USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Habitat and nutritional value of the invasive marsh plant Phragmites australis for estuarine animals, as compared with that of Spartina alterniflora

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Amount Requested: $18,008

Priority Issues

Integrity of aquatic and water-associated systems, D. Impacts of exotic and invasive species. Much tidal marsh "remediation" in NJ is being done by removing the invasive reed Phragmites and replacing it with restored Spartina. This is happening because of the assumption that Phragmites is of low ecological value; data about the habitat or nutritional values of Phragmites to estuarine systems are sparse. IF it is useful as food and/or habitat, and (as has been shown elsewhere) restored Spartina marshes do not reach equivalence with natural marshes for a decade or more, perhaps these projects should be rethought. It may be more beneficial to leave the Phragmites in place, and construct more water channels within the stands to keep the marsh hydrology functioning.

Background

Tidal wetlands are critical for estuarine function, as they are responsible for a high proportion of estuarine productivity. The marsh grass, Spartina alterniflora is not generally consumed by aquatic species until it has died and decayed. Decomposition processes in salt marshes fragment the original dead leaves and stems into smaller sizes and upgrade the protein content by colonization of the substrate by bacteria, fungi and protozoa (Odum and de la Cruz, 1967). Deegan et al. (1990) found that Spartina detritus itself is used by juvenile menhaden, which have the digestive physiology and morphology to break up cellulose into usable carbohydrates. Currin et al. (1995) found that the Spartina detritus was utilized by several consumer species, and noted that the isotopic signature for standing dead Spartina was different from that of live or senescent plants, due to aerial decomposition by fungi.

Phragmites australis is an invasive reed that has replaced the native Spartina alterniflora in many marshes in the Atlantic Coast of the US, particularly in those considered "disturbed." Phragmites is considered less desirable because it shades out other species, causes accumulation of sediments and alters patterns of water flow, reducing habitat heterogeneity and open water space (Buttery and Lambert, 1965). Although in Europe it is considered a valuable plant (Silberhorn, 1982), in the US it is considered a weedy invader by marsh managers. In recent years, many expensive efforts at wetland restoration or rehabilitation have taken place in which elevation and/or drainage patterns have been altered and Spartina has been replanted, often following Phragmites removal. However, constructed marshes generally are less productive and diverse than natural marshes. Minello and Webb (1997) compared natural and created Spartina marshes (up to 15 years of age) on the Gulf Coast and found benthic infauna density and species richness were lower in the created marshes. In addition, densities of most fishes and commercially important crustaceans were lower in the restored marshes. Sacco et al. (1994) similarly found a decreased faunal community in restored marshes. Allen et al., (1994) found that mummichogs (Fundulus heteroclitus) in restored marshes consumed less food than fish inhabiting natural marshes. It may be that decades, rather than years, are needed before normal marsh functions can be restored. As has been pointed out by Levin et al. (1996), a process of succession takes place in created marshes. Therefore, replacing natural with created marshes will result in an overall loss of productivity.

Despite the general dislike for, and frequent removal of Phragmites in US marsh management programs, little is known about its contribution to or effects on estuarine ecology and productivity. There is a general assumption that the plant has little ecological value. However, Stribling and Cornwell (1997), studying consumers in a lower salinity wetland, found a greater contribution from C3 plants (e.g. Phragmites) which are present there, in addition to the C4 Spartina and phytoplankton. This paper thus provides evidence that Phragmites does contribute in a significant way to the food webs in low salinity areas. Wainright et al. (1998) come to the same conclusions. Fell et al., 1998 found that Phragmites-dominated marshes had abundant tidal marsh invertebrates (snails, amphipods, and isopods) which provided suitable food resources to mummichogs, which moved onto the marshes and fed on the invertebrates, as they do in Spartina-dominated marshes.

Another important function of wetland plants to estuarine communities is their role in providing habitat. Salt marshes are well known to be forage habitat and a predation refuge for larvae and juveniles of estuarine and marine species (Shenker and Dean, 1979;Weinstein, 1979; Kneib, 1984; McIvor and Odum, 1988). Some estuarine species, including mummichogs and grass shrimp, utilize the marsh surface at high tide. The marsh surface functions to provide food for these animals as well as refuge from predation. Young individuals of both species may remain on the marsh surface in shallow puddles, even during low tide, an adaptation to avoid high mortality from larger organisms in subtidal habitats (Kneib, 1987). While adult mummichogs prey on grass shrimp, larval mummichogs are preyed on by grass shrimp (Kneib, 1987). Little is known about the impact of the Phragmites invasion on the habitat functions of tidal marshes to resident invertebrates and fish.

Fiddler crabs (Uca spp.) are integral components of many marsh systems. Their burrows serve to aerate the sediments, and are considered beneficial for the marsh grasses (Montague, 1980). The crabs also benefit from the presence of the marsh vegetation, which provides cover to hide from predators (Nomann and Pennings, 1998). Among the shallow habitats utilized during low tide by grass shrimp and larval mummichogs are fiddler crab burrows (Kneib, 1995).

The degree of use of refuge habitat such as vegetation by potential prey species can be affected by the presence of predators. Werner et al (1993), using experimental ponds, found that when predators were absent, juvenile bluegills were found throughout the pond, but when predators were present, the smaller fish restricted themselves to the vegetated regions, a safer habitat. Gotceitas et al (1995) found that juvenile Atlantic cod (Gadus morhua) shifted their habitat from sand to cobble or kelp when an actively foraging predator was present. Similarly, juvenile perch (Perca fluviatilis) and roach (Rutilus rutilus) increased the proportion of time spent in a refuge in the presence of predators (Eklov and Persson, 1995), and survival increased with increased refuge efficiency (Person and Eklov, 1995).