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STUDY TITLE: Georges Bank Monitoring Program: Benthic Infauna.

REPORT TITLE: Georges Bank Benthic Infauna Monitoring Program: Final Report for the Second Year of Sampling.

CONTRACT NUMBER(S): BLM: CT2-07; MMS: 14-12-0001-29192.

SPONSORING OCS REGION: Atlantic.

APPLICABLE PLANNING AREA(S): North Atlantic.

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COST(S): FY 1982: $2,158,359; FY 1983: $1,007,127; FY 1984: $832,530; CUMULATIVE PROJECT COST: $3,998,016.

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KEY WORDS: North Atlantic; fates and effects; infauna; epifauna; benthos; sediment; grain size; benthic photographs; seasonality; community; exploratory drilling; drilling discharges; monitoring; survey; trophic dynamics; life history; multivariate statistics; Georges Bank; Oceanographer Canyon; Lydonia Canyon; Atlantic Region.

BACKGROUND: The Georges Bank is one of the most productive commercial fishery areas in the world. In addition, the underlying geologic structures of the Georges Bank region are of the type that may contain substantial reservoirs of petroleum and/or natural gas. It was recognized that potential conflicts may arise between commercial fishing interests and the petroleum industry in the utilization of the varied natural resources of the Georges Bank environment. Because of these potential conflicts and concerns about the potential effects of oil and gas exploratory activities associated with Lease Sale 42 on the highly productive Georges Bank environment, a Biological Task Force (BTF) was formed. The BTF represented a multi-agency panel chartered to recommend to the U.S. Department of the Interior the design of environmental studies and surveys to provide warning of adverse effects of oil exploration. The BTF proposed the basic design of the Georges Bank Monitoring Program, a multidisciplinary field effort initiated in July 1981. This report provided the results of second year of benthic sampling on Georges Bank.

OBJECTIVES: (1) To link the fate of discharges (i.e., primarily drilling fluids and cuttings) from oil and gas exploratory operations in the Lease Sale 42 area to effects on benthic species and communities; (2) To determine the quantities, the physical characteristics, and the chemical composition of materials discharged during drilling operations; (3) To estimate where discharged materials accumulate and in what concentrations; (4) To measure the existing background levels of contaminants in the sediments and biota and what levels above background can be detected with existing technology; and (5) To determine whether benthic populations change at selected regions on Georges Bank during various stages of oil and gas activity and to relate these changes to pollutant levels associated with discharges.

DESCRIPTION: The study program included intensive sampling of benthic communities collected near, upcurrent, and downcurrent of drilling rigs, analysis of bottom photographs for epifauna and microtopography, dredge and trawl collections, and carbon-hydrogen-nitrogen (CHN) and sediment grain-size analyses. Sampling station locations were established to determine both near-rig and regional environments impacts. Collections of six replicate infaunal samples at each of 46 stations were made on

a seasonal basis. A 0.04 m^2 modified Van Veen grab sampler was used to collect infaunal samples which were live sieved through 500- and 300-μm screens. Subsamples of the infaunal grab samples were taken for CHN and grain size analyses. Three replicate 0.1-m^2 Van Veen samples of undisturbed bottom sediment were also collected at each station for chemistry analysis.

Twenty-nine stations were located in a tight radial array around an exploratory drilling rig positioned at a water depth of 80 m in Block 312. A second group of three stations was located in proximity to a second exploratory drilling site positioned at a water depth of 140 m in Block 410 to determine near-field impacts; stations were located from 200 to 2,000 m up and down current from the drilling rig in Block 410. Remaining stations were positioned over a broad expanse of the Bank and within areas of potential drilling mud deposition, including stations at the head of Lydonia and Oceanographer Canyons.

In the laboratory, each benthic sample was resieved through nested 500- and 300-μm screens, transferred to 70% alcohol, and stained with rose bengal. Biological specimens within each sample were then sorted to into basic taxonomic groups and identified to the lowest possible taxon. Wet biomass was variably determined separately for each species (i.e., wet weights were determined for all species from all samples collected during the first eight cruises; wet weights were taken from only a portion of the samples collected during the last four cruises). Statistical techniques included agglomerative clustering, similarity analysis by the Normalized Expected Species Shared (NESS) and Bray-Curtis techniques, and Shannon-Wiener diversity calculations. Hurlburt's modification of the rarefaction method was used to predict the number of species in a random sample without replacement. If available, six frames from each station per cruise were analyzed for microtopographic features and densities of visible epifauna.

Additional aspects of the program, implemented following the first year effort, included a detailed life history analysis of 23 dominant benthic species, and a study linking fish feeding with benthic production. Life history parameters were determined for a suite of 19 polychaete, three amphipod, and one echinoderm species. For each species, size-class frequency distributions were calculated. Yellowtail flounder (Limanda ferruginea) were collected for gut content analysis as part of the benthic feeding component. Length frequency measurements were made on polychaetes and amphipods contained within the stomachs of collected fish, then compared to similar measurements made on benthic infauna.

SIGNIFICANT CONCLUSIONS: Results from the first and second year of the benthic infaunal monitoring program, based on the completion of eight biological/chemical cruises on Georges Bank, indicated little heterogeneity within stations and good replication between samples. A strong relationship was identified between faunal composition and both sediment type and depth. No biological impacts which could be attributed to drilling activities were detected at any station, including the site-specific array in Block 312, the three stations in Block 410, or any of the remaining regional stations.

STUDY RESULTS: Drilling in Block 312 lasted from December 1981 to June 1982. During this time, an increase in the concentration of barium (from drilling discharges) in surficial sediments was observed between cruises M1 (before drilling) and M5 (after drilling). However, no statistical correlation was measured between community similarity parameters and increase in barium concentrations or percent silt-clay in sediments. A highly significant correlation between community parameters and percent fine sand was observed.

Fluctuations in the numbers of individuals and abundance of certain dominant species was evident in November 1981 and February 1982, and in November 1982 and February 1983. These fluctuations were attributed to seasonal trends. Although there was a small accumulation of petroleum hydrocarbons in sediments at two stations near the exploratory drilling rig located in Block 312, no measurable impact on the benthic infauna was measured. It was concluded that discharges from exploratory drilling activities in Block 312 had no measurable impact on the benthic infauna.

In Block 410, drilling occurred from July 1981 to March 1982. No measurable impact to the benthic infauna had been measured after analysis of eight seasonal samples.

For the three amphipod species studied as part of the life history analysis, much of the variation in abundance could be explained on the basis of recruitment and mortality. Other factors such as adult migration may also have been important. Data on the polychaete species was less conclusive. Only Cossura longocirrata exhibited a decline in abundance which was correlated with timing of reproduction. Only Exogone verugera showed recruitment in winter, while the other species appeared to recruit in spring and summer. The majority of polychaete juveniles appeared in the summer.

It was determined that yellowtail flounder on Georges Bank fed primarily on macrobenthic species which varied seasonally and between stations. However, the flounder appeared to accommodate changes in the abundance of preferred prey species.

Previous data collected between 1975 and 1979 had suggested that benthic macrofaunal communities may play an important role in maintaining bottom sediment stability during a storm event. Results of this study (i.e., through the second year of sampling and analysis) indicated that storms had little effect on macrofaunal communities despite erosion of sediments and the disappearance of a surface biological mat. Comparison of monitoring program samples with eleven station sampled in 1977-1978 showed general agreement between the dominant species. Particularly good correspondence for dominant species was recorded at a Block 312 station, where seven species were found to be common between the two monitoring efforts. Average density of individuals at the eleven stations was generally higher in the monitoring program samples, even when only the 0.5-mm fractions were compared.

STUDY PRODUCT(S): Maciolek-Blake, N., J. F. Grassle, J. A. Blake, and J. M. Neff. 1984. Georges Bank Benthic Infauna Monitoring Program: Final Report for the Second Year of Sampling. A final report by Battelle New England Marine Research Laboratory and Woods Hole Oceanographic Institution for the U.S. Department of the Interior, Minerals Management Service Atlantic OCS Region, Vienna, VA. NTIS No. PB84-169454. Contract No. 14-12-0001-29192. xiv + 173 pp. + app.

The entire set of final reports for years 1 through 3 is available in NTIS No. PB89-220693.

A reference biological specimen collection and benthic photographs are maintained by Battelle New England Marine Research Laboratory, Duxbury, Massachusetts.

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