A PROPOSAL FOR
COORDINATION FOR LAND-MARGIN ECOSYSTEMS RESEARCH (LMER)

Abstract

The LMER Program addresses the need for research on land-margin ecosystems, those at the interface of continental land masses and coastal oceans. These ecosystems are being affected by direct and indirect results of human population growth, land use changes, and global climate change. Basic research is needed to achieve scientific understanding of the causes of major ecological and environmental changes of the land-margin environments and of how the populations, communities, and ecosystems respond to these changes. The LMER Program is made up of interdisciplinary research projects that emphasize experimental studies, various types of models, and a comparative approach.

To achieve the goals of the program, the various LMER projects have received meeting funds from NSF and have met regularly to devise an common approach. The LMER projects continue to develop detailed information on the biota and processes at each site. But an additional synthetic approach is absolutely necessary so that results will be applicable to coastal regions in general and not just to individual sites. At least some of the general goals of the projects should fit with those of the U.S. Global Change Program. The scientists at the various sites will also learn by comparative studies of processes common to many sites. They will continue to cooperate on modeling activities and in development of techniques used by many sites. In order to enhance the information collected at each site, it is necessary for the LMER projects to attract cooperating scientists; this is being carried out through joint efforts of all the LMER sites in making presentations at national and international scientific meetings. The LMER Program now needs the additional step of a coordination office which would aid in communication and the continued development of LMER coordination.

This proposal requests funds for the activities of an LMER Coordinating Committee made up of one investigator from each site plus Drs. C.Delia and J.Hobbie, scientists associated with the development of LMER. Hobbie would act as the committee chair. A small coordination office would be set up at the Marine Biological Laboratory, Woods Hole, to aid in communication and organization of meetings. There will be two meetings per year of the LMER Coordinating Committee and one meeting of most of the LMER scientists.
Introduction to the LMER Program

The coastal areas of the nation and of the world are the sites of the most intense human activity and population growth. For the U.S., some 75% of the population now lives within 50 miles of the ocean or Great Lakes coastline. More people means mounting pressure on natural resources and more disturbance to coastal regions. When these land use and population changes interact with expected global climate changes, the ecosystems at the margin of the land will face still increasing stresses. Among the many changes are: loss of habitat including coastal wetlands, decreasing (changing?) amounts of freshwater and sediments entering coastal zones, invasions of exotic species, increasing rate of sea level rise, increased pollution by agricultural and industrial chemicals, and increased nutrients in near-shore environments. The list is explained in Appendix I.

Research on the effects of disturbance in the coastal regions has usually focussed on one or a few factors, for example, the effect of organic loading on oxygen conditions. Here, a modest amount of research on the causes of oxygen depletion has led to improved wastewater treatment and to curtailed losses of fisheries and recreational resources in many cases. Coastal environments, however, are affected by multiple factors for change including the changing inputs from land, sea level rise, and nutrients. For many questions, studies of changes on land that are the actual causes of coastal ecosystem effects are necessary. To understand the effects of these multiple factors on the land-margin ecosystems and to determine effective management and restoration strategies requires increasingly sophisticated scientific understanding of complex interrelationships. Both understanding and management require research not only on estuaries and other aquatic habitats but also on the coastal watersheds that are inextricably linked to the water.

Questions about how best to address the research needs at the land-margin interface led to three NSF-sponsored workshops in 1987 (an ASLO Workshop at the MBL on Research Needs at the Land-Sea Interface, a University of Washington Workshop on Nearshore benthic ecology, and a SUNY Stony Brook Workshop on sediment dynamics in estuaries. Results are reported in a document titled "At the Land-Sea Interface: a call for basic research." (produced by Joint Oceanographic Institutions, Washington, D.C., and endorsed by ASLO, ERF, and the Southern Association of Marine Laboratories).

The report points out that many of the changes caused by humans and by other aspects of global change have long been studied in coastal regions but studies have been conducted in isolation from one another. Much of the reason the necessary information has been lacking is that these are technically difficult questions that require multidisciplinary, comprehensive, coordinated research. Research projects of the future must focus on interactions of external forces and responses with special emphasis on the connections between land and water. Given the large amount of observational data on coastal regions, research in the future should add the multidisciplinary, comparative, and large-scale approaches. Accordingly, four important elements of research were identified:
- interdisciplinary teams
- comparative approaches to test the commonality of processes
- experimental studies across space and time scales
- development of large-scale conceptual, analytical, or numerical models

The Ecosystems Studies section of NSF Division of Biotic Systems and Resources and the Biological Oceanography Program of the NSF Division of Ocean Sciences issued a call for proposals in 1988 and 1989 under the Land-Margin Ecosystems Research (LMER) initiative. The competitions resulted in the establishment of LMER sites at Chesapeake Bay, Columbia River, Waquoit Bay, and Tomales Bay (Figure 1). As described in Appendix I, the "four current sites are widely distributed geographically and represent different types of land-margin environments. Chesapeake Bay is a large Mid-Atlantic estuary, with a very large, complex watershed in a temperate, relatively moist climate. The Columbia River is an estuary with large freshwater inflow, short residence time for water, and a relatively dry watershed. Tomales Bay is a medium-sized drowned rift valley in coastal northern California, adjacent to a small watershed mostly covered by grasslands. Waquoit Bay is a small shallow bay fed by several forested and urbanized subwatersheds in New England." (from a manuscript submitted to EOS by the LMER Coordinating Committee -- this document is Appendix I).

The four LMER projects are all off to good starts; they are actively gathering data and include many excellent scientists (Table 1). In addition to the scientific research being carried out, the LMER projects offer the opportunity for research training for students at several levels. In the Spring and Summer of 1992, there were 38 students involved in the LMER projects. Of these, 5 were postdoctoral fellows, 13 were graduate students, 7 were undergraduate REU students, and 13 were undergraduates funded through other sources.

**LMER Goals.** The 1991 Announcement of Opportunities for Land-Margin Ecosystems Research (LMER): Studies at the Land-sea Interface, National Science Foundation, includes the following: "The goal of LMER is to increase the understanding of: 1) the organization and function of land-margin ecosystems; 2) the linkages between these systems and adjacent terrestrial and marine systems, and (3) the impacts of major natural environmental perturbations in these regions.

The research proposed should emphasize major ecological questions that stress linkages between terrestrial and coastal ecosystems. The work should seek to understand the causes of major ecological and environmental changes that influence land-marine environments, and how the populations, communities and ecosystems respond to these changes."
The Need for Coordination

There are presently four LMER projects; as a result of the 1992 competition there will be one new LMER project. At present, the four projects coordinate through a P.I. coordinating committee and an annual scientific meeting. To expand the scope of the coordination and to enhance modeling and comparative research, an increased level of coordination is needed for these five projects. It is proposed here that the LMER program of NSF fund for two years the meetings of a coordinating committee and of the LMER scientists, a coordination office at the Marine Biological Laboratory, Woods Hole, and the activities of a committee chair.

Each LMER project is independently designed with its own scientific theme and geographic orientation. Why then is there a need for coordination? In this context, it must be recognized that there exists a great deal of commonality among the present projects; they are not wildly divergent projects, they would be improved by working closely together. Steve Smith of the Tomales Bay LMER project summarizes the commonalities of themes (abstract for the Plymouth meeting in September 1992) as follows: "Three of the projects (Chesapeake, Tomales, Waquoit) deal extensively with aspects of nutrient delivery, cycling, and export; three (Chesapeake, Tomales, Columbia) are also concerned with trapping and processing of particulate material. All are concerned with aspects of hydrology as well as internal water circulation and exchange with the coastal ocean; all are concerned with aspects of human population density, land and water use, and changes in these features of the landscape. Modeling major processes of inputs, outputs, and internal cycling is a common theme, although approached quite differently in each system."

First, there is a need for the projects to work together to solve common problems of methods and sampling. An excellent start has already been made on this by the LMER projects. For example, at the November 1991 meeting of LMER scientists it was decided that denitrification was one process sorely in need of a standard method agreed upon by the entire research community. Accordingly, a series of steps were decided upon leading to a proposal to be submitted for a workshop. In the meantime, a letter of support was prepared for a small methods-development project to be carried out at the University of Maryland (see Appendix II for a report of the 1991 meeting).

Second, there is a need for the projects to compare their results in order to improve the overall understanding of the ecology of organisms and of processes and their controls. Comparisons will extend the range of measurement of the various processes and their controls, allow general patterns to emerge, and allow tests of general patterns of organism response. To carry out this comparative ecology, the projects may decide upon several parallel measurements using exactly the same techniques. They may decide to have similar data management schemes to allow easier comparisons of results. They may decide upon modeling activities to develop and utilize a general estuarine model.
Third, the LMER program is a part of NSF’s global change initiative. The LMER projects must coordinate in articulating their contribution to the common goal of understanding and predicting the effect of global change on the coastal zone. Detailed common goals, such as "The coastal zone's response to changes in population, land use, sea level, and climate" should be developed to focus efforts.

Fourth, the LMER Program needs more extensive presentation to the research community. Widespread knowledge about the LMER Program is vital to attract non-LMER scientists for cooperative work at the individual LMER projects and sites and for comparative work among sites. The LMER P.I.’s need to continue their coordinated efforts to present and explain the LMER program to fellow scientists and to entrain their enthusiasm. Symposia and presentations at national and international meetings should be organized along the lines of the process already begun by the present LMER P.I.’s. For example, a description of the projects has been submitted for publication in EOS (Appendix I) and an LMER-oriented symposium was held at the November 1991 meeting of the Estuarine Research Federation. Also, an overall view of LMER plus detailed descriptions of several LMER projects will be presented at the September 1992 Meetings in Plymouth, England, on Estuarine Comparisons.

Fifth, coordination is needed between LMER projects and other large estuarine projects. For example, there are large projects in Louisiana and San Francisco Bay. An even larger program is the EPA’s Environmental Monitoring Program (EMAP). Some of the LMER sites and scientists could well participate in EMAP's search for suitable measurements of the status or health of coastal ecosystems. Coordination and cooperation on common problems and on system comparisons will only happen through planning. It is also important that LMER scientists participate in the planning of international programs. For example, the planning for LOICZ, a coastal program, has now begun under the leadership of Professor Patrick Holligan, at the Plymouth Marine Biological Laboratory. Various scientists of the LMER program have already offered their help in this planning and have sent Professor Holligan appropriate LMTER information.

Committee Structure

A formal coordinating committee would be set up with one representative from each of the LMER projects plus several experienced scientists from outside LMER. The tasks of the committee are:

1. To help coordinate inter-LMER project activities such as technique agreements, communication, workshops, meetings of scientists, and data sharing;

2. To foster activities at a program level to give definition and visibility to LMER at a national level such as presentations and discussions at agencies and at national meetings;
3. To provide a focal point and collective representation of the LMER sites in their external relationships with other agencies and international programs.

In addition to one representative from each LMER, two scientists long associated with the development of the LMER program have agreed to be on the committee, John Hobbie (as chair) and Chris D’Elia. Several other experienced scientists may be added as rotators on the committee to broaden representation (gender, ethnic, geography, and other large coastal projects (land-based or estuarine based)). All decisions would be made by the entire coordinating committee.

Support from NSF is requested for travel and workshop costs (two coordinating committee meetings per year, partial support for one all-LMER meeting per year), executive assistant partial support, and one month salary for a chairman. This would not be an operation at the scale of the JGOFS management office or of the LTER Coordinating Office but the office would be expected to grow as experience and duties expand.

Functions

There are two main functions of this committee and its chair: LMER project activities and LMER Program matters. The major activities envisaged at the present time include the following.

Activities with LMER projects.

1. Organize LMER meetings. Each year there will be two meetings of the LMER coordinating committee and one meeting of all the LMER scientists. The actual arrangements for the coordinating committee meetings will be made by the LMER Coordinating Office while the arrangements for the LMER Scientist meeting will be made by the host site. The agenda for both types of meetings will be organized by the Coordinating Committee.

2. Improve communications among LMER projects including a newsletter, e-mail, a directory of LMER scientists (specialities, phone, FAX)

3. Develop the comparative approach among LMER projects including appropriate procedures for data sharing and archiving, ideas for synthesis and common measurements, and models of various coastal processes

4. Identify and try to solve problems common to all LMER projects such as organization, methods, and approaches. At one level, the problems might be the need for better denitrification methods or how to foster the use of stable isotopes. At a higher level, the problems might include how to strengthen the land-sea linkages and how to attract other projects to LMER sites.
5. Work with NSF to develop ideas and sources for supplemental funding for equipment (especially items for common use such as GPS), workshops, synthesis.

Activities for the LMER Program

1. Develop scientific community knowledge about the LMER Program and about opportunities for cooperative research. This will be done through presentations at national scientific meetings.

2. Coordinate LMER activities with existing federal programs including LTER, NOAA Coastal Studies, the National Estuarine Program, the Marine Sanctuaries Program, the Estuarine Research Reserve Program, CoOP, EMAP and with other entities such as the Sustainable Biosphere Initiative of the Ecological Society of America.

3. Develop ties to international efforts, both existing and planned. This includes coastal elements of JGOFS as well as LOICZ and workshops planned by SCOPE.
Explanation for Budget Year I

This budget contains 1 month of salary for Hobbie and 6 months of salary for an executive assistant. The duties of this assistant are to organize the meetings of the LMER Coordinating Committee (transportation, lodging), produce reports of the meetings, organize files and phone calls, set up an LMER directory of scientists, serve as a focal point for coordination and information for LMER projects, type and organize letters and agendas, arrange trips to agencies, be the interface between the LTER office and LMER activities (joint meetings, e-mail service), assemble information for a newsletter. A small amount of secretarial-clerical help is also budgeted for help with Xeroxing, printing, etc. In addition, direct Xerox and telephone charges plus depreciation and other direct costs are charged as a proportion of the total cost of running the Ecosystems Center.

The LMER Coordinating Committee is made up of one representative from the four present LMERs, one from the new LMER, one outside scientists to be added, and Hobbie and D'Elia (total 8).

In this budget there are three meetings scheduled as follows:

1. An August 1992 coordinating committee joint meeting with the LTER Coordinating Committee in Fairbanks, Alaska. Six trips to Fairbanks @$700 and one trip to Fairbanks @$350 from Seattle, Hotel @$200, meals @$150. The trip to the Toolik Lake field site will cost an extra @$700 (bus, plane, room, board). The total is $11,900 for seven people (Hobbie comes free through LTER).

2. A spring 1993 coordinating committee meeting in Washington, D.C. Six trips to D.C. two @$500, four @$600, eight hotel rooms for two nights @$110, meals for two days @$35. The total for eight people is $5720.

3. Partial support for a Fall 1992 scientist meeting at the Waquoit site (Woods Hole, MA). Total cost of $30,000 pays for 6-7 persons from each of four sites (this includes the new site but Waquoit personnel are mostly free) and 6-8 additional people representing other estuarine research sites (LTER, San Francisco Bay, etc.). Costs of sending additional scientists this meeting will be met by the individual projects. Transportation for 36 persons @$700, housing and meals for 40 (including Waquoit personnel) for 2 days @$81. The total is $31,680.

The budget includes two additional trips to Washington, D.C. for Hobbie and D'Elia to confer and for consultations with NSF (@$600) and one trip for an LMER representative to take part in the Estuarine Comparisons meeting in Plymouth ($600). In addition, funds are requested for a microcomputer ($1500) and costs for producing and mailing a small newsletter ($1500).
Explanation for Budget Year II.

The personnel duties and months are the same as in Year I with an added 5% pay raise.

Funds are requested for two meetings of the Coordinating Committee (a rise in airfares is built in to the cost) and one meeting of all LMER scientists in Fall 1993.

Funds are requested for an additional microcomputer for travel use and for the costs of producing and mailing a small newsletter as in Year I.
Figure 1. Location and outline maps of the four LMER sites. The dotted lines indicate the watersheds.