

STUDY TITLE: Mitigation of Wetland Impacts Due to OCS Oil and Gas Activities

REPORT TITLE: A Study of Marsh Management Practice in Coastal Louisiana, Volume I: Executive Summary, Volume II: Technical Description, Volume III: Ecological Evaluation, and Volume IV: Appendixes

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BACKGROUND: Coastal Louisiana is experiencing catastrophic losses of its wetland habitats as a result primarily of hydrologic and sedimentologic imbalances caused by natural (e.g., subsidence and sea level rise) and human (e.g., canals) factors. Attempts to mitigate the loss of wetlands are focusing on managing water levels and flows and sediment distribution. One mitigation technique being employed on a sub-basin scale with increasing popularity is marsh management. This technique controls water levels in a tract of marsh by means of levees and water control structures. However, little is known about the environmental impacts and effectiveness of this mitigation technology.

OBJECTIVE: To prepare a factual array of data and data analysis to determine the effectiveness and suitability of marsh management techniques for mitigating wetland deterioration and loss in coastal Louisiana (figure 1).

DESCRIPTION: The project was organized into six major components: (1) a review of marsh management literature; (2) an analysis of administrative, legal, and policy issues;

(3) a description of structural management techniques; (4) a description of the environmental characteristics of the coast; (5) an evaluation of marsh management effectiveness based on a review of existing and newly collected field data; and (6) an ecological evaluation (i.e., synthesis) of marsh management effectiveness.

The state of our knowledge concerning management effectiveness was determined from a thorough review of the secondary (i.e., grey) literature. The laws and regulations governing marsh management activities and the formal and informal procedures, including guidance, employed by the regulatory agencies were determined from a review of authorizing legislation and discussions with agency personnel. An agency's goals were inferred from its policies towards and guidelines on marsh management. The engineering and construction techniques, including the schedule of operation, employed in marsh management were determined from engineering manuals and discussions with marsh managers. The hydrologic and geologic setting of the coast was determined from the literature and recent field data obtained from government and university sources. The degree of habitat change was determined from computer analysis and mapping of aerial photographs and landsat thematic mapper data of the entire coast. A profile of marsh management activities in coastal Louisiana was established from a review of permit applications on file at the Louisiana Department of Natural Resources.

Feasibility of marsh management was determined from an analysis of environmental conditions and engineering and construction requirements. The intensity and quality of landowner-performed monitoring of the effectiveness of management was evaluated by reviewing monitoring reports submitted by landowners to the Louisiana Department of Natural Resources. The influence of marsh management on wetland loss and gain, marsh-to-water ratios, marsh type and vegetation composition, and habitat diversity was determined from analysis of aerial photographs taken before and during management at 16 managed and associated unmanaged marshes. Two of the 16 management sites selected for analysis of habitat change, Rockefeller Refuge in the chenier plain and Fina LaTerre in the delta plain, plus an unmanaged reference area for each, were selected for intense field monitoring over a one-year period. At each site we measured water levels, water and material fluxes, short-term sedimentation (2- to 4-week intervals), recent accumulation (< 1 year) of matter on the marsh surface, soil properties (e.g., bulk density and organic matter content), plant species composition, plant biomass and productivity, substrate conditions affecting plant growth (e.g., redox potential, interstitial salinity, nutrient concentrations), and standing crop and species composition of fish populations under different climatic and operational conditions. An annual water budget was calculated for each site from regional meteorological data.

SIGNIFICANT CONCLUSIONS: The use of structural management to combat saltwater intrusion and wetland loss has increased substantially during the 1980s, particularly the use of manipulated impoundments (i.e., active water level management). However, monitoring conducted by landowners is of limited usefulness in evaluating the effectiveness of management, and a review of the secondary literature revealed large gaps in our knowledge about the influence of management on wetland loss, primary

production, accretionary processes, nutrient cycling, and cumulative impacts. Consequently, our knowledge of the effectiveness of this management technique is limited. In addition, the public interest goals of the federal and state regulatory agencies toward marsh management are often contradictory and in direct conflict with one another partly because of the lack of documentation of management impacts. Monitoring conducted during this study indicated that marsh management was effective at improving marsh-to-water ratios, changing marsh type, and increasing marsh acreage at less than half of the 16 managed sites we evaluated. Monitoring of two brackish marshes during drawdown years indicated that management reduced (1) water-level fluctuations; (2) the import of water, sediment, and nutrients; (3) vertical accretion; (4) soil bulk density; (5) accumulation of organic and mineral matter; and (6) the ingress and egress of marine transient fish species. Management influences on plant growth are likely related to the degree of drawdown that can be achieved; the greater the drawdown, the greater the likelihood of enhancing plant production. These findings suggest that managed marshes may become sediment and nutrient limited, underscoring the potential cumulative impacts of marsh management. Additional research is needed on other marsh types and during other operational scenarios in order to evaluate fully the biological consequences of marsh management.

STUDY RESULTS: Since 1980, the Louisiana Department of Natural Resources has issued 126 permits to manage nearly 121,000 ha (9%) of all coastal wetland habitat. Most permits are issued to (1) actively manage water levels; (2) manage wetlands located in the Terrebonne, Barataria, and Vermilion-Teche basins; and (3) mitigate wetland loss. A review of approximately 150 literature citations revealed little information on (1) the effects of marsh management on wetland loss, sediment deposition, plant health, fisheries habitat, and cumulative impacts; and (2) environmental and socio-economic factors affecting the success and cost-effectiveness of management. The public interest goals of government agencies toward marsh management are often widely divergent. Marsh management is considered by some agencies to further and by other agencies to impede the attainment of certain public goals, such as preventing land loss and increasing biological productivity. The dispute stems, in large part, from a lack of scientific data and disagreement over the existing data.

Monitoring efforts by landowners have provided uneven results concerning the effectiveness of management. The intensity of monitoring efforts varies from intermittent to continuous. Some efforts are dedicated to creating long-term data bases, while for others monitoring has ceased. The quality of monitoring efforts varies because not all programs monitor the same variables and, more importantly, is often poor because rarely were the variables measured in a nearby unmanaged marsh. Consequently, nearly all of the file databases are poorly suited to evaluate the effectiveness of management because of the often low intensity of sampling and usually poor experimental designs. Analysis of management influences on habitat change indicated that marsh management is not always effective at increasing marsh acreage, reversing salinity influence on vegetation composition, or improving marsh-to-water ratios. The lack of uniformity of influence was partly attributable to the type of

management employed. Those sites employing passive water management with fixed-crest weirs rarely showed improvement for any of the variables whereas, compared to unmanaged marsh, actively managed marsh sometimes produced improved marsh-to-water ratios (5 of 10 sites), net gains in marsh (2 of 10 sites), and a net change of water to marsh between 1985 and 1988 (4 of 10 sites).

Field monitoring of two brackish marshes during drawdown years indicated that management had a significant influence on water levels, the flux of matter, marsh accretionary processes, soil substrate conditions, plant growth, plant species richness, and composition of fish populations. Because both managed marshes were isolated from the larger estuarine system, water-level fluctuations and the exchange of water and dissolved and particulate matter were greatly reduced. The ingress of aquatic organisms was also greatly reduced. Management had a similar effect on recent accretionary processes at both marshes even though they are located in different sedimentologic and hydrologic regimes (i.e., near and far from the coast). Vertical accretion, soil bulk density, and the accumulation of organic and mineral matter were significantly lower in the managed marsh. Despite these similarities, the two managed marshes differed importantly in plant growth and soil substrate conditions. At Rockefeller Refuge, water levels were drawn down as much as 22 cm below the marsh surface and edaphic factors were favorable to plant growth. At Fina LaTerre, water levels were drawn down only 8 cm and edaphic factors were less favorable to plant growth. These data suggest that success or failure of management to enhance productivity of *Spartina patens* may depend on the degree of drawdown.

STUDY PRODUCT: Cahoon, D. R. and C. G. Groat, editors. 1990. A Study of Marsh Management Practice in Coastal Louisiana. A final report for the U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA. Cooperative Agreement No. 14-12-0001-30410. 4 Volumes.