The development of fishery habitat value in created salt marshes

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A cooperative study is being completed on the relative value of transplanted and natural Spartina alterniflora marshes for fishery species by the Galveston Laboratory of the National Marine Fisheries Service and Texas A&M University. This Coastal Ocean Program project was designed to examine the functional developmental rate of ten created marshes ranging in age from 3 to 15 years in the Galveston Bay system of Texas. These created marshes were compared with five natural marshes on the basis of overall morphology, sediment characteristics, and the plant and animal communities. In the fall of 1990 and the spring of 1991, samples were collected within the S. alterniflora vegetation in edge habitat (within 1 m of the marsh/water interface) and inner marsh habitat (5 m from the edge). Caging techniques were also used in edge habitat to examine growth of brown shrimp Penaeus aztecus and productivity of benthic infauna.

Differences in Spartina alterniflora growth among marshes followed a typical pattern observed in other studies of transplanted and natural marshes. Above-ground biomass was generally higher in the transplanted marshes compared with the natural marshes, both in the edge and inner marsh habitats. In contrast, below-ground biomass, sediment macro-organic matter (dry weight of roots and detritus in the upper 5 cm) and sediment organic content (determined by combustion; upper 5 cm of sediment) were lower in the transplanted marshes.

Densities of juvenile fishery organisms were estimated using a drop sampler that enclosed a 2.6-m^2 area and allowed quantitative estimates of animal numbers on the marsh surface. The dominant organisms collected in these samples during the fall and spring were decapod crustaceans including various grass shrimp Palaemonetes spp., brown shrimp Penaeus aztecus, white shrimp P. setiferus, and blue crabs Callinectes sapidus. Fishes were less abundant than crustaceans, and fishes were dominated by pinfish Lagodon rhomboides and a variety of species in the family Gobiidae. In the fall samples, juvenile red drum Sciaenops ocellatus and spotted seatrout Cynoscion nebulosus were also collected on the marsh surface. Animal density patterns indicated that transplanted marshes generally supported lower numbers of natant macrofauna, especially juvenile

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brown shrimp, white shrimp, and blue crabs. Separate statistical comparisons were made for dominant species within seasons, and all significant differences detected between transplanted and natural marshes indicated lower densities in transplanted marshes.

A caging experiment to measure growth of brown shrimp in the marshes was completed in the spring of 1991. This study was intended to provide information on the potential for secondary production from the marshes. Mean daily growth rates were slightly higher in natural marshes over the 2-week experimental period, but there was no significant difference in growth between natural and transplanted marshes. However, survival of brown shrimp in cages located in transplanted marshes was relatively low with an overall mean of 33%. Survival in natural marshes was around 93%.

The response of the benthic infauna to a release from predation pressure was also used as an indicator of potential marsh production. A caging experiment designed to exclude predators from the marsh surface was conducted in the fall of 1990. Benthic cores were collected at the initiation of the experiment and both inside and outside of the cages after a 2-week period. In the natural marshes, there was a significant difference in the density of annelid worms (the most abundant infaunal organisms) between the inside and outside of the cages at the end of the experiment. This difference was less and not significant in the transplanted marshes. Annelid densities outside the cages both at the beginning and end of the experiment were similar between the natural and transplanted marshes. These results suggest that there was greater production of infauna in the natural marshes, and this increased production was balanced by a greater predation pressure.

Measurements of animal densities in this study support the general conclusion that fishery species use transplanted marshes less than natural marshes. This pattern of reduced utilization appears to be especially characteristic of juvenile decapod crustaceans and is correlated with low below-ground biomass and sediment organic matter. Results from our predator exclusion experiment also suggested reduced value of transplanted marshes in supporting secondary fishery productivity. There was little evidence in our data, however, supporting one of our initial hypotheses, that utilization and value of transplanted marshes would increase as these marshes developed through time. Although transplanted marshes ranged in age from 3 to 15 years, animal densities and production of benthic infauna did not appear to be related to marsh age. One of our current areas of investigation involves the role of marsh elevation and hydroperiod in determining utilization and value of the marsh surface. Variability in flooding duration of our transplanted marshes appeared greater than in the natural marshes.

Key Words

Spartina alterniflora
salt marsh
transplant
animal density
fishery production
decapod crustaceans
fish
habitat value
restoration