Created Salt Marshes As Habitats For Fishery Species.

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Coastal salt marshes are valuable habitats for juvenile fishery species and other estuarine nekton, and the extent of coastal marsh has been correlated with fishery landings (Turner 1977, Boesch and Turner 1984, Zimmerman and Minello 1984). These nursery habitats provide food for rapid growth and shelter to reduce mortality (Boesch and Turner 1984, Kneib 1987, Minello and Zimmerman 1991). Extensive losses of coastal wetlands in the United States caused by sea-level rise, land subsidence, erosion, and coastal development have increased interest in the creation of salt marshes within estuaries. The habitat value of these created marshes, however, has been questioned (Race and Christie 1982).

Within one to two growing seasons after planting, above-ground biomass in created *Spartina alterniflora* marshes reaches parity with natural marshes if certain basic conditions for marsh establishment and survival are met (Webb et al. 1978, Webb and Newling 1985, Broome 1989, Matthews and Minello 1994). The establishment of vegetation in itself is generally sufficient to provide marsh functions of erosion control, substrate stabilization, and sediment trapping (Knutson et al. 1982). Aside from above-ground biomass, however, characteristics of created salt marshes often differ from natural marshes. Created marshes generally have lower sediment organic content, below-ground biomass, densities of benthic infaunal prey organisms, and densities of nekton on the marsh surface (Cammen 1976, Broome 1989, LaSalle et al. 1991, Minello and Zimmerman 1992, Zedler 1993). There is some evidence that these characteristics are linked, and that trophic support for nekton is relatively low in newly created salt marshes. Objectives of the Fishery Ecology Division at the Galveston Lab of the National Marine Fisheries Service have been to 1) measure relative utilization of natural and created salt marshes by fishery species, 2) examine the development rate of created marshes in relation to their support of estuarine organisms, and 3) obtain a better understanding of what factors are important in determining whether created salt marshes function like natural marshes as nursery habitats.

Two studies on the Texas coast have established the relatively low utilization of created salt marshes by some nekton. Minello and Zimmerman (1992) used a drop sampler to compare springtime densities in three created and three natural *S. alterniflora* marshes (3-5 years in age) on the Texas coast and found overall densities of large macrofauna and decapod crustaceans were significantly lower in the transplanted marshes. These differences were due mainly to daggerblade grass shrimp and young brown shrimp. Diversity of decapod crustaceans was also higher in the natural marshes. Densities of fish (mainly the darter goby and pinfish) as a group were not significantly different between natural and transplanted marshes, and fish diversity was consistently higher in the transplanted marshes. In a larger study of ten created salt marshes (3-15 years in age) in Galveston Bay, Texas, Minello and Webb (1993) also found reduced utilization by commercially important crustaceans; and densities of brown shrimp, white shrimp, and blue crabs in the created marshes were only 25 to 41% of densities in natural marshes. Again, the fishes found within marsh vegetation were predominantly gobies and pinfish, but fish densities were significantly lower by

10 to 30 % in created marshes compared with natural marshes. The age of created marshes did not appear to be an important characteristic governing animal use; none of the nekton or infaunal species exhibited significant positive relationships between marsh age and animal density.

The relative value of salt marsh habitats for juvenile fishery species appears to be related to two environmental characteristics, the amount of marsh/water interface and the elevation of the marsh surface. Minello et al. (1994) examined the relationship between marsh edge and animal use in a planted *S. alterniflora* marsh located in the Galveston Bay system. Marsh edge was increased through the construction of channels without affecting marsh surface elevation. Use of the marsh surface in experimental sectors (with channels) was significantly higher than in controls; densities of brown shrimp, white shrimp, and daggerblade grass shrimp were 4.6 to 13 times higher near the channels. These increased densities of natant fauna along the channel edge may reflect a requirement for departure from the marsh surface at low tide. Overall, the study results indicated that habitat value of created salt marshes can be enhanced by incorporating tidal creeks into the marsh design. Other work has indicated that increased tidal flooding of low-elevation marsh surfaces also increases nekton use. Thus, elevation and the amount of edge are key characteristics affecting marsh use by nekton and should be considered in marsh construction projects.

Bibliography

Boesch, D. F. and R. E. Turner 1984. Dependence of fishery species on salt marshes: the role of food and refuge. Estuaries 7: 460-468.

Broome, S. W. 1989. Creation and restoration of tidal wetlands of the Southeastern United States. p. 37-72 *In* Kusler, J. A. and M. E. Kentula (ed.). Wetland creation and restoration: The status of the Science. Volume I: Regional overviews. EPA/600/3-89/038. U.S. Environ. Prot. Agency, Corvallis.

Cammen, L. M. 1976. Macroinvertebrate colonization of *Spartina* marshes artificially established on dredge spoil. Estuarine Coastal Mar. Sci. 4: 357-372.

Kneib, R. T. 1987. Predation risk and use of intertidal habitats by young fishes and shrimp. Ecology 68: 379-86.

Knutson, P. L. and W. W. Woodhouse, Jr. 1982. Pacific coastal marshes. p. 111-130 *In* Lewis, R., III (ed.). Creation and restoration of coastal plant communities. CRC Press, Inc., Boca Raton, FL.

LaSalle, M. W., M. C. Landin and J. G. Sims 1991. Evaluation of the flora and fauna of a *Spartina alterniflora* marsh established on dredged material in Winyah Bay, South Carolina. Wetlands 11: 191-208.

Matthews, G. A. and T. J. Minello 1994. Technology and success in restoration, creation, and enhancement of *Spartina alterniflora* marshes in the United States. Volume 1. - Executive summary and annotated bibliography. NOAA Coastal Ocean Program Decision Analysis Series No. 2. NOAA Coastal Ocean Office, Silver Spring, MD.

Minello, T. J. and J. W. Webb, Jr. 1993. The development of fishery habitat value in created salt marshes. p. 1864-1865 *In* Magoon, O., W.S. Wilson, H. Converse and L. T. Tobin (ed.). Coastal Zone '93, Volume 2. Proceedings of the 8th Symposium on Coastal and Ocean Management. American Society Of Civil Engineers, New York.

Minello, T. J. and R. J. Zimmerman 1991. The role of estuarine habitats in regulating growth and survival of juvenile penaeid shrimp. p. 1-16 *In* DeLoach, P., W. J. Dougherty and M. A. Davidson (ed.). Frontiers in shrimp research. Elsevier Sci. Publ., Amsterdam.

Minello, T. J. and R. J. Zimmerman 1992. Utilization of natural and transplanted Texas salt marshes by fish and decapod crustaceans. Mar. Ecol. Prog. Ser. 90: 273-285.

Minello, T. J., R. J. Zimmerman and R. Medina 1994. The importance of edge for natant macrofauna in a created salt marsh. Wetlands 14: 184-198.

Race, M. S. 1983. An assessment of salt marsh restoration and implications for coastal zone management. Coastal zone 2: 1473-1476.

Turner, R. E. 1977. Intertidal vegetation and commercial yields of penaeid shrimp. Trans. Am. Fish. Soc. 106: 411-16.

Webb, J. W., J. D. Dodd, B. W. Cain, W. R. Leavens, L. R. Hossner, C. Lindau, R. R. Stickney and H. Williamson 1978. Habitat development field investigations, Bolivar Peninsula marsh and upland habitat development site, Galveston Bay, Texas, Appendix D: Propogation of vascular plants and postpropogation monitoring of botanical, soil, aquatic biota, and wildlife resources. Tech. Rept. D-78-15. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Webb, J. W. and C. J. Newling 1985. Comparison of natural and man-made salt marshes in Galveston Bay complex, Texas. Wetlands 4: 75-86.

Zedler, J. B. 1993. Canopy architecture of natural and planted cordgrass marshes: selecting habitat evaluation criteria. Ecol. Appl. 3: 123-138.

Zimmerman, R. J. and T. J. Minello 1984. Densities of *Penaeus aztecus, P. setiferus* and other natant macrofauna in a Texas salt marsh. Estuaries 7: 421-433.