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STUDY TITLE: Development of an Ecological Overview Appropriate for Management of Resource Development in Continental Slope Habitats

REPORT TITLE: Management Applicability of Contemporary Deep-Sea Ecology and Reevaluation of Gulf of Mexico Studies

CONTRACT NUMBERS: 14-35-0001-30660-19904

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APPLICABLE PLANNING AREA: Central Gulf

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BACKGROUND: The study of deep-sea biology began in the late 1800's, with an ecological perspective being adopted after the 1900's. Unlike terrestrial and neritic ecology, an applied or bio-conservation approach to deep-sea ecology has yet to be developed. As a result, when resource managers and regulators turn to the body of deep-sea knowledge in an effort to develop scientifically sound strategies, they encounter many facts and theories but little indication as to the mission relevance of any. Which of all the fascinating scientific ideas about deep-sea distributions, adaptation, trophic relationships, reproduction, competition, community structure, bio-diversity, etc. are best able to predict, monitor for, and mediate environmental impacts?

OBJECTIVES: The overall goal of the project is to provide the Minerals Management Service with a sense of the status and mission relevance of a cross-section of deep-sea ecology topics. Focusing primarily on the Gulf of Mexico, there are three objectives: (1) to provide an annotated review of relevance of general deep-sea ecology; (2) review and reevaluate in a more contemporary context MMS-supported surveys of the 1980's,

and (3) review and update Gulf of Mexico chemosynthetic community studies from a similar perspective.

DESCRIPTION: The study consisted of three parts. Part one is a status review of deep-sea ecology concepts and capabilities reflected by the open literature up to 1995 with selected additions until 2001. Included in this review are brief consideration of previous deep-sea regulatory efforts dealing with manganese nodule mining, radioactive waste, and deep-sea disposal. Part two is a review and reexamination of data from the Northern Gulf of Mexico Continental Slope (NGMCS) program and the Atlantic Continental Slope and Rise (ACSR) program. Both studies were conducted prior to the refinement of concerns brought about by actual initiation of deep-water development and prior to recent deep-sea ecological syntheses. Part two is a review and extension of work on the Gulf of Mexico chemosynthetic communities. A model of geological/geochemically mediated substrate suitability is proposed.

SIGNIFICANT CONCLUSIONS: Over the last ten years, many generalities about deep-sea adaptation have been questioned and some disproved, thus blurring previously identified distinctions between shallow and deep systems. The most notable aspects of deep-sea ecology with greatest relevance to environmental impact are:

(1) From the legally defined upper limit of 200m to the typical maximum depth of the US EEZ at about 3600m there are dramatic changes in habitat and species composition. Management strategies may require depth stratification.

(2) Embedded within the vast soft-bottom habitat are faunally distinct, smaller-scale “special habitats” such as chemosynthetic communities, cold-water corals, sponge banks. Special management strategies may be required to protect each such habitat.

(3) Most deep fauna is dependent upon the detrital rain of labile carbon, and the paucity of that resource may play a far greater role in community structure than in shallow water. Activities that alter the influx and short-term redistribution of detritus should be examined as potential causes of deleterious impact.

(4) The most notable deep-sea phenomenon that gives evidence of a deep ecology unlike that of shallow water is the very high biological diversity in a seemingly homogenous habitat. The explanations that have been put forward for such high diversity do not address the issue of impacting activities. Efficient management requires that the causative processes be confidently determined.

STUDY RESULTS: Activity for part one consisted of a literature search and reading of all relevant major works on deep-sea ecology from 1960-1996. Part two activities consisted of a review of all reports and publications associated with the NGMCS and ACSR programs. Faunal datasets for NGMCS were recreated in National Oceanographic Data Center format from annual reports. Faunal datasets for ACSR were obtained from Battelle Inc. On reanalysis some of the original NGMCS conclusions about east-west and depth faunal distributions were found dubious due to

the low power of the designs used. Use of dissimilar gear prevented confident comparison of results, but some indication of higher species diversity in the Gulf of Mexico was found. Activitie for the third part consisted of literature review and examination of archived video footage take at seep sites. These allowed consideration of a model whereby time-variant seepage rates produce a transition between fluid-prone and mineral-prone seafloor habitats. The latter support metazoan chemosynthetic communities.

STUDY PRODUCTS: Carney, R.S. 2001. Management applicability of contemporary deep-sea ecology and reevaluation of Gulf of Mexico Studies. Final report. OCS Study MMS-2001- 095. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, La. 190 pp.