Figure 1. The non-native invasive form of the Common Reed (shown here), often referred to simply as *Phragmites*, is taller on average with larger flowers, darker leaves, and more uniformly-coloured stems compared to the native and much less aggressive form.
Photo: Steve Timmermans

How do recent changes in Lake Erie affect birds? Part one: Invasive *Phragmites*

Doug Tozer and Gregor Beck

Pollution in Lake Erie made headlines in the 1960s and 1970s, but action was taken, and the lake recovered enough by the 1980s for the effort to be considered a conservation success (Makarewicz and Bertram1991). However, in the 2000s, we are hearing about harmful algal blooms, botulism, invasive species, climate change and other issues. Recently, Michigan and Ohio even declared portions of Lake Erie as impaired for recreation due to harmful algae and drinking water due to occurrences of microcystin (Michigan Department of Environmental Quality 2016, Ohio Environmental Protection Agency 2018), and Ohio issued an executive order to deal with the issues (State

Figure 2. The rapid spread of invasive *Phragmites* throughout Lake Erie coastal wetlands over the past two decades is well illustrated by data from this marsh located on the south side of the Inner Bay of Long Point.
Background imagery: Google, TerraMetrics. Phragmites data: Wilcox et al. (2003), Ontario Ministry of Natural Resources and Forestry.

of Ohio 2018). What's happening? Why are these extreme measures necessary? Why are conditions in the lake getting worse? What does it all mean for birds? This review article is part one of a series of three articles that will appear in *Ontario Birds*. The articles provide an overview of some of the current environmental and ecological issues for Lake Erie, with emphasis on the implications for the numerous bird species that depend on the lake for nesting and migration. There are dozens of worthy issues to profile. We chose to begin with invasive *Phragmites*. In addition to a review of each issue, the articles will also present new analysis of relevant citizen science data and suggest actions that we, as birders, can take to help alleviate the issues.

The Common Reed (*Phragmites australis americanus*) is a semi-aquatic species of grass native to Ontario (Ontario Ministry of Natural Resources 2011). A non-native invasive form of the Common Reed (*P. australis australis*; hereafter "invasive *Phragmites*", Figure 1), was introduced to North America from Asia, probably by humans through Atlantic seaports during the 1800s (Saltonstall 2002). Invasive *Phragmites* likely spread to Lake Erie sometime between 1910 and 1960 (Saltonstall 2002), but did not get well established until the record-low water levels during the late 1990s and early 2000s (Wilcox *et al.* 2003, Wilcox 2012). During the low water period, exposed lake bottom created ideal conditions for germination, and the invasive form of the plant spread quickly and extensively (Figure 2) (Wilcox 2012). Invasive *Phragmites* is now locally abundant and established throughout the coastal wetlands of Lake Erie, and much of

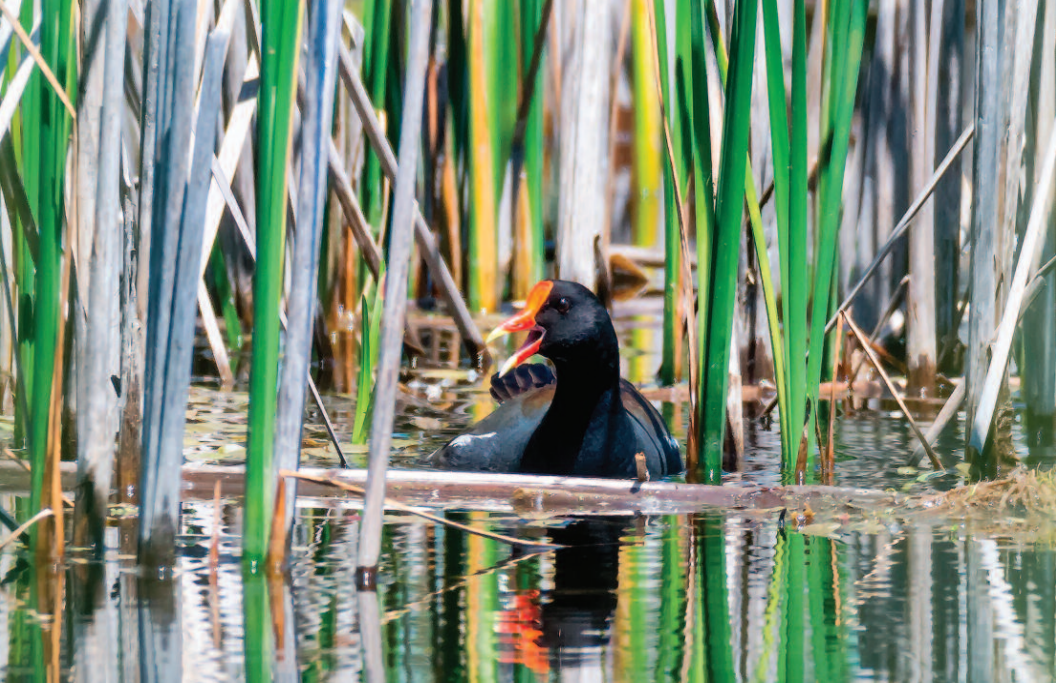

Figure 3. The spread of invasive *Phragmites* is likely a contributing negative factor in the population trends of many marsh-nesting species in Lake Erie and throughout other parts of the southern portion of the Great Lakes basin, including Common Gallinule. *Photo: Tim Arthur*

the rest of the lower Great Lakes and beyond (Bourgeau-Chavez *et al.* 2013, 2015). It is here to stay, even though water levels have come back up in recent years, because the plant is able to survive in deep water and expand rapidly once it is established and full-grown (Ontario Ministry of Natural Resources 2011).

One of the biggest problems with invasive *Phragmites* is that many of Lake Erie's wetland birds avoid it, particularly marsh-nesting species such as Common Gallinule (*Gallinula galeata*) (Figure 3) and Virginia Rail (*Rallus limicola*). They establish fewer breeding territories in it, and settle mostly in other remaining vegetation instead. It appears that invasive *Phragmites* grows too tall (up to 5 m) and too dense (over 190 live and dead stems/m^2) (Robichaud and Rooney 2017) to make good habitat for most marsh-nesting birds. These features eliminate the pools and channels that many local marsh-nesting bird species prefer for feeding (Rehm and Baldassarre 2007). Some marsh-nesting species, such as the Least Bittern (*Ixobrychus exilis*), will place their nests within *Phragmites* (Dupuis-Désormeaux *et al.* 2017), but probably only feed along the edge of invasive *Phragmites* stands or within more attractive vegetation nearby. Compared to large monotypic stands of invasive *Phragmites*, other emergent marsh vegetation is less dense, shorter, more diverse, and is typically more interspersed with the pools and channels that most marsh-nesting birds find attractive (Wyman and Cuthbert 2017).

Three studies in marshes at Long Point, Ontario, support these ideas. Robichaud and Rooney (2017) surveyed

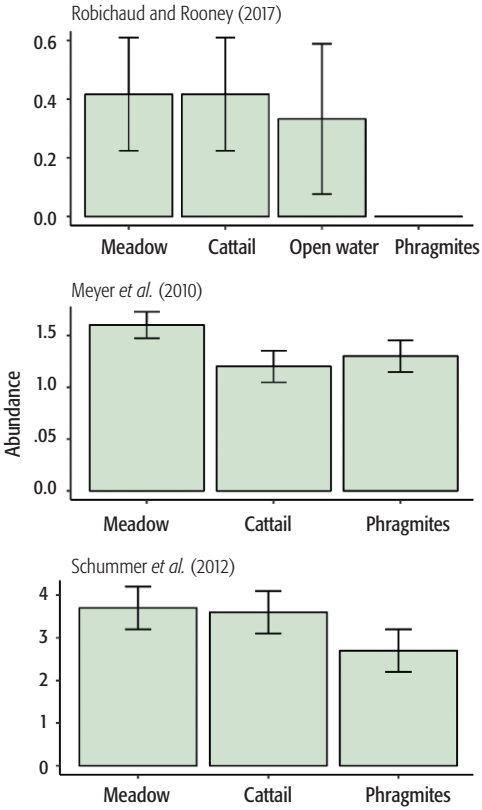

Figure 4. Marsh-nesting bird abundance (mean number of individuals per plot) among different vegetation and pond types according to three different studies within marshes at Long Point, Lake Erie, Ontario. Marsh-nesting bird species included: American Bittern, Least Bittern, Sora, and Virginia Rail (top, Robichaud and Rooney 2017), 13 species (middle, Meyer *et al.* 2010) and 10 species (bottom, Schummer *et al.* 2012) of bitterns, rails, shorebirds, songbirds, and waterfowl. Error bars are ± 1 SE.

Data source: adapted from the originals as cited.

marsh-nesting birds in 48 plots divided equally among four habitats: 1) areas dominated by invasive *Phragmites*, 2) areas dominated by cattail (*Typha* spp.), 3) areas dominated by grasses and sedges and 4) areas dominated by open water. Remarkably, they detected not a single American Bittern (*Botaurus lentiginosus*), Least Bittern, Sora (*Porzana carolina*) or Virginia Rail within the invasive *Phragmites*, yet they detected these species in the other vegetation types (Figure 4). Similarly, Meyer *et al.* (2010) and Schummer *et al.* (2012) surveyed marsh-nesting birds in plots dominated by invasive *Phragmites* compared to plots with a mix of other more typical vegetation types that are being displaced by invasive *Phragmites*, as well as open water, and found that the abundance of marsh-nesting birds was generally lower within large, dense, monotypic stands of invasive *Phragmites* compared to the others (Figure 4). It should be noted, however, that the *Phragmites* stands studied by Meyer *et al.* (2010) did have value for some landbird species during summer and autumn. In fact, Meyer *et al.* (2010) found that abundance and species richness of all bird species combined was highest in *Phragmites* compared to the other vegetation types.

The presence of dense stands of invasive *Phragmites* reduces the utility of Lake Erie's coastal wetlands for marsh-nesting birds. However, invasive *Phragmites* is only one factor negatively affecting these species in Lake Erie. Other negative impacts include pollution and loss and fragmentation of wetland habitats due to encroachment from development and agricultural intensification pressures. There are also factors that influence populations of these species in positive ways, such as changes in water levels that may increase the amount of suitable wetland habitat in some years in certain areas. This complicated interplay of negative and positive factors is illustrated by our analysis of data from Bird Studies Canada's Great Lakes Marsh Monitoring Program, which indicate that populations of 5 of 10 marsh-dependent breeding bird species significantly declined by 2-7% per year in Lake Erie coastal wetlands over the past two decades (Figure 5). Over that time span, this amounts to a total decline of 36-80% for each of those five species. At that rate, within the next 65-230 years, these species would be nearly gone from our marshes. According to our analysis for some marsh-nesting species, such as American Bittern, Black Tern (*Chlidonias niger*) and Marsh Wren (*Cistothorus palustris*), there is strong evidence that the spread of invasive *Phragmites* at a particular location leads to local extinction (Figure 6). However, populations of only one of these three species is decreasing in Lake Erie (Black Tern), whereas the other two (American Bittern and Marsh Wren) show stable numbers (Figure 5), suggesting that positive factors are over-riding the negative factors (including invasive *Phragmites*) for at least some of them during the period. Deciphering cause and effect with so many interacting factors is challenging, although it is reasonable to conclude that

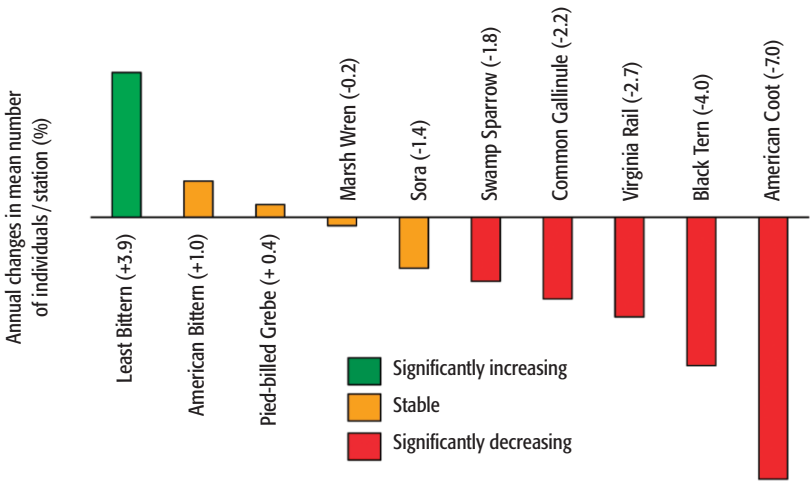

Figure 5. Populations of half of 10 marsh-dependent breeding bird species in Lake Erie coastal marshes significantly declined over the past couple of decades, probably due, at least in part, to the spread of invasive *Phragmites*. *Data source: Bird Studies Canada's Great Lakes Marsh Monitoring Program.*

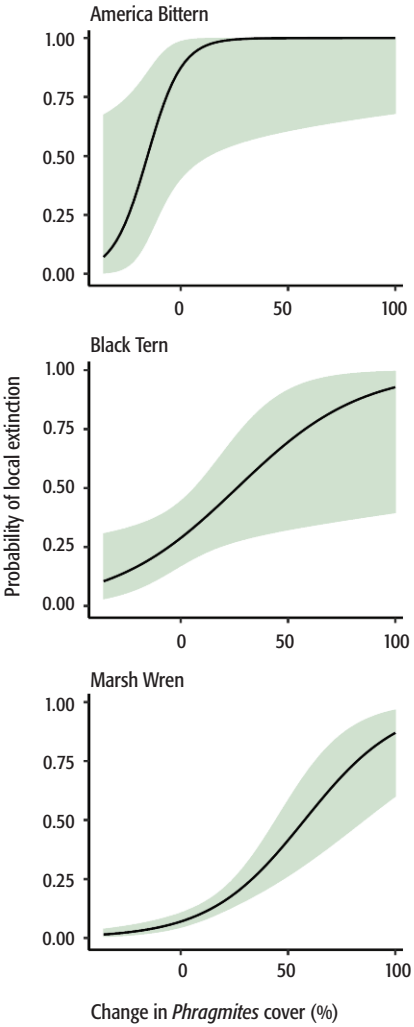

Figure 6. Relationship between the change in amount of invasive *Phragmites* cover within a 100-m-radius semicircular plot and the probability of local extinction (i.e., the disappearance of the species from the plot) of some marsh-dependent breeding bird species in Lake Erie coastal marshes at Long Point and Turkey Point, Ontario, 1995 to 2017. A negative change in *Phragmites* cover indicates that cover decreased between the years of observation, whereas a positive change indicates that cover increased; for example, a change of 50% indicates the final percent cover minus the starting percent cover between years is 50. For the selected species shown, the probability of the species disappearing increased with the spread of invasive *Phragmites*. Shading are 95% confidence limits.
Data source: Bird Studies Canada's Great Lakes Marsh Monitoring Program.

invasive *Phragmites* is a contributing negative factor in the population trends of many marsh-nesting species in Lake Erie. The establishment and spread of invasive *Phragmites* is probably also negatively influencing population changes of marsh-nesting bird species throughout other parts of the southern portion of the Great Lakes basin (Tozer 2013, 2016).

So what does this all mean? As we mentioned above, invasive *Phragmites* is here to stay, although it can be almost entirely removed from targeted areas with great effort and expense (Figure 7) (Ontario Ministry of Natural Resources 2011). In the past few years, invasive *Phragmites* has been removed from portions of the extensive marshes at Long Point, Turkey Point, Rondeau Provincial Park, Kettle and Stony Point First Nation and the surrounding region, and elsewhere (Ontario *Phragmites* Working Group 2018, Lambton Shores *Phragmites* Community Group 2018). These actions appear to greatly benefit marsh-nesting birds presumably by increasing the amount of preferred feeding habitat (D. Tozer pers. obs.). The actions likely also increase the amount of preferred nesting habitat, although as mentioned above, individuals of some species will place their nests within invasive *Phragmites* (e.g., Dupuis-Désormeaux *et al.* 2017). The actions also benefit other wildlife,

Figure 7. Invasive *Phragmites* can probably never be eliminated entirely from Ontario's wetlands. Great effort and expense to control the plant, as illustrated here by aerial application of herbicide at Turkey Point, is one way of strategically maintaining biodiversity in key locations. Birders can help prevent such widespread problems by educating themselves on invasive species issues. *Photo: Gregor Beck.*

including certain species at risk, such as Fowler's Toad (*Anaxyrus fowleri*) and Spiny Softshell (*Apalone spinifera*), whose nesting sites may be encroached upon and shaded out by invasive *Phragmites* to the point of being unusable (Bolton and Brooks 2010, Greenberg and Green 2013). Although these actions are important for strategically maintaining biodiversity in key locations (Badzinski *et al.* 2008), there is no easy fix for invasive *Phragmites* everywhere that it has spread.

The single most important message that we hope to convey is that we, as a society, need to be extremely careful when it comes to invasive species. All it takes is an unintended introduction of, for example, a few individuals of a non-native invasive species and we potentially have a big problem on our hands. The problem might not even become apparent until decades later (as with invasive *Phragmites*). We recommend collectively taking the time to learn more about invasive species issues. A good way to start is by reviewing and implementing actions that can be taken while birding or pursuing other recreation in or near marshes to prevent the spread of invasive species, such as cleaning gear and pets before moving between locations (see summary at Ontario Ministry of Natural Resources and Forestry 2018). It is also good to learn more about government policies and recommended policy changes to deal with invasive species in Ontario (read Environmental Commissioner of Ontario 2018). More information on invasive *Phragmites* can be found in Ontario Phragmites Working Group (2018) and Great Lakes *Phragmites* Collaborative (2018). Then, if you are up for it, you might educate all of

your friends and others about invasive *Phragmites*. Inform everyone that there is much more at stake than most people typically appreciate. The negative effect of invasive *Phragmites* on marsh-nesting birds is something that is too easily forgotten in the larger scheme of things.

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