Introduction to the Eastern Arctic Marine Environmental Studies Program

NATALIE SUTTERLIN[1] and NORMAN SNOW[2,3]

Rationale

The papers that comprise this issue are based on data obtained through the Eastern Arctic Marine Environmental Studies program (EAMES), a comprehensive scientific investigation of a marine arctic ecosystem, initiated in response to proposed oil and gas exploration in the Canadian eastern Arctic. The broad study area encompasses all marine areas adjacent to Baffin Island in the Northwest Territories. For convenience, this area was further subdivided into two sectors. The northern sector, with which all the papers in the present issue are concerned, includes Baffin Bay, Jones Sound and Lancaster Sound. The southern sector includes Davis Strait, the two large fjords of SE Baffin Island (Cumberland Sound and Frobisher Bay), Hudson Strait, Ungava Bay and the northern Labrador Sea.

In recognizing the fact that a detailed environmental assessment of the area was required by government regulatory agencies prior to any oil and gas exploration, it became immediately apparent that there were profound gaps in our knowledge of the structure and function of arctic marine ecosystems. Extrapolation and/or inference from other studies would not suffice. Clearly, there was a need for a large-scale biophysical program in the eastern Arctic, which became manifest in EAMES.

Background and Evolution

Prior to 1977, the Canadian government considered oil and gas exploration on a site-specific (i.e. well-by-well) basis with respect to environmental concerns. However, in the late 1970s the pace of northern non-renewable resource development quickened, and the prospect of activity in relatively large and hitherto unexplored offshore areas became a reality. It became necessary to expand the scope of environmental consideration to include the possibility of environmental impact occurring in areas remote from any given well location. Thus the site-specific approach to environmental assessment was replaced by the concept of "regional environmental clearance", necessitating large, integrated studies of whole ecosystems that would enable the assessment of potential impacts over large areas.

The financial responsibility for the EAMES studies rested with the oil and gas industry. The Canadian government maintained its involvement in the project by providing financing and manpower for management purposes. Program management was accomplished by two primary committees: (1) a management committee comprised of representatives of both the federal government and the oil industry, and (2) an advisory board composed primarily of Inuit representatives from all communities in the Baffin District, with advisors from the academic sector.

Objectives and Approach

The primary objective of the EAMES program was to collect, collate and interpret environmental data in order to prepare Environmental Impact Statements to be submitted to the Federal Environmental Assessment and Review Process. A secondary objective was to provide data to be used in the development of oil spill contingency plans. Within this context, two basic approaches emerge regarding the acquisition of environmental data: (1) survey techniques and (2) process-oriented studies. The data collected by survey techniques form the building blocks of our understanding which augment (or in some cases constitute) the fundamental knowledge base. Process-oriented studies provide the means of interpreting empirical observations and thereby constitute the connecting thread which links knowledge blocks. The two approaches yield different kinds of information, although neither achieves maximum usefulness in the absence of the other.

In view of the large geographical area to be covered and the two-year time frame, the survey approach, of necessity, was predominant. Non-survey studies were carried out where it was felt that specific information was required (for example, studies of trophic interrelationships of biota at ice edges), but these were in the minority. Most of the studies carried out were either comprehensive ship-borne operations or aerial surveys. Work was also undertaken from shore-based camps. Extensive use was made of remote sensing, by radar and satellites.

Physical Studies

The physical studies were comprised of three principal disciplines: oceanography, meteorology and geomorphology.

The oceanographic studies used moored current meters, CTD profiling and satellite-tracked drifter buoys to determine the regional current field and to document its varia-

[1]Guest Editor for this issue; Petro-Canada, Bally Rou Place, P.O. Box 5190, St. John's, Newfoundland, Canada A1C 6H2
[2]Program Manager, Eastern Arctic Marine Environmental Studies
[3]Petro-Canada, Canada Place, Room 902, 407 - 2 Street S.W., Calgary, Alberta, Canada T2P 3Y3

tions; to establish the natural ranges of measurements; and to describe specific features such as eddies and tidal currents, both inshore and offshore.

Iceberg studies were carried out by a combination of techniques: land-based radar tracking, aerial reconnaissance and remote sensing by satellite. In this way the efficiencies of the three methods could be compared. From the data collected it was possible to estimate rates of incursion and to determine overall frequency of iceberg occurrence and movements on a seasonal basis.

Meteorological data were gathered from land- and ship-based stations. Data were obtained for wind, barometric pressure, visibility, air/sea temperatures and wave height. These were integrated with the output from the other physical studies to provide a comprehensive understanding of the factors affecting the safety and efficiency of drilling operations, as well as to assist in the development of oil spill trajectory prediction models and contingency planning in general.

The geomorphological studies provided classification of the shorelines with respect to beach type and coastal processes. The frequency of occurrence of the various shoreline types was also documented. These data were integrated with biological data to provide sensitivity maps for the entire region. These studies have enabled development of a computerized mapping system which should have a significant effect on future real-time analysis of such a wide variety of data.

Biological Studies

The biological studies were primarily large-scale surveys, although there were several smaller-scale studies of specific features such as ice edges. The larger-scale studies were designed to document the distribution and abundance of organisms in all trophic levels: microbiota, phytoplankton, zooplankton, benthos, fish, birds and mammals (including polar bears). For the latter group (birds and mammals), migration and timing of movements were also significant elements of the studies. In keeping with the overall objective of the program, these studies were integrated with the physical oceanographic data in order to interpret the results as comprehensively as possible. This was particularly significant with respect to the distribution and movements of birds and mammals which are tied closely to ice habitats.

The program has produced completely new findings. The role of bacterial heterotrophic processes in the utilization and consolidation of a proportion of the primary productivity has been investigated, and correlations between primary production, heterotrophic activity and particulate and organic carbon have been established. It has also been possible to identify a larger number of zoobenthic faunal assemblages with respect to depth and geographic area than had hitherto been reported, and to describe more precisely such associations. The significance of ice edges has been elucidated to a greater extent than was formerly possible, particularly with respect to the trophic interrelationships in such habitats. It has also been possible to compare under-ice communities at ice edges with similar communities under pack ice. The widespread distribution and density of dovekies in pan ice during May were also documented for the first time, and the first tangible evidence of an offshore breeding population of ringed seals has been obtained.

This Publication

One result of EAMES has been one of the largest compilations of new environmental data on a remote northern environment. Given the fact that the original reports were far too voluminous for distribution, the question arose as to an appropriate mechanism through which the information could be made widely accessible to the scientific community. The decision was made to ask each of the scientists who contributed to the EAMES program to write up the essence of his or her study(s) as a scientific manuscript and subject it to the peer review system. The papers favourably evaluated would be published together in a single number of *Arctic*. Thereby, the quality, accuracy and accessibility of the information would be assured. This edition of *Arctic* contains that series of papers. The idea to publish this special issue orginated within Petro-Canada. The company has contributed significantly through its involvement in and support for the project from its inception to its completion.

The subject matter herein ranges from geology through oceanography to biology at all trophic levels. Interrelationships of biota at various trophic levels in eastern arctic habitats are elucidated. The effects of season (especially as reflected in ice regimes) on life cycles are discussed. The content of this issue is a reflection of the integrated, multi-disciplinary approach of the EAMES program and will permit the reader to see the ecosystem of the Baffin Bay/Lancaster Sound area as a whole, as well as the sum of its component parts.

Further, this publication is proof that baseline data collected meticulously and interpreted expertly as part of environmental impact assessments can indeed withstand the rigorous peer review system demanded by the primary publication system. It is also, perhaps, a caution against the generalization that environmental impact studies are somehow superficial and less rigorous than other scientific pursuits.

The overall contribution of the EAMES program has been to increase significantly our knowledge of the structure and function of arctic marine ecosystems and, within the time constraints of the program, to assess variability. It has broadened the data base not only qualitatively, but also quantitatively. These results represent a noteworthy advance in our understanding of an area for which previous information was either entirely lacking or sparse.