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Phragmites australis: It's Not All Bad

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Observations on the colonization of the invasive tunicate *Didemnum* sp.

BY LINDA A. AUKER AND CANDACE A. OVIATT

An invasive tunicate (Figure 1), referred to presently as *Didemnum* sp. (the organism has not yet been identified to species), has been observed in Narragansett Bay since 2000, when it was found at Coasters Harbor Island in Newport during a rapid assessment survey (Pederson et al. 2001). These tunicates, also called ascidians, have been observed at the University of Rhode Island (URI) Graduate School of Oceanography (GSO) dock since 2002, when Dr. Christopher Deacutis (URI) photographed the dock pilings and noticed *Didemnum* sp. colonizing the pilings above the low water line. *Didemnum* is considered a strong competitor with the ability to rapidly colonize a substrate (Coutts 2002), and it prefers hard substrate, like dock pilings, over soft sediment (Bullard et al. 2007).

The ecology of *Didemnum* sp. is poorly known, and the effects of its introduction to an ecosystem have not been studied in detail. There may be competition for space and food between *Didemnum* sp. and native species (Stachowicz 2004), especially the Blue Mussel (*Mytilus edulis*), a primary food source for important species in Narragansett Bay, e.g., Tautog and Common Eider (Olla et al. 1974). The tunicate frequently overgrows adult mussels, often to the point where the ability of the mussel to open its valves is restricted (personal observation). As part of a larger study of *Didemnum* sp. distribution in Narragansett Bay, we conducted a six-month study at the GSO dock in 2005. We compared *Didemnum* percent cover and recruitment timing to that of *M. edulis*, and also to two other colonial tunicates present in the bay, *Botrylloides violaceous* and *Botryllus schlosseri*.

Dr. Robert Whitlatch of the University of Connecticut has used 100-cm^2 polyvinyl chloride (PVC) panels attached to PVC pipes suspended from floating docks to quantify recruitment of newly settled organisms at different sites in Long Island Sound (Whitlatch and Osman 2005). For our study in Narragansett Bay, the same types of panels were used, which were hung from the GSO dock ladder. Four of these panels—referred to as community panels—were used to examine changes in percent cover of *Didemnum* sp., *B. violaceous*, and *B. schlosseri* over a six-month period. Panels were photographed once per month from May to October in 2005. Photographs were then used to measure percent cover of each of the three colonial ascidians using an image analysis program, Scion Image. All other organisms (i.e., *Mytilus edulis*) were identified and counted. The average rates of growth of each *Didemnum* sp., *B. violaceous*, and *B. schlosseri* on individual panels were calculated as cm^2/day.

Identical panels to those used in the community assemblage study were suspended along with the community panels to measure recruitment. They were replaced once a week and analyzed under a dissecting microscope. All sessile animals were counted and identified using Bullard and Whitlatch (2004), and the counts were averaged by month.

Didemnum sp. and *Mytilus edulis*

Recruitment of Blue Mussels at the GSO site peaked in June, but fell back to very low levels in July (Figure 2). *Didemnum* sp. began to recruit at this time and eventually abundances peaked in September. On the community panels, adult mussels were visible only in August, and occurred at relatively low levels (Figure 3). *Didemnum* was first visible in August, followed by substantial increase in September and a maximum in October.

RHODE ISLAND NATURAL HISTORY SURVEY

Providing Ecosystem Science and Information

Phragmites australis: It's Not All Bad

BY LAURA A. MEYERSON

Rhode Island, like most other states in the U.S., has increasing numbers of invasive species (Figure 1). *Phragmites australis* (Common Reed) is an invader and yet it presents us with what seems to be a paradox. Introduced *Phragmites australis* is a non-native species that is one of the most prominent invaders of coastal marsh systems in the U.S. and is ubiquitous in Rhode Island. Yet there is also a non-aggressive native strain in Rhode Island and elsewhere that seems to be declining and is becoming a cause for conservation concern (Meyerson et al. in press). Introduced *Phragmites* is a very successful colonizer that has produced a suite of ecological changes—some of which are considered beneficial and others that are not. Therefore, as we learn more about this species, we begin to realize that responsible management is perhaps not as straightforward as once thought.

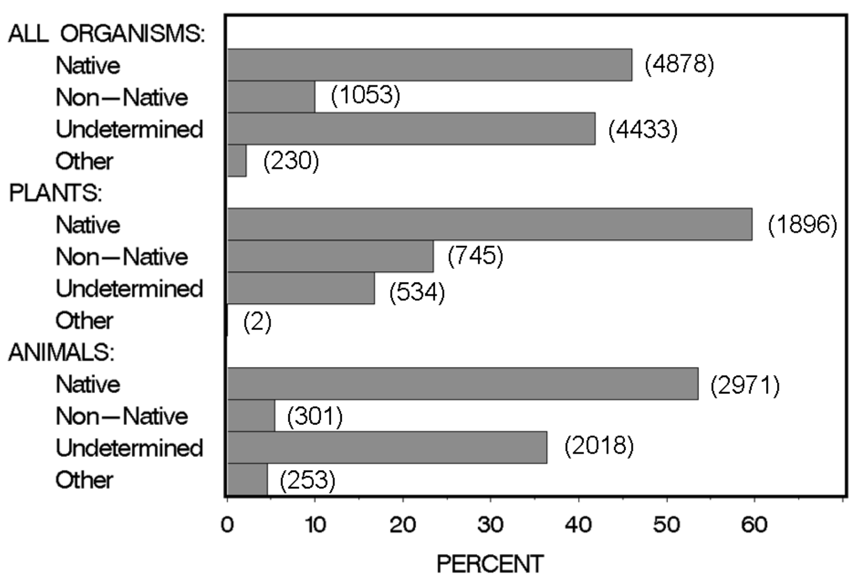

Figure 1. The percent of organisms (numbers of species in parentheses), within each category, documented in Rhode Island by their assigned status of native, non-native, undetermined. or other. "Non-native" includes organisms introduced to Rhode Island from other parts of North America as well as from other continents. "Undetermined" includes species whose nativity status has not yet been determined. "Other" includes non-breeding visitors (e.g., migratory birds that do not breed in the state) and species that may be present in both native and non-native forms. For all documented organisms in Rhode Island, approximately 10% are known to be non-native. When categories are further refined, the percent of non-native plants in Rhode Island is about 23% and non-native animals about 5%. It should be noted that significant data gaps exist in Rhode Island and elsewhere, particularly for taxa such as invertebrates, fungi, and pathogens. Therefore, as more taxa become better surveyed, these numbers are likely to shift. (Data Source: Rhode Island Natural History Survey Biota of Rhode Island Information System [BORIIS])

Phragmites is a robust, perennial emergent grass found on every continent with the exception of Antarctica (Tucker 1990). In North America, introduced *Phragmites* has a wide range of tolerance for environmental conditions and can grow in fresh, brackish, and salt marsh systems (Marks et al. 1994). It establishes new stands both by seed and dispersal of rhizome fragments, but expansion of existing stands is primarily vegetative. *Phragmites* can produce large quantities of seeds, but germination rates are variable and generally low (Galinato and van der Valk 1986). The slow decomposition of its detritus can significantly reduce the availability of nutrients, light, and space, making the survival or establishment of other plants unlikely (Meyerson 2000, Figure 2).

Native *Phragmites* populations that historically were abundant are now rare in the Northeast. The few remnant native *Phragmites* populations that persist in New England salt marshes are under great threat from the continued expansion of introduced *Phragmites*. Native *Phragmites* typically is smaller in stature, grows in mixed-plant communities, and has a lower stem density than introduced *Phragmites*, although populations with high stem densities can occur (Meadows 2006). Native *Phragmites* is typically less aggressive and appears to have a lower tolerance for salinity and flooding (Vasquez et al. 2005).

Different studies have found varying impacts of introduced *Phragmites* on plant and animal communities. For example, the outcomes of several studies suggest that detrimental effects of *Phragmites* on fish communities are ubiquitous among young-of-the-year residents, with potentially important implications for long-term population sustainability and secondary production. Hunter et al. (2006) found that in the mid-Atlantic, the stage of *Phragmites* invasion (i.e., early, middle, late) influences habitat quality for *Fundulus* spp. As an invasion progresses, habitat quality for *F. heteroclitus* (Common Mummichog) and *F. luciae* (Spotfin Killifish) appears to decline and may even result in the extirpation of the less common *F. luciae* in mid-Atlantic coastal marshes. At the same time, adult resident fishes have been documented with the same densities among *Phragmites* and non-*Phragmites* stands unless

Figure 2. Introduced *Phragmites* (right) grows in fresh to very brackish marsh systems. *Phragmites* is an aggressive competitor and can replace native species like native *Typha latifolia* (Broadleaf Cattail, left). (Drawing by Elizabeth Farnsworth)

there is demonstrable impact on hydrology and microtopography (Able and Hagan 2000, 2003; Able et al. 2003; Fell et al. 2003; Meyer et al. 2001; Osgood et al. 2003). For coastal marsh restoration, this result implies that physical setting can be restored and food web function can be maintained without needing to completely eradicate *Phragmites* stands. Other studies have shown little or no effect of *Phragmites* on animal communities and some even suggest benefits. For example, Mclary (2004) found that the abundance of Ribbed Mussels (*Geukensia demissa*) was greater in introduced *Phragmites* than in *Spartina alterniflora* (Smooth Cordgrass) stands in an urban habitat. Clearly much of the evidence remains open to debate and suggests the need for further study.

Restoration of degraded coastal systems has become increasingly important for habitat protection as pressures mount from development, population growth, and global change. In Narragansett Bay, for example, 65% of remaining coastal wetlands have been identified as candidates for restoration because of ditching and tidal restrictions (Tiner et al. 2003). In general, restoration outcomes for systems invaded by *Phragmites* have been variable. Some restoration efforts have successfully reached plant community goals or have restored underlying physical marsh processes, while others have failed to prevent *Phragmites* reinvasion or have not increased productivity. Furthermore, mitigated and created wetlands frequently serve as unintentional nurseries for introduced *Phragmites*. Constructed tidal wetlands are engineered to encourage growth of native species, but *Phragmites* often establishes and spreads to the exclusion of these other species (Havens et al. 2003). As a consequence, wetlands lost to development are replaced by created wetlands dominated by *Phragmites*. However, there is good news about what can be accomplished by a *Phragmites* restoration. A recent study suggests that utilization of *Phragmites* relative to *Spartina* may vary by trophic group. For example, *Phragmites* invasions may cause arthropod food webs to become detritus-based instead of plant-based because the herbivore assemblages the arthropods depend on are largely absent. This is reversed, however, once salt marsh vegetation is restored (Gratton and Denno 2005, 2006).

An existing gap in knowledge is whether or not the native and introduced strains of *Phragmites* can interbreed. In multiple sites, native and introduced *Phragmites* grow together. Despite this overlap, no evidence has been detected for interbreeding between the native and introduced strains. This is surprising given that they are considered to be the same species. However, recent work indicates the potential for interbreeding in the wild by the two subspecies with overlapping flowering periods, since greenhouse experiments have produced hybrid seed (Meyerson and Viola unpublished data).

Somewhat ironically, after extensive resources have been devoted to controlling and eradicating introduced *Phragmites*, there is a groundswell to protect the remaining stands of native *Phragmites*, particularly in areas such as the northeastern U.S. A reasoned, science-based debate is urgently needed on this issue so that better management can be undertaken. Because current knowledge on the ecology of native *Phragmites* is limited, management strategies that would promote the growth of native *Phragmites* over the introduced form cannot yet be implemented. The rhizomes of native *Phragmites* tend to be small relative to the introduced type, are more sparsely distributed, and can undergo intense competition from the high diversity of wetland plants in oligohaline and tidal freshwater marsh systems—all factors which are likely to inhibit the natural spread of native *Phragmites*. To date, native *Phragmites* has not been used in marsh restoration efforts so its ability to survive and prosper in restored systems is unknown. More basically, we do not yet understand which native populations should be used in marsh restoration, which habitats are most suited for native *Phragmites*, and what other native plants would best suit a marsh system that was intended to encourage the growth of native *Phragmites*. In the absence of growth information on native *Phragmites*, the precautionary principle should be applied to prioritize preservation of remaining stands of native *Phragmites*.

Although introduced *Phragmites* is an aggressive invader and managing these invasions is a high priority, the impacts of this species are still not fully understood and warrant further study. Native populations of *Phragmites* are rare and many are in need of protection so that we do not lose our native strains. Identification of native *Phragmites* requires a small amount of training and sharp-eyed naturalists, and ultimately confirmation of the plant's genetics through testing. Learning to distinguish between these two strains is key to responsible management and to preserving our native biological diversity.

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