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STUDY TITLE: MAFLA OCS Multivariate Analysis of Water Column Data

REPORT TITLE: Multivariate Analysis of the MAFLA Water Column Baseline Data

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BACKGROUND: The Mississippi, Alabama, Florida (MAFLA) environmental baseline studies sponsored by the U.S. Department of the Interior were intended to provide pre-impact data to support decisions regarding oil and gas development on the MAFLA shelf. The field sampling program focused on biotic and abiotic components of the seafloor and water column. To investigate correlations between zooplankton community and water column environmental parameters, a follow up study using objective multivariate statistical techniques was conducted. The use of multivariate analyses allows a reduction of an otherwise cumbersome data set into smaller, easier understood components.

OBJECTIVES: (1) To determine the relationship between zooplankton community structure and environmental structure; and (2) to determine the relationship between environmental pollution (trace metals and hydrocarbons) and zooplankton levels of pollution (trace metals and hydrocarbons).

DESCRIPTION: The analyses were performed on two multivariate data sets: zooplankton community variables and environmental variables. Data were collected from five different lease tract areas on the MAFLA shelf during 1974. The zooplankton community data set contained 33 taxonomic categories expressed as numbers per m^3.

The environmental data set contained physical features of the water column (salinity and temperature) and levels of various water column pollutants (suspended trace metals and dissolved low molecular weight hydrocarbons). The analyses were performed separately on data from two different areas (lease tract areas I, II, III and lease tract areas IV and V). Trace metal data were analyzed using the following techniques: suspended trace metals with multivariate regression, factor analysis, and canonical correlation; zooplankton trace metal analyses with multivariate regression and canonical correlation; and zooplankton trace metal residuals with canonical correlation. Multivariate regression and canonical correlation were used for zooplankton hydrocarbon analyses from both lease tract areas. Zooplankton category association analysis was completed using factor analysis.

SIGNIFICANT CONCLUSIONS: In the MAFLA region, a complex set of interacting variables govern variability in zooplankton populations. Much of the observed variation can be attributed to salinity, temperature, depth, and to a much lesser extent, trace metals and hydrocarbons. Within lease tract areas I, II, and III, variation in trace metal concentration showed no significant correlations with standing crop of zooplankton. Relationships between zooplankton and water column parameters were best suited as indicators of water mass characteristics. Zooplankters were classified as positive, neutral, and negative concentrators in terms of trace metal concentrations. Trace metal levels were higher in lease tract areas IV and V. This was undoubtedly due to the proximity of the Mississippi River. The relationship with zooplankton community structure and trace metal levels in the MAFLA region was not significant. Future studies of this nature should strive for synopticity of sampling efforts for zooplankton and environmental parameters.

STUDY RESULTS: The most important factors influencing zooplankton community structure were salinity, temperature, and water mass origin. Approximately 45% of the zooplankton community variation was correlated with various aspects of the environmental variation. The most important environmental factors related to the structure of the zooplankton community were inshore-offshore considerations and the surface to bottom layering of the water column. Environmental variables related to inshore-offshore factors were station depth, net depth range, and salinity range which were all associated with deeper offshore stations. Surface to bottom layering was expressed by a group of environmental variables including net depth, temperature, temperature range, and salinity range. This was exemplified by the calanoid copepods *Acartia, Centropages*, and *Eucalanus*, and chaetognaths which were negatively correlated with salinity and station depth and positively related to temperature and salinity range. Species assemblages found to be correlated with the environment were regulated by depth factors or changes in salinity and temperature. This indicates that the zooplankton community is being influenced by similar forces controlling the water column environment. Results from canonical correlations indicated a strong relationship between the zooplankton community and the water column environment.

Suspended trace metal variation in lease tract areas I, II, and III did not explain zooplankton community variablity. In lease tract areas IV and V, factor analysis revealed trace metals were more important features of the environment, but this was

expected due to the proximity of the Mississippi River, a source of industrial pollution. Despite this, trace metals were not important in predicting zooplankton community structure. The only appreciable relationships were with lead, cadmium, and iron.

Canonical correlation between suspended trace metals and trace metals concentrated in the zooplankters indicated three types of zooplankter in relation to trace metal concentration: positive concentrators (the larvacean *Oikopleura* and nickel); negative concentrators (the copepod *Centropages* and nickel); and those with no particular relationship. The source of variation in trace metal levels in a zooplankter depends on the type of zooplankter and its physiological mechanisms for handling trace metals.

The variation of hydrocarbon measurements in zooplankton was greatly influenced by the category composition of the population. Canonical correlation total redundancy for lease tract areas I, II, and III was 49.61%, and 49.38% for lease tract areas IV and V, indicating that approximately one half of the hydrocarbon variation in zooplankters was accounted for by the categories of zooplankton encountered.

STUDY PRODUCT: Maturo, F. J., Jr., J. W. Caldwell, W. Ingram, III, and F. L. Hearne. 1975. Multivariate Analysis of the MAFLA Water Column Baseline Data. A final report by the University of Florida Marine Laboratory for the U.S. Department of the Interior, Bureau of Land Management Gulf of Mexico OCS Office, New Orleans, LA. NTIS No. PB80-201692. Contract No. 08550-CT5-27. 110 pp.

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