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STUDY TITLE: Planning Workshops for Oil Spill Remediation for Habitats and Resources in the Gulf of Mexico

REPORT TITLE: Effects and Management of Oil Spills in Marsh Ecosystems

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BACKGROUND: This technical report on the effects and management of oil spills in marsh ecosystems contains papers written by participants of a workshop held July 1996 at McNeese State University and sponsored by the U.S. Minerals Management Service. It is the third in a series of three documents, the first being the symposium proceedings entitled Gulf of Mexico and Caribbean Oil Spills in Coastal Ecosystems: Assessing Effects, Natural Recovery, and Progress in Remediation Research (OCS Study MMS 95-0063). The symposium and workshops were supported under a cooperative agreement between MMS and McNeese State University.

OBJECTIVES: This workshop was undertaken to address problems in terms of what is truly "known" (versus what is "asserted" from casual observations) of the effects of petroleum and remediation of these effects.

DESCRIPTION: This report includes papers on topics decided upon by attendees at a workshop on coastal marshes and oil spills held at McNeese State University. The first two papers review the state-of-knowledge of oil spills on marsh macrophytes and soil biogeochemical processes. In the remediation section, the use of chemical cleaners, the efficacy of in-situ burning to remove oil from marshes, and phytoremediation (the use of oil-tolerant plants to remove or detoxify oil) are reviewed. The final paper, by an

U.S. Environmental Protection Agency staff member, discusses bioremediation and especially focuses on directions for future research.

SIGNIFICANT CONCLUSIONS: The effects of oil spills on marshes are complex and should be considered at various scales of spatial and temporal resolution and modes of impact. In general, lighter weight oils are more immediately toxic to plants than heavier oils. However, many of the modes of impact to marsh macrophytes involve effects related to smothering of the gas exchange surfaces of the plant, or of limiting gas exchange into an oil-coated sediment. Oil in the sediment can lead to increased oxygen stress in belowground tissues due to reduced gas exchange, disrupt root membranes and ion selectivity, and may adversely affect vegetative regrowth as newly-emerging shoots contact the oil. Oil may have considerable effects on marsh soil biogeochemical processes, however, the effects warrant further research. Oil has been found in marsh soil 7 years after a spill, which indicates the potential for long term effects. Crude oil greatly but temporarily stimulated soil respiration, affects Eh, and possibly remineralization rates, and may stimulate nitrogen fixation. A research program designed to better understand the long-term effects of petroleum hydrocarbons on nutrient cycling in coastal marshes is needed.

STUDY RESULTS: In some types of spills, prescribed burning is an important remediation alternative. Although all burning results in an immediate short-term reduction in plant cover, favorable recovery of herbaceous wetland plant species often takes places within one to five years. However, recovery rates can be quite variable and “complete” recovery may take as long as a decade. Cleaners and dispersants can also be useful. Regardless of the type of oil to be cleaned, it appears that if the use of the cleaner is feasible, then it should be applied as soon as possible following an oil spill to minimize oil penetration into the sediment, to prevent massive plant tissue death, and to speed up the recovery of plant normal gas exchange functioning. Marsh plants fouled with South Louisiana Crude and Bunker C benefited from cleaning with COREXIT 9580, but the variations in the level of toxicity of the different oils suggests different response strategies when resources are limited. Phytoremediation technology has already been shown to be effective for the removal of both inorganic and organic pollutants, including polycyclic aromatic hydrocarbons. However, work needs to be conducted to determine the most effective plant species and genotypes for use in coastal marsh phytoremediation.

STUDY PRODUCTS: Louisiana Environmental Research Center McNeese State University 1997. Managing Oil Spills in Mangrove Ecosystems: Effects, Remediation, Restoration, and Modeling. A final report for the U.S. Department of the Interior, Minerals Management Service Gulf of Mexico OCS Region, Metairie, LA. NTIS No. PB98-142268. Contract No. 14-35-0001-30690. MMS 97-0003. 76 pp.

Louisiana Environmental Research Center McNeese State University 1997. Symposium Proceedings: Gulf of Mexico and Caribbean Oil Spills in Coastal Ecosystems: Assessing Effects, Natural Recovery, and Progress in Remediation Research. A final report for the U.S. Department of the Interior, Minerals Management

Service Gulf of Mexico OCS Region, Metairie, LA. NTIS No. PB96-185764. Contract No. 14-35-0001-30690. MMS 95-0063. 245 pp.