CHRISTMAS TREE FENCES: THEIR USE IN MARSH EROSION CONTROL

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ABSTRACT

The Coastal Restoration Division (CRD) of the Louisiana Department of Natural Resources (DNR) offered the 19 coastal parishes (counties) $10,000 each for construction of Christmas Tree Erosion-Control Sediment-Capture Fences. In 1991, 15 parishes constructed Christmas Tree projects, and one other parish monitored an ongoing project. Christmas Free Fences are low-cost, small-scale projects which function locally to reduce water velocity and wave action, slow down shoreline erosion, increase sediment accretion, and help restore marsh. Additionally, the projects increase public awareness of coastal issues and mobilize public participation.

Information learned from past and current projects has been compiled to determine relative success of the various fence designs, placement and construction materials. Results indicate that shoreline configuration, energy regime, water depth, sediment supply, and bottom sediment type are the five more important factors to consider when siting a project. A monitoring protocol has been developed which can be accomplished by either scientifically trained personnel or lay-persons.

INTRODUCTION

Coastal Wetland Loss

Louisiana is experiencing the most critical coastal wetland erosion and land loss problem in the United States, accounting for nearly 80% of the nation's coastal marsh loss in the continental United States (U.S. Army Corps of Engineers, 1987). Shoreline erosion rates exceed 6 m/yr in more than 80% of the Louisiana coastal zone and can be up to 50 m/yr in areas impacted by hurricanes (Suter et al., 1988). Land loss from coastal marshlands is estimated to be 79.5 sq km/yr (U.S. Army Corps of Engineers, 1990a, b; Gosselink et al., 1979; Gagliano et al., 1981).

Wetland loss in Louisiana has been caused by subsidence and natural delta senescence (Boesch et al., 1983), wave action, storm damage, channelization of the Mississippi River which has reduced freshwater and sediment inputs and promoted saltwater intrusion into wetlands (van Beek & Meyer-Arendt, 198), and canal dredging and other mineral exploration and extraction activities which have changed wetland hydrology and reduced wetland area (Craig et al., 1979; Environmental Protection Agency, 1987).

Government Response

In response to the serious wetland loss, Act 6 of the 2nd Extraordinary Session of the Louisiana Legislature in 1989 established the Wetland Conservation and Restoration Trust Fund for projects to enhance, create, restore and conserve state coastal wetlands. The Wetland Trust Fund provided $10,000 to each of the participating parishes for materials, equipment, transportation and construction of Christmas Tree Erosion-Control Sediment-Capture Fences (Christmas Tree Fences). The Coastal Restoration Division (CRD) of the Louisiana Department of Natural Resources (DNR) was responsible for aiding the parishes in siting and implementing the projects. In response to this program a number of parishes formed coastal committees for the first time.

Purpose

The purpose of the Christmas Tree Fences was to reduce water velocity and wave action, reduce fetch, slow down shoreline erosion, increase sediment accretion, and help restore marsh. Additionally, the projects were used as a springboard for marshalling local support and educating the public. Newspaper and television coverage of the projects helped to identify local problems and to bring them to the attention of the residents.

STUDY SITES

Figure 1 shows the location of the current Christmas Tree Fence projects. Projects were located across the coastal zone of Louisiana, in fresh, brackish, and salt marsh environments. The majority of the projects occurred in the Lake Pontchartrain area near New Orleans. The LaBranche Project west of New Orleans (Fig. 2) and the Crab Pond Project east of New Orleans (Fig. 3) will be discussed since they have been monitored for the longest period of time.

MATERIALS AND METHODS

Site Selection and Project Design

Christmas Tree Fences are made of parallel rows of fencing material with ends which provide a "crib" which is filled with Christmas trees or brush. In 1991, approximately 80,000 trees were placed in 7,000 m of fence in coastal Louisiana. The design and construction of fences was tailored to the different environments. Shoreline configuration, energy regime, water depth, sediment type and sediment supply were the factors considered when siting and designing fences.

Shoreline configuration was a very important factor in siting the fences. Some typical examples of shoreline configurations are shown in Figure 4. Blocking or restricting a channel connecting an eroded marsh

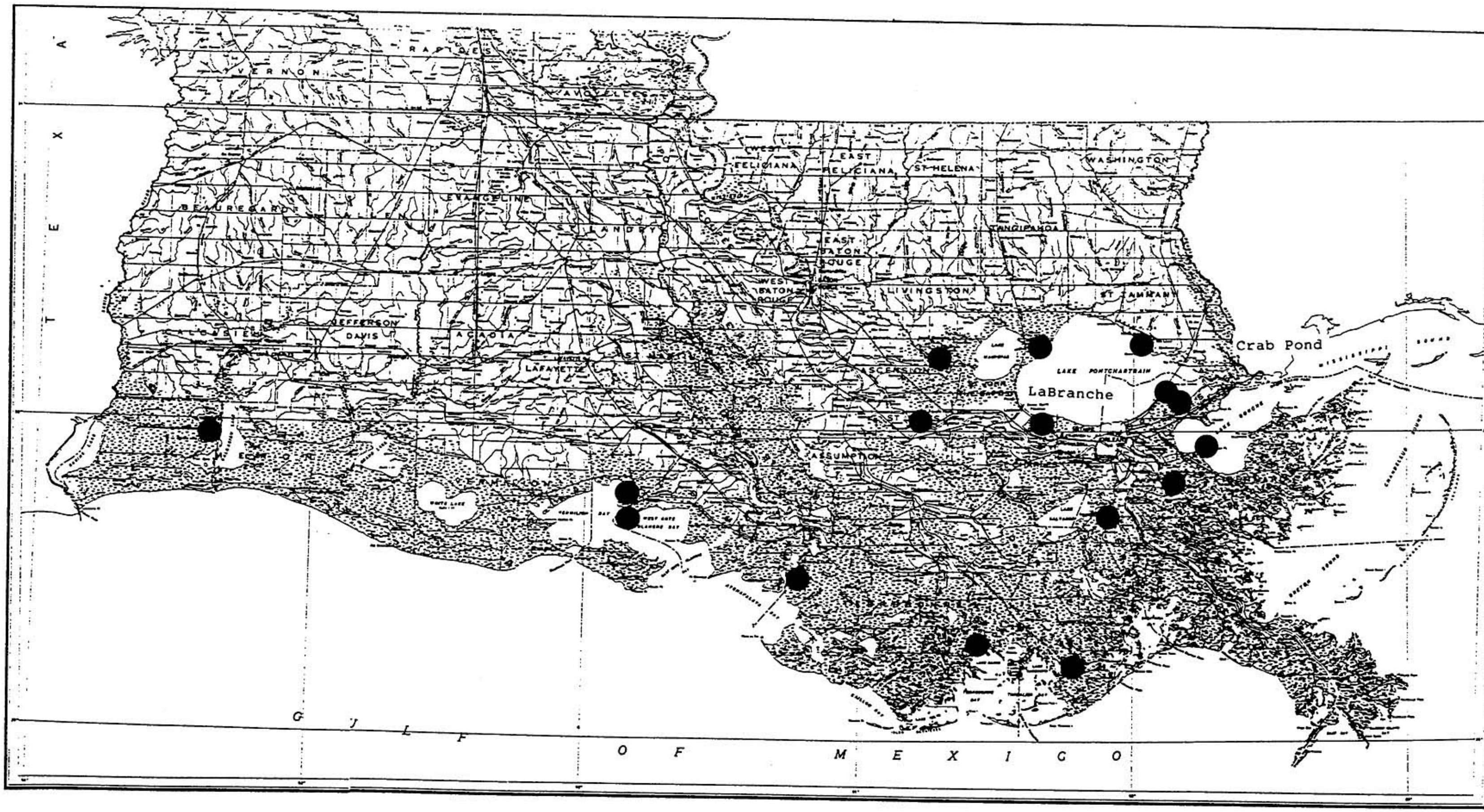


Figure 1. Christmas tree brush fence locations.

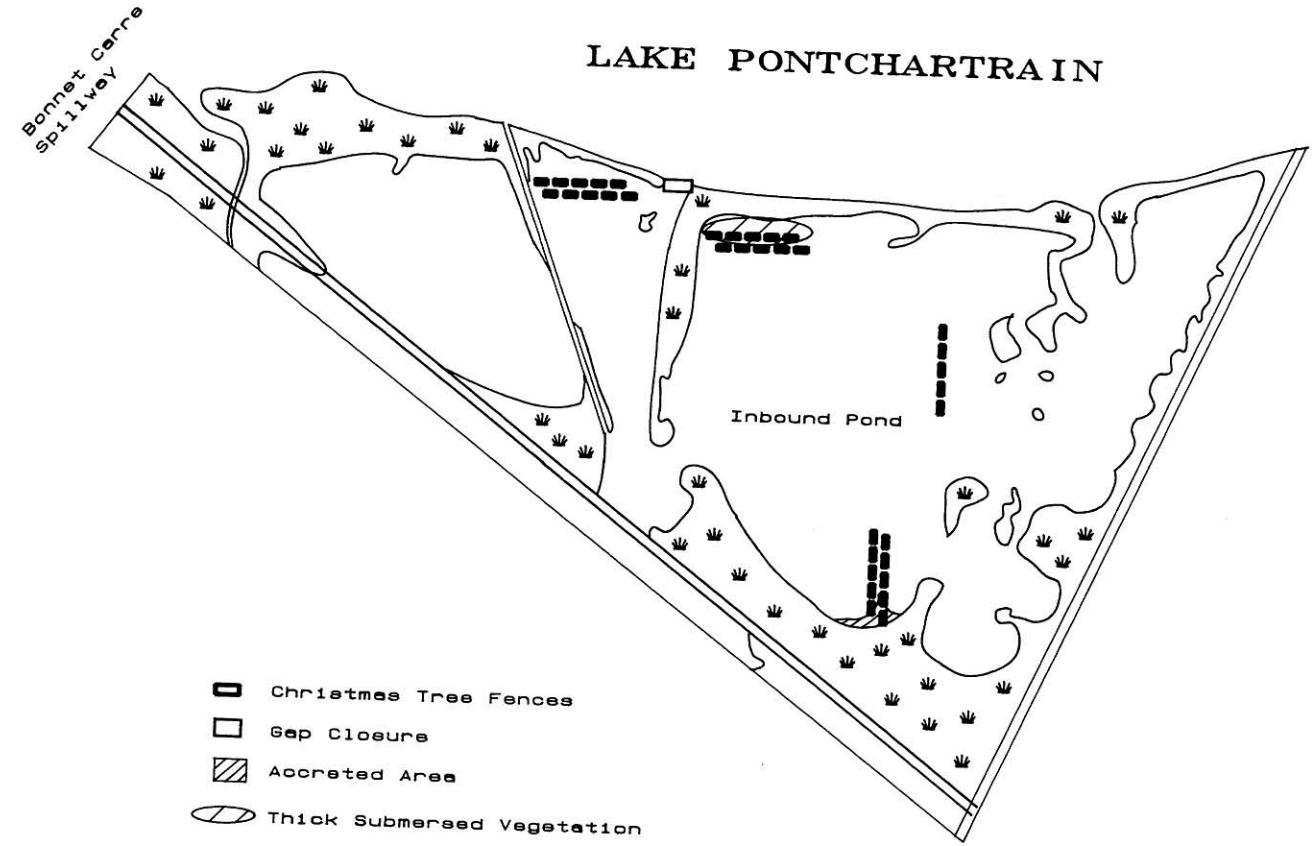


Figure 2. LaBranche wetlands Christmas tree sites.

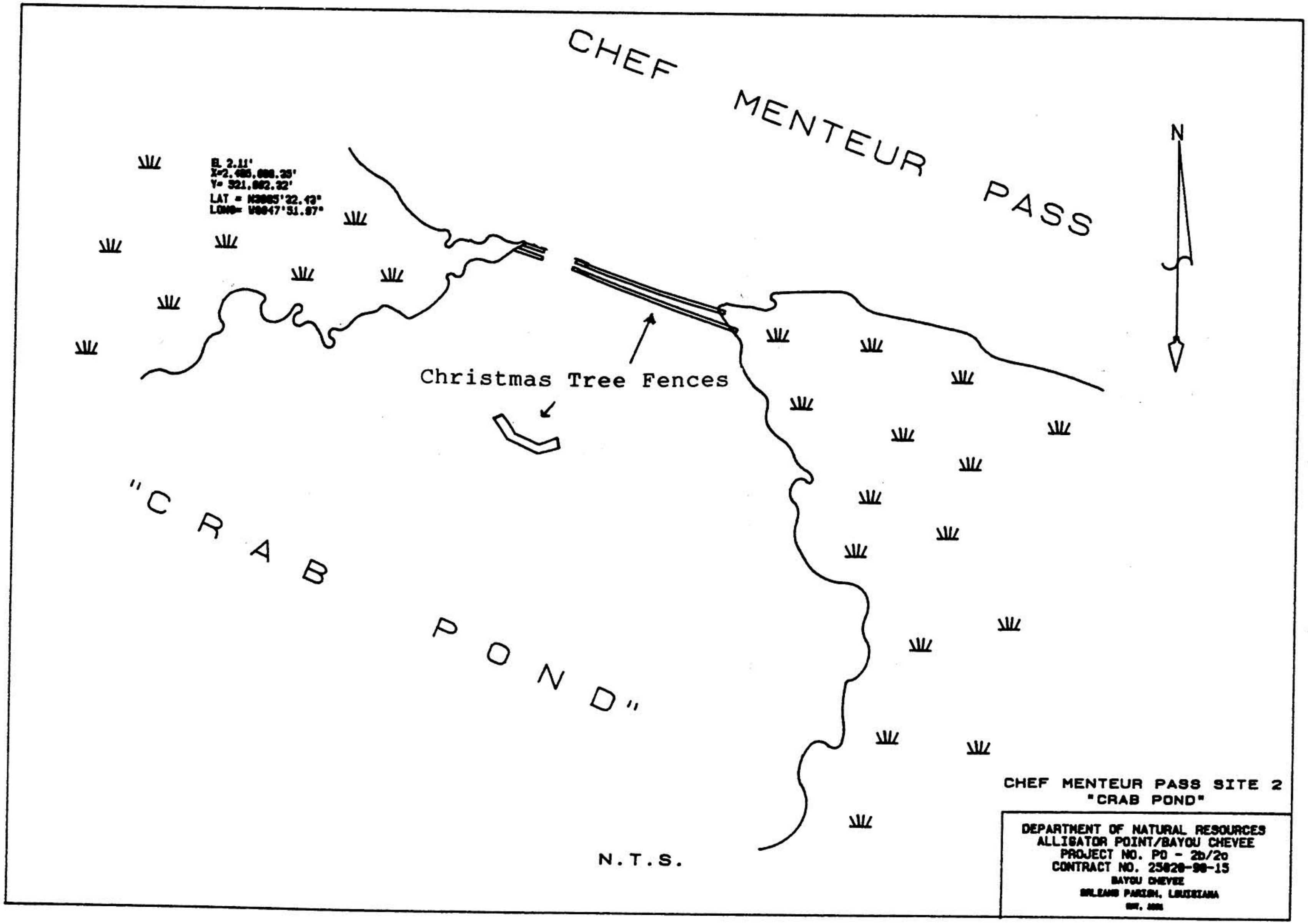
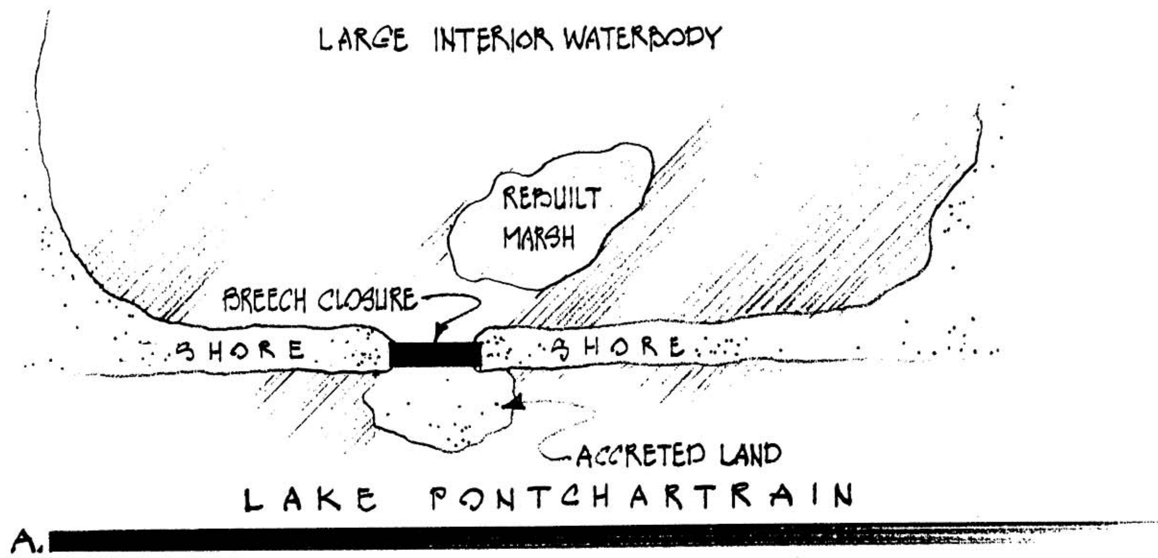


Figure 3. The Crab Pond.



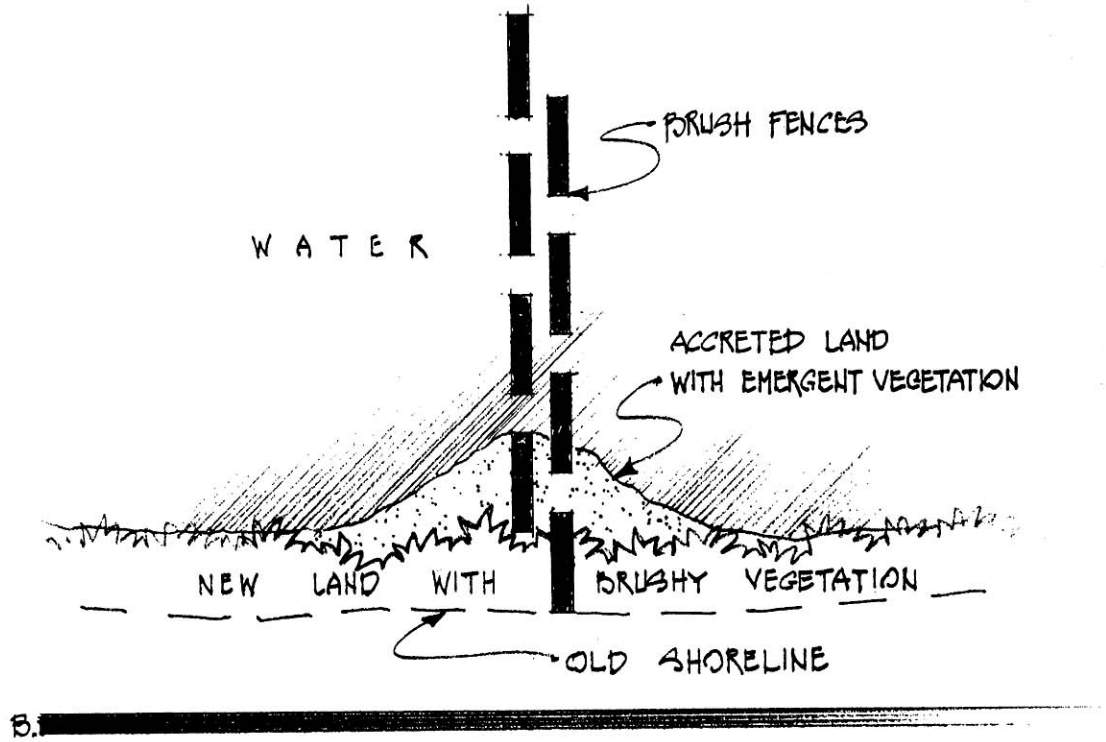


Figure 4. Shoreline configurations.

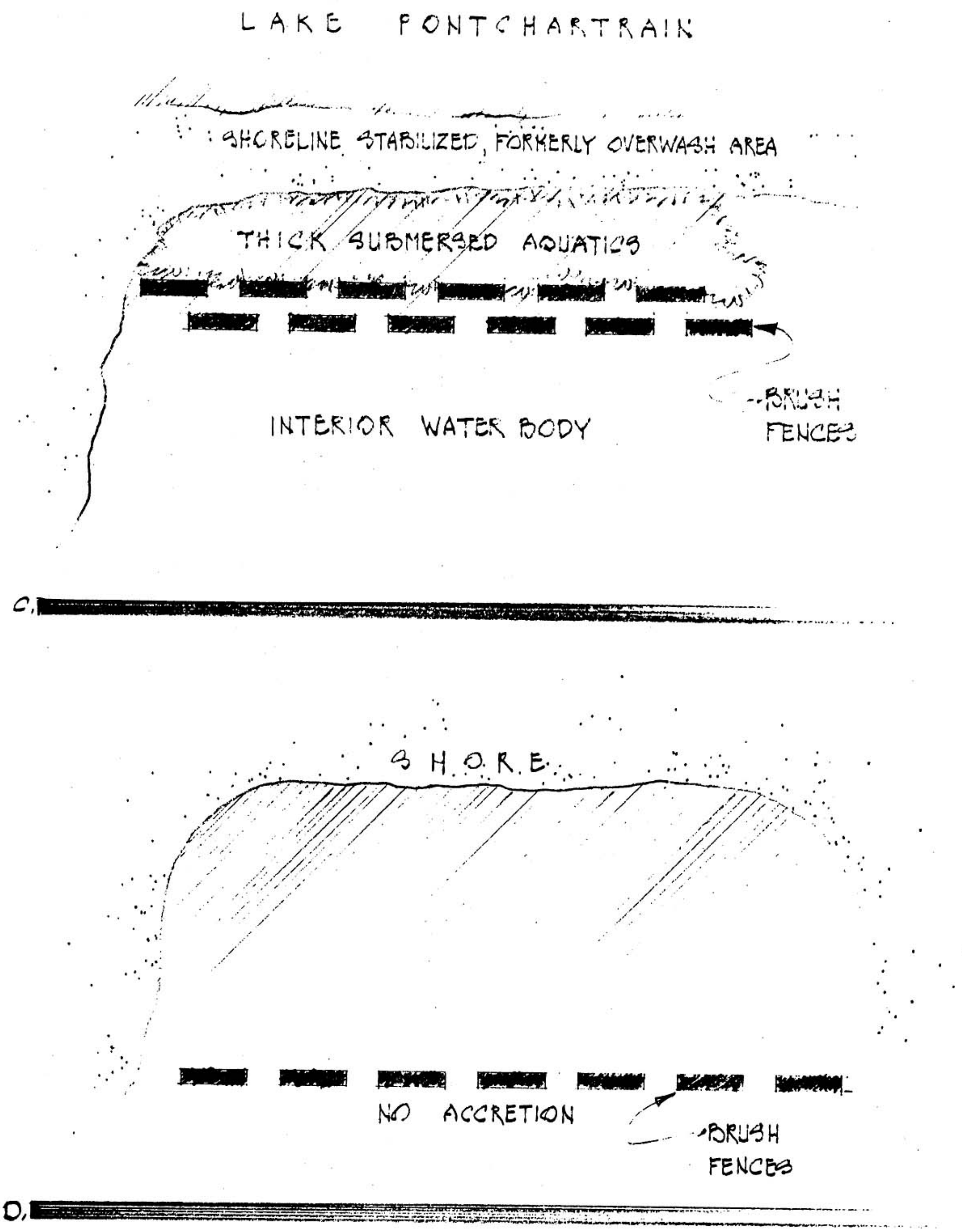


Figure 4 (cont'd.). Shoreline configurations.

pond with a larger water body was one design used (Figure 4a). A double row of overlapping fences oriented perpendicular to shore was a second design (Figure 4b). A double row of overlapping fences enclosing the corner of a large open water area was a third design (Figure 4c). Finally, a long single row of fence placed out in the center of the large open-water area was another design (Figure 4d).

The energy environment determines the sturdiness of the fence necessary to withstand the local conditions. As wave energy increases, the materials used to construct the fence must increase in strength. In low energy environments, it was possible to simply tie the trees into a network of stakes. This requires the least materials and expense, although it is fairly labor intensive. In moderate energy environments, such as protected interior marsh locations, posts were enclosed with hog-wire and the trees placed into the crib. Securing the top ensures that the trees cannot float out. In high energy areas the enclosures were made of heavy-duty posts (4" x 4" wolmanized posts with cross-members for support), wire mesh of a heavy gauge (used in concrete construction) or wooden slats. Cost calculations determined by the materials used and labor necessary were related to physical factors such as the energy regime and the sediment type. Typical costs for materials ranged from \$9.00/m to \$50.00/m of fence constructed for fences 1.5 m wide.

Water depth and sediment type determine the length of the posts that must be used and the type of equipment necessary to set the posts. In shallow areas, the unconsolidated nature of the bottom sediments and the weight of materials carried by boat caused transportation difficulties. Therefore, it was necessary to bring in supplies and equipment by airboat or helicopter.

Finally, in order for the fences to accrete land they had to be placed in areas with an adequate sediment supply. The sediment could be from outside sources or resuspended local sediments. The fences were oriented normal to the direction of the prevailing winds and tides in order to most effectively trap sediments.

Monitoring

The Christmas Tree Fence projects have been monitored to determine the most successful designs. Figure 5 shows a typical monitoring scheme. A bench mark is located at the site (made from PVC pipe or wooden stakes) and water depths were measured in relation to the bench mark. A minimum of three transects were run perpendicular to the fences. Feldspar market horizons were placed near the fence along the transect line to measure sediment accretion. Permanent stakes were placed along the transect and percent cover of plants, water depth, sediment type, and plant species were noted at each of the permanent marker positions.

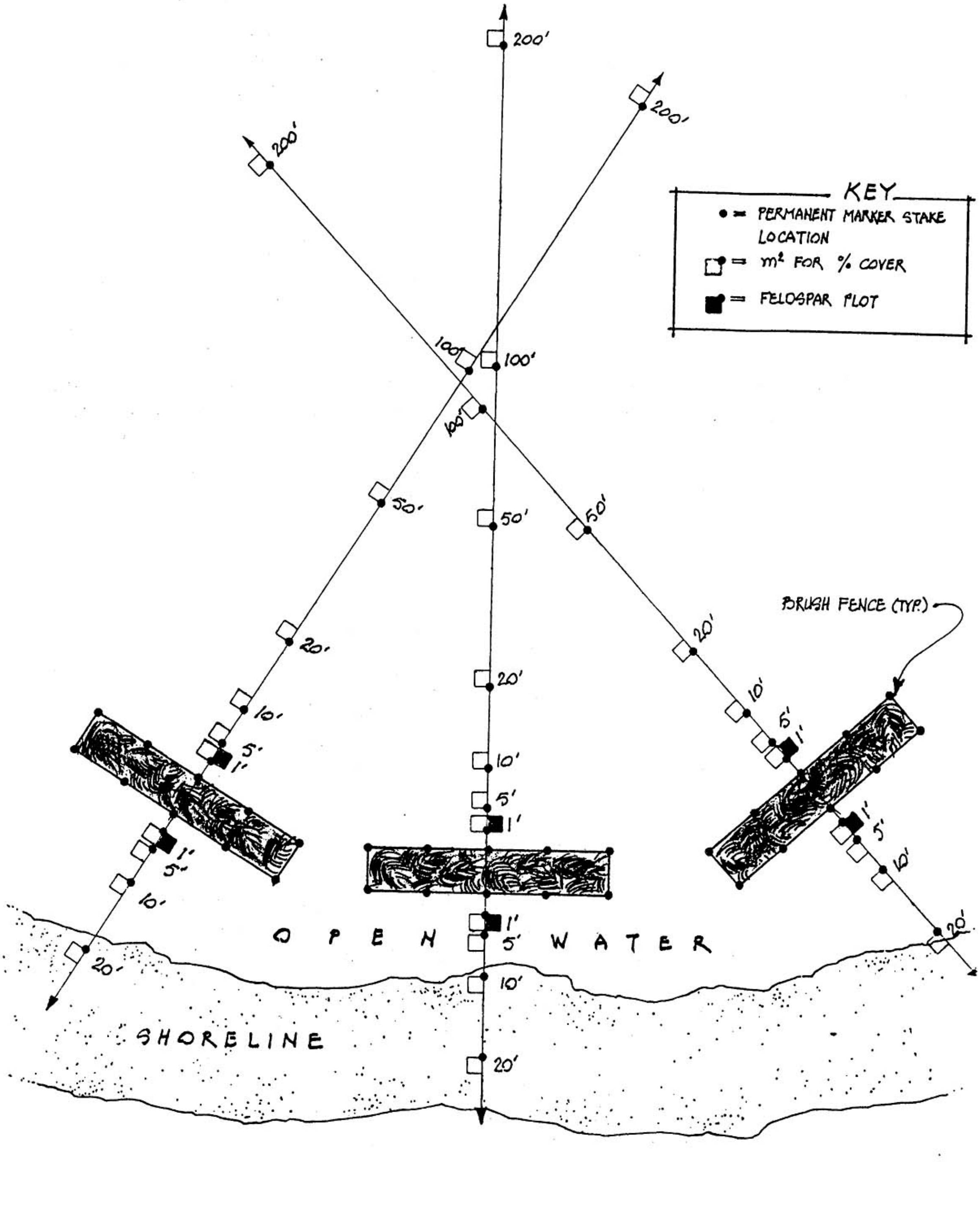


Figure 5. Transects and sampling scheme.

RESULTS

Christmas Tree Fence projects have been constructed in 16 coastal parishes, initial conditions have been measured and monitoring has been initiated. Anticipated results based on monitoring at LaBranche and the Crab Pond are that wave energy and wave heights may be reduced, sediment may be accreted and submersed vegetation growth accelerated. Fences sited in shallow water (<1m) and tied into the shoreline accreted the most sediment. Sufficient information on the remaining sites is not yet available.

LaBranche

At the LaBranche wetland a number of different shoreline configurations were present and a number of designs were tried. Closing off a breach in the shoreline was shown to be a very successful design. When a double row of fences was constructed perpendicular to the shoreline and tied into the shore the fences accreted approximately 1.5 hectares in two years. Enclosing a corner of a large interior pond resulted in dense submersed vegetation and increased water clarity. Wave action and water velocity were greatly reduced by each of these three configurations. However, placing fences in deeper interior areas far from the shoreline did not increase sedimentation rates appreciably.

The Crab Pond

The Crab Pond site was completed in late March, 1991, and by May, 1991, 80% of the pond had a 100% cover of *Myriophyllum spicata*, *Vallisneria americana*, and *Ruppia maritima*. The previous year there had only been sparse submersed vegetation in the pond. Personal observations indicate a substantial increase in water clarity which most likely can be attributed to the rejuvenation of the submersed aquatic vegetation.

CONCLUSIONS

Christmas Tree Erosion-Control Sediment-Capture Fences can be effective in reducing wave energy and water velocity and enhance submersed plant growth and sediment accretion if properly designed and constructed. Other positive benefits of the projects have been to encourage public participation and education. Children all over the state felt that they were a part of helping to restore the coast when they put their Christmas tree out on a special day for collection. Similarly, all the volunteers who ventured out into the marsh to construct fences or deposit trees became intimately aware of coastal processes at work and could feel that they were doing something positive to protect the coast.

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