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Potential impact of common reed expansion on threatened high-marsh bird communities on the seaside: assessment of Phragmites invasion of high marsh habitats

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Potential Impact of Common Reed Expansion on Threatened High-marsh Bird Communities on the Seaside: Assessment of *Phragmites* Invasion of High Marsh Habitats

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EXECUTIVE SUMMARY

Tidal wetlands are important to coastal ecosystems. They provide flood protection, erosion control and improve water quality. Tidal wetlands also provide essential habitats for numerous species of wildlife, many of which rely on these marsh habitats as a site for breeding and development. Historical wetland surveys indicate that as much as half of the marshes present along the Atlantic and gulf coasts in 1900 have disappeared. While direct human activities are still a leading cause of wetland loss, the structure and functioning of high marsh habitats are currently threatened from invasion of exotic and/or invasive plant species such as the common reed (*Phragmites australis*), and sea level rise due to global climatic change. Disturbance of habitat from dredging, filling, ditching, draining, and clearing, as well as the introduction of more invasive genotypes from the Old World, has enabled *P. australis* to invade habitats where it was once absent.

Stands of *P. australis* are considered poor wildlife habitat and large, monocultures of *Phragmites* offer little habitat for birds and support few individuals and low diversity. The high marsh habitats which provide breeding habitat for several avian species of concern, including Saltmarsh Sharp-tailed Sparrows, Seaside Sparrows, Black Rails, and Willets are most at risk from invasive *P. australis*.

A GIS layer of high marsh patches was produced by digitizing high marsh patch boundaries from Virginia 2002 basemap imagery. This layer was compared to a layer of *P. australis* patches to determine the extent and degree of *P. australis* invasion into the high marsh. A total of 264 high marsh patches were identified totaling 1719 hectares. *P. australis* had invaded 123 of these high marsh patches to some degree, and 141 were free of any *P. australis*. Of the 114 patches, totaling 1137 ha, that had been invaded by *P. australis*, at a level of greater that 1%, 327 ha or 28.7% of their area was affected. High marsh patches within northern most and southern most latitudinal classes showed a significantly higher rate of invasion than patches within the middle latitudinal classes.

The information and GIS layer produced has and will be important for the patch selection process of studies on the effect of *P. australis* on threatened high marsh bird communities of the seaside and for making informed decisions on *P. australis* eradication and control efforts to ensure the most benefit to the high marsh bird communities.

BACKGROUND

Context

Tidal wetlands are a vital component to coastal ecosystems for a variety of reasons. They provide flood protection by storing and slowing runoff from upstream sources, this storing and slowing of runoff also contributes to erosion control and improves water quality by trapping sediments and pollutants. Tidal wetlands also provide essential habitats for numerous species of wildlife, many of which require these marsh environments as a site for breeding and development. Many of the wildlife species that rely upon these habitats, such as fish, shellfish and waterfowl, are not only critical components to the ecosystem, but are both economically and recreationally important.

Historical wetland surveys indicate that as much as half of the marshes present along the Atlantic and gulf coasts in 1900 have disappeared. Prior to the 1970's, when measures to curb wetland loss were enacted, most marsh losses were attributable to human activities, including dredging, filling, ditching and draining that were rapidly destroying marsh habitats (Dahl, 1990). While direct human activities are still a leading cause of wetland loss, the structure and functioning of high marsh habitats are currently threatened from invasion of exotic and/or invasive plant species such as the common reed (*Phragmites australis*), and sea level rise due to global climatic change.

Phragmites australis is a grass native to the United States that was historically found in wet meadows, riversides, and freshwater marshes. It is increasingly considered an invasive pest due to its rapid spread into habitats where it often quickly dominates native vegetation. Its rapid invasion over the last century has been facilitated by the human activities that were the primary causes of wetland loss. Disturbance of habitat from dredging, filling, ditching, draining, and clearing has enabled *P. australis* to invade habitats where it was once absent. In addition to the disturbance factors, introduction of more invasive genotypes from the Old World have promoted rapid invasion of this species (Marks et al. 1994).

Stands of *P. australis* are considered poor wildlife habitat. Within monocultures of *P. australis* faunal diversity is generally low (Roman et al. 1984). While some bird species utilize the edges of *P. australis* stands for roosting and foraging, the tall, dense growth generally restricts bird use (Benoit and Askins, 1999). Large, monocultures of *Phragmites* are considered poor habitat for birds and support few individuals and low diversity (Meyerson et. al., 2000). Surveys of tidal marshes along the Pamunkey River, VA found the lowest species richness values at points associated with *P. australis* (Paxton and Watts, 2002)

High marsh habitats are most at risk from invasive *P. australis*. The marsh zone where *P. australis* occurs at the greatest density is the zone of integration between the upland and the irregularly flooded marsh (Fig. 1). The irregularly flooded zone is favored by the short marsh grass species (*Spartina patens, Distichilis spicata*) which provide breeding habitat for several avian species of concern, including Saltmarsh Sharp-tailed Sparrows, Seaside Sparrows, Black Rails, and Willets. Encroachment of *P. australis* into the lower portions of the irregularly flooded zone will reduce the amount of available habitat for species adapted to nesting in short marsh grasses and has been shown to significantly reduce the densities of these short grass specialists (Benoit and Askins, 1999).

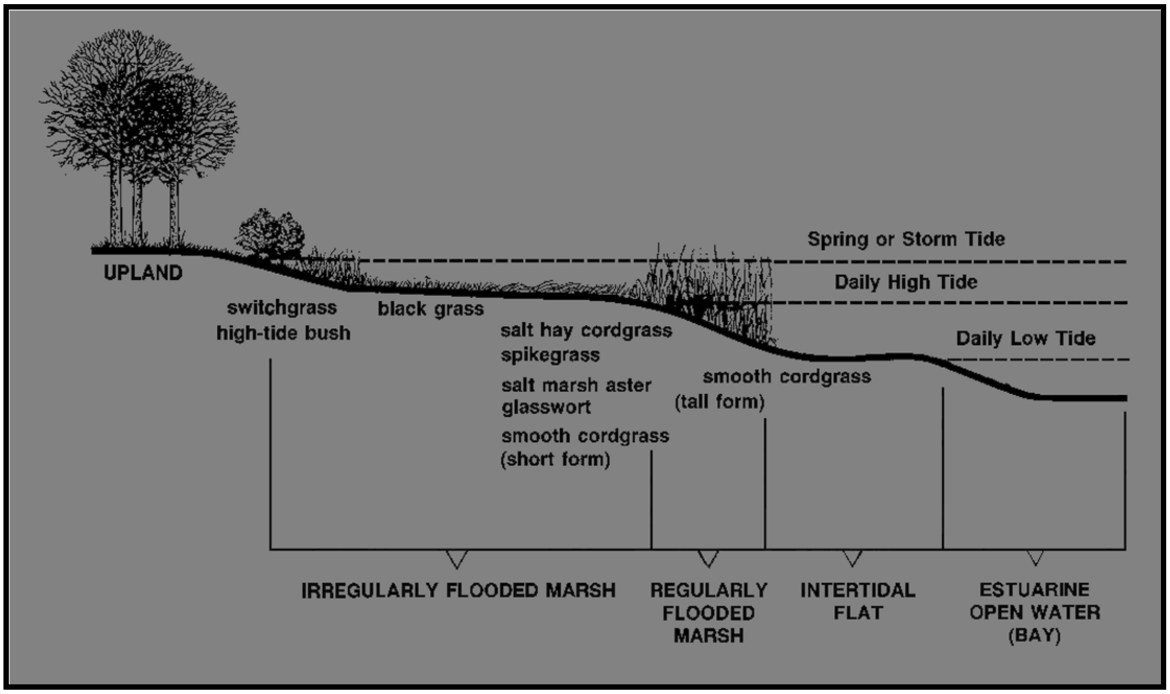

Figure 1. Salt marsh zones, from: Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Fish and Wildlife Service Biological services program. FWS/OBS-79/31

Continued efforts to control the spread of *P. australis*, on the Delmarva Peninsula of Virginia, resulted in a mapping and monitoring project conducted by the Virginia Department of Conservation and Recreation (DCR) – Division of natural heritage in 2004. The GIS layer that resulted from the mapping of *P. australis* patches aids in the assessment of the degree of *P. australis* invasion into high marsh habitats of the lower Delmarva seaside.

Objectives

With the completed GIS layer of mapped *P. australis* patches, and high resolution aerial imagery available it is possible evaluate the spread of *P. australis*. The primary objective of this study is to determine the extent and degree of *P. australis* invasion into the high marsh habitats of the lower Delmarva seaside. Findings will help in selecting research sites for future studies on the effect of *P. australis* on high marsh habitats, and can be used as a tool for guiding control efforts where they are needed most. This information will be useful in monitoring the effectiveness of control efforts as well as serving as a benchmark for measuring future changes to the high marsh habitats due to changes in the vegetation community, sea level rise, or other factors.

METHODS

The area of interest for this study was the Virginia portion of the Lower Delmarva seaside, including the lagoon system and barrier islands of. Particular emphasis was given to the eastern edge of the peninsula from just west of Wallops Island south to the tip, and the barrier and lagoon islands of Accomack County. The area of interest was subdivided into four latitudinal classifications (Fig. 2). Within the area of emphasis, Virginia 2002 basemap imagery was systematically reviewed at approximately 1:5000 scale for high marsh patches. High marsh patches were identified by position in the marsh and by visual evaluation of vegetation. Approximate high marsh patch boundaries were digitized over basemap imagery using ArcMap 8.2. Area and perimeter were calculated for each polygon.

Modifications were made to the GIS layer of *P. australis* patches mapped by DCR. The original layer did not have coverage values associated with individual patches. However, the original GPS polygons, points, and lines collected during helicopter surveys and used to generate the final *P. australis* patch layer did contain coverage values in increments of 25%. GPS data was acquired from DCR and coverage values were associated to patches. It was discovered that several instances of multiple GPS feature contributing to a single *P. australis* patch, and often these GPS features had different coverage values. If the contributing features differed in area by less than 75%, an average of the coverage value was associated to the resulting polygon. When contributing features differed in area by more that 75% or more the greater of the coverage values was associated to the resulting polygon. It was also discovered that several patches had no corresponding GPS feature. Polygons with no corresponding GPS feature were assigned a coverage value based on the values of nearest neighbors and by visual inspection of aerial imagery. We were unable to determine coverage for many patches in and around Chincoteague National Wildlife Refuge (CNWR) as these patches were mapped by CNWR personnel and not included it the GPS data received.

High marsh and *P. australis* layers were compared using ArcMap 8.2 to determine the extent and degree of *P. australis* invasion into the high marsh. We clipped the high marsh layer with the *P. australis* to determine the total area and percentage of high marsh affected by *P. australis*. Coverage values from the *P. australis* layers were used to calculate an estimate of actual *P. australis* area within the high marsh patches. These values were analyzed by latitudinal classification in an effort to determine if *P. australis* invasion into the high marsh was more prevalent within certain portions of the peninsula.

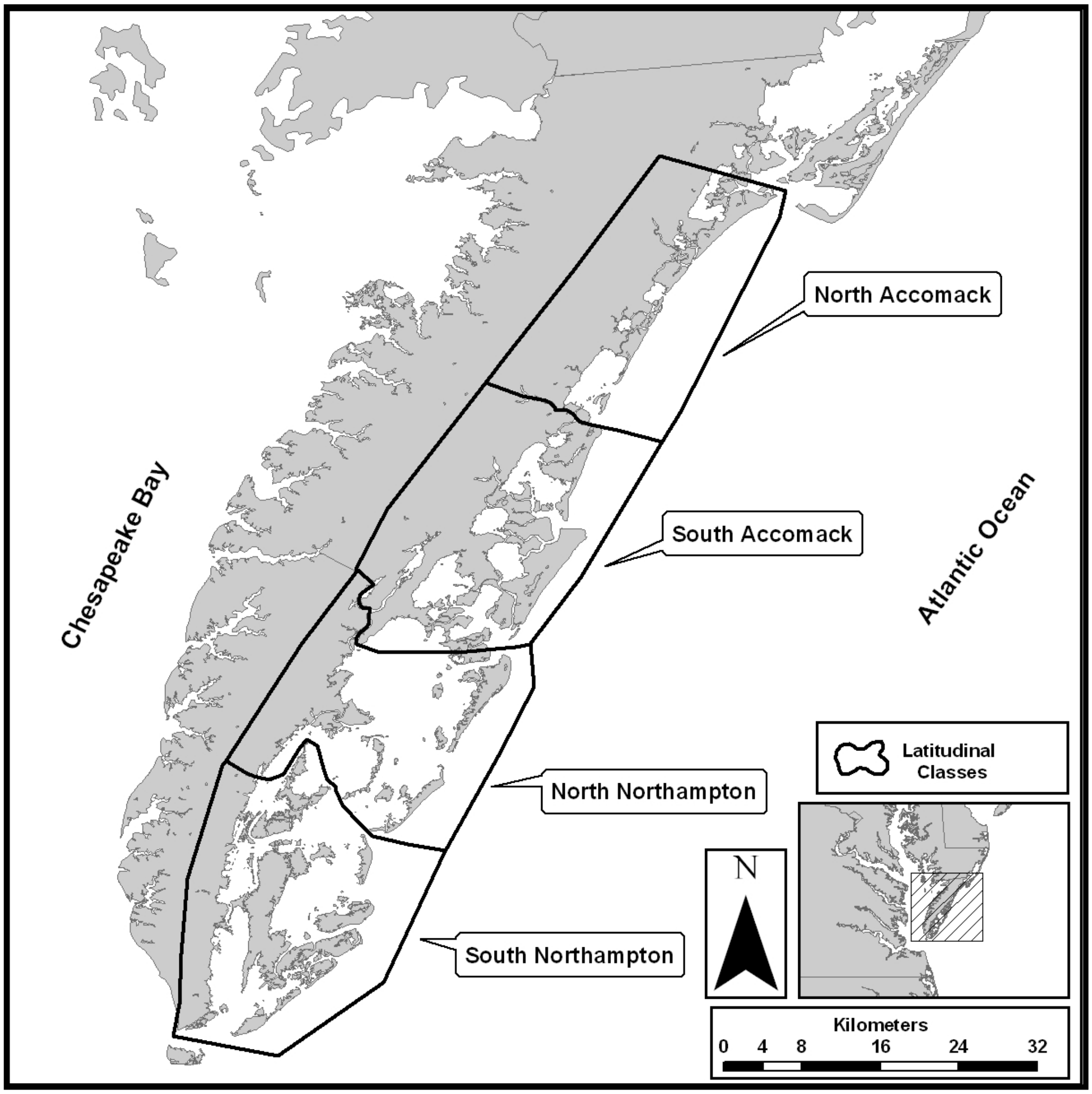

Figure 2. Map of the Lower Delmarva Peninsula showing latitudinal classes.

RESULTS

A total of 264 high marsh patches were identified totaling 1719 hectares. The overall area of *P. australis* invasion was 327 ha or 19%. *P. australis* had invaded 123 high marsh patches to some degree, and 141 were free of any *P. australis*. Of the patches with some degree of *P. australis* invasion, 9 were affected by trace areas of *P. australis* totaling less than 1% of the total patch size. Of the 114 patches, totaling 1137 ha, that had been invaded at a level of greater that 1%, 327 ha or 28.7% of their area was affected (Table 1). Little difference was observed in area affect when actual area was calculated by *P. australis* coverage values. The actual area occupied by *P. australis* within affected patches was 310 ha or 27.3% of the total area. Patches not yet invaded by *P. australis* totaled 507 ha and accounted for 29.5% of all high marsh measured.

Differences were noted rates of *P. australis* invasion with regard to geographic position, but not with size of high marsh patch. The rate of *P. australis* invasion was not equal among latitudinal classes. High marsh patches within northern most and southern most latitudinal classes showed a significantly higher rate of invasion than patches within the middle latitudinal classes (Kruskal Wallace ANOVA H=103.97, p<.001) (Fig. 3). This difference became more apparent when the outer and inner latitudinal classes were grouped and analyzed. High marsh patches within the outer latitudinal class showed a significantly higher rate of invasion than patches within the middle latitudinal class (Mann-Whitney U=2365.5, p<.0001) (Fig. 4).

Table 1. Breakdown of frequency and total area of high marsh patches by percent of patch invaded by *P. australis*.

Percent of Individual Patch Affected	Number of Patches	Total Area (ha) of Patches
0	141	507
<1	9	75
1-25	58	661
26-50	24	283
51-75	11	108
76-100	21	85

DISCUSSION

The high marsh patches of the Lower Delmarva seaside are important breeding, stopover, and winter habitat for a variety of bird species. Invasion of *P. australis* into these habitats is detrimental to populations of short marsh grass specialists. If preserving and reclaiming habitat for high marsh birds is a goal, it is recommended to focus *P. australis* control and eradication efforts on large contiguous patches of high marsh. Although *P. australis* invasion is more prevalent within the northern and southern portions of the Lower Delmarva peninsula, removal and control of *P. australis* within the larger high marsh patches would be more beneficial to high marsh birds since there is a strong correlation in the patch size of marshes and the species richness and abundance of the birds that occupy it (Watts, 1992).

The high marsh/*P. australis* GIS layer produced during this study has proven invaluable in the patch selection process of studies on the effect of *P. australis* on threatened breeding and wintering high marsh bird communities of the seaside. This layer will also be an important guide as to where to focus *P. australis* eradication and control efforts on the patch level to ensure the most benefit to the high marsh bird communities.

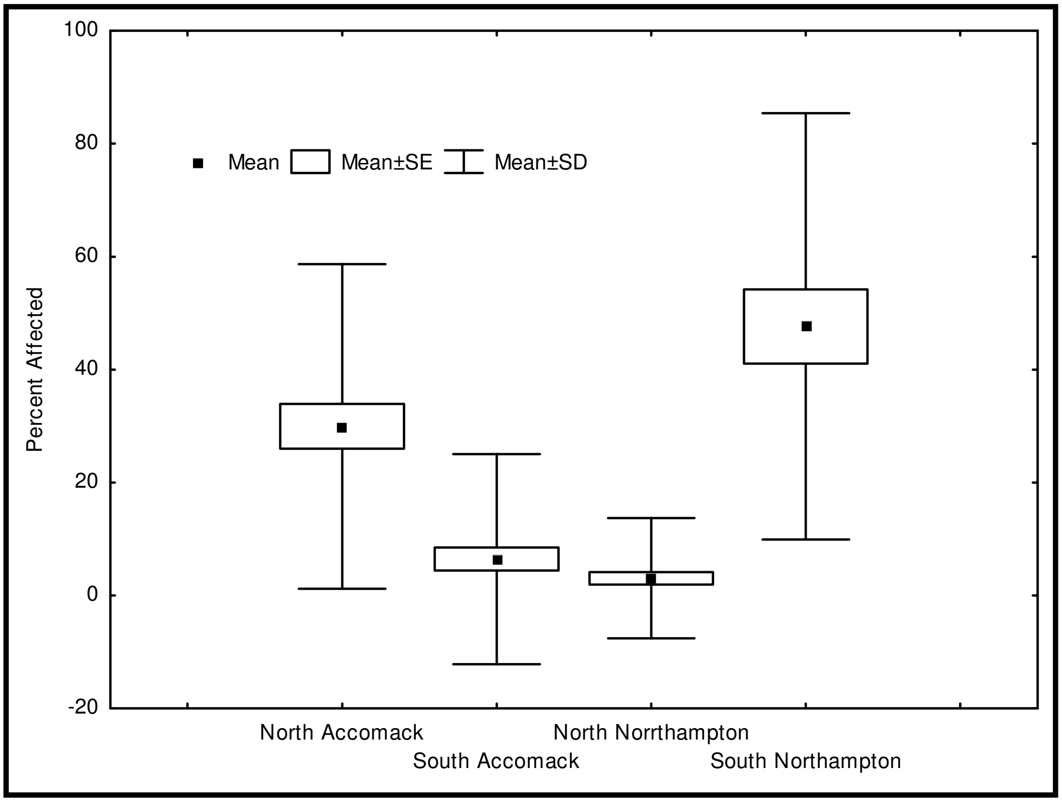

Figure 3. Box and Whisker plot of percentage of individual high marsh patch affected by *P. australis* within the 4 latitudinal classes.

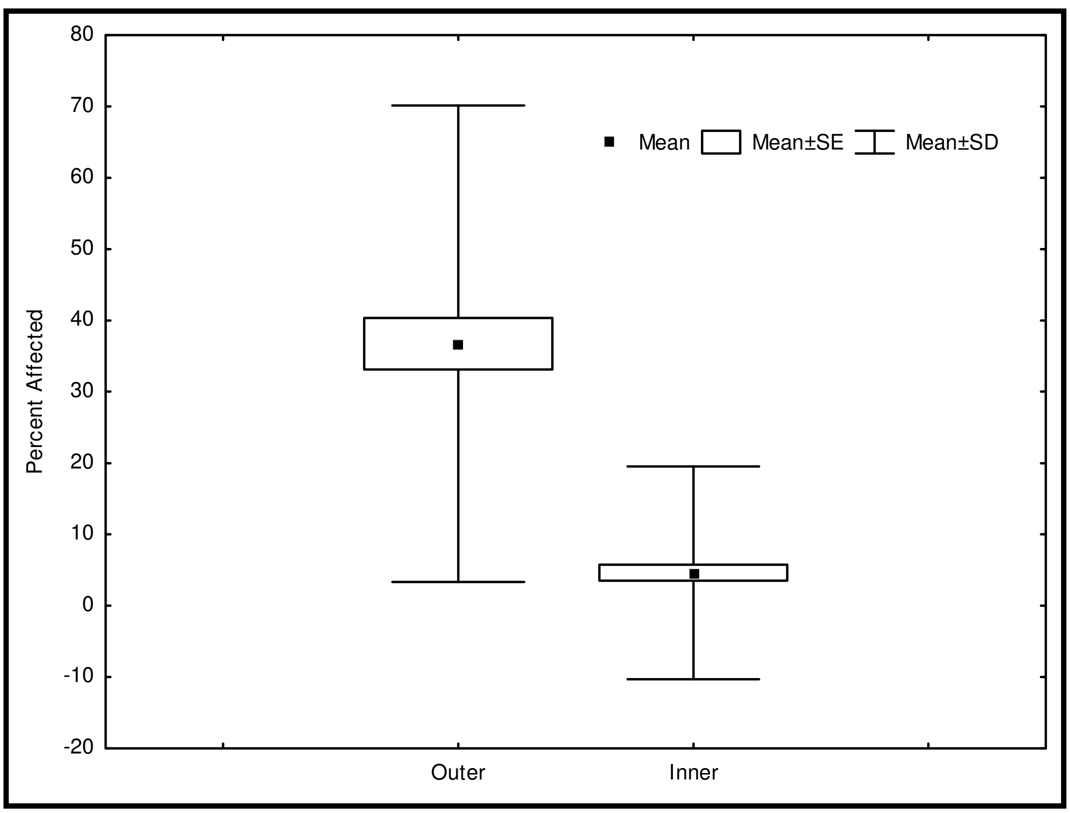

Figure 4. Box and Whisker plot of percentage of individual high marsh patch affected by *P. australis* within the outer and inner latitudinal classes.

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