem is deemed to exist, then addressing it with the underlying principle that cormorants are part of our natural systems, and a healthy and sustainable cormorant population must be maintained, is built into the permit process. The Environmental Impact Statement and subsequent permit system included years of effort from a multitude of fisheries and wildlife experts in crafting an approach that allows flexibility to use multiple non-lethal methods, including site-specific dispersal, nest-site exclusion, nest removal prior to egg-laying, and, when necessary, lethal management such as culling and egg oiling on local rookeries (Federal Register 2020). A critical component to the U.S. permit system is that prior to being approved for a depredation permit for the lethal take of cormorants, permittees must show non-lethal methods have been used. Possibly the most powerful aspect of this permit system is if the permitting agency thinks there is not sufficient evidence to justify cormorant management, they can deny the permit.

Limitations of the new permit system likely exist, but it is too early to fully understand them because 2021 was the first year of implementation. One clear facet of the new permit system is that no single approach or silver bullet has surfaced to manage the cormorant-fisheries conflict. Instead, state or tribal agencies must use a suite of approaches, including stating any lethal-control targets, because the new permit system is allocated at a larger, regional scale, not to exceed allowable take levels to maintain cormorant abundance at a population scale. In the new system, the applying agency is the permittee and directly responsible for control activities and their funding. Given these considerations, state and tribal agencies may be challenged with the question of whether they will have the capacity to implement the requirements of the new permit system.

Currently, an effort is underway in the U.S., funded by the USFWS and the U.S. Department of Agriculture, to develop models based on more easily obtainable physical and chemical measures of lake productivity that can predict production of fish resources. These models will allow management agencies to be better positioned to assess whether cormorant predation may exceed a sustainable level of fish production. The modelling approach to the cormorant-predation question comes from a basis of allocation among competing sources of natural mortality (predation) and fishing mortality (harvest) within the limits of sustainable total mortality. The intent for creating this model is to develop an objective, defensible basis to judge if cormorant predation may be on a scale that warrants action or not, where other data may be limited or absent. Although these models will not be applicable in all situations, an effort is being made to make them robust to areas where most conflicts occur.

In addition to the new permit system, development of tools, such as the models already described, that can better inform whether cormorant management is needed, and at what level to manage cormorant-fisheries interactions, will be important. If integrated into the permit system, this approach may reduce the burden on state and tribal agencies. Although the new approach and permit system have not been free of controversy, the initial response is that they have largely satisfied many interested stakeholders, including recreational and commercial fishing groups as well as other affected constituents closely linked to the resources, e.g., businesses and local economies. Engagement with stakeholders for the new U.S permit system has shown that the U.S. government is taking their concerns seriously. When management agencies fail to address natural-resource-management concerns, including biological and social conflicts, legislative bodies can act instead, without management-agency inclusion. Worse yet, vigilantism directed at cormorants can occur that is either ineffectual, destructive, or both. Avoiding these reactive actions on cormorant-conflict issues can also prevent cormorant management from being labeled persecution and painted with a broad brush as unscientific placation.

CONCLUSION

The question of cormorant impacts is more complex in its ecological dynamics and its societal role than we feel either the Hobson (2021) or Cooke (2021) editorials acknowledged. We believe the conversation around cormorants has evolved from whether they can affect fisheries, to how to best determine when and where those fisheries impacts may be ecologically or socially unsustainable. Careful efforts should focus on the definition and recognition of those problematic situations; then, let's debate what the most appropriate response might be. Asserting that cormorant predation is a non-issue, and dismissing management where supported, can give rise to frustrated constituents, resulting in actions that are counterproductive or even destructive to cormorants and fisheries. We agree that transferring responsibility of cormorant conflicts, either real or perceived, to the public through a hunting season not only will not work but also is antithetical to basic principles of conservation and management of fish and wildlife. We strongly support the recognition that cormorants are native predators and natural components of the ecosystems they occupy; therefore, the maintenance of their populations and, if necessary, the use of non-lethal methods and the least disruptive management, should be primary considerations.

We also recognize that natural-resource managers have the difficult task of maintaining as much remaining diversity and ecological integrity as possible, while meeting multiple societal uses of those resources within systems often undergoing rapid disruptive change (Ridgway and Fielder 2013, Dorr and Fielder 2017). Seeing cormorant predation as an allocation issue of limited resources will require difficult conversations and decisions about priorities by management agencies. Although perhaps costly and difficult, this decision-making process regarding resource use is a fundamental aspect of fishery and wildlife management. By applying the principles of stakeholder involvement and deliberative decision making based on data and science, we have every confidence that this issue can be effectively addressed in a way that is both socially acceptable and ecologically sound.

Responses to this article can be read online at:
https://www.ace-eco.org/issues/responses.php/2249

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