

## Native Plants for Effective Coastal Wetland Restoration

Plant communities, along with soils and appropriate water regimes, are essential components of healthy wetland systems. In Louisiana, the loss of wetland habitat continues to be an issue of major concern. Wetland loss is caused by several interacting factors, both natural and human-induced (e.g., erosion and saltwater intrusion from the construction of canals and levees). Recent estimates of annual coastal land loss rates of about 62 km<sup>2</sup> (24 mi<sup>2</sup>) over the past decade emphasize the magnitude of this problem. In an attempt to slow the rate of loss and perhaps halt the overall trend, resource managers in Louisiana apply various techniques to restore damaged or degraded habitats to functioning wetland systems.

Researchers at the U.S. Geological Survey's National Wetlands Research Center (NWRC) have cooperated with the Louisiana Department of Natural Resources in studies that address effective restoration strategies for coastal wetlands. The studies have identified differences in growth that naturally exist in native Louisiana wetland plant species and genetic varieties (i.e., clones) within species. Clones of a species have a distinctive genetic identity, and some clones may also have distinctive growth responses under various environmental conditions (i.e., preferences). Indeed, large areas of coastal marsh are typically populated by several clones of a plant species, each growing in a microenvironment suited to its preferences.

These studies will provide information that will assist resource managers in selecting plant species and clones of species with known growth characteristics that can be matched to environmental conditions at potential restoration sites.

Before the studies began, a collection of several clones from four plant species native to coastal Louisiana was established. The species collected included saltgrass (*Distichlis spicata*), common reed (*Phragmites australis*), giant bulrush (*Schoenoplectus californicus*), and saltmarsh bulrush (*Schoenoplectus robustus*). Plants connected by roots were collected from public lands across the coastal zone, and then allowed to grow several months and produce new stems and plants from underground stems called "rhizomes." These procedures maintained the genetic identity of the clones and allowed the plants to adjust to greenhouse conditions before experimental treatments began.

### Greenhouse Experiments

#### Experimental Setup

The greenhouse studies allowed strict control of environmental conditions and provided baseline information about what conditions affect plant growth and survival; this information helps determine which plant species and clones are best suited for restoration activities. For the first greenhouse experiment, plants were potted in commercial soil. The species were divided into two habitat groups, brackish marsh (common reed and giant bulrush) and salt marsh (saltgrass and saltmarsh bulrush), and placed into large fiberglass tanks for treatment application (fig. 1).



Fig. 1. In greenhouse studies, clones of the four plant species were arranged in tanks within which salinity, water depth, and nutrients were controlled.

The study treatments consisted of three salinities (fresh, moderate, and high) and two water depths (shallow and deep) per habitat group. In a subsequent experiment, the clones were potted in one of three substrate types: organic, silt, and clay. Salinity, which was the second factor in this experiment, was set at either fresh or moderate. Both experiments were conducted over 3 months during the growing season, and plant growth was monitored during the experiments by measuring the height and number of stems. At the conclusion of each experiment, both aboveground (leaves and stems) and belowground (roots and rhizomes) material were harvested for biomass determination.

### Results

The first greenhouse study indicated that there were differences in clonal responses to salinity and flooding for three of the four species: common reed, saltgrass, and saltmarsh bulrush. These differences were shown by measurements of aboveground and/or belowground biomass (see fig. 2). In the second study, all four species exhibited differences in clonal responses at combined salinity and substrate treatments. The responses were generally complicated and varied with the treatment combinations.

### Field Trial

#### Experimental Setup

The field trial was conducted on unvegetated dredged soil deposited in a deteriorating brackish marsh in southeast Louisiana. In the spring after dredging operations, five to six clones of the four experimental species were planted at the dredge site. The planted plots were inside wire fencing (fig. 3) constructed to prevent grazing by nutria (*Myocastor coypus*). Unvegetated plots inside fencing that were not planted were also established at the dredge



Fig. 2. Significant clonal variation was found in the belowground (roots and rhizomes) biomass of common reed (*Phragmites australis*). Clone 1 (left) accumulated lower biomass than clone 6 (right) at both shallow and deep water depths, regardless of salinity.



Fig. 3. The experimental plants were transplanted from the greenhouse into a brackish marsh that was restored by using dredged sediments from the adjacent bayou.

site to monitor natural succession. Plots were also placed on nearby naturally vegetated nondredge (reference) sites. Plant growth (percent cover, stem numbers), sedimentation, and water quality were monitored over two growing seasons.

## Results

There was 100% survival of planted species, and the plants spread rapidly during the first growing season. Distinctive clonal variation in stem height and cover were found in saltgrass and common reed in the first 3 months of the study; but thereafter, rapid growth and aerial expansion of the plants made visual identification of the individual clones impossible. Cover at the planted sites exceeded cover at the reference sites by the end of the first growing season (fig. 4). Common reed was the predominant species at the planted sites by the end of the second growing season and composed over 80% of the total cover. Natural succession on dredge sites that were not planted was very slow during the first growing season. By the end of the second growing season, however, cover in the dredge sites not planted was similar to that in the reference sites. As in the planted sites, the number of species (richness) was lower in the sites not planted than in the natural marsh (fig. 4). The primary species that naturally colonized the dredged soil were smooth cordgrass (*Spartina alterniflora*) and marsh grass (*Paspalum* sp.). The predominant plant in the natural

marsh, wiregrass (*Spartina patens*), did not colonize the dredge sediment during the 2 years of this study.

## Conclusions

This research provides information that will assist in the massive effort to effectively combat wetland loss in coastal Louisiana. A synthesis of the data on growth performance of the various species and clones obtained from these three studies will provide guidance on which plants and plant clones will grow well under specific environmental conditions. Using this information, wetland managers will be able to select several species and clones that will do best under a range of expected restoration site conditions. By not relying on a single species or plant variety, the overall plant community should have the flexibility to adapt under stress and to persist over time, even if a few species or clones are eliminated. The probability of successful plant community establishment at restoration sites will therefore be improved. The economic benefits associated with healthy wetland systems, such as storm protection and fisheries habitat, will also be enhanced.

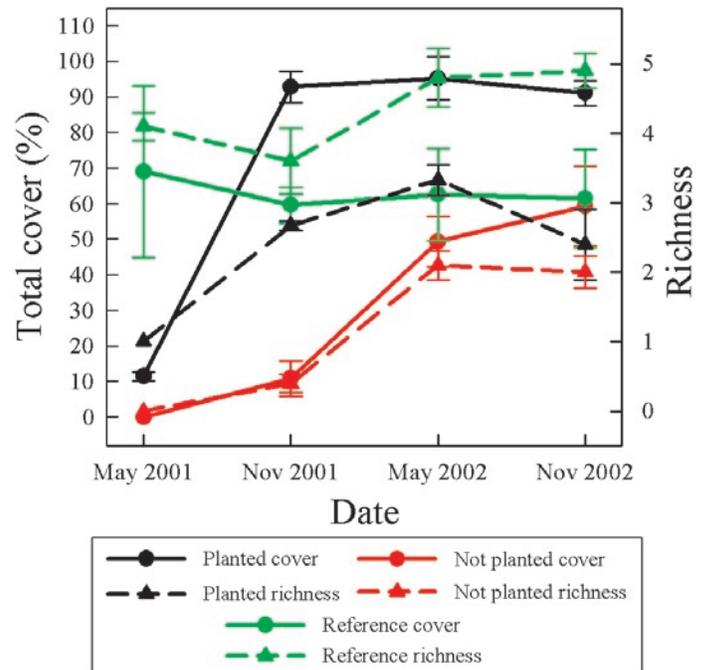


Fig. 4. Percent cover and species richness at the field trial site. The circles represent mean percent total cover, and the triangles represent mean species richness. The error bars represent 1 standard error of the means.

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