SOCIETY OF WETLAND SCIENTISTS

SWS Research Brief

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This Land Was Made for You and Me…. and *Phragmites*, a Wetland Invader

Background

In 1940 Woody Guthrie wrote the folk song "This Land is Your Land" and described the glorious expanse of public lands in North America—from east to west, from north to south. And although this land was "made for you and me", it also has become fertile ground for the invasion and spread of a non-native grass known as common reed, or *Phragmites australis*. *Phragmites* enjoys an almost global distribution in wetlands throughout the world, but the particular type of *Phragmites* expanding in North America appears to have arrived in the mid-19th century from Europe. Its rapid spread into both non-tidal and tidal wetlands has both scientists and managers scrambling to understand the mechanisms for its successful introduction and subsequent growth.

Phragmites is a grass, and a common one at that. Why, then, the fears about its invasion and spread? First, *Phragmites* is a perennial plant that sprouts densely and can grow over 5 meters (16 feet) tall—*Phragmites* is able to wholly displace native, lower-lying wetland species of plants (Fig. 1). The conversion of a wetland to a near-monoculture of *Phragmites* fundamentally reduces plant diversity and changes the community of animals living in the wetland. Especially for tidal wetlands, the habitat support for recreationally and commercially important species of fish in adjacent open waters may be compromised when *Phragmites* takes over a wetland.

On the ground, a number of studies have investigated individual stands of *Phragmites* and identified various aspects of plant growth and interaction with local environmental conditions. For the present study, we stepped back and tried to capture a bigger-scale, regional picture of *Phragmites* distribution in tidal wetlands of Chesapeake Bay.

Figure 1. *Phragmites* looms in the background of this high tidal marsh picture.

Anecdotally, *Phragmites* is thought to be more extensive in the northern portion of the estuary, but this has never been demonstrated at the bay-wide scale. Most of the bay shoreline is potentially susceptible to invasion and spread, however, so we wanted to determine what has contributed to the observed, current distribution of *Phragmites*, considering both where common reed is growing and where it is not.

Study Goal

Our overall goal was to identify "hot spots" of *Phragmites* occurrence associated with different land use activities in the Chesapeake Bay watershed. To accomplish this, we completed extensive boat surveys of over 8,000 kilometers (almost 5,000 miles) of estuarine shoreline (Fig. 2) to document visually the presence or absence of *Phragmites* along the estuarine shoreline of the bay.

We also categorized land use in the adjacent uplands to examine its possible relationship to the presence of *Phragmites* in the wetlands.

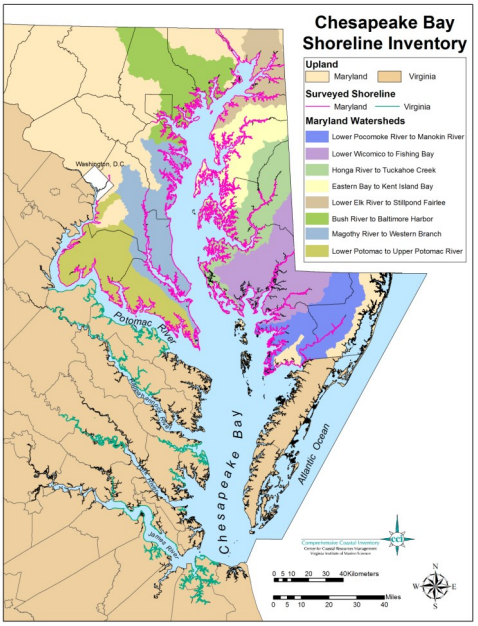

Figure 2. Locations of shoreline inventory in Maryland and Virginia portions of Chesapeake Bay (modified from Chambers et al. 2008)

"DOES PHRAGMITES PROVIDE A CLEAR SIGNATURE OF WETLAND ALTERATION IN DEVELOPING WATERSHEDS?"

A Closer Look

Phragmites *grows big and tall relative to most other species of wetland plants. Tolerant of salinity up to about half-strength seawater,* Phragmites *tends to invade high marshes where flooding is less frequent and young shoots can grow. Once established, however,* Phragmites *is able to "march" into lower wetland elevations by extending rhizomes into more flooded soils.*

Rapid and extensive biomass accumulation requires a large amount of available nutrients. Work by other investigators has suggested that Phragmites *establishment is assisted both by local disturbance at the wetland-upland border (opening space for colonization) and by localized nitrogen enrichment (providing nutrients for growth).*

At the same time that Phragmites *is expanding dramatically in North American wetlands, die-back is common in Europe where* Phragmites *has been a stable component of wetland plant communities for perhaps thousands of years. This geographic and historical separation has led to different research approaches on either side of the Atlantic, focusing on ways to enhance* Phragmites *stands in Europe and ways to eradicate the species in North America.*

Study Area

We restricted our surveys of shoreline and adjacent land use to the tidal waters of Chesapeake Bay in Maryland and Virginia. The Chesapeake Bay is a flooded river estuary formed by post-glacial sea-level rise and subsequent flooding of the Susquehanna River basin. Other major rivers flowing into the bay include the Potomac, Rappahannock, York, and James Rivers.

A majority of the 7 million people living around the bay are located in cities and towns on the western shore, including Baltimore, Washington DC, Fredericksburg, and Hampton Roads. In contrast, the eastern shore of Chesapeake Bay has a much lower human population density and instead is dominated by crop agriculture and commercial chicken farms.

Considered "America's Estuary", Chesapeake Bay had a flourishing shellfish industry last century, but overfishing, shellfish disease, and declining water quality have contributed to near total depletion of shellfish stocks, particularly oysters. Recent research has considered the introduction of Asian oysters to replace native stocks, but concerns over unforeseen ecosystem-level impacts associated with non-native species introductions have put that project on hold. In the meantime, ongoing declines in water quality arising from unregulated watershed management practices have put other species at risk of commercial extinction, including the blue crab.

The past 25 years of bay management for aquatic, wetland, and upland resources has yielded few positives and many negatives, all set against a backdrop of continued pressures associated with human population growth in the watershed. In this sense, *Phragmites* historically was considered a signature of human disturbance. *Phragmites* tended to grow in places where alterations of wetland habitat had occurred.

The present study gave us a chance to determine whether that signature was detectable throughout the bay's sub-watersheds.

Methods

We conducted our survey by boat along some 5,700 km (3,534 mi) of estuarine shoreline in Maryland and 2,700 km (1,674 mi) of shoreline in Virginia (Fig. 2). The presence of *Phragmites* in wetlands along the shoreline was mapped using a global positioning system (GPS) and a geographic information system (GIS) to create digital, fixed points of occurrence (Fig. 3). In addition, the type of land use in the adjacent riparian zone was categorized as either crop agriculture, forested, cleared but undeveloped (open), or developed.

We summarized the percent occurrence of *Phragmites* along shoreline by subwatershed around the bay, and determined the relationship to adjacent land use.

Figure 3. Researcher Sharon Killeen collects shoreline data on the occurrence of *Phragmites* and land use.

"The hotspots for *Phragmites* occurrence are in regions of intense agriculture on the eastern shore of Chesapeake Bay."

Findings

Phragmites was found growing along 14.6% of all estuarine shoreline in Maryland and along only 2.0% of sampled shoreline in Virginia. The "hotspots" for *Phragmites* occurrence were concentrated in Maryland sub-watersheds in the northeastern portion of Chesapeake Bay, from the Honga River north to Kent Island Bay. Roughly 22-30% of all estuarine shoreline in these sub-watersheds was occupied by *Phragmites* (Fig. 4).

Among 12 sub-watershed divisions around the bay, we compared the percentage of shoreline occupied by *Phragmites* as a function of the percentage of shoreline occupied by different land use types. Of these, the only significant correlation was between *Phragmites* occurrence and the shoreline occupied by agriculture (Fig. 5). Especially in Maryland portions of the bay, however, *Phragmites* occurrence was fairly common adjacent to other land use types, including forest. In Virginia, *Phragmites* generally was uncommon adjacent to forest and more common adjacent to cleared, and developed land.

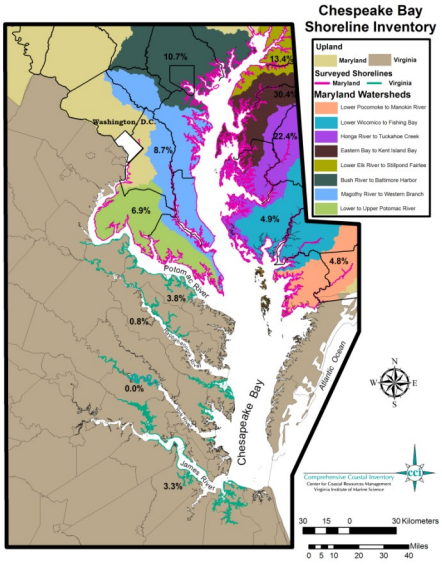

Figure 4. Percent (%) occurrence of *Phragmites* along estuarine shoreline by sub-watershed (modified from Chambers et al. (2008).

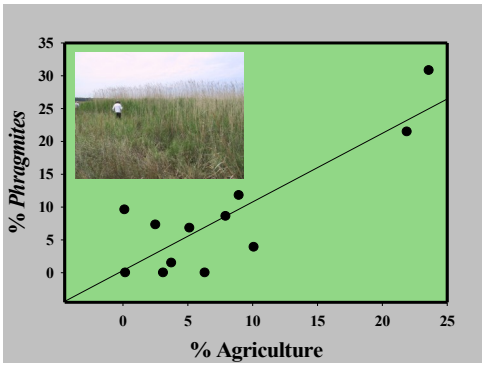

Figure 5. The more agriculture in the riparian zone, the more *Phragmites* along the shoreline.

Significance

This regional study of *Phragmites* occurrence provides a snapshot of the current distribution of an invasive wetland species and its relation to adjacent land use. More common along estuarine shoreline in Maryland than Virginia, *Phragmites* invasion and spread appears to be most strongly correlated with agriculture. Its presence adjacent to other land use types, however, suggests other factors may affect where *Phragmites* is able to get established. Agricultural runoff would provide localized nutrient enrichment to support plant growth, but certainly other forms of shoreline development and disturbance must contribute to *Phragmites* establishment. Land use has changed in many areas along the bay shoreline over the last century, so the distribution of *Phragmites* may reflect the historical influence of shoreline disturbance rather than the influence of the current, adjacent land use.

The pronounced difference in *Phragmites* occurrence by state indicates greater opportunities for plant establishment in the Maryland portion of Chesapeake Bay. *Phragmites* expansion into the Virginia portion of the estuary appears delayed, perhaps due to a north-south direction of invasion and spread (the invasive pulse is only now extending into Virginia), or due to other environmental factors inhibiting plant establishment (salinity, low nutrient availability, or barriers to rhizome or seed dispersal).

To co-opt Woody Guthrie again, "This (Mary)land is made for *Phragmites*." Invasive species management programs should concentrate efforts in Virginia to control sites of local introduction and spread of *Phragmites*. Given the significant ties to agriculture and other coastal development, ongoing efforts to provide shoreline buffers to disturbance and nutrient runoff should be encouraged.

Additional Reading:

R.M. Chambers, K.J. Havens, S. Killeen, and M. Berman. 2008. Common reed *Phragmites australis* occurrence and adjacent land use along estuarine shoreline in Chesapeake Bay. Wetlands 28: 1097-1103.

King, R. S., W. V. Deluca, D. F. Whigham, and P. P. Marra. 2007. Threshold effects of coastal urbanization on *Phragmites australis* (common reed) abundance and foliar nitrogen in Chesapeake Bay. Estuaries and Coasts 30: 469–481.

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