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STUDY TITLE: Evaluation of Oil and Gas Platforms on the Louisiana Continental Shelf for Organisms with Biotechnology Potential

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BACKGROUND: The 1998 National Ocean Conference in Monterey, California identified biotechnology as a high priority issue for the nation. The report of this conference, (Turning to the Sea: America's Ocean Future, 1999; available at http://www.publicaffairs.noaa.gov/oceansreport/) identifies a lack of baseline conditions of the marine environment which makes it difficult to assess the environmental impacts of biotechnology, and listed among its key recommendations:

Increased support for sustainable harvesting and testing of marine compounds by both government agencies and commercial pharmaceutical companies as possible treatments for AIDS, inflammatory diseases and cancers; and support research on the environmental effects of extracting marine organisms for biotechnology purposes.

OBJECTIVES: There were three major goals of this project. The first was to determine which organisms make up the biofouling communities on offshore oil and gas platforms in the northern Gulf of Mexico. The second was to determine if any of these organisms were known sources of pharmaceuticals or other natural products. The third was to determine how the organisms populate the platforms and the distribution of the organisms with platform location, depth and season. The major organisms to be examined were bacteria, algae, bryozoans, benthic foraminiferans and molluscs.

DESCRIPTION: The study was designed to sample bacteria, algae, foraminiferans and molluscs at the same five platforms in the northern Gulf of Mexico. The organisms

sampled included bacteria to determine the numbers and diversity of the bacteria associated with the biomatrix on the oil and gas platforms; the location of these organisms with respect to depth above or below the water line and if any of the bacteria associated with the biomatrix have potential for biotechnological applications.

The algae sampled were screened for being known sources of important natural products. Bryozoans (*Bugula neritina)* were screened for the endosymbiont that produces bryostatin 1, a marine compound that has entered phase II clinical trials to combat the growth of cultured cancer cells.

Benthic foraminiferans with special attention to agglutinated species are studied with respect to their potential use as a source as bioadhesives. The mollluscs that are the subject of this study are also of biotechnological interest because of the interest in mussel adhesive protein (MAP), which is derived from the byssi of mussels. Byssal adhesives are of interest because they provide strong and durable adhesion to surfaces underwater.

SIGNIFICANT CONCLUSIONS: The Gulf of Mexico has over 3,000 oil and gas platforms that provide hard substrate for the attachment of a large and diverse assemblage of epifaunal or fouling organisms. Many of these organisms have the potential to provide compounds useful in industrial and medical applications. Bioprospecting for new compounds requires preliminary elucidation and clarification of the taxonomy of the organisms present and, in some instances, their chemical ecology. The macrofaunal assemblages unique to the oil and gas platforms of the Gulf are not well known and, in this study, the taxonomy and relative abundance with depth and distance offshore of major taxa of epifaunal organisms were addressed. This study involved investigation of various aspects of five major taxa, bacteria, macroalgae, foraminifera, bryozoa,* and molluscs. *The study of the Bryozoa centered on a single genus, *Bugula,* known to be the source of an important chemical, bryostatin, used in cancer treatment.

Conclusions relative to the study of these taxa are as follows.

Bacteria - The study demonstrated that large numbers of bacterial species, many of which are novel and belong to taxonomic groups known to be of biotechnological importance, were present in the fauna.

MACROALGAE - The total number of macroalgal taxa collected during this study was 24. The best represented group was Rhodophyta (approximately 50% of the taxa). There was a vertical distribution of taxa found on the platforms themselves, and there was also a trend identified for biodiversity and abundance of macroalgae to increase from nearshore to offshore and decrease from intertidal to depth.

In all, seven new taxa were added to the list of macroalgae identified from the platforms and there was one new report of Antithamnionella breviramosa from the Gulf of Mexico. Approximately 50% of the taxa collected are known to have biotechnological potential and approximately 20% of the taxa collected are found only on oil and gas platforms.

FORAMINIFERA - Agglutinated foraminiferal species hold promise as a source of bioadhesives for biotechnological and biomedical applications because they can secrete

and then harden adhesive organic compounds in an aqueous medium. The foraminiferal community of Gulf of Mexico oil and gas platforms includes a great variety of species, of both agglutinated and calcareous wall structures. No species with biotechnology potential, however, could be identified in this particular study although further study of the foraminferal fauna may reveal biotechnological potential**.**

BRYOZOA - This study found that B. neritina as currently recognized in US waters comprises three cryptic species: the deep water Pacific form, a Shallow/Southern form present both in shallower Pacific waters and along the Atlantic coast south of Cape Hatteras, and a third form present in the Atlantic north of the Cape Hatteras region. The species collected from the Gulf of Mexico platforms do not produce the commercially important bryostatin I although its cytochrome oxidase subunit sequences were identical to those collected from the Atlantic south of Cape Hatteras.

MOLLUSCA - Bivalve composition was similar to that previously reported from platforms on the Louisiana and east Texas continental shelf where *Isognomon* was most common found from 0-12 m. Bivalves of the Family Arcidae (arcids) were common from 3-12 m; and *Chama macerophylla* was reported between 1 and 20 m.

The bivalve assemblages identified in this study resembled assemblages found on shorelines characterized by hard substrates in Texas and Mexico. The byssus are of biotechnological interest because they provide strong, durable adhesion to wet surfaces. In addition, some of the proteins in the adhesive can chelate metal ions.

The most widely studied byssal protein is mussel adhesive protein (MAP) from *Mytilus edulis*. This compound is used as an attachment factor for cells and tissues in culture; as an immobilization agent for antigens, antibiotics, and enzymes; and as an anticorrosive coating for metals and metal sequestering reagent. Additional potential uses are as medical and dental adhesives and fillers; microencapsulating agents; sizing agents for textiles; and water-resistant inks.

STUDY RESULTS: This study provides a foundation for future analyses of epifauna that may be of biotechnological potential. Organisms may be initially screened for use in medical and industrial applications with little knowledge of their ecology .There is, however, a need for much more information about the taxonomy, seasonality, and ecology of these organisms before any questions can be resolved regarding ways to farm and harvest them economically if they are determined to have medical or industrial applications.

STUDY PRODUCT: Rouse, L., ed. 2009. Evaluation of oil and gas platforms on the Louisiana Continental Shelf for organisms with biotechnology potential. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-059. 60 pp.

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