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A Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras, Final Report, Volume IV - Management

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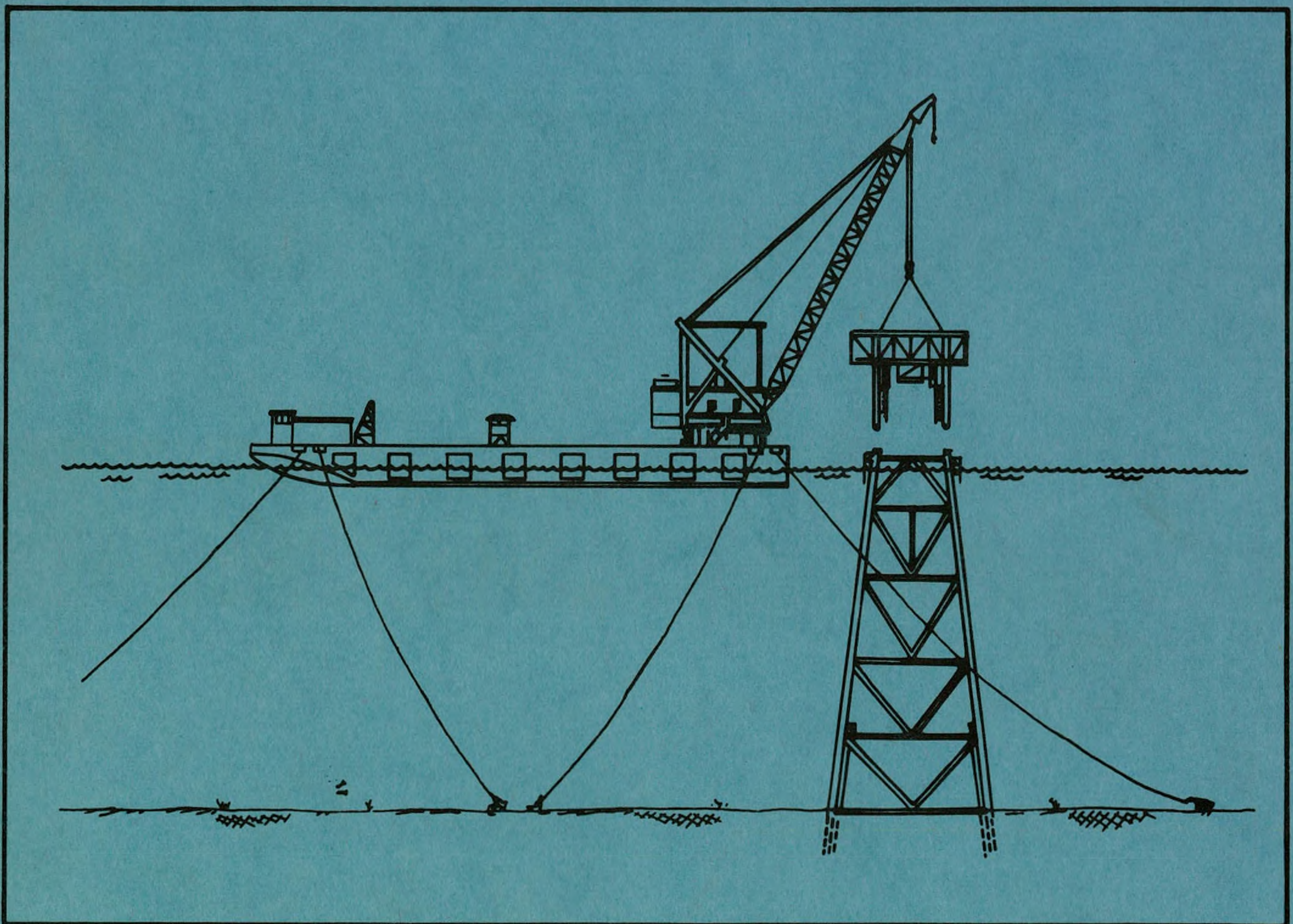
Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras

FINAL REPORT

Volume IV – Management



prepared by
Institute for Conservation Archaeology
Peabody Museum
Harvard University

for the Bureau of Land Management under contract number AA 551-CT8-18

A SUMMARY AND ANALYSIS OF CULTURAL RESOURCE INFORMATION ON THE CONTINENTAL SHELF FROM THE BAY OF FUNDY TO CAPE HATTERAS

FINAL REPORT

Volume IV - Management

This study was funded by the New York Outer Continental Shelf Office of the Bureau of Land Management, Department of the Interior, under contract number AA 551-CT8-18.

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1979

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Great archaeological discoveries on land are frequently made by accident...But to wait upon the ocean to disgorge her secrets is - to wait upon eternity. Let not the archaeologist, then, professional or otherwise, look with too unfriendly an eye upon a quest which has yet to grope among methods, and hazard many a folly and many a piece of empiricism ere it discover the instruments peculiarly applicable to its needs.

Lewis Spence
1926

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PREFACE

This is the fourth in a series of four volumes entitled "Summary and Analysis of Cultural Resource Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras" which were prepared for the Bureau of Land Management (BLM) by the Institute for Conservation Archaeology (ICA) of the Peabody Museum at Harvard University. These four volumes, their accompanying chart sets, a computer-compatible tape documenting the accumulated inventories, and a set of large scale (1:125,000) maps showing the inventory and the results of our analysis constitute the final report for the project, performed under contract #AA551-CT8-18 for the BLM. The purpose of this project is to provide the BLM with information about the existence of known or expected prehistoric sites and historically important sunken ships, as well as appropriate methods for locating the same, and planning recommendations for both offshore and onshore land use.

One of the principal challenges of this project is to develop management recommendations that can be implemented with maximum consideration for cultural resources and minimum impact to well-thought-out and useful development.

Archaeologists and historians generally agree that given the length of time the Continental Shelf (CS) was above sea level (about 15,000 years) and the intensity of European and other shipping along the northeastern coast of the US in the period after the CS was inundated, there is probably no area on the Shelf that does not have the possibility for containing remains of either prehistoric peoples or sunken shipping. All other things being equal, this would mean that whenever federal funds were involved in land-modifying projects anywhere on the CS, federal antiquities legislation would apply to these activities (see 36 CFR 800 for a summary of the necessary procedures). On the other hand, the cost of looking for and recovering data from any possible properties which might be impacted could in many cases exceed the cost of exploring for the resources that are considered necessary for the economic well-being of the nation. It is at this point that decisions about early planning with respect to possible cultural resources on the CS will assist land users not only to meet their legal responsibilities in terms of historic preservation but to use cost-effectively different levels of survey intensity to locate those sites or wrecks which may be endangered by land use.

It is important to stipulate here that, using the data presently available, nobody in the historic preservation community could, in good conscience, ever entirely eliminate any area from consideration for further work. This study attempts to give guidance to potential land users and those having jurisdiction over the use of lands on or abutting the CS from the Bay of Fundy to Cape Hatteras.

Volume IV, Management, integrates the results of the previous three volumes with additional studies aimed at assessing field strategies and approaches to resource management. The integration of the various Historic Shipping zones with the zones of Preserved Archaeology, coupled with recommended locational and management strategies is the end product of the entire project. The key to the accuracy of our models for resource location and preservation, and thus to the management recommendations, is the accuracy and completeness of the data used to generate these models. As described in the various volumes, these data are in many cases sparse, lacking, misleading, and otherwise unreliable. This does not reflect on the reliability of our predictions as much as it calls for the testing of these models through pilot studies. Without this testing, our recommendations might well generate work where none is actually warranted or might indicate survey at a certain intensity. At all times where we have been uncertain, we have erred on the side of caution whereas another level of effort may be more appropriate. We are confident that our models for resource existence and possible preservation are as accurate as possible, given the existing data. The survey and management strategies recommended in this volume are, then, based on our feeling that while some of the details may change, the overall structure is sound and as accurate as possible.

While the Program Manager of this study is the principal author of this volume, it could not have been developed and produced without the material and theoretical assistance of much of the research team and the production staff of the ICA and the Peabody Museum. We would like to recognize the contributions of the following people in the development of the content of this volume: Mr. Warren Riess in underwater technology and conservation technology; Drs. Bruce Bourque and Edwin Churchill and Ms. Evilyn Garnett for historic shipping; Mr. Randall Moir for physical environment of the Shelf; Dr. Russel Barber, Mr. John Rempilakis, Mr. Mitchell Mulholland for prehistoric archaeology. Last, we would like to acknowledge all the consultants that contributed to all sections of this study. These consultants are individually identified in the references of the appropriate volumes of this final report.

Acknowledgements for production on this volume and the 1:125,000 map set goes to a team of dedicated and qualified individuals from the ICA and the Peabody Museum, specifically Janet Johnson, Editorial Assistant; Georges McHargue, Manuscript Editor; Mary Beth Zickefoose, Staff Assistant; Irene Ferriabough and Joyce Christos, typists; Lynne Perrotte, Gretchen Neve and Dorcas Brown, ICA artists; Whitney Powell and her assistant artists at the Peabody Museum, Elizabeth Wahle, Mary Jane Westland, Laura Serafin and finally to Ann Wendell, ICA Business Manager. Thanks goes to Mitchell Mulholland's fine team from the University of Massachusetts at Amherst, namely Elana Filios, Pam Bumsted, Elise Brenner, Aida Choulakian, Susan Mulholland, Rita Reinke, and Cass Mason. Thanks also goes to John Neff, Arthur Spiess, and John Cavallo for their input. The principal author takes full responsibility for the integration of these data.

MANAGEMENT SUMMARY OF RECOMMENDATIONS

Preparing a summary and analysis of cultural resource information involves more than the simple collation of known inventory data with various theoretical predictive models of site distribution. The severity and nature of known and expected impacts upon cultural resources must be considered. Impacts may be natural or man-made, direct or indirect. Finally, it is essential to identify and evaluate possible techniques for mitigating these impacts.

Volumes I, II, and III of this study deal with the inventory, analysis, and predictive modeling of cultural resources on the CS. This volume relates the results of the work previously described in Volumes I, II, and III with potential impacts and identifies possible mitigating measures. The recommendations are cost-effective approaches to cultural resource management in various zones, and thus vary in their degree of specificity. It must be emphasized at the outset that these recommendations necessarily reflect the nature of the data base which, in the present state of knowledge, is quite often deficient both in quantity and quality. Thus, in our recommendations for management strategies, we have felt it was desirable to take the cautious view, because there is too large an uncertainty factor in our predictions for us to be confident that by using less cautious approaches we will not run the risk of destroying valuable cultural resources through our own ignorance. It is imperative that ongoing research be continued and new research (including recommended pilot studies) be initiated, so that we may improve our data base and make possible the more accurate delineation of areas where intensive preliminary survey is required.

Recommendations based on the results of the first three volumes, appear in two places in this report: section 6.0 Management Strategies, and section 7.0 Recommendations. Under Management Strategies are discussed specific approaches to cultural resource management that we believe will serve to minimize the impact upon resources of the many types of activities taking place within the study area, as identified in section 5.0. The recommendations include initiating locational surveys, developing public education programs, identifying impacts to resources in environmental impact assessments, advising federal agencies on the types of expected impacts to archaeological properties, evaluating the effects of chemical dumping, and specifying the general levels of survey that will be required in the various stages of oil and gas development. The Recommendations section deals with both general and fairly large-scale specific recommendations and also proposes some pilot studies.

Some of the large-scale specific recommendations take the form of procedure changes, alterations to present methods of cultural resource

evaluation, and recommended conservation strategies for various materials. Our recommendations for precedural changes comprise responses to the recently published Proposed Regulation 36 CFR 251 "Geophysical and Geological Explorations of the Outer Continental Shelf."

Our evaluation of present methods of cultural resource location and testing led us to the conclusion that the latter were inadequate. We therefore proceeded to review the state of the art in the methods and theory of archaeological survey and testing. On the basis of that review, recommendations were made to replace archaeologists with the project geophysicists for analysis during preliminary or reconnaissance-level surveys.

We also proposed the development of a network of regional conservation centers in order to improve the quality and efficiency of conservation as it applies to materials recovered from the CS. Finally, we integrated all the available information on the size, type, and distribution of prehistoric and historic resources in the study area. By means of this integration, we divided the area into various cultural resource zones and classified them as to the intensity of locational survey recommended for each.

In order to acquire new data which will assist in the answering of important technical questions, we have recommended several pilot studies. Although many more could be developed, we feel these are the ones that will most rapidly and cost-effectively meet the needs of resource managers.

The first is a study of a previously designed natural gas pipeline which was not built. Impact upon cultural properties along the proposed pipeline route and the level and intensity of survey that would have been required to locate previously unknown resources would be evaluated. The result would be an analysis of the cost of cultural resource studies for a typical pipeline project.

The second is a pilot study using on-going OCS activities as the base for assessing the costs of archaeology performed in conjunction with offshore construction and acting as a preliminary test of our predictive models. This study would see archaeologists becoming immediately involved in monitoring current offshore survey and construction activities, so that they would be in a position to identify any cultural materials that might be discovered in the course of pre- and post-construction activities.

The last pilot study is, we feel, of potentially the greatest long-term value. It takes the form of a series of offshore field tests designed to validate our predictive models concerning resource location, density, and distribution. Its principal asset is that, by improving our data base, it should make it possible for us to delineate more closely, thus perhaps paring down, the portions of the study area over which intensive

survey is recommended.

This entire project, including the recommendations sections, has been integrated into a planning model developed by Interagency Archaeological Services, and identifies priorities for action on the basis of a realistic consideration of the needs of managers of resources of all types. The majority of the priorities so developed deal with the scientific and management aspects of cultural resources.

At the same time, the new data must be interpreted to the public for purposes of education, and enjoyment. It is relevant to recall that providing "a sense of orientation to the American people" (preamble to the National Historic Preservation Act), to obtaining data that will "support diversity and variety of individual choice" (preamble to the National Environmental Policy Act), and contributing to the "overall welfare of man" (preamble to the National Environmental Policy Act) are the ultimate goals of cultural resource conservation.

Within the framework of this study, then, the conservation or wise use of cultural resources can go hand in hand with the development of other much-needed resources of the Continental Shelf. With this in mind, we may say that all resources of the Shelf have value to one or more segments of the population of the nation and their proper exploitation should be accomplished in an atmosphere of well-reasoned consideration for them all.

1.0 INTRODUCTION

1.1 General

The three previous volumes (Physical Environment, Archaeology and Paleontology, and Historic Shipping) have established criteria for the locations and potential contents of the Continental Shelf (CS) with regard to cultural resources. This volume is designed to use these data to develop management recommendations for these resources in a manner that will be consistent with both the growth needs of the nation and the letter and spirit of existing historic preservation legislation.

1.2 Background

This four-volume study and the accompanying 1:125,000 scale map set and computerized inventory are one element in the BLM's program for addressing the planning needs of cultural resources. In recognizing this need, the agency is responding to several bodies of historic preservation law and regulations, Coastal Zone Management Acts (state and federal), and state and regional resource management plans. Most notable among these are the Antiquities Act of 1906 (PL 59-206); the National Historic Preservation Act of 1966 (PL 89-665), Executive Order 11593; the Archaeological and Historic Preservation Act of 1974 (PL 93-291); the National Environmental Policy Act of 1969 (PL 91-190); the Coastal Zone Management Act of 1972 (PL 92-583); the Federal Land Policy and Management Act of 1976 (PL 94-579); OMB Circular A-95, published draft on final regulations 36 CFR 60, 36 CFR 63, 36 CFR 64, 36 CFR 66, 36 CFR 800, 33 CFR II 305 (Corps of Engineers); the Submerged Lands Act of 1953; and the Outer Continental Shelf Lands Act of 1953.

These regulations, however, deal only with "significant" resources. Thus it is important for us to address the concept of significance in this section of the study. We will deal in detail with the significance of the CS in a later section.

1.3 Study Objectives

The aim of this project is to identify the areas of the Shelf and coastal zone that can be expected to contain significant cultural resources,

either prehistoric or historic, which may be impacted by natural or human modification of the land or underwater surface. A major component of this study has been the evaluation of locational and data-recovery technology with a view toward making recommendations for the cost-effective location and assessment of cultural resources on the CS. An analysis of tidal-zone sites as well as those within 0.5 miles of the coast is designed to assist planners of coastal facilities to avoid, if possible, impacts to important cultural properties that may be threatened by such activities. The ultimate purpose of the study is to provide the BLM and all other potential users of the Continental Shelf and Coastal Zone with recommendations for the consideration of cultural resources. With this information in hand, resource managers can make cost-effective mitigation plans for possible impacts to cultural resources.

By integrating the material contained in the preceding three volumes with this volume it is possible to identify areas where resources are expected to be encountered, to recommend methods for location of, avoidance of, or data recovery from cultural resources, and to recommend testing programs for validating the models of probable resource density developed in the course of this project.

1.4 Significance Framework

The non-specialist wonders why the specialist is concerned about the welfare of certain resources. Perhaps the public is ill-informed about cultural resources because the specialist spends too much time in "crisis management" as opposed to resource management. Few people know the hows and whys of historic preservation, especially archaeological preservation. The public is, however, realizing on its own the importance of the past. The lines waiting to enter the exhibits of artifacts from the tomb of Tut-ankh-Amen, the city of Pompeii, etc. are strong testimony to popular interest in archaeology, and the public, through its agents in Congress, has indicated its concern for the past and its desire for project planning. These concerns are articulated in the preambles of certain guiding pieces of legislation.

The federal regulations which govern cultural resources are concerned with "significant" resources. "Significant" resources may be eligible for inclusion in the National Register of Historic Places. Once eligible, they come under the protection of the Federal Antiquities Act. A clearly stated discussion of the significance of the site must be a part of the documentation submitted by the federal agency when seeking a determination of eligibility. Thus the concept of significance in historic preservation is one of great importance and at the same time one that brings great consternation not only to resource managers but to the historic preservation community itself. The consternation arises

from the problem of defining significance.

SIGNIFICANCE (Random House Dictionary of the English Language)

1. importance, consequence: The historical significance of an international blunder.

2. meaning, import: The familiar place had a new significance for her.

3. the quality of being significant or having a meaning: To give significance of the dullest of chores.

SIGNIFICANCE (Oxford English Dictionary)

1. The meaning or import of something: What the several significances of each must or may be according to the philosophic conception. (Coleridge).

These definitions imply that the concept of significance is purely philosophical in nature and thus becomes a personal issue not easily subject to objective evaluation.

From outside the archaeological profession the archaeologist must look somewhat like the King in Carroll's Alice in Wonderland.

> "Unimportant, of course, I meant," the King hastily said, and went on to himself in an undertone, "important --unimportant --unimportant--important--" as if he were trying which word sounded best.

It is even true that some archaeologists see the views of other archaeologists in the same way. As an example, for one archaeologists the chronology of a site may be the significant feature, while for another it may be the distribution within it of chipped stone tools. Resource managers cannot have the luxury of such subjectivity. Resources must be managed for the benefit of the people of the nation and not merely to meet the needs of a limited number of specialists who have individual professional interests. This is not to say that, once determined to be such, significant properties should not be investigated within a problem -oriented framework based on the known or expected classes of data associated with them. But it is to say that the initial determination of significance must be established with as much objectivity as possible to allow for the location, identification, and conservation of the widest possible range of properties for the peoples of the nation.

Because of the uncertainty surrounding the concept of significance, a conference was held in 1978 at Ft. Burgwin, New Mexico in an attempt to generate a statement "from the Profession" on this topic and other national policy issues. Although there has been some discussion about different elements of this report, it represents a first step in the

development of a professional consensus (Wendorf 1978). This statement appears in full as Appendix A.

1.5 National Register Criteria

The National Register criteria are quoted below from 36 CFR 800.

(a) "National Register Criteria" means the following criteria established by the Secretary of the Interior for use in evaluating and determining the eligibility of properties for listing in the National Register: The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects of State and local importance that possess integrity of location, design, setting, materials, workmanship, feeling and association and:

(1) That are associated with events that have made a significant contribution to the broad patterns of our history; or

(2) That are associated with the lives of persons significant in our past; or

(3) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(4) That have yielded, or may be likely to yield, information important in prehistory or history.

(b) Criteria Considerations. Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following

categories:

(1) A religious property deriving primary significance from architectural or artistic distinction or historical importance;

(2) A building or structure removed from its original location but which is the surviving structure most importantly associated with a historic person or event;

(3) A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life;

(4) A cemetery which derives its primary significance from graves of persons of transcendent importance from age, from distinctive design features, or from association with historic events;

(5) A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived;

(6) A property primarily commemorative in intent if design, age tradition, or symbolic value has invested it with its own historical significance, or;

(7) A property achieving significance within the past 50 years if it is of exceptional importance.

2.0 METHODS AND MATERIALS

2.1 General

This section describes the materials used and developed in the course of formulating management recommendations and the methods used to apply these materials to this end. By its nature this volume covers a wider range of topics than the three previous volumes. The recommendations made in this volume result from an analysis of the first three volumes, an assessment of the present and projected state of the art in underwater technology, and the development of a planning framework for wise and efficient resource management.

2.2 Volumes I, II, and III

The first three volumes of this study form the data base from which we will proceed to assess the types and probable locations of cultural resources on the CS. These volumes are:

2.2.1 Volume I. Physical Environment

This volume reviews the extant literature on transgressional geological processes in the study area. Since the survival or integrity (state of preservation) of prehistoric cultural resources will be a direct result of the geological processes associated with post-glacial sea-level rise, it was important to concentrate a large part of the study effort on this volume. Similarly, the locations of major Shelf features will have a direct effect on the description of the environment of man on the CS and thus on the density and distribution of those cultural resources that fall into the category of prehistoric sites. Thus the Physical Environment volume describes the existence and geological history of major Shelf features as well as the description of areas affected by the erosional processes resulting from sea-level rise.

2.2.2 Volume II. Archaeology and Palaeonotology

The Archaeology and Palaeontology volume used two approaches to predictive modeling of prehistoric site density and distribution on the CS. These models do not take into account the effects of the destructive transgressional processes evaluated in Volume I, but do rely heavily on the identification of major Shelf features.

The first, an inductive model, is derived from the large body of

inventory data acquired in this study. The environmental situation of each site (when available) and other known elements, such as dates of occupation, were used to get a general idea of possible site distribution on the CS. The second model, a deductive one, applies a body of theory that deals with the behavior of animals (and man) in the search for optimum food-resource acquisition.

2.2.3 Volume III. Historic Shipping

The volume on Historic Shipping also relies heavily on modeling to predict the density and distribution of ships that have been lost at sea and whose remains may rest on the CS. The models are developed in the framework of four separate time periods. The first (pre-1630) is based on analysis of the history of exploration of the north and mid-Atlantic coasts. Predicted locations of ships from this time period are derived from the locations of known exploration routes which include both inbound and outbound courses. The second (1630-1800) is based on an analysis of the history of the growth of shipping along the Eastern seaboard of the United States. Predictions about the density and distribution of lost shipping result from an analysis of the locations of known sunken ships and shipping lanes together with an assessment of the depths at which the majority of ships from this period and earlier tended to be wrecked (five fathoms or less). The final model encompasses two time periods (1800-1880 and 1880-1945). The model for predicting the locations of shipwrecks from these time periods is derived from review and analysis of primary and secondary literature sources. The predictions from the first time period (1800-1880) draw heavily on review of newspaper accounts of ship losses, supplemented by official records and secondary sources. The predictions for the second period, on the other hand, draw more heavily on official records.

2.3 Survey of Cultural Resource Studies

We have assessed the current status of cultural resource studies in an effort to develop a baseline for management recommendations. This has taken the form of assessing coastal zone management studies and specific cultural resource studies that appear to be relevant for developing this baseline. We have separated these studies along the above lines for a specific reason. The management of resources in the coastal zone is regulated by several bodies of federal legislation. Individual projects supported by federal funding or requiring federal licensing are generally dealt with on a project-specific basis under the appropriate federal agencies' rules and regulations. Large-scale land use planning is the goal of coastal-zone management legislation. Thus coastal-zone management is aimed at long-range planning, while individual projects are subject to project-specific or "crisis" management.

2.3.1 Coastal-zone management

In the evaluation of coastal-zone management studies, we have sent to the project area's Historic Preservation Officers a questionnaire which asks for their opinion of the adequacy of the environmental impact statement for Coastal-Zone Management programs within their individual states. In addition, the questionnaire sought information on cultural resource management programs and research programs that had been conducted in their areas.

The results of the questionnaire range over a wide spectrum--from the opinion that the program is completely inadequate because it discusses only properties already on the National Register without recognizing that there are many potentially eligible but so-far-undiscovered sites (New York), to the view that the statement is perfectly adequate (Delaware). However, a review of the documentation provided by the Delaware SHPO's office indicates that no account has in fact been taken of potentially undiscovered sites in Delaware's case, either.

2.3.2 Cultural resource management

The management recommendations attached to the CRM studies so far conducted in the project area run the full gamut from appropriateness to inadequacy. These studies include, but are not limited to, an analysis of the cultural resources in Acadia National Park, ME, and Fire Island, NY, performed for the National Park Service, an analysis of the accuracy of site records in the Merrimack River estuary, MA, a survey for wastewater treatment facilities on Long Island, NY, and studies conducted in the coastal zone of North Carolina. It should be noted also that many smaller CRM studies for a wide range of projects have been conducted in many parts of the study area, and management recommendations of these also are of varying quality.

Certain recent activities of the Corps of Engineers constitute a special case in CRM. They include the granting of permits for private and public development in the coastal zone, as well as special studies aimed at identifying the sources of floating debris encountered in several harbors within the study area. In general, the permit-granting procedures of the Corps in such cases neglect to consider the possible existence of as-yet-undiscovered cultural resources that may be eligible for the National Register. This is not invariably so, however. In a recent example of fruitful cooperation between the Corps and archaeologists, a preliminary survey revealed a complex site on a piece of private property belonging to the Montaup Power Company on which a Corps permit was desired for the dumping of sludge derived from dredging. ICA archaeologists performed field tests on the site, which has since been determined eligible for the National Register, and a preservation strategy was agreed, in consultation with the State Historic Preservation Offices (SHPO), to be the best option for fulfilling attendant legal requirements. Accordingly, barriers are being erected to keep the sludge from invading the confines of the site, which will thus be protected from the adverse effects of sludge-produced changes in soil chemistry (John Wilson, personal communication).

The debris studies alluded to above have been conducted in the following harbors within the study area: Providence, RI, Boston, MA, New York, NY, and (in the planning stages for the near future) Portsmouth, NH (John Wilson, personal communication). The scope of these studies is to find the source(s) of floating debris that present hazards to navigation. Among the possible sources is wrecked shipping which might be found to be eligible for the National Register. The studies had various scopes of work, some assigning criteria for identifying the significance of wrecked shipping, and some merely stating the source of the floating debris.

2.4 Underwater Survey, Evaluation, Excavation

Surveying lease blocks for cultural resources, excavating underwater archaeological sites, and conservation of waterlogged artifacts are fairly new endeavors. Procedures and technologies for these activities are constantly changing. To acquire a comprehensive knowledge of the present state of these related subjects, it was necessary to interview a representative cross-section of professionals in each field.

These people were chosen from a study of the literature, conversations with others in their field, and their accessibility for interview. We do not claim to have interviewed all of the best-qualified individuals, but only a representative sample of well qualified individuals from each field. The locations and affiliation of all individuals contacted appear in the list of personal communications (for locations to all individuals mentioned see Appendix G).

2.4.1 Lease block survey

Three major questions were addressed in researching lease-block surveying: 1) How are lease blocks presently surveyed? 2) What new procedures and/or technology will be utilized in the near future? 3) Are present procedures and equipment satisfactory, or should changes be made? To answer these questions a variety of people and organizations were contacted. These included the Bureau of Land Management, a survey company, a data analysis company, a company which retails and leases survey equipment, several equipment manufacturers, and a number of archaeologists who have used survey equipment.

The survey company (Oceanonics, Houston, TX) provided detailed information about the conducting of a field survey, including type of survey vessel, tow-path coverage, navigation systems, personnel, survey instruments, and recording devices. Discussions included reasons for choosing the various methods and systems, their qualities and limitations of analog and digital data analysis were presented. The effect on survey procedures of a lease block's being in or out of an area of probable encounter with cultural remains was discussed. The survey

company also offered suggestions for improving the cost effectiveness of future surveys.

A number of service firms are not involved with data acquisition but analyze survey data after they are recorded. As lease-block survey archaeologists are not normally directly involved with the field survey, it was felt that such a firm, which specialized in analyzing data it did not collect, might possess valuable insights into the situation. Discussions with personnel at Sytech (Houston, TX) provided such information plus detailed information on digital data analysis and suggestions for improving data acquisition and archaeological analysis.

To gather information on survey equipment, Harvey-Lynch Inc. (Houston, TX), a company which retails and leases survey equipment, was visited. Technical characteristics, uses, possible uses, qualities, and limitations of each piece of equipment which they carried were frankly discussed. They also provided information on new and expected equipment.

To obtain further details on new and expected equipment, and to gather information on equipment research, four survey instrument manufacturers were contacted (EG&G of Massachusetts: Geometrics of California; Johnson Labs of New York; and Klein Associates of New Hampshire). Discussions with these people provided information not only on present features of and future improvements to equipment now being used, but also on new types of equipment which will or may be available in the future.

After speaking with people directly connected with lease-block survey technology, contact was made with three archaeologists who have used similar equipment (J. Barto Arnold III, George Bass, and W. A. Cockrell). These archaeologists provided information on the present efficiency of surveys in locating particular sites. Discussions were conducted on the quality and utility of present lease-block surveys, and suggestions were made for improved procedures and equipment.

The final draft of the survey section was written after discussions with Joseph Guarino, a consulting ocean engineer.

2.4.2 Underwater excavation

In order to gather information on current and future methods of underwater excavation, costs involved, and the practicality of excavating different sites, in-depth discussions were conducted with four archaeologists. J. Barto Arnold III, in addition to being familiar with sea bottom survey, provided information on the excavation of shallow sites in the Gulf of Mexico.

George Bass gave an overview of the present state of nautical archaeology and its probable future. He also provided specific information on the desirability of conducting different types of underwater excavations, and on the requisite qualifications of archaeological excavators. Donald Keith, who participated in the discussions with Bass,

was able to provide unpublished information on the latest benefits, limitations, and techniques of very-deep-water archaeological excavations.

Joseph Shaw provided information about sampling and excavating in a very shallow site. He also discussed probable remains of historic harbors which may exist underwater along the coast.

In addition to in-depth discussions with the four archaeologists named above, papers presented at the latest conference of the Council for Underwater Archaeology, and subsequent conversations with the same speakers (specifically, John Broadwater, W. A. Cockrell, John Gifford, Robert Grenier, James Muche, R. Joseph Murphy, Reymond Ruppe, Don Schomette, and Gordon Watts) provided details of present techniques and future possibilities.

2.5 Conservation

Different conservation techniques are used by various conservators of waterlogged archaeological artifacts for similar materials. This is the product not only of personal preferences, but also of the fact that new techniques usually require extensive, and often lengthy, experimentation before they are published or accepted by other conservators. For these reasons, we decided to undertake a higher-percentage sampling of conservators. Each was asked about present techniques and whether he or she felt they were good, acceptable or not acceptable, future techniques, costs, and the practicality of conserving different types of artifacts.

Kenneth Morris (of Albany, NY) helped structure this investigation and provided information on techniques used in the conservation of artifacts from a Revolutionary War site within the study area. Virginia Greene gave a detailed review of problems with waterlogged artifacts and common treatments and mistreatments.

Robert Organ, as director of conservation laboratories at the Smithsonian, gave an overview of conservation abilities of museums in the U.S. He also discussed possible national policies, costs, and the future of conservation of waterlogged artifacts. His knowledge of the conservation of metals was particularly helpful. Carolyn Rose, also at the Smithsonian, provided insight into the knowledge and technical abilities necessary for conservation, and the possibilities of overseeing the treatment of artifacts from more than one site.

D.L. Hamilton, after 10 years' experience running the largest laboratory for conservation of waterlogged artifacts in the U.S., was able to provide information on techniques, costs, timetables, and the present

and future of the field. Conversation with him also considered the relationship between conservation archaeology as it exists and as it should exist.

A great amount of work on conservation is being done in Ottawa, Canada at both the Canadian Conservation Institute (CCI) and Parks Canada. CCI's mandate includes research on conservation processes. Scientists and conservators there are presently interested in waterlogged wood, among other subjects. Discussions of their work pointed out particular problems which exist with current methods. Their research may develop better methods for preserving artifacts.

Parks Canada's conservation laboratories, which have the responsibility of treating artifacts which belong to the Canadian government, are currently treating a great many objects as well as conducting their own research. However, their research is aimed at developing technical improvements and efficiency. Their political experience enabled the staff to present advice not only on conservation techniques, but also on possible national policies.

Following the thorough literature survey, a total of 41 professionals were interviewed, and six more contacted by mail or telephone to accumulate information for this section. A listing of all contacted people's addresses is in the list of personal communications. This final reduction of information was written principally with the help of Kenneth Morris.

2.6 Significance of Resources in the Study Area

As opposed to the earlier section which dealt with the concept of significance, this section discusses the details of significance with a specific focus on those of the study area.

2.6.1 Documentation of significance

The documentation of significance is generally addressed in the "summary statement of significance" that is called for in Procedures for Requesting Determinations of Eligibility for Inclusion in the National Register of Historic Places (36 CFR 63). What follows here is a discussion of some approaches to writing this summary statement in accordance with the requirements of that document, together with some remarks on the specific significance of the resources that may be found on the CS.

The relevant portions of 36 CFR 63 are these:

> Summary statement of significance
>
> A statement of significance identifies qualities of the

property that may make it eligible for listing in the National Register. A concise opening paragraph summarizing the possible importance of the property being considered should be followed by a more detailed account of the events, personalities, prehistoric or historic occupations, or activities associated with the property. This concise history of the property should be directed to a whole property, rather than some functional segment. Thus, it is inappropriate to discuss a mound and not an associated village, burial area, etc., or to submit a house and not the associated outbuildings, etc. A statement of significance should attempt to relate the property to a broad historical, architectural, archeological, or cultural context: local, regional, State, or national. For example, if a community has a number of neighborhoods with the same or similar qualities as the one being evaluated, this information should be included in the documentation. Any quoted material which appears in this section or the description should be footnoted. Quotations taken out of context must faithfully represent the meaning of the original source. Supplemental information, such as newspaper articles, letters from professional historians, architects, architectural historians, or archeologists, etc. may also be submitted as appropriate. The statement of significance for properties that are less than 50 years old; moved; reconstructed; cemeteries and grave sites; birthplaces, primarily commemorative in nature; or owned or used by religious institutions should address the specific exceptions set forth in the National Register criteria.

(B) Period(s) and Area(s) of significance

Identify the area(s) and period(s) with which the property's significance is associated. This may mean date of construction, major alterations, or association with an individual, event, or culture, etc. For some archeological properties; assignment to a very general time period or periods may be sufficient.

The following areas of significance are listed on National Register forms. Agencies may find it helpful to consider these areas in identifying and evaluating properties:

Archeology-Prehistoric: the scientific study of life and culture of indigenous peoples before the

advent of written records.
Archeology-Historic: the scientific study of life and culture in the New World after the advent of written records.
Agriculture: farming, livestock raising, and horticulture.
Architecture: the style and construction of buildings and structures.
Art: concerning creative works and their principles; fine arts and crafts. Do not include architecture, sculpture, music, or literature here; specific categories are established for these areas.
Commerce: production and exchange of goods and the social contracts thereby encouraged.
Communications: art or science of transmitting information.
Community Planning: the design of communities from predetermined principles.
Conservation: official maintenance or supervision of natural or manmade resources.
Economics: the science that deals with the production, distribution, and consumption of wealth.
Education: formal schooling or the methods and theories of teaching or learning.
Engineering: the applied science concerned with utilizing products and sources of power for supplying human needs in the form of structures, machines, etc.
Exploration/Settlement: the investigation of regions previously unknown; the establishment of a new colony or community.
Industry: enterprises producing goods and services.
Invention: something originated by experiment or ingenuity.
(Properties connected with the inventors themselves would be classified here).
Landscape Architecture: the art or practice of planning or changing land and water elements for the enhancement of the physical environment.
Literature: the production of writings, especially those of an imaginative nature.
Military: concerning the armed forces and individual soldiers.
Music: the art of combining vocal or instrumental sounds or tones.
Philosophy: system or principles for the conduct of life; the theory or analysis of the principles underlying thought or knowledge and the nature of the universe.
Politics/Government: an established system of political administration by which a nation, State, district, etc., is governed and the processes which determine how it is to be conducted.

Science: a systematic study of nature.
Sculpture: the art of forming material into three-dimensional representation.
Social/Humanitarian: concerning human beings living together in a group or the promotion of the welfare of humanity.
Theater: the dramatic arts and the places where they are enacted.
Transportation: concerning the work or business or means of conveying passengers or materials.

2.6.2 Prehistoric cultural resources (Evidence of man's activities prior to continuous European contact in the 1500's)

In general, prehistoric cultural resources will fall within criterion #4 (see Section 1.5 above). "That have yielded, or may be likely to yield, information important in prehistory or history." What follows is a discussion of the kinds of information prehistoric cultural resources on the Continental Shelf may be expected to yield.

Judged by their ability to provide information which can be used to answer questions at the forefront of archaeological discussion, the prehistoric cultural resources of the CS are of the greatest value. Both in the past and in recent years, controversies have developed over a series of topics; the controversies persist because the data sources necessary to resolve them lie untapped beneath the sea.

Broadly conceived, archaeology is concerned with the ways of life of past peoples and with the general cultural and behavioral processes which shaped them. Given this conception, one cannot look at a single narrow band in the spectrum of prehistoric adaptation and expect to understand either the way of life of the prehistoric group or the processes underlying it.

An example will clarify this point. Let us hypothesize that one prehistoric community spent summer on the coast and winter on the coastal plain and a second community spent summer in the uplands and joined the first group on the coastal plain during winter. Archaeologists could not fathom either group's way of life by looking only at coastal sites or only at upland sites. Without viewing the entirety of the evidence, it is doubtful if the most imaginative or clever researcher could guess at the intricacies of scheduling and exploitation which either group certainly would have had. It is even more doubtful that the archaeologist could imagine the existence, let along structure, of the interaction between the two groups.

The example was hypothetical, but it cuts to the core of the problem that has plagued discussion of early coastal adaptations on the Atlantic coast: at best, we have no more than hints about the nature of coastal-zone adaptations. Archaeologists are left in the uncomfortable position of trying to speculate, sometimes on evidence as attenuated as that of the upland sites of our hypothetical example.

As a real-life example, the last decade has brought forth a procession of views on why early cultures along the northern Atlantic coast and elsewhere did not use shellfish. Ritchie (1969) claimed that the earliest coastal dwellers were emigrants from inland and did not know that shellfish were edible; Snow (1972) suggested that technology was insufficient for shellfish exploitation. Osborn (1977) considered shellfish use as an option chosen only when population pressures demanded it. Braun (1974) and Sanger (1975) related shellfish use to availability.

Only through an accident of preservation has a tentative solution been found: early cultures did use shellfish. Brennan and others (1974) have documented shell middens in the Hudson Valley at around 8,000 B.P., some 4,000 years earlier than formerly believed. In this case, it appears that the absence of data from inundated areas so biased the data base that the research question posed was inappropriate. The question of why shellfish were not used could not be satisfactorily answered because it was based on a false assumption.

Other problems whose solutions lie rooted on the CS are broader ones. For example, the apparent density of Paleo-Indian occupation in eastern North America is very low. But nearly all of the coastal zone during Paleo-Indian times is presently inundated and the density there is unassessed. If Perlman's (1978) notions about the attractiveness of the coast to early settlement are correct, the inland data presently available may badly underestimate Paleo-Indian population. Since population is generally recognized as one of several factors which are important in shaping cultures and behavior, the information from beneath the sea may have broad implications for interpretation of early cultures.

Such questions about prehistoric ways of life abound, and the possible studies of cultural processes are limitless. The inveterate skeptic may ask what use such studies are. The answers to that question are various, and only a few will be discussed here.

If human behavior follows general laws, patterns, generalities, or rules (depending on one's terminological preferences), the study of any group at any period has relevance to understanding human behavior as a whole. By studying human behavior, intellectual curiosity about ourselves is fed, if not satisfied; in addition, we may derive valid insights which can be used to guide future decisions.

The idea that archaeology--based on broken tools and bones--may contribute insights superior to those derived from the study of modern peoples is not so far-fetched as it may appear. Only through archaeology can one trace development over long periods of time. (Historic records can be misleading because of the recorder's biases. In addition, the record is short and rarely can be quantified.) Such studies as that of Sabloff and Rathje (1970) on the Classic Maya "collapse," documented only through archaeology, speak of such modern problems as a dwindling critical resource base. (Oil for instance?)

In addition to feeding intellectual curiosity and providing potentially useful insights into cultural processes, archaeology serves another purpose. As long as records have been kept (and surely long before then), human beings have felt a need for a past. At every level, from family or lineage through community, tribe, nation, and finally humanity itself, human groups have needed to know the story of their origin and development. Sometimes the story was created, apparently with no germ of reality in it; in other cases, it appears to have been based on more solid events and elaborated. Only recently have techniques and resources been available to allow us to discover, rather than create, the past. The popularity of "drugstore" archaeology books shows this need clearly and the success of Thor Heyerdahl's works about diffusion to Oceania and South America show that the interest is not confined to the origin of the dominant Euro-American culture.

Archaeology as a discipline has been moving steadily toward a more scientific approach for the last 20 years or more. In view of that tendency, it still remains difficult to conceive of an overall goal more important than providing a satisfactory story of the human past.

2.6.3 Historic-Period cultural resources
For the purposes of this study, Historic-Period cultural resources are those resources that are at least 50 years old (unless determined to be specially significant). They may, however, be as old or older than Viking times (ca. 1000 A.D.). These resources include but are not limited to structures, dump sites, ships, and other material evidence from the period after first European contact in North America. All of these elements have the potential for meeting all four National Register criteria.

2.6.3.1. Historic shipping - In general, those who study wrecked shipping in an academic framework find it difficult to describe in general terms the significance of thse resources in the context required by the National Register and resource managers. In general, the rationale "because it's there" has been considered sufficient to qualify a shipwreck for study, and the importance of the classes of data in any wreck is not generally addressed until after the research is completed. Resource managers, on the other hand, require an explicit statement of significance on which to base management decisions. Thus it is that preliminary examination of the resource will be used to identify those significant data in a resource and thus make possible an explicit statement about the significance of the resource.

As with prehistoric sites, the identification of significant data rests in those areas of limited knowledge. Thus those subjects about which we know little or are misinformed by written sources, are significant. This will change with time as questions are answered and new ones evolve, however.

Since almost all our knowledge about the possible data in ships of the pre-1800 period comes from historic sources whose biases are not clearly

known, it follows that all data classes in all the ships of this period are significant to one degree or another, the earlier and thus less well known being proportionately more significant. On the other hand, ships of the post-1800 period (where there are some objective data available) may be individually significant as a result of carrying special cargoes, associations with important individuals, or other National Register criteria, including design changes through time. This latter subject will be of distinct importance to naval historians. A brief review of the data presented on Chart III-5 will illustrate the point. It appears that there is a clear break in ship types at about the year 1700. The reason for this phenomenon would be instructive if evaluated in the light of events and trends on land. Similarly, an understanding of the effects of the industrial revolution on experimentation with different types of ship design, along with the necessity for more rapid travel between Europe and the New World, will be useful to students of the Industrial Revolution and thus to students of cultural change in general.

The above discussion deals with significance (in a very general way) on the world and/or regional level. Certain wrecked ships also have local followings. Local heroes or villains (Captain Kidd, for example) can be associated not only with individual ships but with the salvage of such ships and the folklore growing up around such concepts as "moonrakers," "pirates," "treasure ships," etc. Locally important ships may in many ways be the subject of more intensive local concern than prehistoric sites. Such concern may not be restricted to ships lost in the local region, but may extend to those that went down "on distant shores, in seas forgotten." For example the loss off Cape Cod of a vessel captained by a famous Maryland mariner would have more local significance to Marylanders than to the general Massachusetts public. For this reason we have polled some (not all) local marine museums to acquire an idea of the distribution of locally significant historic shipping resources.

From the discussion above and elsewhere in this volume, it should be clear that the significance of wrecked shipping of all periods can be as important to the study of humanity and its adaptations to environmentally caused culture change as can the data from prehistoric sites. These data are complementary rather than discrete. For example, the remains of an average twentieth-century "liberty ship" for which there are plans and many examples, may not be as archaeologically important as those of a seventeenth-century fishing vessel. But the remains of a <u>particular</u> liberty ship whose cargo, history, or design features are significant, may be of much greater interest.

A typical question that may be asked in the above context might be, "What was the effect of outlawing the slave trade in the colonies (1808) and nearby West Indies (in the 1830's) on the actual makeup of shipping to and from southern ports?" The written records may tell us one thing, biased by the view of the writer, while the archaeological data might tell us a different story. Accurate data may be important in explaining

how cultures react to changing situations and might thus help us to understand how we may adapt and/or react to changing circumstances.

2.6.3.2 Historic-Period occupation sites - Volume III has discussed the early history of settlement along the coast of the study area. Many of these settlements have been destroyed or inundated by storm and recent sea-level rise. There are early fishing settlements in the endangered coastal zone of Maine that are known to the State Historic Preservation Officer (Arthur Spiess, personal communication). Other sites within the study area may still be more or less intact in the nearshore area. The significance of these sites lies in their potential ability to help us understand a little-known element in the early history of North America, namely the day-to-day life of the earliest European settlers which was documented sparsely or not at all in the chronicles of the period. How these people actually lived, worked, and played will fill in a large gap in our understanding of the settlement period in the New World. Some of these sites may well meet most of the National Register criteria. The erosion-caused eradication of certain of their elements or features will not necessarily be as extensive as for prehistoric sites. Thus artifacts documenting the ethnic origin, class, and trade of individuals or groups may still be encountered with enough integrity to generate considerable significant data.

2.6.3.3 Dump sites - To the historic archaeologist terrestrial dumps are similar to gold mines. Just as prehistoric archaeologists derive most of their data from the "garbage" of prehistoric peoples, the "garbage" of Historic Period peoples is a significant source of data for the historic archaeologist. Artifacts found in terrestrial dumps are in general more nearly intact than those found in sheet refuse (materials randomly scattered across a site's surface or subsurface). Offshore dumps on the other hand are not subject to the terrestrial soil compaction processes that lead to the fracturing of brittle materials such as ceramics. At the same time terrestrial soil chemistry destroys many classes of material including wood, leather, textiles, metals, and others, which are often better preserved in undersea environments. The significance of these offshore sites lies in the fact that the preserved material will complement data extracted from terrestrial sites to give us a more complete picture of the day-to-day life of the Historic-Period peoples along the coast. Thus these sites can be of primary significance in answering questions regarding the lifestyles of the populations of early coastal America.

2.7 Planning Framework

For the purpose of this study, the planning framework combined a planning model developed by Interagency Archaeological Services, Office of Archaeology and Historic Preservation of the Heritage Conservation and Recreation

Service with "A Study Design for Resource Management Decisions: OCS Oil and Gas Development and the Environment" (BLM Oct. 1, 1978). The IAS planning model was developed in a workshop held at Harper's Ferry, VA in 1978, and is currently being tested in several states. ICA performed a modest pilot study of this model in a cultural resource overview of the Green Mountain National Forest, Vermont, under a contract with the U.S. Forest Service (ICA #72, Casjens and others 1978). In addition, we elected to use the format of the BLM "Study Design," so that our recommendations may be more easily integrated into the planning procedures to be used in connection with oil and gas development on the CS. It should be noted, however, that the format has been generalized to meet the needs of all resource managers.

2.7.1 IAS planning model

This framework was developed in a planning workshop held by the Heritage Conservation and Recreation Service of the Department of the Interior. A pilot study of this approach was conducted in an ICA study for the Green Mountain National Forest. The framework proved a viable approach to this type of planning and is used here as a further step in its development.

Description of planning method, adapted from workship project (Fig. IV-1 will assist the reader in visualizing the process as described in the text.)

Step 1--Organize Existing Data: The purpose of this operation is to provide the basis for defining archaeological study units. This is the start of the planning process, and must depend upon existing substantive and theoretical knowledge about the history and prehistory of the area. The knowledge gathered during this part of the project is based on distributional studies, published or unpublished synthesis, models developed to account for cultural variability, ethnographies, and histories. Environmental data, as they bear on cultural/historical problems, are also considered. The model is clearly based on incomplete information and may be somewhat impressionistic or inaccurate, but it provides an approximation of the existing state of knowledge and theory and a foundation for initiation of the planning process. As time goes on, new data will feed back, making possible successively more satisfying formulations.

Step 2--Define Study Units: Study units will be logically derived from the model(s) developed in Step 1. The precise nature of the units will vary, but all should be conceived with the intent of maximizing the internal homogeneity of the units in terms of cultural processes and events, and their resulting material remains. Because patterns of human behavior have varied over time and space, study units which mirror these patterns will be defined in terms of temporal and spatial dimensions. Because the initial study units will be created using imperfect information, we envision them as being broadly, rather than particularistically conceived. (That is, as an initial strategy, "lumping" is probably more appropriate than "splitting.") It would be

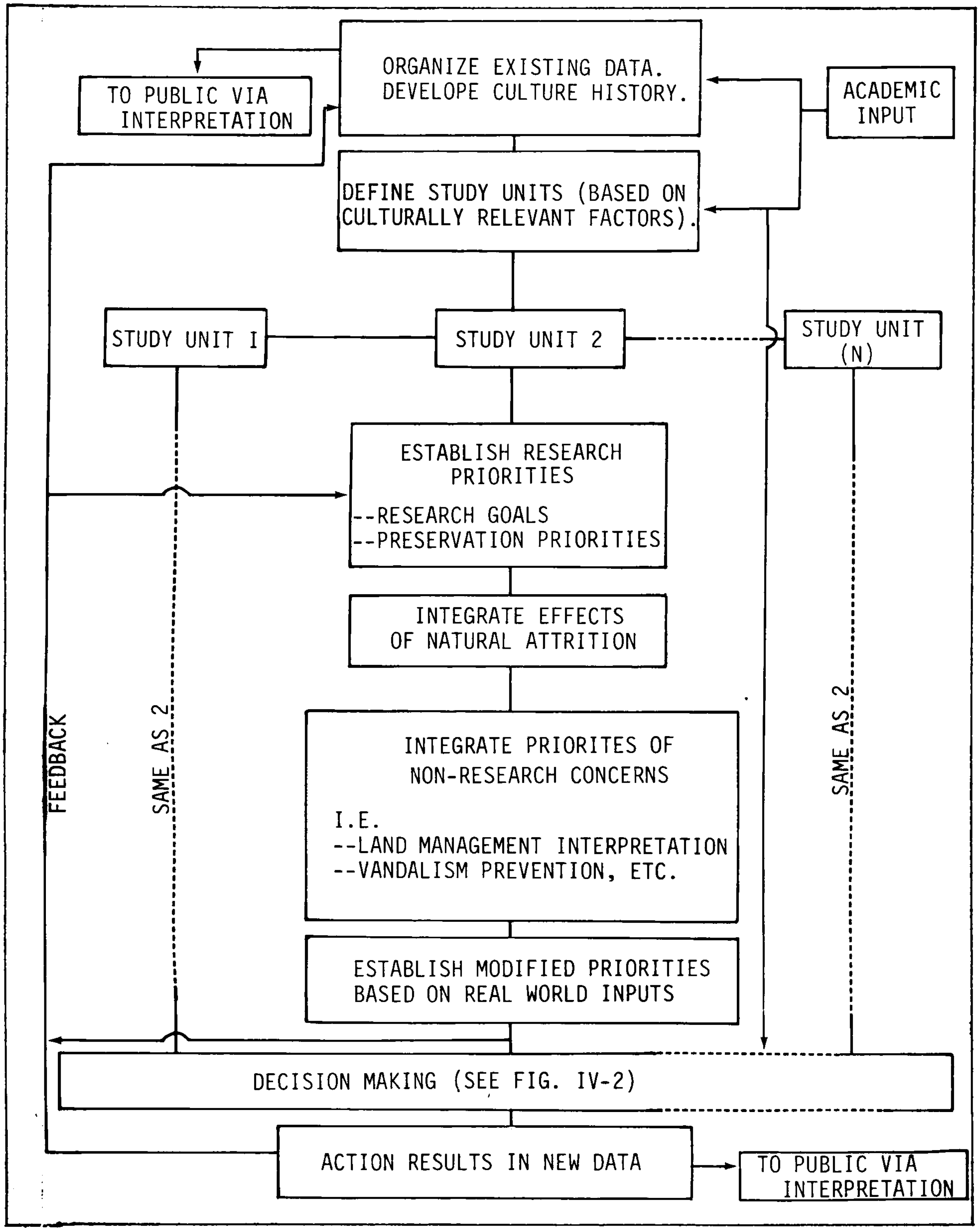


Fig.IV-1: Planning process flow chart.

counter-productive to define the study units on the basis of political or administrative boundaries. As in Step 1, input from the academic/ professional community will be vital to delineation of useful initial study units.

As the accumulation of new information permits the restructuring of the way in which cultural variability is conceived--thus necessitating the refinement of the model(s)(Step 1)--study units must be redefined.

After the study units have been defined, each will be individually treated in the manner described below. Details may vary in accordance with characteristics of the particular unit, but the general approach will be as follows:

a. Organize existing archaeological information as it pertains to the study unit.

b. Define a set of "ideal" research and preservation priorities.

c. Consider the impact of natural attrition, damage factors, and the interests of other groups on the "ideal" priorities.

d. Redefine research and preservation priorities in the light of the above "real-world" impacts.

Step 3--Organize Existing Data on the Study Area: At this level, all available data specific to this study unit shall be collected and synthesized. This material will include, but not be limited to, lists of site locations and contents, inventories of collections, published and unpublished reports, data from locally knowledgeable individuals, ethnohistories, histories, archival materials, and existing predictive statements and supporting data regarding locations of historic resources. Consideration of these data, in light of the character of the study unit, will permit delineation of a set of "ideal" priorities.

Step 4--Define "Ideal" Priorities: At the very least, these priority statements should include:

a. Formulation of research goals appropriate to the study unit.

b. Formulation of priorities for data retrieval consistent with these research goals.

c. Development of a program for the in situ preservation of a proper array of archaeological resources, and for the orderly and parsimonious consumption of other resources in the retrieval of research data.

It should be kept in mind that this is an "ideal" framework, which should be kept formulated with exclusive reference to scientific goals.

<u>Step 5--Consider Effects of Natural Processes:</u> A variety of ongoing natural processes contribute to the attrition of archaeological resources. At this point in the development of the plan, it is important to modify the "ideal" priorities taking these factors into account. For example, it may be necessary to reorder data and/or preservation retrieval priorities when sites in a particular part of the study unit are subject to greater than usual threat from this class of phenomena. For example, natural attrition to the resource base will result from flooding, erosion, inundation, etc. These and more are constantly contributing to the loss or modification of Prehistoric and Historic Period resources. In some cases the effects of these processes on the land surface are familiar and localized. For instance, certain river courses may be well known to be subject to erosion in rain storms while some rivers and tides are continually eroding shorelines.

<u>Step 6--Consider the Interests of Other Groups:</u> In addition to "natural" forces, activities of many special interest groups will have direct or indirect impact on the archaeological resources of the study unit. These impacts must also be assessed and priorities should be modified taking these "real-world" factors into account. Early consideration of these problems should make it possible to minimize potentially negative impacts and to take advantage of new positive opportunities. Some examples of interest groups will include:

- Archaeologists
- Other academics
- Students
- The public in a non-structured education context
- The public in a context of recreation, tourism, etc.
- Social groups whose material culture is the subject of study, e.g., ethnic, professional, local groups, etc.
- Avocational (sometimes called amateur) archaeologists
- Private landowners
- Federal agencies involved in specific projects
- State and local agencies involved in specific projects
- Land-using design and engineering firms
- The State Historic Preservation Officer
- Federal land management agencies
- Looters/vandals/pot-hunters/treasure hunters

<u>Step 7--Modify Priorities--Develop Management Strategy:</u> The operations described in Steps 5 and 6, above, should result in the formulation of a set of revised archaeological priorities that are acceptable as a scientifically sound research strategy and which simultaneously provide guidance for a realistic resource management program.

These should not differ substantially from the "ideal" priorities in relation to research goals, but will reorganize the methods through which these goals will be reached. For example, data retrieval priorities may be reordered in the context of threats posed by natural or human agencies, or opportunities created by new data or technology or

by new sources of funds or public support. Similarly, preservation priorities may be modified to reflect positive and negative influences as well as purely scientific considerations.

Step 8--Decision Making: Once a management strategy has been developed in Step 7, decisions must be made regarding the course of action at several levels. These levels will be:

a. State and local historic preservation objectives and priorities

b. Continental Shelf land management

c. Project planning

d. Project execution

Each of these levels will require different approaches to recommend actions.

1) State and Local Historic Preservation Objectives and Priorities. The objectives and priorities for the State will normally be articulated in the State Historic Preservation Plan, while local priorities and objectives should be elicited from interested and concerned citizens of local communities. Local historical societies, commissions, and avocational societies are often the sources of these local data.

2) OCS Land Management. There are many potential uses for the resources on and beneath the Shelf. In the main, the exploitation of these resources will have positive effects on the economy of the nation. Some contend that these positive economic benefits are outweighed by negative effects to the environment and to the detriment of other sources of positive economic input to the nation.

This study is not designed to assess the relative merits of the contending parties but to act as an advocate for the wise use of the nonrenewable evidence of the nation's cultural heritage at a time of increasing demands for energy and economic independence. This can best be accomplished by the early consideration of impact to cultural resources in any cultural resource management plan. Appendix B has demonstrated the complexity and thus the costly nature of mitigating project impact through site evaluation and excavation in an underwater situation. Thus Appendix B is important data for the resource manager and will help to identify the potential costs at the earliest possible planning stage and thus make possible reasoned planning decisions by resource managers.

As will be pointed out in later sections, some land use as presently conceived should be encouraged to proceed (for cultural-resource-location objectives). These recommendations proceeded from the realization that industry is more appropriately adapted for these tasks than academia, but that industry will require academic supervision of specific tasks to assist resource managers in meeting their historic preservation

responsibilities for planned projects.

This study, in identifying zones of potential resource existence, will urge that the full range of possible resources be located and that sites be protected and preserved for exploration and explanation by future generations with greater sensitivitiy to theory, more advanced analytical techniques, and new, previously unthought-of research questions, the answers to which may solve the overriding problems of the day.

For the preliminary purpose of land management, this study represents a first step in the acquisition and analysis of extant data for the purpose of predicting the location and distribution of archaeological resources on the Shelf. Pilot studies recommended in this report and the integration of industrial/scientific cooperative testing of the CS will direct the refinement and courses of future resource management studies.

3) Project Planning. As individual projects are planned, decisions must be made as to the need for survey and what level of survey is required to maximize the wise use of the resources. These decisions will also consist of making statements about significance in the context of the study unit and decisions compatible with the social and economic needs of the proposed project regarding the best treatment of these significant properties. Fig. IV-2 illustrates the relationship between the general planning process and the project planning. As illustrated, the process becomes one of the continuous decision-making concerning the need for the project and the classes of impacts that may derive from various alternative designs of the project. Similarly, as the process develops, new data are obtained which feed back into the basic planning process and may aid in the reordering of priorities and redefinition of study units. The following is a discussion of each of the figure's elements:

a) As social or economic needs are perceived, a specific project is proposed to meet these needs.

b) During the design stage of the project, an assessment of the various classes of impacts will be made. These impacts will be not only direct (such as disturbance from land movement or construction activities) but indirect (such as increased potential for vandalism).

c) Once the classes of impacts have been defined, cultural resource planning decisions will be made. These decisions will be based on the modified priorities established in the general planning process for the particular study unit involved. These decisions can take several directions. The need for the project may be reevaluated in the light of the impact to significant cultural resources, resulting in the possible abandonment of the project. An alternate result may take the form of project redesign to reduce the potential for impacts to a maximum.

d) The above-mentioned surveys may provide essential data for formal

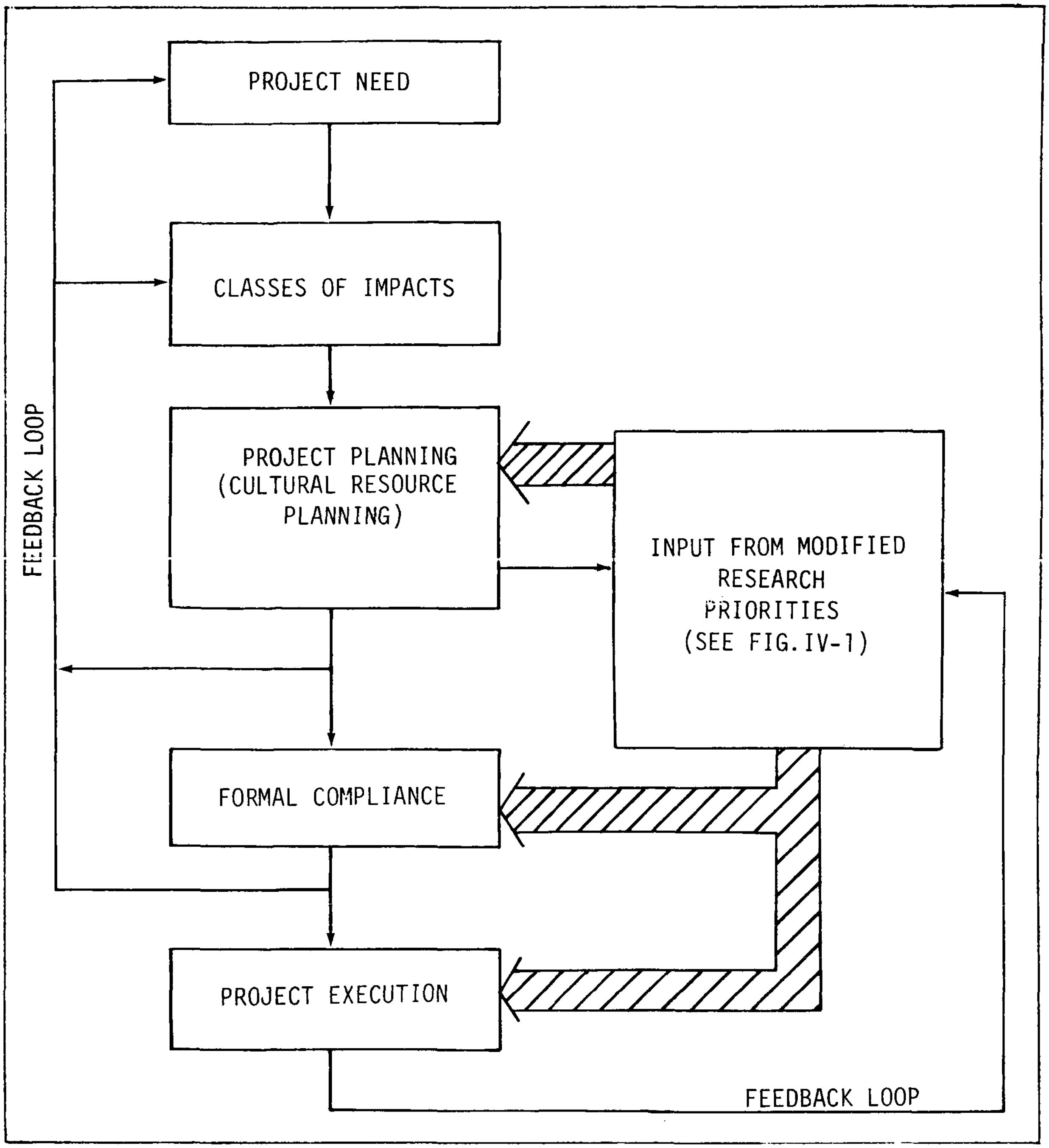


Fig. IV-2
Project decision-making.

compliance processes such as those associated with environmental assessments and others. At the same time, full-scale surveys may not be undertaken until the formal compliance process is begun. Whatever form the survey takes, the data may well influence the perceived need for the project or the final design.

e) This entire process of decision-making will allow for the maximum consideration of cultural resources in the planning of resource management.

4) Project Execution. Before the execution of a specific project, all cultural resource planning should be completed. There are circumstances that will require the involvement of cultural resource specialists with the beginning of construction. For example:

a) There is always a possibility that the results of a locational study will predict the existence of resources that will not be discovered in a survey. At the same time a data recovery program may not recover 100% of the data (that is, in a sampling framework). In both these cases, monitoring of construction may be recommended. This monitoring will be used to recover data turned up in the construction process. Monitoring is clearly not a recommended procedure, as in general the data contexts are destroyed by the construction well before the monitor can do anything about it. When it is recommended, however, management decisions must be made concerning the types of steps that will be taken in the event of encountering resources.

b) Another circumstance that will require decisions to be made during construction will result from unforeseen discovery (emergency) situations. In other words, provisions should be made to alert the land users to the appropriate procedures in the event the construction process encounters previously undiscovered resources.

Once a planning framework for cultural resources has been developed, the application of this framework to actual large-scale land use projects must be addressed.

2.7.2 <u>BLM resource management</u>

Leasing of offshore federal lands for oil and gas development is a planning process, involving decisions prior to and after the issuance of leases. The various steps in this decision-making process are identified in the national program document published by BLM, "A Study Design for Resource Management Decisions: OCS Oil and Gas Development and the Environment: BLM (1978). Fig. IV-3 outlines these various steps. As in the IAS "Planning Model," each step in the process requires more detailed information and precise analysis than the preceding one.

This present study has provided environmental information necessary for pre-sale decisions (Items 1-9), has delineated methods for use in post-sale decisions (Items 10-14), and has identified recommended studies required to supplement the data base of environmental information. Pre-sale

1) TENTATIVE SCHEDULE

↓

2) CALL FOR NOMINATIONS

↓

3) TENTATIVE TRACT SELECTION

↓

4) PREPARATION OF ENVIRONMENTAL STATEMENT

↓

5) DRAFT SECRETARIAL ISSUE DOCUMENT AND PRELIMINARY NOTICE OF SALE

↓

6) FINAL SECRETARIAL ISSUE DOCUMENT

↓

7) FINAL TRACT SELECTION

↓

8) NOTICE OF SALE

↓

9) SALE - LEASES ISSUED

↓

10) EXPLORATION PLAN AND DRILLING PERMIT APPROVAL

↓

11) TRANSPORTATION MANAGEMENT PLAN APPROVAL

↓

12) DEVELOPMENT AND PRODUCTION PLAN EVALUATION AND APPROVAL

↓

13) PIPELINE PERMIT ISSUANCE

↓

14) LEASE TERMINATION OR EXPIRATION

Fig. IV-3
Steps in the BLM decision-making process.

decisions generally need regional information, with the necessity for more site-specific infromation in final tract selection (Item 7) and post-sale decisions. The final product of this study is a set of predictive models which indicate the probability and location of cultural resources in the mid- and North Atlantic regions. The information can be used in tentative tract selection (Item 3), environmental analysis (Item 4), and for development of mitigating measures to protect and preserve cultural resource areas (Items 4 and 5). The information, however, is only based on predictive models, and needs to be verified. Post-sale decisions require more site-specific information than pre-sale. If a tract is leased (Item 10) in an area which contains or probably contains a cultural resource site, then a lease stipulation (mitigating measure) could be imposed requiring an archaeological survey. The survey, conducted prior to exploratory drilling, would be performed to identify the precise location of the sites in the tract. Appendix B reviews recommended archaeological field strategies. Transportation management planning (Item 11) may need surveys to identify any cultural resources that may lie in the path of the pipeline, and may require development of mitigating measures necessary to protect those resources. Development planning (Item 12) should address the results of previous studies, and should develop a monitoring program designed to identify archaeological and cultural resource sites which may be encountered.

2.8 Computerization

The form of computerization used for data acquired during this project is illustrated in Fig. IV-4. Most of the data was recorded on magnetic tape for computer data processing. There are several reasons for computerizing that information, and these include the following:

1. Creation of a data file listing all archaeological sites located within one-half mile of the coast that may be impacted by operations resulting from exploitation of the CS.

2. Creation of a data file containing all the historic shipwrecks located within the project area that can be located with an accuracy of 10 miles.

3. Creation of a sorted list including environmental and locational data on archaeological sites and known shipwrecks collected during the project. This file will serve as documentation of research completed, can be used as a reference for future CS studies, and have been used as data which were tabulated for inclusion in Volume II of this report.

4. Tabulation and analysis of the site and environmental data for inclusion in the final report.

5. Creation of a list of bibilographic references researched for the project that are referenced in the computer file.

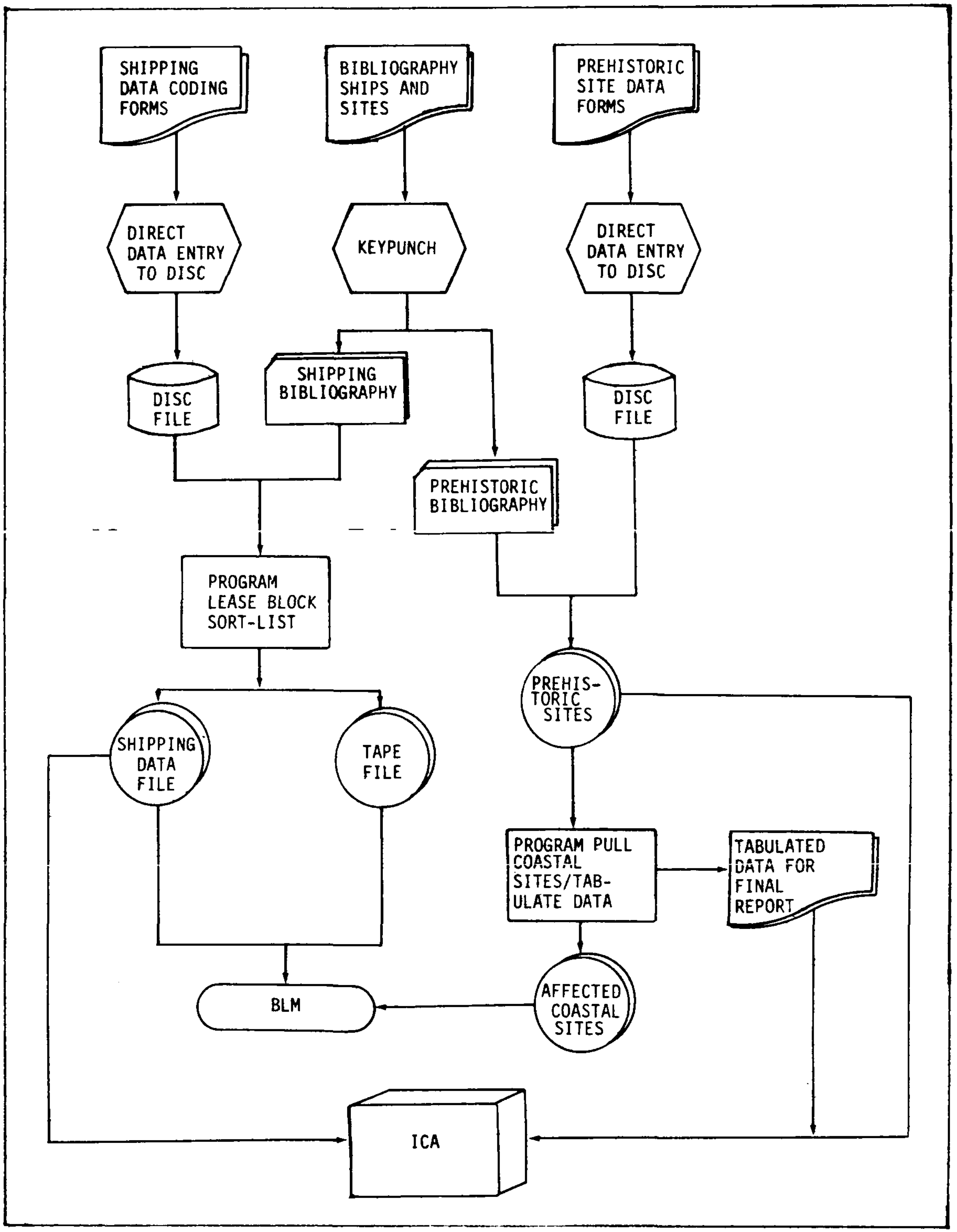


Fig. IV-4: Flow chart for OCS computerization.

Records of approximately 8,000 prehistoric terrestrial sites have been collected from the literature and state archives, and 2,000 sunken historic vessels have been located to within 10 miles of their probable actual sites. In addition, over 1,000 bibliographic references have been researched. Because of the large volume of data, tabulation and analysis by hand was unmanageable.

In order to accomplish the automation of the site records, the following steps have been taken:

1. The bibliography researched for the project has been keypunched, and unique 5-digit reference numbers assigned to each bibliographic entry. These numbers allow for the entry of three references per site on the computer site file.

2. A program has been written that will print the final selected bibliography in the proper order.

3. A program has been written that will load the bibliographic file on magnetic tape for inclusion with the historic-shipping and archaeological site files to be discussed below.

4. The data recorded on the archaeological site data records, the historic shipping records, and the ethnohistoric site data forms have been coded on computer data sheets. A copy of the coding form is shown in Figs. IV-5 and IV-6.

5. The data were keypunched and entered on a disc pack, verified, sorted by town, county, state and lease block and written on magnetic tape. A separate file was written for prehistoric sites and historic shipping.

6. A short program was written that will tabulate the data on the file, for use in the final report. The program will also extract all of the affected coastal sites and record them on a tape to be submitted to the BLM.

7. A short program was written that will convert the historic-shipping data file into a list of all lease blocks containing possible shipwrecks. This was determined to be necessary because the majority of the ships, as a result of vague and inexact locational data, may be found in any one of the six lease blocks. Therefore, all possible lease blocks were recorded for each ship. In any case where more than one lease block may contain a given wreck, the listing program will show each separate lease block as possibly containing that ship. The listing produced will be supplied on magnetic tape, and a "print-out".

The files will be submitted in sequential order by lease block in the case of historic shipping, and by the ICA-assigned lease block in the case of coastal prehistoric sites.

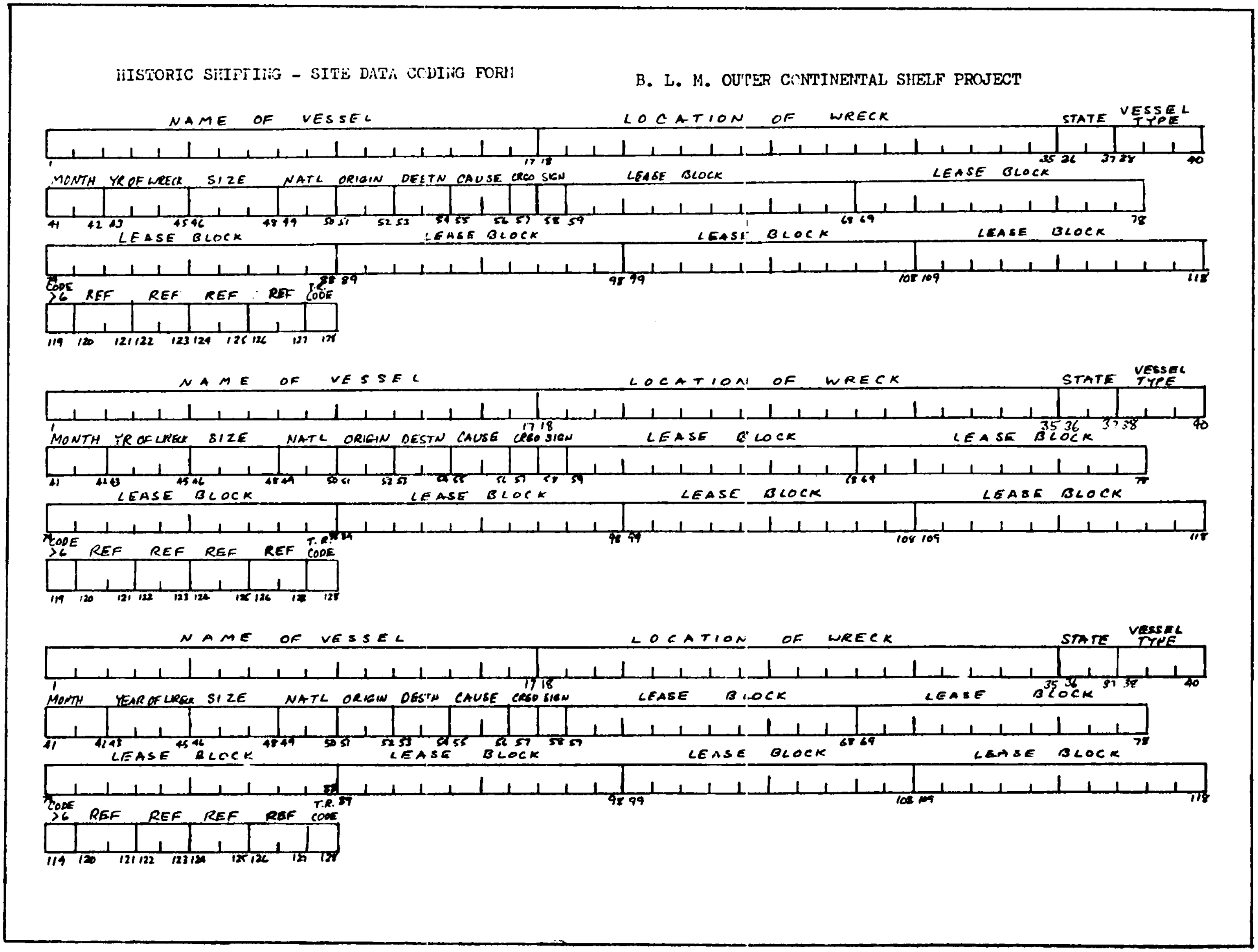


Fig. IV-5

Computer coding form for storage of shipwreck data.

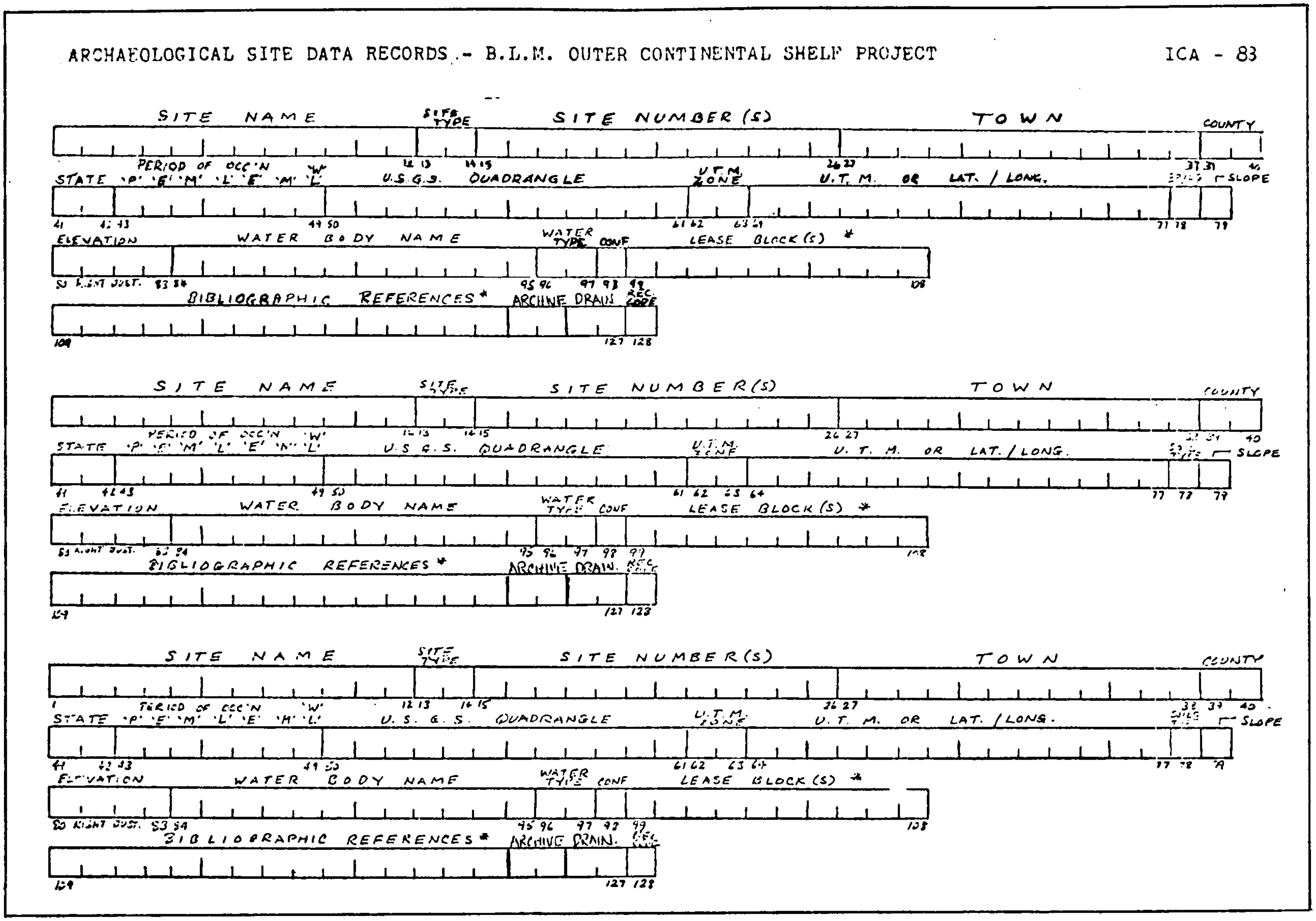


Fig. IV-6: Computer coding form for prehistoric sites.

2.9 Map Production

A series of 41 maps at a scale of 1:125,000 were produced by the Peabody Museum staff artist and team of assistants. Twenty-five of these maps were drawn originals, while 16 were made available from the U.S. Coast and Geodetic Survey. The diazo blackline printing process was selected for aesthetic and economic reasons; all maps were prepared with the diazo process in mind. Thus, those maps which were originals were drawn on mylar, and those maps from the U.S. Geodetic Survey were converted into plastic autopositives. Both mylar and plastic autopositives are capable of undergoing the diazo blackline process.

Our aim was to transfer lease blocks and lease block numbers from a series of BLM maps at a scale of 1:125,000 and to lay them over the bathymetric lines on the USGS maps (1:125,000), using the coastline (when applicable), but mainly using latitude and longitude as a guide. In examining the 1:125,000-scale maps, it was discovered that, in some cases, the measurement from one known point to another known point varied between 1.987 mm and 2.123 mm. The variance occurred not only along latitude and longitude lines; a different degree of error occurred from 15-minute block to 15-minute block.

To compensate for this variance, a series of cardboard templates marked at 0.5 millimeter intervals (36.0, 36.5, 37.0, 37.5) were constructed. After plotting the end points of each 15-minute latitude and longitude block, a template was selected to match with the two end points. Though the resulting lease blocks may appear to be of uniform size, each may actually vary along its sides by 0.5 mm. This is because the mapmaker had two choices in transferring information from one map to another, when confronted with a given error: 1) establish a fixed point and choose an interval which remains constant, or 2) distribute the error. We chose the latter course in order that the position of the lease blocks on the 1:250,000-scale maps be as close as possible to their position on the 1:125,000-scale maps. The lease blocks were plotted this way on both the plastic autopositives and the mylar originals.

The mylar originals were produced by determining the area (i.e., latitude and longitude limits) of each new map, and laying out the borders of each new map at 1:125,000, taking into account the fact that the maps below the forty-second parallel were Mercator projection and those above the forty-second parallel were Transverse Mercator projection. The areas of the new maps at 1:125,000 were then marked off on the CS protraction diagrams (1:250,000). Lease blocks were added in accordance with the aforementioned procedure.

These maps, however, were lacking bathymetric lines. Bathymetry was not supplied by the 1:125,000-scale maps, so a map at 1:1,000,000 of the entire area, drafted by the American Association of Petroleum Geologists, was consulted. This map was broken into two areas, north and south, and photographed using the Pro-480 process. Two Pro-480's were produced at 8" x 10" and mounted for use in an overhead projector.

Tissue paper guides of the 1:125,000-scale maps were mounted on the wall, and the overhead projector and slide were adjusted until the latitude and longitude lines on the slide and the tissue matched each other. Coastlines were drawn on the tissues wherever applicable in order to test accuracy in matching. Everything matched perfectly, and the bathymetric lines projected on the wall were traced onto the tissues. The tissues were then laid under the mylar maps with the lease blocks already on them and inked in.

In producing the series of 1:1,000,000-scale maps for each task group, the advantages of the diazo process again were utilized. A series of plastic sepias were printed from one original, drawn on mylar. The plastic sepia process, as an intermediate step, is even less expensive than the plastic autopositive process.

Figure IV-7 presents the locational key for these maps and indicates the new maps made for this study.

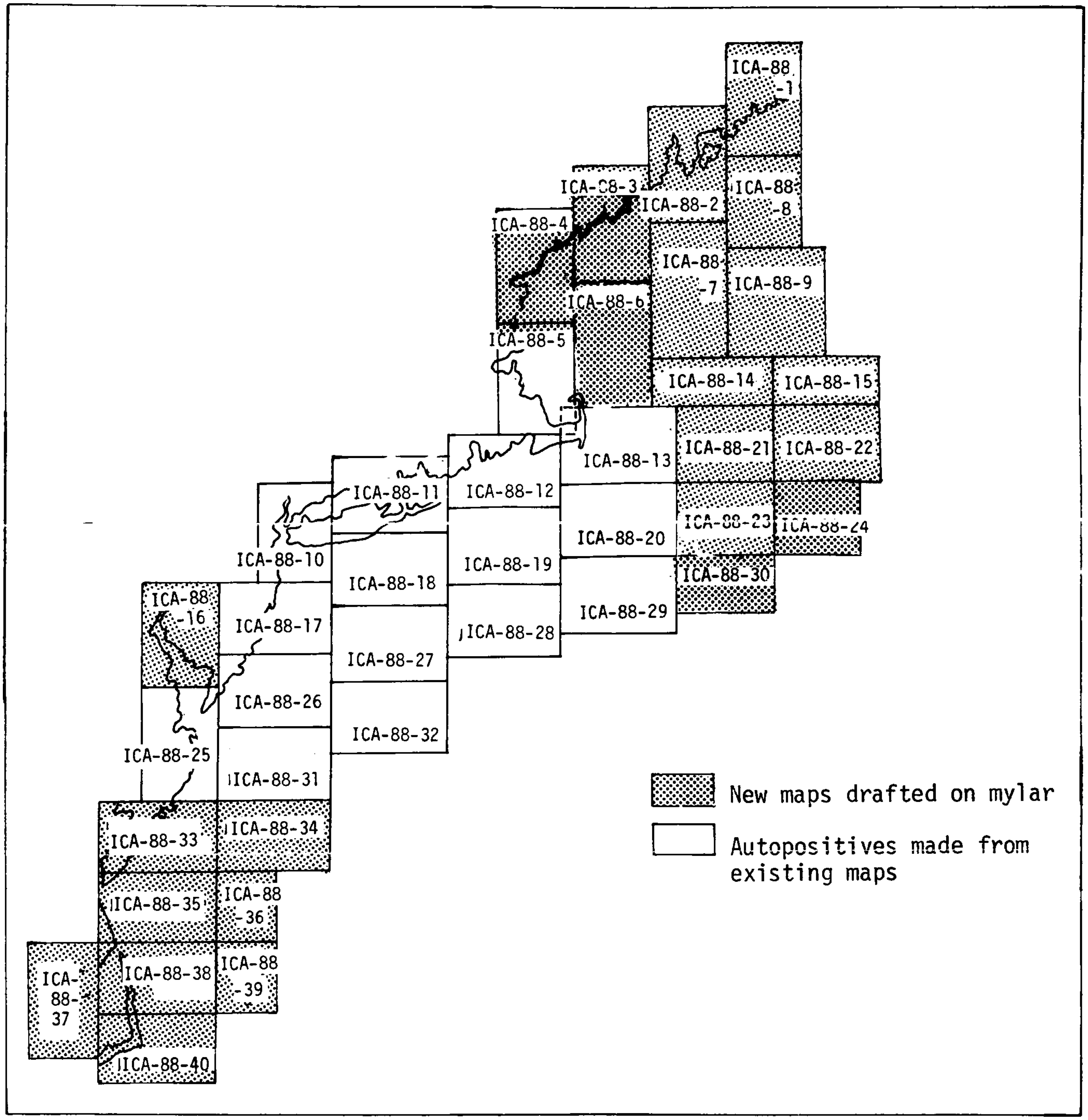


Fig. IV-7
Location diagram for 1:125,000 scale map set identifying those maps created by the ICA.

3.0 SUMMARY OF RESULTS OF PREVIOUS STUDIES

The following summaries describe the results obtained in the three special studies undertaken for previous volumes of this project. These described the CS's physical environment, its archaeology and paleontology, and its Historic Period shipping patterns. The findings of these special studies are hereby integrated into this volume and related to expected impacts from natural and manmade processes. The results of this integration will be used to make our management recommendations concerning cultural resources on the CS.

3.1 Physical Environment

The study's goals of locating major shelf features and describing the shoreline positions through time have been accomplished with a degree of accuracy limited only by the scale of the existing data. In some (very few) cases this accuracy is reasonably well refined, while in other cases, the results are strictly representative of hypotheses or best guesses. Shoreline positions have been described at 3,000-year intervals. These data provide the seaward limits of archaeological sites of different time periods. For instance, possible sites of the Paleo-Indian Period may be found anywhere on that portion of the CS that has been exposed since about 15,000 B.P. as well as on land presently exposed, while sites of the Archaic Period will not be found further seaward than the identified position of the 9000 B.P. shoreline. Identification of the major shelf features and analysis of the effect of transgression on the pre-transgressive exposed land surfaces (subaerial surfaces) have made it possible to predict the relative amount of preserved sub-areal surface on the Shelf. While the predictions are based on the expected percentage of preserved surface per unit area, this figure does not refer to the percentage of any one site which may be preserved, but to the percentage of unit area that may remain intact. That percentage may thus contain all or none of the sites originally present, or any number in between, assuming site distribution is asymmetrical. The expected amount of preserved surface is assigned to one of seven categories:

1. Considerable subaerial preservation on the basis of published data
2. Considerable subaerial preservation deduced hypothetically
3. Partial subaerial preservation on the basis of published data

4. Partial subaerial preservation deduced hypothetically

5. Negligible subaerial preservation on the basis of published data

6. Negligible subaerial preservation deduced hypothetically

7. No preservation

"Considerable" generally means an expected preservation of from 40 to 100% of the subaerial surface per unit area. In buried river valleys we can expect close to 100%, while on the valley slopes we can expect closer to 40%. "Partial" generally means preservation of from 5-40%. Negligible preservation generally means less than 5% preservation. Figure IV-8 illustrates the concept.

The vast majority of these predictions are deduced hypothetically from the available data and thus their accuracy is yet to be proven. Our recommendations for pilot studies are formulated partially around the need to verify these predictions.

3.2 Archaeology and Palaeontology

Volume II of this report presents discussions of the former distribution of plants and animals in the project area and of the archaeological culture believed to have been present there. Through the study of palaeontological remains, past environments on the CS have been reconstructed, with special emphasis on resources which could have been valuable to human occupants of the area and which are believed to have exerted strong influences on the location of human settlements.

Models of human settlement on the CS were derived by two methods. On the one hand, data were assembled on archaeological sites known from areas contiguous to the project area which have not been inundated by rising sea levels. Using these data, patterns of settlement were derived for different periods, site types, and portions of the project area (Table IV-1). These patterns, it is argued, can be extended to portions of the project area, with certain reservations, which are discussed in Volume II. Optimal foraging theory, a body of ecological theory concerned with the patterns of subsistence followed by populations in different types of environments, was also applied. Next, using the reconstruction of environment, models of human settlement in different zones were developed. These two sets of models -- one derived from archaeological data from adjacent areas, the other from theoretical expectations -- were combined to form a final model of settlement pattern believed to be the best approximation possible. The absence or virtual absence of direct archaeological evidence from the study area necessitates the use of such relatively indirect methods of prediction. The

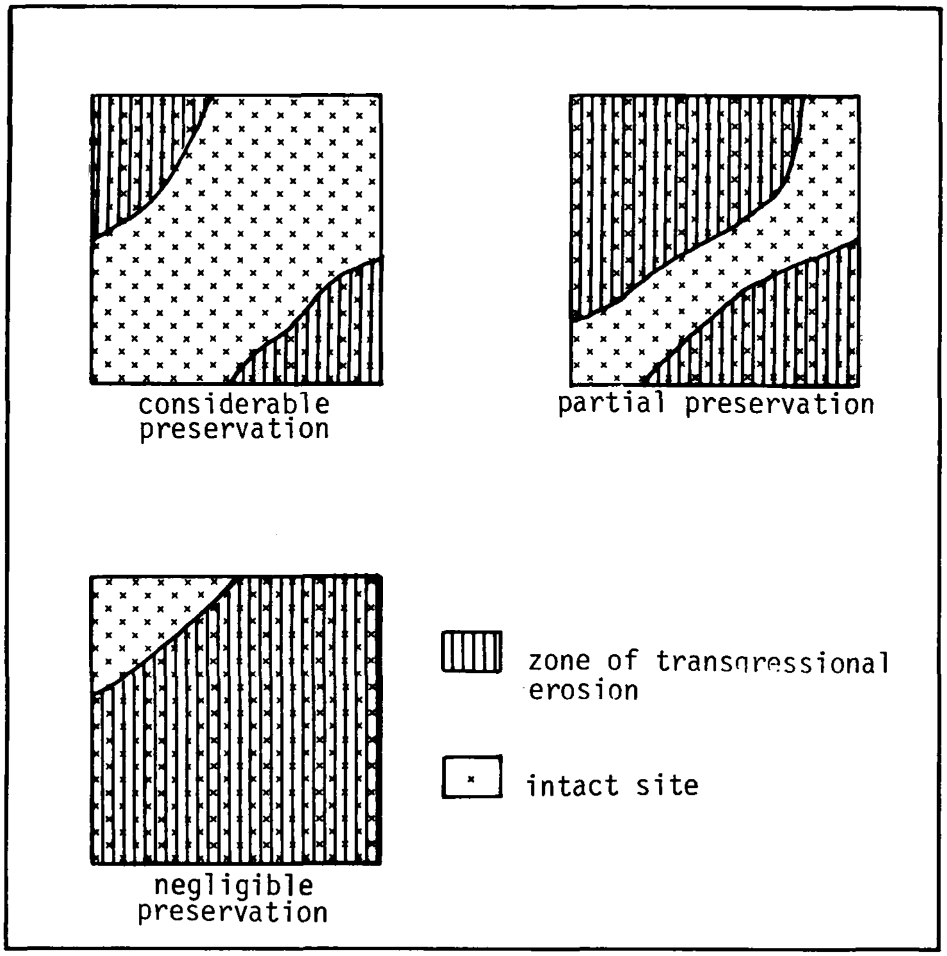


Fig. IV-8: Example of types of expected preservation of archeological sites for unit area.

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras.

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
Maine	18,000-12,000	under glacier or sea		none				
	12,000-9,000	full coastal	seal hunting camp	low	small			
		estuarine	fishing camp	low	small		X	near falls, rills, rapids, and narrows
		inland valley	fishing camp	low	small		X	near falls, rills, rapids, and narrows
		upland	habitation	low	small			wide variety; especially lakesides
	9,000-6,000	full coastal	seal hunting camp, shell midden	low-medium	small-medium	X		
		estuarine	fishing camp, shell midden	medium	small	X	X	

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		inland valley	fishing camp	low, in-creasing	small		X	stream or river shores; near falls, rills, rapids, and narrows
		upland	habita-tion	low, in-creasing	small			
	6,000-3,000	full coastal	shell midden	medium	small-large	X		near shellfish beds; near sizable waterways with access to open sea
		full coastal	black earth midden	low?	medium-large			
		full coastal	other habita-tions	--	--			
		estuarine	shell midden	medium	small-large	X		near shellfish beds; near sizable waterways with access to open sea
		estuarine	fishing camp	medium	small-medium		X	near falls, rills, rapids, and narrows

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		inland valley	fishing camp	medium	small-medium		X	near falls, rills, rapids, and narrows
		inland valley	other habitations	--	--			
		upland	habitation	low	small			
	3,000-present	full coastal	shell midden	high	small-large, mean 20 ft diameter	X		near shellfish beds; elevation usually less than 5 ft above present sea level; protected shores; southwest or south-facing slopes
		full coastal	black earth midden	medium?	medium-large			
		estuarine	shell midden	high	small-large, mean 20 ft diameter	X		near shellfish beds; elevation usually less than 5 ft above present sea level; southwest or south-facing slope

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		estuarine	fishing camp	high	small-medium		X	near falls, rills, rapids, and narrows
		inland valley	fishing camp	high	small-medium		X	near falls, rills, rapids, and narrows
		inland valley	other habitations	--	--			
		upland	habitations	low	small			
Southern New England	18,000-12,000	full coastal	seal hunting camp	low	small			
		estuarine	fishing camp, other habitations	low	small		X	
		inland	fishing camp, other stations	low	small		X	

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		upland	habitation	low	very small			
	12,000-9,000	full coastal	seal hunting camp	low	small			
		estuarine	shell midden, fishing camp	low	small	X	X	
		inland valley	fishing camp, other habitations	low	small-large		X	
		upland	habitation	very	small		X?	wide variety; near small rivers and streams especially; usually below 400 ft above present sea level, often on landforms higher than surrounding terrain
	9,000-6,000	full coastal	shell midden	medium	small-medium	X		

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		estuarine	shell midden, fishing camp	medium	small-medium	X	X	
		inland valley	fishing camp, other habitations	low-medium	small-medium		X	near falls, rills, rapids, and narrows; well drained soil/locally high ground/less than 8% slope; usually below 100 ft above present sea level; zones with 20% or greater oak pollen
		upland	camp	low	small			above 200 ft above present sea level; zones with 20% or greater oak pollen; well drained soil/locally high ground/less than 8% slope/stream or small river shores
	6,000-3,000	full coastal	shell midden	high	small-large	X		near shellfish beds; protected shores; well drained soil/locally high ground/less than 8% slope
		estuarine	shell midden	high	small-large	X	X	near shellfish beds; well drained soil/locally high ground/less than 8% slope

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		estuarine	fishing camp	medium-high	small		X	near falls, rills, rapids, and narrows; well drained soil/locally high ground/less than 8% slope; sometimes at estuary heads
		inland valley	fishing camp, other habitations	medium-high	small			near falls, rills, rapids, and narrows; well drained soil/locally high ground/less than 8% slope; all elevations
		upland	habitation	medium	small			well drained soil/locally high ground/less than 8% slope
		coastal or inland	camp	high	small-medium			all elevations; well drained soil/locally high ground/less than 8% slope/stream or small river shores
		stream or river	fish weir	low-medium	small		X	near fishing camps (see above)

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		inland valley or upland	village	low-medium	large			lowlands; usually below 100 ft above present sea level; well drained soil/locally high ground/less than 8% slope; lake shores
	3,000-present	full coastal	shell midden	high	small-large, mean 80 ft diameter	X		near shellfish beds; protected shores; well drained soil/locally high ground/less than 8% slope
		estuarine	shell midden	high	small-large, mean 80 ft diameter	X		near shellfish beds; protected shores; well drained soil/locally high ground/less than 8% slope
		estuarine	fishing camp	high	small-large		X	often at estuary heads or near falls, rills, rapids, and narrows; well drained soil/locally high ground/less than 8% slope
		inland valley	fishing camp	high	small-large		X	stream or river shores; often near falls, rills, rapids, and narrows; well drained soil/locally high ground/less than 8% slope

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		coastal or inland	camp	high	small-medium			predominantly lowland, below 200 ft above modern sea level; well drained soil/locally high ground/less than 8% slope/stream or small river shores
		inland	rock-shelter	low	small			protected area near rock out-crops or cliffs
		upland	camp	low-medium	small			above 200 ft above present sea level; well drained soil/local-ly high ground/less than 8% slope/stream or small river shores
	900-15,000 A.D., in particular	estuarine	fishing camp	medium-high	large		X	estuary heads; well drained soil/locally high ground/less than 8% slope
		full coastal or estuarine	habita-tion	high	small			associated with and near shell middens (see above)

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		inland valley	village	high	large			lowlands; arable and fertile soil; usually on floodplains; well drained soil/less than 8% slope
		inland valley	farm-stead	high	small			lowlands; arable and fertile soil; usually on floodplains; well drained soil/less than 8% slope
Mid-Atlantic	18,000-15,000	full coastal	camp	very low	small			
		estuarine	fishing camp	low	small		X	
		inland valley	fishing camp	low	small		X	
		upland	camp	low	very small			
	15,000-12,000	full coastal	camp	very low	small			

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
		estuarine	fishing camp	low	small		X	
			shell midden	low	small	X		
		inland valley	fishing camp	low	small		X	
		upland	camp	very low	very small			
	12,000-9,000	full coastal	shell midden	medium	small-medium	X		
		estuarine	fishing camp	medium	small-medium		X	
			shell midden	medium	small-medium	X		
		inland valley	fishing camp	medium	small-medium		X	along small to medium sized rivers; areas of contemporary coniferous swamps

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
			other camp I	medium	very small to small			sandy coastal plain; near "pingos"
		upland	other camp II	low	small-large			upland bluffs; ridge tops; near permanent water
	9,000-6,000	full coastal	shell midden	medium	small-medium	X		
		estuarine	fishing camp	medium	small-medium		X	
			shell midden	medium	small-medium	X		
		inland valley	fishing camp	medium	small-medium		X	along small to medium sized rivers; areas of contemporary coniferous swamps
			other camp I	medium	very small to small			sandy coastal plain; near "pingos"
		upland	other camp II	low-medium	small-large			upland bluffs; ridge tops; near permanent water

Table IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
	6,000-3,000	full coastal	shell midden	medium-high	small-large	X		along protected coasts
		estuarine	fishing camp	high	small-large		X	along small to medium sized rivers; at falls, rills, rapids
			shell midden	high	small-large	X		near shellfish beds
		inland valley	other camp I	medium-high	small-medium		X	in piedmont; near permanent water, wide variety of habitats
			other camp II	medium-high	small-very large			on coastal plain; near permanent water; wide variety of habitats
		upland	other camp II	medium	small-medium			on coastal plain; near permanent water; wide variety of habitats
	3,000-present	full coastal	shell midden	very high	small-large	X		along lagoons; on barrier islands; protected shores; near shellfish beds

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
			black earth midden	high	small-medium			along lagoons; headlands and protected embayments
		estuarine	shell midden	very high	small-large	X		along estuaries; near shell-fish beds
			fishing camp	medium	small-medium		X	along estuaries of small to large rivers; at falls, rapids, rills
			black earth midden	high	small-medium			along estuaries; headlands and protected embayments
		inland valley	fishing camp	medium	small-medium		X	along small to large rivers; at falls, rapids, rills
			other camp I	medium	small, less than 100 ft diameter			in piedmont; near permanent water; wide variety of habitats

TABLE IV-1. Summary of predictions, final model of settlement, outer continental shelf from the Bay of Fundy to Cape Hatteras. (cont.)

Subarea	Period, B.P.	Paleo-environment	Site Type	Predicted Site Frequency	Predicted Site Size	Includes Shell Middens	Includes Anadromous Fishing Sites	Locational Attributes
			other camp II	medium-high	small, less than 100 ft diameter (sometimes larger near estuary head)			on coastal plain; near permanent water; wide variety of habitats (low density in New Jersey)
		upland	other camp I	medium	small, less than 100 ft diameter			in piedmont; near permanent water; wide variety of habitats
	900-1,500 A.D.	full coastal	shell midden	very high	small-medium	X		along lagoons; on barrier islands; protected shores; near shellfish beds
		estuarine	shell midden	very high	small-medium	X		along estuaries; near shellfish beds
		inland valley	village	high	large			on arable soils, especially river valleys; usually near coast

final model discusses expected site type, location, size, frequency, and special characteristics and has been translated into graphic form on maps.

In addition to the sections mentioned above, Volume II presents discussions of culture history, the history of previous archaeological research, and other topics. These sections are included to aid the reader by indicating in which periods, topics, and areas present archaeological and palaeontological knowledge is weakest, suggesting possible flaws in models necessarily based upon such knowledge.

3.3 Historic Shipping

An inventory of approximately 2,000 wrecked ships was compiled in the course of developing models for the distribution of wrecked historic shipping. The analysis of the history of shipping, population growth, and published sources of wreck location, has made it possible to predict the locations of wrecked ships of various time periods. The predictions derive from the integration of information on known shipping lanes, expected number of ships of any one period, hazards to navigation, and other elements. As a result of this analysis, it was determined that the 5-fathom and 10-fathom depths are critical boundaries for predicting historic shipping sites of different time periods in much the same way as shorelines of different time periods are critical to predicting the existence of possible archaeological sites. In this context ships from the pre-1880 era can be expected to cluster within the 5-fathom line while ships earlier than 1945 can be expected to be distributed inside the 10-fathom line. This does not rule out the existence of ships of these periods outside these boundaries. These boundaries define zones of highest probability for containing ship wrecks of the different periods. Zones located outside these limits are zones of lower probability and will affect the recommendations for locational strategies. Figure IV-9 illustrates the expected distribution of ships of all periods as a function of water depth.

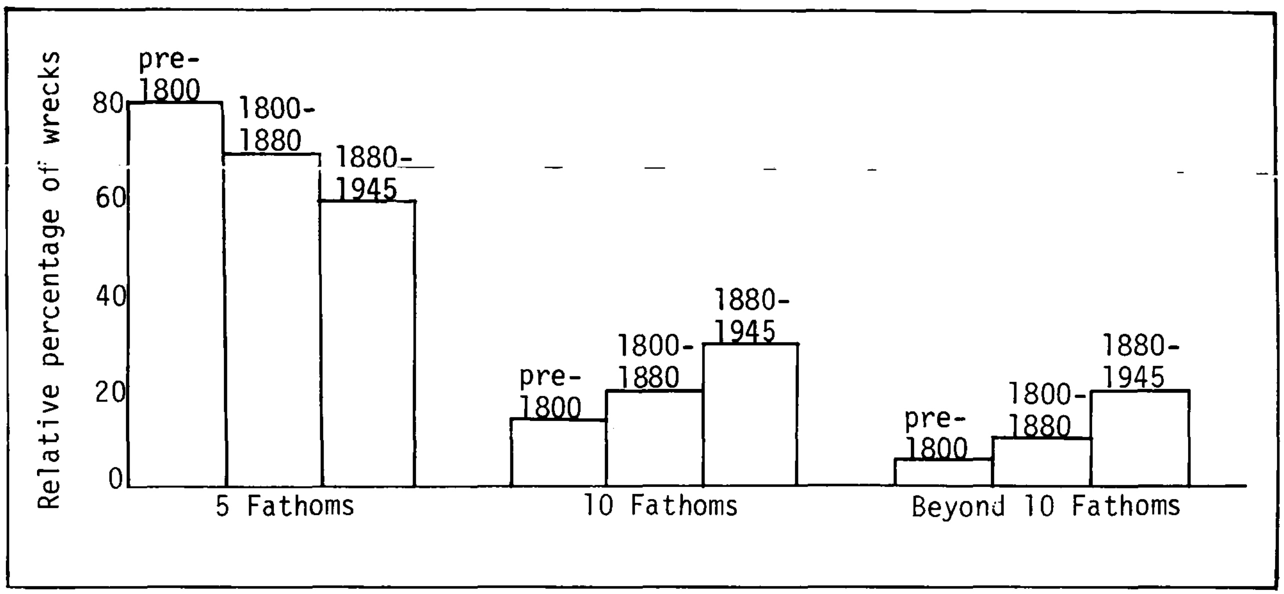


Fig. IV-9

Relative wreck densities for the three time periods studied.

4.0 LOCATIONS OF RESOURCES

As has been stated several times and in several different ways throughout this study, it is highly probable that virtually every square inch of the CS contained at one time or another the remains of either prehistoric peoples, sunken shipping, or refuse from the Historic Period cities, all of which have the potential for meeting the criteria of eligibility for inclusion in the National Register of Historic Places (Ref 36 CFR 800.10). Volumes II and III of this study discuss the known and potential prehistoric and historic cultural resources and their expected distribution. All other things being equal, this situation would require that resource managers implement intensive locational studies prior to development in order to meet the requirements of historic preservation legislation. While the conclusions drawn from the assessment of geological data give rise to models for offshore processes rather than to explicit maps showing preserved subaerial surfaces, these models become important factors in deciding the level of survey that will make it possible to comply with historic preservation legislation in the most cost-effective manner.

4.1 General Identification of Zones of Cultural Resource Potential

The identification of zones on the CS that have the potential for containing significant cultural resources results from a process of correlating all the available data (site locations, zones of probability, preserved former subaerial surfaces) and plotting the results on the large-scale maps. The correlation process takes the form of superimposing maps on which zones of prehistoric and historic potential have been plotted. The result is overlaid on the maps of predicted subaerial-surface preservation or severe disturbance. The final result is a complex but useable overview.

The fact that zones of high resource potential are identified does not mean that resources existing in these zones will be encountered, either intentionally through locational surveys, or accidentally through land use. At present, little is known about the actual kinds of data that are preserved in sites that have been inundated on the CS. However, studies by the National Park Service (NPS) (Lenihan and others 1977) indicate a significant range of data may be preserved. These data sources can include bone, shell, seeds, and soil discolorations, as well as stone tools, etc. This being the case, it seems clear that locating such subtle indications with today's technology is a difficult job. In

this study we have identified zones of high potential for containing prehistoric resources and recommended various subsurface testing strategies for actually locating the sites. Sunken shipping, on the other hand, is in general less difficult to locate than prehistoric sites. The unique features of ships, such as shape, presence of metal, etc. lend themselves to types of locational techniques that are somewhat different from those used to locate prehistoric sites. In the case of historic shipping, remote sensing takes the place of subsurface testing.

Because of various restrictions (depth, currents, etc.) on how and where locational techniques are used, we have identified zones where different combinations of strategies will maximize the possibility for locating resources. These zones are plotted in the same way as the zones of site potential and constitute our final recommendations for site-location strategies.

4.2 Detailed Location of Resources

Before resource managers or land users can identify the actual impacts to archaeological sites, it is important to locate any known cultural resources that may occur in the area of proposed impact and also to designate any zones that are considered likely to contain so-far unidentified resources. (These zones will hereafter be termed probability zones, or cultural resource zones.)

The locations of known prehistoric archaeological sites, known Historic-Period shipwrecks, and designated cultural resource zones are displayed on Maps ICA-88-1 through ICA-88-41. Additional environmental, cultural and other descriptive data relating to known sites (both prehistoric and historic shipping) have been placed on computer tapes and delivered separately to the BLM under the terms of this contract.

Figure IV-10 shows the key for interpreting data designations on these map sets. Six possible lease blocks were determined to be the maximum for this study, as described in Table IV-2. This decision was further influenced by computerization requirements as well as by analysis of accumulated data.

The number of possible lease blocks which can contain the remains of a specific ship represents in effect a measure of probability that a given block may contain that ship. For example, 1 indicates that we know that a particular ship is this block, 2 indicates that there is a 50% probability that the ship can be in this block, 4 indicates that there is a 25% probability that the ship is in this block, 6 indicates that there is a 16.7% probability that the ship in in this block.

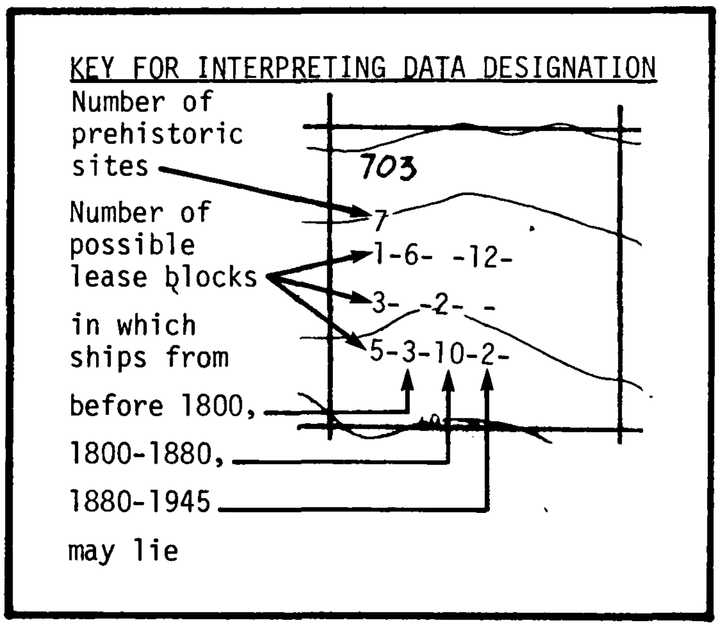


Fig. IV-10

Key for interpreting data designation on 1:125,000 scale map sets. In lease block 703 we have 7 known prehistoric sites, 6 ships from before 1800, and 12 ships from 1880-1945. Two ships from 1800-1880 may lie either in this block or in 1 of 2 others (33.3% probability); and 3 ships from before 1800, 10 from 1800-1880, and 2 from 1880-1945 may lie in this block or 1 of 4 others (20% probability).

Table II-2: Illustration of method for designating 6 lease blocks as the maximum number possible.

Preliminary Analysis of First 959 Reports Which Could Be Assigned to Lease Blocks, Performed by Historic Shipping Group:

	1	2	3	4	5	6	7	8	9	10	Total
Maine											0
Mass.	87	81	61	61	18	4	3	1	1	2	319
R.I.	27	20	8	6		9	2	3			75
Conn.	12	6	3	6		2					20
N.Y.	15	47	27	38	14	22	2		9	10	184
N.J.	20	63	29	48	12	14	2	3	2	1	194
Del.	5			4							9
Md.											
Va.	37	14	12	13	8	2		2			88
N.C.	42	5	3	16						4	70
Totals	245	236	143	192	52	53	9	9	12	17	959
Accumulated Totals		481	624	816	868	921					
÷ 959=	26%	50%	65%	85%	90%	96%					

Note: Since 96% of the reports could be assigned to 6 blocks or fewer, we defined the limit at 6 and recorded as the maximum, 6 blocks plus the x-code on the computer site data form.

4.2.1 Historic shipping

This section is designed to be used in conjunction with the 1:125,000 map set, but can stand by itself when used with the maps that appear in this section. This latter scale will be used here to locate generally those zones described in Table IV-3. We have identified and described separate historic shipping zones, their expected contents, what wrecks are known to be located in them, and what density of lost shipping of all periods they are predicted to contain. These zones were identified on the basis of several variables. These are:

1. Bathymetry and the predictions made by the various models regarding depths of shipping concentrations lost.
2. The groups involved in shipping at different time periods, as the Dutch, the English, etc.
3. The incidence of early (pre-1630) exploration.
4. Location of major and minor shipping lanes after 1630.
5. Direction of currents into and out of heavily traveled shipping lanes.
6. The known inventory as developed in this project, sometimes separated by time period.
7. The expected density, based on a combination of factors.

The following figures (IV-11 to IV-20) illustrate the various zones which are described in Table IV-3. A detailed presentation of the locations of the wrecks inventoried is presented on the 1:125,000 scale maps.

Definition of the terms used in the columns identified as "Known Inventory" and "Predicted Density" have in general been derived from the subjective evaluation of the existing record of known sites and past shipping densities. For the purposes of this report the following definitions of these terms are used:

1. None

   In the case of known inventory this means that no wrecks were identified in this zone in the course of this study. In the case of predicted density it means that we know of no wrecks and due to factors such as depth, scour, etc. we expect none to exist.

2. Very Light

   In the case of known inventory, this generally means that we know of one to two ships from all time periods which may each be in any one of six or more lease blocks in the zone.

   In the case of predicted density it implies a very small and random distribution of lost shipping.

3. Light

   This term generally means that several ships of all time periods (known only to an accuracy of six or more lease blocks) exist or are predicted to exist in the zone.

4. Moderately Light

   In both known and predicted categories, this term means that not only are several ships known (to an accuracy of six or more lease blocks) to exist in the zone, but that a small number (between one and five) are known to an accuracy of between three and six lease blocks (33% to 17% probability per lease block). Predicted density is similar, even though known density may be less.

5. Moderately Heavy

   For both known and predicted categories, the term means that more than five ships are known to exist within the zone to an accuracy of more than six blocks. At the same time, several ships may be known to a lease block or to within two to three blocks (50%-33% probability per block) while more will be known to within four and six blocks (25%-17% per block).

6. Heavy

   A large number of ships are known to exist in the zone at an accuracy of six or more blocks, while several ships are known to exist within each block and many more are known to exist to an accuracy within two to six blocks.

7. Very Heavy

   Many ships known to be in individual lease blocks, with more identified at an accuracy of two to

six blocks, and very many (up to 30) known to within six blocks.

Where predicted density differs from known inventory we have relied on an evaluation of the history of exploration, shipping, and population growth to assess the difference between known and expected densities. In general, the places where predicted densities are greater than known densities are in areas in which few data are available but where the histories of the area indicate that the inventory should be greater than that already known.

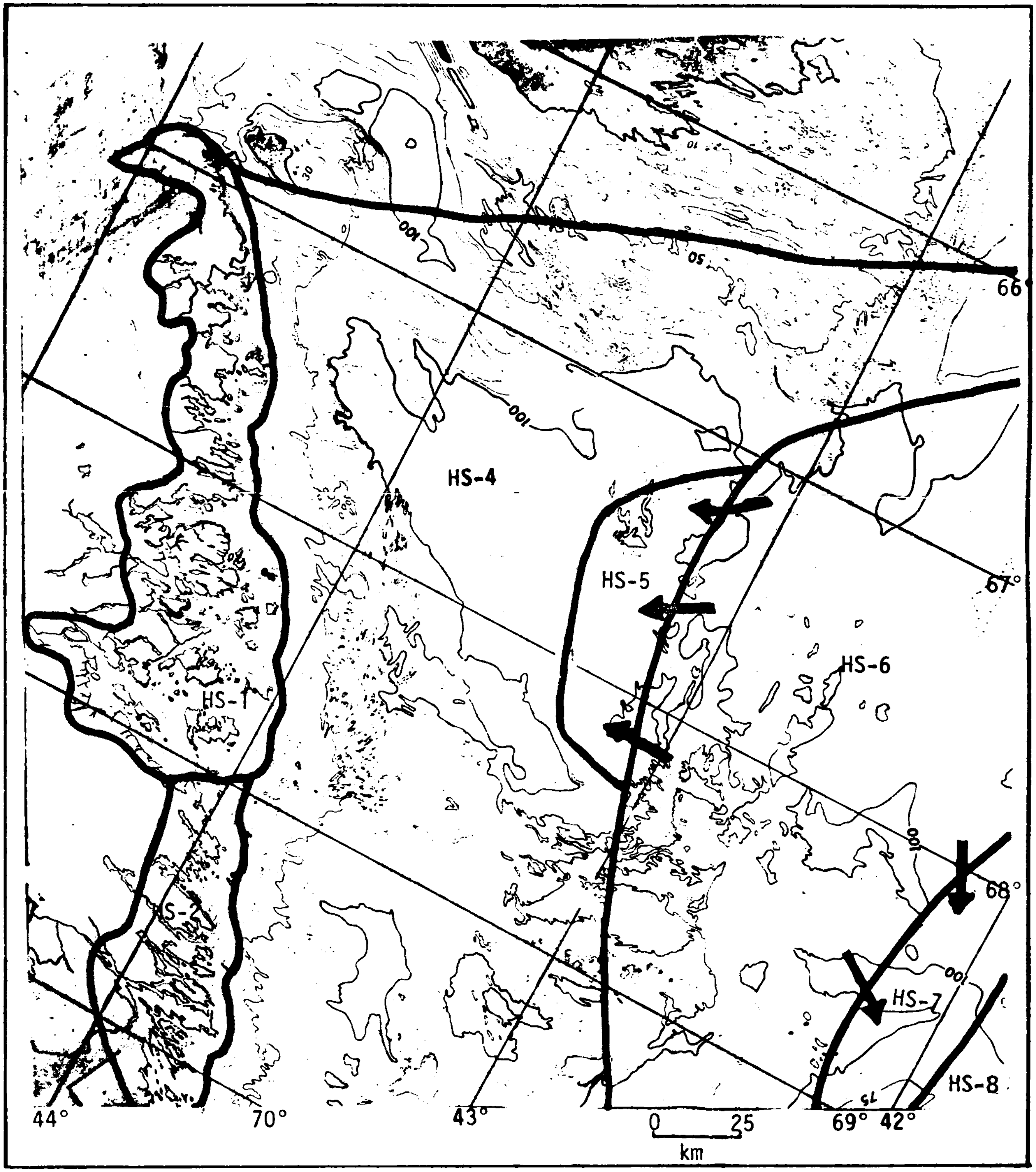


Fig. IV-11

Historic shipping zones: HS-1,-2,-4,-5,-6,-7,-8. Arrows indicate direction ships may have drifted out of the major inbound shipping lanes. (northern Gulf of Maine).

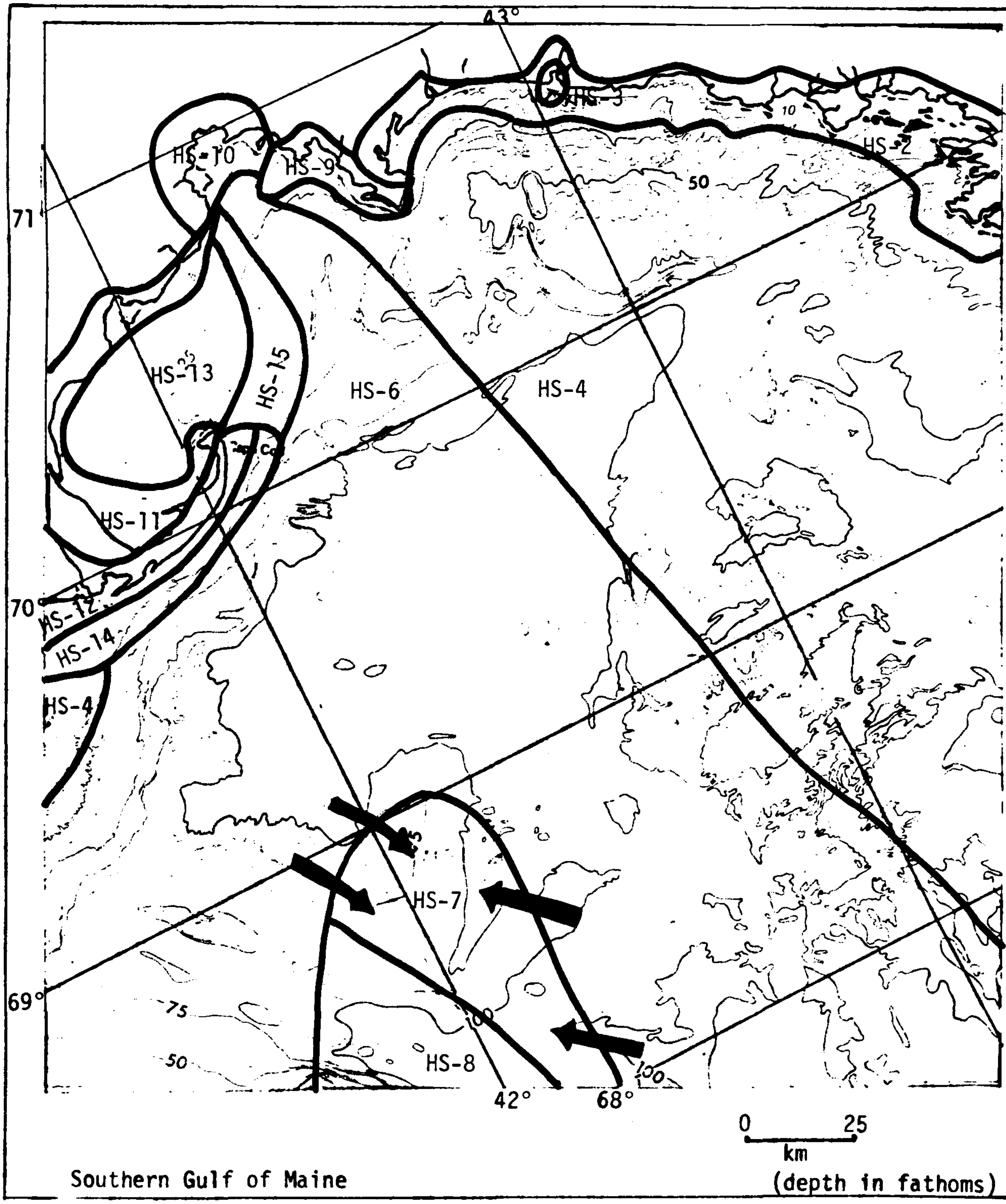


Fig. IV-12

Historic shipping zones: HS-2,-3,-4,-6,-7,-8,-9,-10,-11,-12,-13,-14,-15. Arrows indicate direction ships may have drifted out of the major zone of inbound shipping. (southern Gulf of Maine).

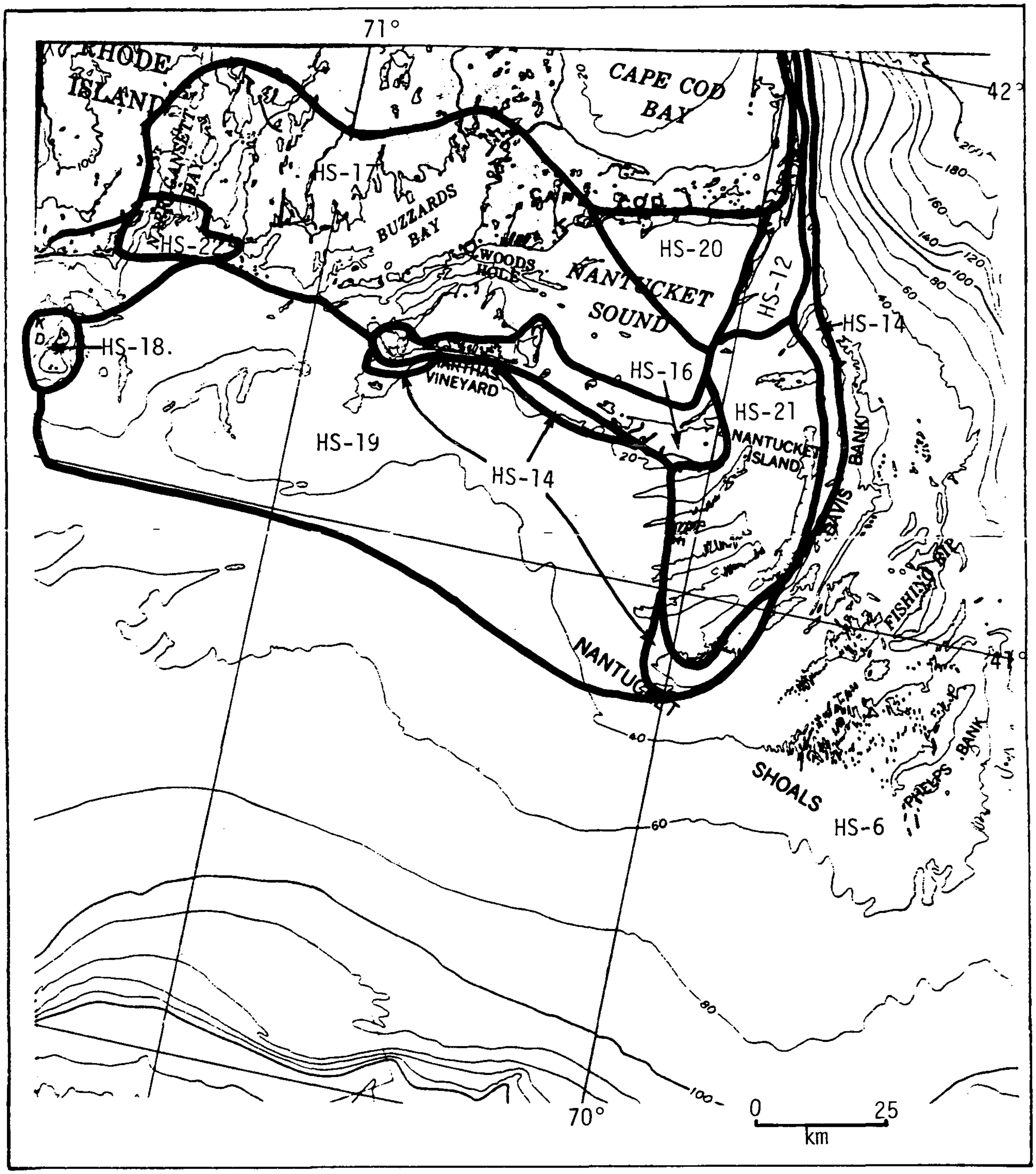


Fig. IV-13
Historic shipping zones: HS-6,-12,-14,-16,-18,-19,-20,-21,-22,-17. (southeastern New England shelf).

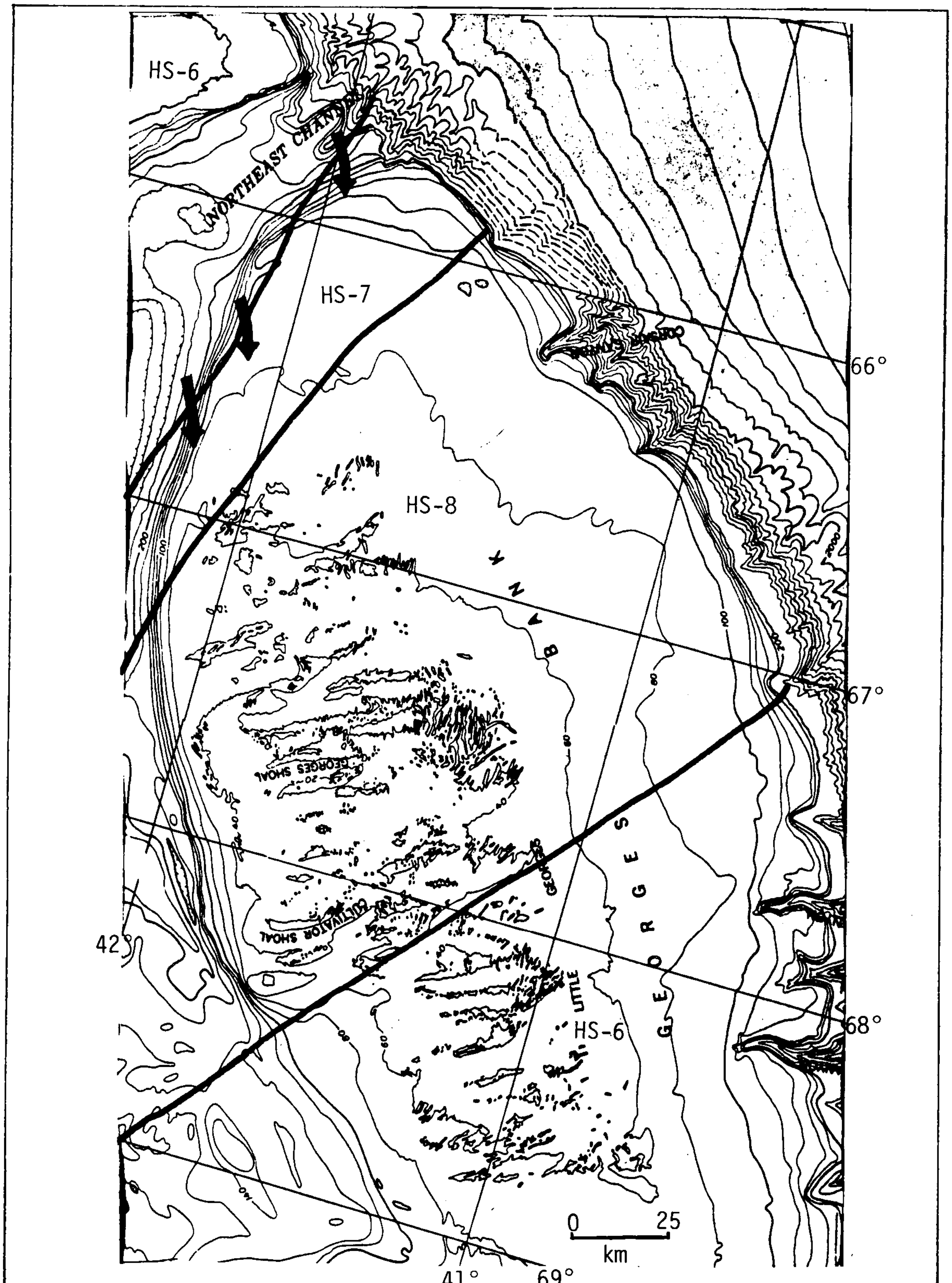


Fig. IV-14

Historic shipping zones: HS-6,-7,-8. Arrows indicate direction ships may have drifted out of the major trade route zone of inbound shipping. (Georges Bank).

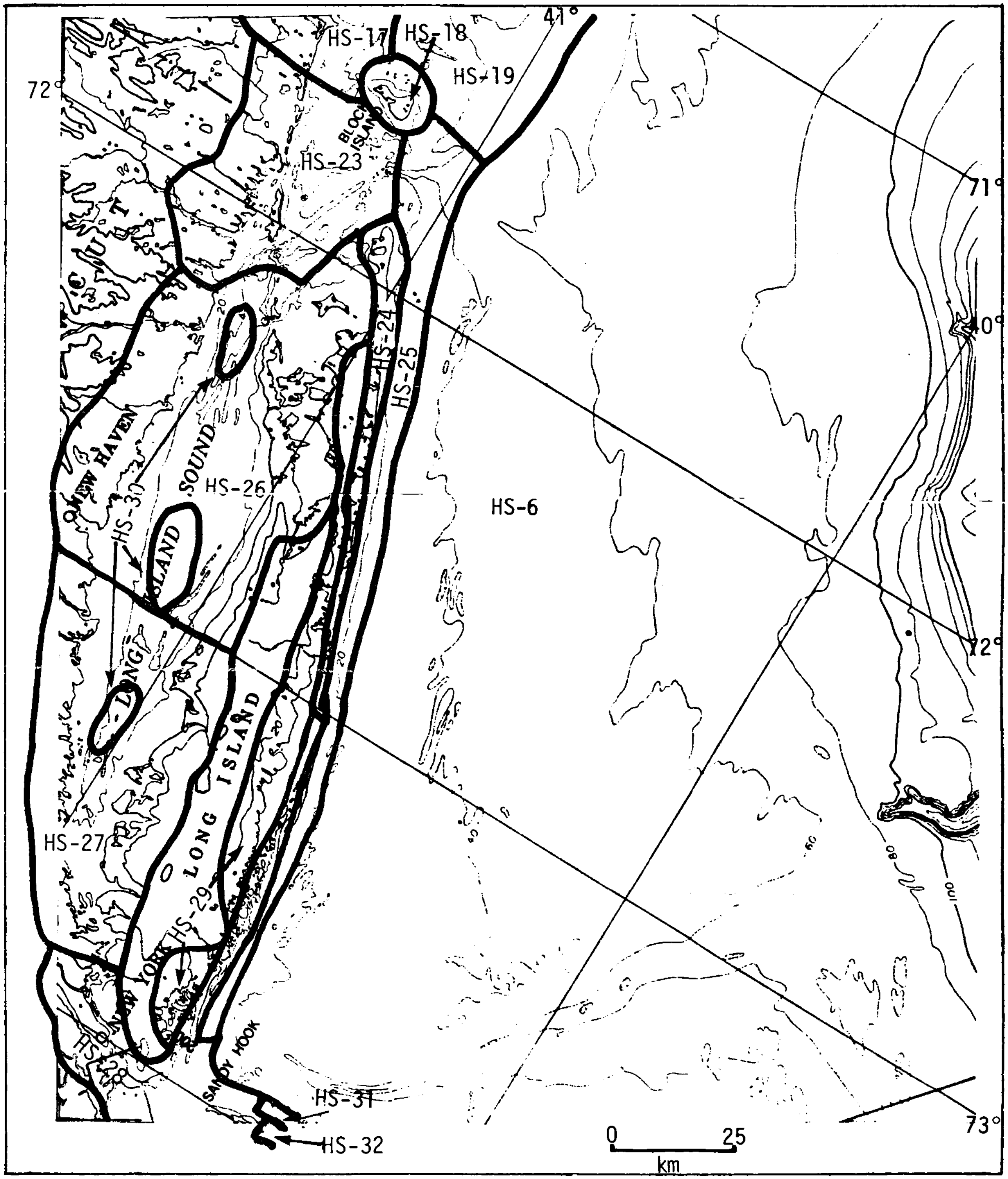


Fig. IV-15
Historic shipping zones: HS-17,-18,-19,-23,-24,-25,-26,-27,-28,-29,-30,-31,-32. (Long Island Sound).

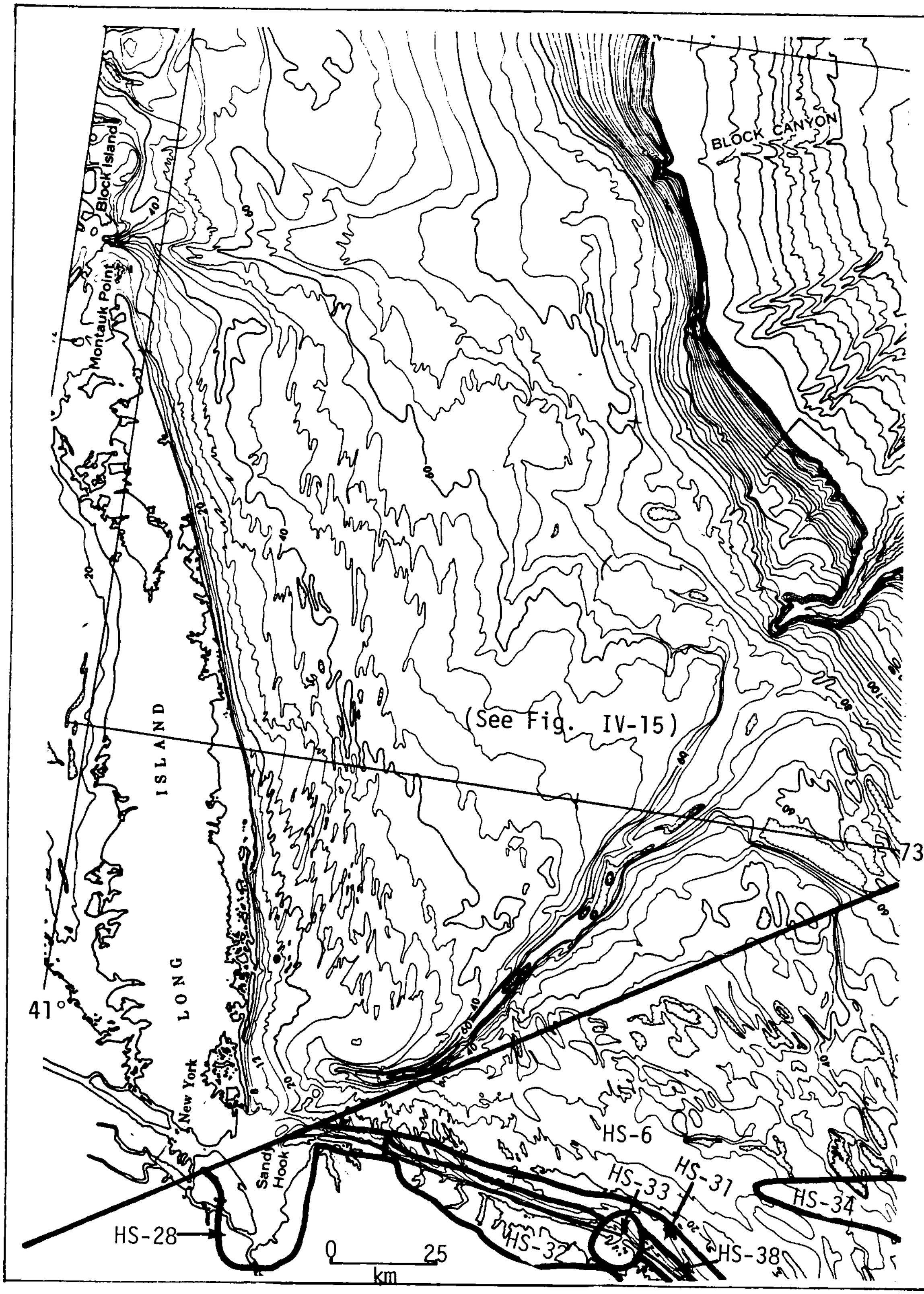


Fig. IV-16
Historic shipping zones: HS-6,-28,-31,-32,-33,-34,-38. (Long Island shelf)

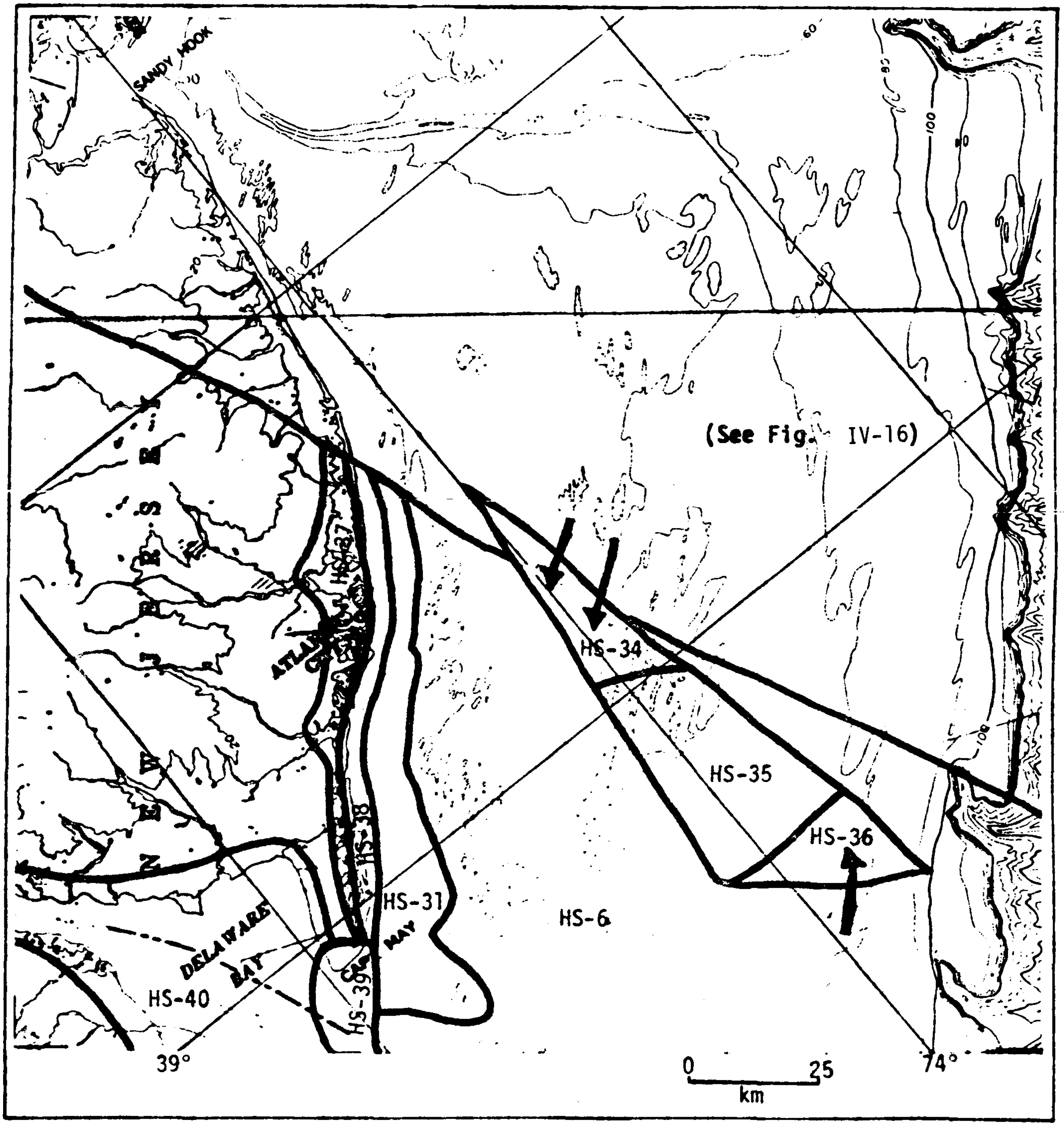


Fig. IV-17

Historic shipping zones: HS-6,-31,-34,-35,-36,-37,-38,-39,-40. Arrows indicate direction ships may have drifted out of the trade route zone. (New Jersey shelf).

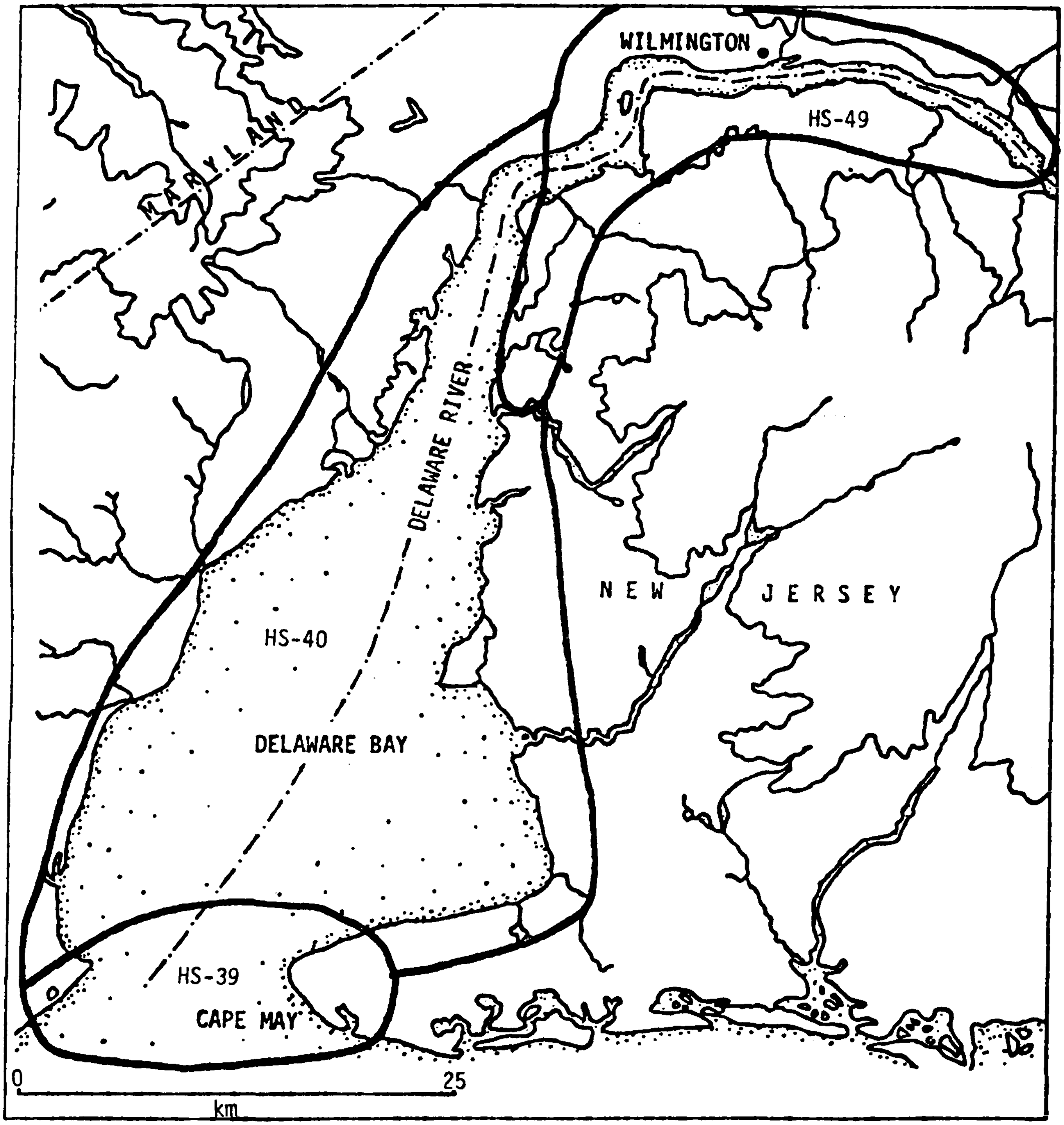


Fig. IV-18
Historic shipping zones: HS-39,-40,-49. (Delaware Bay).

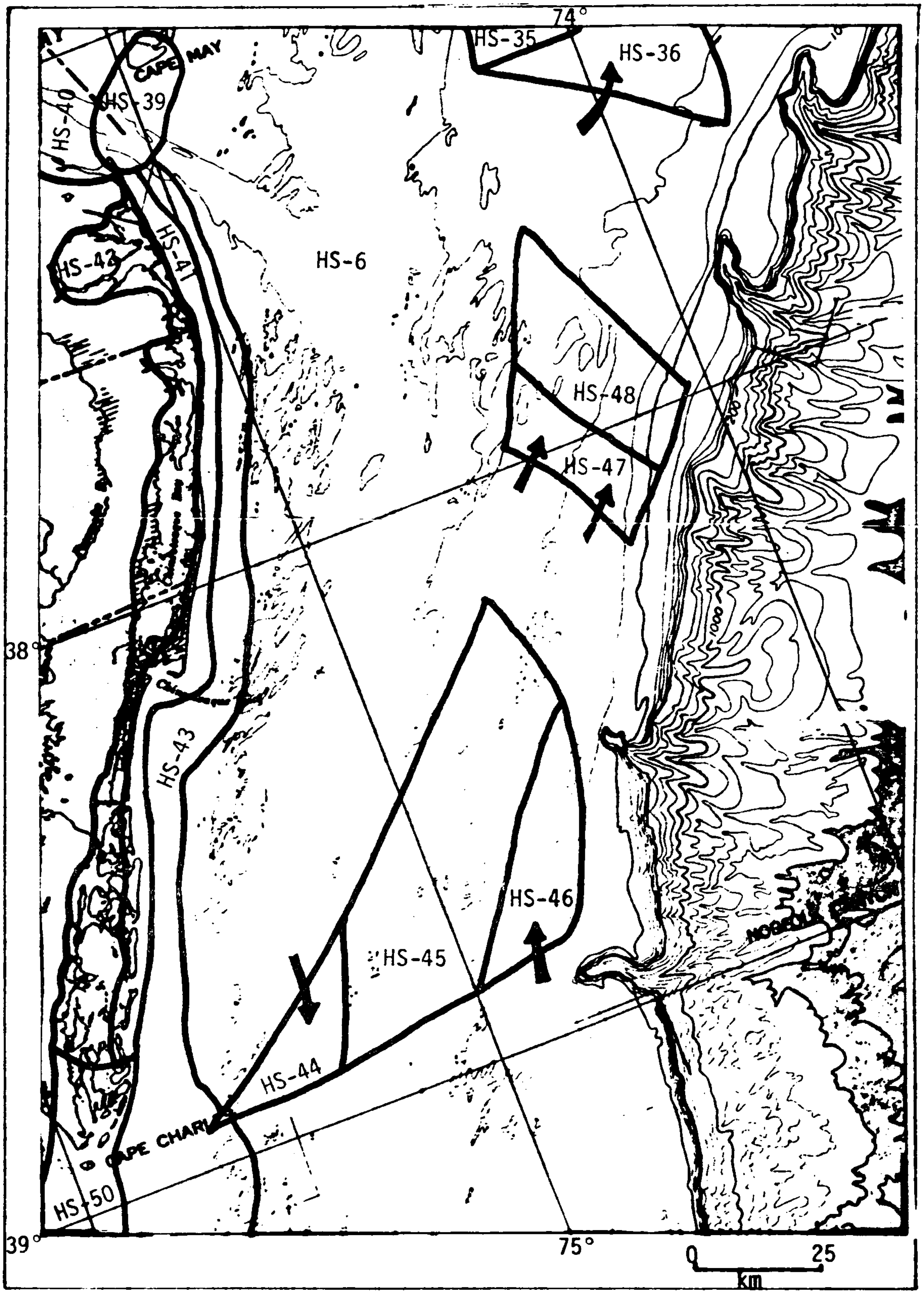


Fig. IV-19

Historic shipping zones: HS-35,-36,-39,-40,-41,-42,-43,-44,-45,-47, -48,-50. Arrows indicate direction ships may have drifted out of the major shipping zones. (Delmarva shelf).

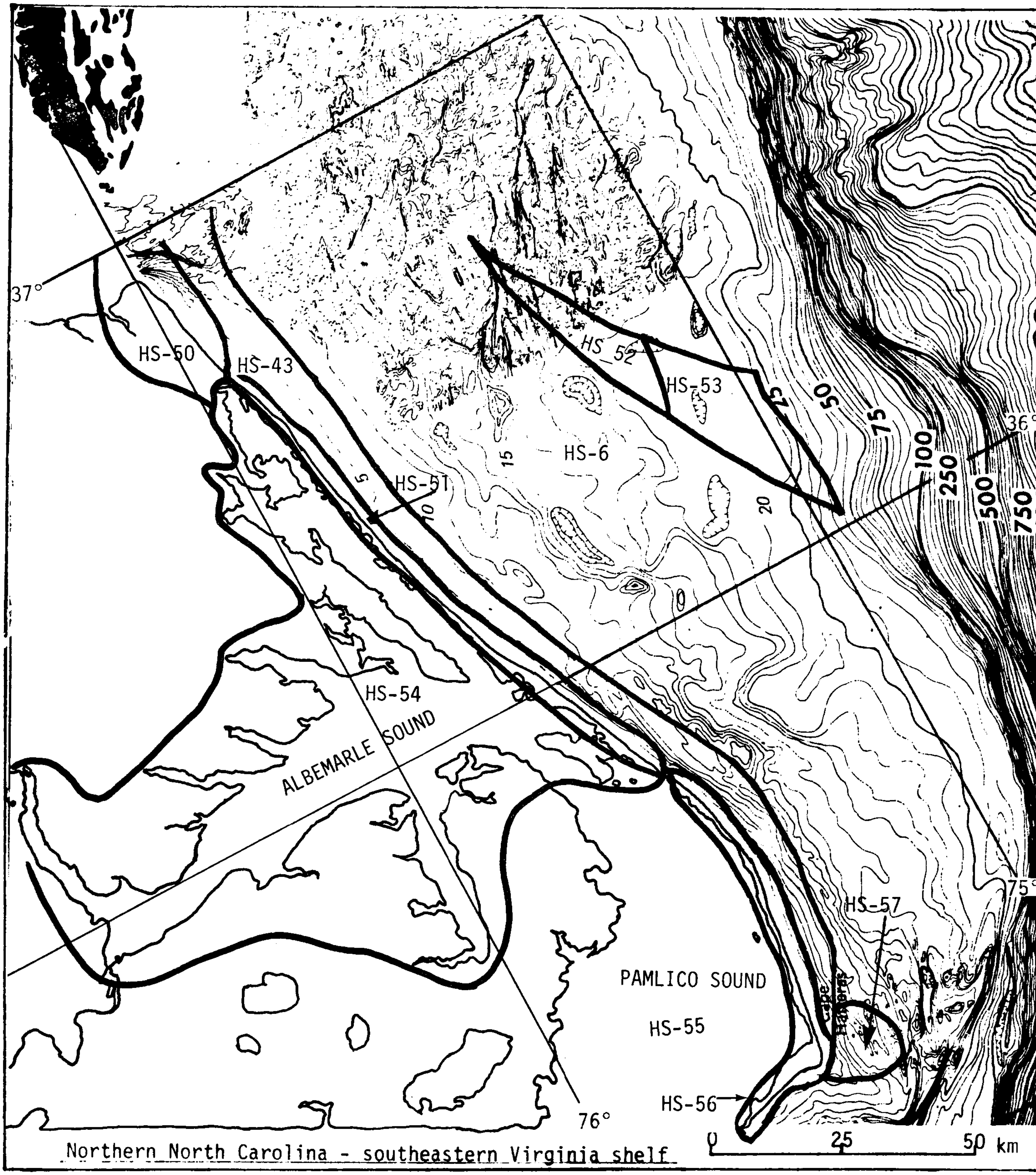


Fig. IV-20

Historic shipping zones: HS-6,-43,-50,-51,-52,-53,-54,-55,-56,-57.

Table IV-3: Detailed description of historic shipping zones.

Description	Expected to Contain	Known Inventory	Predicted Density
HS-1: Inside the 20-fathom line from the St. Croix River to a point south of Vinalhaven Island, and inland to mean high tide influence.	pre-1630: Light shipping associated with French trade. Some evidence of early exploration. 1630-1945: Light shipping associated with coastal trade and fishing.	Light distribution, but generally more accurately known than other zones. Majority in and around major bays.	Light.
HS-2: Inside the 20-fathom line from south of Vinalhaven to Essex bay just north of Cape Ann; excludes HS-3 around Portsmouth, NH inland to mean high tide influence.	pre-1630: Light shipping associated with early fishing and English settlement. May contain evidence of early exploration 1630-1800: Evidence of shipping from minor trade routes; English and American occupation and conflict; French and English conflict. 1800-1945: Light shipping associated with coastal trade, recreation, and fishing.	Light.	Light.
HS-3: Area in and around Portsmouth Harbor inside the 10-fathom line from Cape Neddick to approximately Rye Beach.	pre-1800: Heavy shipping of all types and some evidence of early exploration. 1800-1945: Moderately heavy shipping of all types.	Moderately heavy distribution with a concentration on pre-1800 wrecks.	Heavy.
HS-4: Waters deeper than 20 fathoms and outside major trade routes (HS-6) and drift zone (HS-5).	Randomly distributed shipping of all periods.	Very light.	Very light.
HS-5: Waters deeper than 20 fathoms to westward of HS-6. In the drift zone of the Labrador Current, out of the major sea lanes of principally inbound shipping.	Randomly distributed wrecks. The greater number should be of ocean-going class, but light in tonnage, i.e., those of 1800-1880.	None.	Light.
HS-6: This zone is the largest in the study area. It includes the major shipping lanes outside those zones of highest expected density, i.e., inside the 10-fathom line. This zone includes inbound, outbound, and coastwise major sea lanes. See Chart III-2a for a generalized view of these lanes.	1630-1945: Randomly distributed wrecks of this period. Later wrecks will be localized inside this zone because later lanes were most restricted. However, drift from these zones will fall into these wider areas.	Moderately heavy distribution of shipping of the periods after 1630 randomly distributed in this zone.	Moderately heavy, random distribution of post-1630 shipping.

Table IV-3 (continued): Detailed description of historic shipping zones.

Description	Expected to Contain	Known Inventory	Predicted Density
HS-7: Waters deeper than 20 fathoms to eastward and east-southeast of HS-6 in the area north of 41° north in the drift zone of the Labrador Current out of this major trade route zone of principally inbound shipping. At the far western end may be discovered drift from out-ward-bound shipping drifted in from the south.	Randomly distributed wrecks. These greater numbers should be of oceangoing class, but light in tonnage, i.e., those of 1800-1830.	None.	Light.
HS-8: Eastward of HS-7. This is not included in the inbound/outbound coastwise major shipping lane north of 40°.	Occasional wrecks of all periods, with more emphasis on evidence of early through modern fishing.	None.	Very light.
HS-9: Cape Ann from Essex Bay to Swampscott inside the 20-fathom line to mean high tide influence.	pre-1630: Reasonably dense evidence of early exploration (pre-1614) (English settlements). 1630-1800: Minor trade activities and from the Penobscot (English settlement activity). 1800-1945: Local trading and fishing activity.	Moderately heavy distribution clustering around Cape Ann and Beverly. Beverly distribution tending to be pre-1800 while Cape Ann distribution almost equally over all time periods.	Moderately heavy.
HS-10: Boston Bay and outer islands from a line drawn roughly from Nahant to Strawberry Point. Mean high tide defining inner bounds.	A high density of shipping from all periods. A large percentage from pre-1800. Evidence of early exploration and English occupation.	Heavy distribution, with a large percentage from before 1800.	Heavy.
HS-11: Boston Bay inside the 10-fathom line from Scituate to Provincetown (Race Point).	A distribution of shipping of all periods with clusters close to established points.	Moderately heavy concentrations representing all time periods at Scituate, Plymouth Bay, and Provincetown. Barnstable Harbor concentrating in the years 1800-1880.	Moderately heavy.
HS-12: Heavily traveled zone seaward of Cape Cod inside 5-fathom line from Provincetown to just south of Monomoy Point.	Ships of all periods evenly distributed throughout. Possible strong evidence of early exploration, as almost all exploratory voyages passed close to this zone.	Moderately heavy density of ships of all periods.	Very heavy density of ships of all periods.
HS-13: In Cape Cod, outside the 10-fathom line, and major shipping lanes.	pre-1800: Evidence of early exploration and trade. 1800-1945: Light evidence of shipping related to trade and fishing.	One possible later-period wreck.	Light.
HS-14: A discontinuous zone between the seaward 5- and 10-fathom lines from Martha's Vineyard to Provincetown.	Randomly distributed shipping concentrated in the period 1880-1945.	Light.	Moderately heavy density of post-1880 shipping.

Table IV-3 (continued): Historic shipping zones.

Description	Expected to Contain	Known Inventory	Predicted Density
HS-15: Off Scituate and Strawberry Point, outside zones HS-11 and 13, southeasterly to Provincetown.	Lightly distributed shipping of all periods; some possible evidence of earliest exploration.	Very Light.	Moderately heavy.
HS-16: Inside the 5-fathom line around Nantucket Island, to Martha's Vineyard, and the seaward side of Martha's Vineyard.	High density of shipping of all periods, with clusters of earlier shipping around points off Martha's Vineyard and Nantucket.	Heavy distribution, with the majority in the pre-1800 period and that from 1800 to 1880; pre-1800 wrecks around points of islands.	Heavy.
HS-17: Landward from Nantucket, Martha's Vineyard, and Block Island. Generally inside the 10-fathom line to mean high tide, excluding a limited zone around the mouth of Narragansett Bay.	pre-1630: Evidence of early exploration, Dutch settlement and coastal trading and exploration. post-1630: Evidence of minor coastal trading with some random distribution of ships carried into eastern end by Labrador Current.	A moderately light distribution of ships of all periods, with concentrations of post-1800 shipping between Martha's Vineyard and Cape Cod and in Upper Narragansett Bay.	Light with some clustering in the Cape Cod-Martha's Vineyard region.
HS-18: Inside the 5-fathom line around Block Island.	pre-1630: Light evidence of early exploration; some evidence of the Dutch occupation period. post-1630: Moderately high distribution of shipping related to minor coastal trade routes.	Moderately heavy for shipping of all periods.	Heavy.
HS-19: Landward of major shipping routes from Nanatucket Shoals west to Block Island, bounded by other zones to landward (north).	All periods: Very low, random distribution of wrecks of all periods.	Very light distribution of post-1880 shipping clustering off Martha's Vineyard.	Very light.
HS-20: West of Monomoy Point to Osterville on Cape Cod, inside the 5-fathom line.	Some evidence of early exploration. Early coastal trading vessels of all periods.	Light.	Light.
HS-21: Eastward of Nantucket Island and southward of Monomoy Point, and including portions of the Nantucket Shoals of less than 5-fathoms' depth.	Some small evidence of historic exploration and early Dutch occupation; also randomly distributed shipping of the post-1800 period, carried into this zone from HS-6 by the Labrador Current.	Light distribution of post-1880's shipping.	Moderately heavy distribution of shipping of all periods.
HS-22: Around the mouth of Narragansett Bay.	pre-1630: Evidence of Dutch occupation and coastal activities, possibly light random evidence of early exploration. post-1630: Evidence of coastal trade with increasing but still light coastal and transoceanic commercial shipping bound for Providence.	Moderately heavy for all time periods.	Moderately heavy for all time periods.
HS-23: Between Block Island and Long Island Sound from points deeper than 10 fathoms to mean high tide.	pre-1630: Light evidence of Dutch occupation. post-1630: Evidence of minor coastal trade routes.	Light distribution of pre-1880 shipping along coastline and around Fishers Island.	Light but emphasizing early shipping.

Table IV-3 (continued): Historic shipping zones.

Description	Expected to Contain	Known Inventory	Predicted Density
HS-24: Inside the 5-fathom line on the south shore of Long Island from Montauk Point to the 73rd parallel.	pre-1630: Reasonably dense evidence of early exploration and Dutch occupation. post-1630: High density of all types of shipping associated with coastal trade northeast of New York City. post-1800: Recreational shipping.	Moderately heavy density clustering around Montauk Point, with pre-1880 ships concentrated around bay entrances.	Moderately heavy for all periods.
HS-25: A discontinuous zone running from Block Island along the south shore of Long Island to just off Fort Tilden (L.I.), between the 10- and 5- fathom lines.	Moderate distribution of post-1880 shipping.	Moderately heavy distribution of post-1880 shipping.	Moderately heavy distribution of post-1880 shipping; light random distribution of earlier shipping.
HS-26: Long Island Sound from Orient Point to the 73rd parallel, including Peconic Bay and Gardiners Bay and excluding depths greater than 10 fathoms.	pre-1630: Evidence of early Dutch occupation. post-1630: Evidence of minor shipping lanes. post-1800: Pleasure boating.	Light distribution of shipping, concentrated from 1800 to 1880, predominantly in bays. Light density throughout, 1880-1945.	Light, post-1880. Very little prior to 1880 due to navigation hazards for wind-powered vessels.
HS-27: All of Long Island from the 73rd parallel to Flushing Bay, excluding depths over 10 fathoms.	pre-1630: Evidence of early Dutch occupation and early exploration. post-1630: Shipping associated with minor trade routes. post-1800: Recreational shipping.	Moderately heavy density of randomly distributed ships of all periods. Ships of pre-1800 period cluster toward west end of Sound.	Maybe moderately heavy in western end of zone pre-1800. Light, post-1800. Very little 1800-1880 due to navigation hazards for wind-powered vessels.
HS-28: Inside the 10-fathom line from the 73rd parallel west to junction of Ambrose and Sandy Hook Channels, and south to Long Beach, NJ, including all of New York Harbor and Raritan Bay.	High densities of ships of all periods, clustering in upper and lower New York Bay and around Sandy Hook and the south shore of Long Island. Considerable evidence of early exploration, Dutch and English occupation.	Heavy density of ships of all periods; very heavy density of pre-1800 shipping.	Very light.
HS-29: A discontinuous zone of southern Long Island inside the outer beaches and including the landward side of most bays east to the 73rd parallel.	pre-1630: Evidence of early Dutch occupation. post-1630: Evidence of early colonial occupation and coastal trade. post-1800: Recreational.	Light distribution of ships of all periods.	Light.
HS-30: A discontinuous zone in Long Island Sound Sound containing areas deeper than 10 fathoms.	Very light, randomly distributed shipping of all periods.	Very light, 1800-1880.	Very light.

Table IV-3 (continued): Historic shipping zones.

Description	Expected to Contain	Known Inventory	Predicted Density
HS-31: From Long Beach, NJ south to south of Cape May between the 5- and 10-fathom lines, with a satellite subzone at approximately 73°45' and 39°45'.	post-1880: Shipping associated with coastwise trade, recreation, and fishing.	Very light distribution of post-1800 shipping, clustered at far northern end.	Light distribution of post-1880 shipping.
HS-32: Inside the 5-fathom line from Long Beach, NJ to just north of Barnegat Inlet.	pre-1630: Evidence of early exploration and Dutch occupation. post-1630: Remains of shipping along major trade routes southbound from or northbound to New York City.	Moderately heavy distribution of ships of all periods, concentrated after 1800.	Moderately heavy.
HS-33: In and around Barnegat Inlet.	pre-1630: Evidence of early explpration and Dutch occupation. post-1630: Remains of shipping along major trade routes southbound from or northbound to New York City.	Moderately heavy density of ships of all periods, clustering before 1880.	Heavy.
HS-34: Part of a north-south-trending zone between major shipping lanes, possibly containing shipping, both inbound and outbound, that was carried into it by the Labrador Current.	Very light random distribution of post-1630 shipping.	None.	Very light.
HS-35: The central section of a north-south-trending zone with its northern bounding at 74° west, 39° north.	Negligible.	None.	Very light.
HS-36: Southern section of a north-south-trending zone with its southern limit at 73° 45' west, 38° 30' north. Possible contains outbound shipping carried northward into it by the Labrador Current.	Very light random distribution of post-1630 shipping.	None.	Very light.
HS-37: Landward from the outer islands of New Jersey, from approximately Mill Creek to approximately Marmora, NJ.	pre-1630: Light evidence of early exploration and Dutch occupation. post-1880: Recreational and commercial shipping.	Light distribution of shipping of all periods.	Light.
HS-38: Along the outer coast of NJ, inside the 5-fathom line from south of Barnegat Inlet to just north of Cape May.	pre-1630: Evidence of early exploration and Dutch occupation. post-1630: Shipping associated with major coastwise shipping routes.	Moderately heavy density of ships of all time periods.	Heavy.

Table IV-3 (continued): Historic shipping zones.

Description	Expected to Contain	Known Inventory	Predicted Density
HS-39: Inside the 5-fathom line from Cape May to Rehoboth Beach, including Henlopen but excluding the interior of Delaware Bay.	pre-1630: Evidence of early exploration and Dutch occupation. 1630-1700: Evidence of Swedish exploration and Swedish-Dutch conflict. post-1700: Shipping associated with major coastwise trade routes, including commercial and pleasure craft bound from Philadelphia to both northern and southern ports.	Very heavy density of ships dating before 1800 clustering around Cape Henlopen. Heavy density from post-1800 period, clustering around Cape May.	Very heavy especially around Cape Henlopen.
HS-40: Interior of Delaware Bay, excepting the upper reaches.	pre-1630: Evidence of Dutch occupation, possibly very light evidence of Dutch-Swedish conflict. post-1630: Evidence of commercial vessels in- and outbound from Philadelphia, and fishing and recreational craft from Philadelphia and other local ports.	Light distribution of shipping from before 1880.	Moderately heavy.
HS-41: Inside the 5-fathom line from Rehoboth Beach to just south of Hog Island Bay.	pre-1630: Evidence of early exploration and Dutch activities. post-1630: Evidence of shipping in major sea lanes coastwise in both directions.	Moderately heavy distributions of ships of all periods, somewhat more dense in the pre-1800 period around the inlet to Hog Island Bay.	Moderately heavy.
HS-42: A discontinuous zone comprising the inland portions of bays from Rehoboth Beach to Hog Island Bay.	pre-1630: Evidence of Dutch activities. post-1630: Evidence of local fishing, commercial, and pleasure craft.	Very light distribution post-1880.	Very light.
HS-43: Between the 10- and 5-fathom lines from Rehoboth Beach to just north of Cape Hatteras, including one satellite subzone east of Hog Island Bay.	post-1880: Shipping associated with major sea lanes.	None.	Moderately heavy.
HS-44: The western portion of an east-west-trending zone between major shipping lanes. Likely to contain remains of wrecks carried into the zone by the Labrador Current.	post-1630: Shipping associated with major coastal sea lanes.	Very light, 1800-1880.	Very light.
HS-45: Central portion of east-west-trending zone between major shipping lanes.	post-1630: Shipping associated with major coastal sea lanes.	Very light distribution, 1800-1880.	Very light.

Table IV-3 (continued): Historic shipping zones.

Description	Expected to Contain	Known Inventory	Predicted Density
HS-46: The eastern portion of an east-west-trending zone between major shipping lanes. Likely to contain remains of outward-bound shipping carried northward into the zone by the Labrador Current.	post-1630: Outward-bound shipping associated with major sea lanes.	None.	Very light.
HS-47: The south-western portion of a rectangular zone between major shipping lanes, off Delaware Bay. Likely to contain wrecks carried into the zone from the south by the Labrador Current.	post-1630: Evidence of inbound shipping associated with major sea lanes.	None.	Very light.
HS-48: The northwestern section of a rectangular zone between major shipping lanes, off Delaware Bay.	post-1630: Very light distribution of commercial shipping associated with adjacent sea lanes.	None.	Very light.
HS-49: The upper reaches of Delaware Bay extending into the Delaware River.	pre-1630: Evidence of Dutch occupation. 1630-1700: Evidence of Swedish occupation and Swedish-Dutch conflict. post-1700: Evidence of commercial vessels in- and outbound from Philadelphia, and of fishing and recreational craft from Philadelphia and other local ports.	Moderately heavy distribution overall, with a somewhat heavier distribution of ships of all time periods around Philadelphia, and a concentration in the lower reaches of the Delaware River of ships of the period 1800-1880.	Moderately heavy.
HS-50: Inside the 5-fathom line from just south of Hog Island to Virginia Beach, including Cape Charles and Cape Henry.	pre-1630: Evidence of early exploration and occupation by the London Company. post-1630: Shipping associated with major sea lanes, both inbound and outbound, in Chesapeake Bay.	Heavy distribution of ships of all periods with ships of the pre-1800 period clustered around Cape Henry.	Heavy.
HS-51: Inside the 5-fathom line from Virginia Beach to Oregon Inlet, not including the inland portions of bays.	pre-1630: Evidence of early exploration, including Spanish, and possible the Roanoke colony. post-1630: Shipping associated with major sea lanes in- and outbound.	Moderately heavy distribution of ships of all periods, with ships of the pre-1800 period clustered in the northern portion.	Moderately heavy.

Table IV-3 (continued): Historic shipping zones.

Description	Expected to Contain	Known Inventory	Predicted Density
HS-52: the northern half of a north-south-trending zone between shipping lanes. The rough center of this zone lies at 75° 15' west, 36° 30' north.	post-1630: Shipping associated with major outbound sea lanes and carried in from the north by the Labrador Current.	None.	Very light.
HS-53: Southern portion of a north-south-trending zone between sea lanes. The southern tip of this zone lies approximately 74° 5' west, 36° north.	post-1630: Shipping associated with major sea lanes, both in- and outbound, and carried into the zone from the south by the Labrador Current.	None.	Very light.
HS-54: Albemarle Sound and that part of Currituck Sound north of Oregon Inlet, including the Alligator River.	pre-1630: Possible evidence of exploration by the Roanoke colony. post-1630: Local fishing and commercial shipping.	Very light distribution post-1880.	Moderately heavy.
HS-55: Southern Croatan Sound and all of Pamlico Sound, including cakes and marsh areas.	post-1630: Evidence of fishing activities. post-1880: Recreational activity added to the above.	None.	Moderately heavy.
HS-56: Inside the 5-fathom line from Oregon Inlet to Hatteras Inlet, including the 5-fathom portions of Diamond Shoals.	pre-1630: Evidence of early exploration, including Spanish. post-1630: Moderate distribution of wrecks associated with in- and outbound traffic, clustered especially around Diamond Shoals.	Heavy distribution of ships of all periods, with ships from before 1880 clustering around Hatteras and Diamond Shoals.	Very heavy.
HS-57: Between the 5- and 10- fathom lines of Diamond Shoals off Cape Hatteras.	post-1880: Shipping associated with major coastwise sea lanes.	Moderately heavy distribution, clustering between 1800 and 1880.	Heavy.
HS-58: A small zone of less than 10-fathoms' depth on Georges Banks.	post-1630: Moderate density of shipping of all periods.	None.	Very light.

4.2.2 Archaeology

In this study, known archaeological sites are documented for their exact location (to the nearest 3 x 3-mile block) and predictions concerning the locations of unknown sites are made on the basis of an analysis of the models developed in Volume II. The models specify the expected site type and expected site frequency as well as, in some cases, site size. In the past, many archaeologists have used the term "site density." It is clear to us, however, that density should mean size per unit area and since prehistoric site size tends to be small, the number of sites in a given area will have more of an influence on encounterability than any integration of size with number. For this reason, we will use throughout the discussion of archaeological site location the term site frequency.

In this section two further terms will be discussed: original predicted site frequency, and residual predicted site frequency. The first term reflects the integration of the models of Volume II with the geography of the study area. Original predicted site frequency can thus be considered to show the area as it would have been without inundation. The second term reflects the integration of the first with the results of expected post-transgression preservation as discussed in Volume I, and thus refers to the resource predicted to remain intact after the inundation process.

The following three sections deal with archaeological resource location in three ways, each building on the previous one. The first section describes 122 detailed zones of prediction, the second describes 19 "sequences" that are derived from an analysis of these zones and are used to lump site frequency predictions as a function of the environments of the study area. The third describes the expected effect of inundation on resource preservation on these sequences for specific areas, and thus acts as a predictor for the type and frequency of sites left in a given area (eighty-nine such zones have been described). The predictions are based on the multiplication of "original predicted site frequency" by the expected percentage of preservation for a given area.

4.2.2.1 Archaeological zones - Figs. IV-21 - IV-29 and Table IV-4 document and describe the zones according to predicted site type and period throughout the study area. Geographical location of the zone, period(s) represented, site type, and expected frequency, are documented.

The site types used for the final model of settlement in the study area are based in part on those in the inductive model, and in part on those in the deductive model. The inductive model's site types were drawn from those found in existing literature and it was noted that they had not been developed systematically, but that their definitions were more or less generally agreed upon. The nature of the deductive model is such that the number of site types derived was very limited, since only exploitation of a zone was being discussed. Site types included "habitation" (for most zones) and special purpose sites, such as fishing camps.

The site types used in the final model of settlement are defined and described below. Prefixes and suffixes modifying a basic site type are named for locational, functional, or arbitrary factors, but are necessary to differentiate sites of the same basic type whose site size, frequency, and locational attributes may differ.

Camp: a habitation site, usually presumed to be more or less temporary; sometimes there is a connotation of special purpose use.
fishing camp: used for fishing
seal hunting camp: used for seal hunting
other camp I: along coast
other camp II: in piedmont or upland

Rock shelter: a habitation site, located in a cave or under a rock overhang providing shelter; usually small, with the connotation of impermanence.

Farmstead: a habitation site, small, associated with agricultural fields; associated with but separate from larger sites.

Village: a habitation site, of considerable size; permanent or semi-permanent.

Habitation: a residual category, embracing sites which human beings occupied but whose exact nature is unknown or does not fit other types.
other habitation: in addition to habitation sites of documented or inferred type.

Black earth midden: a deposit of organic refuse with little or no shell included; may be a habitation or work area, where restricted functions were performed by people from a separate habitation.

Shell midden: a deposit of organic refuse with considerable quantities of shell included; may be a habitation or locale where functions were performed by people from a separate habitation.

Fish weir: a non-habitation site, consisting of a system of stakes, mats, nets, and/or other materials, placed in a river to capture fish.

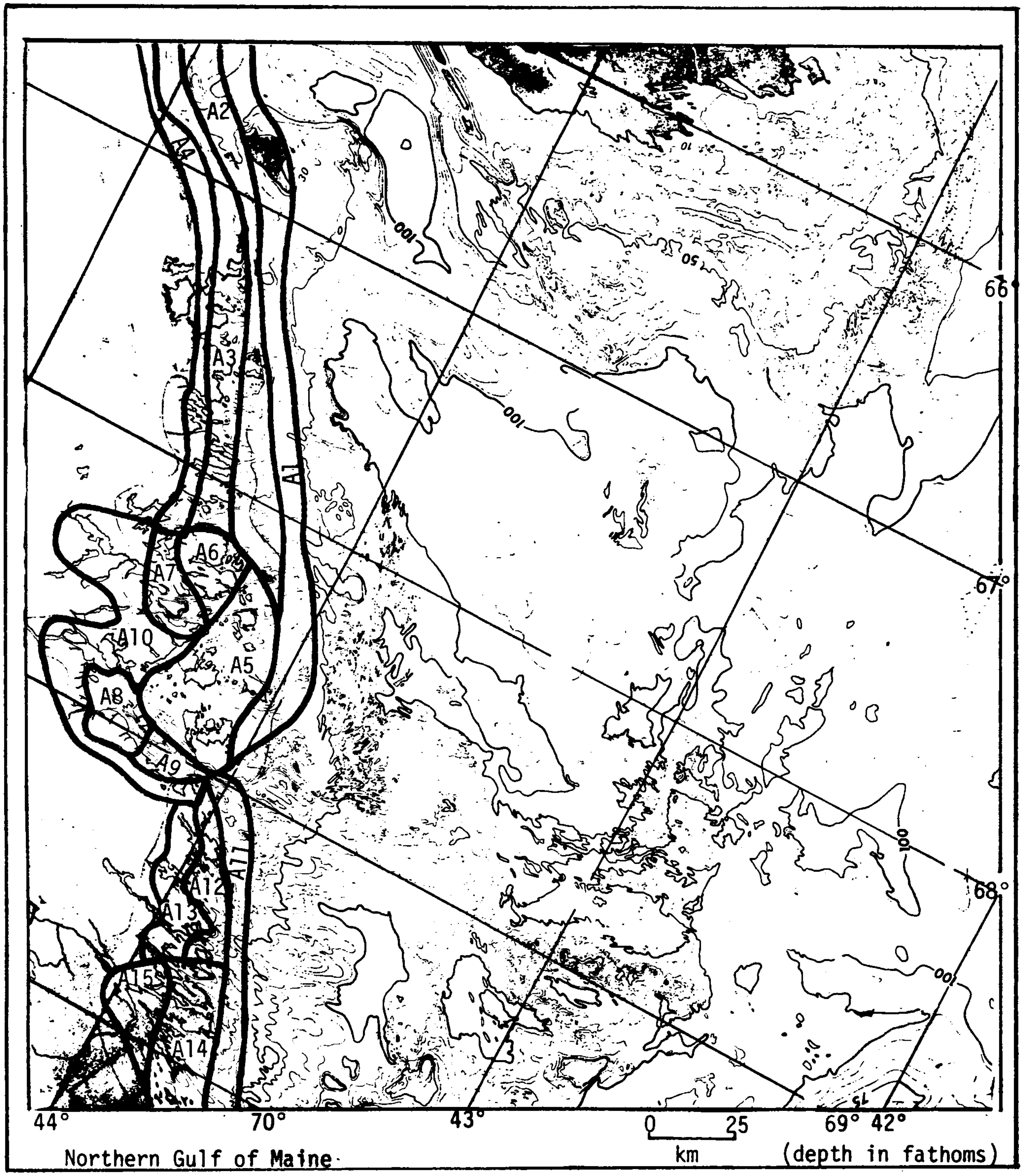


Fig. IV-21
Archaeology zones.

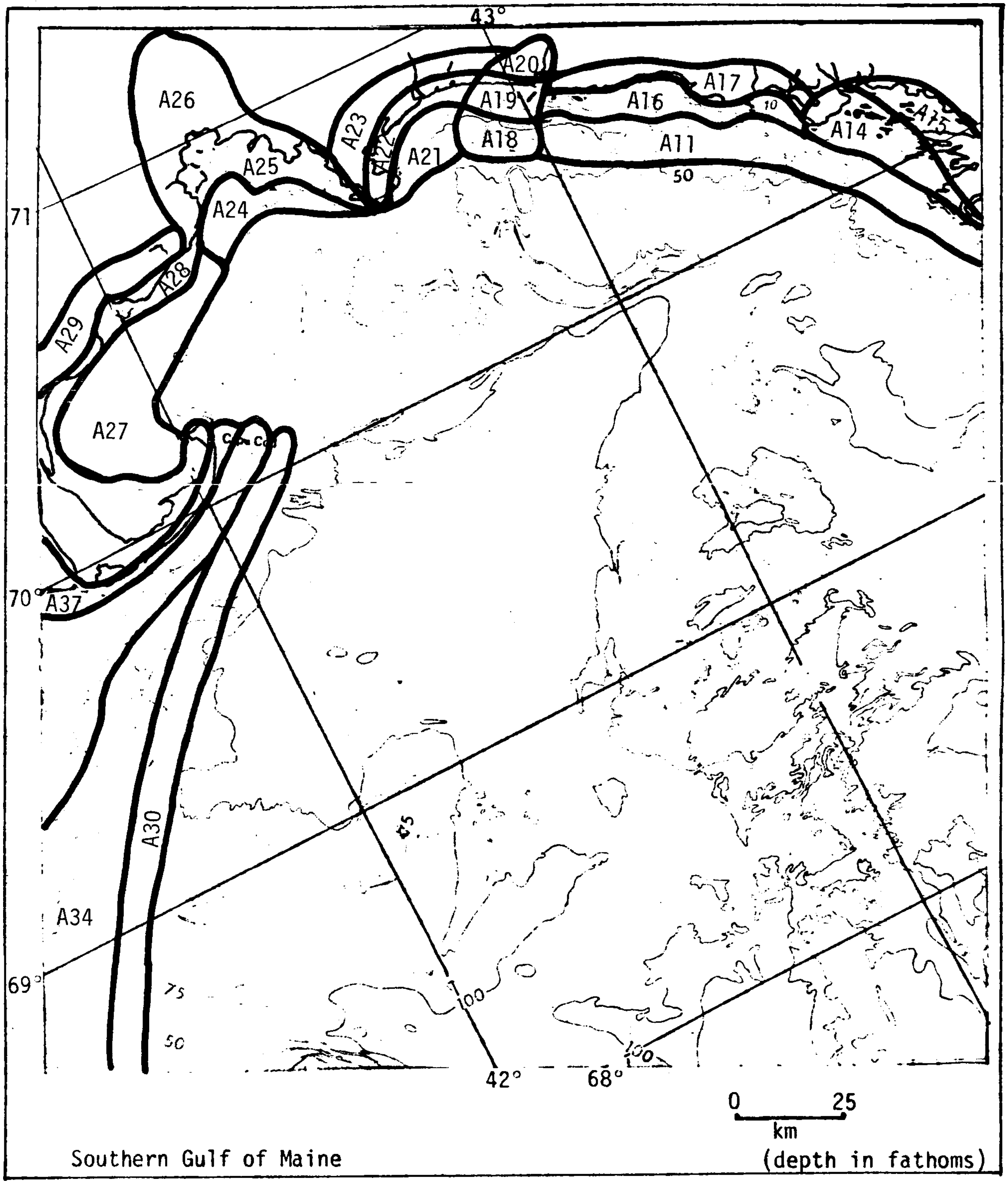


Fig. IV-22
Archaeology zones.

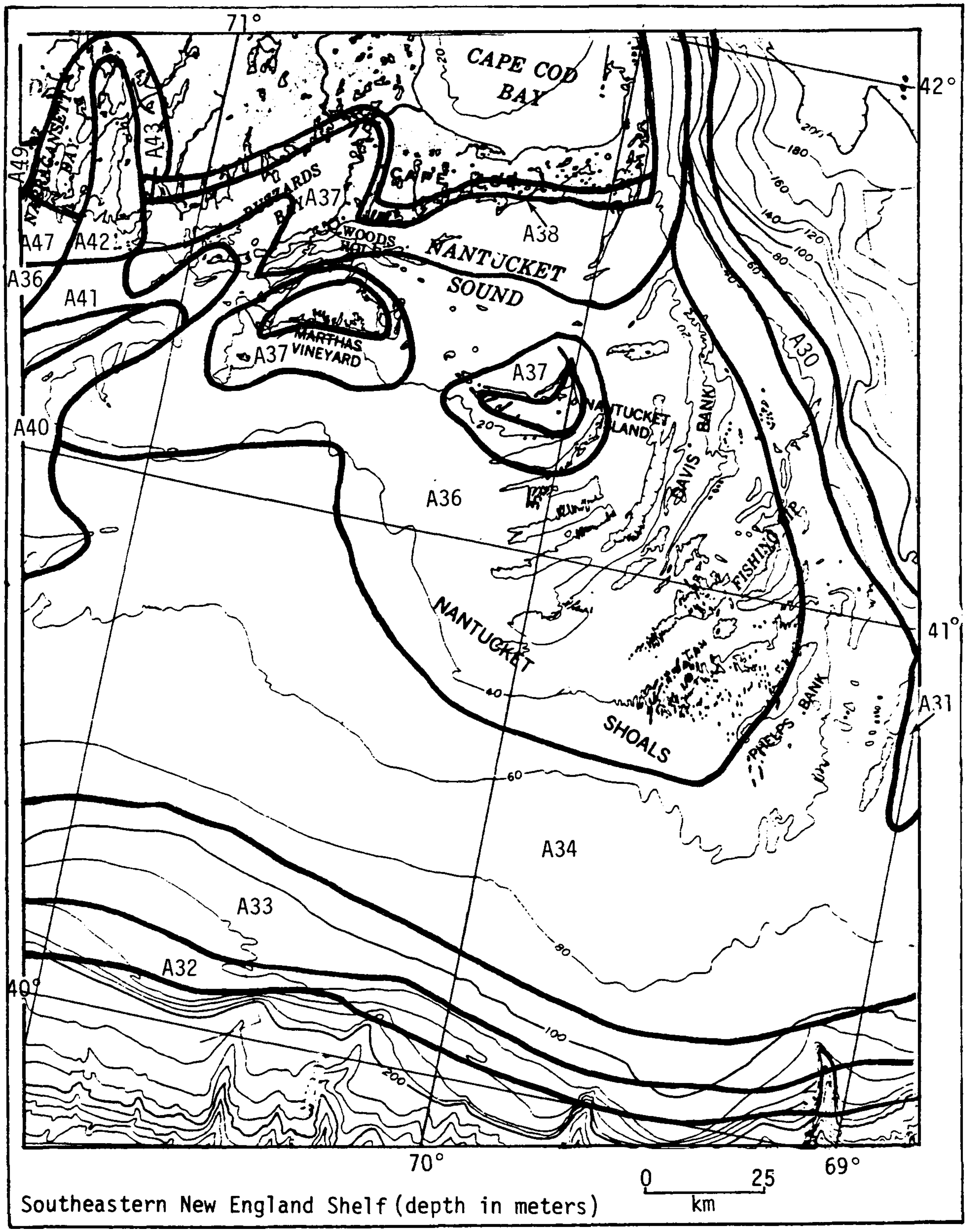


Fig. IV-23
Archaeology zones.

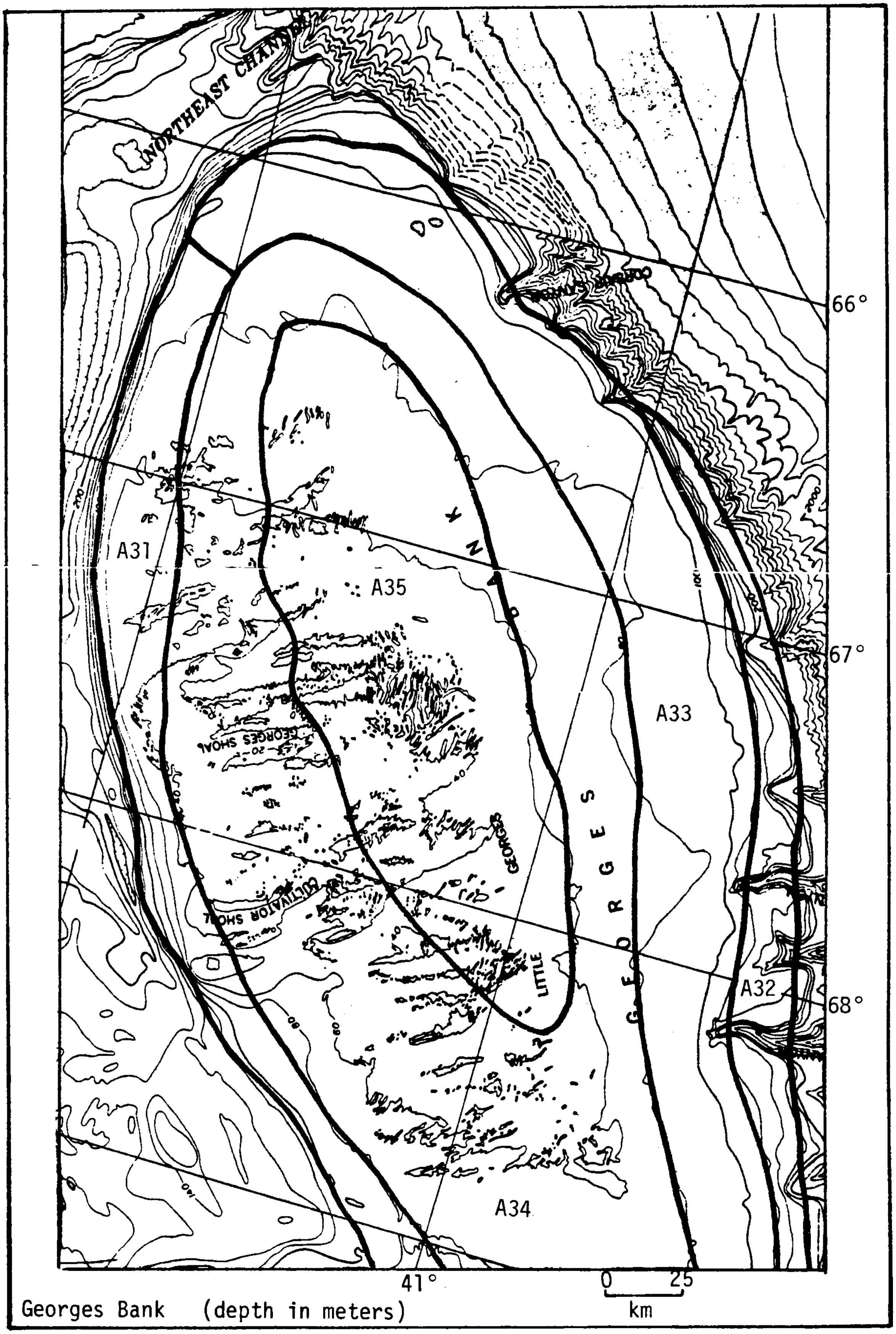


Fig. IV-24
Archaeology zones.

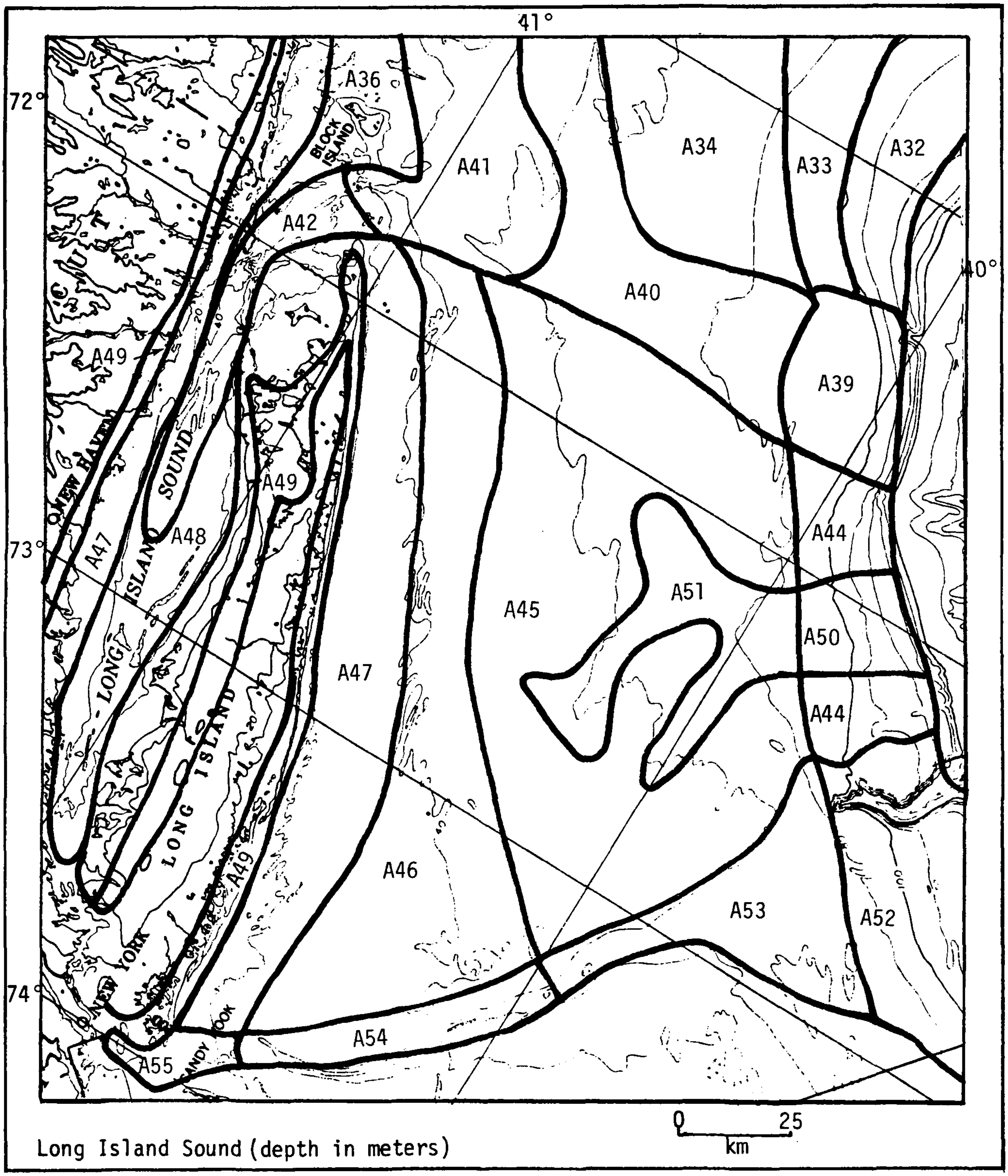


Fig. IV-25
Archaeology zones.

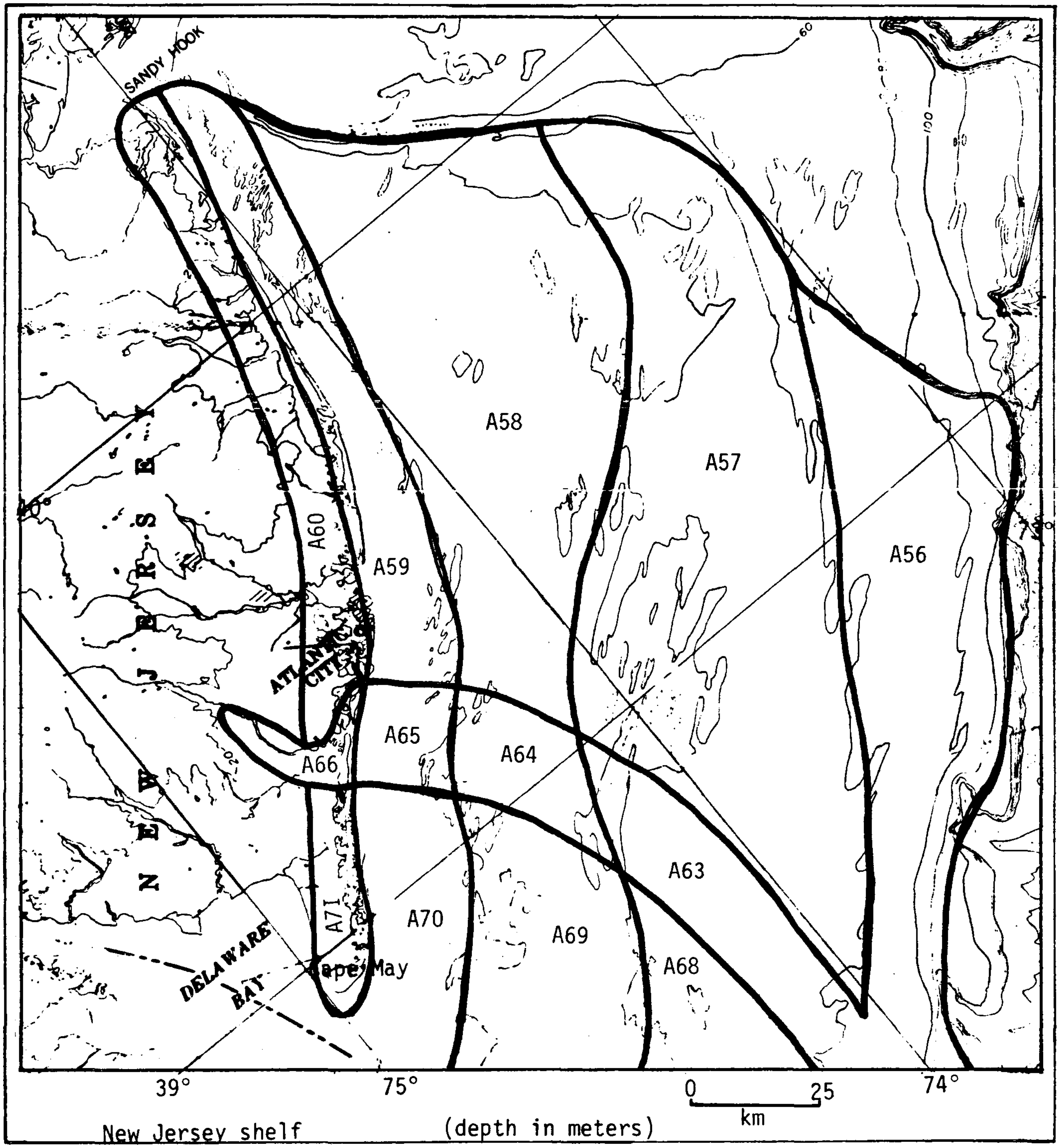


Fig. IV-26
Archaeology zones.

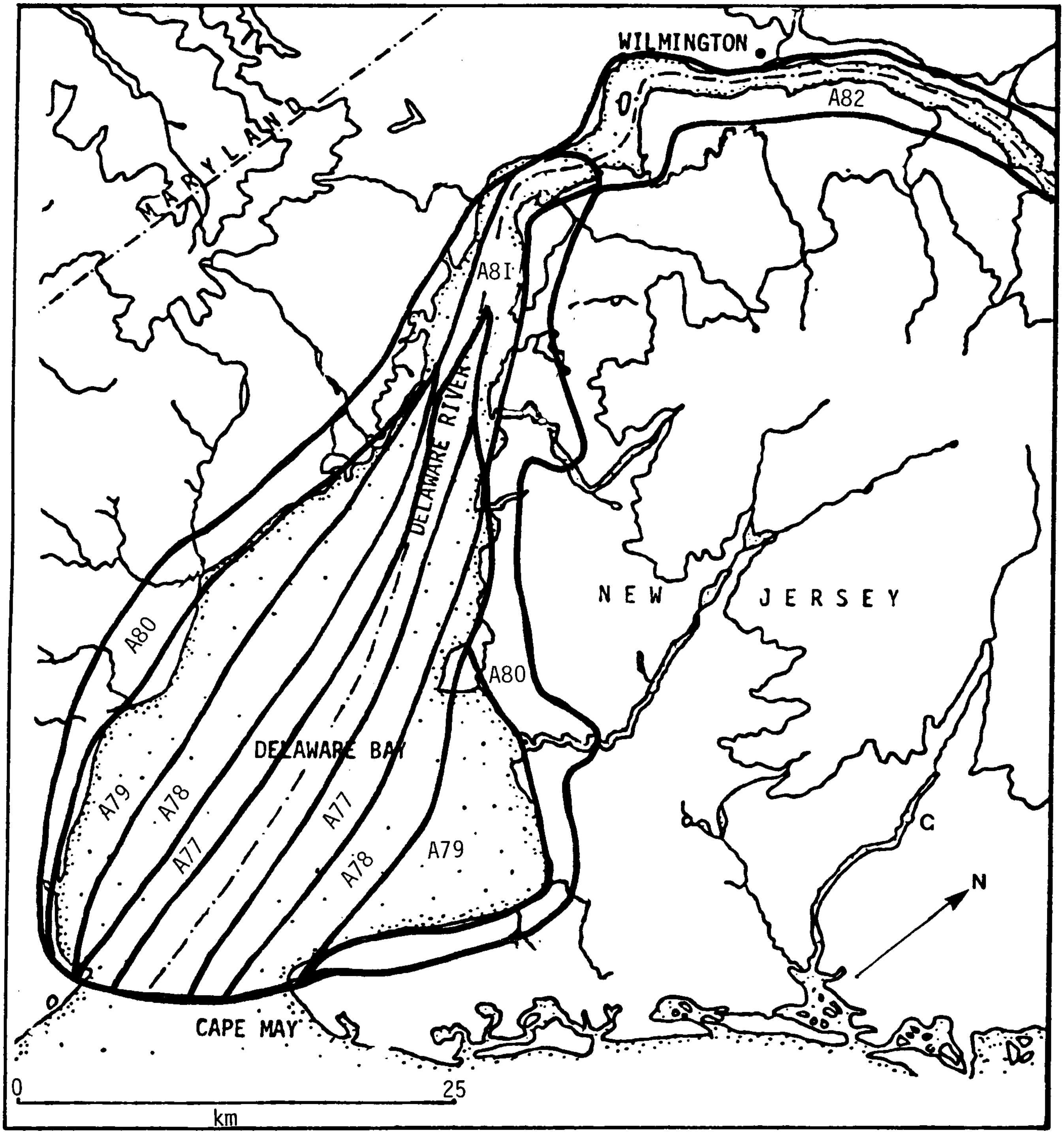


Fig. IV-27
Archaeology zones (Delaware Bay).

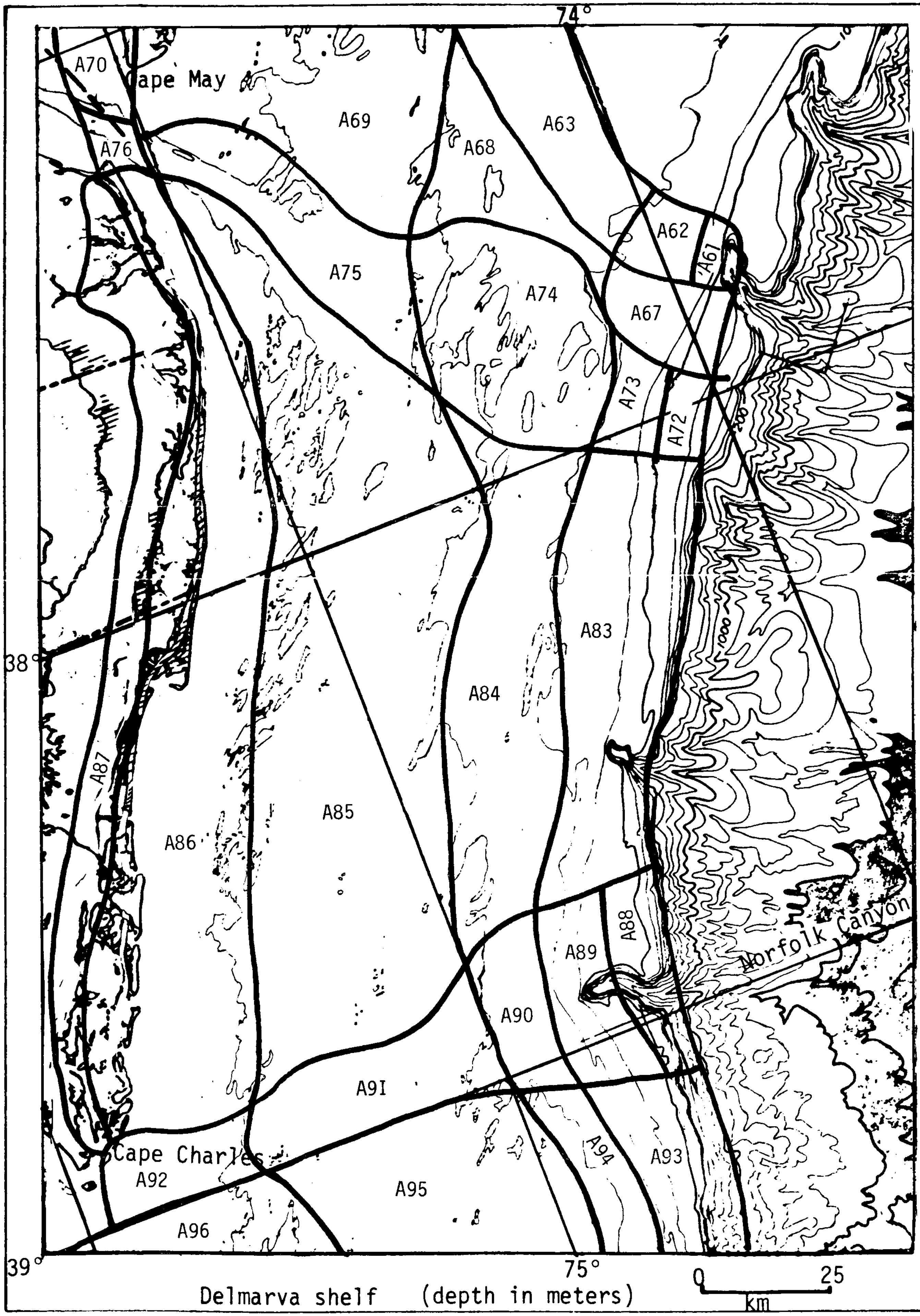


Fig. IV-28 Archaeology zones.

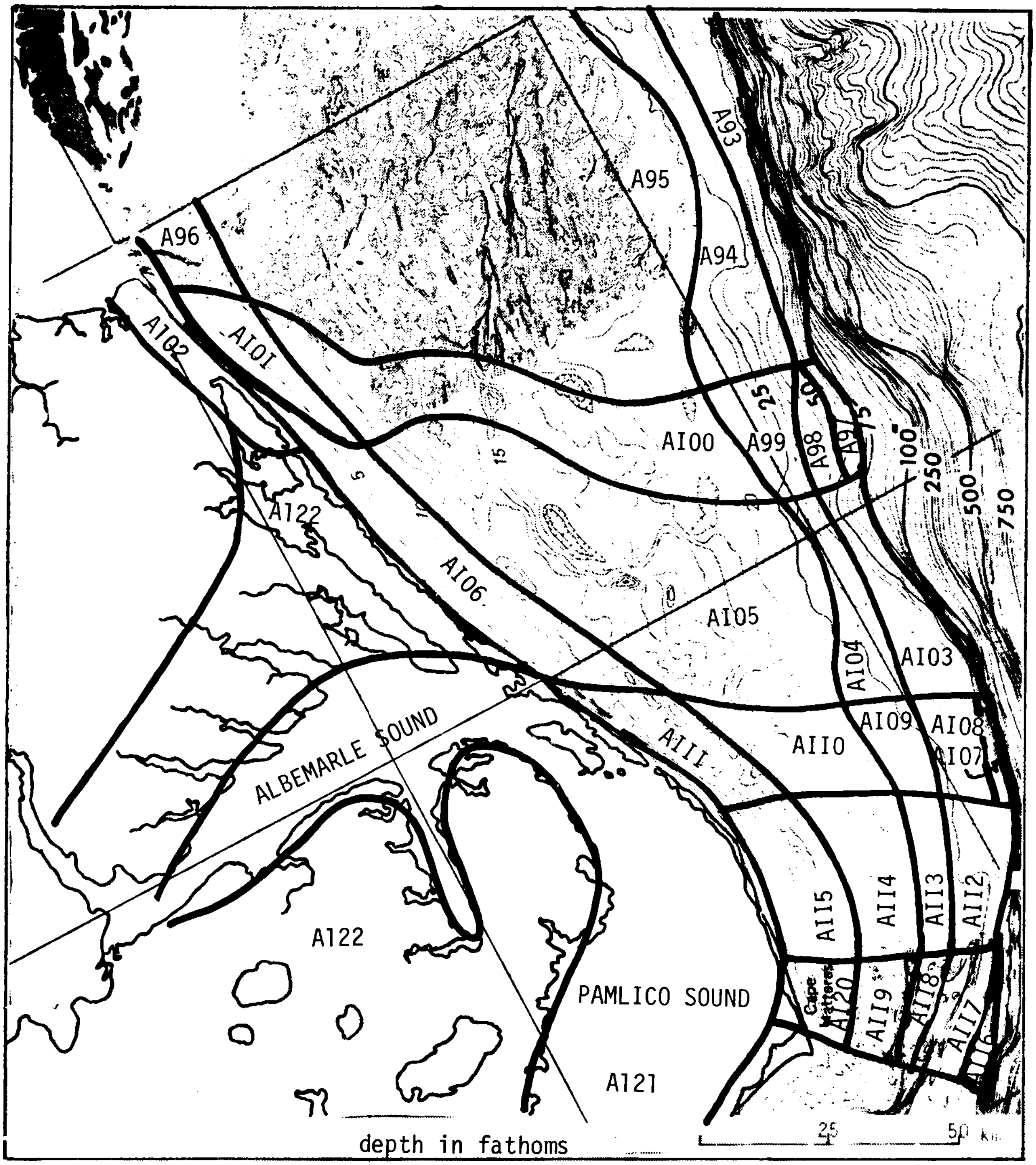


Fig. IV-29
Archaeology zones. Northern North Carolina - southeastern Virgin:a shelf.

Table IV-4: Detailed description of archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A1: 12,000 coastline from St. Croix to Vinal Haven Island.	12,000-9000	Seal hunting camp	Low	Small
A2: 9000 coastline from St. Croix to Mt. Desert Island.	12,000-9000	Habitation	Low	Small
	9000-6000	Seal hunting camp/ shell midden	Low-medium	Small-medium
A3: 6000 coastline from St. Croix to Mt. Desert Island.	12,000-9000	Habitation	?	?
	9000-6000	Habitation	Low	Small
	6000-3000	Shell midden	Medium	Small-large
		Black earth midden	Low?	Medium-large
A4: Modern coastline St. Croix to Mt. Desert Island.	12,000-9000	Habitation	Low	Small
	9000-6000	Habitation	Low/increasing	Small
	6000-3000	Habitation	?	?
	3000-present	Shell midden	High	Small-large
		Black earth midden	Medium	Medium-large
A5: 12,000 shoreline to 6000 shoreline from Mt. Desert to Vinal Haven Island.	12,000-9000	Estuarine fishing camp	Low	Small
	9000-6000	Fishing camp/ shell midden	Medium	Small
A6: 6000 shoreline to inland of present day shoreline around Mt. Desert Island.	12,000-9000	Estuarine fishing camp	Low	Small
	9000-6000	Fishing camp/ shell midden	Medium	Small
	6000-3000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-large
	3000-present	Shell midden	High	Small-large
		Black earth midden	Medium?	Medium-large
A7: Modern coast from Mt. Desert Island to Brooklin.	Same as A6	Same as A6	Same as A6	Same as A6
A8: 6000 coastline to Belfast in Penobscot Bay.	12,000-9000	Same as A6	Same as A6	Same as A6
	9000-6000	Same as A6	Same as A6	Same as A6
	6000-3000	Shell midden	Medium	Small-large
A9: 6000 coastline from Vinal Haven to Camden in Penobscot Bay.	12,000-9000	Same as A6	Same as A6	Same as A6
	9000-6000	Same as A6	Same as A6	Same as A6
	6000-3000	Shell midden	Medium	Small-large
		Black earth midden	Low?	Medium-large
		Other habitations	?	?
	3000-present	Shell midden	High	Small-large

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A10: 6000 coastline to head of Penobscot Bay and Graham Lake.	12,000-9000	Fishing camp	Low	Small
	9000-6000	Fishing camp	Medium	Small
	6000-3000	Same as A9	Same as A9	Same as A9
	3000-present	Same as A9	Same as A9	Same as A9
A11: 9000 coastline to 6000 coastline from Rockland to Portsmouth, NH	12,000-9000	?	?	?
	9000-6000	Seal hunting camp/ shell midden	Low-medium	Small-medium
A12: 6000 coastline to modern coastline from Rockland to Casco Bay.	12,000-9000	Habitation	Low	Small
	9000-6000	Habitation	Low/increasing	Small
	6000-3000	Shell midden	Medium	Small-large
		Black earth midden	Low?	Medium-large
		Other habitations	?	?
A13: Modern coastline from Rockland to Casco Bay.	12,000-9000	Same as A12	Same as A12	Same as A12
	9000-6000	Same as A12	Same as A12	Same as A12
	6000-3000	Habitation	?	?
	3000-present	Shell midden	High	Small-large
A14: 6000 coastline to modern coastline.	12,000-9000	Fishing camp	Low	Small
	9000-6000	Fishing camp/ shell midden	Medium	Small
	6000-3000	Shell midden	Medium	Small-large
		Fishing camp	Medium	Small-medium
A15: Modern coast to heads of Casco Bay.	12,000-9000	Habitation	Low	Small
	9000-6000	Fishing camp	Medium	Small
	6000-3000	Fishing camp	Medium	Small-medium
	3000-present	Fishing camp	High	Small-medium
A16: 6000 coastline to modern coastline from Casco Bay to Portsmouth, NH.	9000-6000	Habitation	Low/increasing	Small
	6000-3000	Shell midden	Medium	Small-large
		Habitation	?	?
A17: Modern coastline from Casco Bay to Portsmouth, NH.	9000-6000	Same as A16	Same as A16	Same as A16
	6000-3000	Habitation	?	?
	3000-present	Shell midden	High	Small-large
		Habitation	?	?
A18: 9000 coastline to 6000 coastline off Portsmouth, NH.	12,000-9000	Fishing camp	Low	Small
	9000-6000	Shell midden/ fishing camp	Medium	Small-medium

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A19: 6000 coastline to modern coastline off Portsmouth, NH.	12,000-9000	Fishing camp	Low	Small-large
	9000-6000	Shell midden/ fishing camp	Medium	Small-medium
	6000-3000	Shell midden	High	Small-large
		Fishing camp	Medium-high	Small
A20: Modern coastline around Portsmouth, NH.	12,000-9000	Same as A19	Same as A19	Same as A19
	9000-6000	Fishing camps	Low-medium	Small-medium
	6000-3000	Fishing camps	Medium-high	Small
	3000-present	Shell midden	High	Small-large
A21: 9000 coastline to 6000 coastline from Portsmouth, NH to Cape Anne.	12,000-9000	Habitation	Very low	Small
	9000-6000	Shell midden	Medium	Small-medium
		Camp	Low	Small
A22: 6000 coastline to modern coastline from Portsmouth, NH to Cape Anne.	12,000-9000	Habitation	Very low	Small
	9000-6000	Camp	Low	Small
	6000-3000	Shell midden	High	Small-large
A23: Modern coastline from Portsmouth, NH to Cape Anne.	12,000-9000	Habitation	Very low	Small
	9000-6000	Camp	Low	Small
	6000-3000	Habitation	Medium	Small
	3000-present	Shell midden	High	Small-large
		Camp	High	Small-medium
		Habitation	High	Small
A24: 9000 shoreline to 6000 shoreline off Boston.	12,000-9000	Fishing camp/ habitation	Low	Small-large
	9000-6000	Fishing camp/ shell midden	Medium	Small-medium
A25: 6000 shoreline to modern shoreline off Boston.	12,000-9000	Fishing camp/ habitation	Low	Small-large
	9000-6000	Fishing camp/ shell midden	Medium	Small-medium
	6000-3000	Shell midden	High	Small-large
		Fishing camp	Medium-high	Small
A26: Modern shoreline around Boston.	12,000-9000	Fishing camp/ habitation	Low	Small-large
	9000-6000	Fishing camp/ habitation	Low-medium	Small-medium
	6000-3000	Fishing camp	Medium-high	Small
	3000-present	Shell midden	High	Small-large
		Fishing camp	High	Small-large
		Habitation	High	Small

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A27: 9000 shoreline to 6000 shoreline from Boston to Provincetown.	12,000-9000	Fishing camp/ habitation	Low	Small-large
	9000-6000	Shell midden	Medium	Small-medium
		Camp	Low	Small
A28: 6000 shoreline to modern coastline from Boston to Provincetown.	12,000-9000	Fishing camp/ habitation	Low	Small-large
		Habitation	Very low	Small
	9000-6000	Camp	Low	Small
	6000-3000	Shell midden	High	Small-large
		Habitation	Medium	Small
		Village	Low-medium	Large
A29: Along modern coast from Boston to Provincetown.	12,000-9000	Fishing camp/ habitation	Low	Small-large
		Habitation	Very low	Small
	9000-6000	Camp	Low	Small
	6000-3000	Habitation	Medium	Small
		Village	Low-medium	Large
	3000-present	Shell midden	High	Small-large
		Camp	High	Small-medium
		Habitation	High	Small
A30: 18,000 coastline to 12,000 coastline from Cape Cod to Great South Channel.	18,000-12,000	Seal hunting camp	Low	Small
A31: 15,000 coastline to 12,000 coastline from Great South Channel to tip of Georges Bank.	18,000-12,000	Habitation	Low	Very small
A32: 18,000 coastline to 15,000 coastline from approximately 66° 30'/41° on Georges Bank to Block Canyon.	18,000-15,000	Seal hunting camp	Low	Small
		Habitation	Low	Small
		Fishing camps	Low	Small
A33: 15,000 coastline to 12,000 coastline from tip of Georges Banks to Block Canyon.	18,000-15,000	Habitation	Low	Small
		Fishing camp	Low	Small
	15,000-12,000	Seal hunting camp	Low	Small
		Habitation	Low	Very small
A34: 12,000 coastline to 9000 coastline from Cape Cod to Block Canyon including Georges Banks.	18,000-15,000	Habitation	Low	Very small
	15,000-12,000	Habitation	Low	Very small
		Fishing camp	Low	Small
	12,000-9000	Seal hunting camp	Low	Small
		Habitation	Very low	Small

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A35: Inside 9000 coastline on Georges Banks.	18,000-12,000	Habitation	Low	Very small
	12,000-9000	Habitation	Very low	Small
	9000-?	Shell midden	Medium	Small-medium
		Habitation	Low-medium	Small-medium
A36: 9000 coastline to 6000 coastline from Cape Cod to Block Canyon including Nantucket shoals and around Block Island.	18,000-12,000	Habitation	Low	Very small
	12,000-9000	Habitation	Very low	Small
	9000-6000	Shell midden	Medium	Small-medium
		Habitation	Low-medium	Small-medium
A37: 6000 coastline to modern shoreline from Cape Cod to Narragansett Bay including Martha's Vineyard and Nantucket Island.	18,000-12,000	Habitation	Low	Very small
	12,000-9000	Habitation	Very low	Small
	9000-6000	Habitation	Low-medium	Small-medium
	6000-3000	Shell midden	High	Small-large
		Habitation	Medium	Small
		Camp	High	Small-medium
A38: Along modern coastline from Chatham, MA to Narragansett Bay.	18,000-12,000	Same as A37	Same as A37	Same as A37
	12,000-9000	Same as A37	Same as A37	Same as A37
	9000-6000	Same as A37	Same as A37	Same as A37
	6000-3000	Shell midden	High	Small-large
		Habitation	Medium	Small
		Camp	High	Small-medium
		Village	Low-medium	Large
	3000-present	Shell midden	High	Small-large
		Habitation	High	Small
		Camp	High	Small
A39: 18,000 coastline to 12,000 coastline in Block Valley.	18,000-12,000	Fishing camp/ habitation	Low	Small
A40: 12,000 coastline to 9000 coastline in Block Valley.	18,000-12,000	Fishing camp/ habitation	Low	Small
	12,000-9000	Shell midden/ fishing camp	Low	Small
A41: 9000 coastline to 6000 coastline in Block Valley.	18,000-12,000	Fishing camp/ habitation	Low	Small
	12,000-9000	Fishing camp/ habitation	Low	Small-large
	9000-6000	Shell midden/ fishing camp	Medium	Small-medium

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A42: 6000 coastline in Block Valley to end of Block Valley in Long Island sound and up Narragansett Bay.	18,000-12,000	Same as A41	Same as A41	Same as A41
	12,000-9000	Same as A41	Same as A41	Same as A41
	9000-6000	Fishing camp/ habitation	Low-medium	Small-medium
	6000-inundation (LIS)-3000 in (NB)	Shell midden	High	Small-large
		Fishing camp	Medium-high	Small
		Fish weir	Low-medium	Small
A43: Modern coastline around Narragansett Bay.	18,000-12,000	Habitation	Low	Very small
	12,000-9000	Habitation	Very low	Small
	9000-6000	Fishing camp/ habitation	Low-medium	Small-medium
	6000-3000	Shell midden	High	Small-large
		Fishing camp	Medium-high	Small
		Habitation	Medium	Small
		Village	Low-medium	Large
		Camp	High	Small-medium
	3000-present	Shell midden	High	Small-large
		Fishing camp	High	Small-large
		Habitation	High	Small
A44: 18,000 coastline to 12,000 coastline from Block Canyon to Hudson Canyon except A50.	18,000-12,000	Seal hunting camp	Low	Small
		Habitation	Low	Very small
A45: 1,200 coastline to 9000 coastline from Block Canyon to Hudson Canyon except A51.	18,000-12,000	Habitation	Low	Very small
	12,000-9000	Seal hunting camp	Low	Small
		Habitation	Very low	Small
A46: 9000 coastline to 6000 coastline from Block Canyon to Hudson Canyon.	18,000-12,000	Habitation	Low	Very small
	12,000-9000	Habitation	Very low	Small
	9000-6000	Shell midden	Medium	Small-medium
		Camp	Low	Small
A47: 6000 coastline to modern coastline seaward of Long Island, from boundry of A48 to present shoreline, along Long Island and to Narragansett Bay.	18,000-12,000	Same as A46	Same as A46	Same as A46
	12,000-9000	Same as A46	Same as A46	Same as A46
	9000-6000	Camp	Low	Small
		Habitation	Low-medium	Small-medium
		Shell midden/ fishing camp	Medium	Small-medium
	6000-3000	Shell midden	High	Small-large
		Habitation	Medium	Small
		Camp	High	Small-medium
		Fishing camp	Medium-high	Small
		Village	Low-medium	Large

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A48: Long Island Sound inside 6000 coastline outside Block Canyon and inundated prior to 3000.	18,000-12,000	Habitation	Low	Very small
	12,000-9000	Habitation	Very low	Small
	9000-6000	Fishing camp/ habitation	Low-medium	Small-medium
		Camp	Low	Small
	6000-inundation	Fishing camp	Medium-high	Small
A49: Modern coastline of Long Island and coast from Narragansett Bay to New York City.	18,000-12,000	Habitation	Low	Very small
	12,000-9000	Habitation	Very low	Small
	9000-6000	Camp	Low	Small
	6000-3000	Fishing camp	Medium-high	Small
		Habitation	Medium	Small
		Camp	High	Small-medium
		Village	Low-medium	Large
	3000-present	Shell midden	High	Small-large
		Habitation	High	Small
		Fishing camp	High	Small-large
		Camp	High	Small-medium
A50. 18,000 coastline to 12,000 coastline Long Island Valley.	18,000-12,000	Fishing camp/ habitation	Low	Small
A51: 12,000 coastline until inundation of Long Island Valley.	18,000-12,000	Fishing camp/ other stations	Low	Small
	12,000- inundation	Shell midden/ fishing camp	Low	Small
A52: 18,000 coastline to 12,000 coastline Hudson Canyon.	18,000-12,000	Fishing camp/ habitation	Low	Small
A53: 12,000 coastline to 9000 coastline in Hudson Canyon.	18,000-12,000	Fishing camp/ other station	Low	Small
	12,000-9000	Shell midden/ fishing camp	Low	Small
A54: 9000 coastline to 6000 coastline in Hudson Canyon.	18,000-12,000	Fishing camp/ other stations	Low	Small
	12,000-9000	Fishing camp/ other habitation	Low	Small-large
	9000-6000	Shell midden/ fishing camp	Medium	Small-medium

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A55: 6000 coastline to modern caostline in Hudson Canyon.	18,000-12,000	Fishing camp/ other stations	Low	Small
	12,000-9000	Fishing camp/ other habitation	Low	Small-large
	9000-6000	Fishing camp/ other habitation	Low-medium	Small-medium
	6000-3000	Shell midden	High	Small-large
		Fishing camp	Medium-high	Small
		Fish weir	Low-medium	Small
A56: 18,000 coastline to 12,000 coastline from Hudson Canyon to Great Egg Valley.	18,000-12,000	Coastal camp	Very low	Small
		Upland camp	Low	Very small
A57: 12,000 coastline to 9000 coastline from Hudson Canyon to Great Egg Valley.	18,000-12,000	Upland camp	Low	Very small
	12,000-9000	Shell midden	Medium	Small-medium
		Upland other camp II	Low	Small-large
A58: 9000 coastline to 6000 coastline from Hudson Canyon to Great Egg Valley.	18,000-12,000	Upland camp	Low	Very small
	12,000-9000	Upland other camp II	Low	Small-large
	9000-6000	Shell midden	Medium	Small-medium
		Upland other camp II	Low-medium	Small-large
A59: 6000 coastline to modern coastline from Hudson Canyon to Great Egg Valley.	18,000-12,000	Upland camp	Low	Very small
	12,000-9000	Upland other camp II	Low	Small-large
	9000-6000	Upland other camp II	Low-medium	Small-large
	6000-3000	Shell midden	Medium-high	Small-large
		Upland other camp II	Medium	Small-medium

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A60: Modern coastline from Hudson Canyon to Great Egg Valley.	18,000-12,000	Upland camp	Low	Very small
	12,000-9000	Upland other camp II	Low	Small-large
	9000-6000	Upland other camp II	Low-medium	Small-large
	6000-3000	Upland other camp II	Medium	Small-medium
	3000-present	Shell midden	Very high	Small-large
		Black earth midden	High	Small-medium
		Village	High	Large
		Inland valley camp I	Medium	Small
A61: 18,000 coastline to 15,000 coastline in Great Egg Valley.	18,000-15,000	Fishing camp	Low	Small
A62: 15,000 coastline to 12,000 coastline in Great Egg Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
		Shell midden	Low	Small
A63: 12,000 coastline to 9000 coastline in Great Egg Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
A64: 9000 coastline to 6000 coastline in Great Egg Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Inland valley other camp I	Medium	Small
		Upland other camp II	Low	Small-large
	9000-6000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
A65: 6000 coastline to modern coastline in Great Egg Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Inland valley other camp I	Medium	Small
		Upland other camp II	Low	Small-large
	9000-6000	Fishing camp	Medium	Small-medium
		Inland valley other camp I	Medium	Small
		Upland other camp II	Low-medium	Small-large
	6000-3000	Fishing camp	High	Small-large
		Shell midden	High	Small-large

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A66: Modern coastline around Great Egg Harbor.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Inland valley other camp I	Medium	Small
		Upland other camp II	Low	Small-large
	9000-6000	Fishing camp	Medium	Small-medium
		Inland valley other camp I	Medium	Small
		Upland other camp II	Low-medium	Small-large
	6000-3000	Fishing camp	High	Small-large
		Inland valley other camp I	Medium-high	
		Inland valley other camp II	Medium-high	Small-very large
	3000-present	Shell midden	Very high	Small-large
		Black earth midden	High	Small-medium
		Fishing camp	Medium	Small-medium
		Inland valley camp II	Medium-high	Small
		Inland valley camp I	Medium	Small
		Village	High	Large
A67: 18,000 coastline to 12,000 coastline from Great Egg Valley to Delaware Valley.	Same as A56	Same as A56	Same as A56	Same as A56
A68: 12,000 coastline to 9000 coastline from Great Egg Valley to Delaware Valley.	Same as A57	Same as A57	Same as A57	Same as A57
A69: 9000 coastline to 6000 coastline from Great Egg Valley to Delaware Valley.	Same as A58	Same as A58	Same as A58	Same as A58
A70: 6000 coastline to modern coastline from Great Egg Valley to Delaware Valley.	Same as A59	Same as A59	Same as A59	Same as A59
A71: Modern coastline from Great Egg Harbor to Cape May.	Same as A60	Same as A60	Same as A60	Same as A60

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A72: 18,000 coastline to 15,000 coastline in Delaware Valley.	Same as A61	Same as A61	Same as A61	Same as A61
A73: 15,000 coastline to 12,000 coastline in Delaware Valley.	Same as A62	Same as A62	Same as A62	Same as A62
A74: 12,000 coastline to 9000 coastline in Delaware Valley.	Same as A63	Same as A63	Same as A63	Same as A63
A75: 9000 coastline to 6000 coastline in Delaware Valley.	Same as A64	Same as A64	Same as A64	Same as A64
A76: 6000 coastline to mouth of Delaware Bay.	Same as A65	Same as A65	Same as A65	Same as A65
A77: 18,000 river bank to 9000 river bank of Delaware River from Cohansey River to present bay mouth.	18,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
A78: 9000 river bank to 6000 river bank of Delaware River from Cohansey River to present bay mouth.	18,000-12,000	Upland camp	Low	Very small
	12,000-9000	Inland valley camp I	Medium	Small
		Upland camp II	Low	Small-large
	9000-6000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
A79: 6000 river bank to 3000 river bank of Delaware River from approximately Cohansey River to present bay mouth.	18,000-12,000	Upland camp	Low	Very small
	12,000-9000	Inland valley camp I	Medium	Small
		Upland camp II	Low	Small-large
	9000-6000	Inland valley camp I	Medium	Very small-small
		Upland camp II	Medium	Small-large
	6000-3000	Fishing camp	High	Small-large
		Shell midden	High	Small-large
		Inland valley camp II	High	Small-very large
		Upland camp II	Medium	Small-medium

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A80: Modern coastline of Delaware Bay.	18,000-12,000	Upland camp	Low	Very Small
	12,000-9000	Inland valley camp I	Medium	Small
		Upland camp II	Low	Small-large
	9000-6000	Inland valley camp I	Medium	Very small-small
		Upland camp II	Medium	Small-large
	6000-3000	Inland valley camp II	High	Small-very large
		Upland camp II	Medium	Small-medium
	3000-present	Shell midden	Very high	Small-large
		Black earth midden	High	Small-medium
		Fishing camp	Medium	Small-medium
		Inland valley camp II	High	Small
		Village	High	Large
A81: Upper reaches of Delaware Bay to modern coastline from Cohansey River to Delaware City.	18,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
	9000-6000	Fishing camp	Medium	Small-medium
	6000-3000	Fishing camp	High	Small-large
		Shell midden	High	Small-large
A82: Delaware River from Delaware City to Philadelphia.	15,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
	9000-6000	Fishing camp	Medium	Small-medium
	6000-3000	Fishing camp	High	Small-large
	3000-present	Fishing camp	Medium	Small-medium
		Inland valley camp II	High	Small
		Village	High	Large
A83: 18,000 coastline to 12,000 coastline from Delaware Valley to Susquehanna Valley.	Same as A56	Same as A56	Same as A56	Same as A56
A84: 12,000 coastline to 9000 coastline from Delaware Valley to Susquehanna Valley.	Same as A57	Same as A57	Same as A57	Same as A57
A85: 9000 coastline to 6000 coastline from Delaware Valley to Susquehanna Valley.	Same as A58	Same as A58	Same as A58	Same as A58

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A86: 6000 coastline to modern coastline from Delaware Valley to Susquehanna Valley.	Same as A59	Same as A59	Same as A59	Same as A59
A87: Modern coastline from Cape Henlopen to Cape Charles.	Same as A60	Same as A60	Same as A60	Same as A60
A88: 18,000 coastline to 15,000 coastline in Susquehanna Valley.	Same as A61	Same as A61	Same as A61	Same as A61
A89: 15,000 coastline to 12,000 coastline in Susquehanna Valley.	Same as A62	Same as A62	Same as A62	Same as A62
A90: 12,000 coastline to 9000 coastline in Susquehanna Valley.	Same as A63	Same as A63	Same as A63	Same as A63
A91: 9000 coastline to 6000 coastline in Susquehanna Valley.	Same as A64	Same as A64	Same as A64	Same as A64
A92: 6000 coastline to present mouth of Chesapeake Bay.	Same as A65	Same as A65	Same as A65	Same as A65
A93: 18,000 coastline to 12,000 coastline from Susquehanna Valley to James Valley.	Same as A56	Same as A56	Same as A56	Same as A56
A94: 12,000 coastline to 9000 coastline from Susquehanna Valley to James Valley.	Same as A57	Same as A57	Same as A57	Same as A57
A95: 9000 coastline to 6000 coastline from Susquehanna Valley to James Valley.	Same as A58	Same as A58	Same as A58	Same as A58

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A96: 6000 coastline to modern coastline from Susquehanna Valley to James Valley.	Same as A59	Same as A59	Same as A59	Same as A59
A97: 18,000 coastline to 15,000 coastline in James Valley.	Same as A61	Same as A61	Same as A61	Same as A61
A98: 15,000 coastline to 12,000 coastline in James Valley.	18,000-15,000	Fishing camps	Low	Small
	15,000-12,000	Fishing camps	Low	Small
		Shell midden	Low	Small
A99: 12,000 coastline to 9000 coastline in James Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
		Shell midden	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
A100: 9000 coastline to 6000 coastline in James Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
		Inland valley camp I	Medium	Very small-small
		Upland camp II	Low	Small-large
	9000-6000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
		Inland valley camp I	Medium	Small-medium
		Upland camp II	Medium	Small-large
A101: 6000 coastline to modern coastline in James Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Inland valley camp I	Medium	Very small-small
		Upland camp II	Low	Small-large
	9000-6000	Fishing camp	Medium	Small-medium
		Inland valley camp I	Medium	Small-medium
		Upland camp II	Medium	Small-large
	6000-3000	Fishing camp	High	Small-large
		Shell midden	High	Small-large

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A102: Modern coastline from Chesapeake Bay to Currituck Sound.	Same as A60	Same as A60	Same as A60	Same as A60
A103: 18,000 coastline to 12,000 coastline from James Valley to Albemarle.	Same as A56	Same as A56	Same as A56	Same as A56
A104: 12,000 coastline to 9000 coastline from James Valley to Albemarle.	Same as A57	Same as A57	Same as A57	Same as A57
A105: 9000 coastline to 6000 coastline from James Valley to Albemarle.	Same as A58	Same as A58	Same as A58	Same as A58
A106: 6000 coastline to modern coastline from James Valley to Albemarle.	Same as A59	Same as A59	Same as A59	Same as A59
A107: 18,000 coastline to 15,000 coastline in Albemarle Valley.	Same as A61	Same as A61	Same as A61	Same as A61
A108: 15,000 coastline to 12,000 coastline in Albemarle Valley.	Same as A98	Same as A98	Same as A98	Same as A98
A109: 12,000 coastline to 9000 coastline in Albemarle Valley.	Same as A99	Same as A99	Same as A99	Same as A99
A110: 9000 coastline to 6000 coastline in Albemarle Valley.	Same as A100	Same as A100	Same as A100	Same as A100
A111: 6000 coastline to modern coastline in Albemarle Valley.	Same as A101	Same as A101	Same as A101	Same as A101

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A112: 18,000 coastline to 12,000 coastline from Albemarle Valley to Diamond Valley.	Same as A56	Same as A56	Same as A56	Same as A56
A113: 12,000 coastline to 9000 coastline from Albemarle Valley to Diamond Valley.	Same as A57	Same as A57	Same as A57	Same as A57
A114: 9000 coastline to 6000 coastline from Albemarle Valley to Diamond Valley.	Same as A58	Same as A58	Same as A58	Same as A58
A115: 6000 coastline to modern coastline from Albemarle Valley to Diamond Valley.	Same as A59	Same as A59	Same as A59	Same as A59
A116: 18,000 coastline to 15,000 coastline in Diamond Valley.	Same as A61	Same as A61	Same as A61	Same as A61
A117: 15,000 coastline to 12,000 coastline in Diamond Valley.	Same as A98	Same as A98	Same as A98	Same as A98
A118: 12,000 coastline to 9000 coastline in Diamond Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
		Shell midden	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
A119: 9000 coastline to 6000 coastline in Diamond Valley.	18,000-15,000	Fishing camp	Low	Small
	15,000-12,000	Fishing camp	Low	Small
		Shell midden	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
	9000-6000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium

Table IV-4 (continued): Archaeology zones.

Description	Period B.P.	Site Type	Frequency	Size
A120: 6000 coastline to modern coastline in Diamond Valley.	18,000-15,000	Fishing camp	Low	
	15,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
	9000-6000	Fishing camp	Medium	Small-medium
		Shell midden	Medium	Small-medium
	6000-3000	Fishing camp	High	Small-large
		Shell midden	High	Small-large
A121: In present day Pamlico and Albemarle Sounds and Barrier Beaches the more recent sites tending toward modern shorelines.	18,000-12,000	Fishing camp	Low	Small
	12,000-9000	Fishing camp	Medium	Small-medium
		Inland valley camp I	Medium	Small-medium
		Upland camp II	Low	Small-large
	9000-6000	Fishing camp	Medium	Small-medium
		Inland valley camp I	Medium	Very small-small
		Upland camp II	Medium	Small-large
	6000-3000	Fishing camp	High	Small-large
		Inland valley camp I	High	Small-medium
		Inland valley camp II	High	Small-very large
		Shell midden	High	Small-large
	3000-present	Fishing camp	Medium	
		Shell midden	Very high	Small-large
		Inland valley camp II	High	Small
		Village	High	Large
		Black earth midden	High	Small-medium
A122: Wetland zones inside North Carolina Barrier Beaches and bordering Pamlico and Albemarle Sounds.	18,000-12,000	Upland camp	Low	Very small
	12,000-9000	Upland camp II	Low	Small-large
	9000-6000	Upland camp II	Medium	Small-medium
	6000-3000	Upland camp II	Medium	Small-medium
		Inland valley camp II	High	Small-very large
	3000-present	Inland valley camp II	High	Small
		Village	High	Large

4.2.2.2 Archaeological sequences - In this section Figs. IV-30 through 37 locate areas where uniquely identifiable cultural sequences can be isolated. Table IV-5 describes in graphic terms what the composition of these zones (prior to inundation) may be expected to have been. The predictions are presented as an index (relative number) of original predicted site frequencies located within areas described by a combination of past shoreline positions and geophysical circumstances.

The site frequency index is developed by adding the predicted site frequencies for each type of site in each area. Individual site frequency is derived from the model in Volume II (Table IV-1). From the combination of expected site types and expected site frequency for given environmental situations is derived a series of identifiable archaeological sequences. These sequences will be the key to management recommendations in the remainder of this volume. Each sequence describes the expected site type and expected site frequency in geographically identifiable zones These zones have been developed using a combination of geographical and anthropological attributes extracted from Volumes I and II of this study.

The sequences are described as a function of site type/frequency for a given area within identifiable shoreline positions.

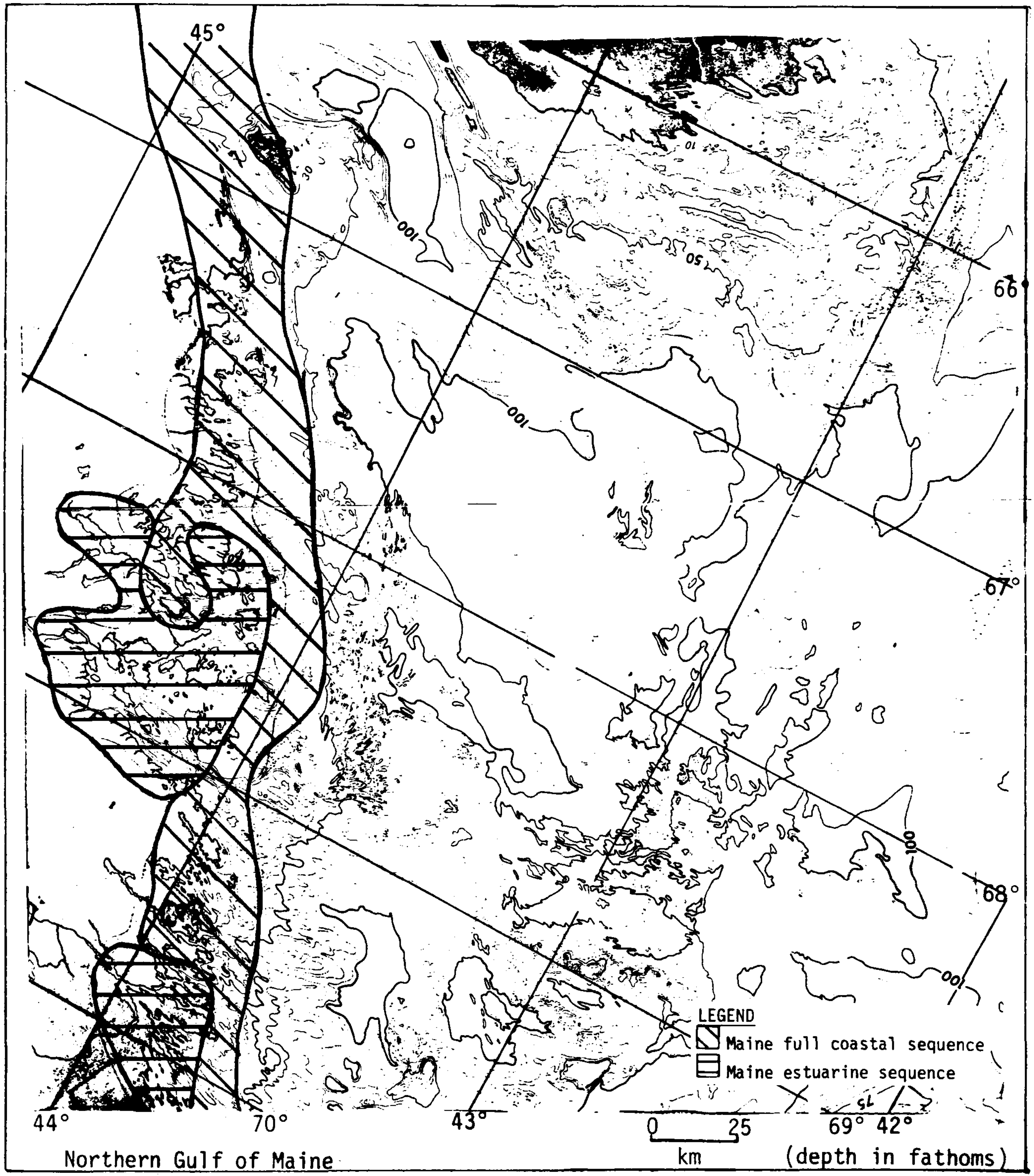


Fig. IV-30
Archaeological sequences.

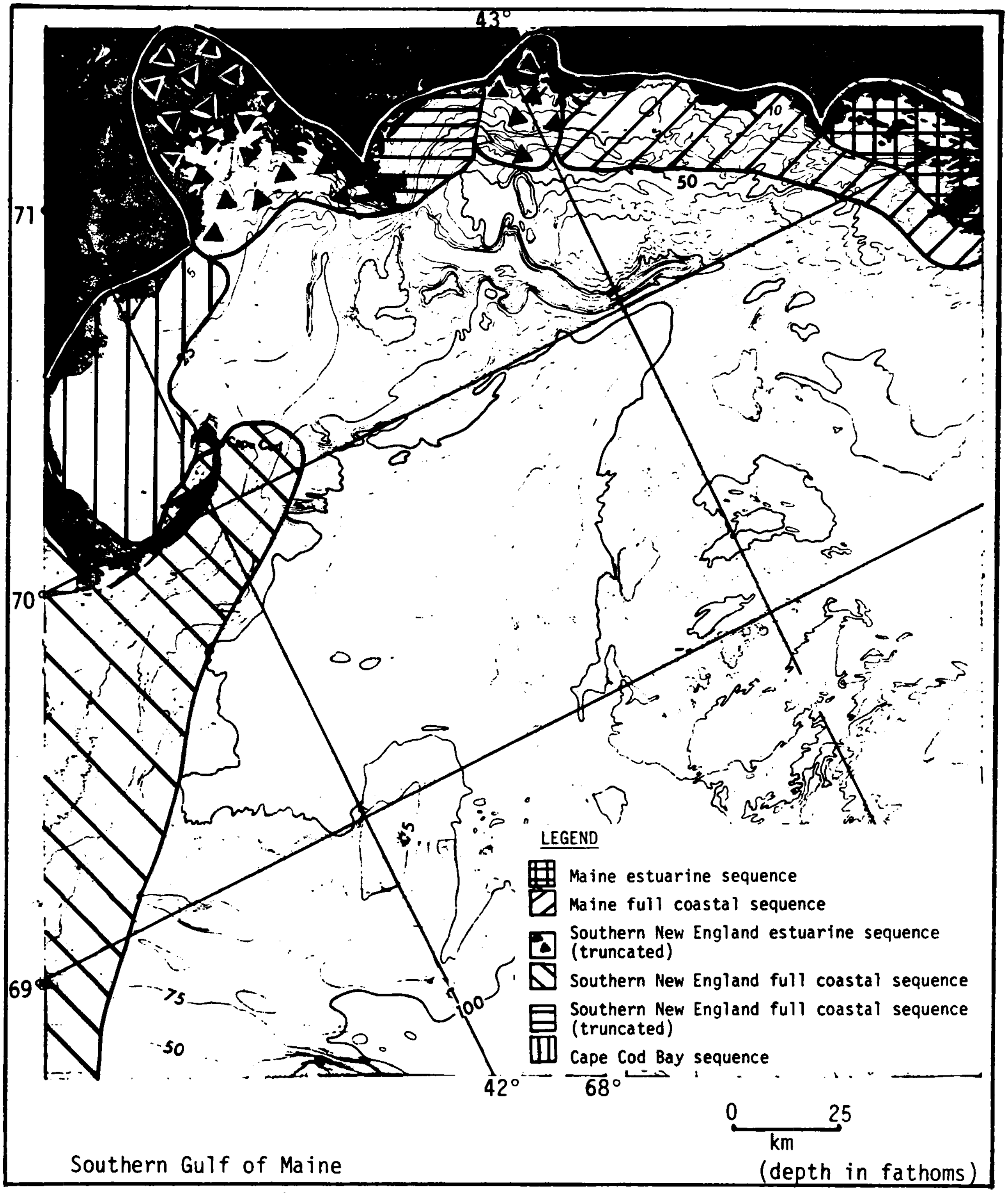


Fig. IV-31
Archaeological sequences.

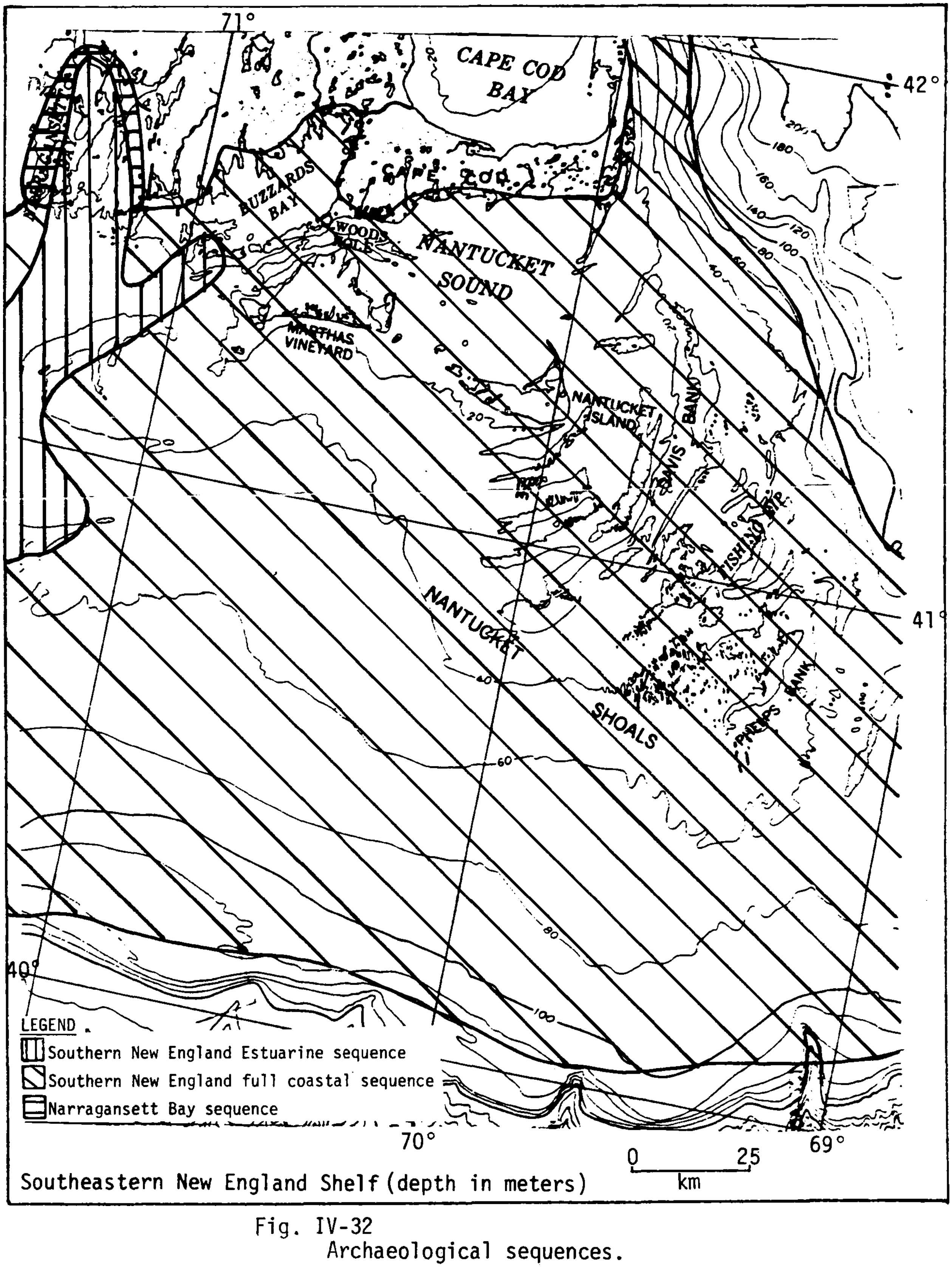


Fig. IV-32
Archaeological sequences.

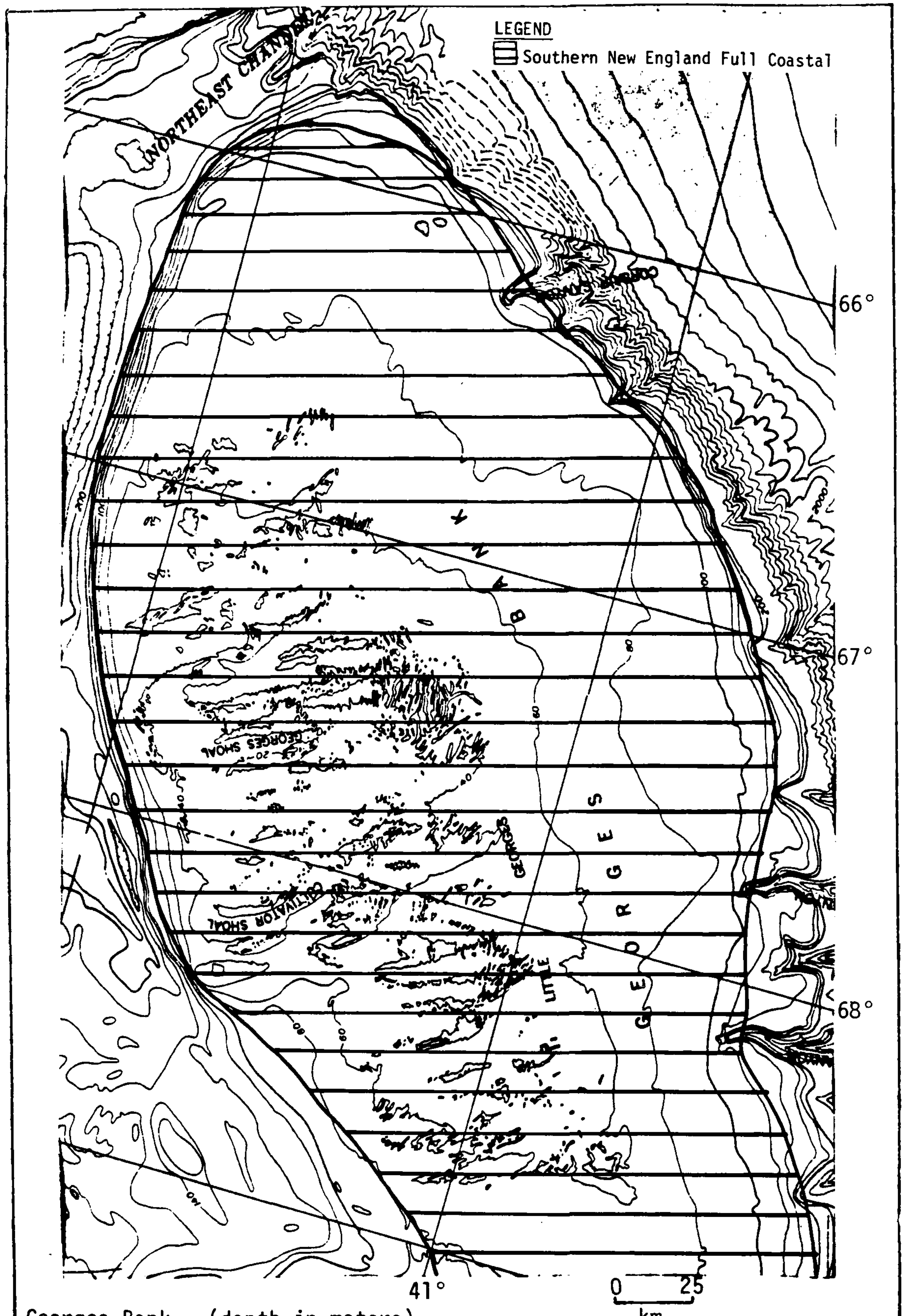


Fig. IV-33
Archaeological sequences.

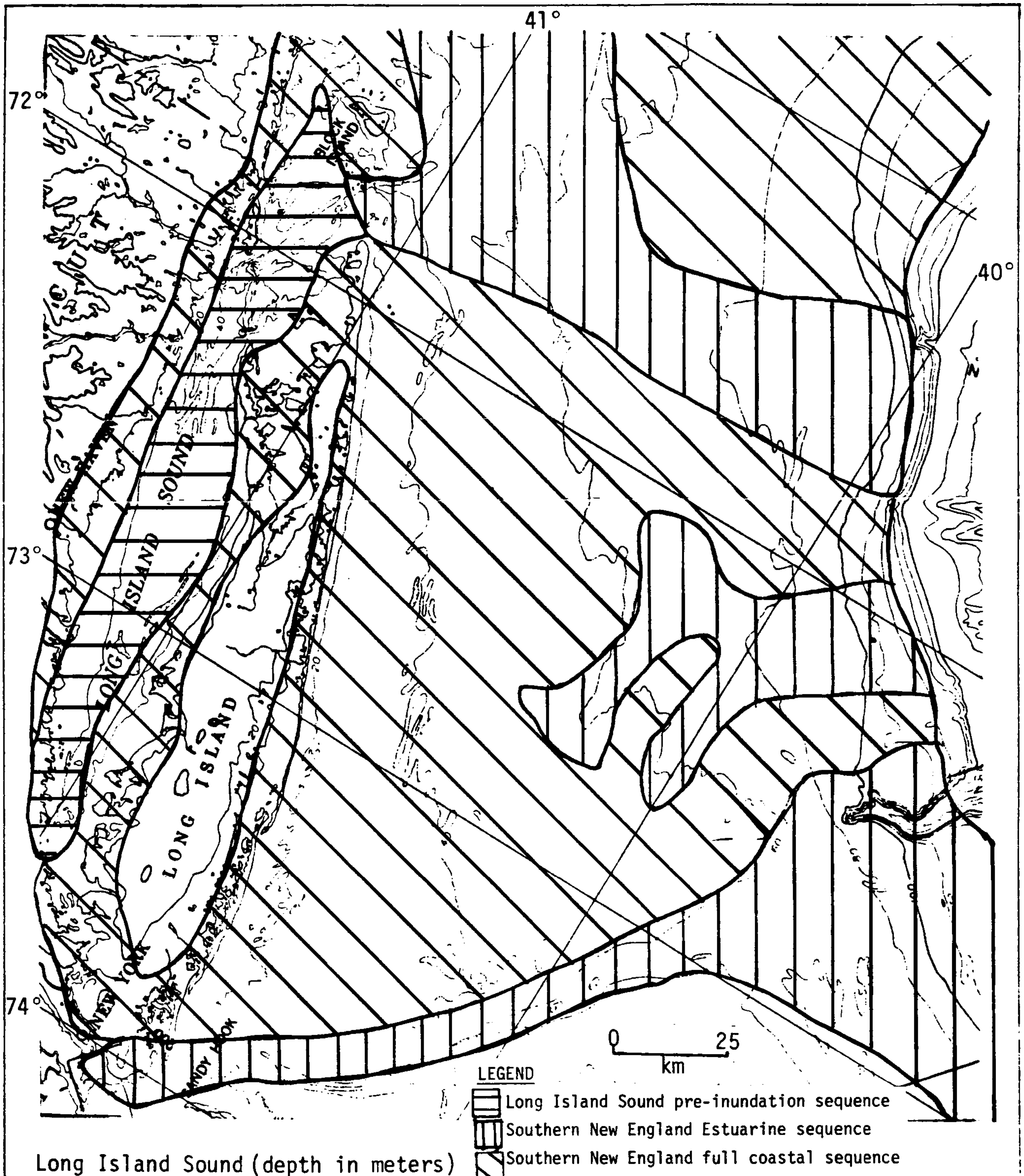


Fig. IV-34
Archaeological sequences.

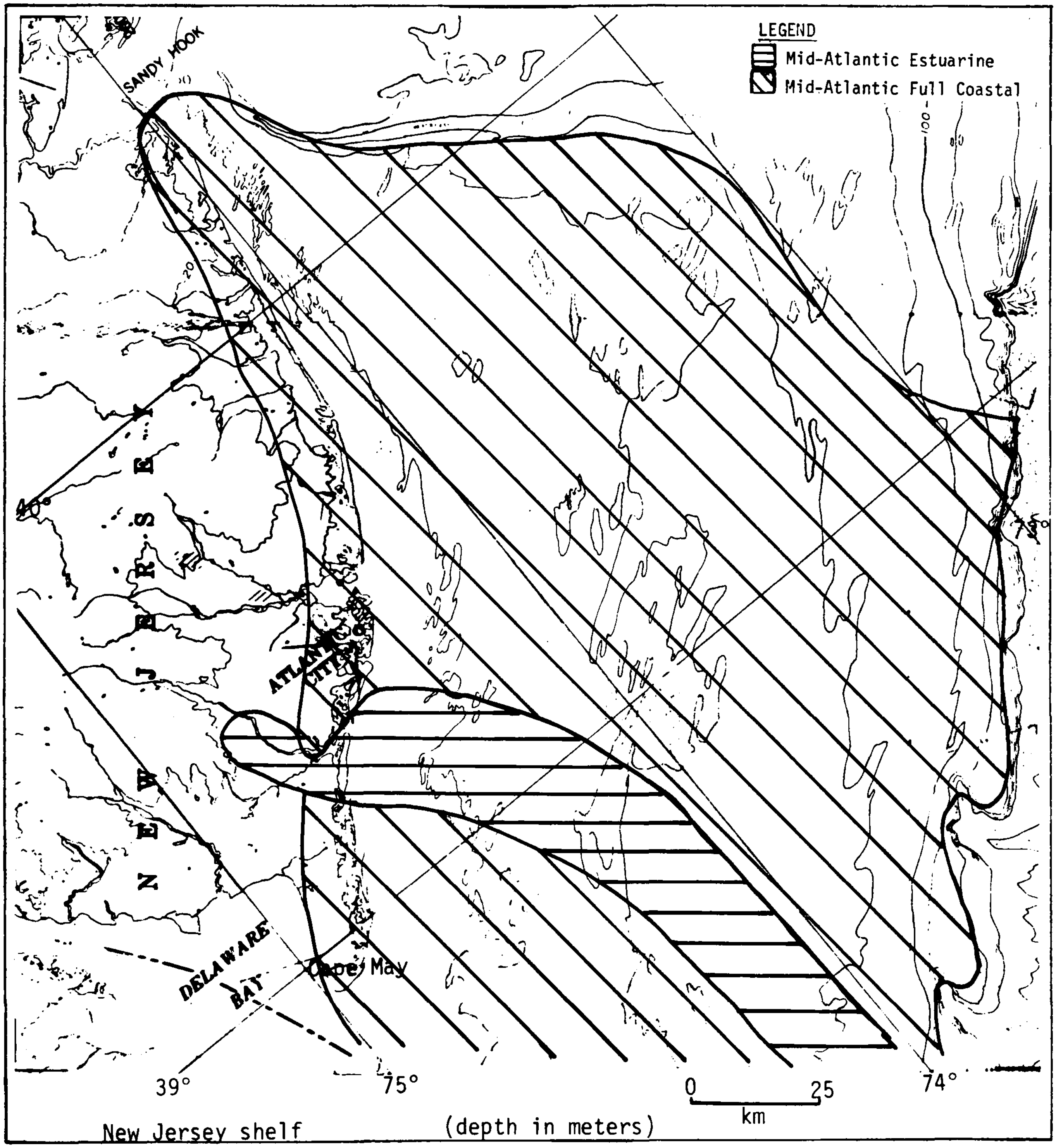


Fig. IV-35
Archaeological sequences,

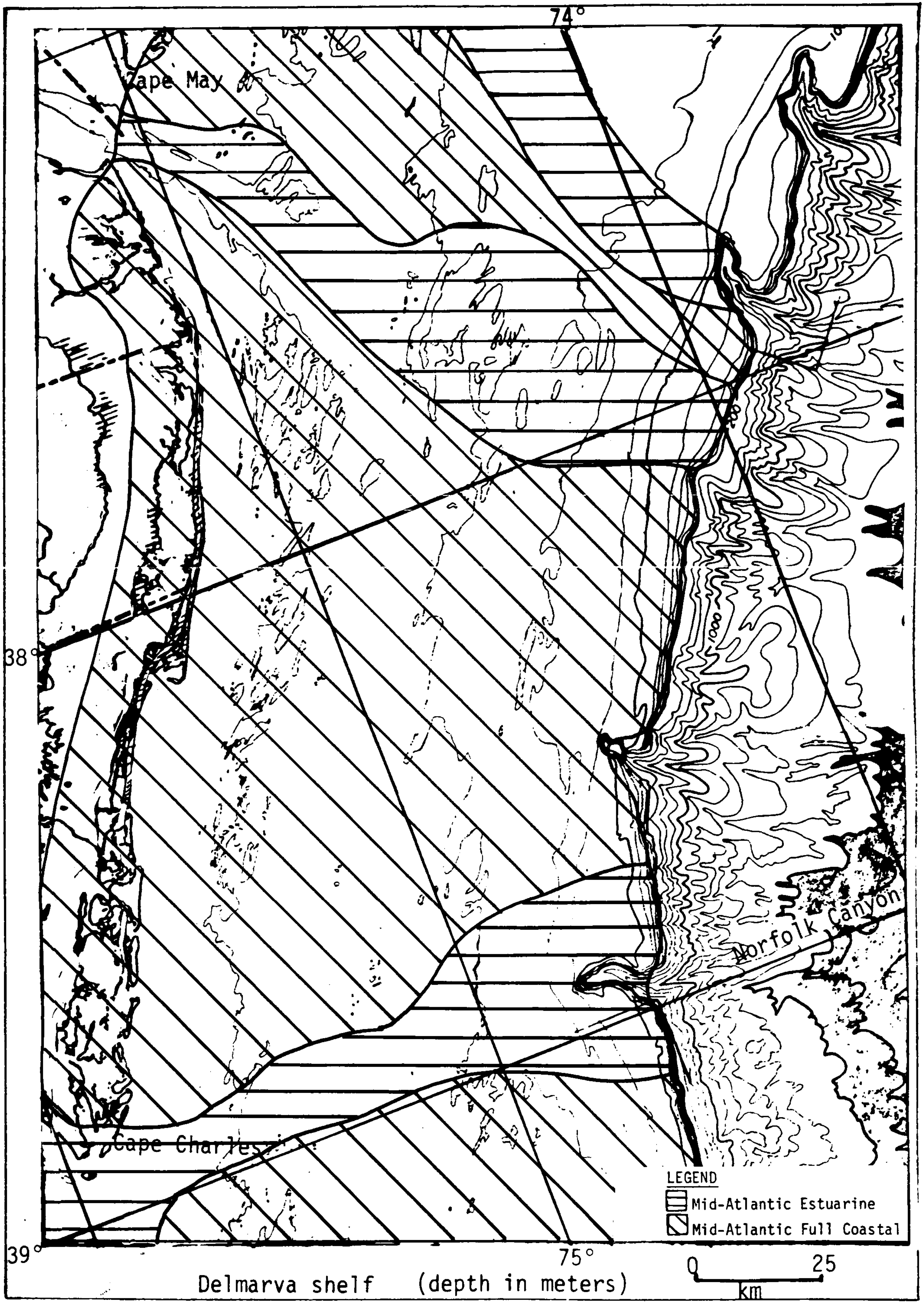


Fig. IV-36: Archaeology sequences.

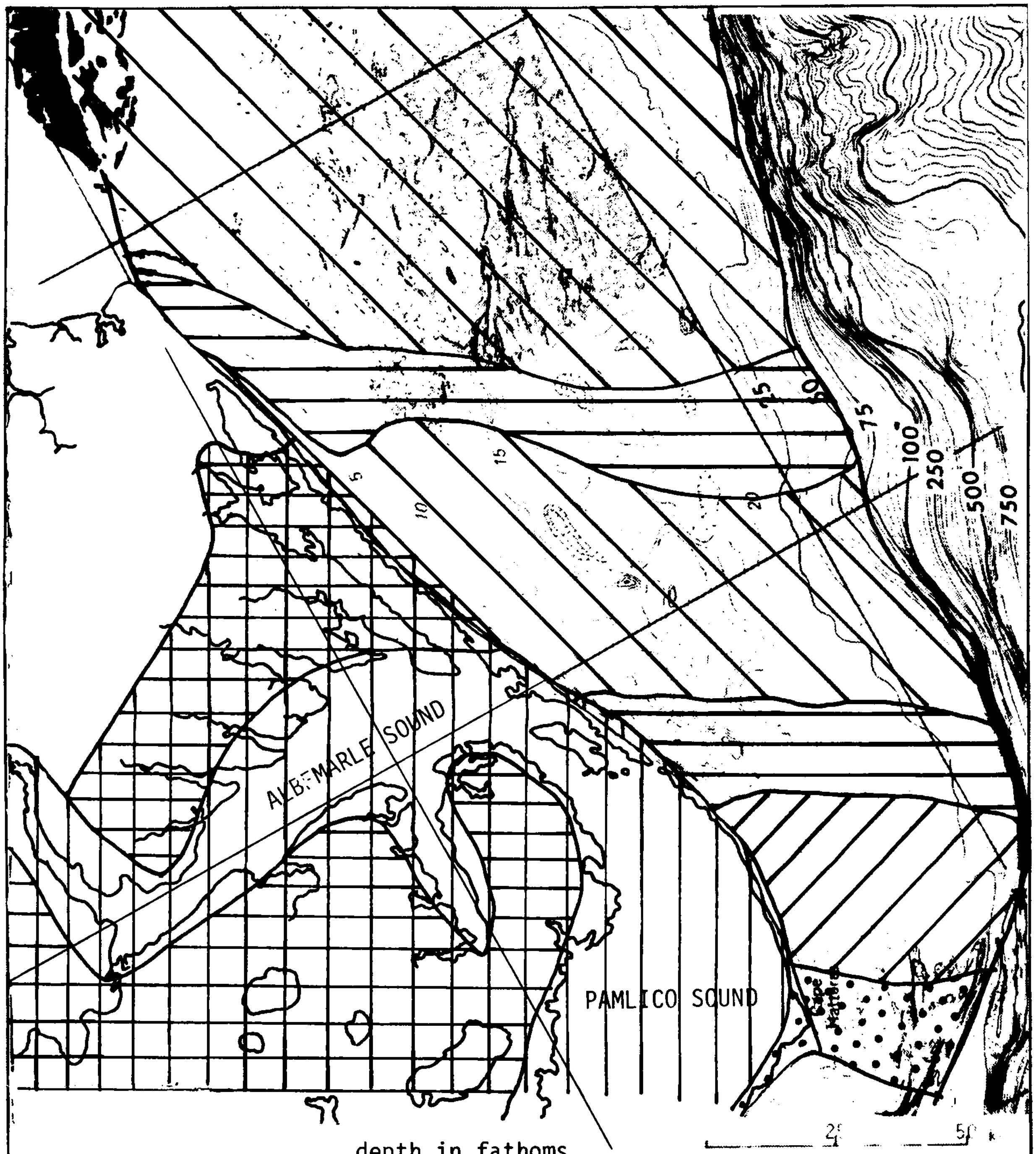


Fig. IV-37

Archaeological sequences (North Carolina - Southeastern Virginia shelf). [legend symbol] - Mid-Atlantic Full Coastal; [legend symbol] - Southern Mid-Atlantic Full Coastal; [legend symbol] - North Carolina Sound; [legend symbol] - Southern Mid-Atlantic Estuarine; [legend symbol] - North Carolina Wetlands; [legend symbol] - Diamond.

Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation.

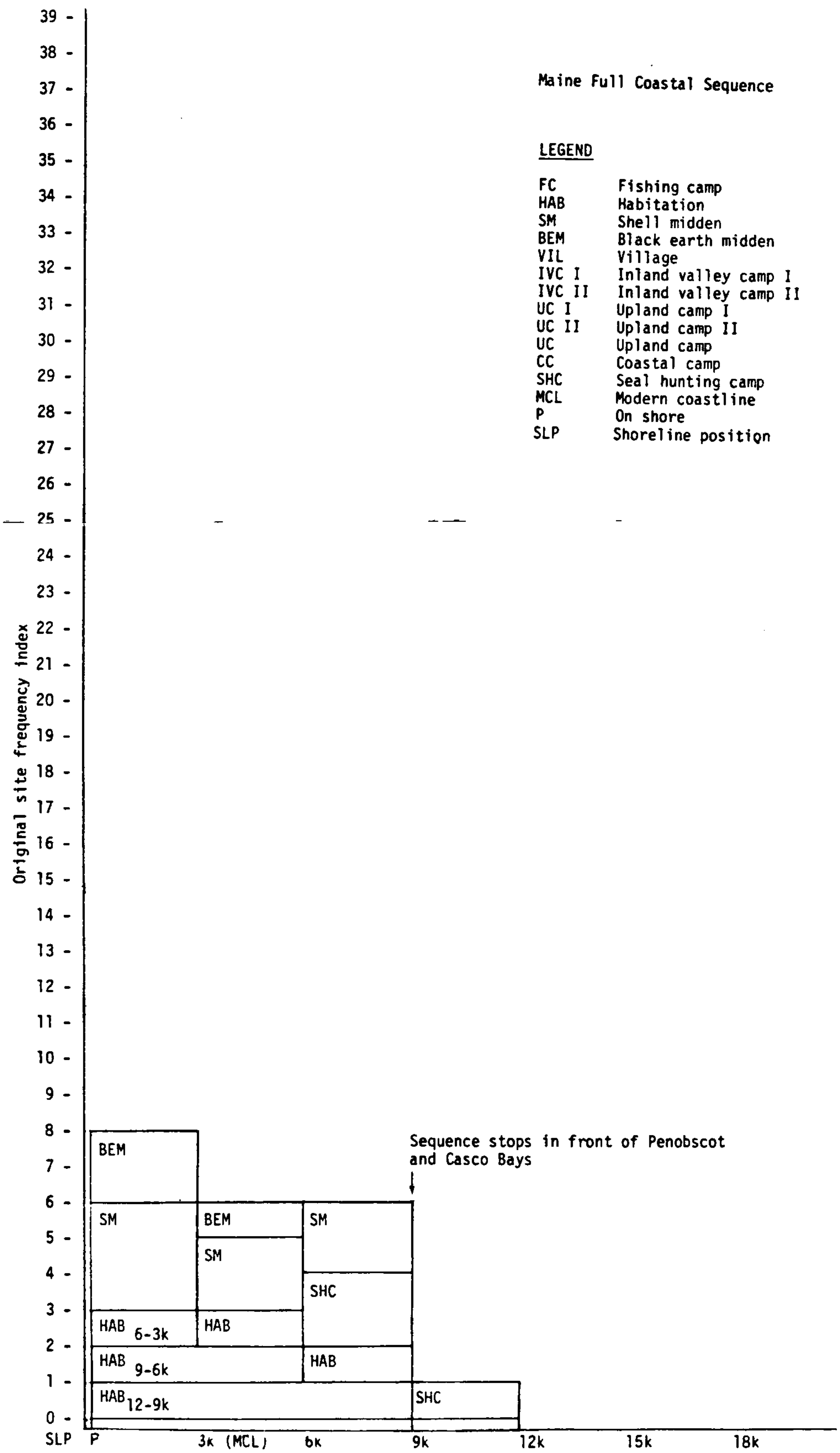


Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation. (continued)

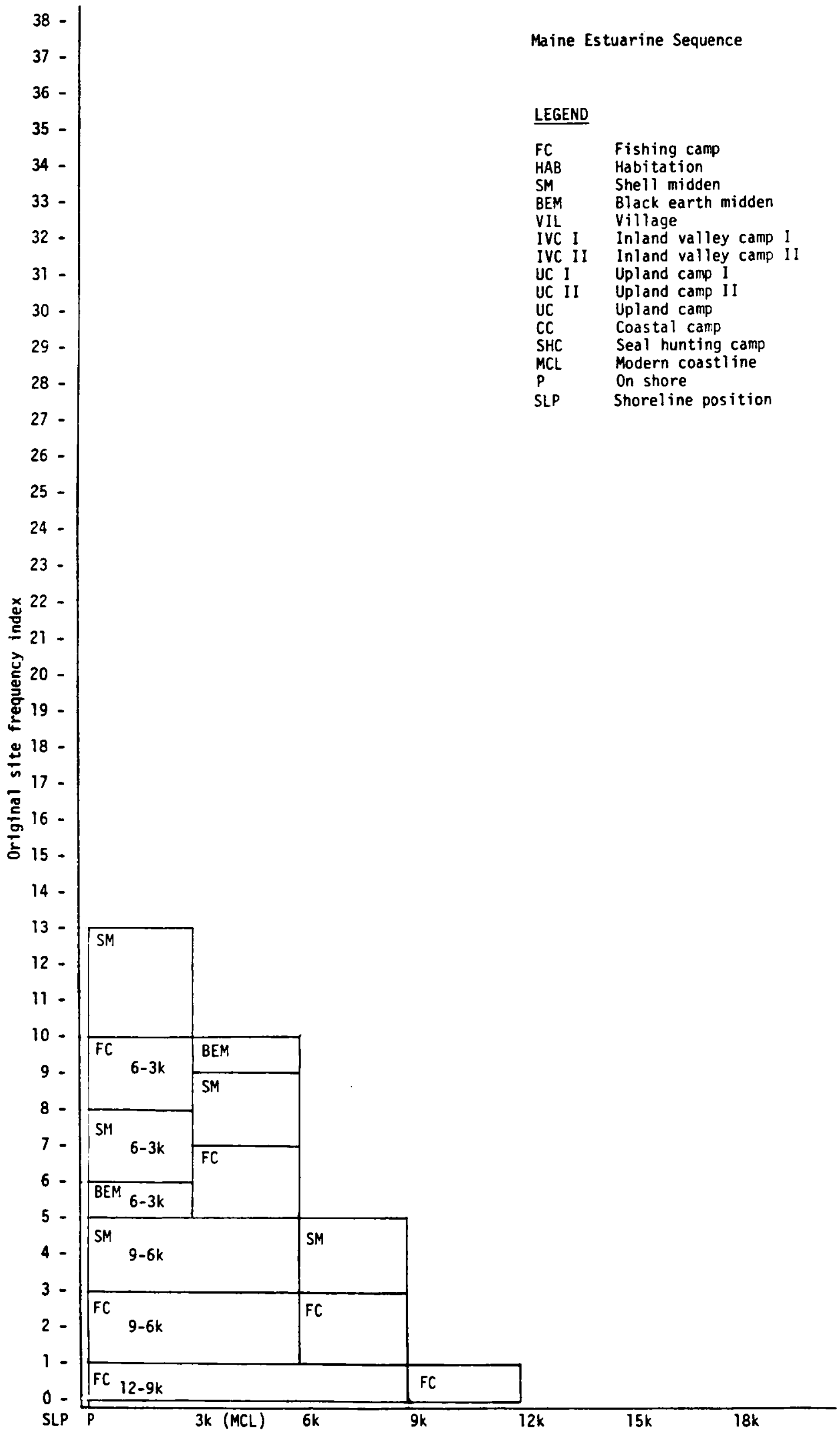


Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation. (continued)

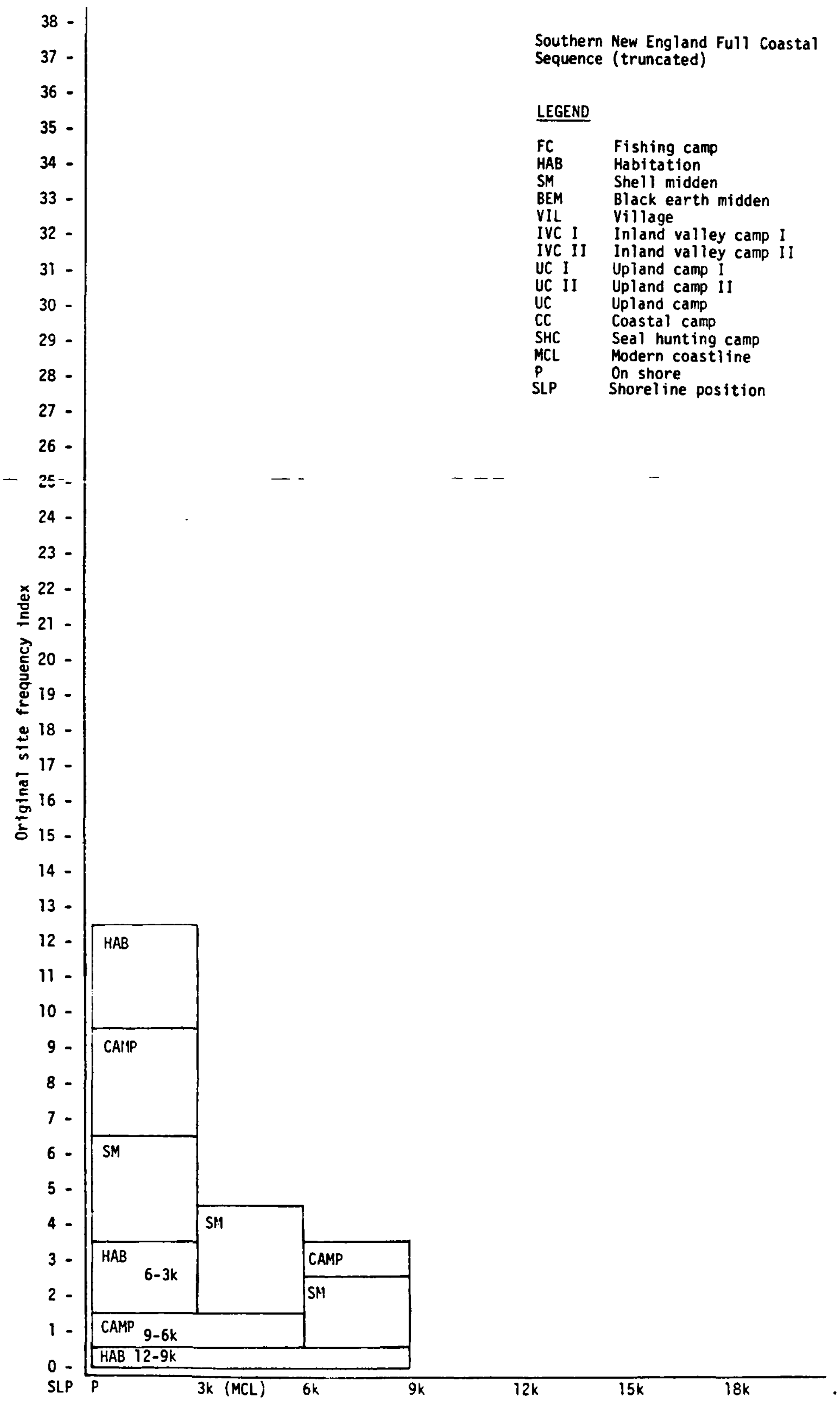


Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation. (continued)

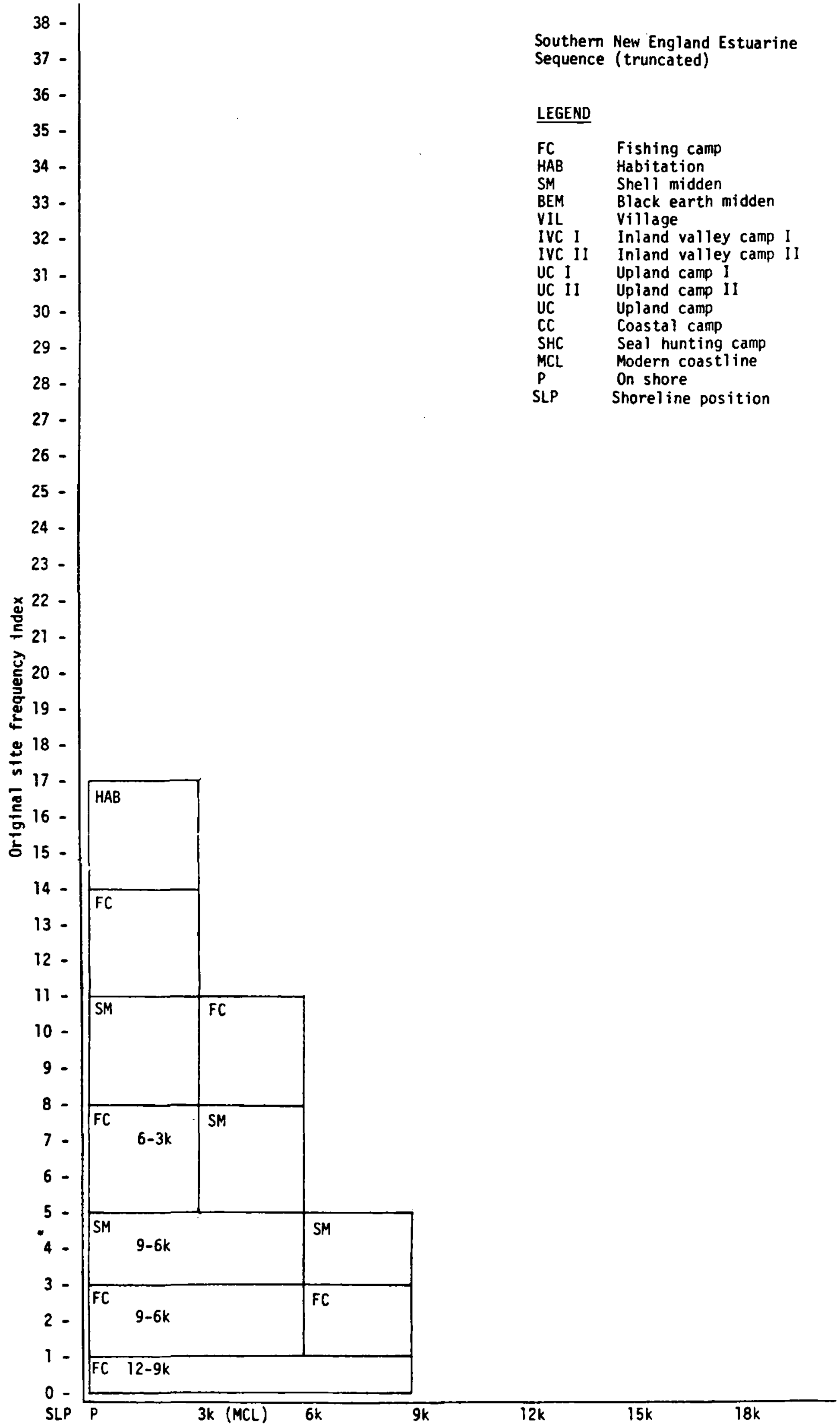


Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation. (continued)

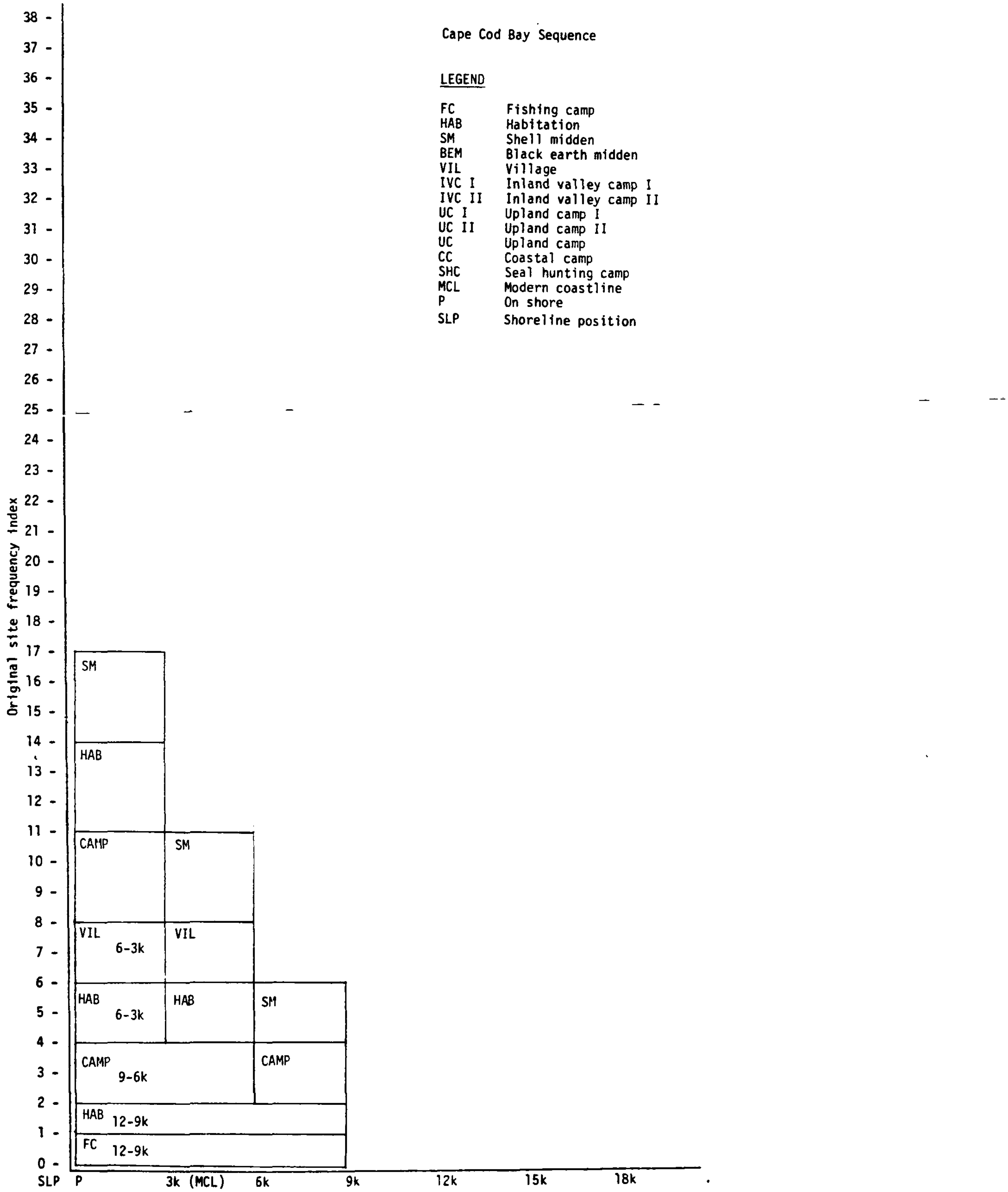


Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation. (continued)

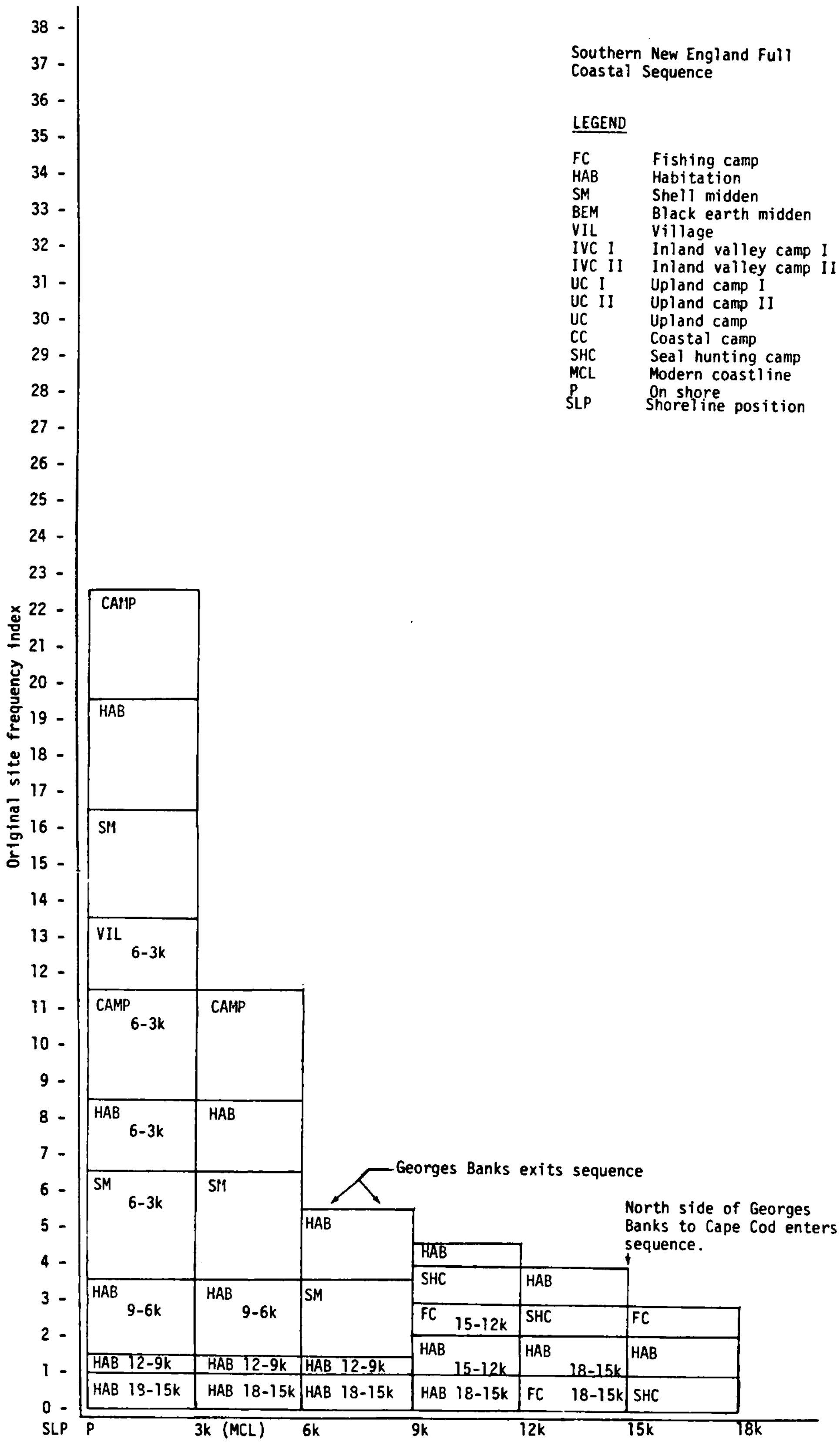


Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation. (continued)

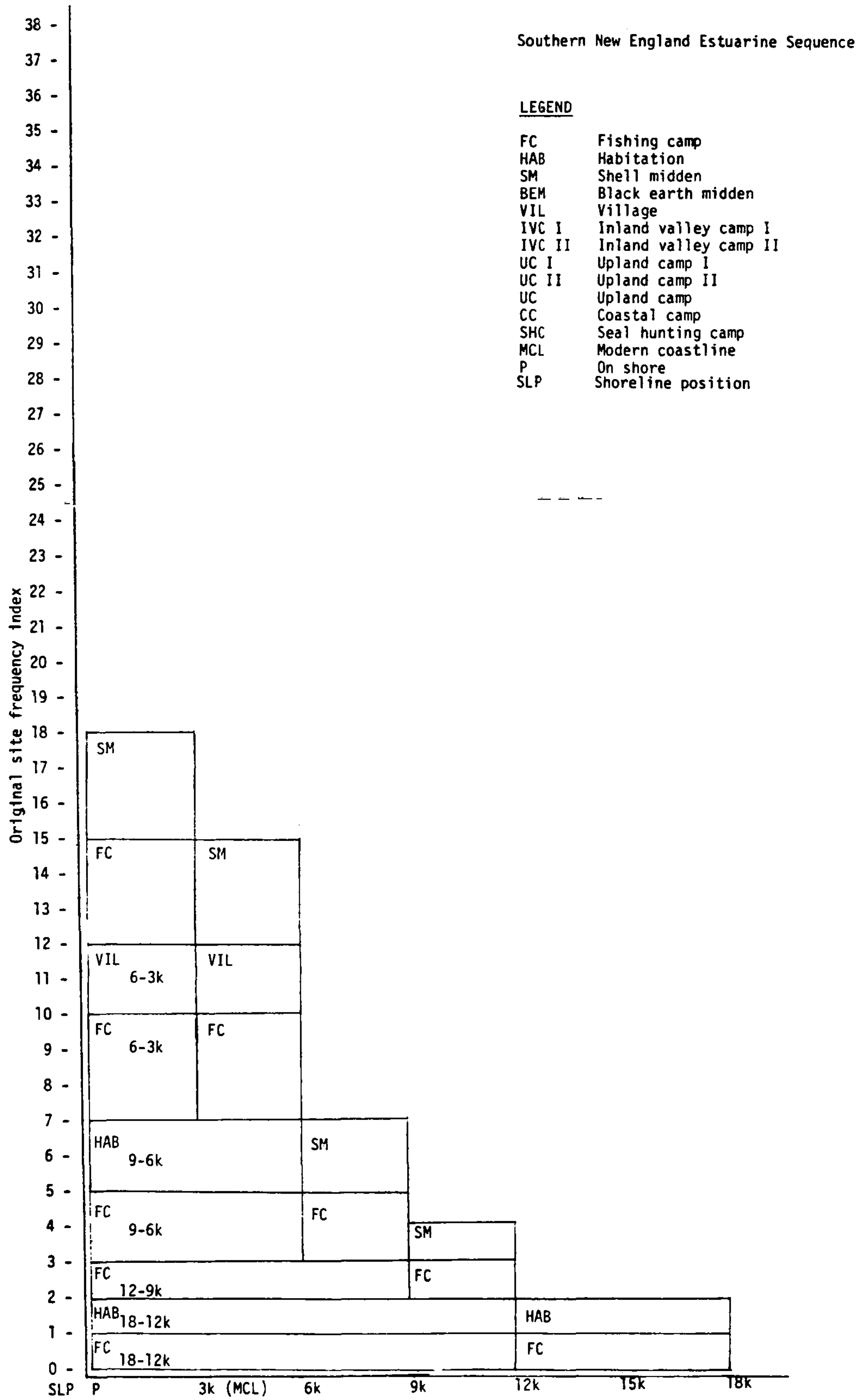
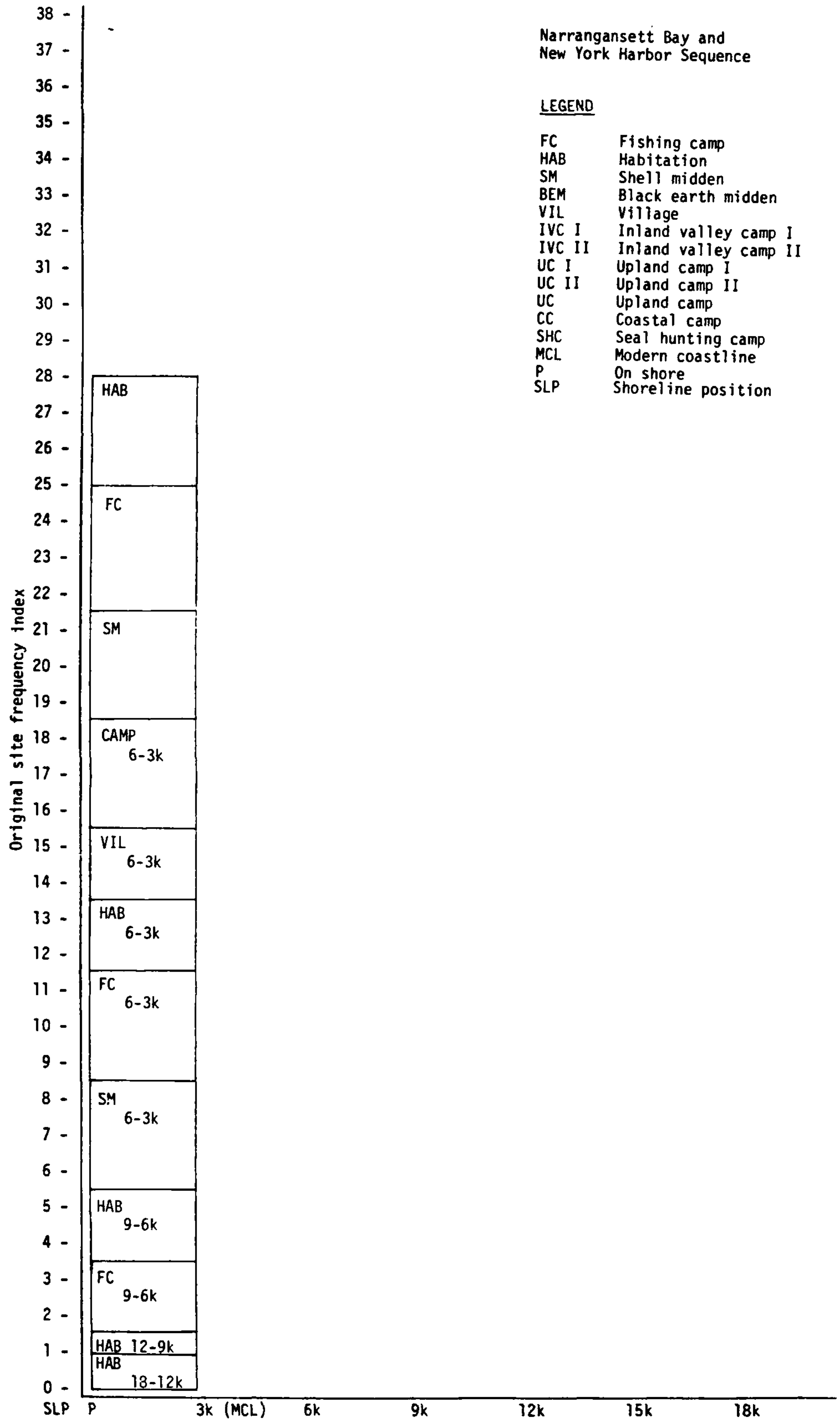


Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation. (continued)



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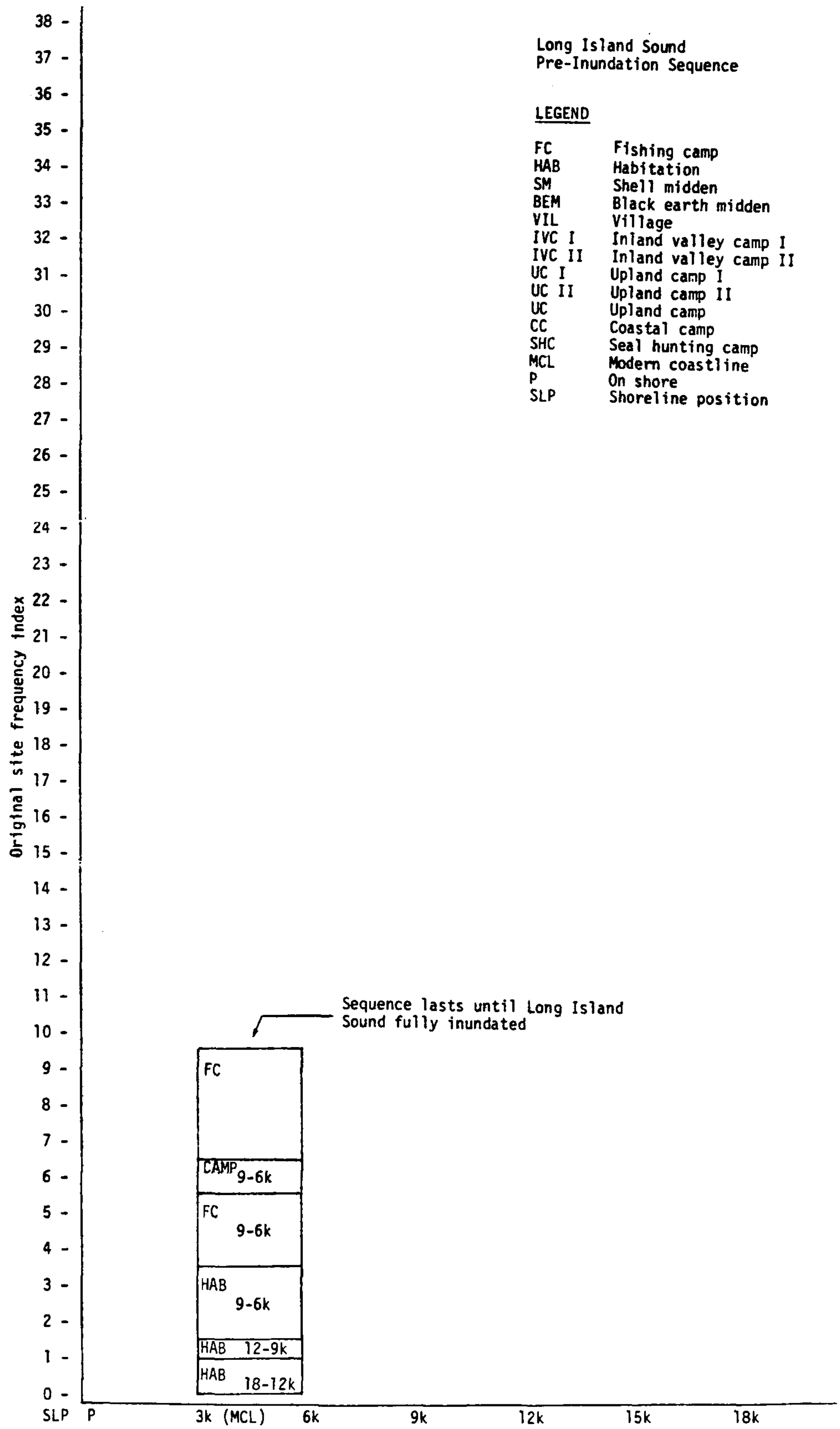

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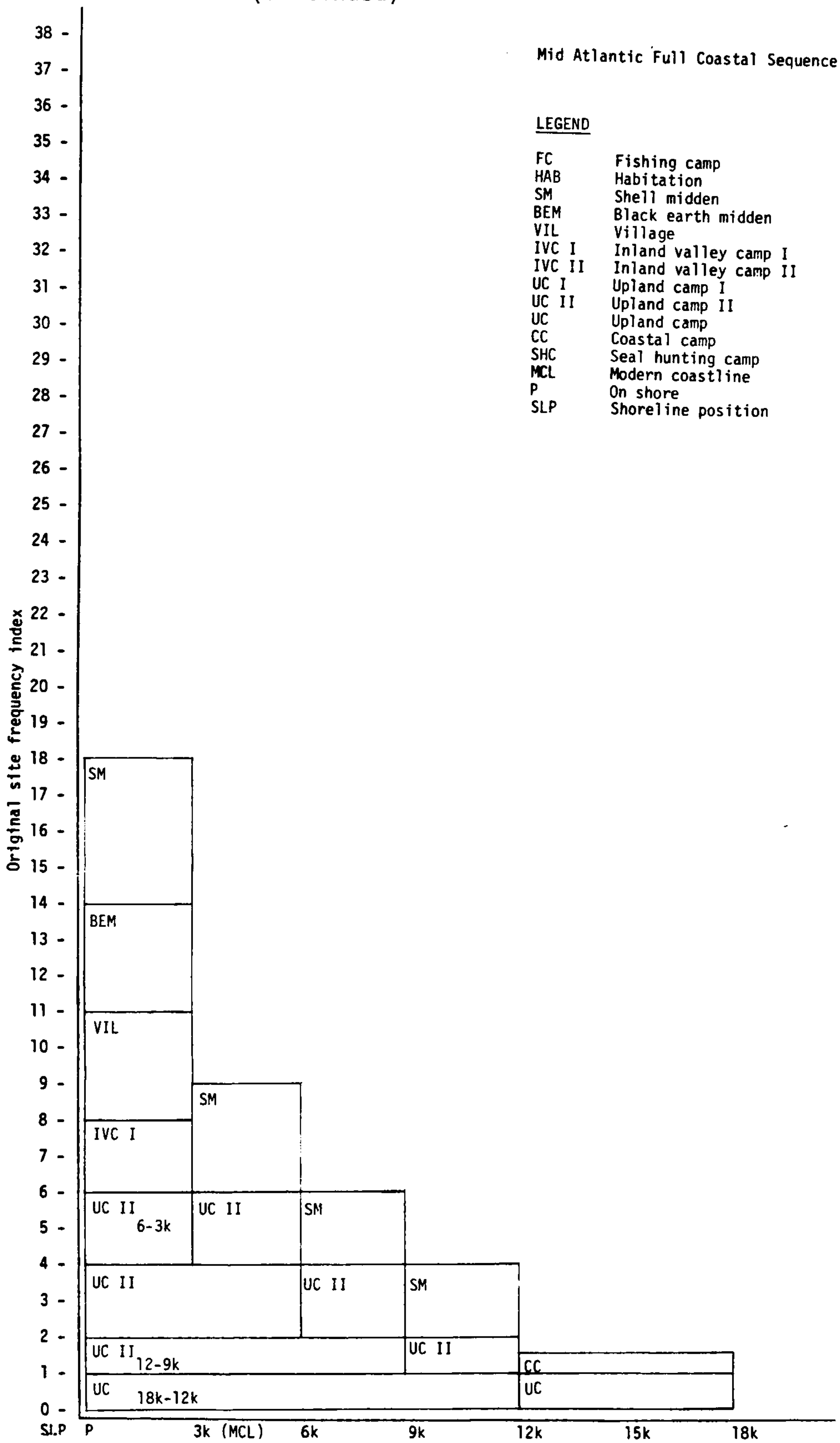

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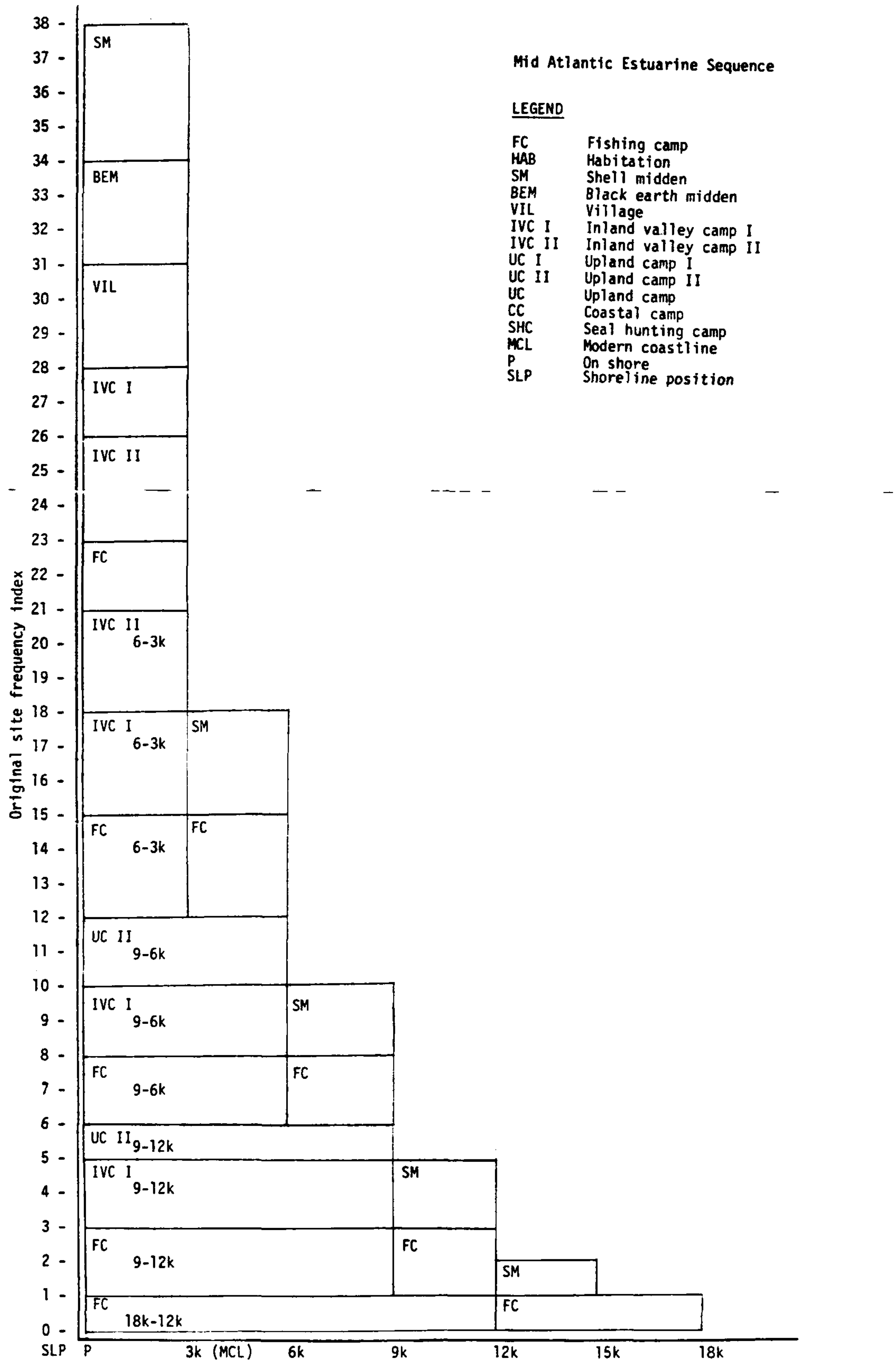

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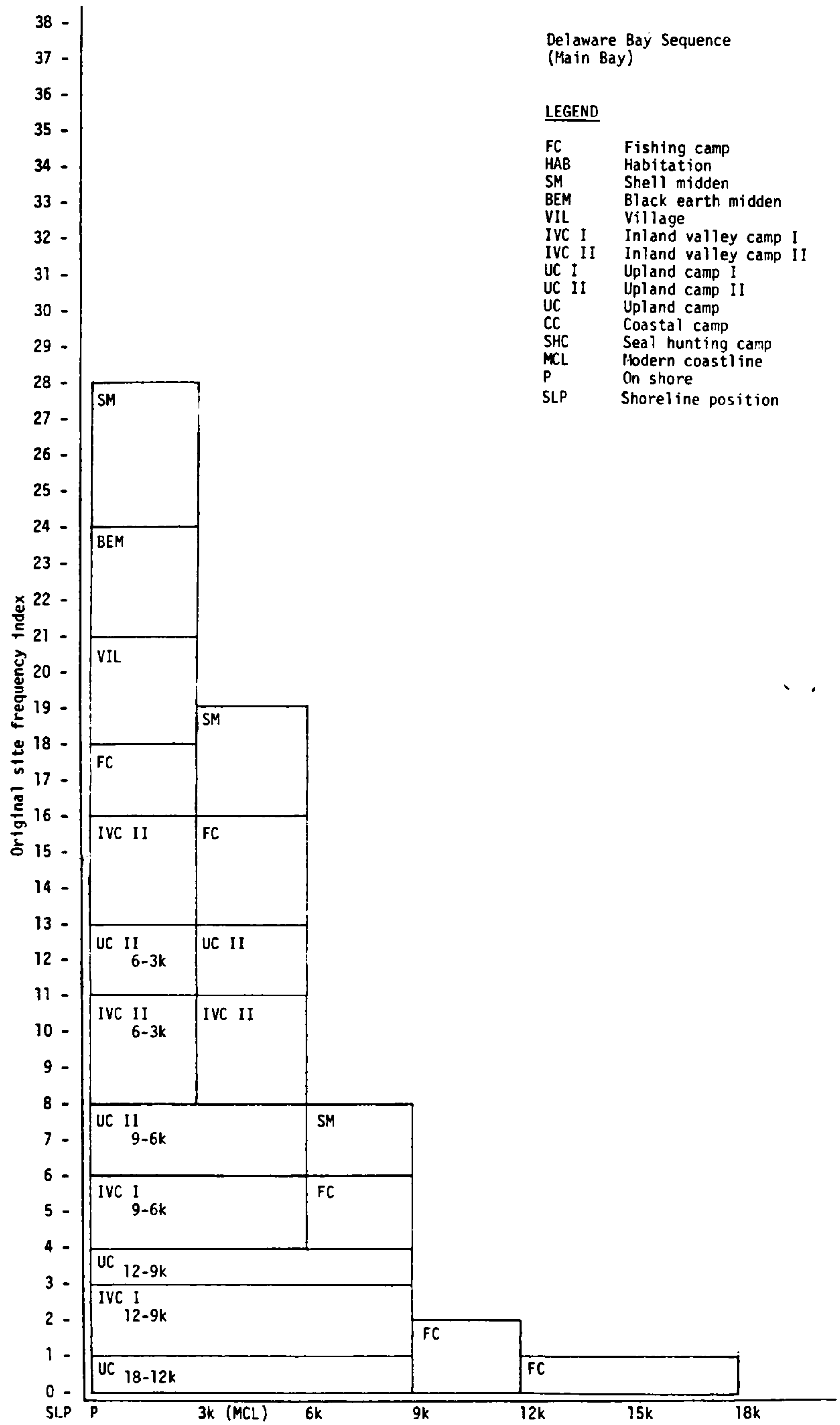

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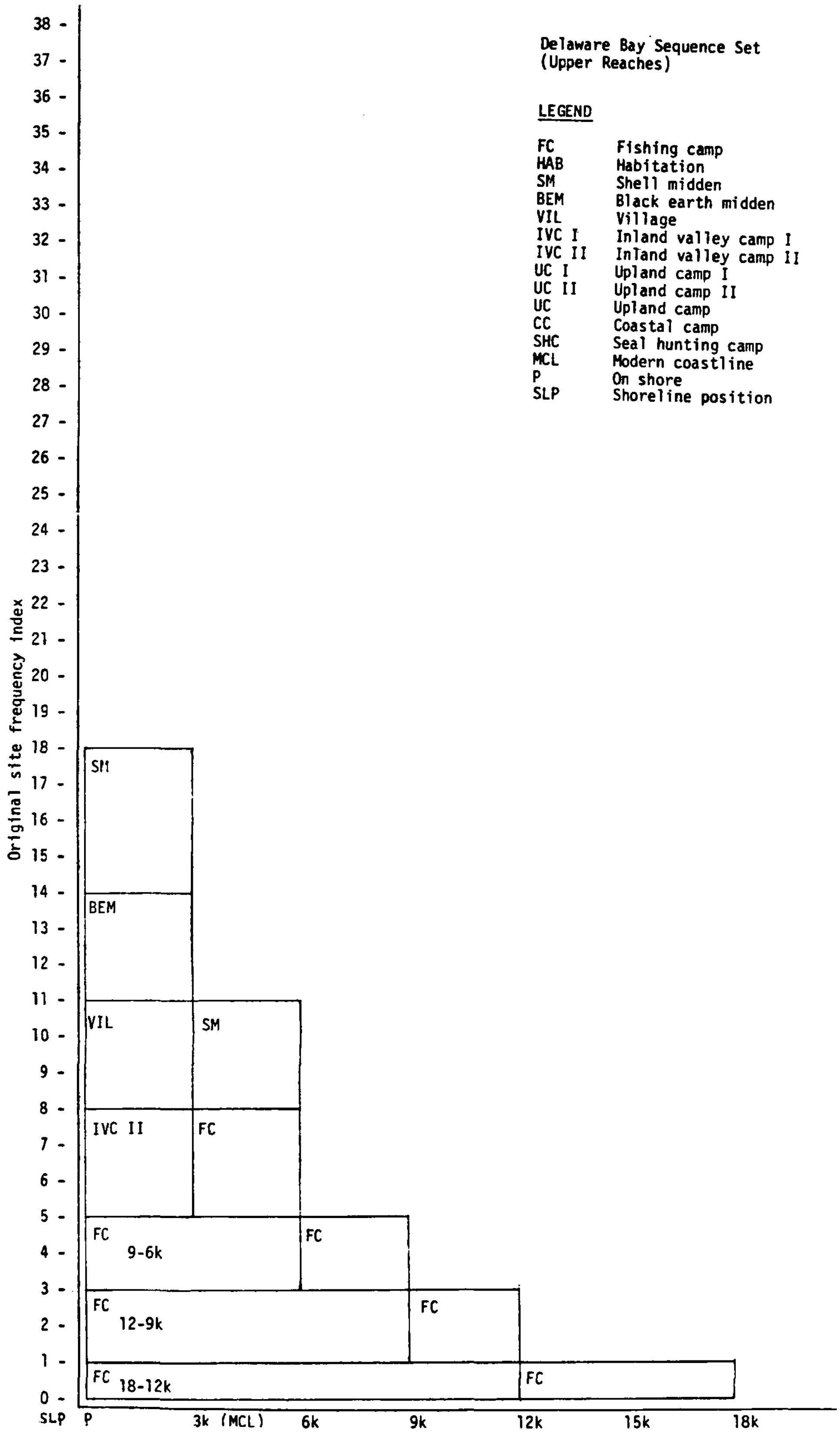

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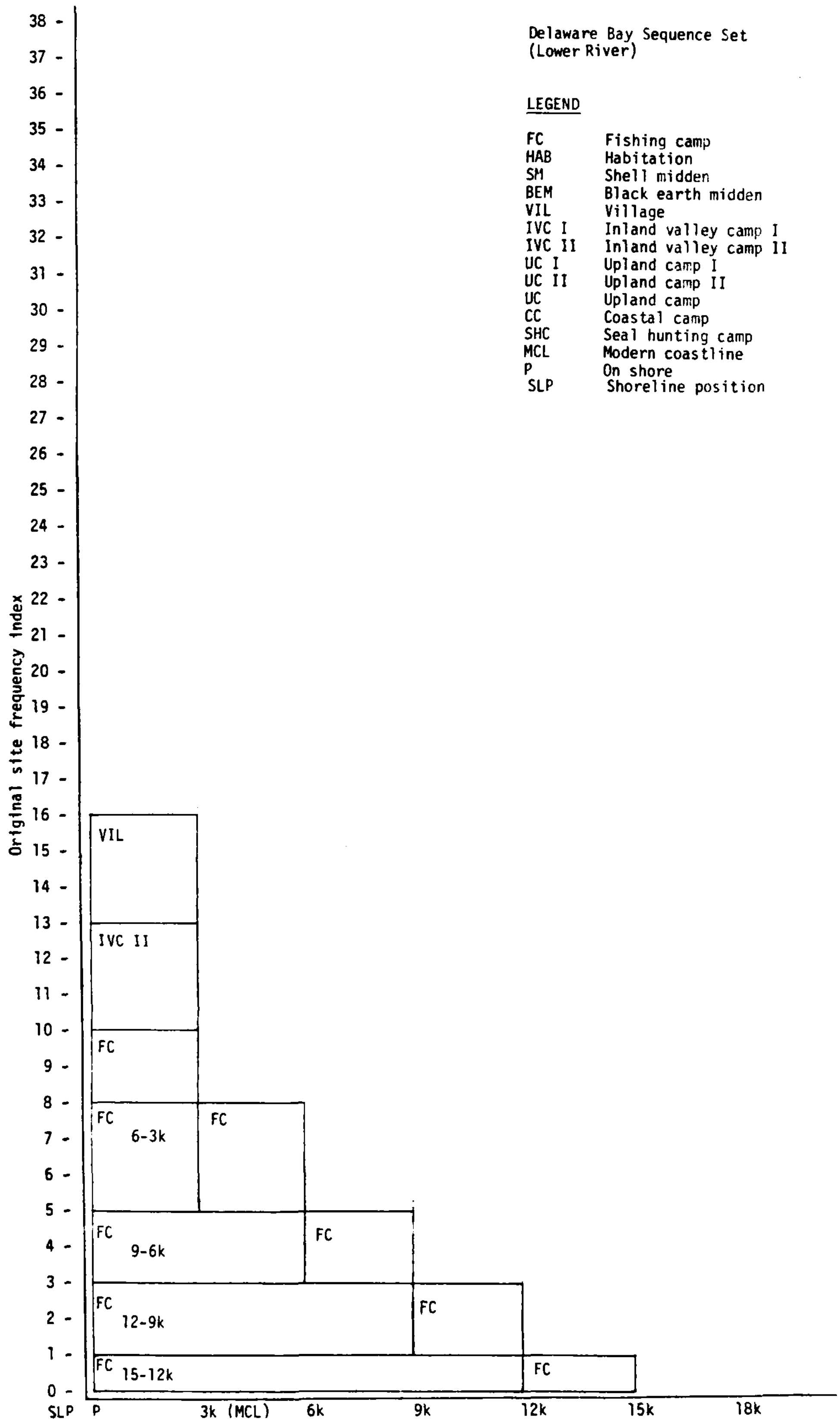
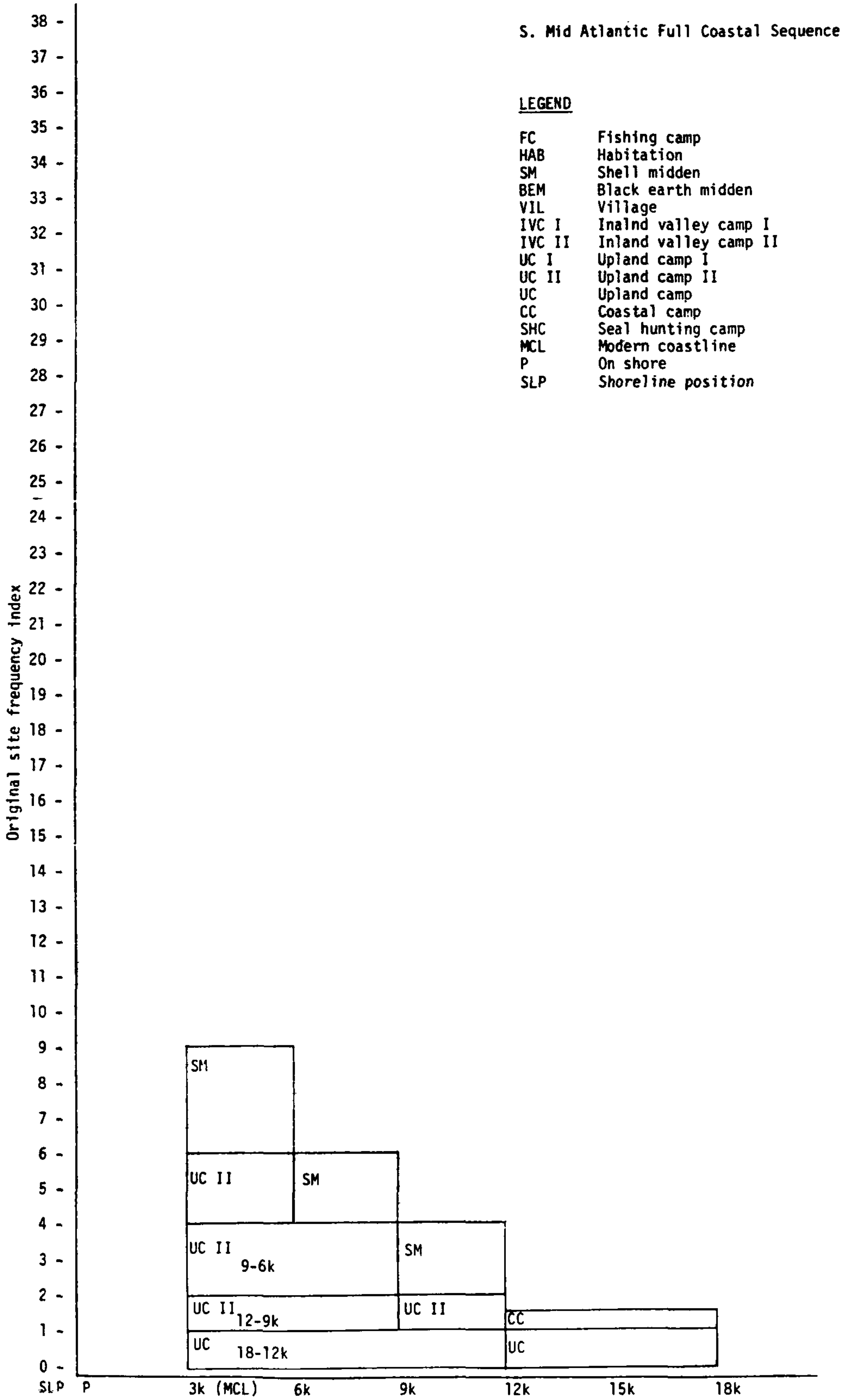


Table IV-5. Expected composition of Archaeological Sequence Zones prior to inundation. (continued)



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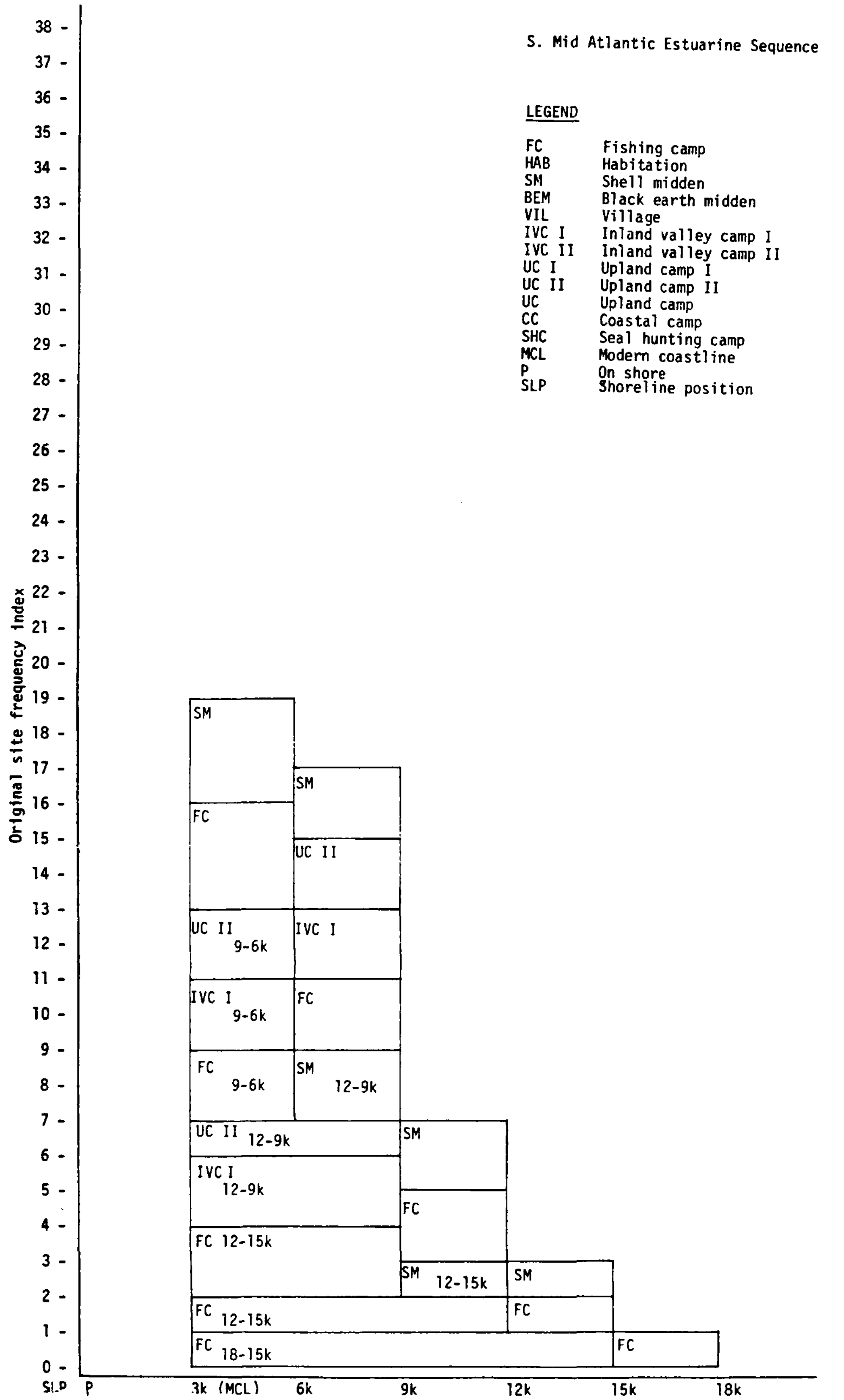

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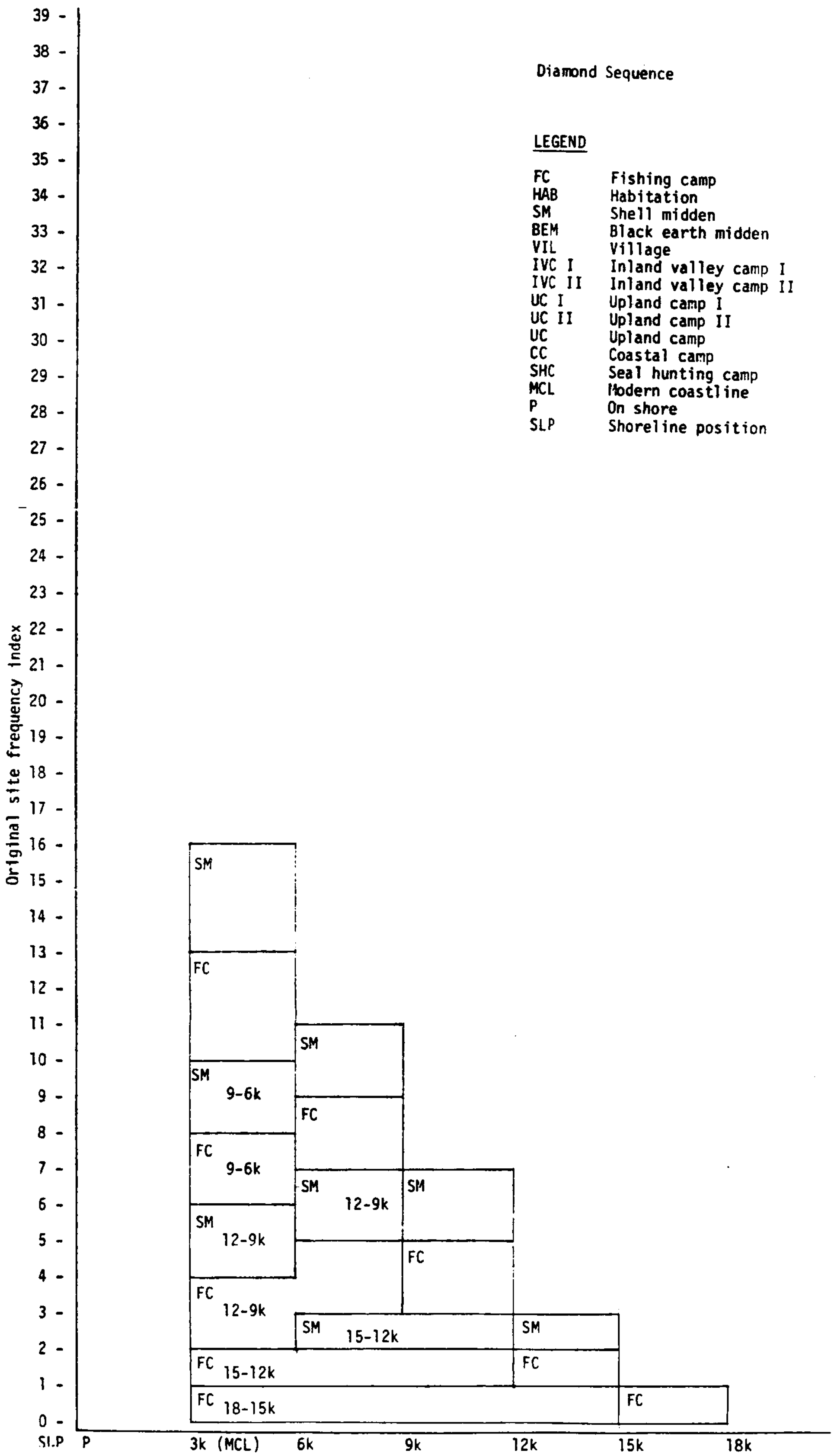

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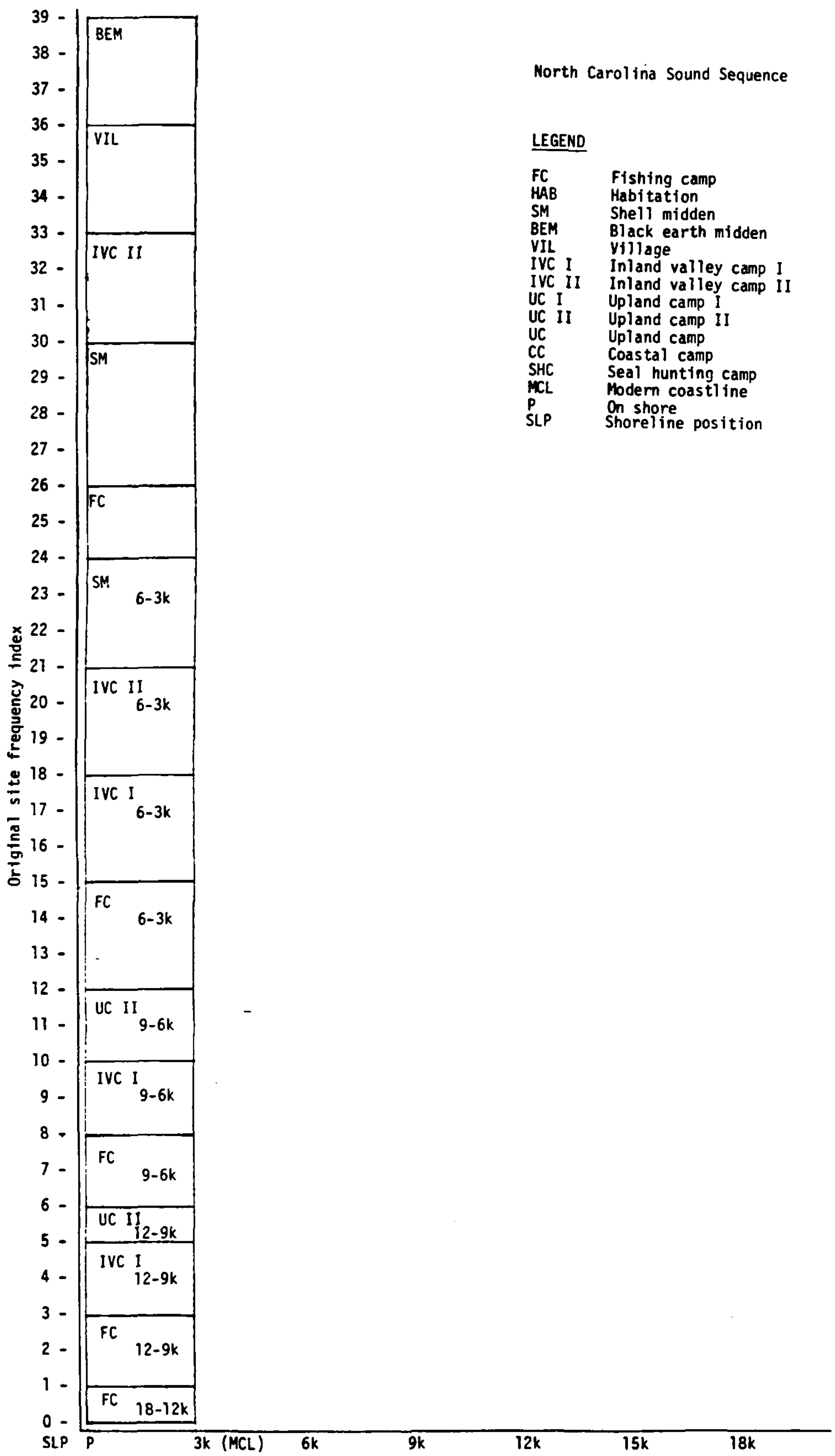

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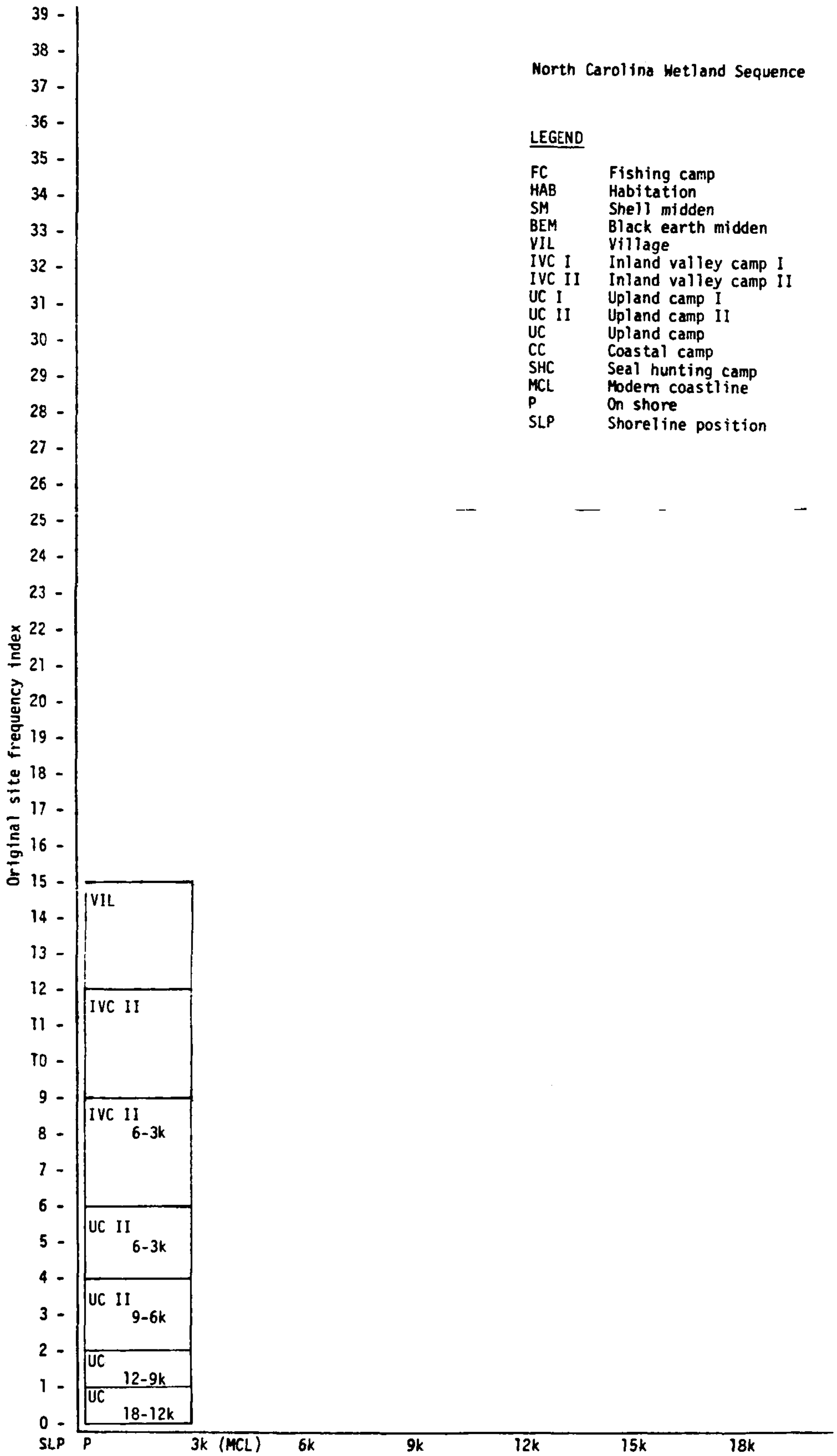

4.2.2.3 Preserved archaeology zones - The integration of archaeological sequences with zones of different expected subareal surface preservation results in identifiable preserved archaeology zones. Figs. IV-38 through 46 shows the location of these zones while Fig. IV-47 illustrates by means of histograms the difference between original predicted site frequency and residual predicted site frequency for each zone.

The calculation of residual site frequency is performed by multiplying the original site frequency index for a given archaeological zone by the percentage of expected preservation in that zone. The percentages are:

1. negligible preservation - expect a maximum of 5% of the subareal surface intact.

2. partial preservation - expect a maximum of 40% of the subareal surface intact.

3. considerable preservation - expect from 40% to 100% of the subareal surface to be preserved. (The multiplier for this level of preservation has been arbitrarily set at 75%.)

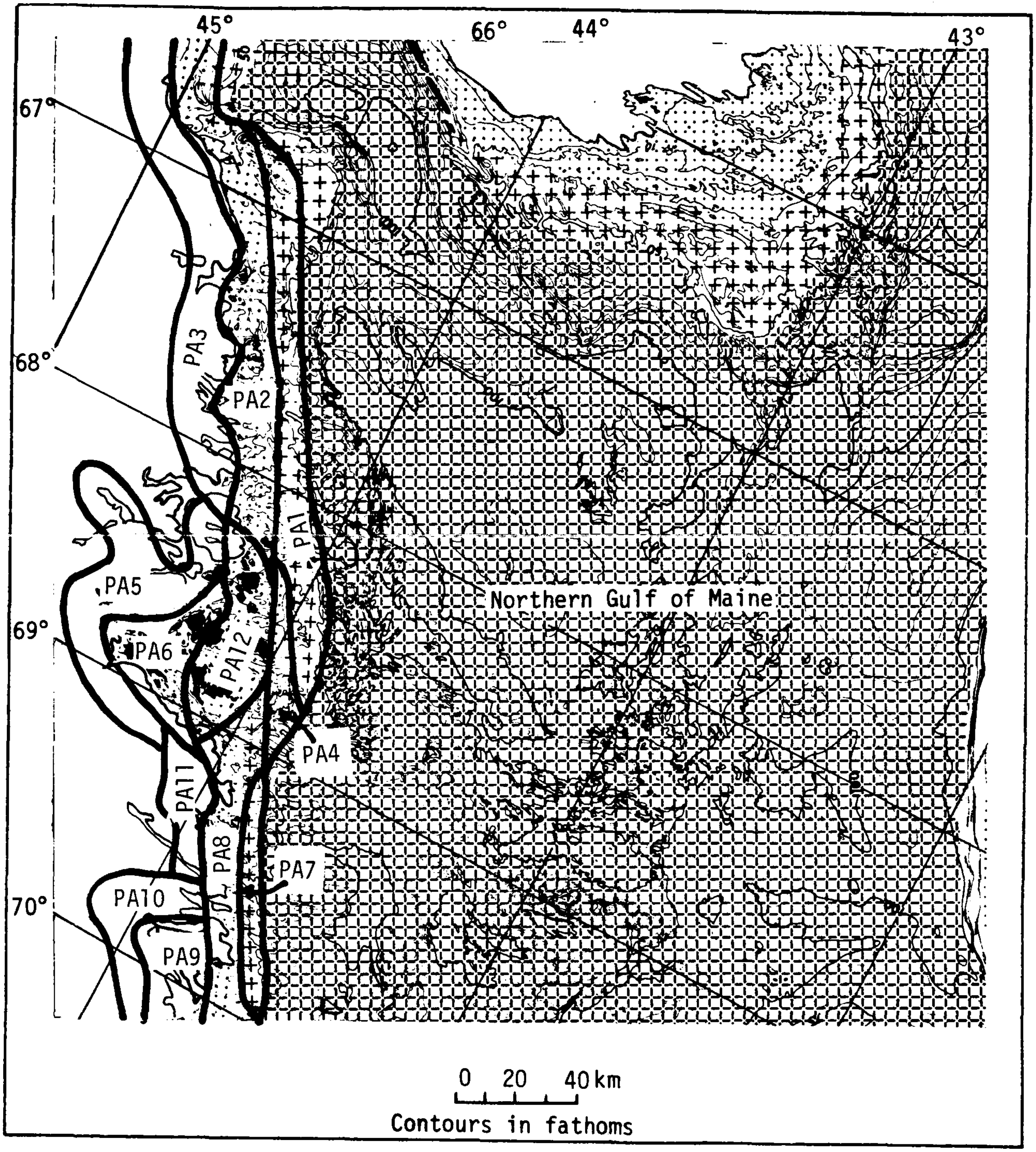

Fig. IV-38
Preserved archaeology zones.

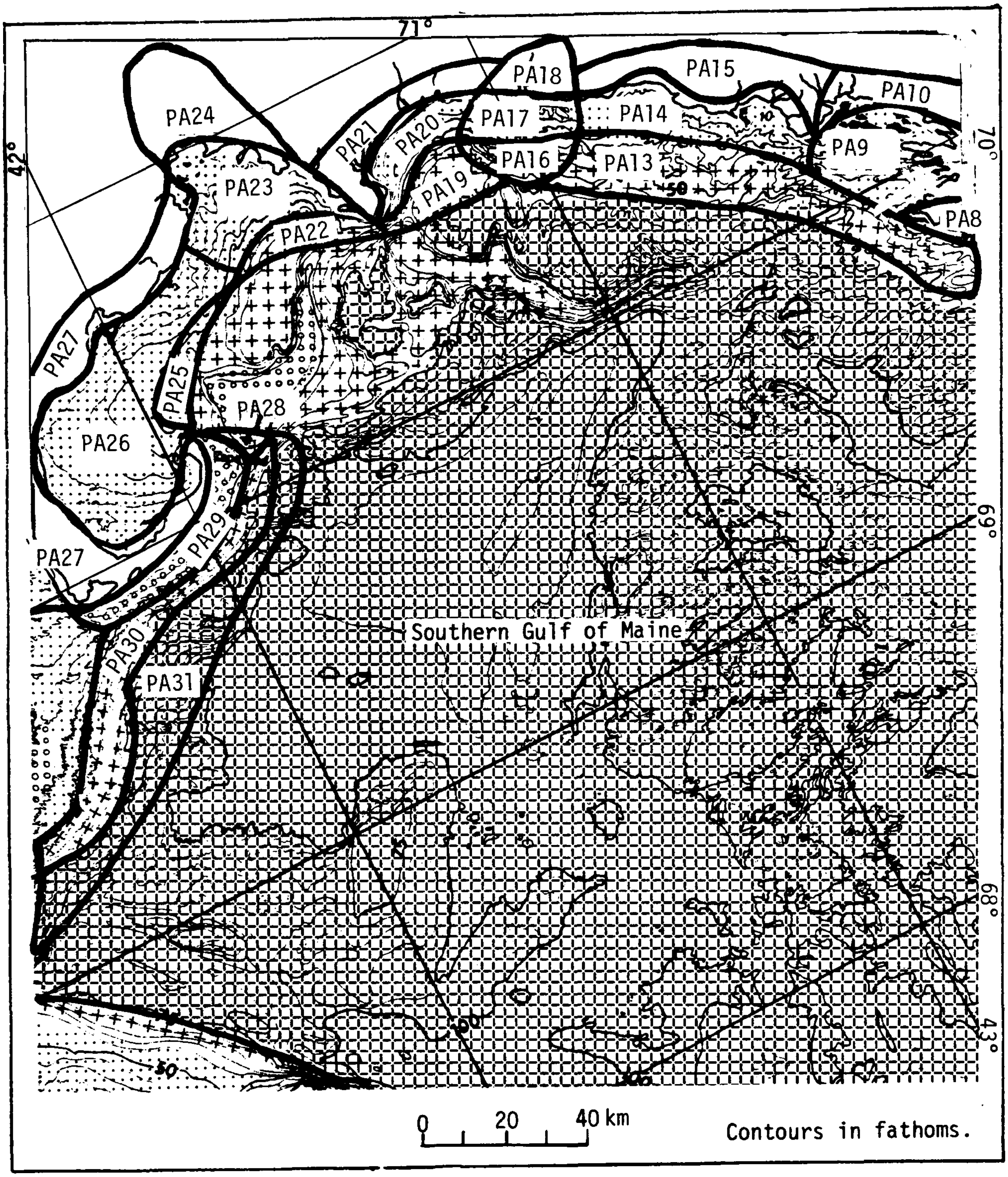

Fig. IV-39
Preserved archaeology zones.

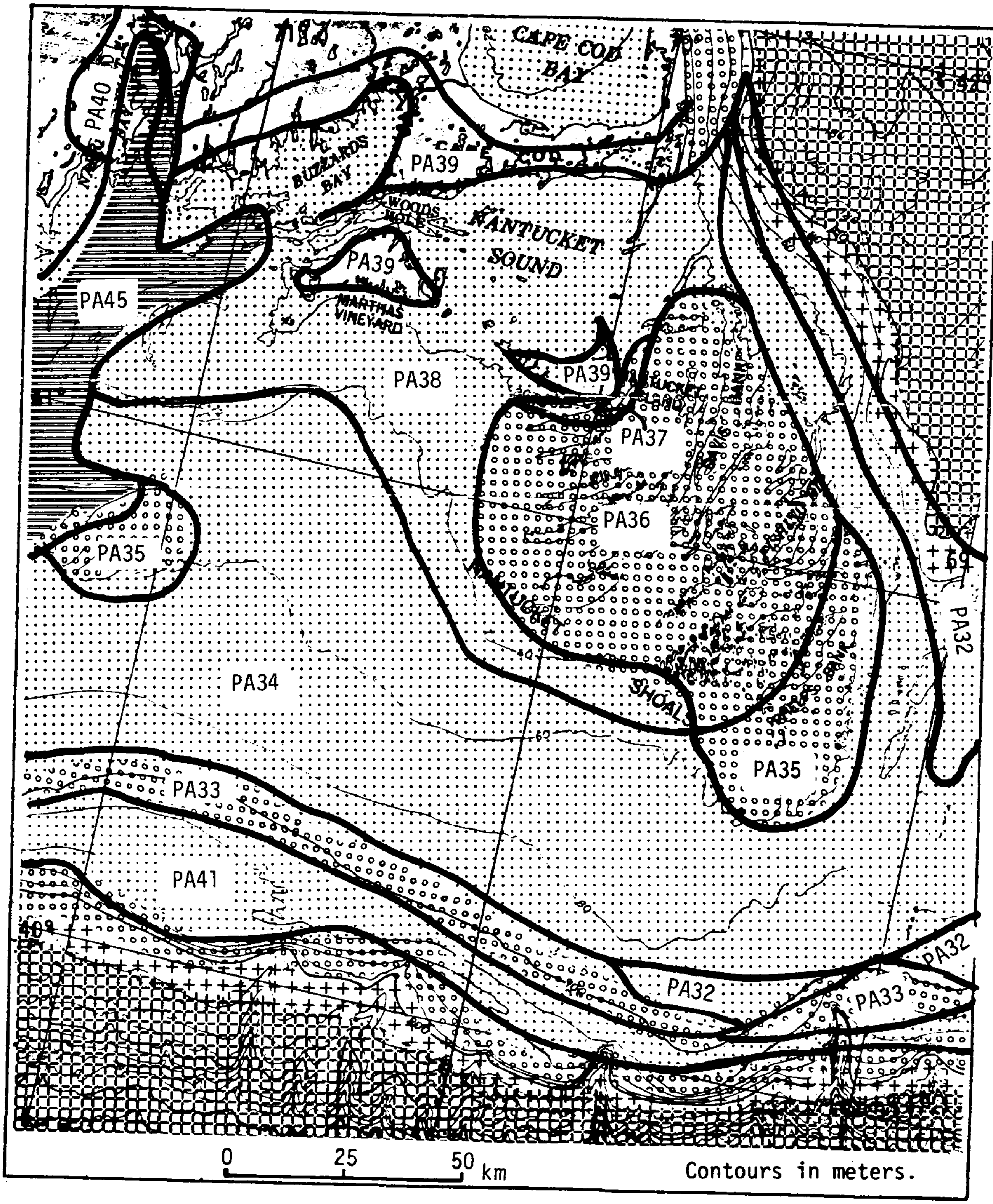

Fig. IV-40
Preserved archaeology zones.
Southeastern New England shelf.

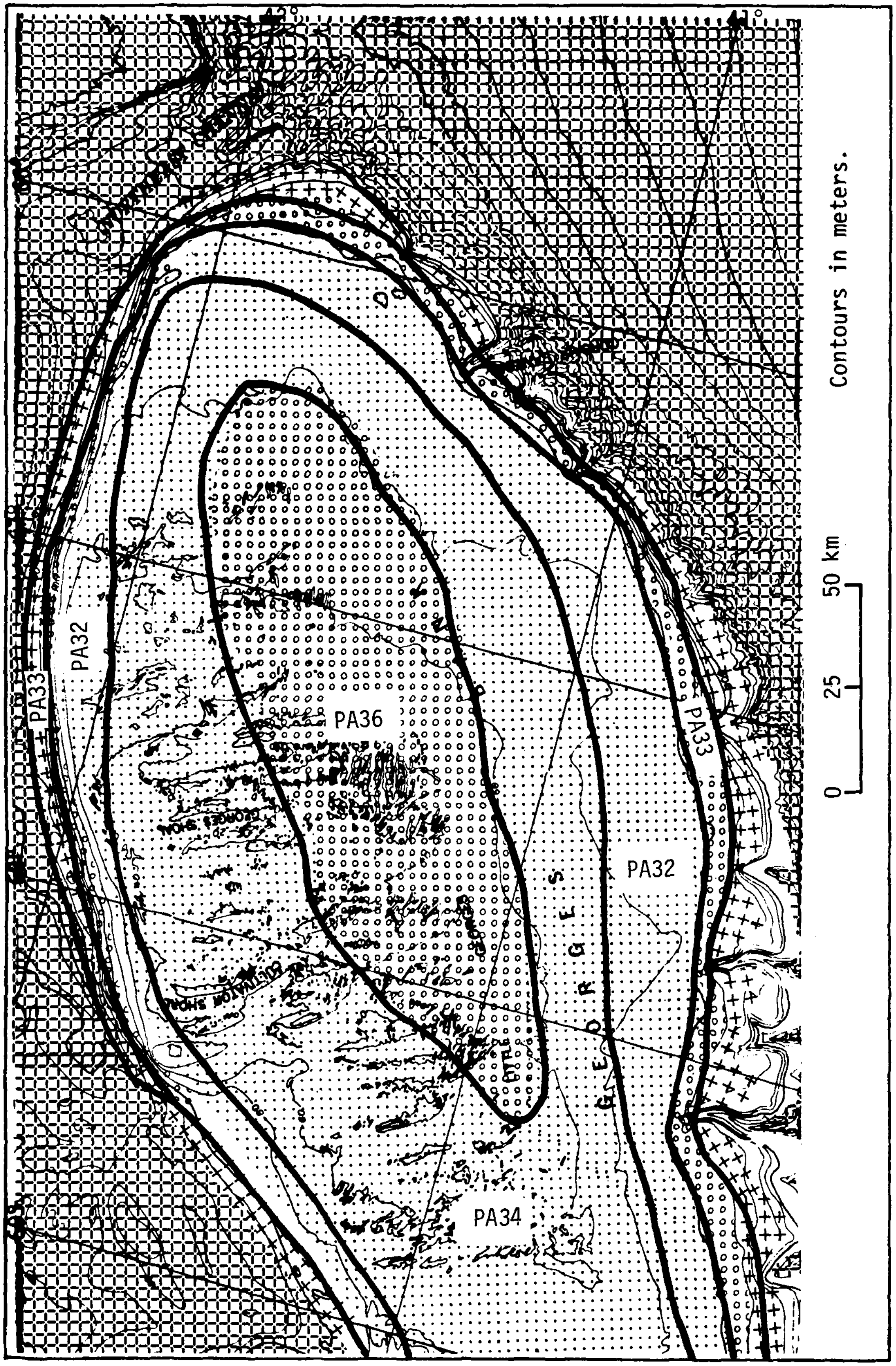

Fig. IV-41: Preserved archaeology zones. Georgess Bank.

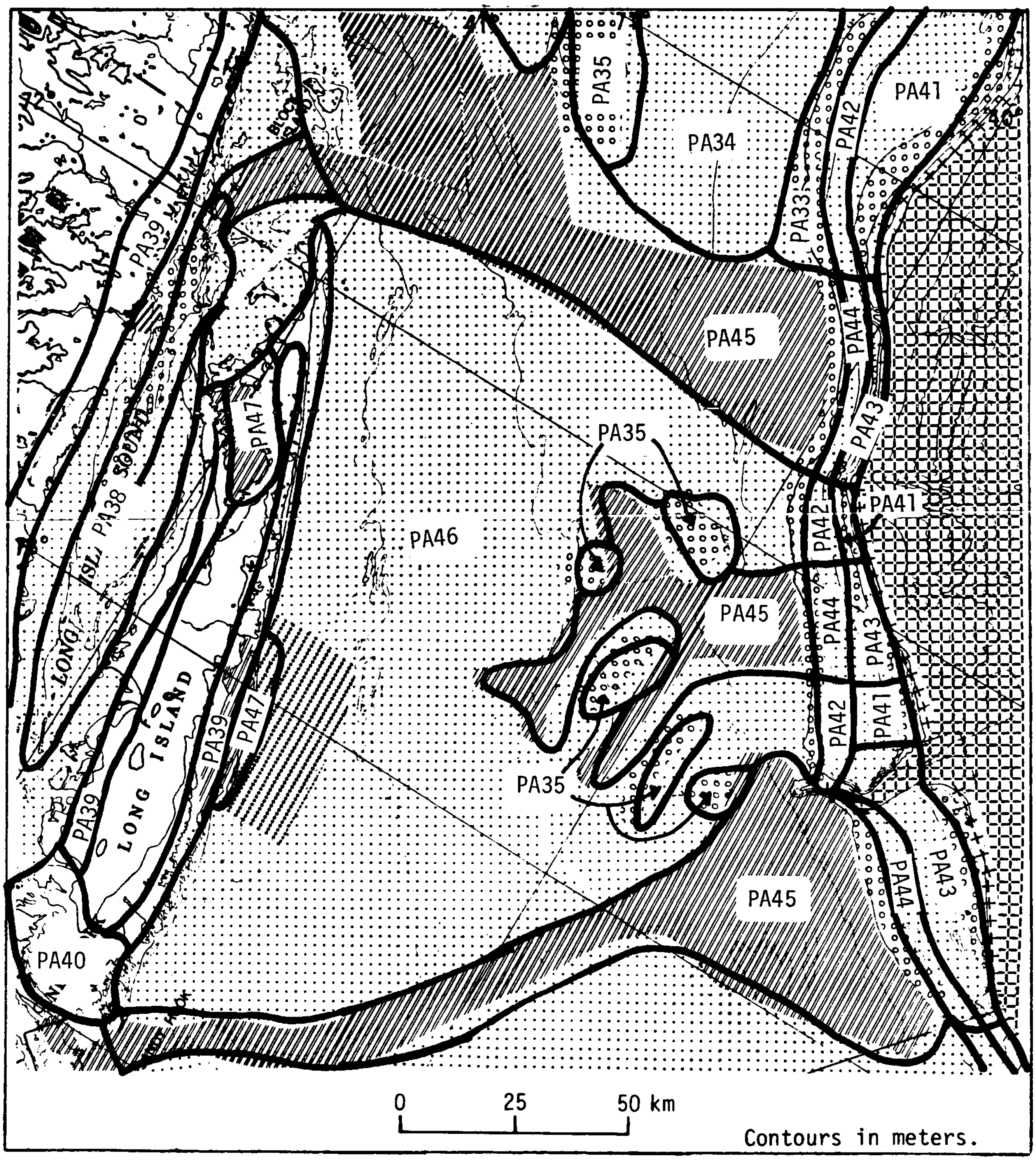

Fig. IV-42: Preserved archaeology zones, Long Island Sound.

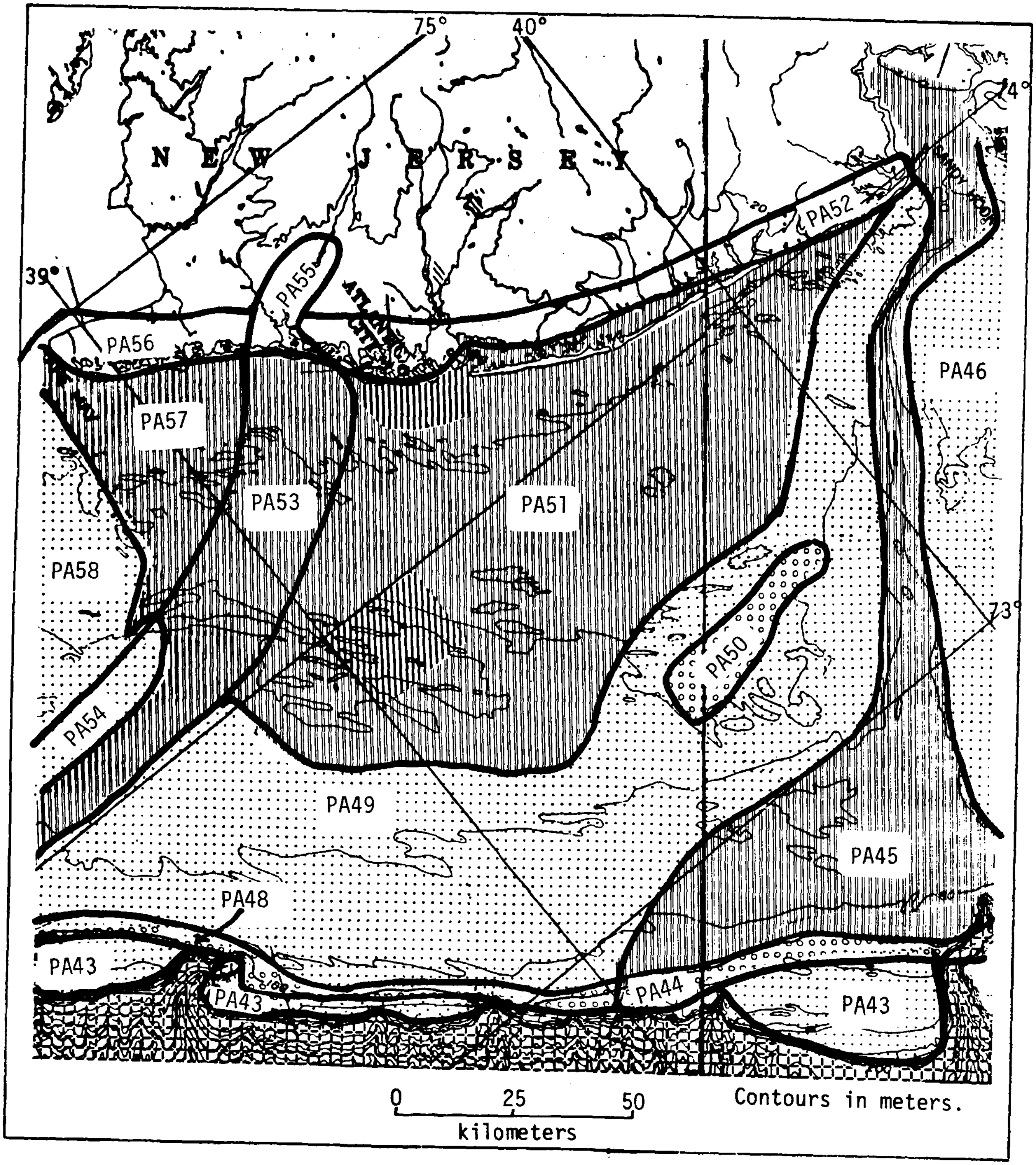

Fig. IV-43: Preserved archaeology zones. New Jersey shelf.

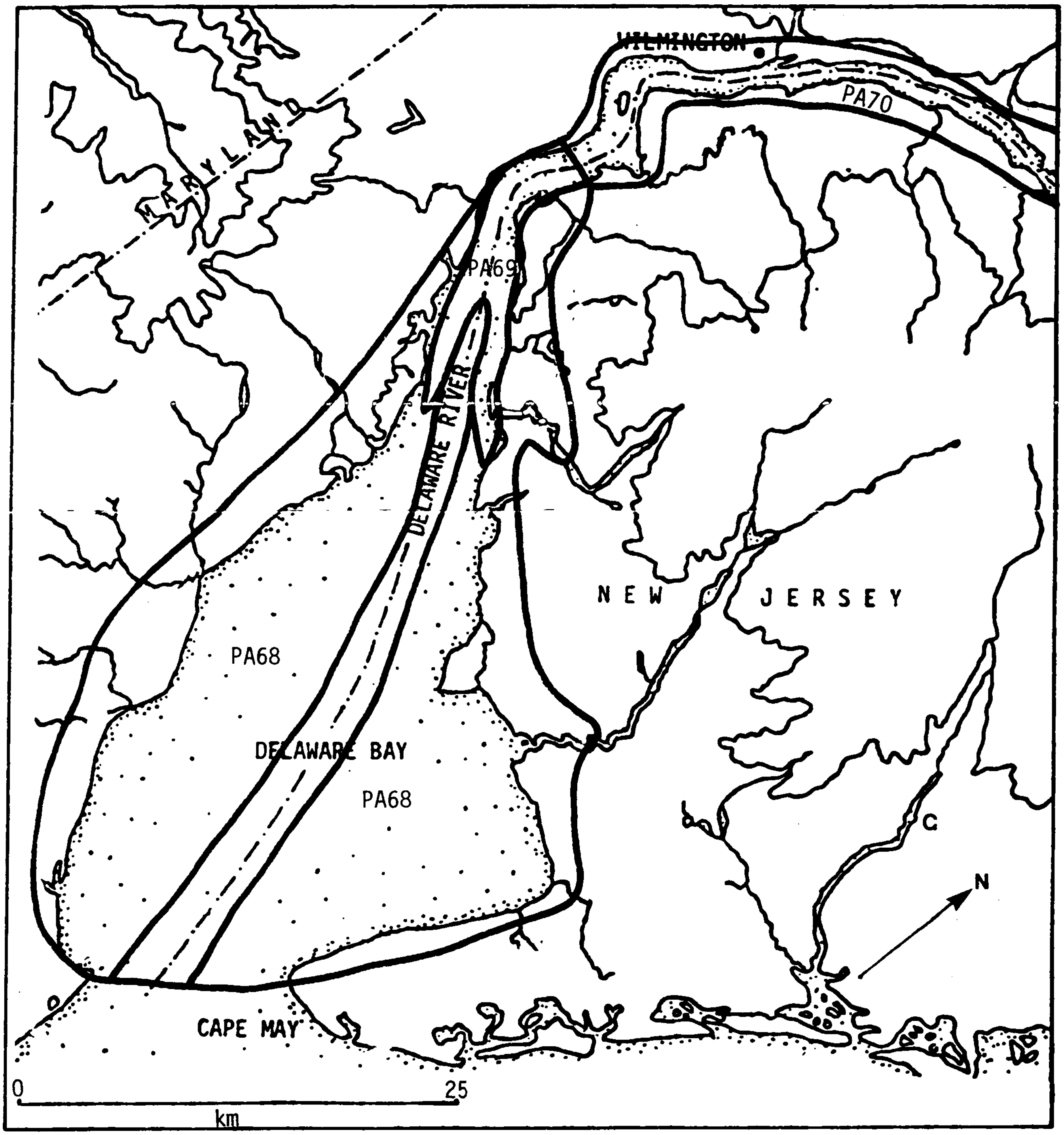

Fig. IV-44 : Preserved archaeology zones. Delaware Bay.

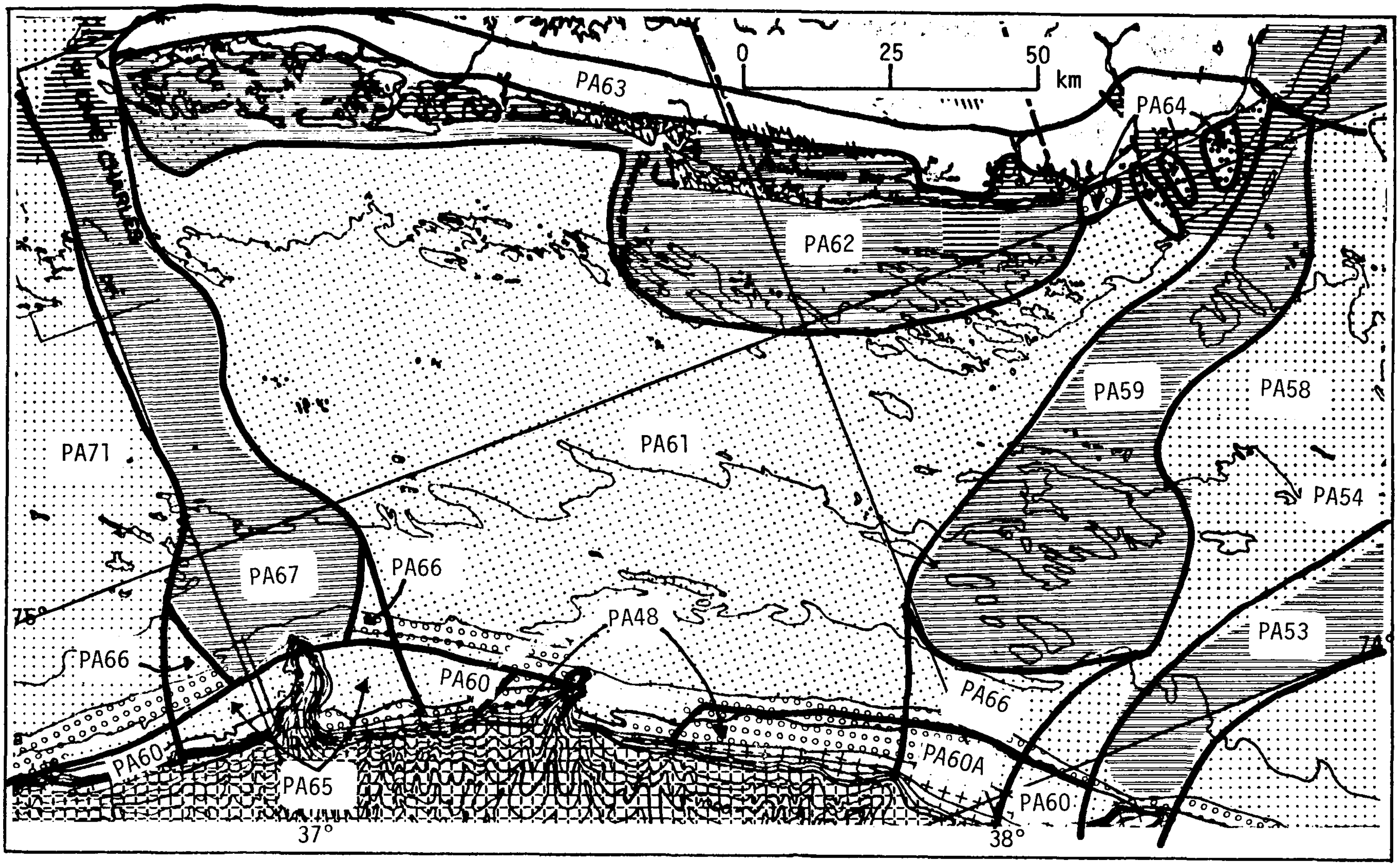

Fig. IV-45 : Preserved archaeology zones. Delmarva shelf.

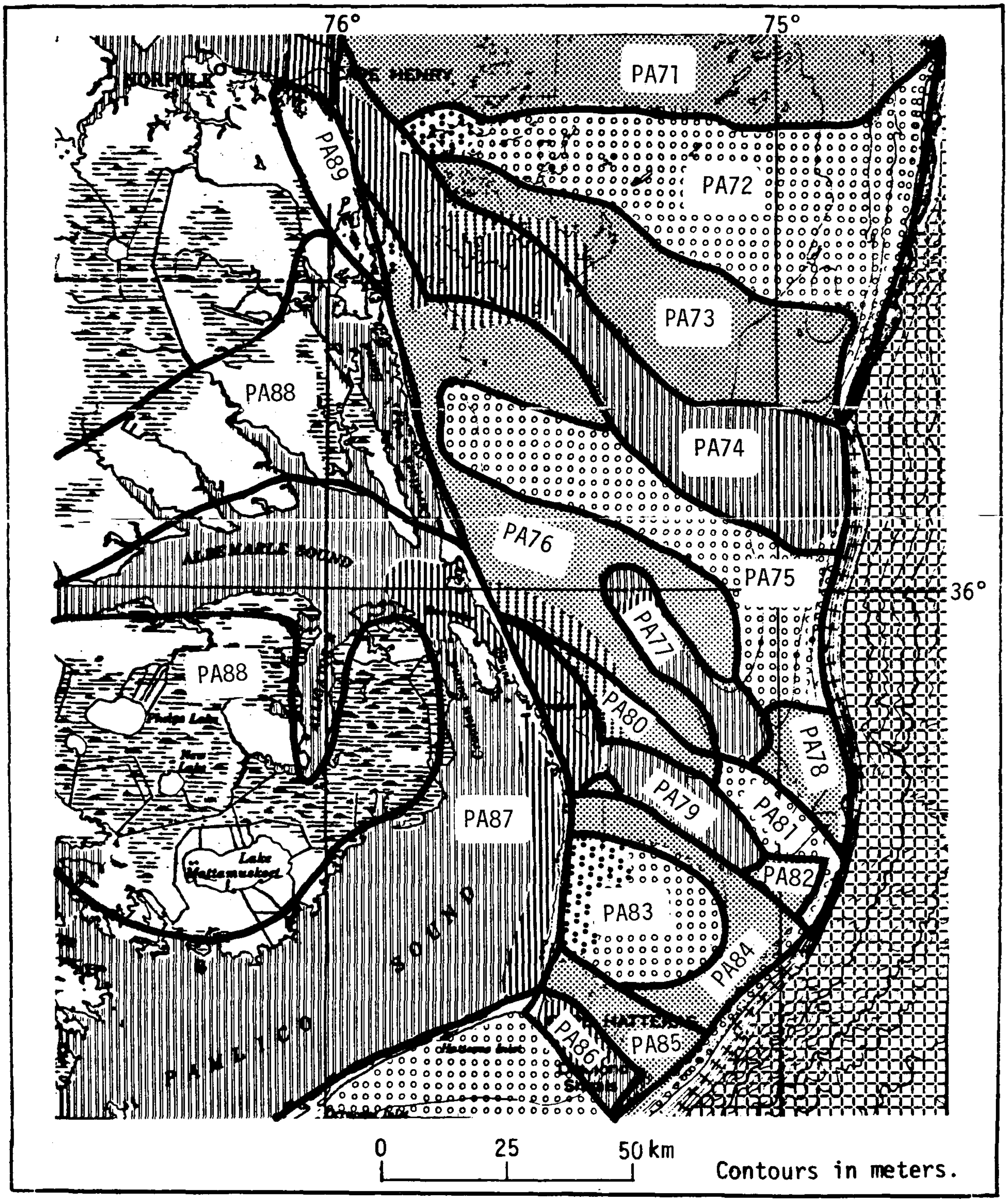

Fig. IV-46: Preserved archaeology zones. Northern North Carolina - southeastern Virginia shelf.

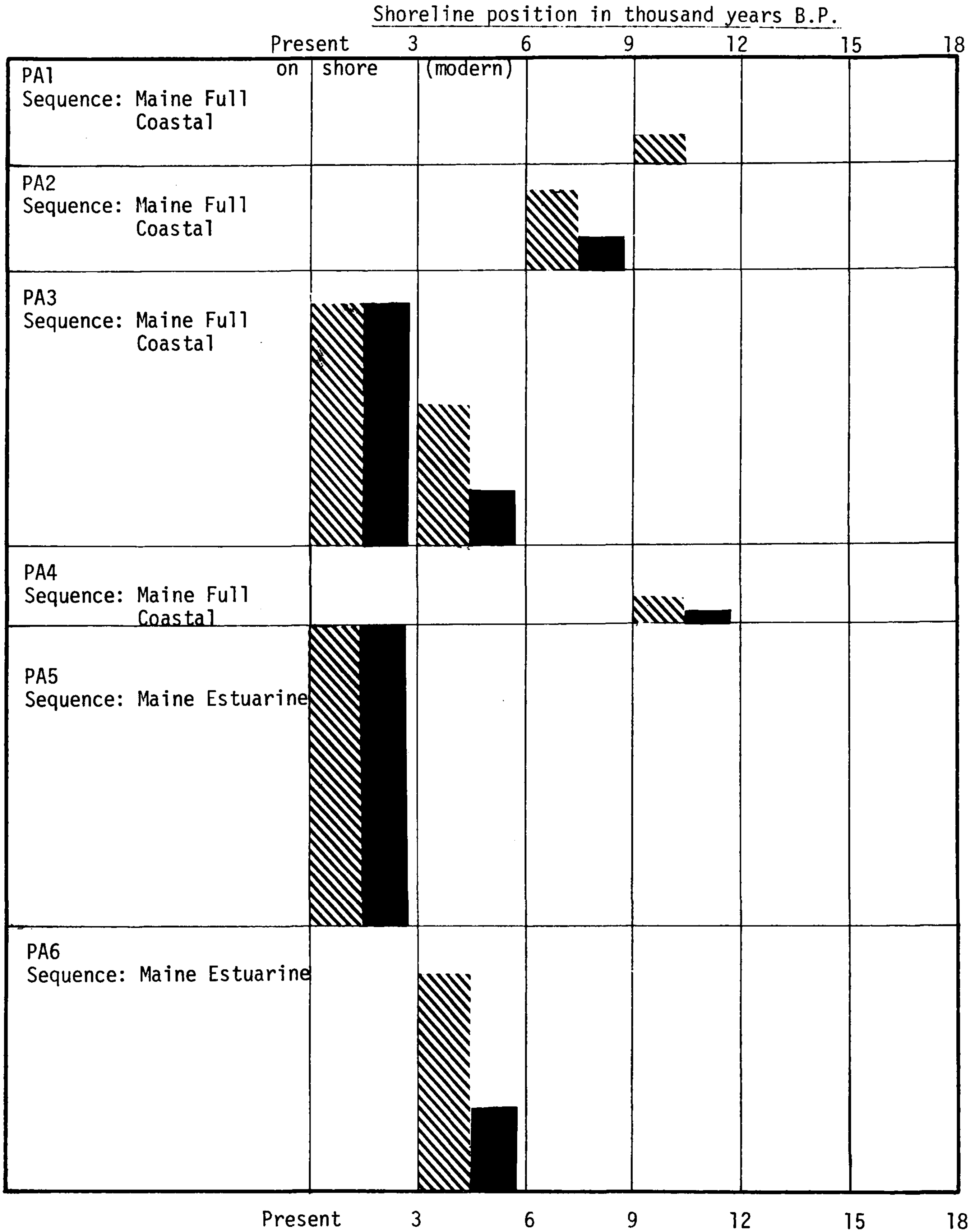

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency (▨ - Original; ■ - Residual).

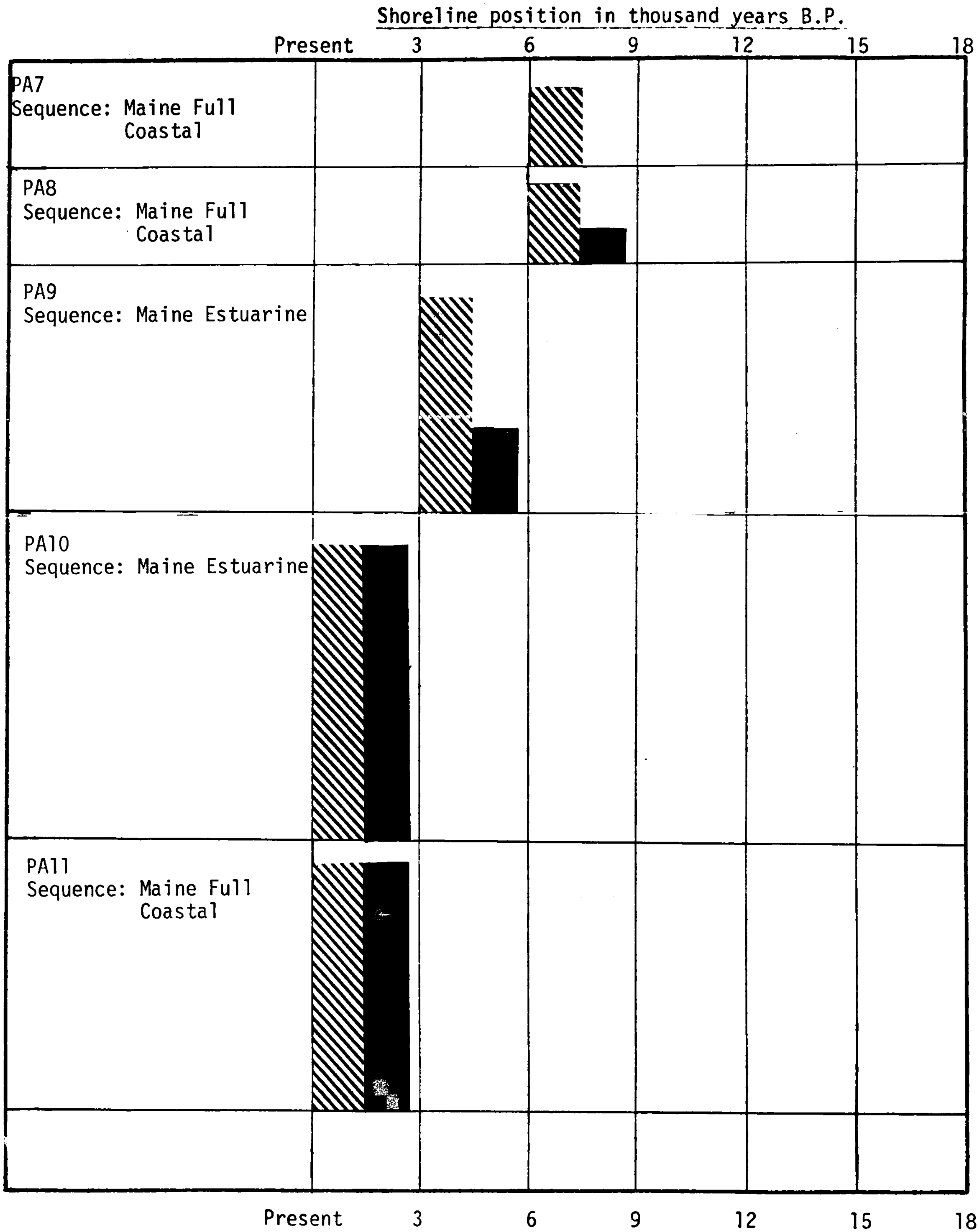

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

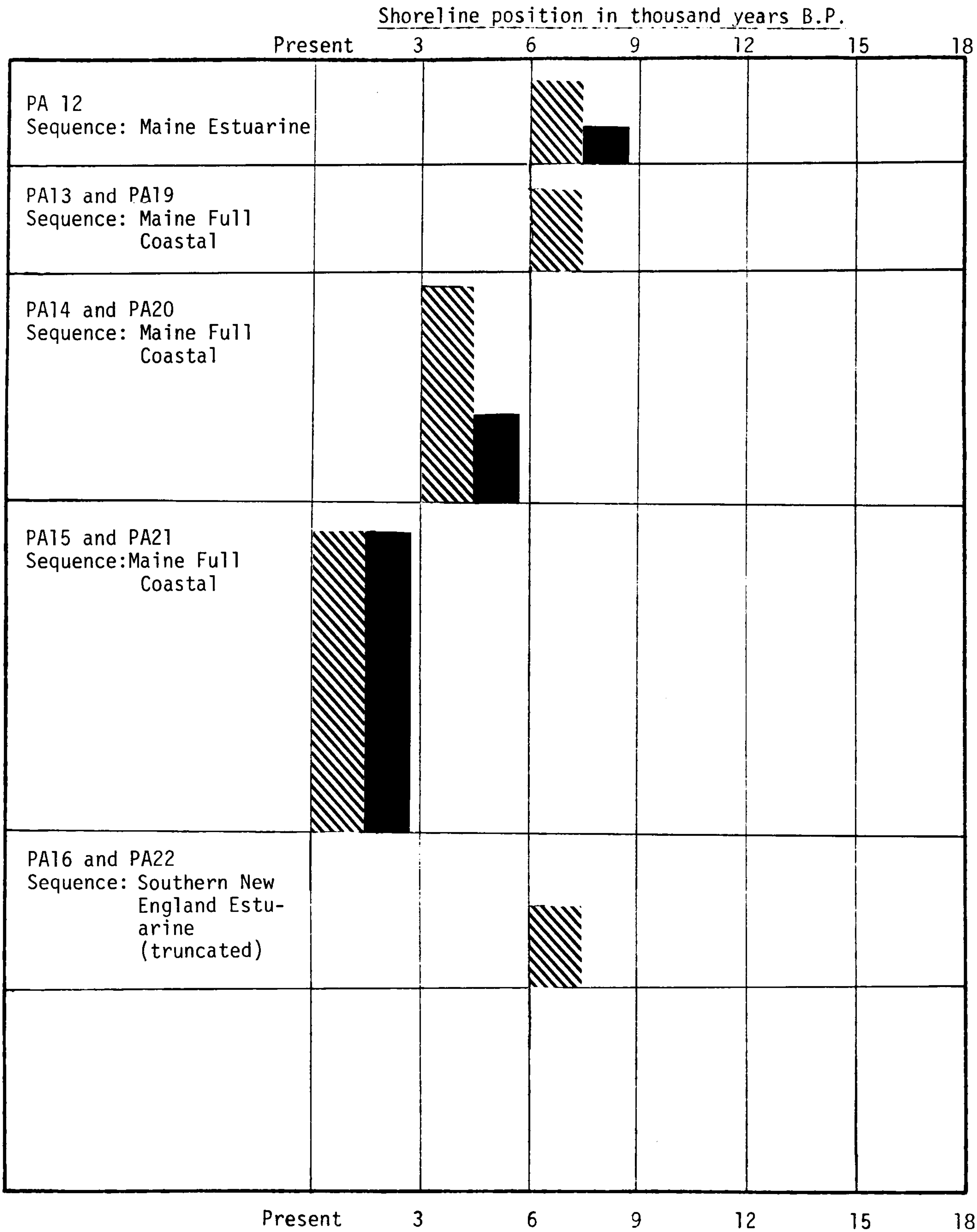

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

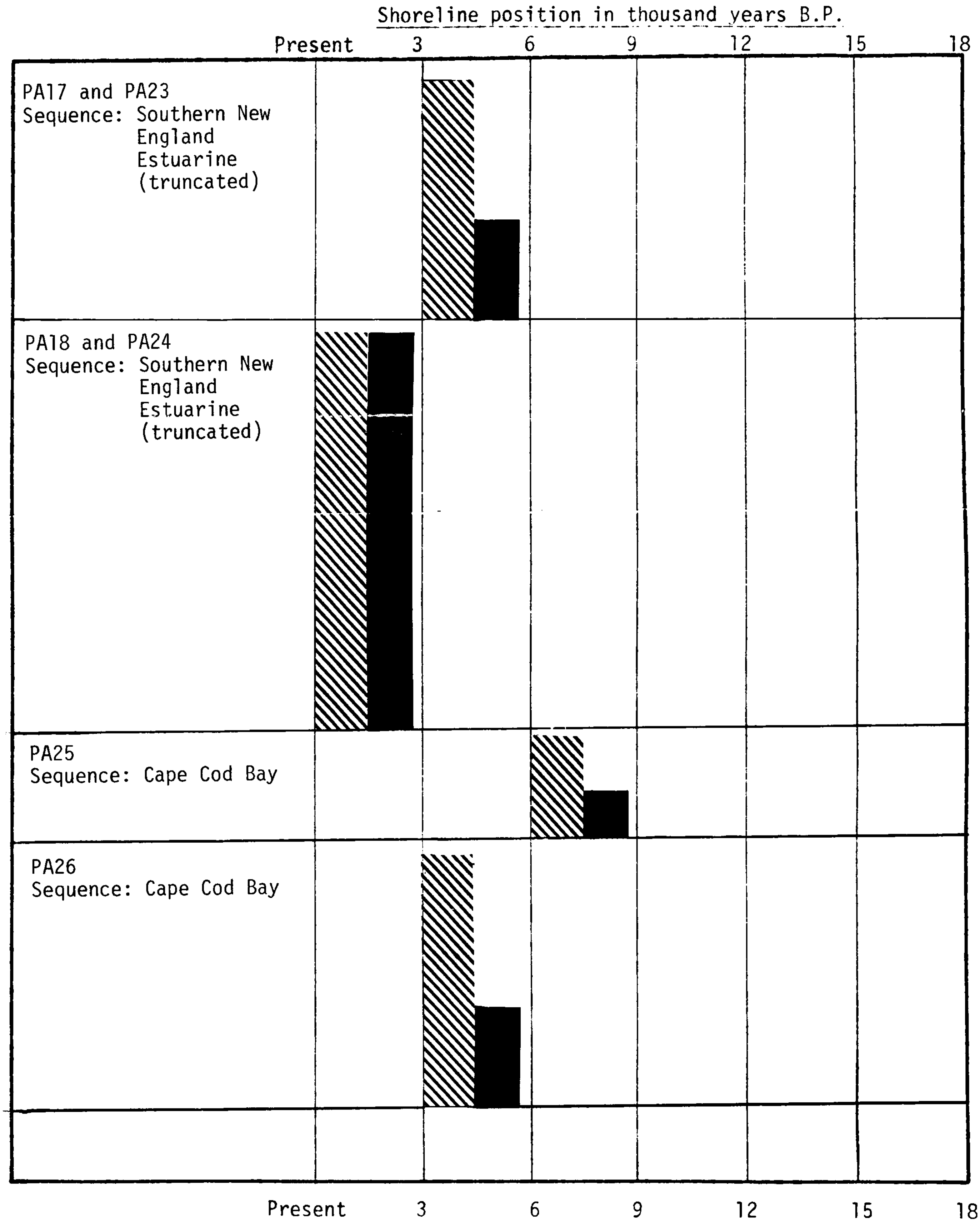

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

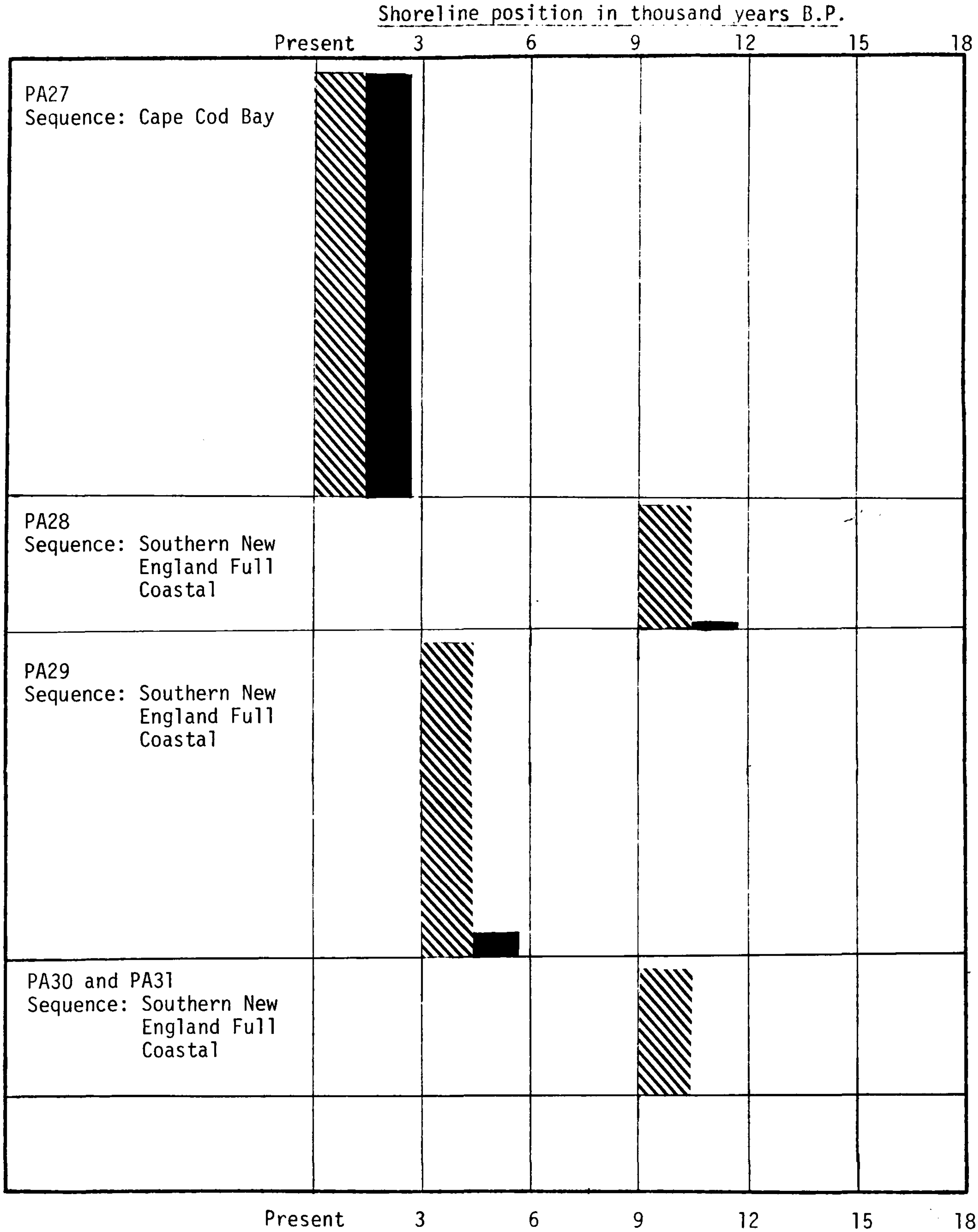

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

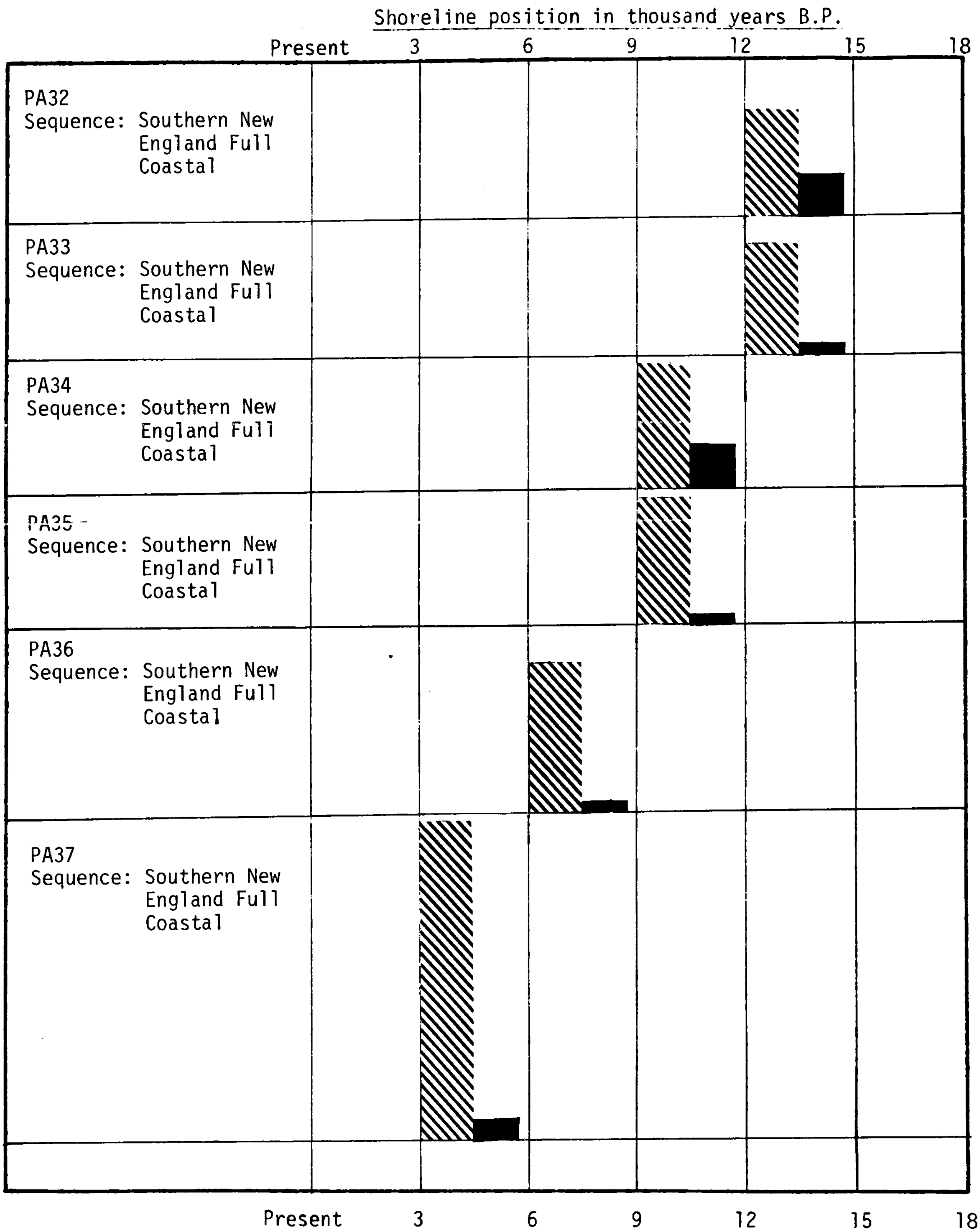

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

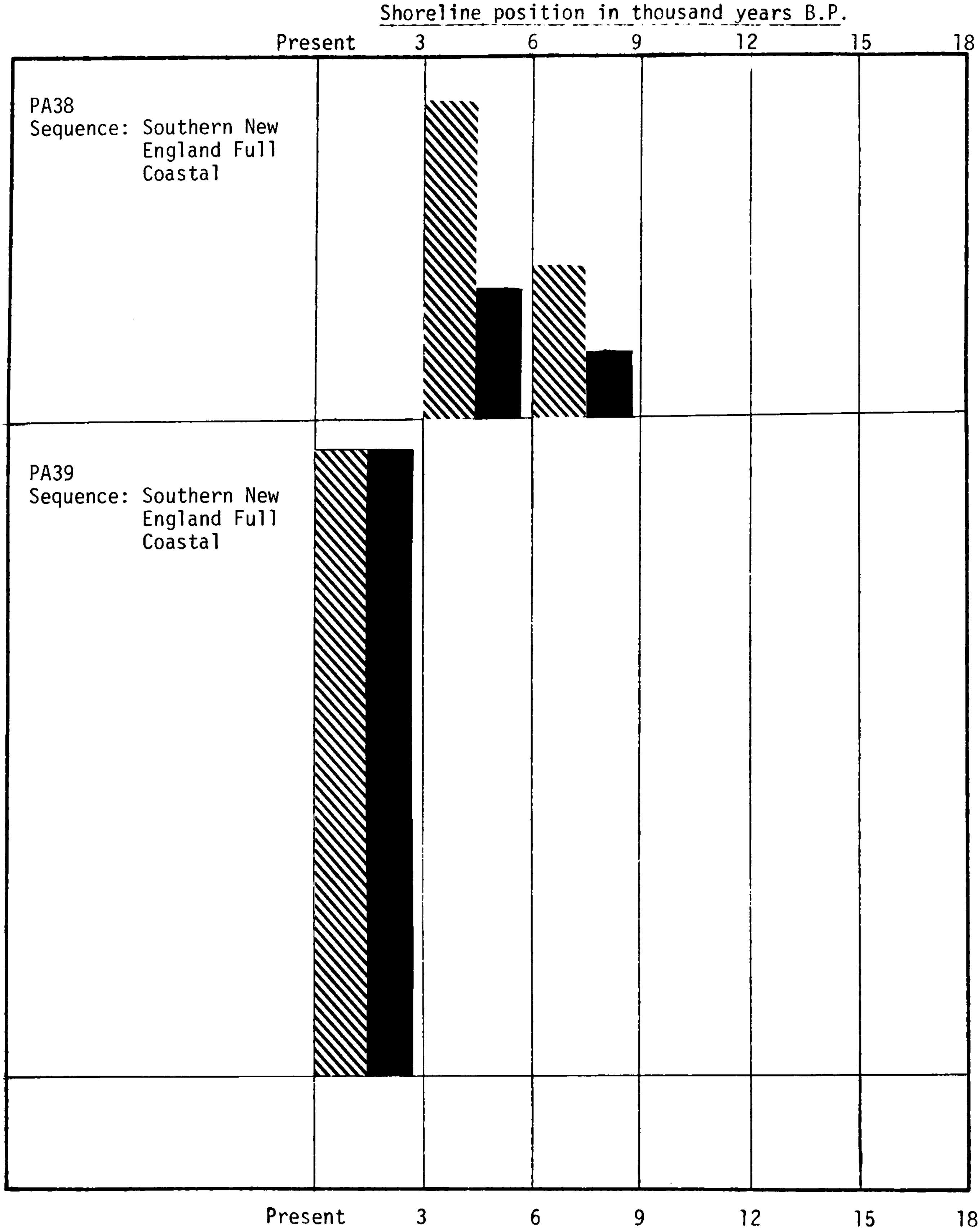

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

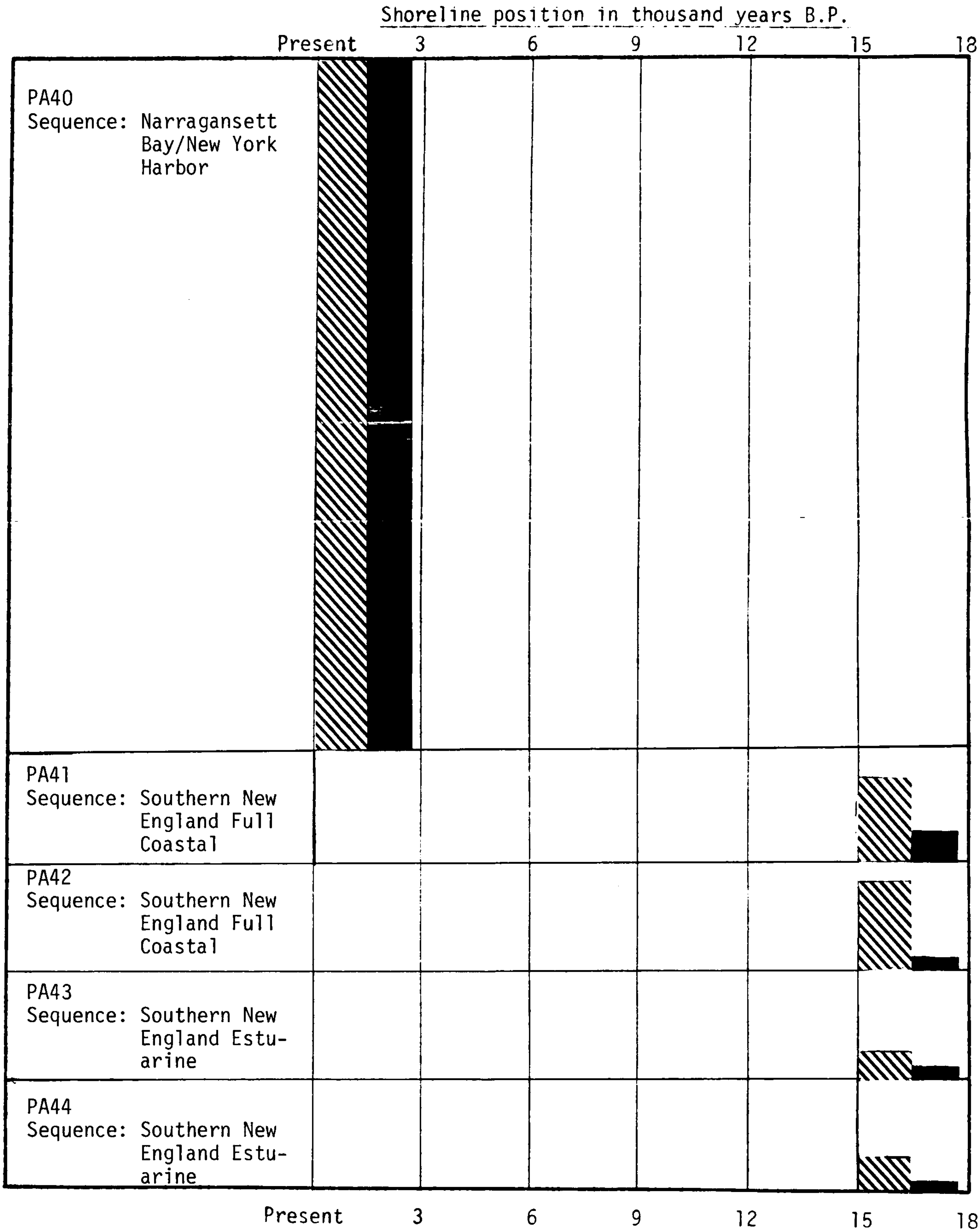

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

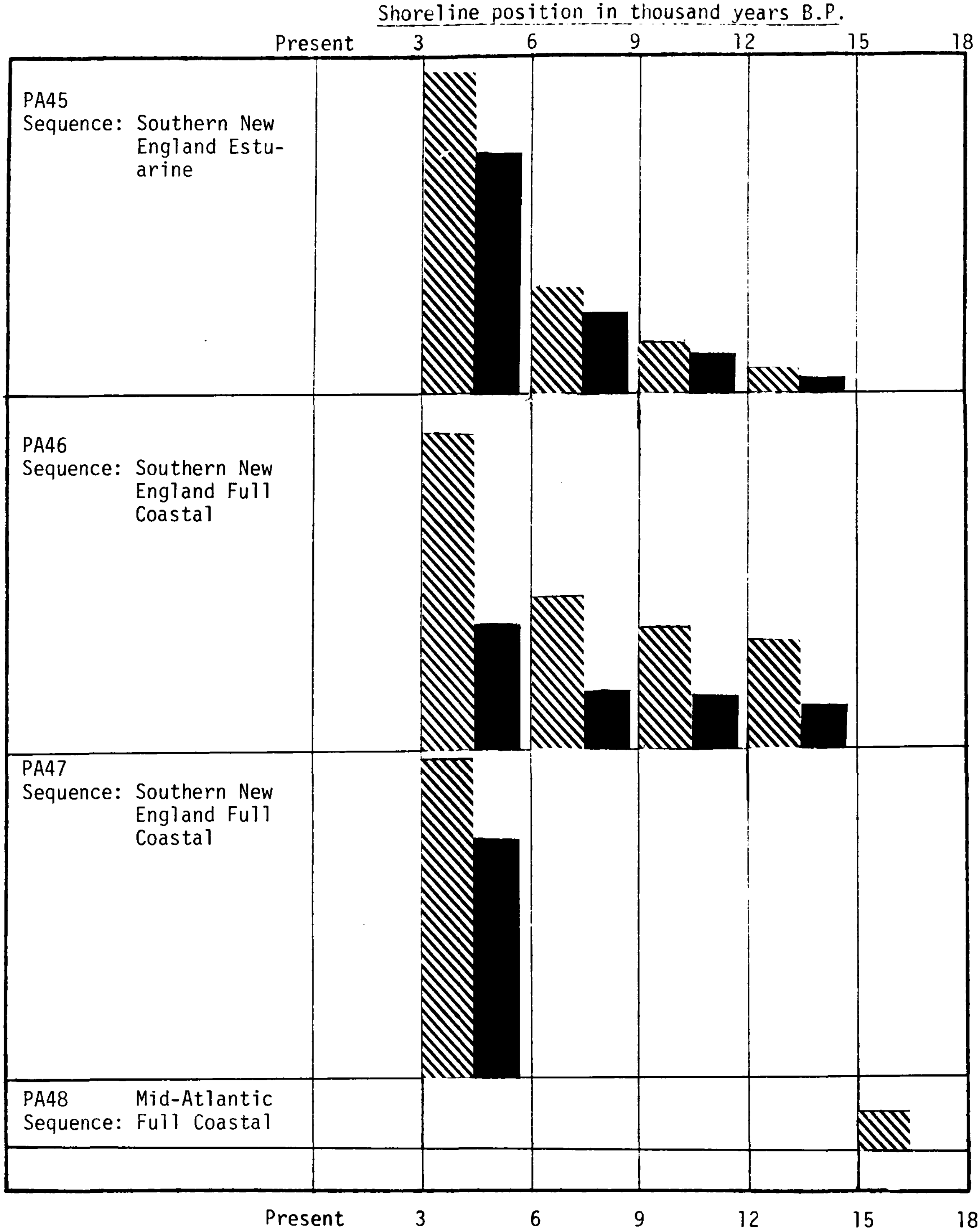

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

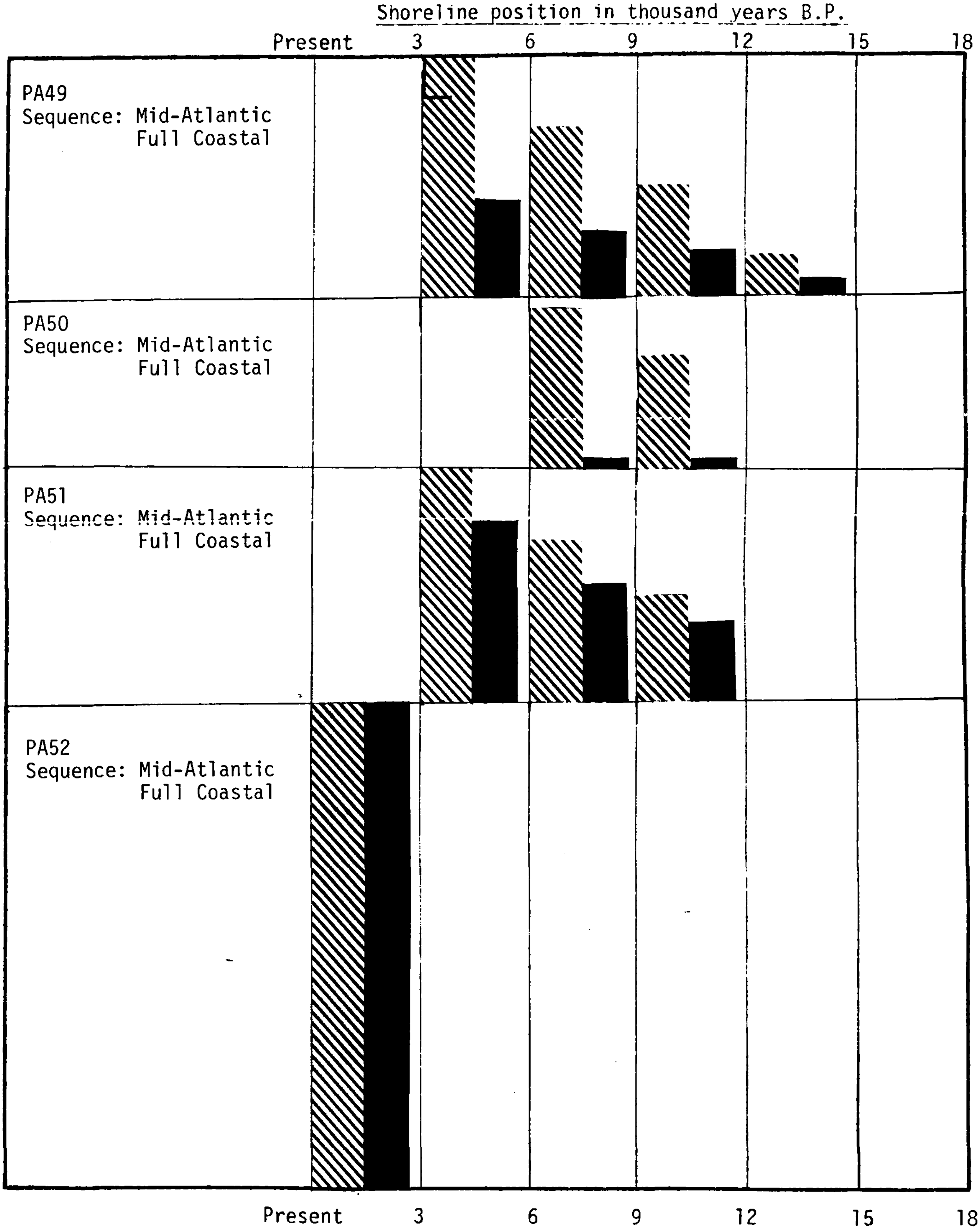

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

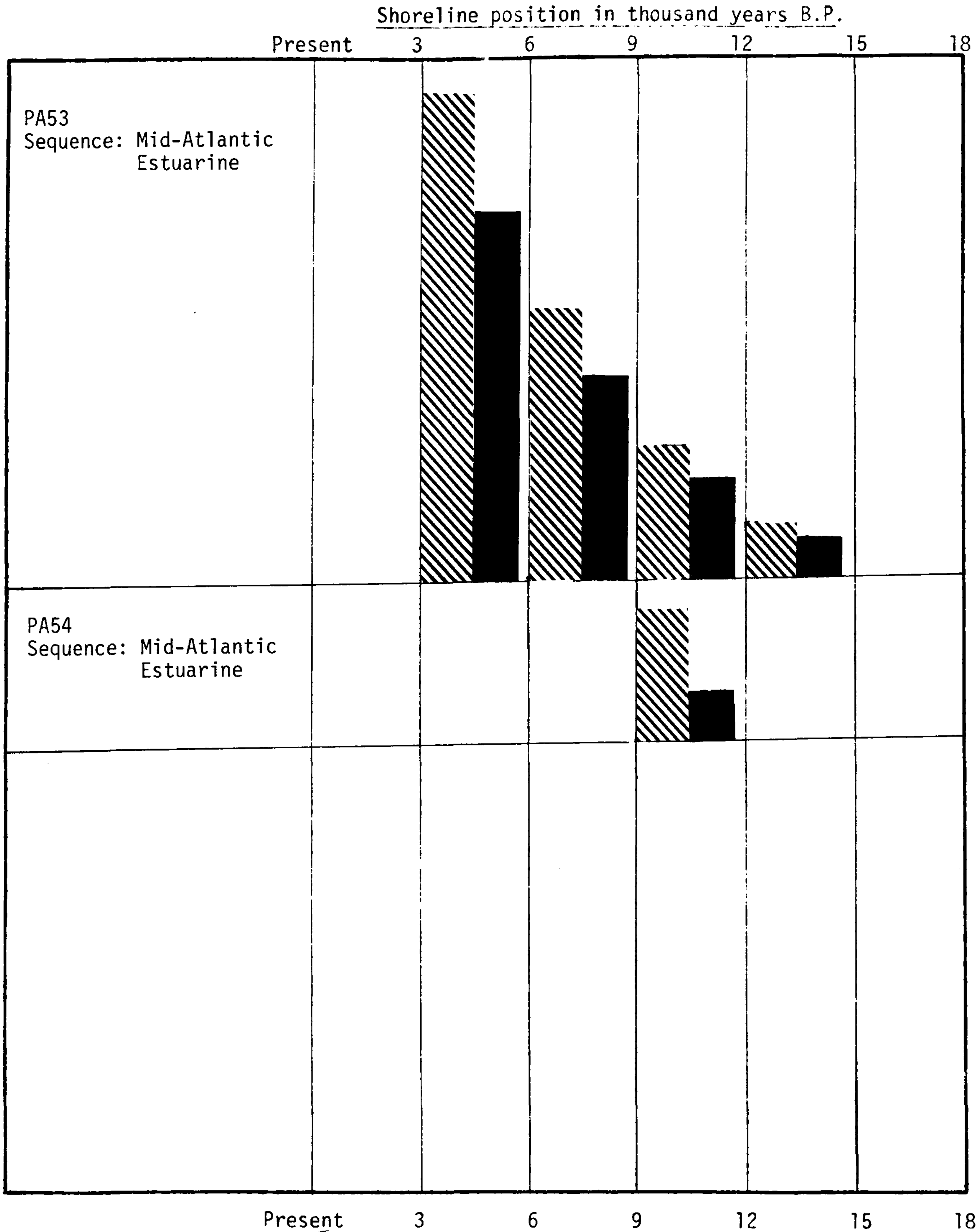

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

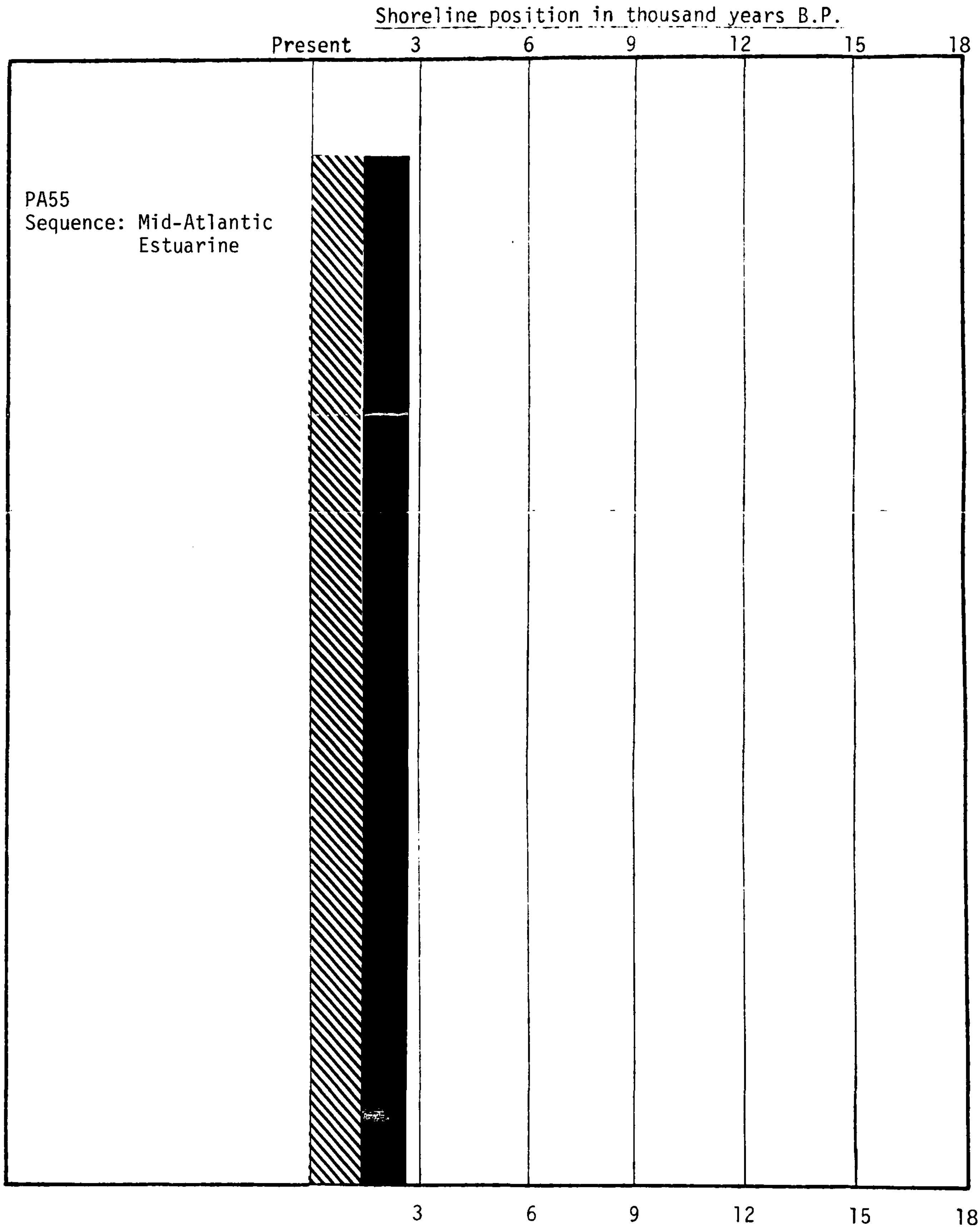

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

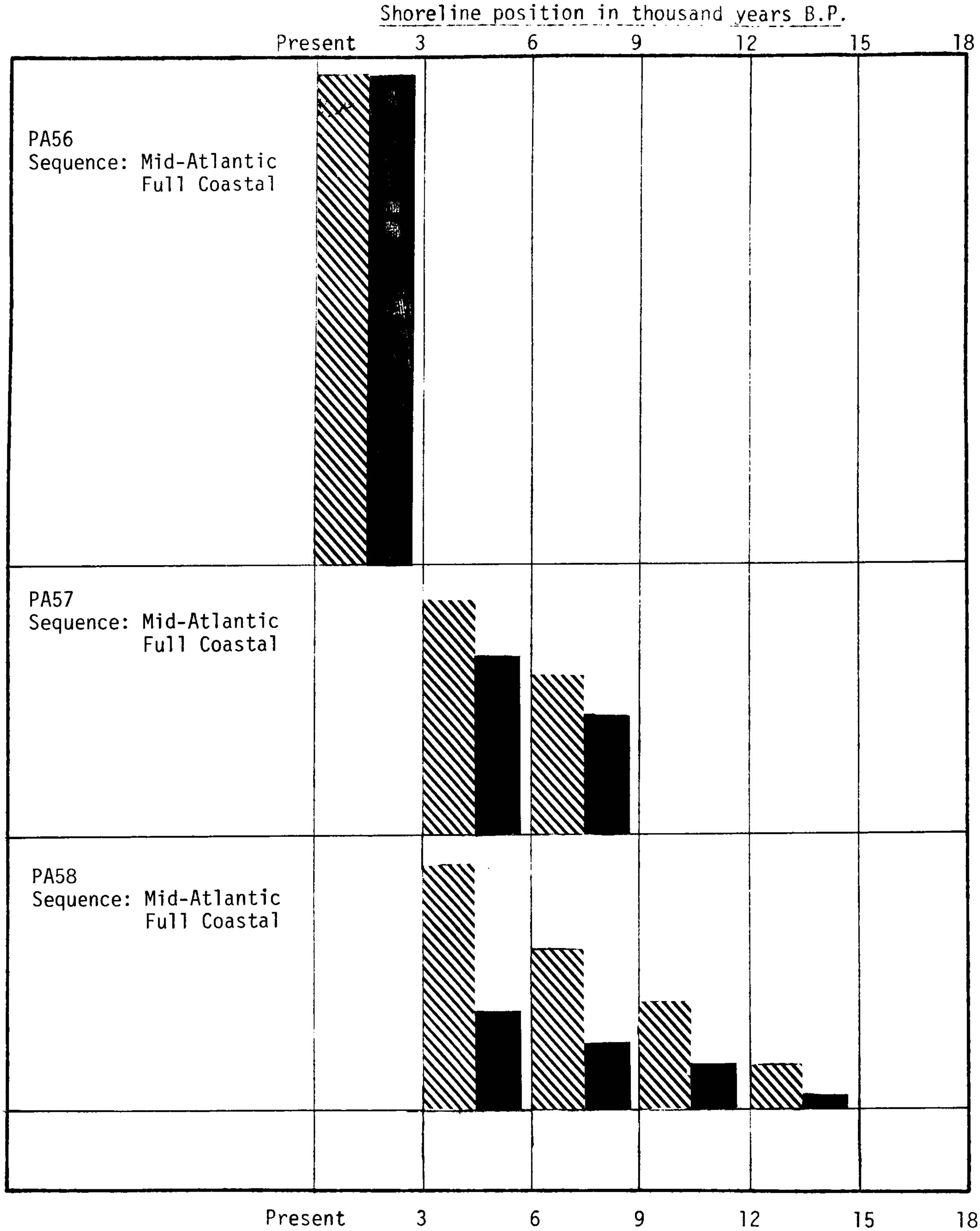

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

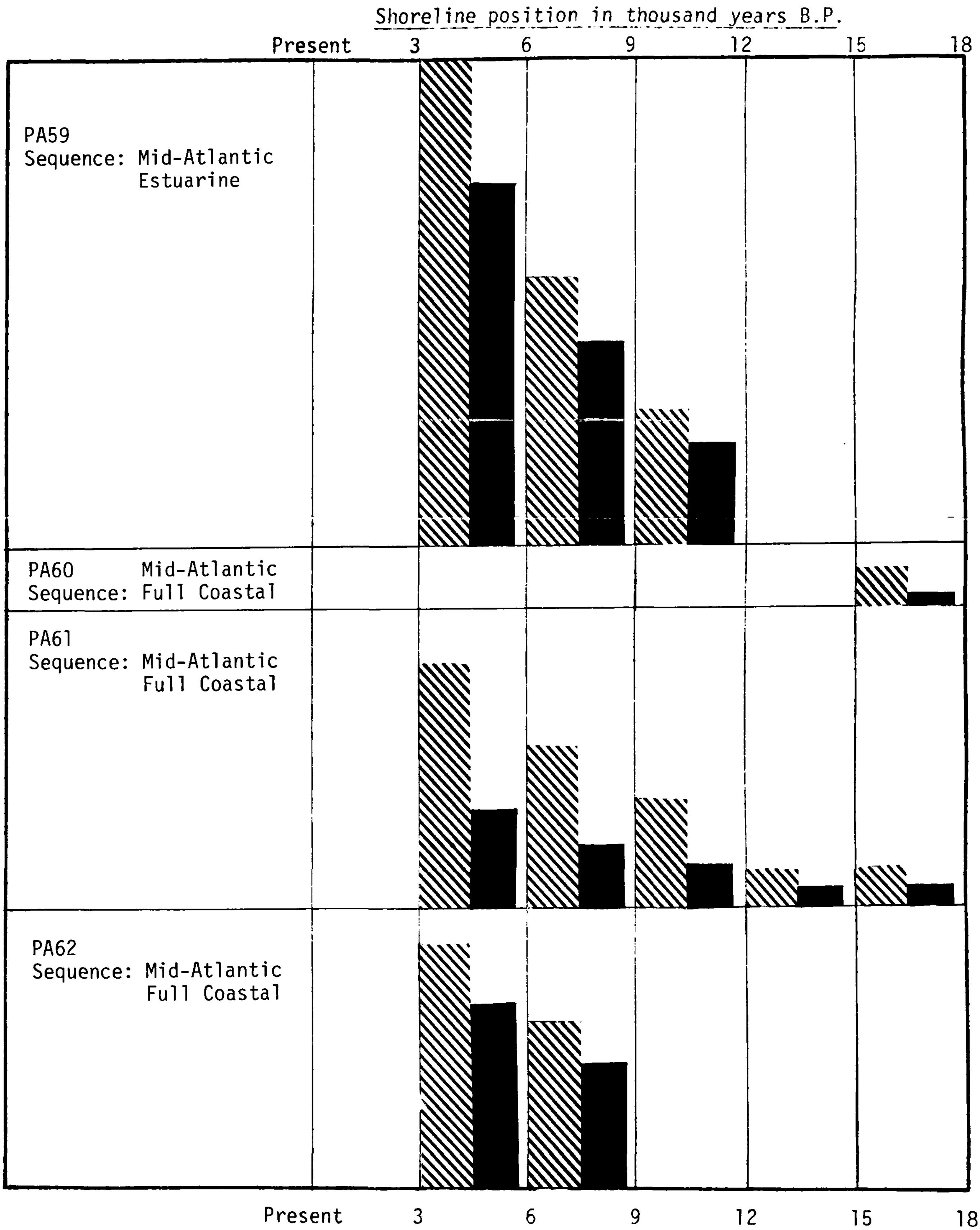

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

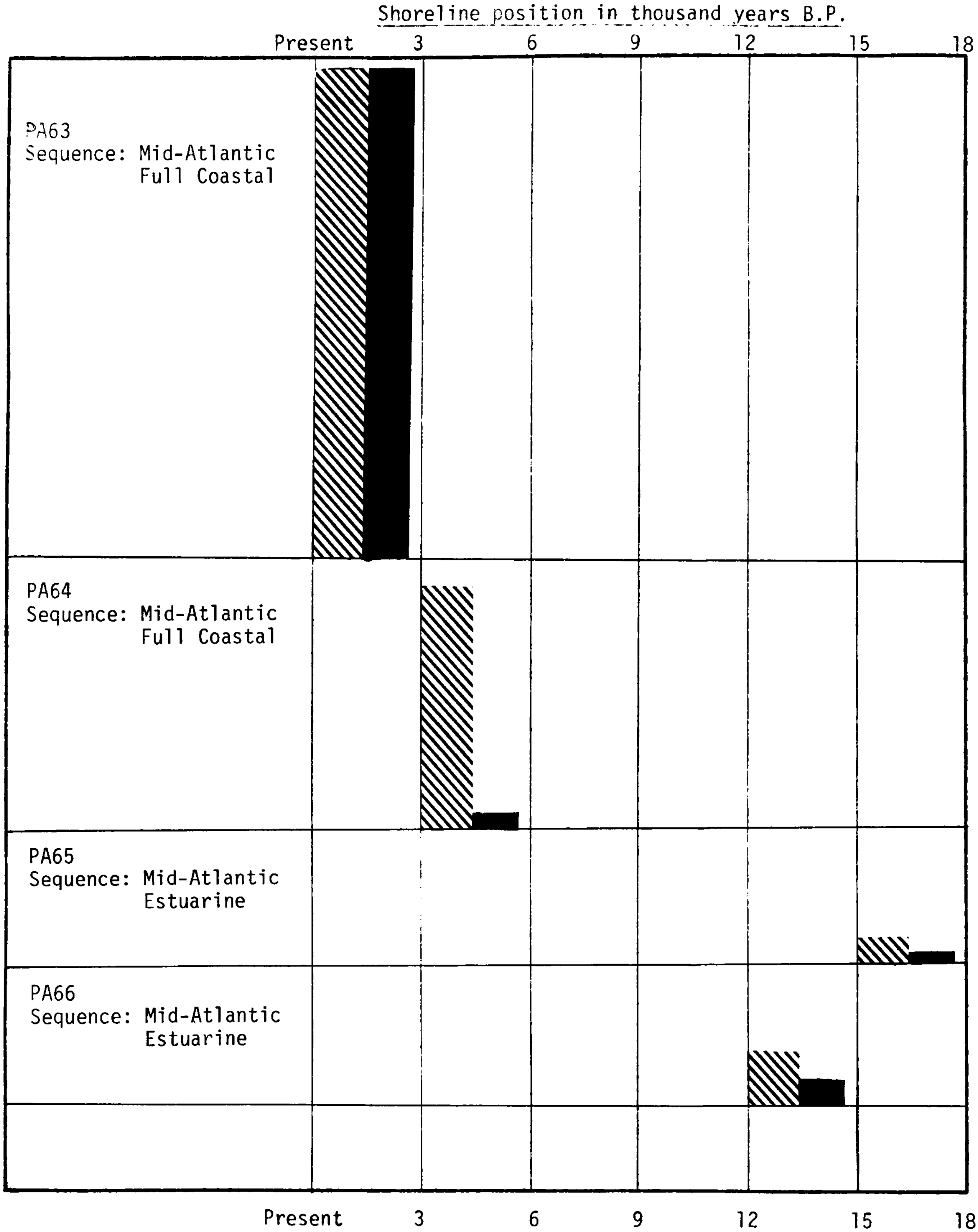

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

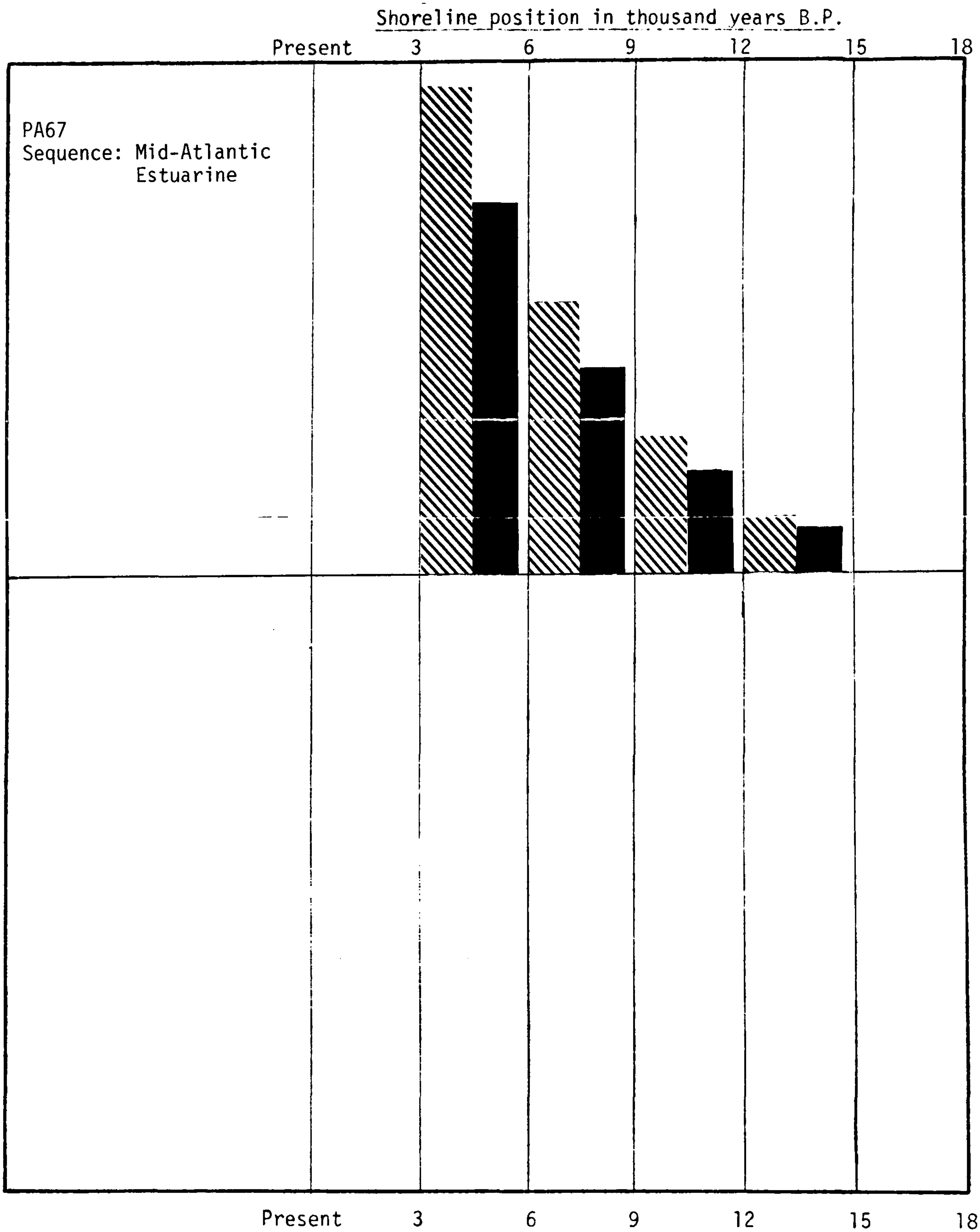

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

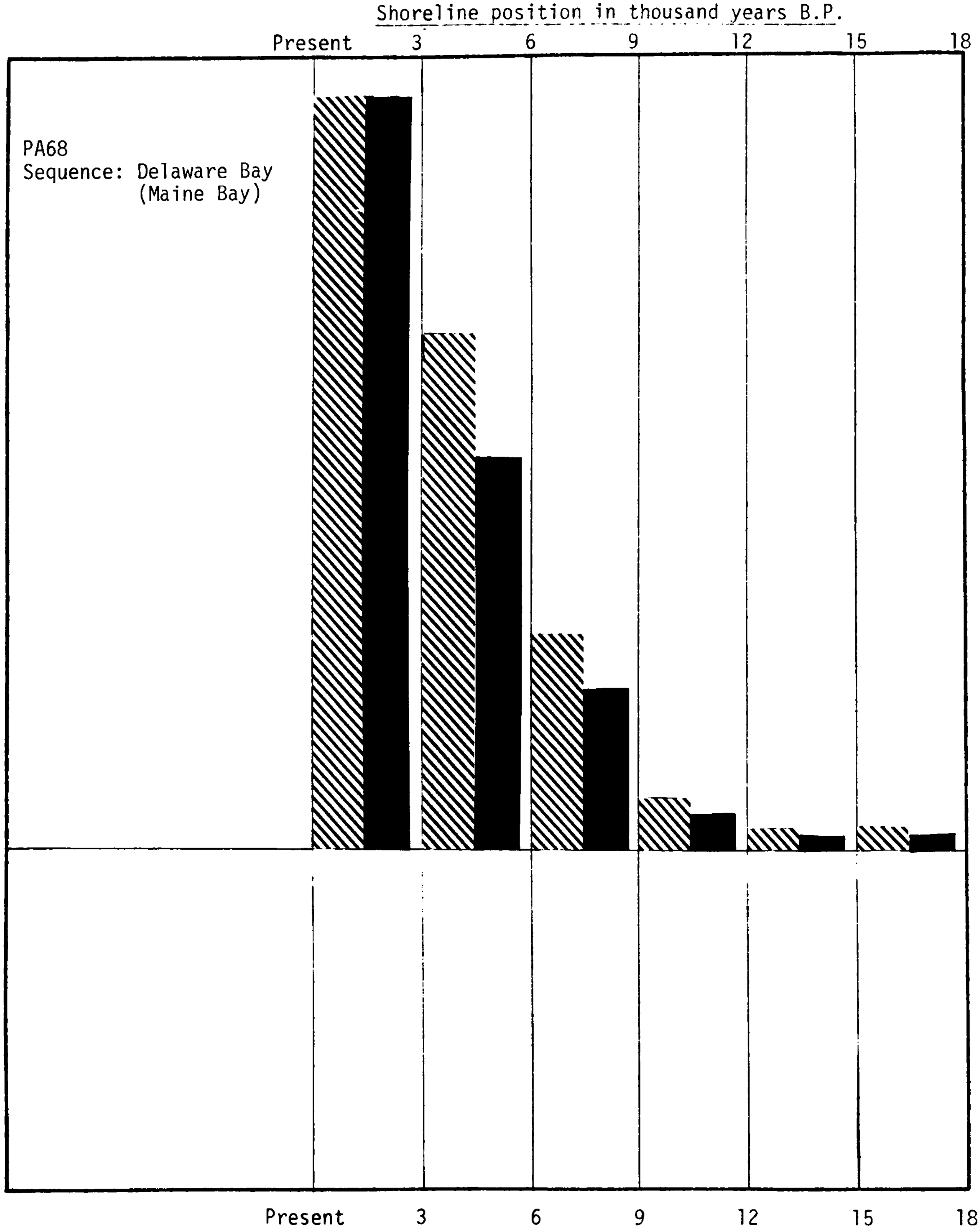

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

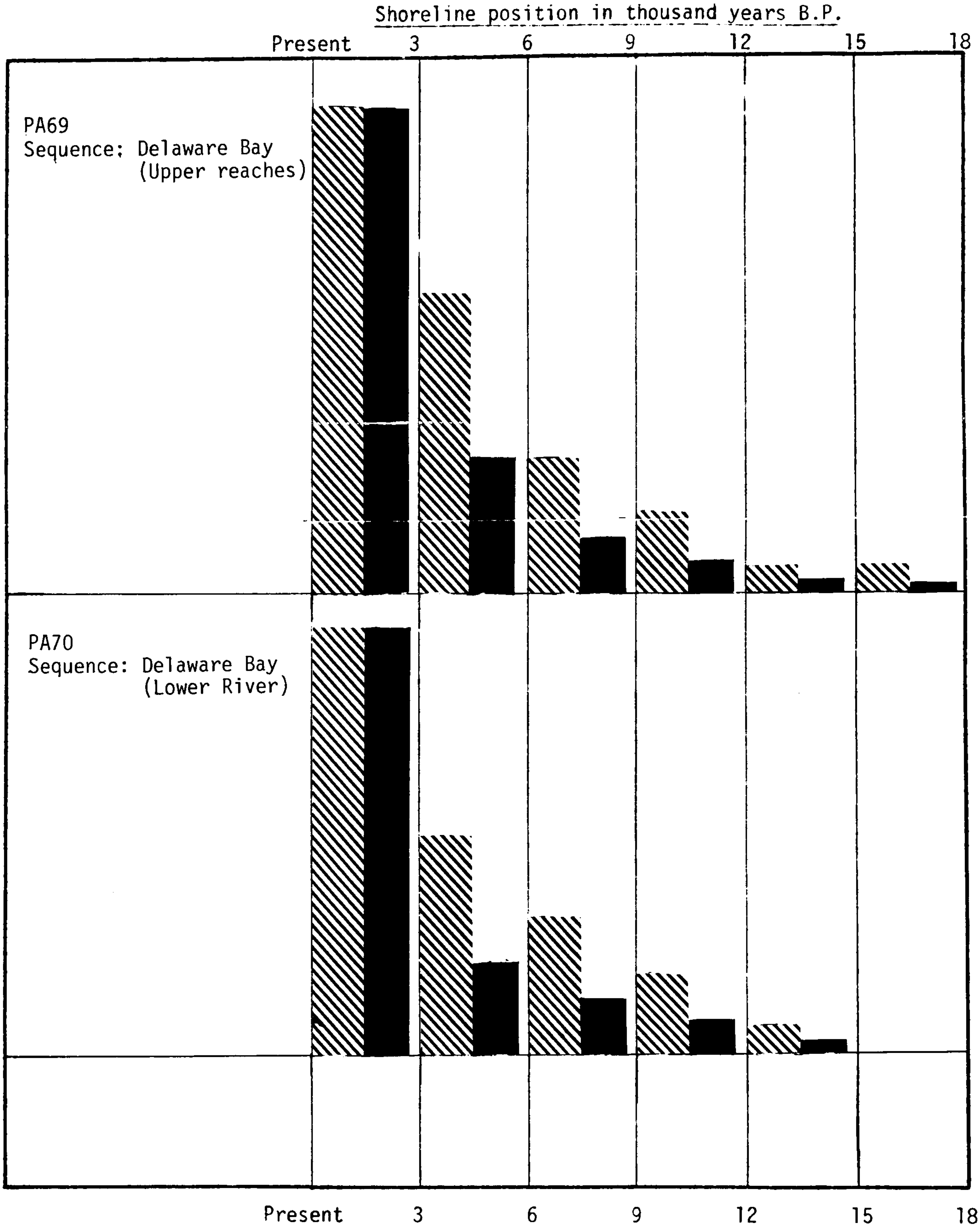

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

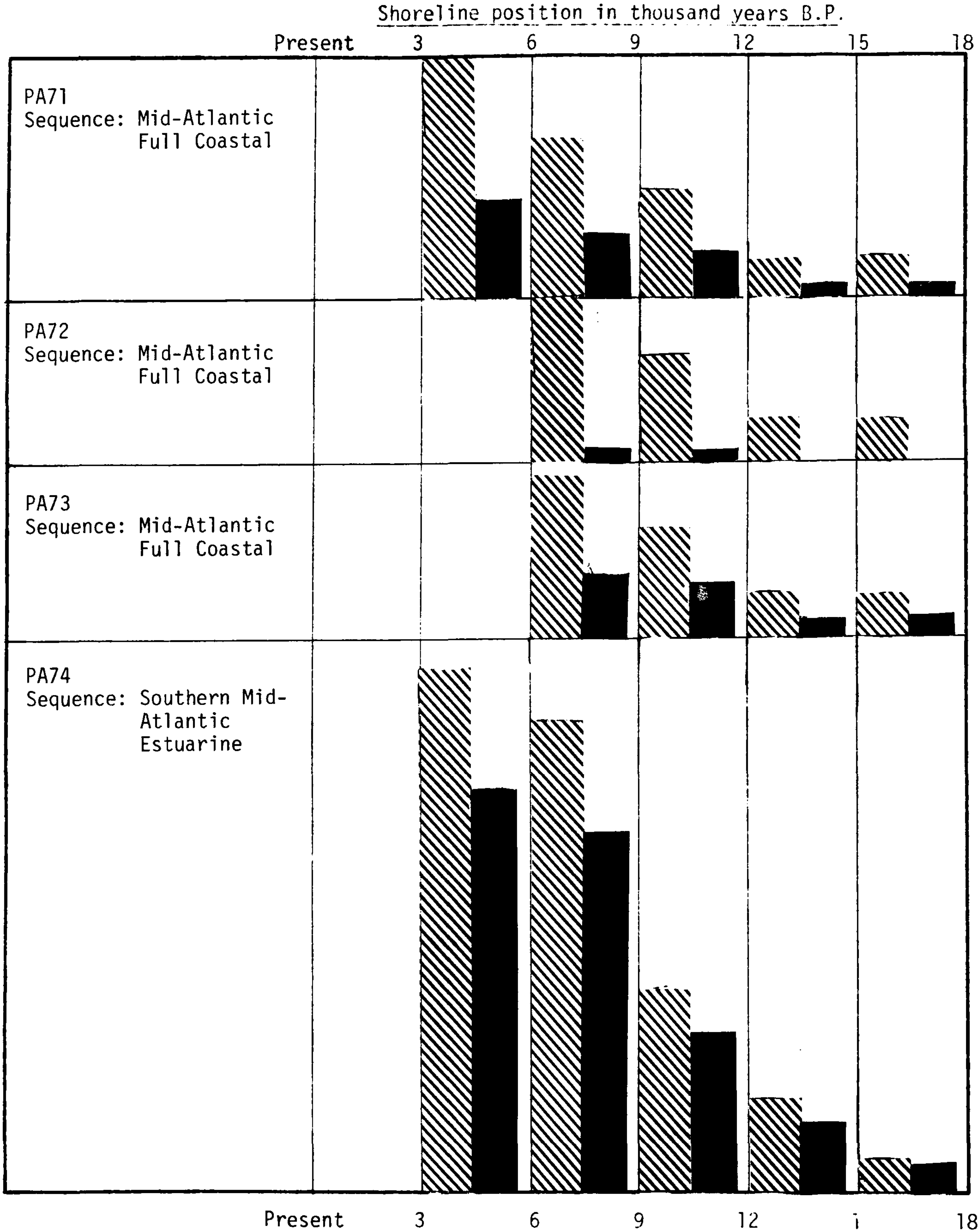

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

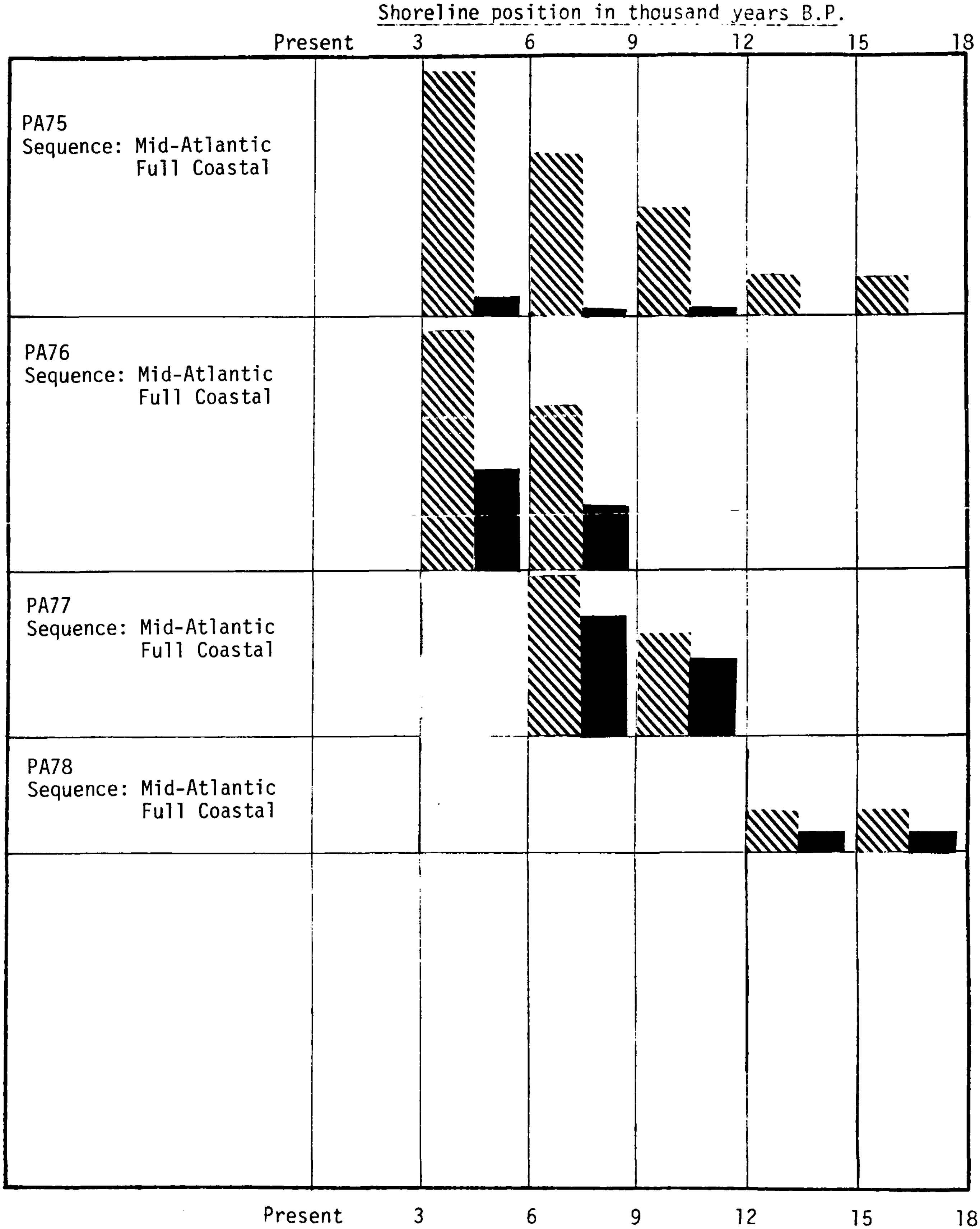

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

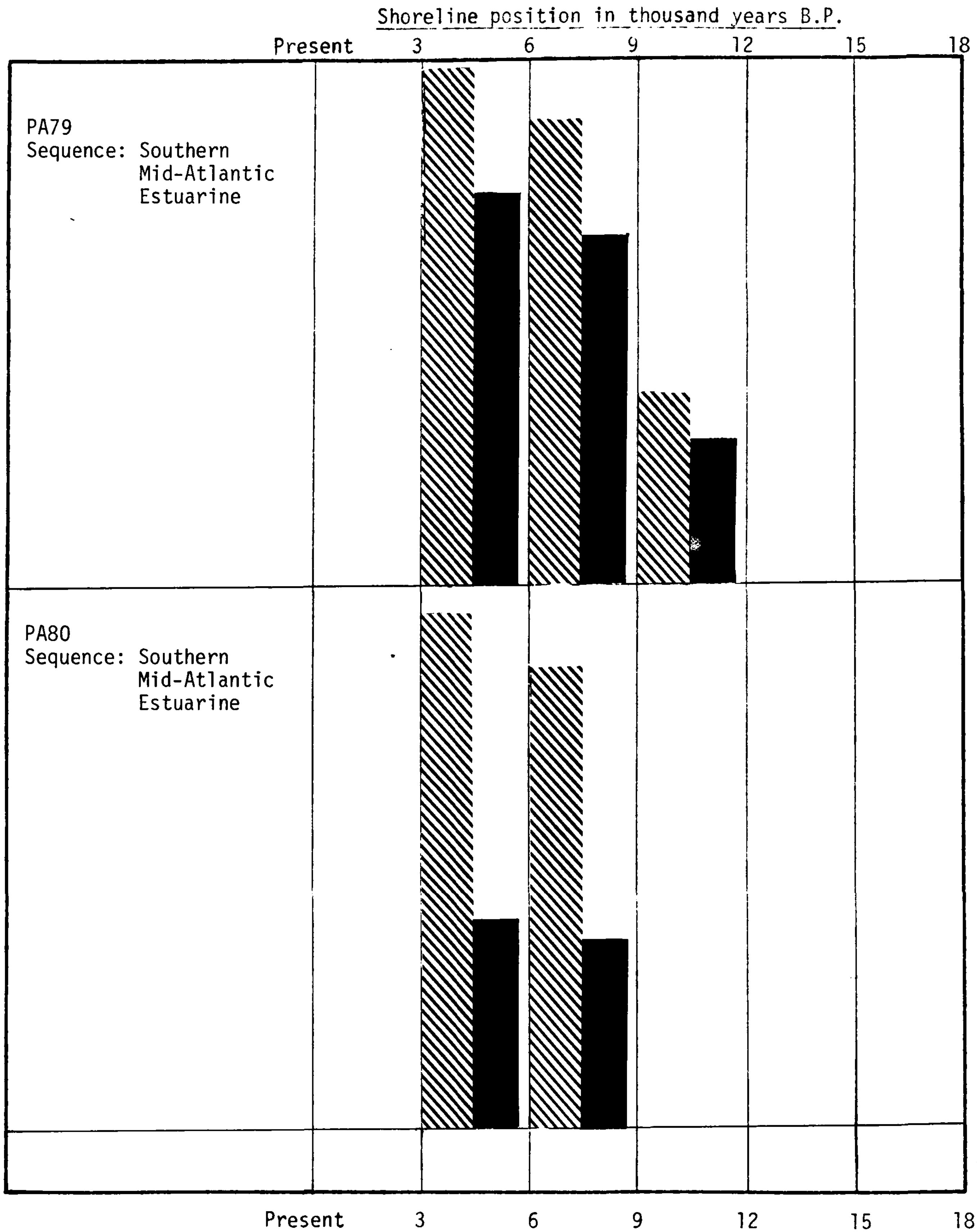

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

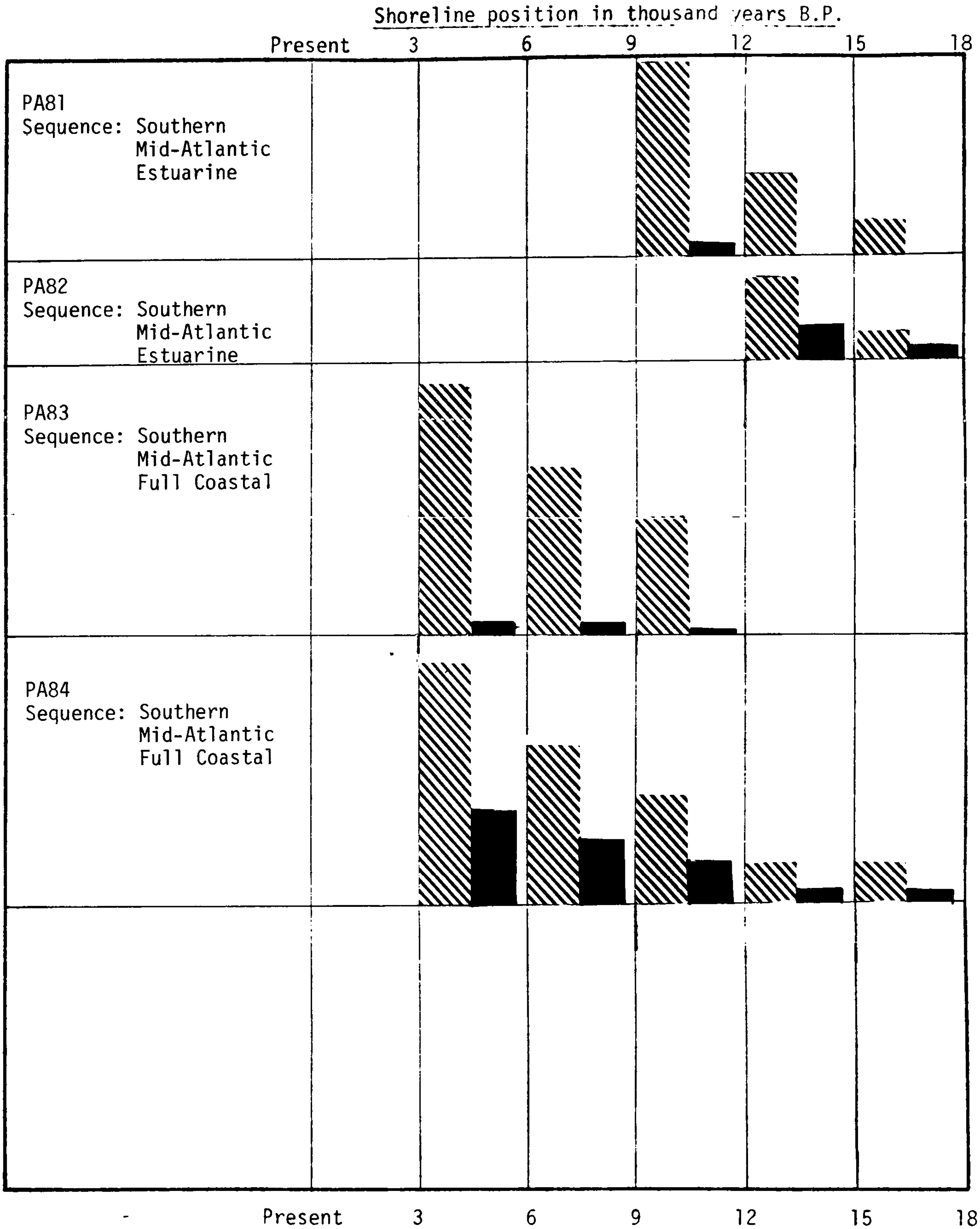

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

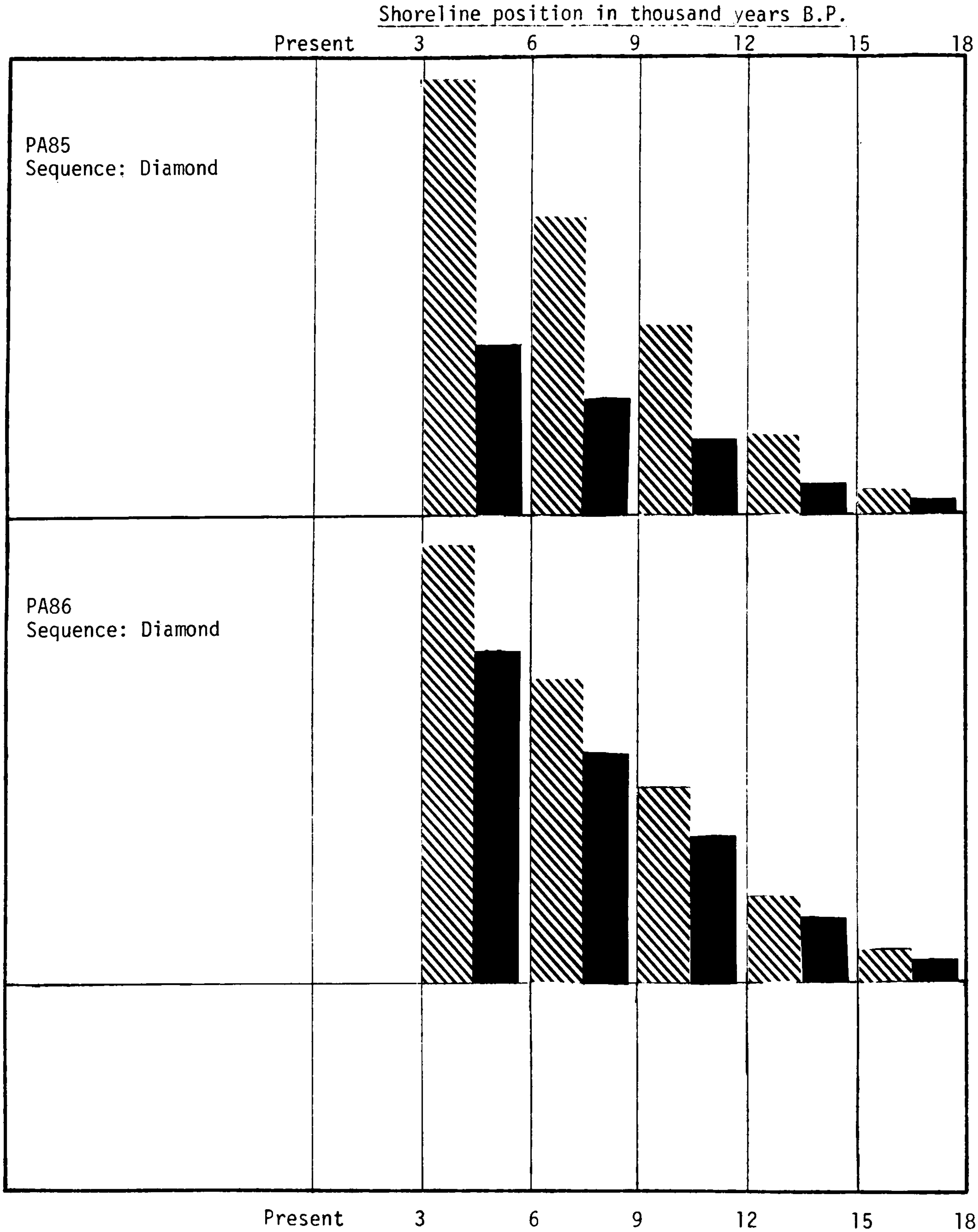

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

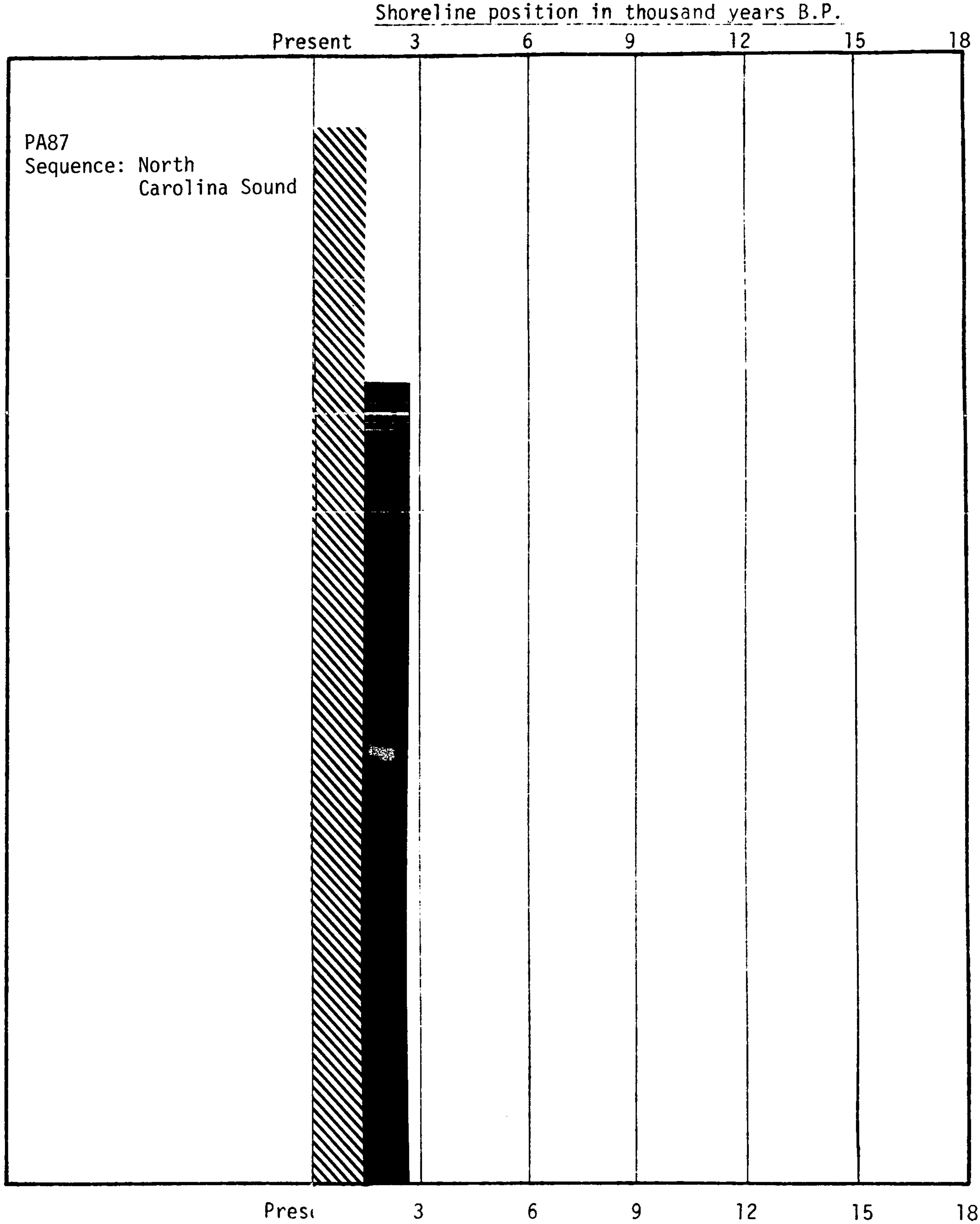

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

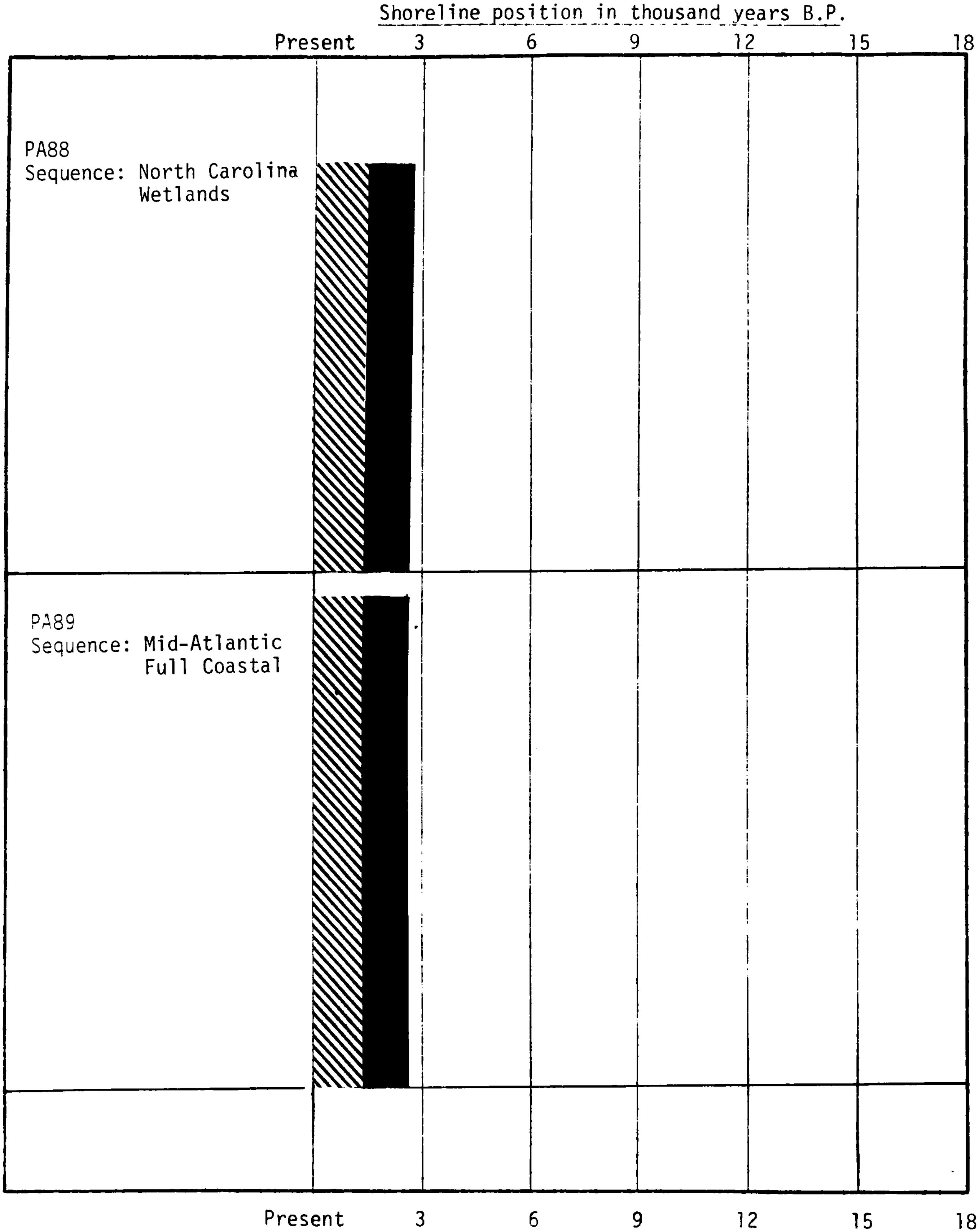

Fig. IV-47 (continued)
Original predicted site frequency versus residual predicted site frequency

4.3 Impacts To Cultural Resources By Ocean Inundation

Using an existing study (Lenihan and others 1977), we have assessed the effects of inundation on site integrity. This was done in an effort to determine the data classes which might still be found in archaeological sites on the CS.

The effect of inundation by ocean waters on prehistoric archaeological sites is little known. The same is true for Historic Period sites, although work at places such as Port Royal (inundated rapidly as a result of earthquake) has helped to illuminate the results of this process on Historic Period materials (Flemming 1962). On the other hand, the work of Lenihan and his colleagues at the National Park Service has provided an impressive body of data on the known and expected effects of inundation by fresh water on prehistoric as well as historic archaeological sites. The following analysis will draw heavily on Lenihan's work under the assumption that the differences between ocean inundation and reservoir inundation are identifiable. We will retain the general format used by Lenihan in our analysis, while at the same time discussing the special effects of the ocean environment.

4.3.1 Mechanical impacts

Lenihan and others (1977) dealt with the mechanical effects on the structure of archaeological sites, focusing primarily on architectural sites as found in the Southwest. There are, however, predictive data on intensity of impact to some site types that may be found in the various environments of the now-inundated shelf.

The following statement conceptualizing the interrelated variables of mechanical impacts, modified for the ocean situation, is presented below:

> A TYPE OF SITE (VARIABLE 1: CULTURAL MANIFESTATION) IS LOCATED IN A SOIL OF A CERTAIN TYPE AND CONSISTENCY (VARIABLE 2: ENVIRONMENTAL MATRIX) WHICH IS SUBJECTED TO THE EFFECTS OF WAVE, TIDE, STORM, UNDERCURRENT, ETC. (VARIABLE 3: OCEAN DYNAMICS).

Table IV-6 is an adaptation of Lenihan's chart (found on P.20 of the work referred to above) applying the predictions of relative impacts to different environmental matrices under various conditions of ocean dynamics. It must be emphasized that the predictions are relative, with effects of ocean dynamics extrapolated from the freshwater predictions.

The susceptibility of some types of archaeological sites to the mechanical effects of ocean dynamics is illustrated in Table IV-7 and is based again on the extrapolation of freshwater predictions. Ocean dynamics in the several forms it may have taken during the process of sea-level rise has been extensively discussed in Volume I of this study. The susceptibility scales are from 0 to 3. A rating of 1 indicates lesser susceptibility, 3 indicates greater susceptibility, while 0 indicates negligible or even favorable impact.

Table IV-6: Relative impact of ocean dynamics to soils.

Environmental Matrix (Soil Types)	Local and/or trans-gressional water flow dynamics	Erosion Factors				
		Water velocity in river over site dependent on such factors as slope and nature of flow rate	Water with high carrying capacity	Subject to wave action	Flood plain inside river channel	Flood plain outside river channel
Well-graded gravels, gravel-sand mixtures, little or no fines.		1	1	1	1	1
Poorly-graded gravels, gravel-sand mixtures, little or no fines.		1	1	1	1	1
Silty gravels, poorly graded gravel-sand-silt mixtures.		2	2	1	2	1
Well-graded sands, gravelly sands, little or no fines.		2	2	2	2	1
Poorly graded sands, gravelly sands, little or no fines.		2	2	2	2	1
Silty sands, poorly-graded sand-silt mixtures.		3	3	3	3	2
Clayey sands, poorly-graded sand-clay mixtures.		2	2	2	2	1
Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.		3	3	3	3	3
Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.		1	1	1	2	1
Organic silts and organic silt-clays of low plasticity.		3	3	3	3	2
Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.		3	3	3	3	2
Inorganic clays of high plasticity, fat clays.		1	1	1	2	1
Organic clays of medium to high plasticity.		2	1	3	2	1
Peat and other highly organic soils.		3	3	3	3	2

*Numerical weighting predictions in this chart are courtesy of the Bureau of Reclamation Engineering and research Center. Numeral 1 = minimal impact, numeral 2 = moderate impact, and numeral 3 = maximum impact.

Table IV-7. Susceptibility to mechanical impact due to general transgressive processes (after Lenihan 1977).

	Susceptibility Value
A. Low-lying rubble of stone: In the absence of such water dynamic specifics as high current and/or heavy erosion, the material should be only minimally disturbed.	1
B. Lithic and/or ceramic surface-scatter: Very little impact will occur. If the material is located on a slope, high current may cause redistribution.	1
C. Standing earthworks, prehistoric mounds, and military structures: These situations will be highly susceptible to the impact of transgression specifics such as current, erosion, and silting on the soil matrix.	2
D. Subsurface foundations: Negligible impact may be expected.	0
E. Subsurface foundations of wood: If the matrix in which the foundations are located is well-consolidated, the impact will be lessened somewhat.	3
F. Shell midden: Minimal impact may be expected, although silting and redistribution due to current and erosion may take place under certain conditions.	1
G. Soil midden: The material will be more susceptible to erosion than a shell midden.	2
H. Talus-slopes in front of rockshelters: In the absence of specifics such as high current and/or erosion, the talus-slope should remain relatively intact, though redistribution of any surface material may take place.	1
I. Non-backfilled archeological excavations: Trenches, test pits, balks, etc., created as a result of archeological activity, will be heavily impacted, primarily because of slumpage. Backfilling will substantially reduce the severity of the impact.	3

4.3.2 Differential preservation of cultural materials

In our discussion of the preservation of submerged archaeological materials, we will focus on freshwater effects as they are modified by the chemistry of sea water, using the chemical model of sea water developed by Sillen (1961), in which the pH of sea water is taken as 8.2.

The following discussions relate to materials buried below the sea floor and not to those that may be presently on the surface of the floor, and thus subject to ongoing erosional processes.

4.3.2.1 Bone - It has been shown that submerged bone may be either preserved or destroyed in a freshwater situation depending on a combination of factors such as soil and water chemistry. In ocean water the case may well be the same, with the bias in favor of greater preservation. For example in a case where bone is deposited in bog (bog being acidic, a condition which accelerates the deterioration of bone) and is subsequently covered by the more basic sea water, deterioration may be arrested and preservation enhanced. Similarly, the process of fossilization may be increased by the liquification of the surrounding soil matrix, coupled with the introduction of more of the minerals that contribute to the process than are normally found in terrestrial soil in the Northeast.

4.3.2.2 Ceramics - Ceramic preservation will depend on the porosity and permeability of the original ceramic. Samples of low porosity and permeability, and high strength, will be in a state of preservation comparable to samples of similar nature taken from a non-inundated context. At the same time samples of high porosity and permeability, and low strength, will not be well preserved.

4.3.2.3 Stone - Stone materials of varying chemical compositions react to fresh water, and probably ocean inundation differentially. Patina on cherts, quartzites, and other materials of similar type is developed as a function of hydration or dehydration and can change the surface characteristics of the artifact. Other effects may help to maintain surface configuration if the chemical properties of the material are not subject to dissolution. Lithic (stone) artifacts manufactured from feldspar or carbonate minerals are subject to degradation when inundated by acidic liquids (rain water) and generally (?) fresh water. Thus the inundation of these stone types by the more basic (pH 8.2) ocean water may well enhance the preservation of these materials; at the very least it should reduce the rate of degradation of these stone types.

One can expect in ocean submergence that chert-like stone (found in different sites of different periods in the study area) may be well preserved (neglecting other effects of the inundation process) to the point of use-wear retention, while even ground stone artifacts created from more granular, granitic types (which are more susceptible to acidic reduction) will be better preserved than similar materials in a freshwater context.

One important element of the analysis is that chipped and ground stone artifacts that have been structurally weakened in the process of inundation (or previously by chemical processes) are subject to severe modification of all features that may be used in the analysis of function. At the same time it has been shown that stone tools can be analyzed for function even after severe modification of sandblasting, (a process of dune activity in coastal situations) with a reasonably high degree of specificity (Roberts 1975).

It will be important to discover the degree to which specific characteristics generally used for the analysis of stone tools are modified by the effects of ocean submergence. In general, however, it is predicted that stone artifacts below the ocean floor will have a higher probability of survival than those in the fresh-water situation of the NPS study.

4.3.2.4 Glass - In general, glass materials (normally of the Historic Period) will not react differently in the submerged ocean environment than in freshwater. In other words, the condition of glass from saltwater inundation sites will not differ markedly from that of samples extracted from terrestrial sites except for the effects of the inundation process itself.

4.3.2.5 Shell - It has been shown elsewhere that shell material will generally deteriorate faster in an inundated condition than in abovewater situations. Qualifications dependent on the distribution of shell in the environmental matrix are offered. Shell appears in the archaeological record in several forms. First it appears in industrial contexts (see Vol. II) as shell mounds resulting from the extraction of meat from the shellfish. Second, it appears in a utilitarian form as tools or other functional artifacts. And lastly, it appears in a social context as ornamentation such as beads, plaques, decorated shell, etc. In the industrial context, shell will appear as concentrations in a localized setting. The concentrations will, in a submerged state, tend to form their own microchemical environment, such as to increase the pH value above that of the present model for sea water (8.2). This more basic environment will tend to preserve or fossilize otherwise reducible materials within the shell mound, while at the same time enhancing the shells' own preservation. The more dispersed utilitarian and cultural shell artifacts are at the mercy of the surrounding environment. However, with a pH higher than that of fresh water, it is predicted that the degradation of shell will be somewhat inhibited.

4.3.2.6 Leather - Leather in the form of skins, clothing, etc. may have a better opportunity for survival in an inundated context than is generally the case for terrestrial sites. It has been shown (Reed 1972) that leather recovered from waterlogged situations (especially where oxygen is reduced) has an excellent chance of survival. However, in highly acid situations (pH less than 5), leathers may be subject to chemical attack. Reed also indicates that in alkaline situations bacteria become the major destructive element.

Nevertheless, we can predict with a reasonable level of confidence that skins and leather deposited in sites subsequently covered by lagoonal deposits followed by ocean inundation (see Volume I) have a good chance of survival. While this is primarily due to the expected anaerobic condition of the site, the pH of the sea water may help to neutralize the acid of possible bog materials to such a level that preservation over a long period is acutally enhanced.

4.3.2.7 Animal and vegetable fibers - Animal fibers in the form of sinew, etc. and vegetable fibers in the form of basketry, mats, etc. are similar to leather in their reactions to local pH factors and oxygen presence. Therefore, we can predict that in sites such as those described above these materials also have a good chance for survival.

4.3.2.8 Wood - The same elements that act to preserve wood in freshwater inundation situations will probably operate in sea water, while preservation may even be enhanced under anaerobic conditions. Thus the preservation of wood in inundated sites is superior to that found on land.

4.3.2.9 Ferrous materials - Iron artifacts are not expected from archaeological sites of the Pre-contact Period (the era before European contact with peoples indiginous to the study area). However, sites of the Contact Period and those associated with wrecked shipping can be expected to contain such materials. The reduction of this material occurs at different rates, depending on the level of oxygen in the water. In general, however, corrosion may completely reduce the artifact or may form a protective covering thus reducing the rate of destruction. In essentially anaerobic environments, corrosion of iron may be effectively inhibited, but only when sulphate-reducing bacteria are absent.

4.3.2.10 Non-ferrous metals - These materials can be found in prehistoric as well as Historic Period sites. It is expected that non-ferrous metals will be subject to greater corrosion in sea water and this effect may be accelerated in anaerobic situations where sulphate-reducing bacteria survive (Lenihan and others 1977).

4.3.2.11 Discussion - From the above analysis it can be seen that certain artifact types actually stand a better chance of preservation after inundation, assuming they have survived the pre-inundation environment and the mechanical effects of inundation. Thus the recovery of materials from sites on the CS may give us opportunities to add significantly to our knowledge of man. At the same time, some classes of artifacts are destroyed more rapidly after inundation than before. In some cases, the presence of such objects may be detected from the hollow cavities left in a dense matrix after the reduction of the material. Remains of either type will be extremely fragile, and suitable excavation strategies must be developed to deal with this probability.

4.3.3 Impacts on analytical techniques

An understanding of the function, time, and population components (number of individuals, purpose, culture, etc.) of an archaeological site is derived from more than the simple recovery of surviving artifacts. The application of techniques for analyzing many of the non-artifactual components of a site can lead to significant insights which make possible a greatly refined description of the site. These techniques and their effectiveness will be different for submerged ocean sites than they would be for terrestrial ones.

4.3.3.1 Soil-chemistry analysis - There are many tests presently being used by archaeologists on archaeological site soils. We predict that the utility of the selected analysis techniques will be much the same in the ocean environment as in the fresh-water one. Thus, pH analysis will be useful for describing the relative pH values in a site. Nitrate analysis will be ineffective. Phosphate analysis will be useful in the description of relative concentrations, except when applied to iron-rich sandy loam. The analysis of organic matter will only be useful in contexts below the bottom surface. Finally, potassium analysis can be applied for relative measurements both vertically and horizontally across the site.

4.3.3.2 Flotation - The recovery of micro-floral and micro-faunal remains by flotation will be affected by the process of inundation. Remains deposited in loose soils or on the surface will be floated or washed out of context so that the analysis will be skewed. However, remains in the buried strata could be found intact.

4.3.3.3 Lithic-source identification - Lithic-source analysis techniques will not be affected by aqua-chemical results of site submergence.

4.3.3.4 Microscopic analysis of stone tools - The function of specific stone tools has been inferred from microscopic analysis by many researchers (Tringham and others 1974, Roberts 1975, Semenov 1973, among others). Microscopic use wear implying function may even be detected on tools that have been subjected to minor levels of erosion by air- and water-borne sands (Roberts 1975). Ocean inundation, regardless of how low an energy regime, will in general eradicate all traces of use wear and, if violent, will destroy the evidence of human manufacture completely. When the tool is buried and not subjected to these effects, however, modification of use-wear patterning will only be accomplished through chemical changes on the surface of the stone. These effects are a function of chemical interchange between stone and deposition medium and may be severe or negligible (Lenihan and others 1977).

4.3.3.5 Pollen analysis - The use of pollen analysis in the reconstruction of paleo-environments has been discussed elsewhere in this study (Volumes I and II). Several of the samples used came from the study area and from other inundated contexts. Thus it is clear that this type of analysis is little affected by submergence. It is important to note, however, that redistribution and redeposition of pollen grains is

possible during inundation and thus analyses derived from zones subject to this effect may give faulty data.

4.3.4 Impacts upon dating techniques

The general effects of fresh-water submergence on selected dating techniques will probably be found to be similar in sea water (Erickson, personal communication). Thus the summary of effects in Table IV-8 will suffice for the purposes of this report.

Table IV-8 summarizes the predicted effectivity of selected dating techniques, adapted for the ocean situation from the fresh-water case. As can be seen from our discussion of both dating techniques and analysis techniques it is reasonable to expect that many of the sophisticated types of analysis presently in use for terrestrial sites can be used with equal effect in the submerged context of sites on the CS. At the same time, other techniques may not be effective, so that it may be necessary to develop new methods especially adapted to the submerged environment.

As with the fresh-water examples cited by Lenihan and others (1977), we do not expect to find significant impact to soil profiles and/or features on sites that have maintained their integrity through the inundation process.

Table IV-8. Summary of Effects on Dating Techniques.

Technique	Effect
Carbon-14 dating	No effect, except larger sample sizes may be required.
Dendrochronology	No effect if structural integrity of wood is not lost.
Archaeomagnetic dating	No effect if feature sample retains its structural and direction integrity after submergence.
Fluorine dating	Not useful after inundation.
Thermoluminescence dating	Useful only at reasonable small depths on sites that have been inundated for only 20% of their archaeological life. Example: a site 15,000 years old that has been inundated for only 3,000 years.
X-ray diffraction dating	Not useful.
Fission-track and alpha-recoil-track dating	Would normally be tested using thermoluminescence techniques (samples that have had their temperatures raised to the annealing point).

5.0 NATURAL AND HUMAN CONFLICTS WITH KNOWN OR EXPECTED RESOURCES

Conflicts with resources are generally discussed in terms of impacts to these resources through various agents. In this section we will discuss these agents' impacts to cultural resources. This discussion will form the basis for management and planning recommendations designed to deal with known and expected impacts.

We have relied on several sources in our assessment of the impacts of human activities upon archaeological sites. These impacts may be loosely identified as those deriving from fishing, oil and gas development, boating and recreational activities, and onshore land development. The impacts from fishing were analyzed with the aid of various documents that describe fishing methods and the degree of bottom disturbance they cause. The impacts of oil and gas development activities (a primary and major type of impact) was ascertained through the services of the consulting firm of H.O. Mohr, Inc. of Houston, Texas, specifically from communication with their employee Mr. Joseph Guarino, who has extensive personal experience in the oil and gas industry. Mr. Guarino is also familiar with the requirements of the historic preservation process, having overseen on behalf of the Tenneco Corporation an environmental impact study performed by ICA in connection with a proposed LNG pipeline running from Canada to Pennsylvania.

The assessment of impact from inshore and offshore coastal zone activities was made from a study of the Massachusetts Coastal Zone Management Environmental Impact Statement.

5.1 Ongoing Coastal Erosion

Volume II has shown the importance of the coastal and estuarine environments for the location of prehistoric sites, while Volume III has shown the zones of Historic Period activities in the nearshore environment. These locations are under constant threat from erosion caused by either storms or shoreface erosional processes, as described in Volume I. Natural tide and wave activities are constantly destroying archaeological sites. This is one of the factors contributing to the estimate that two sites a day are lost in each state in the United States (Davis, Dincauze, King, McGimsy, Roberts among others, personal communication). Because of this statistic, it will be important for resource managers to initiate locational and evaluational surveys in the coastal zone of all states potentially subject to such erosional loss.

5.2 Storm-Caused Impacts

The study area is one which has been subjected to severe storms since the earliest recording of such data. It can be expected that storms were prevalent in the more distant past as well. Variation in this pattern would be a function of climatic change, which has been discussed earlier in this study (see Volumes I and II).

The impact of storms on archaeological sites will be assessed from two points of view: effects on sites in the nearshore environment, and effects on sites in the offshore environment.

5.2.1 Nearshore effects

The primary effect of storm conditions on archaeological sites is the erosion generated by increased wave energy and the higher tides associated with both the wave activity and, in some cases, the season of the storm. As an example, the "great storm of 1978," the worst in close to 100 years, caused the loss of a great many prehistoric sites on the coast of Maine. We can expect similar conditions to exist throughout the study area, even though in some areas in the effects of wave action will be dampened by the presence of tidal marshes and lagoons.

An important secondary effect of storms is the general increase in water runoff, which produces further erosion along rivers and streams and is thus destructive of sites that favor these situations. These two effects are especially devastating at stream and river mouths, a zone that was considered highly attractive by prehistoric peoples.

The movement and redistribution of shore-front sands during a storm is well known for its ability to cover and uncover wrecked ships. Thus a storm's effect on the "locatability" of wrecked shipping may be great.

5.2.2 Offshore effects

The effects of storms on the ocean floor can have considerable impact on archaeological sites. The increased strength of currents will have a scouring effect on stone tools and other artifacts which may be lying on or very near the bottom surface. At the same time, transported sediments and/or shifted sand waves may cover previously exposed sites (or, of course, uncover sites previously hidden).

5.3 Human Impacts

In this area, we have assessed human impacts to archaeological sites on three fronts. First, we have considered the impacts of shell- and fin-fish extraction on the archaeological record. Next, we have assessed the effect of predicted coastal-zone activities as described in the

Coastal Zone Management Environmental Impact Statement for Massachusetts (assuming that similar patterns of activity will pertain throughout the study area). Finally, we have assessed the known and predicted impacts of offshore mineral- and energy-extraction activities on the archaeological record in light of both present practices and preferred practices.

5.3.1 Fishing

The importance of fishing of the Northeast coast has been established since the sixteenth century (Jensen 1967). For the purpose of this report the analysis of fishing will be divided into fin-fishing and shellfishing.

5.3.1.1 Fin-fishing - The adverse impact to potential archaeological sites from fin-fishing can be considered to have been low from the sixteenth century until about 100 years ago. This is due mainly to the fact that methods in general were limited to handlines, line trawls, and gill nets (Jensen 1967). These devices may occasionally snag on wrecked ships or the odd prehistoric artifact, but their adverse effect on a site is minimal. A worked bone implement assumed to be part of a fishing spear was "brought up by the anchor of a fishing vessel at the mouth of Vinal Haven Harbor, Maine" and is presently on display at the Peabody Museum, Harvard University. After this period, with the introduction of the beam trawl, otter trawl, and other advanced methods, the potential impacts to submerged sites increased. The dragging along the sea floor of hauls weighing in excess of several thousand pounds can have a significant adverse effect on prehistoric sites.

5.3.1.2 Shellfishing - It was not until after World War II that shellfishing (surf clam) became a major industry on the East Coast. At that time, an increased demand for high-protein food sources produced a greatly increased interest in shell-fishing, which had previously been confined to rather casual and peripheral operations such as dory raking. The impact of dory raking was very limited in area, as work was seldom carried out more than 1.5 miles from shore (Parker 1971). Its effect on submerged sites would have been slight, and limited in most cases to the recovery of a few odd artifacts.

The 1920's saw the introduction of scraper-type dredges, which left a swath on the bottom 18 to 28 in wide and 6 to 9 in deep. With the expansion of the market, less dense clam beds were exploited with the aid of the hydraulic jet dredge. This dredge impacts a bottom swath 40 to 84 in wide and may dig 12 to 20 in deep. At present it is used to harvest surf clams (Parker 1971) and recent experiments have shown it can be successfully used for ocean quahogs as well (National Fisherman, Dec. 1977). The potential crop of quahogs harvested from between Canada and Cape Hatteras has been estimated at 100 to 150 million bushels per year, and it has been predicted that the U.S. production of quahogs could grow to a yearly sustained catch of 150 million pounds yield of meat per year (National Fisherman, Dec. 1977). Because established clam-fishing grounds are shrinking as a result of pollution and over-exploitation, jet dredging operations are being carried on at greater

and greater distances offshore.

The impact of these operations on archaeological sites near the bottom surface may be severe. Mathieson (1974), working from data obtained in Maine, has shown that jet dredges may excavate 6 to 10 in into the blue clay of the bottom. The recent development of mechanical oyster harvesters, which excavate a track 32 to 36 in wide and 3 to 4 in deep, will also have an effect, similar to but not so deep as that of jet dredging.

Airlife systems, very much like those used for archaeological excavation (see Appendix B), have been shown to be effective for use in smaller clam beds (Parker 1971). Quahog, oyster, and surf-clam fishing tends to be concentrated in beds reasonably near the shore, while scallop-dredging takes place at much greater depths and offshore distances, an example being the Georges Banks (National Fisherman, Jan. 1978).

Scallop beds, generally on gravel, sand or sand/mud bottoms are dredged all the way from the Gulf of St. Lawrence to Cape Hatteras. North of Cape Cod, scallop beds lie just below the low tide line; further south, they are found in the deeper, colder offshore water. However, the richest known sea-scallop grounds are found between the 20- and 50-fathom marks on the Georges Banks. Since sea scallops live on the bottom surface, it is not necessary to excavate to recover them, but the dredgers are dragged along the bottom, creating a certain minimal shallow disturbance. As an example of the fact that scallop dredging can effect archaeological evidence is the experience of Foye Brown of North Haven, Maine, who recovered a plummet and hammerstone from his scallop dredge while working near Dogfish Island off Vinal Haven, Maine (Robert Lewis, Maine State Museum, personal communication). In general, each boat drags two 11-ft-wide dredges. While it is expected that these activities will have only small impact on archaeological sites, it must be noted that prehistoric artifacts have been recovered by scallop dredges.

Offshore lobster dredging such as that now practiced on the Georges Banks may well have an impact similar to that of other shellfish dredging techniques.

In summary, the expected impact to archaeological sites from shellfishing occurs within the first two feet of the bottom surface, so that in the case, at least, of jet dredging, impact to sites at those levels may be severe. In view of the fact that annual shellfish yields are expected to rise, archaeological impacts from these activities can also be expected to rise.

5.3.2 Other human impacts

It is of course impossible to document every single one of the multiple types of human impact to cultural resources on the CS. So far we have reviewed the impacts derived from the fishing industry, but others still remain to be considered.

5.3.2.1 Coastal zone activities - The types of activities that may impact archaeological sites close to shore have been evaluated by means of a review of the Massachusetts Coastal Zone Management Program Environmental Impact Statement. We feel that these classes of impact are representative of those that prevail throughout the study area.

5.3.2.1.1 New private development - By far the largest portion of the coastline along the study area is privately owned. For this reason, there is little that can be done to control impacts of these properties except in such cases as require Corps of Engineers permits or fall under the purview of state or local ordinances.

The impacts from private development can be among the most destructive to the archaeological resource base. This is due primarily to the fact that private individuals have little knowledge of the fragility and the importance of archaeological resources and, in a vast majority of cases, are unaware of their existance in a specific project area. As is evident from other sections of this volume, any land disturbance has the potential for destroying archaeological sites. Thus private individuals proposing land modification have the power to destroy a large portion of the nation's cultural heritage.

5.3.2.1.2 Harbor dredging and pier construction - The dredging of harbors and the construction of piers can have a severe effect on underwater archaeological resources, principally by removing large amounts of underwater soils that either contain archaeological material or have hitherto served to protect sites that lie beneath them. Pier construction may have a more severe impact on deeply buried sites because of the deep footings required.

5.3.2.1.3 Cable laying - With the advent of communications satellites, cable laying for the purpose of international communication has been greatly reduced or eliminated. However,cable is still laid for local use in some cases, and may have some subsurface impact when it is buried, although much of the cable laid in the earlier decades has had minimal impact on cultural resources, having been laid on the bottom surface rather than buried. It should be noted, also, that old, sometimes disused cable can be a source of confusion to instruments used in locating historic shipping remains such as magnetometers.

5.3.2.1.4 Pipeline construction, coastal zone to the shoreline - Construction in this area can be classified under two headings:

1) Dry-land construction
2) Wet-land construction

Conventional dry-land construction for a nominal size pipeline (36 in) will require a right-of-way (ROW) of not less than 50 ft in width. This allows room for the heavy equipment to maneuver and pass, and for a spoils bank containing the excavated dirt. Ditching is usually done with a back-hoe. The ditch is to be deep enough to allow for three ft of cover over the top of the pipeline. Thus a 36 in pipe would require a

ditch approximately five ft wide by six ft deep. The pipe is set in with side-boom machinery equipped with tracks like the back-hoe. The initial clearing and the use of this heavy equipment can destroy up to three ft of the ROW's upper surface, depending upon soil conditions. The ditch will be refilled, graded and resodded. Marsh construction methods are determined by the amount of water and the depth. In some cases if the water is deep enough, a barge is used. The pipe is joined and "pushed" into the ditch. Should the marsh or swamp be shallow, or the soil condition such that the pipe will not bury itself naturally, a ditch is again required. This ditching is done with a dragline either from a barge or from padding placed in the marsh.

5.3.2.1.5 Pipeline construction, shoreline to the 10 ft water depth - As in onshore conditions, this area requires that the pipe be buried three ft deep. Ditching is normally done at the shoreline crossing with a back-hoe or dragline. The offshore trenching will be done according to the soil conditions listed below:

1) Dragline barge - silt, sand, clay
2) Water or air jet sled - silt, light sand
3) Bury plow - hard clay
4) Explosives - rock

The pipe is lowered into the trench from a small barge (spud barge). It is moved along the route as the pipe is laid. Anchors may be used as the water depth increases. An alternate method is called the "beach pull method." This method requires the pipe strings to be assembled on the beach, then pulled into place and joined. Onshore, the beach crossing requires a lot of dirt work (bulkheads, piers, etc.). A 200 ft right-of-way is normal in this shallow water.

All these activities that disturb the surface have the potential for impacting sites which may be in the zones discussed.

5.3.2.1.6 Industrial and sewage discharge - Although discharge of industrial waste and sewage does not impact the physical structure of archaeological sites, it may be found to have altered the preservation characteristics of the sites' environments by changing their pH, anaerobic characteristics, or quantities and types of dissolved salts.

5.3.2.1.7 Disposal of dredge soil - Although the disposal of spoil from dredging will not of itself directly affect the physical structure of a submerged archaeological site, it may do so indirectly, either by changing the anaerobic characteristics of the site's environment or by altering the underwater topography in such a way as to increase erosion of the site by current action. It may also alter the site's "discoverability," by making it more difficult to detect or its "excavatability," by covering it with yards of undifferentiated overburden. At the same time, it must be admitted that deposition of dredge spoil might serve to protect a site from erosion already occurring.

5.3.2.1.8 Flood- and erosion-prevention measures - Many parts of the study area, most notably those coastal localities that are historically susceptible to erosion by storms, have been or are being protected from further damage by the excavation of offshore sand and gravel for the purpose of beach nourishment, erosion prevention, or the creation of dunes. Such operations may potentially destroy remains of historic shipping in the sand or gravel layer, or remove protective covering from prehistoric sites buried beneath them.

5.3.2.1.9 Mariculture - Since mariculture involves the possible excavation of marshes and wet-lands, it has a potential for destroying prehistoric sites in these environments, which have been shown to be particularly favorable for preserving certain types of archaeological materials not usually preserved in terrestrial sites (Robbins 1965).

5.3.2.1.10 Recreation - "The beach" is of course proverbial as a magnet for recreational activities of all types for persons of all ages, as may be demonstrated by the rapidly increasing numbers of public beach facilities under state, local and national auspices. In addition, recreation also takes place in certain other nearshore environments, both above and below water.

5.3.2.1.10.1 Shore access - The provision of rights-of-way for public access to the shore carries with it the potential for producing heavy impacts to prehistoric archaeological sites. Primary impacts under this heading include those resulting from the use of heavy construction equipment and the concomittant erosion caused by wind, water or foot traffic. A notable secondary impact is the opening up of previously inaccessible areas where sites may exist (both historic and prehistoric), to vandalism.

5.3.2.1.10.2 Boating - The greatly increasing popularity of recreational boating may have impacts very similar to those mentioned above under Shore Access, with the exception that the areas affected are likely to be even more remote--for example, offshore islands, where the construction of landing slips, piers, and campgrounds may seriously impact sites, especially prehistoric ones, and render sites of all types more vulnerable to vandalism.

5.3.2.1.10.3 Scuba diving - The growth of public interest in recreational scuba diving has the potential for both positive and negative effects on underwater archaeological resources. On the one hand, scuba divers engaged in treasure hunting may disrupt or even destroy the remains of significant sites of the Historic Period. On the other hand, there are instances in which scuba divers have aided archaeologists by reporting the locations of previously unknown undersea sites, both historic (wrecks) and prehistoric.

5.3.2.2 Offshore activities - Note: For the purpose of this report, "offshore" is defined as the zone of federal jurisdiction that lies beyond the 3-mile limit.

5.3.2.2.1 Sand and gravel mining - The archaeological impacts of sand and gravel mining in the offshore zone are similar to those that occur in the coastal zone (5.3.2.1.8), except that an additional purpose of mining activities in the offshore area is the borrowing of materials for stabilization of oil and gas pipelines, such as is now taking place in the North Sea (Guarino, personal communication). Increased mining may also be expected to provide differentiated construction materials to a growing eastern seaboard.

5.3.2.2.2. Offshore mineral extraction - The form of undersea mining that is presently receiving the greatest attention from industry is the extraction of manganese nodules, a resource that normally occurs at depths much greater than those found on the CS. However, it is certainly within the bounds of possibility that other mineral resources will in the future be found to occur in commercially valuable concentrations on the Shelf, and in that case, the dredging operations usually associated with recovery of undersea minerals would be highly destructive to any historic or prehistoric archaeological resources that lay in their path.

5.3.2.2.3 Offshore dumping - The dumping of materials in offshore locations falls generally into four categories, each of which has its associated types of archaeological impact:

a) Dumping of heavy materials may physically alter the integrity of sites by crushing them, and also serves to restrict access.

b) Dumping of chemicals (such as arsenic, acids, alkalis, sewage) may alter the preservation characteristics of undersea soils, thus destroying preserved materials therein.

c) Dumping of explosives restricts access to sites for all but the fool-hardy.

d) Dumping for the purpose of creating artificial fishing reefs combines the impacts listed under a) and c) above, namely, crushing and restricting access.

5.3.2.2.4 Gas and oil construction - The following table (Table IV-9) shows the archaeological impact of various operational CS activities. It uses the item names and activity descriptions from Chapter 3 of the BLM's "Study Design for Resource Management Decisions" (BLM, 1978). While this section deals mainly with offshore impacts this table includes some coastal zone activities.

Table IV-9: Archaeological impacts of gas and oil construction.

Operation Phase	Activity/Technology Used	Pollutant/Agent	Archaeological Impacts
1. Geophysical/ Evaluation	A. Seismic surveying	A. Noise from explosives, sparkers, or acoustic	A. Positive—may result in site location
	B. Bottom sampling (1) Coring (2) Dredging	B. Disturbed sediments	B. Negative—will disturb surface and buried resources; positive—may result in site location
2. Oil and Gas Exploration	A. Rig fabrication	A. Location of fabrication facility	A. Waterfront land use = site destruction
		Dredging	Destroy tidal-zone sites
		Filling	May protect sites from mechanical activity; may destroy sites chemically
	B. Rig emplacement	B. Rig location	B.
	Anchoring and installation	(1) Disturbed surface sediments	(1) Disturb surface resources
		(2) Disturbed subbottom sediments	(2) Disturb buried resources
	C. Drilling	C. Drill cuttings, drilling muds and fluids	C. Site burial, site destruction through chemical activity
	D. Temporary rig servicing (1) Logistic bases (2) Service craft	D. (Same as 2.A. above)	D. (Same as 2.A above
3. Field Development	A. Platform fabrication	A. (Same as 2.A. above)	A. (Same as 2.A. above)
	B. Platform installation	B. (Same as 2.B. above)	B. (Same as 2.B. above)
	C. Drilling	C. (Same as 2.C. above)	C. (Same as 2.C. above)
	D. Completion—installation of "Christmas Tree," riser, and flow lines and connection of wellhead to flow lines	D. Oil and petroleum compounds	D. Chemical effects to historic shipping (asphalting) and chemical modification of surface soils.
		Risers, connections, flow lines	Disturb surface sites
	E. Routine rig operations	E. (Same as 2.D. above)	E. (Same as 2.D. above)
	F. Platform servicing (1) Permanent logistic bases (2) Service craft	F. (Same as 2.E. above)	F. (Same as 2.E. above)
4. Production	A. Separation of oil/water oil/gas, and scrubbing	A. Refinery location	A. (Same as 2.A. above)
	B. Workover	B. (Same as 2.C. and 3.D. above)	B. (Same as 2.c. and 3.D above)

Table IV-9 (continued): Archaeological impacts.

Operation Phase	Activity/Technology Used	Pollutant/Agent	Archaeological Impacts
4. Production (continued)	C. Improved recovery (1) Fracturing (2) High pressure reinjection (3) Water/Detergent Flooding (4) Polymer floating (5) Thermal techniques	C. Chemical residues	C. Chemical modification of sites
5. Transportation and Storage	A. Fabrication of transportation and/or storage facilities	A. *	A. *
	B. Storage facility emplacement at sea or ashore	B. Storage facility location	B. Sea—surface site disturbance; ashore—site destruction
	C. Transfer to tankers/barges	C. Chronic oil discharge from tank cleaning and bilge pumping. Sewage/effluent discharge Atmospheric discharges Disposal of debris	C. (Same as 3.D. above)
	D. Construction and emplacement of pumping facilities	D. Pumping facility location Competition for labor	D. Shore site destruction
	E. Routine tanker/barge operations	E. (Same as 5.C. above)	E. (Same as 5.C. above)
	F. Pipeline fabrication and emplacement	F. ** Disturbed sediments Pipeline location Competition for labor	F. ** Surface site disturbance
	G. Pipeline operations	G. Oil	G. (Same as 3.D. above)
6. Refining	A. Construction or expansion	A. Refinery location Dredging and filling	A. (Same as 2.A. above)
	B. Processing	B. Refinery emissions Waste disposal	B. (Same as 4.C. above)

* Fabrication of storage and transportation facilities will probably be done at existing facilities. Impacts associated with this activity are the same as those for any steel fabrication plant.

** Fabrication of pipe will probably be done at existing facilities. Impacts associated with this activity are the same as for those of any steel fabrication plant.

6.0 MANAGEMENT STRATEGIES

Management strategies are designed to mitigate conflicts between recognized impacts to resources and planned development. We say planned development because management is virtually impossible in unplanned situations. However, regulatory agencies with this study in hand may also be in a better position to assess the destructive effects of unplanned activities on resources.

The following management strategies take the form of recommendations for impact mitigation and are arranged according to the impacts identified in Section 5.0 (Natural and Human Conflicts with Known or Expected Resources).

6.1 General Management Strategies

As data in Volumes II and III indicate, much work remains to be done on the location and assessment of cultural resources in the study area, especially along the coastline, which may be expected to experience heavy pressure from public and private development and natural erosional forces. Therefore, we recommend that each state implement a comprehensive program of locational studies in the coastal zone, with the specific purpose of identifying any sites endangered by natural processes or by human activity. Next, we recommend that each state begin a thorough review of existing state and local regulations governing land use in the coastal zone, so that it may identify and remedy any deficiencies in such legislation.

6.2 Specific Management Strategies

6.2.1 Impacts from fishing

Although the impacts of shell- and fin-fishing upon deeply buried archaeological sites appear at this time to be minimal, impacts to sites on or near the surface may be very severe.

It will be very difficult to regulate the choices made by fishermen as to where and how they work, for which reason we do not recommend the development of any new legislation or regulations to be applied to the fishing industry. At the same time, fishermen should be made aware of the valuable contributions they can make to archaeological knowledge by

reporting to the proper authorities (that is, the State Historic Preservation Officer) the location and nature of any archaeological materials they may recover in the course of their operations. There are several mechanisms that may be used to accomplish this goal:

1. Direct discussions between the SHPO and the local fishing community.

2. The writing of articles for journals such as the "National Fisherman" on the research value of archaeological resources and the correct manner of reporting them.

3. Giving of credit to individual fishermen involved in any published reports of archaeological sites discovered in this manner.

4. Institution of a program to encourage fishermen to report sunken shipping that may be a hazard to navigation or to fishing gear not only to navigation authorities but to the SHPO. Information on possible archaeological sites beyond the three-mile limit (that is, on federal property) should be reported to the BLM directly.

6.2.2 <u>Impacts from coastal-zone activities</u>
Any activities that will result in disturbing coastal lands or the nearshore bottom surface should be evaluated for their cultural resource potential through one of several survey strategies.

6.2.3 <u>Impacts from recreational and boating activities</u>
Although archaeological surveys should be conducted in connection with any projected development of recreational facilities, it will be very difficult to control the activities of members of the public who use such facilities, or of private individuals engaged in recreational pursuits such as boating and scuba-diving. Accordingly, we recommend a well-thought-out program of public education which will encourage a responsible attitude toward archaeological resources (which are after all the property of the public), and discourage destructive activities such as vandalism. In no case should the location of any archaeological site be marked or disclosed to the press or general public unless adequate precautions have been undertaken to protect the sites against destruction by looting. At the same time, any sites discovered by users of a recreational facility should be promptly reported to the SHPO and appropriate agency and the value of such discovery and recognition of the discoverer given due emphasis.

6.2.4 <u>Impacts of offshore activities</u>

6.2.4.1 <u>Sand and gravel mining</u> - Sand and gravel mining has not yet had any major impact on the CS, except in the instance of nearshore activities for the purpose of beach stabilization. However, with the increase in these activities that is associated with oil and gas exploitation and

with an increased need for construction materials, one may expect a steep upswing in sand and gravel mining of the kind now being experienced in the North Sea. Therefore, environmental impact statements and permitting procedures relating to future oil and gas exploration and sand or gravel extraction for construction will have to address the types of expected impacts to archaeological properties.

6.2.4.2 Offshore mining - At present, offshore mining activities are confined to depths greater than those found on the CS, but the possibility exists that commercially valuable mineral resources will be found there at some future time. Accordingly, the BLM and U.S. Geological Survey should be aware of the types of impacts to archaeological properties that may result from undersea mining, and should integrate the archaeological element into its planning and permitting procedures.

6.2.4.3 Offshore dumping - Although alternatives to the offshore dumping of sludge, acid, and other noxious or hazardous materials are currently being developed, such dumping is still going on in the study area. Indeed, sewage sludge from New York City is currently being disposed of 12 miles offshore in the Hudson Canyon (Seaport 1978), one of the areas pinpointed in this report as being most likely to contain preserved subaerial surfaces (Vol. I). The fact that this type of sludge dumping is a potential hazard to archaeological properties should be added to the other arguments advanced against this practice. At the same time, it should be borne in mind that these archaeological impacts are predicted, not demonstrated. It would be very helpful to resource managers if bottom studies could be undertaken in order to determine what, if any, chemical changes in submerged sediments actually occur as a result of sludge dumping, since chemical changes constitute the major type of archaeological impact predicted from such dumping.

6.2.4.4 Oil and gas development - By far the most extensive types of new impact to archaeological properties that may be foreseen for the CS in the study area are those that are occurring as a result of oil and gas development. For this reason, we intend to treat this type of development separately, addressing both offshore and onshore facilities and their associated impacts. The framework for this discussion will be the BLM's "Study Design for Resource Management Decisions: OCS Oil and Gas Development and the Environment", modified for a more general audience of resource managers.

The following discussion, like the "Study Design", is developed around certain questions that resource managers ask about cultural resources. In essence these questions can be stated as follows: Where are cultural resources? What are the impacts to cultural resources? and What is cost-effective (socially efficient) mitigation of impact?

6.2.4.4.1 Q) Where are cultural resources on the CS? - A) The previous volumes of this study give the resource manager a view of the likelihood that prehistoric sites are preserved on the CS, the potential type, size, and distribution of prehistoric sites through time, and the expected

density and distribution of wrecked shipping on the CS. This volume integrates these data to give the resource manager a view of the presently expected type, size, time period, distribution, and integrity of all cultural resources on the CS. The inventories have been acquired and documented to the nearest-leaseblock level, in order to maintain their security and preserve these data from misuse by unauthorized persons. Cultural resource zones have been defined as a result of integrating historic shipping with preserved archaeology. Figures IV-42 to IV-51 and Table 10 (Section 7.4) illustrate and describe these zones. They appear in Section 7.4 because they are accompanied by recommended survey strategies and are thus classifiable as recommendations.

6.2.4.4.2 Q) What are the impacts to cultural resources? - To expand upon the above question, - what losses due to damage of archaeological and historic resources or gains by discovery can be expected as a result of a land-use proposal, or what damage to or enhanced preservation of these resources will result from oil spills? A) The losses due to damage of archaeological and historic resources as a result of any land-use proposal may be assessed with the aid of this report in the early stages, and in greater detail as those further reports required in more advanced stages of planning provide better data and more solid recommendations from which to work. It should be noted, however, that the losses described in these reports will be exclusively those to the archaeological data base, and not, as elsewhere specified, economic in nature. Some would argue that the mere consideration of archaeological impacts entails economic losses, and we will discuss socially efficient mitigating measures below. The primary loss from the destruction of archaeological resources is the loss of valuable scientific information. Contrary to what is generally supposed, this information has broad potential applications beyond the narrow bounds of one academic discipline. Scientists of many disciplines are coming to understand the value for their own research needs of data locked in archaeological sites. These disciplines include, but are not limited to, climatology, geography, ecology, geology, and biology. Thus it can be said that archaeological sites have become much more valuable to science in general in the last few years. In addition, many anthropologists and archaeologists share our view that data of the kind that may be recovered from sites on the CS may assist humanity in its effort to understand the processes that drive both cultural change and the environmental interactions that ultimately make it possible or impossible for our species to survive on the planet Earth. We also wish to point out that, as stated below, it is possible that distinct benefits to archaeology may accrue from oil and gas development and that these possible benefits should be taken into consideration in any decision-making process.

In the event of an oil spill, resources that have been determined eligible for the National Register of Historic Places will come under the protection of Section 106 of the National Historic Preservation Act. However, the vast majority of known (and unknown) archaeological

resources in the tidal zone (that zone where we expect the greatest danger to cultural resources from oil spills) have not been evaluated as to their eligibility for the NR. Until such evaluations are complete, it will be impossible to determine the full impact of oil spills on the resource base.

It is entirely possible that oil spills may actually serve to protect archaeological resources by reducing the physical impact upon them of wave energy and/or sealing them off from oxygen and creating an anaerobic condition inimical to decay of organic materials or corrosion of metals. At the same time, oil may modify the chemical characteristics of overlying soils, though it is impossible to know whether this effect would be positive or negative. Any land-moving operations undertaken as part of spill clean-up would probably be entirely negative in their effects.

Resources that may be impacted by oil spills are those in the tidal zone. The impacts will be of two kinds: the mixing of the oil itself with the surface materials of the site, producing as-yet-unknown physical and chemical effects; and disturbance of the land surface incidental to clean-up activities such as bulldozing. While this study has identified many of the resources in the tidal zone, it is clearly not a comprehensive listing of all such sites. Therefore, it is important, when assessing the possible archaeological impact of oil spills, to take into account not only the known but the probable locations of sites.

While this study has identified resources with sufficient specificity for the environmental statement (that is, tract-specifically or to the nearest two to five km of coastline) (BLM "Study Design"), further activities cannot be carried out until we are in possession of more detail. Thus, in the development of the Exploration Plan, the locations of specific sites which may be impacted by the proposed exploration should be identified. Since exploration in the study area will probably be performed from floating drill rigs (Philip Thomas, personal communication), expected impact to the bottom will arise only from the drilling template, subsequent drilling, and disposition of drilling muds. The evaluation of potential archaeological impact can be accomplished by means of an appropriately applied hazards analysis. Mitigation may be assured by avoidance of any areas indicated by the survey to be highly likely to contain cultural resources. If avoidance is judged undesirable because of other factors, intensive locational surveys must be performed in order to determine the exact locations of any resources to be impacted. If no resources are discovered, then the exploration may continue. However, if resources are discovered, it should still be possible to avoid them by accurate placement of the drilling template, thus obviating the necessity for expensive site evaluation and excavation. We wish to emphasize here that even the reporting of previously unknown sites will constitute a valuable scientific contribution which may, among other things, assist in verifying the models developed in this report.

In the development of transportation-management plans, the specific locations of sites to be impacted by pipeline routings, platform placement, establishment of onshore facilities and other land-disturbing activities must be identified. This may be accomplished by a reconnaissance survey or hazards analysis, either on land or offshore, as part of early planning activities for possible pipeline corridors or offshore platforms. When more detailed planning is undertaken, an attempt should be made to avoid those locations that have a high probability for containing archaeological resources. If such avoidance is impractical, then an intensive survey must be performed in order to determine the exact locations of any resources to be impacted. If, after the intensive survey, avoidance is still judged to be impossible, the sites must then be evaluated in order to determine whether or not they are eligible for the NR.

The expected damage to cultural resources will vary according to the type of proposed activity. The construction of onshore facilities may disturb large areas and thus destroy one or more entire sites, while the excavation of a pipeline trench may only impact narrow sections of any site encountered, and the establishment of platforms will have only a limited effect on deeply buried sites, but cause considerable damage to sites on or near the surface. Table IV-9 details the impacts associated with various activities.

Resources that have been determined eligible for the NR will come under the protection of Section 106 of the National Historic Preservation Act. As discussed earlier, the vast majority of archaeological resources in the study area have not been evaluated to determine their eligibility for the NR.

An important factor in this discussion is that, as we have demonstrated elsewhere in this study, cultural resources on the CS are to be located not only horizontally (in terms of submerged and/or buried subaerial surfaces), but vertically (in terms of the depth at which they may be buried by protective sediments). Thus we must ascertain the depth at which cultural resources may be expected to occur in the impact area. For example, the laying of a pipeline by plow-trenching, which may disturb an area two m deep by six m wide (Oil and Gas Journal, May 8, 1978), may not destroy a prehistoric site located 12-15 m beneath the "surficial sand sheet." On the other hand, footings for platforms, which may go down many meters, will disturb such a site. Similarly, sites on the bottom surface may be impacted by anchor drag or many other types of superficial disturbance. We have tried here to identify the depths of expected impacts from various types of offshore activities so that appropriate survey strategies may be selected for each case. Consider the situation in which a pipeline will disturb the top two m of bottom surface in an area where predictions indicate either a sunken ship (on the bottom surface) or a prehistoric archaeological site (at a depth of 12-15 m) may be found. The desired survey strategy will be designed to locate only the wrecked ship, as the prehistoric site will not be

impacted by this particular activity.

In contrast to the foregoing discussion of negative impacts is the possibility that there may be positive benefits to cultural resources from oil and gas development. At present, the predictions about site location that we have been able to make in this report rest on an inadequate data base. Thus, even in cases where all site location procedures have been followed and no sites have been found, it will still be important to watch for unpredicted archaeological sites that may be encountered in the course of land-moving operations on the sea bottom. Since we are predicting that portions of the CS may contain exceptionally ancient Paleo-Indian sites displaying organic preservation superior to that known from any comparable sites anywhere in the world, the public relations benefits accruing to any exploration or development firm that uncovered such a site or sites could be considerable. An additional point is that a discovery of this kind might easily be made in the course of normal exploration or development activities. It cannot be emphasized too strongly that discovery of an example of Paleo-Indian site or certain other types of site would constitute an extremely significant contribution to mankind's knowledge of its past.

6.2.4.4.3 Q) What is cost-effective mitigation? - A) The socially efficient level of investment in mitigation of impacts is difficult to assess, since the value of a given cultural resource may be inestimable. An example of the way in which such a socially efficient level of investment in mitigation may be determined has been given by the BLM in its "Study Design".

> "When the planned investment in a mitigating measure reduces expected damage by an amount equal to the social rate of discount, the investment is socially efficient. For example, if commercial fishing losses due to placement of onshore and offshore OCS related structures was projected to be $10 million, then clearly the investment of $20 million to avoid this damage would not be appropriate. If an investment of $9.1 million would eliminate the projected loss, and the social discount rate is 10%, the investment would be socially efficient. It should be noted that with respect to marine and coastal ecosystems, expected dollar damages cannot be determined. Where populations or habitants are defined as having high biologic or social value, <u>it is assumed that whatever investment is necessary to reduce damage to an acceptable level of risk of interference with ecological relationships is socially efficient</u>."

Since it is equally true that the intrinsic value of archaeological sites cannot be assigned a dollar figure, we suggest that in any case where the cost of avoiding a site is less than that of Site Evaluation and 100% excavation (see Appendix B for typical field strategies) the socially efficient option is avoidance. This statement assumes, as required by the relevant federal regulations, that any site considered

for mitigation or avoidance has been judged "significant" in terms of the criteria for inclusion on the-National Register of Historic Places. A discussion of the nature of archaeological significance may be found above.

After arcaheological sites have been located through survey, and after they have been determined eligible for the NR on the basis of Site Evaluation, the level of investment in mitigating measures may be discussed. These discussions will most often result in the preparation of memoranda of agreement indicating appropriate mitigation measures. We have just considered an approach to social efficiency in mitigation planning in terms of trading off the coast of evaluation and complete excavation against project modification. In some cases, operating orders and special stipulations can be developed in order to implement the memorandum/memoranda of agreement that result from site evaluation and eligibility determination. At the same time, tract deletions may be implemented if Intensive Survey has indicated large concentrations of potentially eligible cultural resources and the cost-benefit of mitigating the impact will be less than that of avoiding the area completely, as a result of the uncertainty inherent in tract development potential.

7.0 RECOMMENDATIONS

7.1 General Recommendations

7.1.1 Philosophy behind recommendations

We think it appropriate to stipulate at the outset that there is a philosophical outlook behind the following recommendations concerning suitable action to be taken in mitigating impacts to historic or prehistoric resources located on the Continental Shelf. Stated simply, this philosophy is one based on our current state of ignorance. Since we do not really know anything substantive about the nature or distribution of sites on the CS, it would be pointless for us to adopt a hardline "preservationist" position concerning the "wise use" of these submerged cultural resources. In short, we consider that any recovery of data will leave us further ahead than we were before, and for this reason, we do not advocate the indefinite delaying or "turning off" of projects that may impact the submerged CS environment.

The recommendations set forth in this volume will be of two types. General recommendations will address assessments of any modification to existing or pending federal regulations concerning activities and each state's Coastal Zone Management Statement (the latter being in many forms, from drafts to accepted final versions). In the event that Coastal Zone Management Statements are already accepted, recommendations will be made for improving any inadequate impact-mitigation plans that may be included. If the statements are in process of preparation, measure for strengthening their archaeological input will be suggested.

Specific recommendations will deal with the various classes of impacts that were identified in Section 5.0. It should be noted that impacts treated there included those presently known to be occurring and those readily predictible for the future, but also that there are additional types of impact that may easily develop in years to come.

The point to be made here is that any activity that disturbs the undersea surface, penetrates bottom sediments, or chemically modified undersea deposits on the CS is likely to have an impact on whatever archaeological properties may lie in its path.

7.1.2 Summary of general recommendations

The following is a summary of general recommendations for the mitigation of impacts identified in various other sections of this volume.

1. States and agencies responsible for coastal zones should initiate locational surveys to locate sites undergoing or subject to coastal erosional processes.

2. States should review their coastal zone management programs with

a view toward locating those presently unknown resources that may be eligible for inclusion in the National Register.

3. Programs of public education should be initiated by states, federal agencies, and archaeologists to inform fishermen, recreational land-users, commercial land-users and private land developers of the fragility of cultural resources and the valuable contributions to science that can be made by reporting the locations of sites discovered in their day to day activities.

4. Commercial land-users and land-using agencies should integrate the location of cultural resources into their land use planning. Cooperation between resource managers and land users is the most cost effective use of the taxpayer's dollar to meet the growth and resource management needs of the nation.

7.1.3 Recommended changes to proposed regulations

The USGS has recently issued and called for comment on a set of regulations entitled 30 CFR, Part 251, "Geological and Geophysical Explorations of the Outer Continental Shelf." These proposed regulations amend those that currently govern activities on the CS and result from a policy decision by the Secretary of the Interior. In reviewing these regulations, we have some comments to offer regarding the adequacy or inadequacy of their consideration of cultural resources. What follows are detailed recommendations for dealing with those deficiencies. These comments address specific sections which are quoted herein. The full body of proposed regulation is found in Appendix F.

1) 251.3 Definitions.

(h) Permit. The contract or agreement approved for a specified period of not more than 1 year under which a person acquires the right of conduct (1) geological exploration for mineral resources, (2) geophysical exploration for mineral resources, or (3) geological and geophysical exploration for scientific research which includes the use of solid or liquid explosives or a deep stratigraphic test.

Comment on Section 251.3

It is important to note, under h) Permits, that allowance should be made for the examination by archaeologists committed to the SOPA code of ethics (see Appendix F) of results obtained from geological and geophysical exploration for mineral resources.

An additional definition should be provided for cultural resources. Such a definition should be developed by knowledgeable individuals within the federal bureaucracy in consultation with the professional archaeological community.

2) 251.4 Functions of Director.

The Director shall regulate all operations and other activities under this Part and perform all duties prescribed by this part. In order to do so effectively, the Director is authorized to issue OCS Orders and other written and oral orders and to take all other actions necessary to carry out the provisions of this part and to prevent damage to, or waste of, any natural resource or injury to life and property from any activity hereunder. The Director shall confirm oral orders in writing as soon as possible.

Comment on Section 251.4

Cultural resources should be considered as well as natural resources.

3) 251.5 Requirement of notices and permits.

(b) Geological or geophysical exploration for scientific research.
1. A person may not conduct geological and geophysical exploration for scientific research without a permit if the exploration includes the use of solid or liquid explosives or a deep stratigraphic test. Separate permits will be issued for geological exploration for scientific research and for geophysical exploration for scientific research.

2. A person may conduct geological and geophysical exploration for scientific research without a permit if the exploration does not include the use of solid or liquid explosives or a deep stratigraphic test. However, the person must file with the Director a notice of intent to conduct exploration which does not involve such explosives or a deep stratigraphic test at least 30 days prior to commencing the exploration. Shallow test drilling may not be conducted if within 21 days of the filing of the notice the Director rejects the notice by sending a statement of rejection by certified mail to the person who filed the notice. A statement of rejection may suggest changes in the notice which, if filed again, may render the notice acceptable to the Director.

Comment on Section 251.5(b) 1 and Section 251.5(b) 2.

(b)1. Permits for scientific research should include survey activities designed to locate, identify, and recover data from cultural resources.

(b)2. Shallow test drilling may be especially useful for cultural-resource identification.

4) 251.8 General conditions of notices and permits

(b) General restrictions on operations. Exploration authorized under this part shall be conducted so that operations do not:

6. Disturb cultural resources, including sites, structures, or objects of historical or archaeological-significance.

(c) Report of hydrocarbon shows, hydrocarbon discoveries, or adverse effects. Any person conducting exploration under this part shall immediately report to the Director any hydrocarbon shows, possible hydrocarbon discoveries, or any adverse effects of the exploration on the environment, aquatic life, cultural resources, or uses of the area in which the exploration is conducted.

Comment on Section 251.8

(b)6. It is not clear how cultural resources will be identified, although disturbance of such resources may be important to the scientific community. It should be recognized that planning for impact avoidance requires close cooperation between land users and cultural resource managers.

(c) There seems to be no mechanism for reporting potential adverse impacts to cultural resources.

5) 251.9 Test drilling under notices and permits.

General comment: With the proper cooperation between land users and cultural resource managers, shallow test drilling can lead to the identification of cultural resource potential. The drilling plan should specify the means that will be used to identify and assess impacts to cultural resources. It should also address the question of possible impacts to cultural resources resulting from oil spills or other natural or man-made accidents.

6) 251.9 Test drilling under notices and permits

(v) High resolution geophysical data, processed geophysical information, and interpreted geophysical information from, but not limited to, bathymetric, side-scan sonar, and magnetometer systems collected across any proposed drilling location so as to permit determination of shallow structural detail in the vicinity of the proposed test, and for stratigraphic tests proposed to depths greater than 1,000 feet (304.8 meters) below the mudline, common depth point seismic data from the area of the proposed test location, and processed geophysical information and interpreted geophysical information therefrom.

Comments on Section 251.9

(v) It is imperitive to note that if explorers and cultural-resource managers cooperate, they can use the techniques described in this section to locate and assess important cultural resources, thus assisting in their protection. These data will be important inputs to the Environmental Reports (VI) in its assessment of the "significant environmental consequences of the proposed activities" as they

relate to cultural resources.

7) 251.9 Test drilling under notices and permits

(vi) An Environmental Report. At the same time the permittee submits a proposed plan to the Director, he shall submit an Environmental Report. The report shall address all activities included in the proposed plan and shall identify all environmental and safety features required by law, together with such additional measures as the permittee proposes to employ. The report shall be as detailed as necessary to enable identification and evaluation of the significant environmental consequences of the proposed activities and shall include all information available to the permittee at the time of submission. The Environmental Report shall include data and information obtained or developed by the permittee, together with other sources. The permittee shall cross-reference information in the most recent applicable environmental documents and shall summarize pertinent information contained in other published, accredited reports. The report shall clearly identify the source of all data and information contained therein. The Environmental Report may be tiered to other environmental documents or Environmental Reports for the same or adjacent areas. Specific guidelines for implementing this section will be issued by the Director. The Environmental Report shall contain the following sections:

(A) Description of the Proposed Action. This section shall briefly summarize the nature and scope of the proposed action contained in the proposed plan. This section shall include, but not be limited to, the following: Company and operator name, objective of the proposed action, a description and location of vessels or platforms, and time frames for completion of various functions. In describing the proposed action, the report will also include a discussion of equipment, a discussion of oil spill contingency plans, statements of certification of consistency with appropriate coastal zone management programs when applicable, a comprehensive list of new or unusual technologies to be used, a detailed description of these technologies, the location of travel routes for supplies and personnel, the kinds and approximate quantities of energy to be used, and the environmental monitoring systems proposed for use by the permittee. The proposed action section will also include suitable maps and diagrams showing details of the proposed project layout.

(B) Description of existing environment. This section is to contain a narrative description of the existing environment, and emphasis shall be placed on those environmental values that may be affected by the proposed action. This section shall include, but not be limited to, discussion of the following: Geology, physical oceanography, other uses of the area, flora and fauna, cultural resources, socioeconomics, and existing environmental monitoring systems, other unusual or unique characteristics which may be affected by the drilling.

(C) Impact evaluation and mitigating measures. This section shall contain a narrative description or tabulation of the probable impacts of the proposed action on the environment and existing mitigating measures, as well as measures which have been proposed in the plan, to mitigate the impacts.

(D) Alternatives to the proposed action. This section shall discuss all relevant alternatives to the proposed action or major segments of the proposed action which would result in less risk of adverse environmental impacts.

(E) Unavoidable adverse environmental effects of the proposed action. Any unavoidable or irreversible adverse environmental effects that could occur as a result of the proposed action shall be summarized in this section.

The permittee shall, when required, submit an appropriate number of copies of each Environmental Report to permit the Director to transmit a copy to the Governor and Coastal Zone Management Agency of each affected State and to the United States Office of Coastal Zone Management. This director shall transmit such copies at the same time he transmits copies of the applicable plan. The Director shall also make copies of the Environmental Report available to the public, in accordance with the Freedom of Information Act.

Comments on Section 251.9 (vi)

There does not seem to be enough detailed description of the way cultural resources are assessed and evaluated in the specifications for the contents of this report (including the NEPA Guidelines of the recently revised 36 CFR 800.

8) 251.9

(d) Cultural resources. Any person who holds a permit authorizing a deep stratigraphic test shall, if requested by the Director, conduct studies sufficient to determine the possible existence of any cultural resources, including sites, structures, or objects of historical or archaeological significant (sic) that may be affected by such drilling, and shall report the findings of the studies to the Director. Any person who holds a permit authorizing shallow test drilling or who has filed a notice for shallow test drilling may be required to conduct such studies at the discretion of the Director. If any study indicates the possible presence of a cultural resource, a full explanation will be included in the report. The person shall take no action that may result in the disturbance of cultural resources without the prior approval of the Director, and if any cultural resource is discovered during a test, the person shall immediately report the finding to the Director and make every reasonable effort to preserve and protect the cultural resource from damage until the Director has given directions as to its preservation.

Comment on Section 251.9 (d)

The discussion of cultural resources in this section is adequate as far as it goes, but there are other types of testing besides deep or shallow stratigraphic testing that will reveal the presence of cultural resources, and the results of these other types of tests should be reported to the Director. Examples are sub-bottom profiling, side-scan sonar, magnetometry, and a host of others discussed in this volume.

7.2 Recommended Changes To Present Methods Of Cultural-Resources Evaluation Associated With Oil And Gas Development

In assessing present cultural-resource-evaluation practices as they relate to impacts of oil and gas exploration on cultural resources, we have asked Mr. Joe Guarino of H. O. Mohr and Associates Inc., Houston, Texas, to identify the methods of cultural resource assessment now used by firms engaged in leasing for oil and gas exploration and/or production in the Gulf of Mexico. The adequacy or inadequacy of these practices may in turn constitute a guideline for procedures to be undertaken in the North and Mid-Atlantic study area.

7.2.1 Pipeline routing and survey, coastal zone to shoreline

7.2.1.1 Present practices - The onshore pre-lay archaeological survey consists of a library search and walkover. If marsh or swamp is encountered, helicopter flyover is substituted for walkover.

7.2.1.2 Recommended practice - The above procedure is clearly inadequate to locate all of the resources that may be impacted in the course of pipeline construction. Library research identifies only sites that are well known and/or obvious, while a walkover identifies only surface manifestations of previously unknown sites, although it also makes it possible to assess any previous disturbance that may have destroyed whatever sites were present. We recommend that if a pipeline corridor is in the final evaluation stage, Intensive (land) archaeological survey be instituted (Appendix B). Swamp or marsh sites (as distinct from submerged ocean sites) should be treated differently. Library search is just as inadequate to locate previously unknown marsh sites as in the terrestrial case described above, while a helicopter flyover offers little possibility of locating historic or prehistoric sites buried in the marsh or swamp environment. Arnold (1979) has described a procedure of helicopter-borne magnetometer exploration and R. Anuskiewicz of the U.S. Army Corps of Engineers (personal communication) has been testing methods of coring in shallow-water situations. Intensive survey (nearshore) should be instituted in this case (Appendix B).

7.2.2 Pipeline routing from the shoreline to the 10-foot water depth

7.2.2.1 Present practices - According to Mr. Guarino of H. O. Mohr and Associates, this zone receives the least adequate cultural-resource survey of any potential study area. This is partially due to the fact that most vessels designed for pipeline survey draw too much water to operate in depths less than 10 ft. Small boats could handle a small magnetometer, however, although it would be difficult to take cores and virtually impossible to use the side-scan sonar and sub-bottom profiler. In present practices, these areas are not surveyed at all, and only a library search is performed. As we have said in other parts of this report, the area inside the present five-fathom (30-ft) mark is that with the greatest potential for containing the remains of historic shipping, and is also the area where a large fraction of prehistoric and Contact Period (when European explorers made contact with native peoples) sites may be found (see Figs. IV-11 to IV-20). It is unfortunate that this particular zone should be the one to be skimped by current procedures.

7.2.2.2 Recommended practice - Once the right-of-way has been established in detail, it will be important to locate any sites that lie within its corridor at this depth. The recommended locational strategies will be found in Appendix B of this report. These may be used as a basis for the appropriate federal agencies to generate regulations.

7.2.3 <u>Pipeline routing from the 10-foot to 600-foot depth</u>

Present practices - Information is taken and recorded by side-scan sonar, sub-bottom profiling, magnetometer, and core samples, and the raw data given to archaeologists. This present practice is, to put it bluntly, inadequate for cultural-resource identification.

One major problem is that few if any marine archaeologists have the training that is required for competent interpretation of raw data from side-scan sonar or sub-bottom profiling. What usually happens in practice is that the archaeologist on the project is given only the raw seismic data to work with and never sees the reduced, mapped out data produced later by the project geophysicist. It would be much more productive and cost-efficient if site-locational information were derived from the reduced data, either by geophysicists who have been briefed on what to look for, or by marine archaeologists with access to the reduced data. It must be remembered, however, that the reduced seismic data will serve only to give an idea of where sites may be, and cannot be considered a tool for pinpointing actual site locations. In some cases wreck marks which are bottom scour and sand ridges, that result from bottom sediment transport around wrecks and are distinctive in shape with respect to wreck orientation and bottom condition are identifiable on side-scan data and can be used to pinpoint the locations of possible wrecks. These areas should be subjected to intensive magnetometer scan for confirmation of wreck location.

Since the lessor is sometimes the party who perform these kinds of surveys (except in the case of hazards analysis) and since the data are

often capable of a number of interpretations, some more favorable to the lessor than others, the reduced data and their accompanying operating logs should form a part of any submittals of documentation associated with the Transportation Management Plan and the Development and Production Plan. In this way, qualified agency personnel may review the information upon which conclusions about the presence or absence of potential sites are based.

A second difficulty with present practice in pipeline routing at these depths lies with magnetometer survey. We will document (Appendix B) the inadequacy of this type of instrumentation to locate the remains of most early shipping because these contain less ferrous metal than is required to produce a detectable magnetic anomaly unless the survey vessel happens to pass very close to them. Thus it is precisely those wrecks that are potentially the most interesting, namely the earliest, that are likely to be missed by the standard magnetometer search. Magnetic anomalies usually show up as point sources. Since magnetometry results are customarily analyzed for other purposes by the project geophysicist, and since it is relatively simple to route pipelines around such sources without further investigation, there seems little reason to bring in an archaeologist at all in the preliminary stage of survey. The project geophysicist, or even the magnetometer technician, can simply note the locations of anomalies without attempting to determine whether they result from sunken shipping or other causes.

This study has defined, as accurately as possible, given the current state of the data base, those portions of the study area where prehistoric and/or historic cultural resources may be expected to occur. It is therefore unnecessary to engage in future work until the proposed locations of offshore facilities are more accurately known. The prelay survey or hazard analysis will ordinarily provide the information required for a reconnaissance archaeological survey. If, after such surveys, locations of proposed offshore facilities are found to lie in zones of high archaeological probability, that is the time to institute intensive survey procedures, detailed recommendations for which will be found in the section on field strategies (Appendix B).

7.2.4 Offshore platforms

7.2.4.1 Present practices - Survey performed before installation of offshore platforms usually uses the same complement of instruments as that described above under Pipeline Survey (7.2.3), and is just as adequate. The only necessary data that are not available before installation are the results of deep stability coring.

7.2.4.2 Recommended practice - We recommend the same procedures as those described above under Pipelines (7.2.3), with the reminder that platform installation generally disturbs bottom sediments right down to bedrock, so that any sites beneath a platform are sure to suffer some impact, no matter what their depth.

7.2.5 Recommended additions or changes to present underwater archaeological practices

While Appendix B describes the current state of the art in archaeological methodology we feel it important to discuss some of the expected advances in this area and to recommend changes to current practice as appropriate.

7.2.5.1 Reconnaissance or, preliminary survey (offshore) - Presently of major importance to reconnaissance survey in offshore areas are three types of instrumentation. Of these, the sub-bottom profiler and the side-scan sonar may be treated together. The two patterns presently in use with these instruments are generally adequate, and in the case of the profiler, no important technical innovations seem imminent. New developments are constantly taking place, however, and there are two advances in side-scan sonar that may have an effect on archaeological survey. One is the SMS 960 system of EG&G, which has the capacity to convert the standard raw data into an aerial-view "map" of the bottom without any processing delay. (In computer terms, the conversion is performed in real time.) Onboard preliminary analysis is thus made possible, so that the survey procedure becomes much more flexible and responsive. For example, interesting bottom features may be investigated more thoroughly on the spot and it would seldom be necessary to come back another day for an expensive second look that seemed indicated after data reduction. In another development, Klein Associates has this year (1979) come out with a side-scan system whose pulse repetition rate is 500 kHz rather than the standard 100. This increase in frequency will provide significantly better resolution of objects on the bottom than is now possible. Fig. IV-48 illustrates the difference. Note that because they are so new, these two improvements have not yet been integrated with each other, but it is hoped that they may be combined in the future.

On the subject of magnetometry, we demonstrate in Appendix B the inadequacy of this technique, as presently used, for locating remains of early shipping. This results directly from the fact that standard tow paths are too far apart for the magnetometer to pick up other than very large anomalies if these happen to lie halfway between the paths. Using the example sited in Appendix B, a seventeenth-century cannon could only be discovered if the magnetometer were within 36 ft of it, whereas the instrument may be as far away as 225 ft in a standard tow pattern. Accordingly, an adequate distance between tow paths for magnetometry would appear to be more like 100 ft than the standard 450 ft. There are several approaches to this problem. One is to have the magnetometry performed from a separate vessel, which has the added advantage that the vessel may be smaller and made of nonferrous material, thus making it possible to reduce the minimum detectable anomaly from five to three gammas. Alternatively, more than one magnetometer might be streamed from a single survey vessel, one in central position and another on each side. This three-instrument array could be accomplished by means of either paravanes (100 ft on either side of the vessel) or of steerable magnetometer fish at a similar distance.

Fig. IV-48
Comparison of resolution of side-scan systems between 500 kHz and 100 kHz.

A final element in the survey is the taking of cores from the bottom for the purpose of verifying the existence of any preserved subaerial surfaces delineated by the electronic survey.

7.2.5.2 Intensive survey (offshore) - For offshore work, we believe that the most cost-effective approach to intensive survey is the use of mechanized coring for the extraction of samples of subsurface sediments that may contain the cultural materials necessary to identify a site. Any coring program whose goal is to locate a site should be performed within a statistically valid sampling strategy. The analysis of these cores must be done by an archaeologist familiar with the kinds of cultural materials associated with either prehistoric or historic sites.

A remote-controlled vehicle (RVC) carrying closed-circuit video should be used to examine the bottom surface and should be monitored and guided by a qualified archaeologist who can identify the materials observed or, if necessary, direct the RCV toward areas of particular interest. When there is a question of locating sunken shipping, the RCV should be equipped with a gradiometer, so that the gradiometer readings may be used to direct the RCV to the location of the anomaly. Once located, the anomaly may be examined by an excavating mechanism such as an air lift. In our estimation, this procedure will be significantly less expensive than using two or more human divers for visual inspection of the bottom surface. A further point is that this phase of intensive survey can be accomplished with the same equipment and at the same time as pre-construction survey.

It should be noted that technologies are constantly evolving, and the recommendations we have made here may be made obsolete at any time by developments that either reduce the expense or improve the quality of bottom-inspection techniques.

7.2.5.3 Data recovery (underwater) - The techniques described in Appendix B reflect the current state-of-the-art as it applies to data recovery. However, with the testing of new techniques and procedures, we anticipate tremendous advances in data recovery procedures. One expected innovation is in the more accurate and rapid recording of three-dimensional (x, y, z) coordinates of underwater objects. One system, described in Appendix B, is that of Mazel and Smith (1979), in which three tapes are used to define the position of an object in relation to a grid. A second method is in the early development stage and consists of very short-range three-dimensional sonar positioning system which can be integrated into computer graphics systems to produce a three-dimensional representation of an object or the relative positions of several objects.

It has previously been standard practice that data recovery under deepwater saturation diving conditions is carried out by commercial divers who are observed by archaeologists in a submersible. However, saturation diving training is now available, and we believe it will be much more cost-effective to have this work carried out in future by the archaeologists themselves.

7.3 Recommended Materials Conservation Strategies

Because necessary resources are not always available, laboratories staffed by untrained or inexperienced "conservators" may be all that is available for potentially important artifacts. At present, even the existing laboratories are operating with few if any qualified staff members, on limited budgets.

The creation of many small conservation laboratories dissipates available personnel and resources. Erratically-funded laboratories have trouble keeping good personnel who may move to jobs outside either this specific field or a given geographical area. When a good conservator has become familiar with a region's artifacts, specific conservation problems, archaeologists, museum staffs, and helpful scientific laboratories, he/she is a great asset, not only to that conservation center but also to the area's archaeology and museums. If funds are temporarily not available, or one center closes while another opens in a neighboring state, the staff is often lost. Thus conservation suffers a loss which takes a great deal of time, effort, and funding to recover. In addition, the first artifacts from new sites are typically lost due to unavailability of qualified conservation personnel and proper equipment.

The establishment of regional conservation centers for waterlogged artifacts in the U.S. would make it possible for objects from any site to receive the best possible treatment at a reasonable level of funding. There is a drastic difference in necessary funding per artifact treatment between that conducted at an ongoing special conservation laboratory and that conducted at a general conservation laboratory which must handle a waterlogged artifact. A solitary waterlogged artifact, treated at the Smithsonian Institute conservation-analytical laboratory, which needed to prepare especially for it alone, cost approximately $6,000 to conserve (Orgon, personal communication). The central conservation laboratory of Parks Canada, Ottawa, Canada, which constantly deals with many waterlogged artifacts, estimated conservation costs of $40 to $60 per artifact in 1978 (Miback, personal communication).

In addition, a stable regional center would provide information and advice for the region. A stable staff of at least one professional conservator and one technician would be most cost efficient. The conservator would become familiar with waterlogged artifacts and their problems, and with the region as well as area archaeologists, museums, helpful scientists in universities and industry, and the center's staff and physical capabilities.

The existence of a few permanent, or long-term, regional centers would allow these centers to not only have necessary laboratory equipment, but also to be a clearing house, or lender, of necessary field conservation equipment. The latter would obviate the present need for purchasing separate field conservation equipment for each archaeological excavation.

Well-equipped centers would be ideal locations for practical training

of newly educated conservation students. These centers could also serve as research laboratories for in-house conservators, who wish to investigate conservation problems or theories.

These facilities would quickly become regional centers of knowledge with which museums and archaeologists could communicate to answer questions which often must be dealt with quickly, before an artifact is lost. Correct, realistic estimates of funding for the conservation of a group of artifacts could be derived while an archaeologist was planning an excavation or a museum considering the acquisition of a collection.

A second step in promoting a more organized policy toward conservation, would be the encouragement of conferences or seminars at national and international general conservation meetings, on the conservation of waterlogged artifacts. Stimulating private, academic, and government (local, state, and federal) conservators to develop their methodology, with the aid of regular intercommunication, would be a notable service for the preservation of cultural material in this country.

Meetings would promote cooperation and dissemination of ideas and information on the quality and limitations of present methods, newly developed techniques, and techniques used by other conservators which might be applicable to waterlogged artifacts. Informal cooperation with museums and archaeologists, including advice on the care of artifacts before and after their treatment at conservation centers, might also develop.

It is suggested that a federal agency establish a committee to provide guidelines for setting up regional conservation centers to meet the needs of archaeologists who recover waterlogged materials. The members of this committee should be conservators and conservation scientists who are actively involved in the conservation of waterlogged artifacts. Suggested general qualifications for serving on the committee are either an appropriate degree in conservation (MS, MA, or BA) and more than one year's active experience in the conservation of waterlogged materials or simply 10 years' experience in the conservation of waterlogged archaeological materials. The committee would consist of six persons; two would rotate off the committee each year, and new members would be chosen at random from the pool of qualified applicants.

7.4 Recommended Survey Strategies In Designated Cultural Resource Zones

Using the information from earlier sections on the location of historic shipping (Section 4.2.1) and preserved archaeology (Section 4.2.2), it is possible to identify zones of combined expected cultural resources. For the purpose of this report these zones will be called Cultural Resource Zones (CRZ). Figs. IV-49 through IV-57 locate the various

zones, while Table IV-10 describes the location, composition, and recommended preliminary survey strategy for locating resouces or more accurately defining zones of potential.

The tables illustrate the fact that survey procedures for lost shipping and preserved prehistoric resources will differ but survey strategies can be devised that maximize the probability of encountering both classes of sites. In general, the strategies can be related to the expectations for resource existence. Thus, in depths shallower than five fathoms where we expect to find the majority of lost shipping from before 1880 (generally wooden ships with metal fixtures), a magnetometer survey as recommended in Section 7.2.5 should be required in all cases. In areas deeper than five fathoms, intensive magnetometer survey should only be performed once the location of facilities is in the planning stage. Survey recommendations for prehistoric sites are based on the expected depth and degree of preservation of these resources. The section on preserved archaeology describes the various zones of preservation for these resources. As a general rule for the recommendations in Table IV-10 , the following criteria have been established: 1) In areas of negligible preservation (5% maximum) the monitoring of land disturbance appears to be the most appropriate form of locating resources that may be encountered by a given project. 2) In areas of partial preservation (40% maximum) we can expect prehistoric resources to be reasonably close to the sea floor and thus any type of project may possibly disturb them. In this area we recommend thorough study of the data derived from a Hazards Analysis aimed at locating lagoonal soils, gassy sediments, buried river channels or other indicators of possible site location. Intensive (Appendix B) survey should be performed if proposed bottom disturbance will impact these areas. Monitoring of construction is appropriate when construction will not directly impact these areas. 3) In areas of considerable preservation (75% average) sites will tend to be deeply buried. Thus sub-bottom profiles must be taken to determine the actual depth of expected preserved surfaces. Once this depth is determined, the proposed impact of a specific project can be assessed. Intensive survey should only be required when expected preserved surfaces will be disturbed. A pipeline, for example, will not disturb surfaces ten meters below the ocean floor while the installation of a platform will. In this case intensive survey will be recommended for only the platform construction.

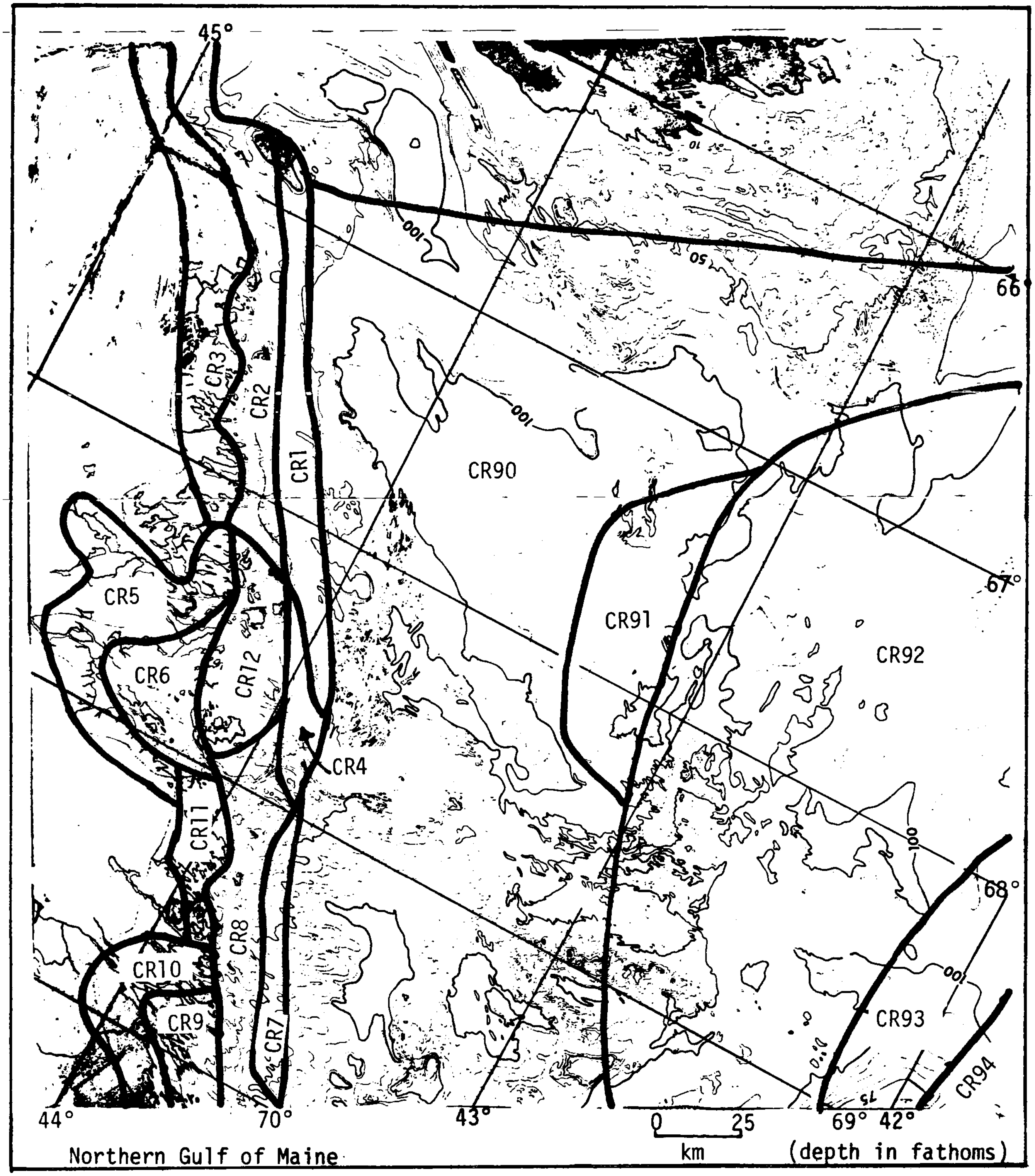

Fig. IV-49: Cultural Resource Zones.

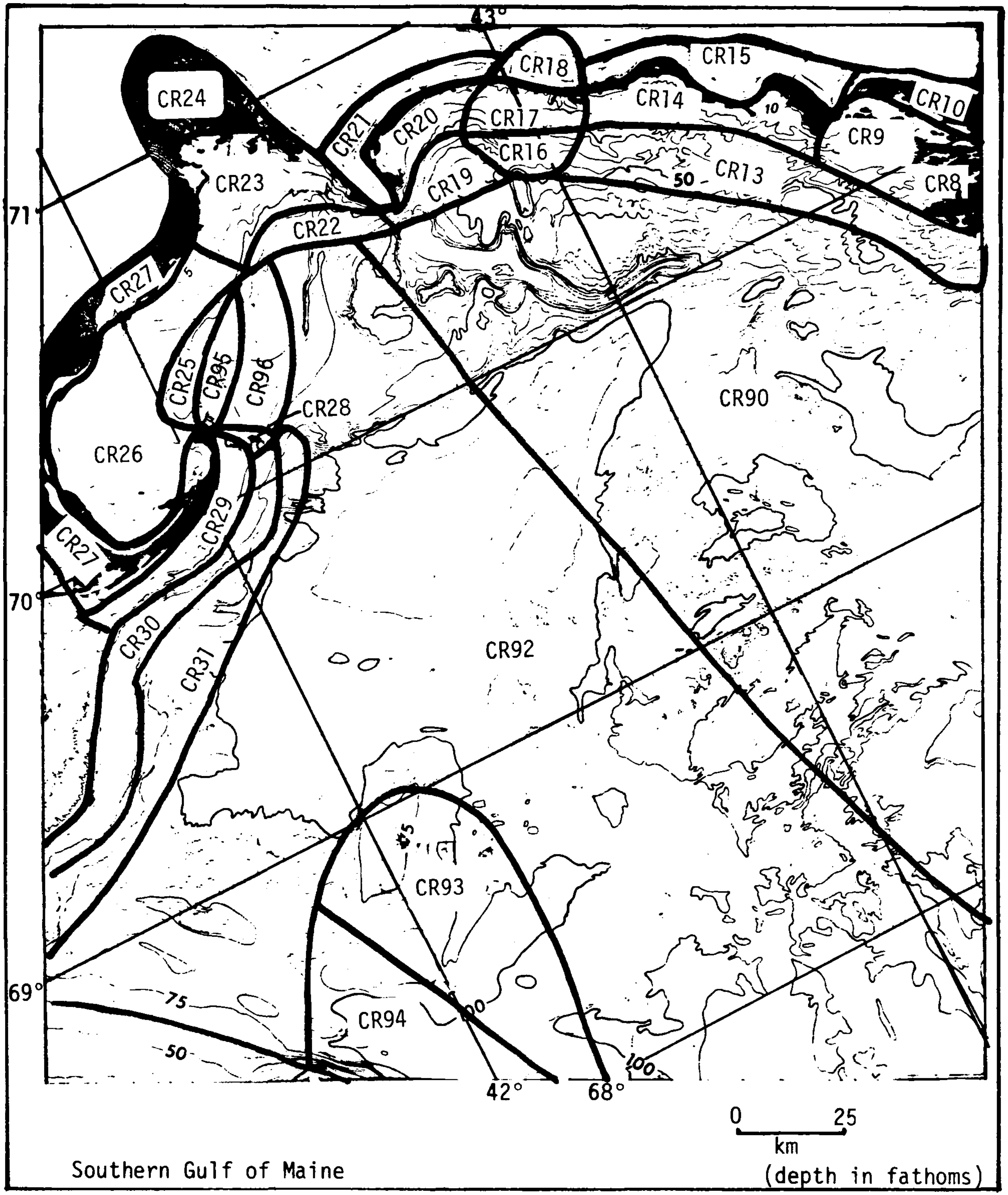

Fig. IV-50: Cultural Resource Zones.

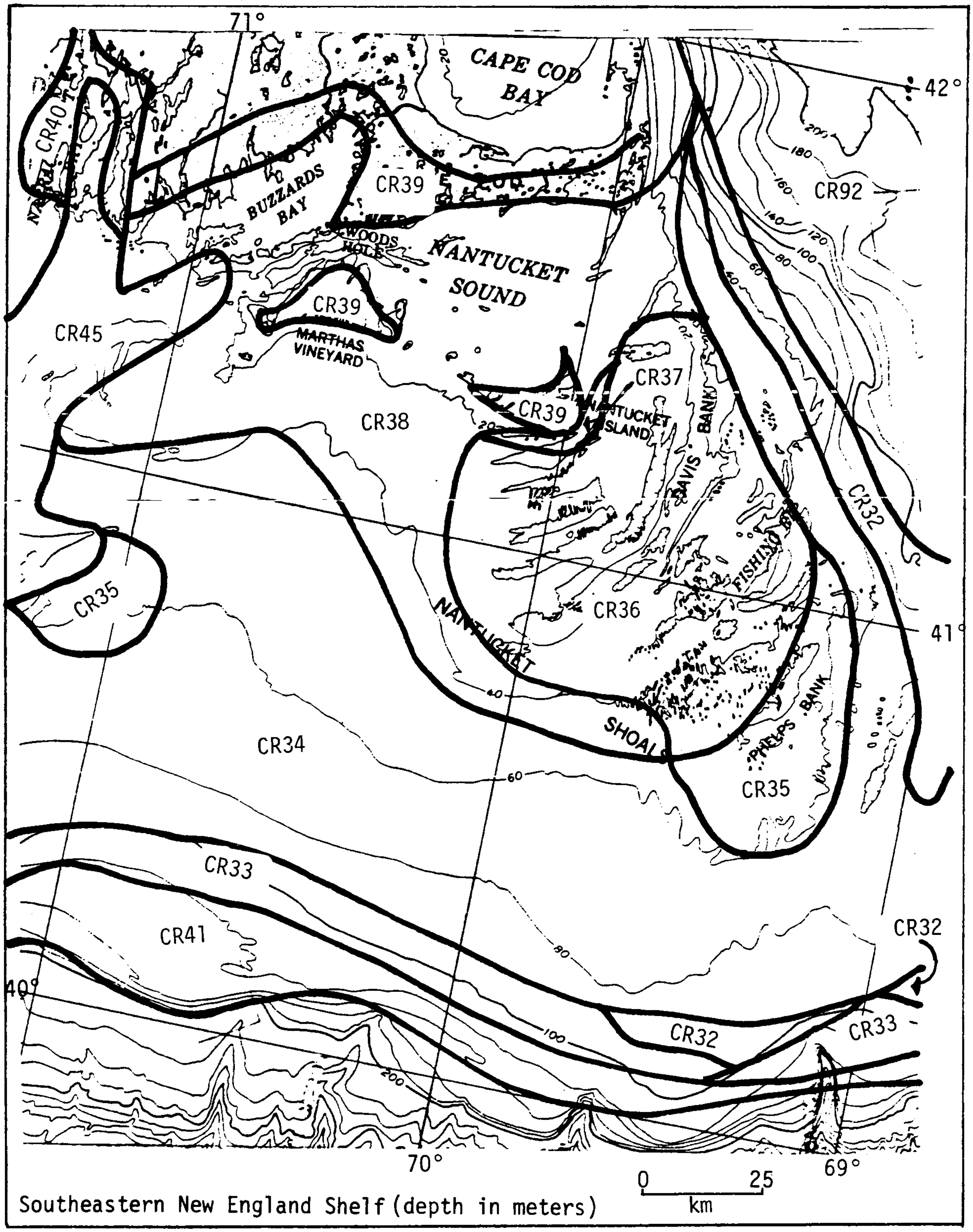

Fig. IV-51: Cultural Resource Zones.

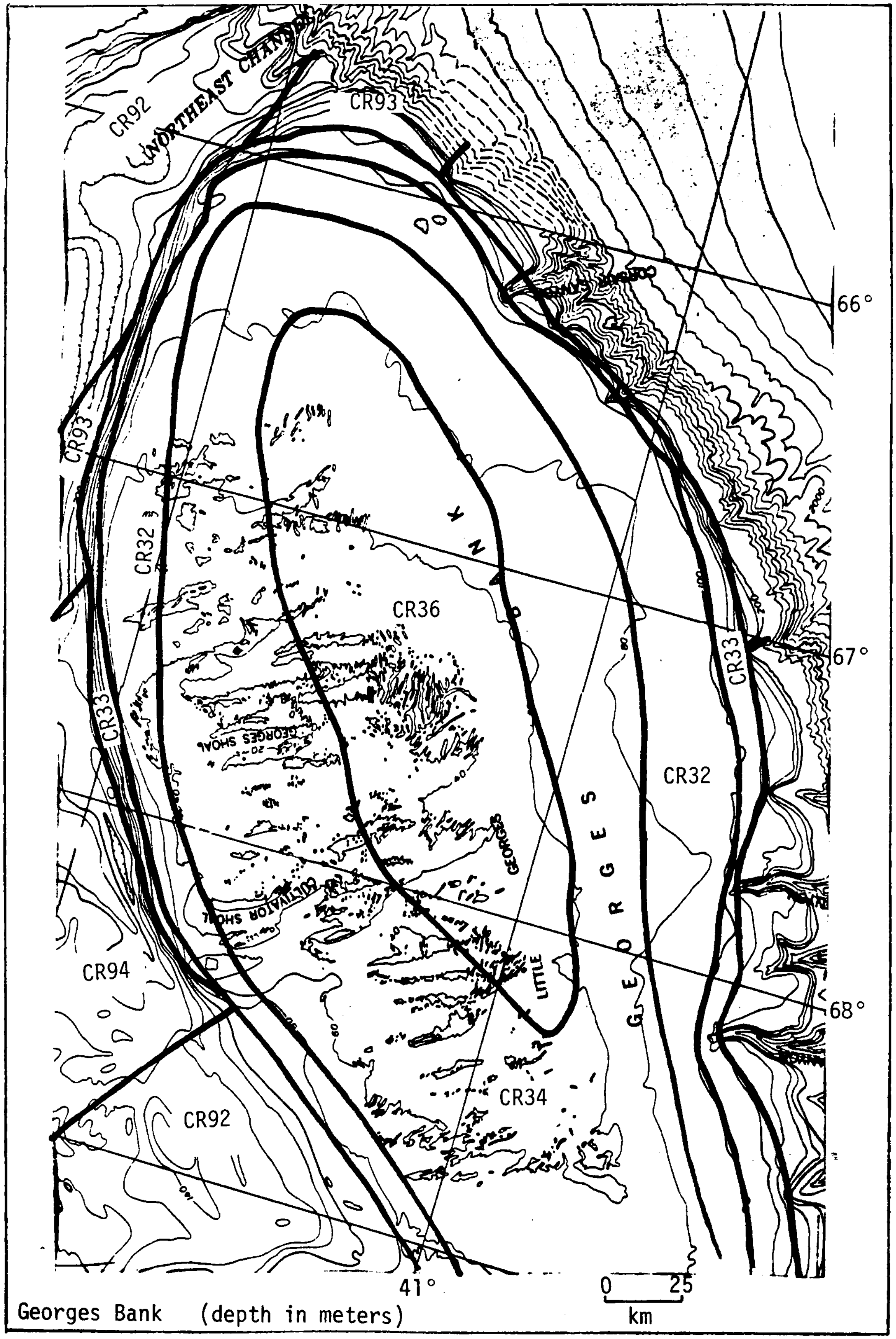

Fig. IV-52: Cultural Resource Zones.

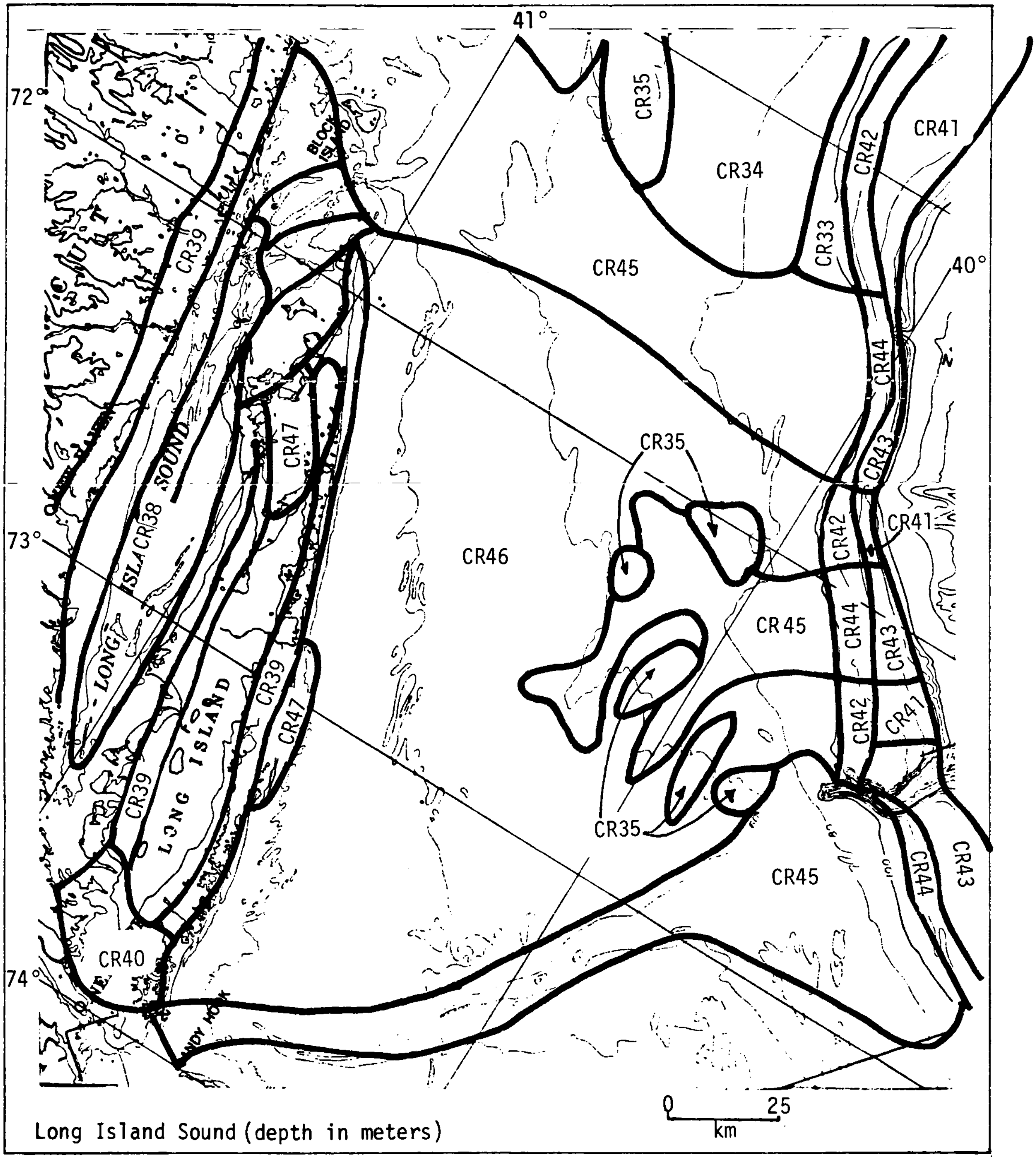

Fig. IV-53 Cultural Resource Zones.

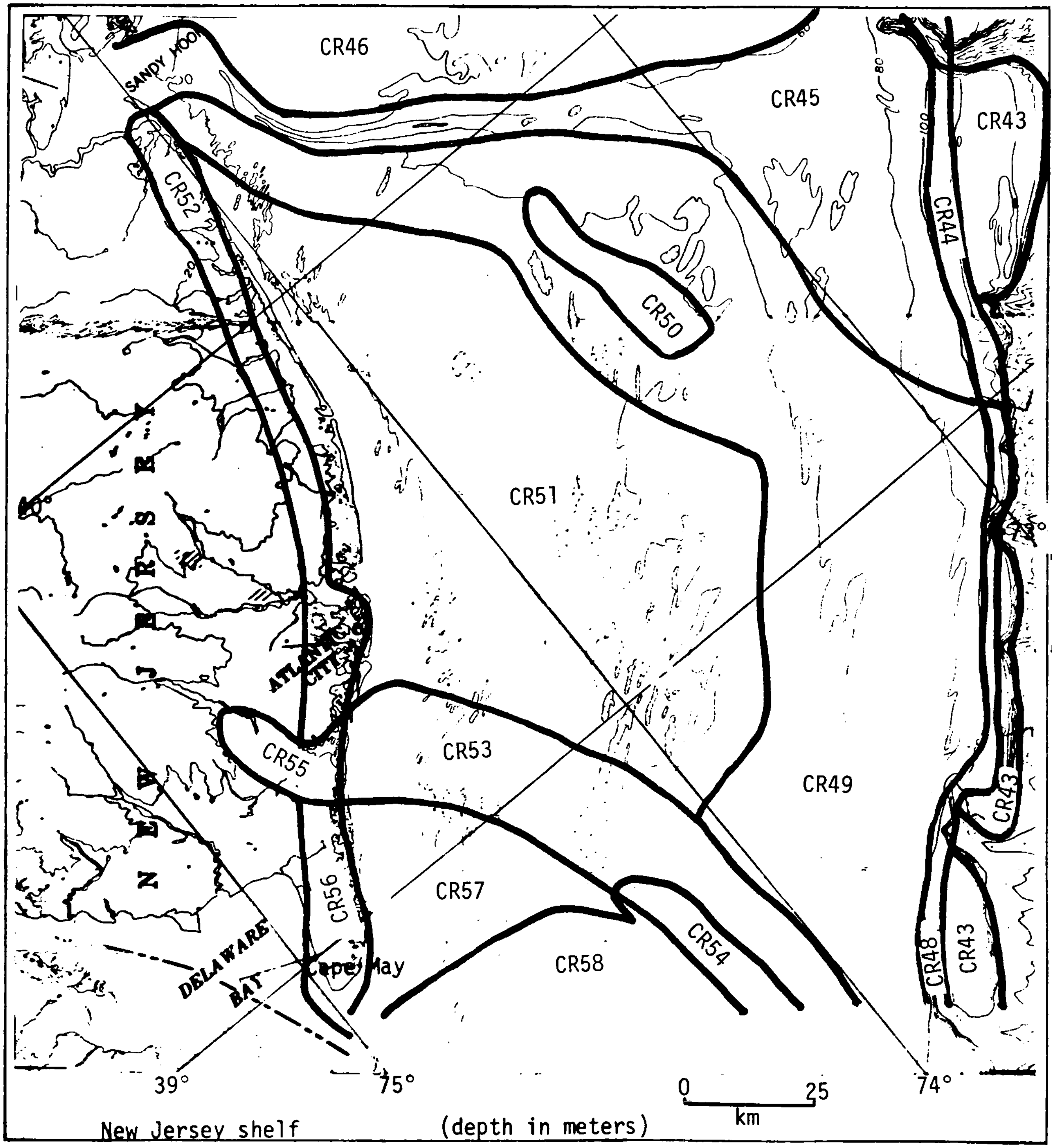

Fig. IV-54: Cultural Resource Zones.

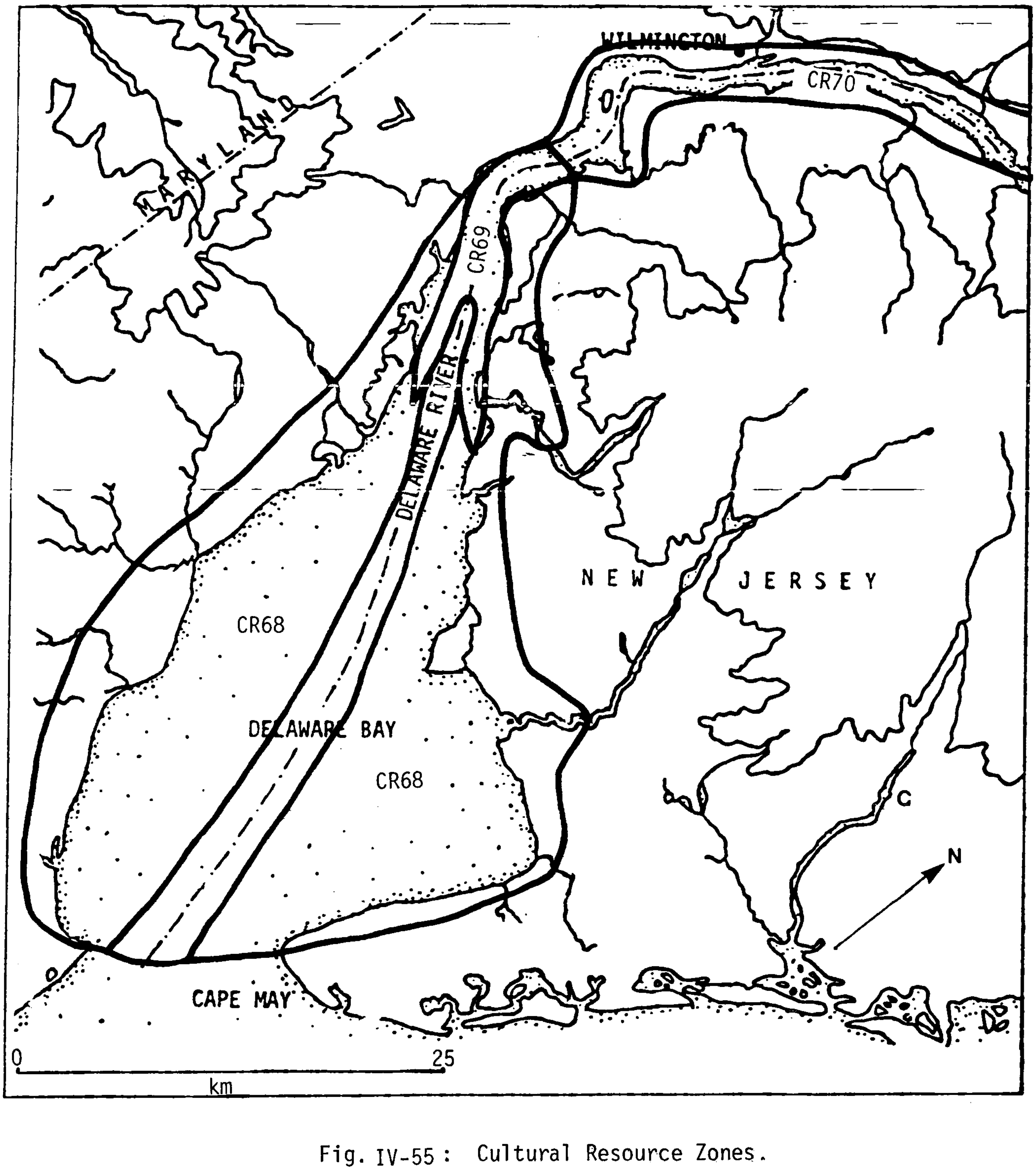

Fig. IV-55 : Cultural Resource Zones.

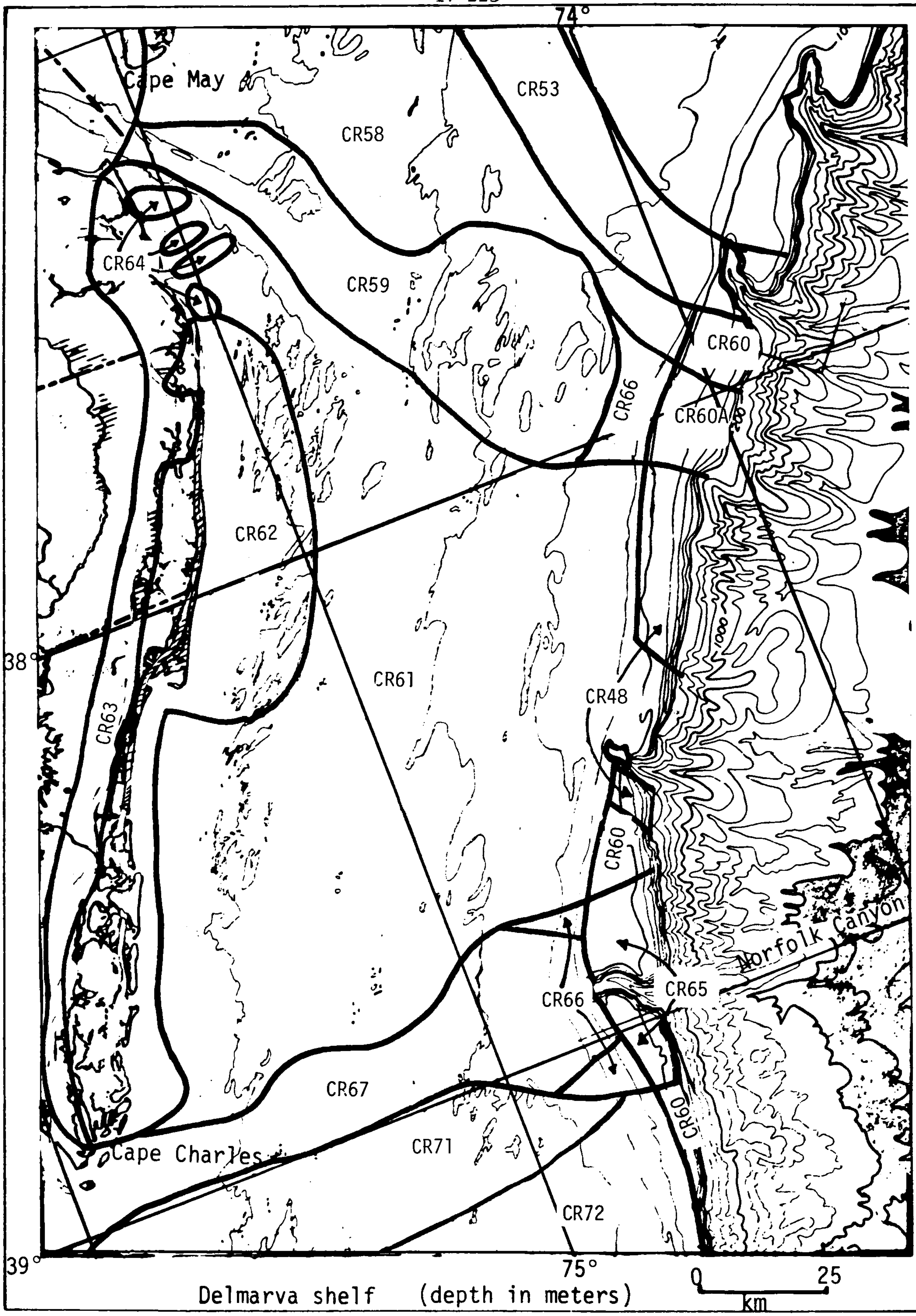

Fig. IV-56: Cultural Resource Zones.

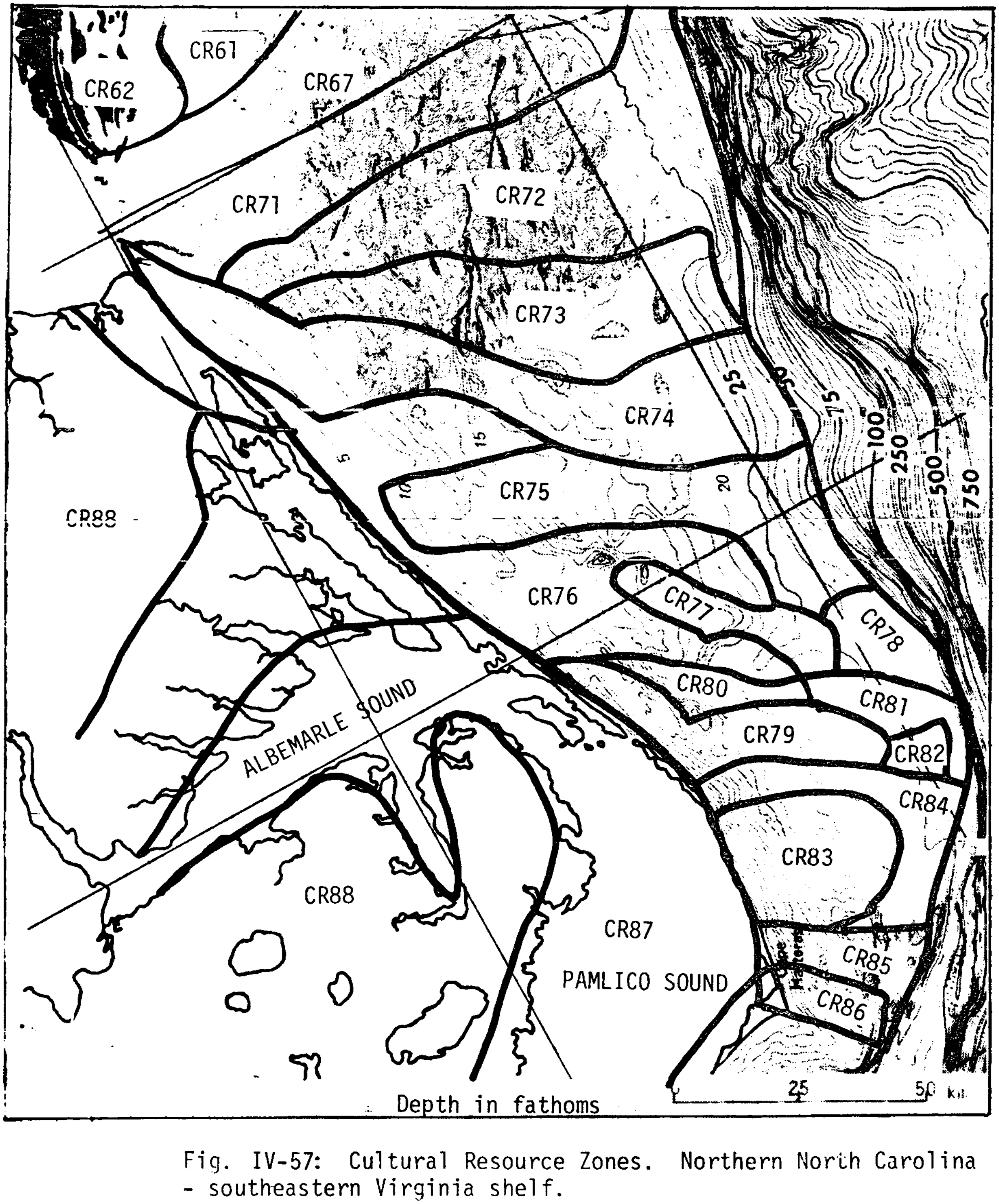

Fig. IV-57: Cultural Resource Zones. Northern North Carolina - southeastern Virginia shelf.

Note to Table IV-10

1) In this table the composite results of the entire study are presented. The identification of Cultural Resource Zones and the recommended survey strategy are the results of careful consideration of the data found in Section 4.0 (Location of Resources). For each Cultural Resource (CR) Zone we have identified the Historic Shipping (HS) Zone and Preserved Archaeology (PA) Zone to be encountered. In many cases several Historic Shipping Zones exist in a single Cultural Resource Zone. This is due to the similar nature of those Historic Shipping Zones in terms of recommended survey strategy. In those cases where predicted density of shipping in a given Historic Shipping Zone may be less than that in another Historic Shipping Zone of the same Cultural Resource Zone, we have recommended the more intensive survey strategy for all zones due to the uncertainty inherent in our models.

2) The following is a summary of features which, when located in an offshore reconnaissance survey, indicate cultural resource potential and should lead to intensive survey or avoidance.

A. Lagoonal sediments
B. Buried river/stream channels (and areas just outside)
C. Gassey sediments
D. Exposed surface with limited scour
E. Identifiable buried subareal surfaces
F. Magnetic anomalies
G. Wreck marks
H. Obvious surface features such as wrecks

The results of recommended pilot studies may modify or eliminate some of these criteria.

Table IV-10: Recommended survey strategies in Cultural Resource Zones.

C.R. Zone	Description	Contains HS	Contains PA	Reconnaissance Survey: On-shore	Reconnaissance Survey: Near-shore	Reconnaissance Survey: Hazards Anal.	Reconnaissance Survey: Notes	Intensive Survey: On-shore	Intensive Survey: Near-shore	Intensive Survey: Off-shore	Intensive Survey: Notes
1	Maine full coastal sequence; St. Croix River to Penobscot Bay; coastline 12,000-9000 B.P.	4	1			X				X	-Magnetometer survey in area of impact. -Only if reconnaissance indicates need for further work.
2	Maine full coastal sequence; St. Croix to Penobscot Bay; coastline 9000-6000 B.P.	1 4	2		 X	X			X	X	-Magnetometer survey in area of impact. -Only if reconnaissance indicates need for further work.
3	Maine full coastal sequence; St. Croix to Penobscot Bay; coastline 6000 B.P. to present shore area.	1	3	X	X			X	X		-Magnetometer survey in area of impact. -Only if reconnaissance indicates need for further work.
4	Maine full coastal sequence; in front of Penobscot Bay; coastline 12,000-9000 B.P.	4	4			X				X	-Magnetometer survey in area of impact. -Only if reconnaissance indicates need for further work.
5	Maine estuarine sequence; around Penobscot Bay; present shore area.	1	5	X				X			
6	Maine estuarine sequence; offshore Penobscot Bay; coastline 6000 to modern coastline.	1	6		X				X		-Magnetometer survey in area of impact. -Only if reconnaissance indicates need for further work.

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	Contains PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
7	Maine full coastal sequence; Penobscot to Casco Bay; coastline 9000-6000 B.P.	4	7			X				X	-Only if hazards analysis indicates preserved surfaces.
8	Maine full coastal sequence; Penobscot to Casco Bay; coastline 9000-6000 B.P.	2 4	8		X	X			X	X	-Magnetometer survey in area of impact.
9	Maine estuarine sequence; Casco Bay; coastline 6000 B.P. to modern coastline.	2	9		X	X	-Intensive magnetometer survey.		X	X	
10	Maine estuarine sequence; Casco Bay; present shore area.	2	10	X				X			
11	Maine full coastal sequence; Casco to Penobscot Bay; present shore area.	2	11	X				X			
12	Maine estuarine sequence; Penobscot Bay; coastline 9000-6000 B.P.	1	12		X	X			X	X	-Magnetometer survey in area of impact.
13	Maine full coastal sequence; Casco Bay to Portsmouth, NH; coastline 9000-6000 B.P.	4	13			X				X	-Only if hazards analysis identifies preserved surfaces. -Magnetometer survey in area of impact.
14	Maine full coastal sequence; Penobscot Bay to Portsmouth, NH; coastline 6000 B.P. to modern coastline.	2	14		X	X			X	X	-Magnetometer survey in area of impact.

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
15	Maine full coastal sequence; Casco Bay to Portsmouth, NH; present shore area.	2	15	X				X			
16	Southern New England estuarine (truncated) sequence; off Portsmouth, NH; coastline 9000-6000 B.P.	4	16			X				X	-Only if hazards analysis identifies preserved surfaces. -Magnetometer survey in area of impact.
17	Southern New England estuarine (truncated) sequence; off Portsmouth, NH; coastline 6000 B.P. to modern coastline.	2 3 4	17		X	X	-Intensive magnetometer survey.		X	X	
18	Southern New England estuarine (truncated) sequence; around Piscataqua River mouth; present shore area.	2 3	18	X				X			
19	Maine full coastal sequence; Portsmouth, NH to Cape Ann; coastline 9000-6000 B.P.	4	19			X				X	-Only if hazards analysis identifies preserved surfaces. -Magnetometer survey in area of impact.
20	Maine full coastal sequence; Portsmouth, NH to Cape Ann; coastline 6000 B.P. to modern coastline.	2 4	20		X	X			X	X	-Magnetometer survey in area of impact. -Only if reconnaissance indicates need for further work.
21	Maine full coastal sequence; Portsmouth, NH to Cape Ann; present shore area.	2	21	X				X			

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy								
				Reconnaissance Survey				Intensive Survey				
C.R. Zone	Description	Contains HS	PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
22	Southern New England estuarine (truncated) sequence; Cape Ann to Scituate; coastline 9000-6000 B.P.	4 6	22			X				X	-Only if hazards analysis identifies preserved surfaces. -Magnetometer survey in areas of impact.
23	Southern New England estuarine (truncated) sequence; Cape Ann to Scituate; shoreline 6000 B.P. to modern coastline.	4 6 9 10 11 13 15	23		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
24	Southern New England estuarine (truncated) sequence; Cape Ann to Scituate; present shore area.	9 10	24	X				X			
25	Cape Cod Bay sequence; Scituate to Provincetown; coastline 9000-6000 B.P.	13	25			X				X	-Magnetometer survey in area of impact.
26	Cape Cod Bay sequence; Scituate to Provincetown; coastline 6000 B.P. to modern coastline.	11 13	26		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
27	Cape Cod Bay sequence; Scituate to Provincetown; present shore area.	11 12	27	X				X			
28	Southern New England full coastal sequence; Provincetown to Nantucket Shoals; coastline 9000-6000 B.P.	6 14	28			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
29	Southern New England full coastal sequence; Provincetown to Monomoy; coastline 6000 B.P. to modern coastline.	12 14	29		X	X	-Intensive magnetometer survey.	X			-Only if hazards analysis identifies preserved surfaces.
30-31	Southern New England full coastal sequence; Provincetown to Nantucket Shoals; coastline 9000-6000 B.P.	6	30-31			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
32	Southern New England full coastal sequence; Cape Cod around Georges Banks to south of Nantucket; coastline 15,000-12,000 B.P.	6 7 8	32			X	-Intensive magnetometer survey, inside 10-fathom line.			X	-Magnetometer survey outside 10-fathom line in area of impact.
33	Southern New England full coastal sequence; Georges Banks to Block Valley; coastline 15,000-12,000 B.P.	6 7 8	33			X				X	-Only if hazards analysis identifies preserved surfaces. -Magnetometer survey in area of impact.
34	Southern New England full coastal sequence; Monomoy to Georges Banks to Block Valley; coastline 15,000-12,000 B.P.	6 7 8	34			X	-Intensive magnetometer survey from Block Valley to lower part of Georges Banks.			X	
35	Southern New England full coastal sequence; discontinuous zones include Georges Banks, Nantucket Shoals, Block Island Valley and Long Island Valley; coastline 9000-6000 B.P.	6 7 8	35			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces. -Magnetometer survey in area of impact.

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
36	Southern New England full coastal sequence; Nantucket Shoals; coastline 9000-6000 B.P.	6 14 19 21	36			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
37	Southern New England full coastal sequence; Nantucket Shoals; coastline 6000 B.P. to modern southeastern coastline on Nantucket Island.	14 21	37		X		-Intensive magnetometer survey.		X		-Only if hazards analysis identifies preserved surfaces.
38	Southern New England full coastal sequence; Nantucket Shoals to Narragansett Bay; coastline 9000 B.P. to modern coastline.	6 12 14 17 19 20 21	38		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
39	Southern New England full coastal sequence; Chatham to Narragansett Bay and Narragansett Bay to New York Harbor, including north of coast of Long Island; present shore area.	17 20	39	X				X			
40	Narragansett Bay/New York Harbor sequence; Narragansett Bay; present shore area.	17 22	40	X				X			
41	Southern New England full coastal sequence; northern edge of Georges Banks to Block Valley; coastline 18,000-15,000 B.P.	6 7 8	41			X	-Intensive magnetometer survey.			X	
42	Southern New England full coastal sequence; north of Block Valley; coastline 18,000-15,000 B.P.	6	42			X	-Intensive magnetometer survey.			X	

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
43	Southern New England full coastal sequence; at mouth of Block Valley and Hudson Canyon; coastline 18,000-15,000 B.P.	6	43			X	-Intensive magnetometer survey.			X	
44	Southern New England full coastal sequence; at mouth of Block Valley and Hudson Canyon; coastline 18,000-15,000 B.P.	6	43			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
45	Southern New England estuarine sequence; Block Valley and Hudson Canyon; coastline 15,000 B.P. to modern coastline.	6 17 19 22 28			X	X	-Intensive magnetometer survey.		X	X	-Only if subbottom data indicate preserved surfaces within impact zone.
46	Southern New England full coastal sequence; Block Valley to Hudson Canyon; coastline 12,000 B.P. to modern coastline.	6 25 28	46		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
47	Southern New England full coastal sequence; 2 discontinuous areas off Long Island-Peconic Bay and Great South Bay; coastline 6000 B.P. to modern coastline.	25 26	47		X		-Intensive magnetometer survey.		X		
48	Mid-Atlantic full coastal sequence; between Hudson Canyon and Great Egg Valley; coastline 18,000-15,000 B.P.	6	48			X				X	-Only if hazards analysis identifies preserved surfaces.

Table IV-10 (continued): Recommended survey strategies.

C.R. Zone	Description	Contains HS	Contains PA	Reconnaissance Survey: On-shore	Reconnaissance Survey: Near-shore	Reconnaissance Survey: Hazards Anal.	Reconnaissance Survey: Notes	Intensive Survey: On-shore	Intensive Survey: Near-shore	Intensive Survey: Off-shore	Intensive Survey: Notes
49	Mid-Atlantic full coastal sequence; between Hudson Canyon and Great Egg Valley; coastline 15,000 B.P. to modern coastline.	6 31 33 34 35 36	49			X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
50	Mid-Atlantic full coastal sequence; south of Hudson Canyon; coastline 12,000-6000 B.P.	6	50			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
51	Mid-Atlantic full coastal sequence; Hudson Canyon to Great Egg Valley; coastline 12,000 B.P. to modern coastline.	6 31 32 33 34 35	51		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work. -Only if subbottom data indicate preserved surfaces within impact zone.
52	Mid-Atlantic full coastal sequence; Sandy Hook to Great Egg Harbor; present shore area.	28 32 33 37	52	X				X			
53	Mid-Atlantic estuarine sequence; Great Egg Valley; coastline 15,000 B.P. to modern coastline.	6 31 38	53		X	X	-Intensive magnetometer survey.		X	X	-Only if subbottom data indicate preserved surfaces within impact zone.
54	Mid-Atlantic estuarine sequence; Great Egg Valley; coastline 12,000-9000 B.P.	6	54			X	-Intensive magnetometer survey.			X	-Only if reconnaissance indicates need for further work.
55	Mid-Atlantic estuarine sequence; around Great Egg Harbor; present shore area.	38	55	X				X			

Table IV-10 (continued): Recommended survey strategies.

C.R. Zone	Description	Contains HS	Contains PA	Reconnaissance Survey: On-shore	Reconnaissance Survey: Near-shore	Reconnaissance Survey: Hazards Anal.	Reconnaissance Survey: Notes	Intensive Survey: On-shore	Intensive Survey: Near-shore	Intensive Survey: Off-shore	Intensive Survey: Notes
56	Mid-Atlantic full coastal sequence; Great Egg Harbor to Cape May; present shore area.	38 39	56	X				X			
57	Mid-Atlantic full coastal sequence; Great Egg Valley to Cape May; coastline 9000 B.P. to modern coastline.	31 38 39	57		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work. -Only if sub-bottom data indicate preserved surfaces within impact zone.
58	Mid-Atlantic full coastal sequence; Great Egg Valley to Delaware Valley; coastline 15,000 B.P. to modern coastline.	6 31 39	58		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
59	Mid-Atlantic estuarine sequence; Delaware Valley; coastline 12,000 to mouth of Delaware Bay at 12,000 B.P.	6 39 47 48	59		X	X	-Intensive magnetometer survey.		X	X	-Only if sub-bottom data indicate preserved surfaces within impact zone.
60	Mid-Atlantic full coastal sequence; discontinuous zone flanking Delaware and Susquehanna Valleys; coastline 18,000-15,000 B.P.	6 48	60			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
61	Mid-Atlantic full coastal sequence; between Delaware and Susquehanna Valleys; coastline 18,000 B.P. to modern coastline.	6 41 43 44 45 46	61		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
62	Mid-Atlantic full coastal sequence; between Delaware and Susquehanna Valleys; coastline 9000 B.P. to modern coastline.	6 41 43	62		X	X	-Intensive magnetometer survey.		X	X	-Only if sub-bottom data indicate preserved surfaces within impact zone. -Only if reconnaissance indicates need for further work.
63	Mid-Atlantic full coastal sequence; Cape Henlopen to Cape Charles; present shore area.	39 42 50	63	X				X			
64	Mid-Atlantic full coastal sequence; several discontinuous zones south of Delaware Valley; coastline 6000 B.P. to modern coastline.	39 41 42 43	64		X	X	-Intensive magnetometer survey.		X	X	-Only if hazards analysis identifies preserved surfaces.
65	Mid-Atlantic estuarine sequence; Susquehanna Valley; coastline 15,000-12,000 B.P.	6 46	65			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
66	Mid-Atlantic estuarine sequence; 2 discontinuous zones on either side of the Susquehanna Valley; coastline 15,000-12,000 B.P.	6 46	66			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
67	Mid-Atlantic estuarine sequence; Susquehanna Valley; coastline 15,000 B.P. to mouth of Chesapeake Bay.	6 43 44 45 46 50	67		X	X	-Intensive magnetometer survey.		X	X	-Only if sub-bottom data indicate preserved surfaces within impact zone.

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
68	Delaware Bay (Main Bay) sequence; mouth of Delaware Bay to Susquehanna River excluding ancestral river channel; coastline 18,000 B.P. to present shore area.	39 40 49	68	X	X		-Intensive magnetometer survey off coastline.	X	X		
69	Delaware Bay (upper reaches) sequence; from Susquehanna River to Delaware City; coastline 18,000 B.P. to present shore area.	40 49	69	X	X		-Intensive magnetometer survey off coastline.	X	X		
70	Delaware Bay (lower river) sequence; Delaware City to Philadelphia; coastline 15,000 B.P. to present shore area.	49	70	X	X		-Intensive magnetometer survey off coastline.	X	X		
71	Mid-Atlantic full coastal sequence; south of Susquehanna Valley; coastline 18,000 B.P. to modern coastline.	6 43 50	71		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work. -Only if sub-bottom data indicate preserved surfaces within impact zone.
72	Mid-Atlantic full coastal sequence; between Chesapeake and Susquehanna Valleys; coastline 18,000-6000 B.P.	6 52	72			X				X	-Only if hazards analysis identifies preserved surfaces.
73	Mid-Atlantic full coastal sequence; north of Chesapeake Valley; coastline 18,000-6000 B.P.	6 52 53	73			X	-Intensive magnetometer survey.			X	-Only if sub-bottom data indicate preserved surfaces within impact zone. -Only if hazards analysis identifies preserved surfaces.

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	Contains PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
74	Southern Mid-Atlantic estuarine sequence; Chesapeake Valley; coastline 18,000 B.P. to mouth of Chesapeake Bay.	6 43 50 51 52 53	74		X	X	-Intensive magnetometer survey.		X	X	-Only if sub-bottom data indicate preserved surfaces within impact area.
75	Mid-Atlantic full coastal sequence; south of Chesapeake Valley; coastline 18,000 B.P. to modern coastline.	6 43 51 53	75		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
76	Mid-Atlantic full coastal sequence; between Chesapeake and Albemarle Valleys; coastline 9000 B.P. to modern coastline.	6 43 51	76		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
77	Mid-Atlantic full coastal sequence; north of Albemarle Valley; coastline 12,000-6000 B.P.	6	77			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
78	Mid-Atlantic full coastal sequence; north of Albemarle Valley; coastline 18,000-12,000 B.P.	6	78			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
79	Southern Mid-Atlantic estuarine sequence; Albemarle Valley; coastline 12,000 B.P. to modern coastline.	6 43 51 56	79		X	X	-Intensive magnetometer survey.		X	X	-Only if sub-bottom data indicate preserved surfaces within impact area.
80	Southern Mid-Atlantic estuarine sequence; Albemarle Valley; coastline 9000 B.P. to modern coastline.	6 43 51	80		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.

Table IV-10 (continued): Recommended survey strategies.

C.R. Zone	Description	Contains HS	Contains PA	Reconnaissance Survey: On-shore	Reconnaissance Survey: Near-shore	Reconnaissance Survey: Hazards Anal.	Reconnaissance Survey: Notes	Intensive Survey: On-shore	Intensive Survey: Near-shore	Intensive Survey: Off-shore	Intensive Survey: Notes
81	Southern Mid-Atlantic estuarine sequence; Albemarle Valley; coastline 18,000-9000 B.P.	6	81			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
82	Southern Mid-Atlantic estuarine sequence; Albemarle Valley; coastline 18,000-12,000 B.P.	6	82			X	-Intensive magnetometer survey.			X	-Only if hazards analysis identifies preserved surfaces.
83	Southern Mid-Atlantic full coastal sequence; between Albemarle and Diamond Valleys; coastline 12,000 B.P. to modern coastline.	6 51 56	83		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
84	Southern Mid-Atlantic full coastal sequence; between Albemarle and Diamond Valleys; coastline 18,000 B.P. to modern coastline.	6 43 56	84		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
85	Diamond sequence; Diamond Valley; coastline 18,000 B.P. to modern coastline.	6 43 56 57	85		X	X	-Intensive magnetometer survey.		X	X	-Only if reconnaissance indicates need for further work.
86	Diamond sequence; Diamond Valley; coastline 18,000 B.P. to modern coastline.	6 43 56 57	86		X	X	-Intensive magnetometer survey.		X	X	-Only if subbottom data indicate preserved surfaces in impact area.
87	North Carolina sound sequence; Albemarle and Pamlico Sounds; coastline 3000 B.P. to present shore area.	51 54 55 56	87	X	X		-Intensive magnetometer survey offshore.	X	X		

Table IV-10 (continued): Recommended survey strategies.

				Recommended Survey Strategy							
				Reconnaissance Survey				Intensive Survey			
C.R. Zone	Description	Contains HS	PA	On-shore	Near-shore	Hazards Anal.	Notes	On-shore	Near-shore	Off-shore	Notes
88	North Carolina wetland sequence; wetland areas between Pamlico and Albemarle Sounds and adjacent to Albemarle Sound; coastline 3000 B.P. to present shore area.	54 55	88	X				X			
89	Mid-Atlantic full coastal sequence; Cape Henry to head of Currituck Sound; coastline 3000 B.P. to present shore area.	50 51 54	89	X				X			
90	Lightly travelled trade routes from Cape Ann to St. Croix River.	4	-								-Magnetometer survey in area of impact.
91	Drift zone to west of major northern shipping lanes from Boston.	5	-								-Magnetometer survey in area of impact.
92	Major coastal lanes from Boston to Georges Banks.	6	-								-Magnetometer survey in area of impact.
93	Drift zone of Labrador Current south from major northern shipping lanes east of Cape Cod.	7	-								-Magnetometer survey in area of impact.
94	Outside of major shipping lanes and drift zones east of Cape Cod.	8	-								-Magnetometer survey in area of impact.
95	Beyond the 10-fathom line in Cape Cod Bay.	13	-			X	-Intensive magnetometer survey.				

Table IV-10 (continued): Recommended survey strategies.

C.R. Zone	Description	Contains HS	Contains PA	Reconnaissance Survey: On-shore	Reconnaissance Survey: Near-shore	Reconnaissance Survey: Hazards Anal.	Reconnaissance Survey: Notes	Intensive Survey: On-shore	Intensive Survey: Near-shore	Intensive Survey: Off-shore	Intensive Survey: Notes
96	Outside Cape Cod Bay from Boston Harbor to Cape Cod.	15	-			X	-Intensive magnetometer survey.				

7.5 Recommended Further Studies

Throughout the previous three volumes of this study, data gaps have been identified and recommendations have been made for additional work designed to fill those gaps. This section will not repeat all of those recommendations, but some of the more important of them will be discussed in further detail. We will also propose pilot studies that will test the models of prehistoric and historic site "encounterability" on the CS. This section will recommend the acquisition of new data to answer technical questions.

7.5.1 Test evaluation of a previously designed gas pipeline

The Tenneco Corporation has designed a pipeline right-of-way from the Georges Banks to the east coast of the U.S. (Joe Guarino, personal communication). Although this pipeline apparently will not in fact be installed, the right-of-way was established and pre-construction data were assembled and analyzed. It would be highly instructive to resource managers if the models developed in this present study were tested against that proposed right-of-way in a "paper study," so that the impact of the pipeline's routing on any known sites or cultural resource zones could be assessed, and the cost of any required intensive surveys or mitigation efforts estimated. It should be pointed out that as of this writing this pipeline appears to traverse every possible sort of cultural resource zone, from minimum to maximum likelihood of encountering previously unknown sites. The proposed pilot study should include a review of all existing design data, an analysis of the proposed right-of-way and its various cultural resource zones, and a discussion is adequate for identifying cultural resources to the "site-specific" level required for an environmental study by the BLM (BLM 1978).

These actions should be followed by an actual pre-lay survey, performed in accordance with the recommendations made for such surveys earlier in this study. Since the proposed pipeline traverses such a wide range of cultural resource zones, it will be possible to test not only the predictive models, but survey techniques as well. This element of the pilot study will evaluate the effectiveness of our attempt to integrate cultural resource surveys with presently accepted industry procedures for pre-lay pipeline right-of-way inspection. (In this phase of the pilot study, surface manifestations of prehistoric or historic shipping sites may be located.)

7.5.2 Archaeological monitoring of sea-bottom activities already planned

On the basis of present information, it is clear that offshore oil drilling and/or undersea mineral exploration will take place in the study area in the near future, if indeed they are not taking place already. We recommend that qualified archaeologists follow these activities by monitoring the remote video units of the RCV's used in pre- and post-construction surveys to identify geological hazards. By observing both phases of this undersea reconnaissance, archaeologists will gain valuable insights into the actual, as opposed to the predicted, impacts of various types of disturbance on the sea bottom, and thus on any potential sites

that may be located there. It cannot be emphasized too heavily that in the present state of our knowledge, any prehistoric archaeological site that might be discovered in the course of this study would be of national, and probably world-wide interest because of the uniqueness of the circumstances and the extraordinary degree of preservation of organic materials that has been predicted to occur in, for example, sites of the Paleo-Indian Period. Therefore, considerable public relation benefits may accrue to any corporations who are willing to accept our recommendations for the integration of archaeologists into the construction or exploration team. This study, like the preceding one, can and should be carried out as soon as possible.

7.5.3 Analysis of existing cores

Many cores have been taken in the study area and the sediments and biological materials from a large percentage of these are preserved and are available for study. These constitute a data source which can efficiently and effectively be studied to provide reconstructions useful in refining the models presented in this study.

A few examples will clarify this point. To date, only two pollen samples have been analyzed from the study area and they were taken from major river valleys and are believed by those who published them (Balsam and Heusser 1976) to be composed of pollen transported from areas upstream, areas which today are dry land. In essence, therefore, there are no pollen reconstructions based on data from the CS, only reconstructions extrapolated from dry land data. Cores have been taken from many interfluve areas of the study area, which, if analyzed for pollen, could provide direct evidence of vegetational and climatic sequences on the CS. If enough samples were analyzed, it might be possible to assess the effects of the ocean on the paleoclimate and paleoenvironment of nearby areas, a critical but unsolved problem.

In addition to terrestrial climate, marine climate should be examined in greater detail to refine concepts of marine resource distribution in the past. Studies of the remains of plankton in ancient sediments can help reconstruct water temperatures and salinities, as can technical studies of element and isotope ratios in the shells of marine bivalves (Butzer 1972; Dodd 1967). Using cores with nearshore sediments, these factors, so critical to assessing marine resource abundance, could be assessed.

Many more such studies aimed at refining resource reconstructions could be undertaken using already collected (but as yet unanalyzed) data. The more specific environmental reconstruction becomes, the more specific can predictive models be made. By using existing samples, costs are reduced and more effective decisions can be made regarding field study for pilot studies.

7.5.4 Testing this studys' models of distribution and density

This present study is not the last word or the definitive statement on the location of every historic or prehistoric site on the submerged CS, in the tidal zone, or on parts of the shoreline, that may be impacted by future construction related to Shelf development. We have, however,

attempted to construct predictive models for the probable distribution and densities of historic and prehistoric sites in the study area. These models require to be tested, since they are based principally on extrapolations from terrestrial data and on unverified hypotheses about past environmental conditions.

Unlike the three previous pilot studies, this one will require a certain amount of preparation, planning, and funding, and may not be undertaken immediately. It is therefore desirable (though not necessary) that the results of the first three studies be available before this fourth study is fielded, as the information derived from them will be of great use to those who carry it out. We recommend that surveys, both Reconnaissance and Intensive (as described in the section on Recommended Field Strategies (Appendix B) be implemented in a selection of areas on the CS. These areas will be chosen so as to include within them the widest possible spectrum of preservation classes, probability zones (both historic and prehistoric) and environmental types known or predicted to exist within the study area.

Since we expect shell middens to be the most easily identified type of sub-bottom (and possibly bottom-surface) prehistoric archaeological remains in the study area, we have analyzed the site type data for the nineteen archaeological sequences discussed above and have eliminated from these sequences every component except that of shell midden. The expected offshore shell-concentration index thus derived is displayed in Fig. IV-58. In this manner, we can identify those archaeological sequences that may be expected to contain the greatest frequency and broadest range of time periods for shell middens. It may be seen from Fig. IV-58 that the most favorable combination of shell-midden frequency and time depth are displayed by the mid-Atlantic estuarine, southern mid-Atlantic estuarine, and Diamond sequences. However, an examination of the data on expected preserved archaeology in the three zones indicates that the two estuarine zones fall almost entirely within the areas where preservation is expected to be a maximum. The estuarine sequences, therefore, must be considered less suitable for the purpose of verifying our site-preservation predictions than the non-estuarine Diamond sequence.

This pilot study is designed to test our models of both expected subaerial preservation and site frequency and type distribution. It thus seems appropriate that several areas be selected for underwater reconnaissance and intensive survey.

7.5.4.1 Test 1 - The goal of this test is to verify or refute our models of site frequency and type distribution, so that it would be desirable to choose for this test an area with high indexes of expected preservation and broad ranges of expected site types and time periods, as well as a dense expected concentration of shell middens. A review of the shell-concentration index in Fig. IV-58 and the zones of preserved archaeology (Fig. IV-47) indicates that estuarine sequences in the mid-Atlantic and southern mid-Atlantic are particularly suited for this test. The maps in section 4.2.2. characterize the Susquehanna Valley as lying almost

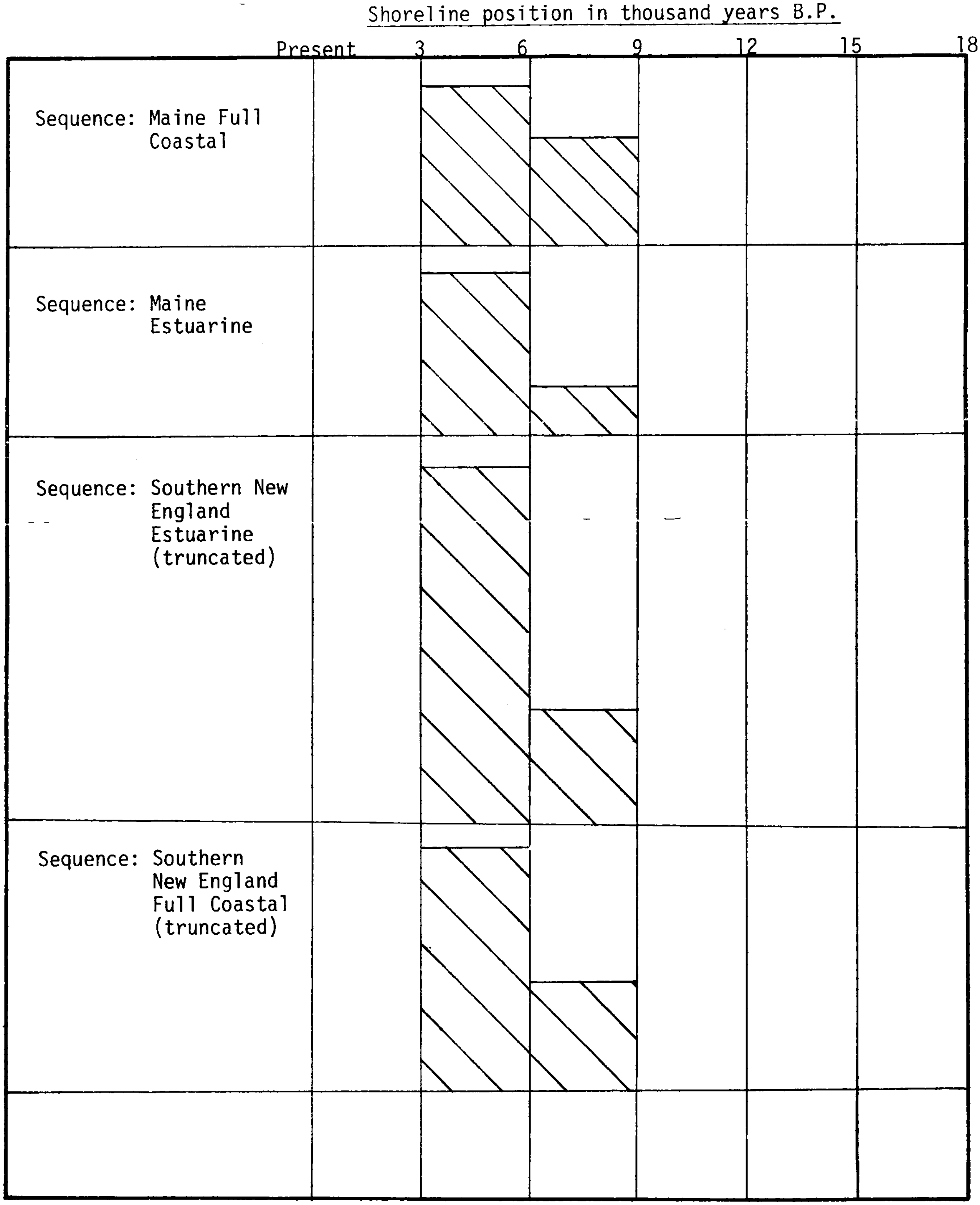

Fig. IV-58.
Expected offshore shell concentration index.

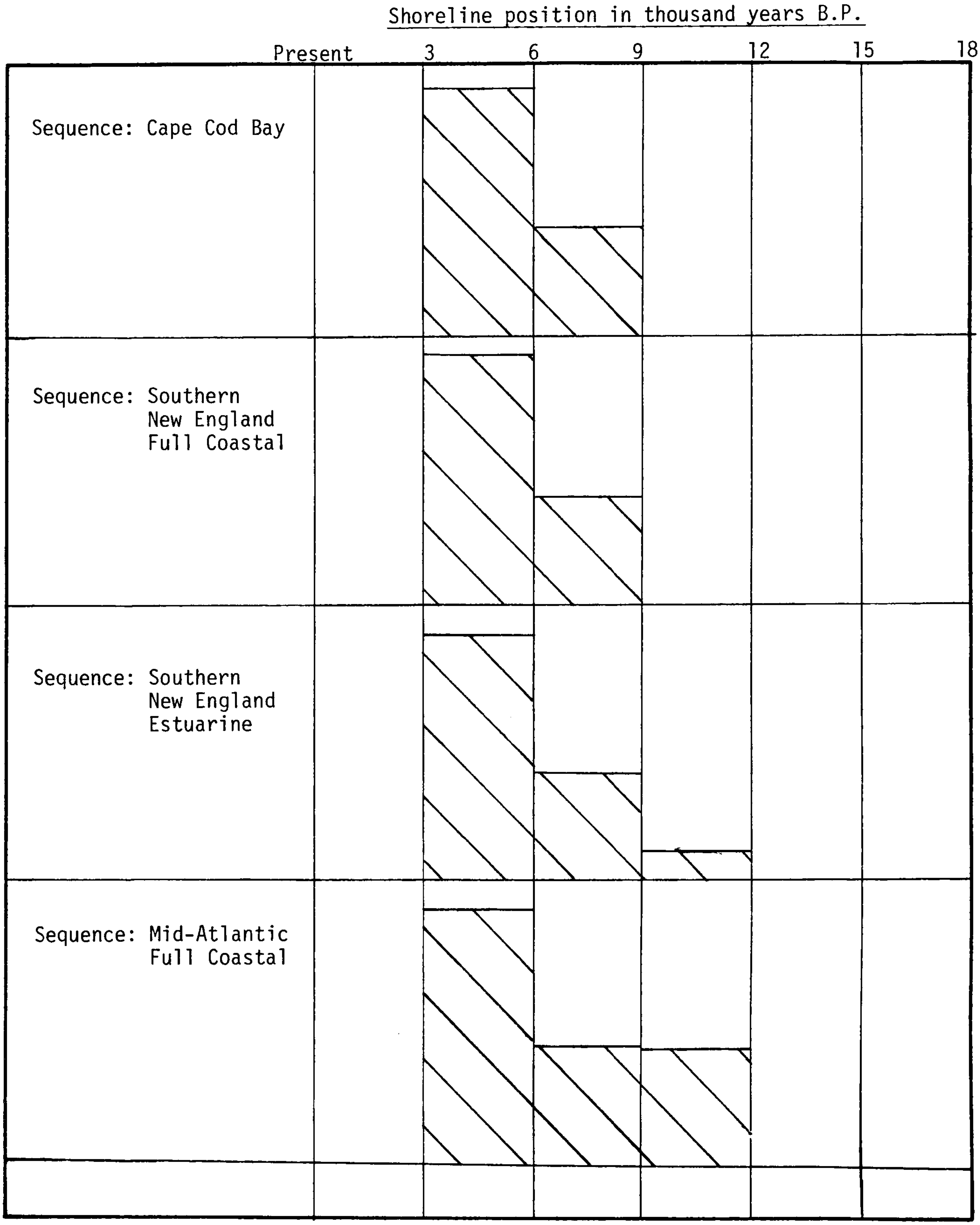

Fig. IV-58 continued.

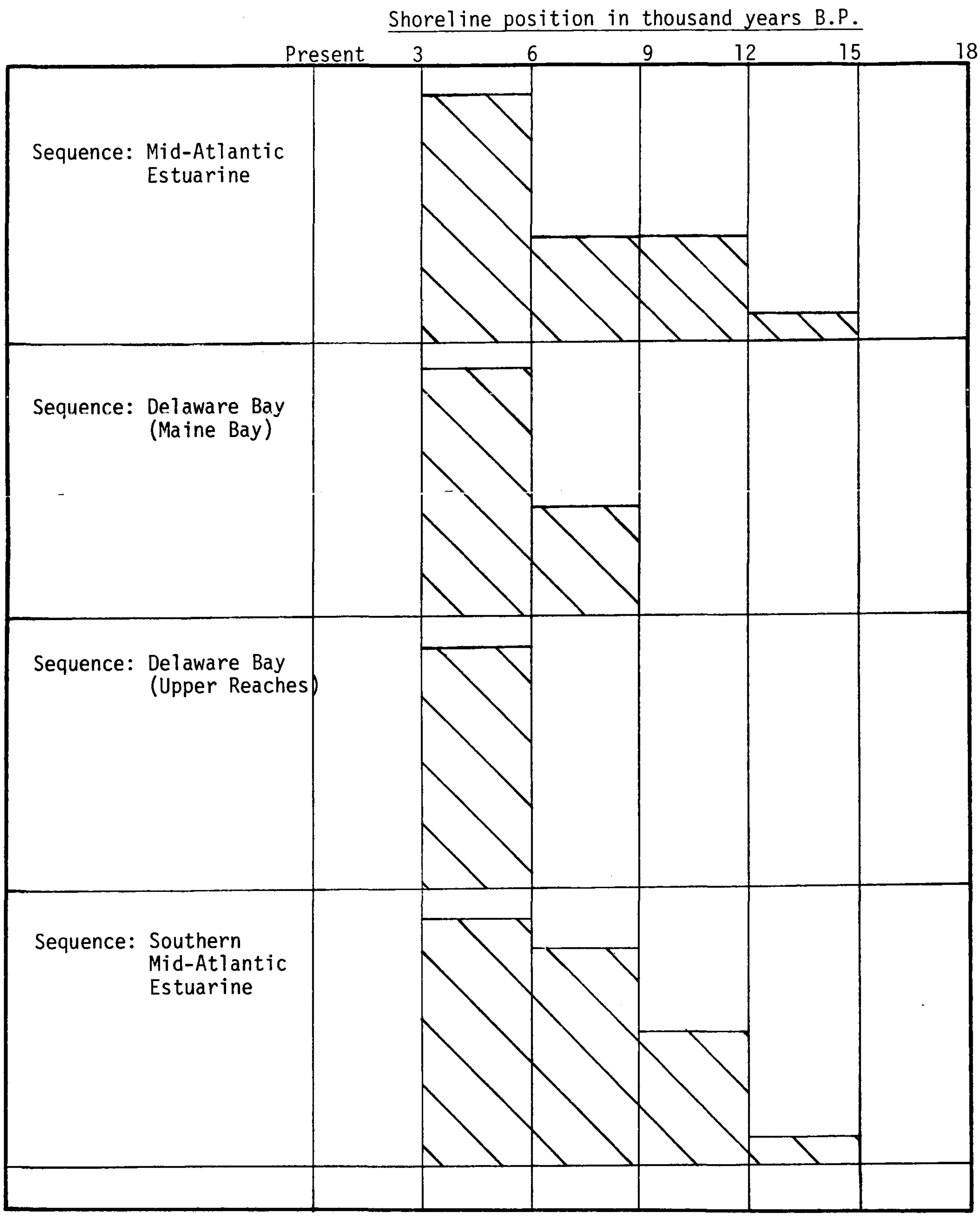

Fig. IV-58 (continued).

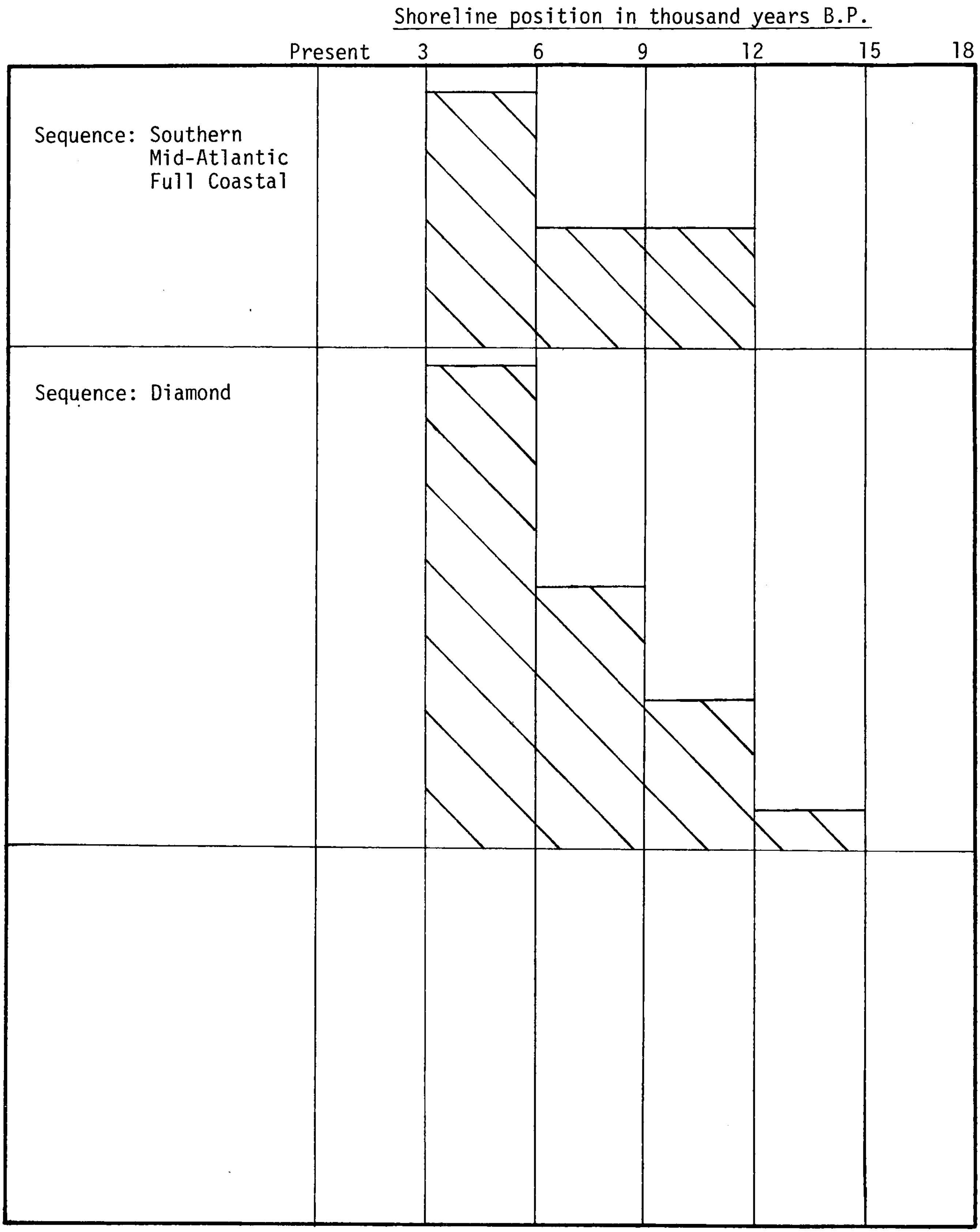

Fig. IV-58 Continued.

precisely on an east-west line, thus making it unnecessary to change course during the entire transect, from the 200-m depth to the mouth of Chesapeake Bay. All shell middens are expected to lie in the zone of maximum preservation (from the shoreline of 15,000 B.P. westward). Also, the line of the entire transect has the added advantage of traversing, in its eastward portions, zones of moderate preservation as well. We recommend that the test consist of reconnaissance survey using side-scan sonar and sub-bottom profiler along four parallel transects at 150-m intervals, from the 200-m line to the mouth of Chesapeake Bay in an area just north of the 37th parallel. In addition, magnetometer survey should be performed along parallel transects of 30-m separation over the same ground.

Once the data from this test have been analyzed, intensive archaeological survey (offshore), such as that described in Appendix B of this study, should be performed in those areas where preserved subaerial surfaces appear to exist, where wreck marks or magnetic anomalies are identified, and where gassy sediments have been found. Special attention should be paid to subaerial surfaces identified as lagunal deposits, buried river valleys, and sub-bottom reflectors that may be evidence of shell concentrations.

7.5.4.2 Test 2 - The goal of the second test is to verify or refute our models of subaerial preservation. The criteria for selecting the test zones are the same as those applied in Test 1, except that the transects will be designed to traverse a complete sample of the various preservation zones. A review of the maps of Figs.IV-38-46, the shell-concentration indices of Fig. IV-58, and the residual predicted site frequencies of Fig. IV-47, have been used in selecting the area for Test 2. Methodology should be exactly the same as that described in Test 1, but the zone to be tested lies along a line due east-west from the mouth of the Hudson Canyon to Atlantic City, NJ, at approximately 39 degrees, 30 minutes north. A second test zone, on which an identical test strategy will be employed, lies across Georges Banks along latitude 67 degrees, 30 minutes north.

7.5.4.3 Test 3 - The goal of this test is to discover whether prehistoric shell concentrations played a part in the evolution of shoals in the CS. A review of the shell-concentration indices in Fig. IV-58 indicates that the Diamond sequence has the greatest concentration of predicted shell middens, and coring from previously untested parts of that area could serve to validate or deny the hypothesis that the creation of prehistoric shell middens may have played a role in the development of the surficial geology of the CS.

8.0 PLANNING FOR THE FUTURE

The IAS Planning Model and the BLM Study Design can provide useful frameworks for future planning activities. Some of the elements in these models have already been addressed by this study. In this section, we will describe the present status of work performed within the framework of the models with a view toward helping managers to foresee future needs. Figure IV-59 illustrates the planning process flow chart presented at the beginning of this volume and the effect of this study on the completion of the various steps.

Step 1 - Organize Existing Data: The preceding sections of this study represent the gathering of known data with the subsequent development of models for past human use of the project area.

Step 2 - Define Study Units: The integration of Historic Shipping Zones with Archaeological Sequences can be used to define study units for the CS.

Step 3 - Organize Existing Data on Study Area: At this point in our study, it is too early to differentiate data organization into various study units.

Step 4 - Define "Ideal" Priorities: At this point, with the limited inventory of offshore prehistoric sites, it is difficult to isolate a great body of "ideal" priorities. However this lack of data can itself lead to the development of a set of priorities. For the Historic Period a larger inventory exists but our predictions concerning resource location and density are based on inductively derived models and require verification. Thus priorities similar to those for prehistoric sites can be developed.

Priority #1

Test the accuracy of models developed in this report for environmental, cultural, and demographic predictions. The testing of these models can be achieved through a combination of pilot studies (some of which are recommended in Section 7.5), cooperation between science and industry (as described in Section 6.0), and public education programs (discussed in Section 6.0).

Priority #2

Test the predictions about the effect of inundation of cultural materials as described in Section 5.0. These predictions, while testable in some of the studies recommended for Priority #1, should be the subject of

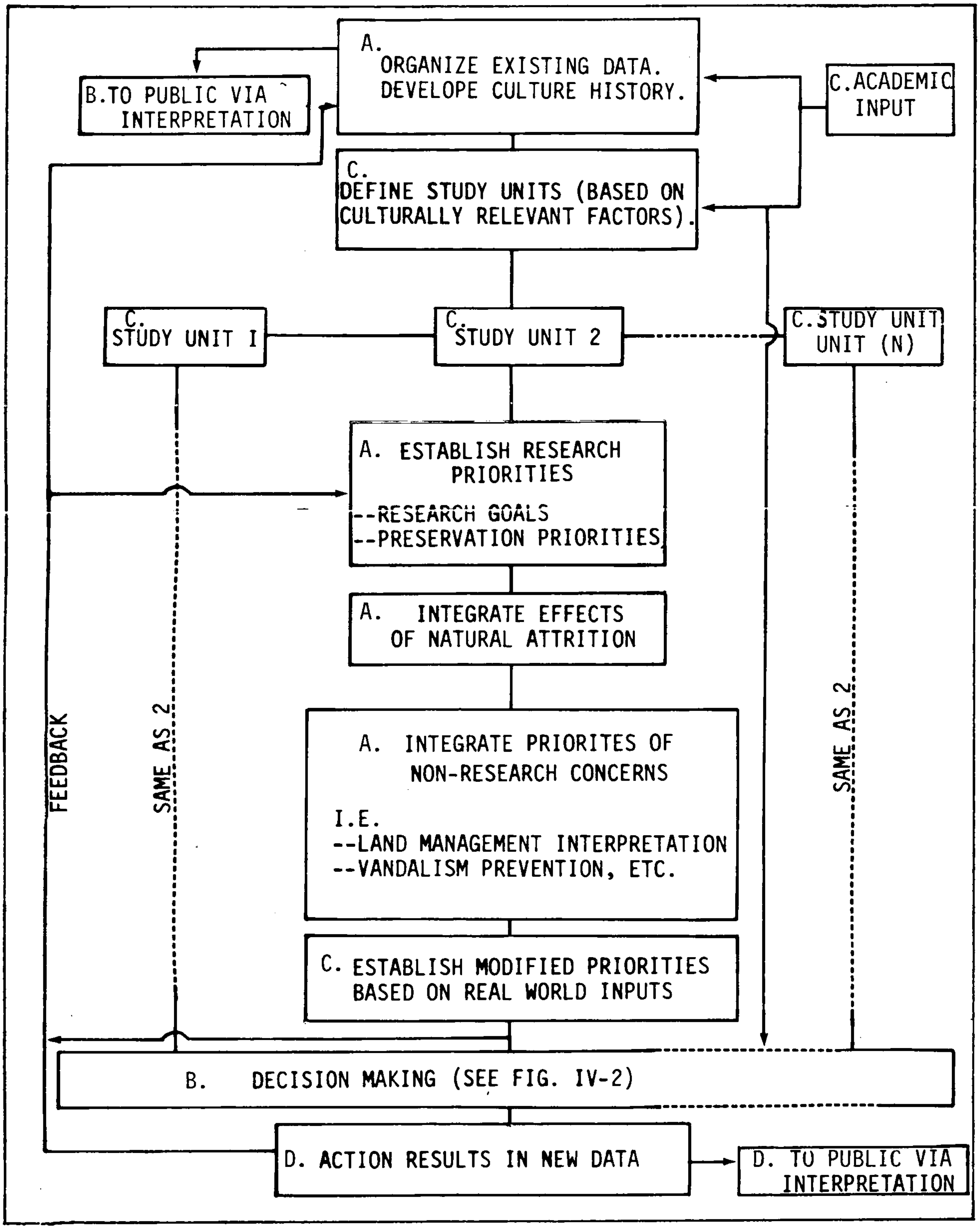

Fig. IV-59
Planning process flow chart. A. Completed in this study; B. Recommended in this study; C. Partially completed in this study; D. Accomplished if recommendations followed.

separate pilot studies. Some of these studies are recommended in Section 7.5.

Step 5 - Consider the Effect of Natural Processes: Earlier (Section 5.0) we identified the predicted effects to archaeological material and sites as a result of natural processes. These effects can be separated into 2 elements, first, past effects resulting from sea-level rise and second, present on-going effects of coastal erosion, etc. Once having recognized the possible impacts of ongoing processes on cultural resources, those individuals in federal, state and local agencies can plan for their protection. Such planning may take the form of encouraging interested individuals to report cases of site damage to the SHPO's office, reviewing results of storm damage for impact to sites, and increasing efforts to locate all cultural resources which may be subject to these processes. Protection may take the form of bank stabilization, site burial, or data recovery from sites incurably endangered.

Step 6 - Consider the Interests of Other Groups: In the section on impacts (5.0) we discussed the effects to cultural resources of various human activities within the study area. The persons performing these activities represent the groups whose interests are to be considered at this step. In summary, these activities are:

Fishing
Fin-fishing
Shellfishing
Private development (coastal zone)
Harbor dredging
Pier construction
Cable laying
Industrial and sewage discharge
Gas and oil facility construction
Dredge spoil disposal
Flood and erosion prevention
Mariculture
Recreation: shore access, boating, scuba diving
Sand and gravel mining
Offshore mineral extraction
Offshore dumping

It should be remembered that the above do not represent all the activities that may be going on in the study area, but they do represent the range of types of such activities.

Step 7 - Modify Priorities/Develop Management Strategy: The priorities for future action identified in Step 4 will be modified on the basis of the expected loss or modification of the existing resource base that may result from the factors identified in Steps 5 and 6. It should be kept in mind, however, that any modifications should strongly consider the priorities outlined in Step 4.

Modified Priority #1

Begin surveys to locate all archaeological sites that may presently be undergoing modification or destruction due to erosion and other natural impacts. Once located, the sites should be protected if possible. If it is impossible to stabilize the erosion or otherwise protect the sites, then mitigation of this impact should be performed. This mitigation will most probably take the form of data recovery. A data-recovery program must be accomplished within a professionally developed research design that not only recovers as much data as possible but recovers it in such a manner that questions which the data from this site might help solve are formulated and used to direct the course of data recovery.

Modified Priority #2 (Ref. Priority #1 & #2)

Begin a program of industry/scientific cooperation, pilot studyies, and independent research that will allow for the testing of models for settlement distribution and expected preservation. As described more fully in Section 6.0 and 7.0, this will involve archaeologists in the actual construction phases of planned offshore land use.

Modified Priority #3 (Ref. Priority #1)

Begin a series of pilot studies using terrestrial as well as underwater data. Some recommended pilot studies are discussed in Section 7.5. The studies should be designed to assist in confirming or modifying the models presented in this study. These designs should include but not be limited to statistically valid sampling strategies in all the various zones of expected resources.

Modified Priority #4

Once the models are verified, land-users and archaeologists should be encouraged to interact with the goal of avoiding where possible areas where cultural resources are expected. This will also include the development of an industry/scientific communications network designed to provide the interested scientific community with locational and other information relating to accidental encounter of archaeological sites.

Step 8 - Decision Making: With the revised priorities in hand, we can provide recommendations for future activities on the Continental Shelf. These will take the form of general recommendations and short-term and long-term recommendations geared to the sources of impacts as identified in Section 7.0.

With this study in hand, and with the implementation of the recommendations of this volume by resource managers, land users, the scientific community, and the public, new data will be generated which must be used to reinforce or modify the conclusions of this summary and analysis of known data. These new data derived from the implementation of the recommended pilot studies will provide necessary support for our management recommendations. Without this confirmation (or denial) the management recommendations regarding the level of intensitivity of survey must stand as the best approximation of the actual needs of the resource manager. The new data, however, are expected to give a greater level of accuracy to our delineation of the different zones of cultural resource potential. This refined accuracy could conceivably reduce the area of those zones that are expected to have the highest potential for containing resources and that thus require the most intensive survey procedures since we have tended to be conservative (on the side of resource protection) in our present zone descriptions.

At the same time, the new data must be interpreted to the public for purposes of education, and enjoyment. It is relevant to recall that providing "a sense of orientation to the American people" (preamble to the National Historic Preservation Act), obtaining data that will "support diversity and variety of individual choice" (preamble to the National Environmental Policy Act), and contributing to the "overall welfare of man" (preamble to the National Environmental Policy Act) are the ultimate goals of cultural resource conservation.

Within the framework of this study, then, the conservation or wise use of cultural resources can go hand in hand with the development of other much-needed resources of the Continental Shelf. With this in mind, we may say that all resources of the Shelf have value to one or more segment of the population of the nation and their proper exploitation should be accomplished in an atmosphere of well-reasoned consideration for them all.

Appendix A

THE FORT BURGWIN CONFERENCE ON NATIONAL ARCHAEOLOGICAL POLICIES

This is a draft of a report on the results of a conference on national policies regarding archaeology, held at the Fort Burgwin Research Center at Taos, New Mexico on September 29–October 1, 1978.

The Advisory Council on Historic Preservation has recently convened a Task Force to consider national archaeological policies. The Coordinating Council of National Archaeological Societies was invited to nominate a delegate to this Task Force, and Fred Wendorf was so designated. The Task Force is to deliver its report to the Advisory Council on May 2, 1979; two meetings have already been held, and several others are scheduled.

Among the problems to be considered by the Task Force is a national policy relating to the determination of significance as this refers to archaeological occurrences. There has been persistent and increasing criticism that no understandable system exists whereby the relative importance of archaeological remains can be determined, and therefore that consistent procedures to protect these resources cannot
[1] be devised. As responsible citizens archaeologists have an obligation to provide a basis whereby it is possible to determine which archaeological sites must be saved, and, of those which cannot be saved, which should be scientifically excavated and which might be destroyed without excavation or study.

As the first step toward the involvement of the larger archaeological community in these deliberations, the Fort Burgwin Conference was organized by Fred Wendorf and funded by the Office of Archeology and Historic Preservation, U.S. Department of the Interior. The conference was attended by twenty archaeologists with three non-archaeologist observers representing several federal agencies. [2]
Five of the archaeologists had been participating in the Task Force discussions, and the remaining fifteen were selected to provide a diversity of geographical, topical, and theoreti- [3]
cal interests.

The conference began with the presentation of five "position papers" reflecting the variety of policy problems concerning archaeology. After discussion of these papers, the participants were divided into four groups each assigned a different set of topics. The reports of these groups were then debated, revised, and finally adopted by the entire conference.

The results of their deliberations are presented below. It is our hope that you will read and carefully consider their statements, and should you have any substantive criticisms that you will convey them to us as soon as possible, and in any case before December 1, 1978. They should be mailed to:

Fred Wendorf
Department of Anthropology
Southern Methodist University
Dallas, Texas 75275

REPORT OF THE FORT BURGWIN CONFERENCE ON NATIONAL ARCHAEOLOGICAL POLICIES

Significance and Compliance

Until recently, few archaeologists found it necessary to give much thought to archaeological site significance in the context in which the term has now come to be used. That situation has now changed dramatically, and there appears to be growing concern about the application of the term significant. Nonetheless, it is sometimes argued that the term is unclear, that it has been extended to sites that are not significant under the original intent of the pertinent federal policies, and that application of the concept results in slow and expensive planning processes.

It is, however, appropriate to point out that some of the most critical concepts of many professions are less than precise. Were, for instance, the meanings of legal concepts

exquisitely clear, courts of law would not spend so much time in dealing with complex issues of their interpretations in specific cases. By structuring issues and controversy, the concept of significance may, in fact, have accomplished a great deal.

A variety of proposals have been made for
modifying the concept of significance, such as
[4] checklists or scorecards, preserving a random
[5] or representative sample of sites, and preserv-
ing an honor roll of sites. Unfortunately, all such proposals have one or more of the following problems:

1. they presume that neither our understanding of the archaeological record nor the criteria by which significance is judged will change through time;
2. checklist approaches could not be consistently applied on a national scale; and
3. checklist approaches might well increase rather than decrease the grounds for arguments about significance.

We believe that:

1. The need to deal with significance derives in large measure from its relationship to the management concept of eligibility
[6] for listing on the National Register.
2. Significance is a value judgement made for administrative reasons; it is not an inherent property of an archaeological resource.
3. The value system relevant to such a judgement reflects diverse research and preservation goals.
4. Significance assessments change through time so that sites that are judged significant now may be judged insignificant in the future and vice versa.
5. The units of reference for significance determination should be states and cultural
[7] historical regions.
6. The existing Register criteria are satisfactory for the purpose of identifying the classes of cultural properties to be listed on the National Register.
7. The problems of efficiency and cost-effectiveness that exist in compliance procedures stem from problems other than those generated by the current significance
criteria. [8]

We further believe that application of the following processes may go far towards removing the difficulties associated with the concept of significance.

1. *The Process of Making Professional Judgements.* Professional judgements concerning cultural resources represent the most important contribution archaeologists have to
make. Decisions about the fate of cultural re- [9]
sources should not be made in the absence of such judgements, and these judgements should be sought and provided early in the
planning process. A major opportunity to [10]
manage archaeological resources has been lost to the extent that archaeologists have not provided such judgements in an explicit and detailed manner and that such judgements have not been sought by federal agencies. We recommend every effort to change this situation.

2. *The Process of Documenting the Basis for Judgement.* Judgements are credible only when clearly and objectively documented. The major basis for documenting such judge-
ments should be the State Plan. [7,11]

3. *The Process of Comparison.* In the final analysis, comparison within a region is the optimal basis for significance judgements. While cultural-historical regions might be the most appropriate, the state emerges as the practical unit to employ. We therefore recommend the development of thorough state cultural resource plans, and also that means be developed for coordination of effort between ad-
jacent states. [7,12]

4. *The Process of Setting Priorities.* Once comparative frameworks have been developed, priorities of archaeological site significance can be established. Archaeological significance is not an all-or-none affair. We should state in a well-documented manner which sites should be preserved, which ones

investigated, and which ones denied protection.

We believe that the preservation and compliance processes will increase in efficiency in proportion to the development of these processes.

Compliance Problems

Past difficulties with compliance and compliance procedures are not of sufficient magnitude to warrant an overhaul of the system, nor can the problem be blamed solely on archaeologists, on the Advisory Council, or on federal agencies. We believe the following commitments are necessary to avoid future occurrence of these problems:

1. The professional archaeological community should accept the responsibility for identifying and documenting site significance or eligibility decisions, within the framework of the State Plan as explained
[9] above.
2. The Advisory Council is obligated by Section 106 procedures to act in the public interest. Public interest in this respect should be defined in terms of the national cultural resource management policies and goals established by Congress in the existing historic preservation legislation.
3. The Advisory Council should adopt a position as advocate for the preservation
[13] community. Agency compliance will be variable until the Council demonstrates its commitment to utilize those legal resources available to it to insure compliance by all agencies.
4. The Council should adopt the position that preservation is the preferred conservation approach and that data recovery should be employed only when no prudent
[14] and feasible alternative exists.
5. Greater attention should be given by the Advisory Council to the question of whether federal agencies have formulated plans and implemented programs that will conserve archaeological resources.
6. Means of monitoring overall agency performance within these implemented programs should be developed by the Advisory Council. [15]
7. At the same time, means of monitoring compliance with Memoranda developed in the 106 process should be developed. [16]

The State Historic Preservation Plan

The State Plan is the logical framework for making determinations of archaeological significance and hence demonstrations of eligibility for the National Register. The advan- [7,17]
tages to this approach are:

1. National policy already requires a State Plan. [18]
2. National policy requires some uniformity and standardization.
3. National policy has established a focal point for action, the Office of the State Historic Preservation Officer. [19]
4. A state is a small enough unit to make it possible for the creation of effective working groups.
5. Most states already have such working groups or archaeological councils.
6. This approach would encourage better communication between the archaeologists in each state.
7. It would encourage the archaeologists and the State Historic Preservation Officers to work more closely together.

The goals of a State Plan are to establish a statewide system for archaeological survey; to maintain a data center; to design a decision-making framework for establishing priorities; to promote communication with the professional archaeological community working within the state; to coordinate with state and federal agencies that have management responsibilities within the state, and to provide for dissemination of information to the public. Specific recommendations for realizing these goals are as follows:

1. We recommend that formal guideline statements from the Office of Archeology and His-

toric Preservation of the Department of Interior to the State Historic Preservation Officers should emphasize the absolute necessity for highly focused state planning programs in order to achieve an efficient preservation program.

2. Current State Plans amount only to inventories, status reports and progress reports, which are inadequate for assessing archaeological significance. The State Plan should contain a planning framework for the practical management of the state's resources. A research orientation should be employed to structure practical management assessments for determining the significance of cultural resources. It is through the research process that management practices change, so that a State Plan, by its very nature, is a dynamic document.

3. Funding for state planning is a cooperative federal-state-private venture. There should be substantial federal encouragement to upgrade and revise State Plans to accomodate the particular concern of significance for cultural resources. Encouragement should take the form of provision for a 70-30% match for survey and planning purposes as provided by Section 102C of the National Historic Preservation Act of 1966, as amended, and provision by the Heritage Conservation and Recreation Service
[20] vice of revised guidelines for the State Plans. State appropriated funds, in-kind matches and the solicitation at the state level for contributions from the private sector constitute means to implement the revised functions for State Plans.

4. State based planning can be successful and credible only if given the opportunity for open participation by the archaeological community. In formulating State Plans it is therefore incumbent upon the State Historic Preservation Officers and the federal agencies to work with professional archaeological organi-
[21] zations in states where they exist. In states without such organizations the State Historic Preservation Office, federal agencies, and national archaeological community should cooperate in fostering the development of such organizations.

5. The State Plan is the vehicle for coordinating the management of the state's cultural resources. Maintenance of a data base consisting of site inventory records, supporting documents, and study results is a major charge of the state. [22]

Federal-State Commitments

These recommendations are intended to reinforce the mandate given to the federal government to take the lead in the identification, protection and enhancement of our nation's cultural and historic environment.

We encourage the Advisory Council to explore various means to improve and enhance mechanisms for better communication between the federal agencies with cultural resource responsibilities, the profession and the general public. The support of the President could be solicited to assist in this effort.

Sound archaeological judgements depend upon the availability to the profession of the results of federally-sponsored cultural resource activities. Furthermore, an informed and supportive public deserves the opportunity to understand and appreciate the cultural resource activities undertaken by federal agencies. Therefore, we recommend that the federal agencies be encouraged to develop and implement a mechanism for dissemination of such information in such forms as indices, annotated bibliographies and summaries of the cultural resource activities, as well as more popular accounts for the general public. Also, [23]
in order to increase the effectiveness of interaction between the professional archaeological community and federal agencies, we recommend the dissemination by the agencies of information about cultural resource policies and procedures. [22]

To avoid or eliminate unnecessary delays in federal program planning we recommend that the Advisory Council revise its procedures in

order to expedite the execution of Memoranda of Agreement under their Section 106 review process.

Because the State Plan has been recognized as the critical element in achieving an efficient preservation program, we recommend that the Advisory Council explore ways of improving and strengthening the position of the State
[24] Historic Preservation Officer in state government. Furthermore, the Advisory Council should urge the President to provide the full funding which has been authorized by Congress for all historic preservation programs.

An efficient state planning process has been recognized as a reflection of the state-federal commitment to historic preservation, and we therefore urge the Secretary of the Interior to use his authority in Section 102C of the 1966 National Historic Preservation Act for the
[25] 70-30 percent funding formula.

The Advisory Council should urge all federal and state agencies to recognize that adequate curation of cultural resources (both collections and data) is an integral and necessary
[22] part of their responsibilities.

We recognize the need for increased professional competence in cultural resource management throughout the federal government. Therefore, we recommend that efforts be directed toward upgrading the Civil Service Commission standards of professional competence and the agencies' standards of per-
[26] formance in archaeology. We also recommend that the Advisory Council provide for high level professional archaeologists in their Washington and field offices, and that the Advisory Council urge all federal agencies to develop cultural resource management awareness training programs for their non-archaeological employees.

We recommend that all federal agencies be required to undertake field investigations to locate and identify archaeological resources and to make evaluations of their significance, whenever a federal undertaking involves land modification, in order to prevent inadvertant destruction of these resources. Such investigations should be conducted as a part of the pre-project planning and should be made before the implementation of procedures for determination of National Register eligibility.

We recommend that federal agencies, before contracting for archaeological services, should insure that the contracting organization or individual has the professional capability and resources to fulfill the contract in a manner consistent with historic preservation policies. [27]

Archaeological site preservation, sanctioned site destruction, and professional credibility

In order to participate fully and effectively in the federal process relating to the conservation of the nation's archaeological resources, the archaeological profession must take a strong stand for the preservation of archaeological resources, must make difficult and well-reasoned decisions which may sanction the destruction of archaeological resources and must maintain high professional standards.

Definitions:

1. *Protection:* we use the term "protection" in the archaeological context to refer to the review process of the Advisory Council on Historic Preservation, as codified in the Council's "Procedures for the Protection of Historic and Cultural Properties" published in 36 CFR 800.
2. *Preservation:* we use the term "preservation" to refer to maintenance of archaeological resources in or on the ground in perpetuity. Some active arrangement to guard against the accidental or purposeful destruction of the preserved resource is implied by the term. Such an arrangement may range from withholding knowledge of the location of a site to its actual purchase.
3. *Conservation:* we use the term "conservation" to refer to the wise use of archaeological resources through time. Techniques

of conservation include protection, preservation and data recovery, as well as other archaeological resource management tools.

Preservation

The preservation of archaeological resources should be a prime goal of the federal-
[14] state historic preservation program and for the following reasons: archaeological resources are non-renewable parts of the cultural environment, only a small proportion of which is considered in any kind of protective decision-making process; archaeological perceptions of data change through time (as occurs in every dynamic science); and techniques for recovering such data are continually improving. Only if this goal is effectively pursued can the national policy to protect and enhance the cultural environment of the nation be achieved. While data recovery in the salvage setting may often be appropriate, we urge that the following principles be recognized:

1. The preservation of archaeological resources should be viewed as the preferred management alternative. Once implemented, preservation of a given resource or set of resources should remain in effect until some wiser use of these resources can be convincingly demonstrated. Such use may, for instance, include data recovery operations for salvage forced by changed circum-
[28] stances, or for pure research purposes;
2. The goal of archaeological data recovery must be to obtain the greatest amount of archaeological data for the least amount of archaeological resource destruction, and
3. Archaeological resource preservation may be a cost-effective means of avoiding the expenses relating to archaeological data recovery and to the curation of the resultant materials.

We are concerned that insufficient consideration has been and is being paid to the preservation of archaeological resources by federal agencies, by the Advisory Council on Historic Preservation and by the archaeological profession. We urge that preservation be given a greater role in the management of archaeological resources, and that, in any revision of federal cultural resource procedures, this principle be embodied in all appropriate places.

Recommendations to the Profession

It is clear that the continued success and improvement of the federal cultural resource management program is greatly dependent upon the maintenance of high professional standards by all members of the archaeological community. Accordingly, we urge the following policies be adopted by all those involved in the program:

1. If preservation of the cultural resources is not possible, the first responsibility of the archaeologist is to fulfill the terms of a cultural resource contract through the employment of a professionally acceptable data recovery strategy. If it is the professional judgement of the archaeologist that the Request for Proposal and Scope of Work do not allow good archaeology, the archaeologist should not respond to the Scope of Work. The archaeologist should, however, supply the agency with a detailed explanation as to why the Scope of Work was not
acceptable. [29]
2. In order to avoid misunderstanding between the contracting agency and the archaeologist accepting the contract, the work to be performed must be stipulated in detail in the legally binding contract. Any deviation from such contractual agreements must be agreed to in writing by both parties prior to their implementation. Archaeologists should avoid promising more than they can deliver and should demonstrate their ability to complete the contract.
3. Archaeologists should provide contractors with maximum results for reasonable costs and should not inflate the cost of a project in any way. It is, for instance, unethical to impose personal or institutional

research goals on projects when such action results in costs above those which would otherwise be necessary to fulfill the con-
[30] tract. Such actions severely harm the credibility of the archaeological profession.

4. It is a prime responsibility of archaeologists to inform the public about their goals and accomplishments and about the public benefits thereof. It is equally important that the sponsor be provided with a report which not only meets contract requirements, but is also intelligible to that sponsor. In certain cases, this may require that portions of a report be summarized in terms readily understandable by the non-
[31] archaeologist.

Sanctioned Archaeological Resource Destruction

There are situations in which archaeological resources must be destroyed without mitigation. Accepting that such destruction may be a necessary part of the federal cultural resource management program, how are the decisions best made as to which parts of a set of archaeological resources might be destroyed?

There are two separate points in the management process at which the decision to allow the destruction of archaeological resources may be made. The first occurs when a set of resources is determined not to be eligible for the National Register. The second point at which it may be decided to allow archaeological resources to be destroyed occurs in the formulation of management plans for the appropriate treatment of National Register eligible resources. The need for such a decision may arise for the simple reason that, once all significant resources have been identified, it may be impossible to mitigate the adverse effects of a project on all of those sites. While such situations are extremely unfortunate and run counter to the intent of the law, it should be recognized that they do nevertheless arise.

Therefore, we recommend that, in situations in which adverse effects upon National Register eligible sites by federally related projects cannot be avoided, the federal agency should solicit, and the archaeologists should provide, the best professional judgement about alternative mitigation strategies. Such strategies should recognize that archaeological resource significance is not an all-or-none affair and that some National Register eligible sites are of greater import than others. The preferred mitigation strategies may include some combination of archaeological data re-
covery and resource destruction. Detailed [32]
documentation and explanation of all steps of all alternative mitigation strategies should be supplied, and all such steps should be congruent with the state or regional archaeologi-
cal resource management plan. [33,34]

Adrian Anderson (Iowa State Historical Commission)
Lawrence E. Aten (U.S. Department of the Interior)
James E. Ayres (University of Arizona)
Sarah Bridges (U.S. Department of the Interior)
Carl H. Chapman (University of Missouri, Columbia)
John L. Cotter (University of Pennsylvania)
Hester Davis (Arkansas Archaeological Survey)
Donald K. Grayson (University of Washington)
Ernestine L. Green (U.S. Forest Service)
James J. Hester (Advisory Council on Historic Preservation)
Alexander J. Lindsay (Museum of Northern Arizona)
Fred Plog (Arizona State University)
David G. Rice (University of Idaho)
Michael E. Roberts (Harvard University)
Bert Salwen (U.S. Department of the Interior)
Robert L. Stephenson (University of South Carolina)
Raymond H. Thompson (University of Arizona)
Curtis Tunnell (Texas State Historical Commission)
Fred Wendorf, *Chairman* (Southern Methodist University)
Rex L. Wilson (U.S. Department of the Interior)

W.N. Irving	F. Levine	C. Irwin-Williams	J. Word	D. Scott	R. Kelly	G. Somers	J. Welch	R. Yerkes	L. Davis	T. Cook	R. Desautels	G. Lewis	L. Zimmerman	D. Henry	L. Reynolds	Burkstra, et al.	B. Sudbury	C. Toulouse	J. Judge	James Hinds	W. Creamer	Molitar & Opperman	C. Chaloupka	G. DeGarmo	C. McNutt	Jane Rosenthal	J. King	J.P. Wilson	A.S. Downer	A.K. Guthe	Jan Dyck	
	A	A	A			A	A		A			D	A				A		A								A			A	A	1. State Plan should be central focal point for planning
						A										?			D								D	A				2. Site Preservation is the best alternative
		A																												A		3. S.H.P.O. needs an archaeological advisory council
																												A				4. Need to do inventory at earliest stage of planning
																				A						A		A				5. Need a central data repository
																												A	A			6. Research and mitigation are different goals than management
	A	A				D																		A			D					7. Advisory Council should be the Preservation Advocate
						A													A							A						8. Supports upgrading of Civil Service Requirements for archaeologists
	A	A						A																		D						9. Need to augment the performance of the S.H.P.O.
					A						A												A									10. Need to recognize Native American values
		A																					A			A						11. Need revision in the National Register nominations and eligibility forms
				?																			A									12. Compliance foul-ups are due to the A.C.H.P. guidelines
																						A										13. Curation needs should have higher priority
																A		A														14. Need a better site protective system
													D		A																	15. Supports concept of regional centers
		A	A				A		A																							16. Need for public input and dissemination of information to the public
										A				A													A					17. Need for superior research as a part of mitigation
																								A								18. Supports concept of regional research designs
																				A	A											19. Need to justify sanctioned site destruction

Footnotes

1. It has, however, been suggested that consistency is undesirable, and that each assessment of significance should be made in the light of its own, unique set of circumstances. (Fox)

2. Not all federal agencies involved in cultural resource management were represented. (Scott)

3. The far West (Oregon, and especially California) were not represented.

4. There was one advocate for the use of informal check-lists. (Henry)

5. It has been suggested that a "significant" "representative sample" of sites might in fact be preserved (a certain percentage of every type of site). (DeGarmo, Hinds)

6. This is not universally accepted. (King)

7. There is some feeling that regions are a more useful division than states. (Lewis, Davis, McNutt, Henn)

8. Compliance and eligibility procedures are too long and complex. (Rosenthal, Chaloupka)

9. Federal agencies are also responsible for making decisions of Register eligibility (Roy); and ultimately decide the fate even of eligible occurrences. (Henn)

10. There is some doubt that significance really can be assessed purely on the basis of field-surveys. (DeGarmo, Yerkes, McNutt)

11. It was pointed out that a clear distinction must be maintained between the State Plan and the Annual Preservation Plan. (Downer)

12. The "regions" should play a part in the development of State Plans. (Henry, McNutt)

13. While there was some comment that the Advisory Council has an obligation to act in the interests of preservation (Irwin-Williams), it was also felt that it cannot be expected to do so and that archaeologists should be their own advocates. (King, Somers)

14. There is general agreement with the point, provided that "preservation" also implies protection if necessary (Wilson, Limp et al.), but there is also some feeling that the statement is rather inflexible: that excavation might sometimes be preferable, such as to prevent site-deterioration from natural causes or to "use the cultural resource" by obtaining knowledge from it now, rather than later. (King, Judge, Henn)

15. It was felt that the agencies are not consistent in interpreting the laws (McNutt), but also that greater reliance should be placed upon the agencies and less upon the Advisory Council. (Scott)

16. It was suggested that the State Historic Preservation Officer should also develop a monitoring system, and that effective compliance should be integrated into the State Plan. (Roy)

17. There is however, great variability in standard between State Plans, from highly sophisticated to almost non-existent. They also have some tendency to become rigid and fossilised. (Irwin-Williams, Levine, Lewis)

18. It was suggested that there should be a schedule established for the completion of the State Plans. (Guthe)

19. However, State Historic Preservation Officers are political appointees and therefore open to political pressure; some know very little about archaeology proper and would therefore not be competent to administer or revise State Plans; some can be actually unhelpful (it was suggested that there might be a need to monitor S. H. P. O. s). Finally, in states with tightened budgets (notably California), the Office of the S. H. P. O. no longer has the staff necessary to create a State Plan, so that the Office could arrange to have a Plan drawn up, but could not do the work itself. (Irwin-Williams, Rosenthal, Guthe, Yerkes)

20. It was observed that the Heritage Conservation and Recreation Service Branch of Plans seems to be moving away from true planning towards "program management". (King)

21. There was felt to be a need for a survey of the states' archaeological councils and that those states lacking such bodies should be actively encouraged to create them. Such encouragement could involve an actual requirement that the State Historic Preservation Officer consult with the state archaeological council (which might also help to improve the standards of the S. H. P. O. s), it was also suggested that the relevant ethnic groups (such as Native Americans) should be consulted as well as interested members of other disciplines, such as ethno-historians. (Irwin-Williams, Kelly, Brugge)

22. There is also a need for a central, national source of site-survey information and other data, and a nationwide system of federal curation facilities might not be inappropriate. (Wilson, Rosenthal)

23. There is some feeling that archaeologists themselves should be responsible for the dissemination of popular accounts of their work. (Somers)

24. and of the State Archaeologist. (McNutt)

25. These funds might be used in part for strengthening the Office of the State Archaeologist, if this permissible. (McNutt)

26. The Civil Service should be sure that their "archaeologists" really have been formally trained as such, and should recognise that there are two types of M. A. degrees (the M. A. proper, and the "failed Ph. D."). The Advisory Council itself might recommend improved standards of professional competence for the Civil Service. (McNutt, Judge, Rosenthal)

27. It should also be ensured that the project-schedule in the Scope of Work is realistic, and it is suggested that funds be assigned in accordance with the importance of the cultural resources, not as a fixed percentage of the total project costs. (McNutt, Kelly)

28. The fear was expressed that, since techniques are continually improving, it might be difficult to determine when "pure research" is justifiable. (Somers)

29. The archaeologist should also inform the State Historic Preservation Officer why the Scope of Work was not acceptable. (McNutt) The question was raised of whether an agency would be taken to court if its (inadequate) Scope of Work was rejected by all archaeologists, and it nevertheless continued the project without mitigation. (Somers)

30. It was widely felt that research must have a place in contract work since it deals with a research resource; perhaps "inappropriate, idiosyncratic or unrealistic" research goals should be avoided. (King, Downer, Limp et al., Reynolds, Cook)

31. An additional Recommendation: The archaeologist accepting a contract shall inform the appropriate agencies (the State Historic Preservation Officer, the State Archaeologist and the archaeological council of the state(s) concerned) of the planned work (including plans for curation) as soon as the contract is awarded; he shall remain in contact with them during the work, which shall be performed in accordance with the State Plan, and shall supply to them complete records of all observations and activities. (Sudbury, McNutt)

32. It was noted that some archaeological resources, such as petroglyphs, can be reproduced if destruction is inevitable. (Swanger)

33. Several Californians said there was no mention of their having to bring in the Indians.

34. A couple (Toulouse and Molitar/Opperman) thought something ought to be done about protecting all sites, not just those that get involved with the Feds.

APPENDIX B

ARCHAEOLOGICAL FIELD METHODS

The following discussion provides the reader with an idea of the field methods used by many archaeologists at present to identify areas of site potential, locate sites, and recover data from sites unavoidably endangered. These methods vary from the on-land to the nearshore and offshore cases. The organization of this section deals with reconnaissance survey (all environments), intensive survey (all environments), site evaluation (all environments), and data recovery.

B.1 RECONNAISSANCE SURVEY (LAND)

A reconnaissance survey is designed to give planners an idea of where significant archaeological resources may be. In practice, reconnaissance survey is usually performed over a relatively wide area, some portion of which will ultimately be selected as the site of a land-moving construction project.

Once the area is established, it becomes important to identify those sections of the project area that have been so disturbed that if properties were extant their integrity would be too much comprised to qualify them as eligible for the National Register. Disturbance can be assessed through interviews with the consulting professional engineer (PBD, ect planner) and the local or regional engineer for the town or district. Disturbance can be inferred from the existence of buried utilities installations, whose original emplacement would have severely disturbed the subsurface soils. Another source of disturbance may be previous construction that may have stripped or filled various sections of the project area. It is important to note that the mere existence of some disturbance does not rule out the possibility that intact properties exist. The depth and magnitude of previous disturbance must be compared with the depth and magnitude of the proposed construction. If the former is less than the latter, significant historic properties may still be impacted.

At the same time, it has been demonstrated that the mere fact of disturbance does not eliminate a property from eligibility for the National Register. The types of data that can be recovered from a property must be assessed by the archaeologist.

The next step is to verify sites that are well known from documentation. Even though a review of previous disturbance indicates that the

project area is seriously disturbed, the location of previously known sites with respect to the project area should be pinpointed. Previously known sites are in general large, easily identifiable concentrations of cultural remains that, even though disturbed, may at some time have been determined eligible or may still qualify as eligible properties. In any event, the fact that previously known properties have been disturbed should be communicated to the official data banks.

The following sources of data should be checked at this time:

1. The National Register of Historic Places.
2. The files of the State Historic Preservation Officer (SHPO).
3. The files of the State Archaeologist (if different from the SHPO).
4. The files of universities and colleges known to be active in local archaeological research.
5. The files of local avocational archaeological societies.
6. The files of local historical societies and commissions.
7. The local or regional library or libraries.
8. The local town hall, etc. (especially the offices of the Town Clerk and Assessor).
9. Any local or regional museum.
10. This present study.

The archaeologist and others using these sources must be cautioned that the accuracy of much of this information is variable and must be evaluated before the analysis of archaeological potential is accomplished. Part of the process consists of reading local and regional histories and noting references to historic properties that appear to be in the project area. These histories can be found in widely scattered places and not necessarily in the local area. As with those in the official records, the location of properties described in these histories may not necessarily be accurate, and field checking is the best way to confirm their location.

At this point a decision must be made regarding the continuation of the survey. If it is clear from the analysis of past disturbance and other factors that no significant properties will be impacted then no further work may be required. If it is determined that no further work is required, then a report should be written documenting the condition of the project area and containing sufficient data to assure the reviewing authorities that no significant properties will be impacted. This is a highly unlikely eventuality at this stage, however, since in earlier steps of the historic preservation process the project designer and the SHPO or other reviewing archaeologist will have determined in general terms the extent of previous disturbance.

If the survey is to continue, the next step is to locate those properties that are known from local sources. This operation has been so far

delayed because it is considerably more labor-intensive than the location of properties recorded in well known and easily available documentation.

The basic approach is interviewing local collectors of artifacts. While in general collectors reside in the local area, in some cases the most active live elsewhere (being summer residents, casual visitors, etc.). The identity of collectors is in many cases known to residents of the area, who must be interviewed in order to find them.

Once data have been gathered concerning well known or locally known sites, the next step is to obtain data that will assist in the prediction of unknown sites. The prediction of sites is based on models of past human occupation or resource utilization. These models are continually evolving and are usually based on existing concepts of human use of the environment. Thus it is that reconstruction of past environments is essential in the development of predictions about the location of properties. Once the survey area's environments are reconstructed, it is important to apply regional theories of settlement distribution supported (or contradicted) by the location of known sites identified in earlier steps of the survey. The result should be a hypothesis about the location of various types of sites. This hypothesis will be tested in the field by the various methods employed by the archaeologist. It must be emphasized that the survey should be designed to locate all the properties in the survey area, and that hypotheses leading to the "prediction" of site location are merely that, hypotheses, and will not guarantee the location of all sites. However, well-thought-out predictions by archaeologists with experience in the location of sites in the region are more reliable than predictions by those less well qualified.

The major contribution of environmental reconstruction and settlement prediction is to establish the intensity and depth of field testing required to locate properties. At the same time, too much reliance on predictive models can become blind adherence to possibly fallacious hypotheses and thus lead to testing that may fail to discover properties. Thus while prediction can make the process of site location more efficient (if valid hypotheses are used), the use of good judgment, based on experience and scholarly evaluation of the background data, is also necessary.

The reconstruction of past environments to assist in the prediction of historic property location is by its very nature complex. However, much of the necessary data is usually available at the time a survey is initiated. The kinds of data that are useful to the archaeologist for this purpose are represented in the following list (although many archaeologists will expand the list on the basis of personal experience or other information):

1. Geohistory

2. Hydrology
3. Climatology
4. Floral and faunal studies

The geohistory of an area is available in documentation (maps, reports, etc.) that reveals the changing pattern of land form and deposition of soils. This category includes, but is not limited to:

1. Bedrock geology.
2. Surficial geology.
3. Soils data.
4. Land-form studies or topography.

Bedrock geological data can be used to indicate formations that may lead the researcher to outcrops of special materials useful to prehistoric and historic populations. Examples are soapstone and copper.

The local topography will in many ways be determined by the bedrock geology, which will define the slope of the land surface and thus be factored into predictions of site potential. Surficial geological data illustrate the results of glacial scouring and other phenomena, and can be useful in reconstructing land forms of the near post-Pleistocene Period.

Bedrock and surficial geology, coupled with data from soil surveys, will lead to an analysis of post-Pleistocene soil deposition and of the chemical and drainage characteristics of this soil. It is important in the development of a field strategy to understand the processes and chronology of soil deposition. For instance, the recurring deposition of alluvium (as in a flood plain) will perhaps enhance the potential for diachronic separation (stratification) by preserving cultural strata sandwich-wise between layers of sterile soil. Similarly, heavily alluviated areas may require the use of heavy equipment in order to get deep enough to locate impacted properties (although one must remember that testing should only be done to the depth that is expected to be disturbed by the project). Areas of thin soils may only require the use of hand tools for the same purpose. The chemical and drainage characteristics of the soil can be used to predict the occurrence of soil types known to have been favored by the early populations for occupation, farming, or other activities.

Hydrological data provide the researcher with information pertaining to the location and distribution of wetlands, springs, watercourses, and possible near-surface aquifers. All of these features can be factored into the process of predicting site location because proximity to water was an essential consideration in settlement location by early populations. At the same time, islands or rises in wetlands tend to be highly favored site locations.

The local climate of the survey area, coupled with the past and present topography as derived from geological information, will give the researcher a sense of the location of those areas that may have been used by previous populations as protected habitation sites or for other purposes.

It should be remembered, however, that present climates do not necessarily reflect those of the past. Thus paleoclimatic data must be used in prediction as well.

The nature and distribution of present-day flora and fauna can provide an index to soil chemistry, drainage characteristics, and other ecological data that may be clues to the areas favored by previous populations or areas exploited by those populations.

The prediction of settlements and settlement systems has not presently reached a state of great sophistication. (Thus the warning given above concerning over-reliance on predictive methods to locate all properties in a project area.) However, well-thought-out prediction can provide a level of confidence that properties will be located in a more cost-effective manner than would be achieved by subjectively-directed subsurface testing. At the same time, a compromise between dependence on theoretical prediction and the individual's best judgment seems the most appropriate strategy for maximizing accuracy in locating properties. It should also be noted that prediction becomes increasingly powerful as it is reinforced by new techniques and additional data.

Once data concerning settlement prediction have been collected and analyzed, and a degree of confidence in their reliability has been established, it is time to apply these data to the task of prediction in the project area. This is in general a process of "stratifying" the project area in terms of its archaeological potential. Zones of the project area are, on the basis of the analysis of background data, assigned various levels of probability that they will contain historic properties. The strata may be identified as "primary," "secondary," or "tertiary," although other terminologies may be used.

For a reconnaissance survey, it is now time to undertake limited testing in order to locate those areas of previous disturbance that may be unknown to official sources and to verify the environmental analysis.

This testing will generally consist of a walkover survey of the project area, accompanied by some limited subsurface testing designed to locate disturbance (as identified by disruption of soil layers). It is possible that this testing will happen upon previously unknown properties but the limited testing itself is not meant to locate all the resources to be impacted by the project.

The testing may employ one of several techniques, whichever may be considered by the consulting archaeologist to be the most reliable method of meeting the requirements of the strategy. In many cases, combinations of techniques will be proposed. Some, but not all of the possible techniques are:

1. Soil coring.
2. Shovel test pitting.
3. Area clearing (wide test excavations exposing large areas of subsurface soil).
4. Post-hole excavation.
5. Chemical soil testing.

The field work is also designed to verify the conclusions developed in the environmental analysis and initial stratification. This is done, of course, by direct observation of the local environment.

A report analyzing the area's archaeological potential should be prepared at this time. For a sample report outline, see below.

The final report of a reconnaissance or intensive survey should document all the background data used in the initial analysis and provide the reviewer with a framework within which to evaluate the potential significance of sites discovered in the location process. This can generally be done by describing the historic and prehistoric background of the region and the local area.

The reports should contain, but not be limited to, the items found in the following outline/check list.

- Abstract
- Table of Contents
- Introduction
    - Outline and Justification of Background Study and Field Work
    - Relevant Federal and State Legislation (by citations)
- Site Location
- Project Description and Impact
- Environmental Description
    - Climate
    - Physiography
    - Geology
    - Hydrology
    - Soils
    - Flora
    - Fauna
- Land Use and Prior Disturbance of the Project Area
- Overview of Regional Historical and Prehistoric Resources
    - Paleoclimatic Reconstruction
- Overview of Local Historic and Prehistoric Resources
    - Description of Known Sites in Area
    - Prediction of Areas of High Potential

Field Work
  Methodology
  Results (profiles, descriptions, cultural materials, chemical tests)
Impact Evaluation
  High potential/moderate potential/low potential areas for analysis of potential
  Sites for intensive survey or site evaluation
    Description, extent
    Eligibility for the National Register of Historic Places, justification (if evaluation study also done)
  Secondary impact
Conclusion
  Recapitulation of areas of archaeological potential or sites (primary and secondary impact)
  Further work or mitigation needed
    Estimated time and labor required
Bibliography
Acknowledgments
Illustrations
Appendices
  List of collections
  List of collectors
  List of known sites

B.2 RECONNAISSANCE SURVEY (NEARSHORE)

This zone is currently the one that receives least adequate archaeological attention, a fact that results primarily from the limitations of existing technology. Another factor is the unwillingness of the present survey companies to undertake the additional expense of using shallow-draft vessels for nearshore survey. However, shallow-water surveys have been successfully carried out in the past. An example is helicopter-borne magnetometry as employed by Arnold (1978). Magnetometers have also been placed in rubber rafts and towed behind shallow-draft boats, making it possible to survey virtually up to the shoreline (Warren Riess, personal communication). It is also possible to fix a sub-bottom profiler to the bow of a shallow-draft boat, rather than dragging it behind as is normally done (Warren Riess, personal communication). However, this technique is limited to depths greater than 10 or 12 ft because of the "noise" characteristics of the equipment. Similarly, some side-scan sonar systems can be used so that they look sharply sideways into shallow water while the survey vessel itself cruises further out (Klein Associates, n.d.). Another shallow-water technique is the use of aerial photographic survey, which should be done in black-and-white, color, and infrared during periods of optimum sea state and lighting but minimal algal bloom. A further possible refinement of nearshore

survey from boats could be accomplished by use of a radar positioning system, such as the Mini-Ranger, to achieve more accurate plottings of survey tracks followed by other instrumentation. An inherent limitation on radar positioning systems, of course, is that they must normally operate within 20 miles and line-of-sight from shore reflectors. Other navigational systems, such as those that use range markers and theodolites or transits with programmed calculators, are often used in academic projects having a large pool of student labor, but they are highly labor intensive and may not be cost-effective from the point of view of commercial employers.

In certain parts of the nearshore zone, it may simply be impractical to perform effective survey. Examples are salt marsh and shallow lagoon, where the only easy alternative may be helicopter-borne magnetometry. In such cases, it may be important to supplement magnetometry with coring techniques of the kind developed by Anuskiewicz (personal communication). An ideal combination might be coring and the use of a helicopter for both magnetometry and aerial photography as described above.

B.3 RECONNAISSANCE SURVEY (OFFSHORE)

The location of archaeological sites offshore is normally performed by remote sensing techniques. The same techniques are used by geophysicists to identify potentially hazardous zones or features in a potential lease area. Thus the "hazards analysis" in many ways performs the functions and meets the needs of a reconnaissance offshore survey. What follows is a discussion of the techniques employed and the way archaeologists can use them in reconnaissance survey.

Typically, 3 or 4 seismic instruments are simultaneously utilized during field acquisition of data: a sub-bottom profiler, a mid-range seismic boomer, and/or a seismic sparker. A sub-bottom profiler produces a sound whose frequency is 3.5 to 14 kHz (Fig. IV-B1). The frequency of the soundwaves is great enough to allow penetration of the sea bottom, reflection off geophysical layers typically down to 60 m (200 ft) below the water-sediment interface, and return to the hydrophone receiver. The hydrophone converts the soundwaves into electronic impulses which are recorded on the survey vehicle. Transmitting and receiving are performed by the same fish (hydrophone) towed behind a survey vessel. The data record, when properly interpreted, indicates the existence, depth, and consistency of various geophysical strata and large objects, which have implications for site location.

Mid-range seismic boomers and sparkers are similar to sub-bottom profilers, except they produce and receive higher energy, lower frequency soundwaves. These waves penetrate deeper, down to 1,200 meters (3,900 feet), into the sea floor.

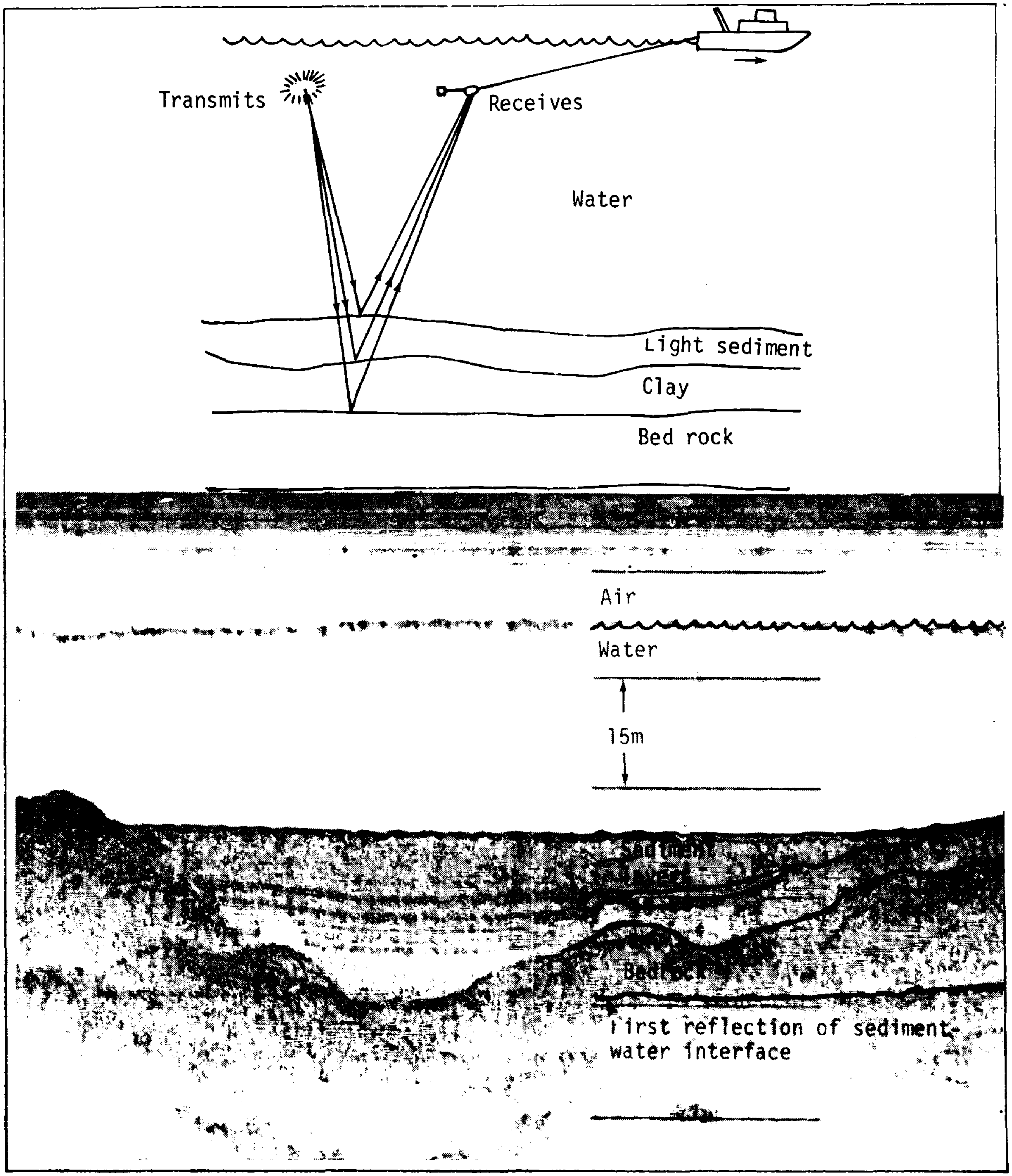

Fig. IV-B1

(A) Sub-bottom profiler being towed; (B) a typical analog record (provided by Klein Associates, Inc.).

While bottom-penetrating instruments are being towed, a side-scan sonar equipment and a magnetometer are towed to investigate sea-bottom topography and objects on or near the bottom, respectively. Side-scan sonar transmits high frequency sound waves in fan-shaped beams from a fish towed near the sea bottom (Fig. IV-B2). Objects or topographic features on the sea floor produce echoes which are received by transducers on the same fish. The high frequency of the unit allows almost no penetration; a relatively accurate map of the topography, or objects lying on the sea bottom, can therefore be made from side-scan sonar records.

A magnetometer records the earth's magnetic field. A proton-precession magnetometer measures the earth's magnetic field by aligning and then measuring the natural realignment of protons in an incased fluid. The earth's magnetic field naturally varies little over a small area. But iron, steel, or other ferrous objects, or in the case of prehistoric sites the burned and solidified soils of a fireplace (hearth), measurably change the field in their immediate area. A magnetometer will therefore indicate the presence of ferrous material or burned soil.

A number of geophysical conclusions are reached through interpretation of survey data. Geophysicists construct maps of the lease block, and suggest probable areas of hydrocarbon deposits utilizing seismic data obtained from the sub-bottom profiler, mid-range boomer, and sparker. Dangers to construction and operation can also be identified with sonic equipment.

Manmade obstructions can be particularly dangerous to offshore construction (Table IV-B1). Although some manmade obstructions, such as gas-filled pipelines, produce signatures on sonic records, a larger number of such objects will contain ferrous material and are thus best detected with magnetometers.

Archaeological resources require identification before they can be avoided, but such identification is difficult. Prehistoric inundated sites have been located by coring, but sonic detection signatures for prehistoric sites are presently not easily recognized (Ruppe 1978). Probable sites are therefore inferred from data which indicate pre-inundation topography. Prehistoric archaeologists recognize certain topographical features which often yield cultural remains just as they do in presently dry sites. Magnetic anomalies produced by ferrous material are rare in North American prehistoric inundated sites.

Seismic signatures for inundated historic sites also are not easily recognized, especially from the quick passes used on present surveys. However, some historic sites are recent enough to protrude above the sea floor. Side-scan sonar would show structural remains, such as pier pilings or chimneys. A fair number of iron and steel objects were used on historic sites, but except for cannon or caches of shot or tools, a site will often produce only many small anomalies which are

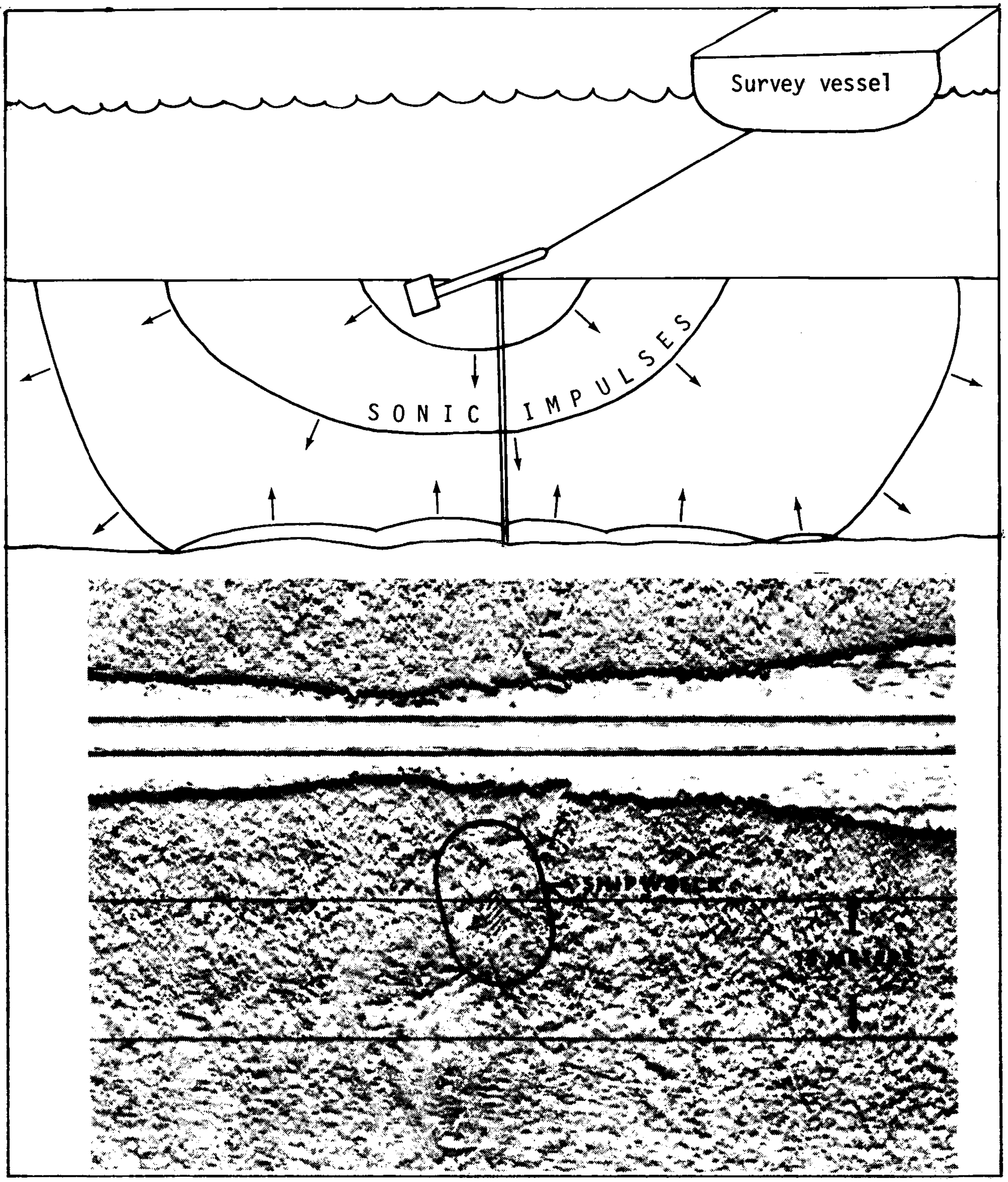

Fig. IV-B2

- (A) Side scan sonar being towed; (B) an analog record (provided by Klein Associates, Inc.) showing the frames of a shipwreck lying in a rocky shoal area.

Impacted Drilling and Construction Equipment

Dangerous Marine Obstruction	Drill rig Jack up (leg)	Drill rig Jack up (barge)	Drill rig Floating	Lay Barge	Jet Barge	Jet Sled	Crane Barge
Sunk ship	Serious damage	Serious damage	Foul anchor	Damage pipe; Foul anchor	Foul anchor	Foul sled and anchors	Foul Anchor
Pressure Pipeline	Serious damage; Death	Serious damage; Death	Serious damage; Death	Serious damage; Death	Serious damage; Death	Serious damage; Death	Serious damage; Death
Drill pipe Joint pipe	Serious damage	Serious damage	Foul anchor	Damage pipe; Foul anchor	Serious damage; Foul anchor	Serious damage; Foul anchor	Foul Anchor
Sub-sea Well head	Serious damage	Serious damage; Sink barge	Foul anchor; Serious damage	Foul anchor; Serious damage	Foul anchor; Serious damage	Foul anchor; Serious damage	Foul Anchor; Serious Damage
Cables/chain	Minor damage	Minor damage	Foul anchor	Foul anchor & pipe	Foul anchor	Serious foul sled	Foul Anchor
Ship Anchors Large	Negligible	Serious damage	Negligible	Endanger Pipeline	Negligible	Serious foul sled	Negligible
Anchors, small	Negligible	Negligible	Negligible	Negligible	Negligible	Foul sled	Negligible
Bombs	Serious damage	Serious damage	Negligible	Endanger Pipeline	Negligible	Serious damage; Death	Negligible
Mines	Serious damage	Serious damage	Negligible	Endanger Pipeline	Negligible	Serious damage; Death	Negligible
Torpedos	Serious damage	Serious damage	Negligible	Endanger Pipeline	Negligible	Serious damage; Death	Negligible
Mud Slide	Serious damage	Serious damage	Negligible	Over stress Pipeline	Negligible	Negligible	Negligible
Gas cones	Serious damage	Serious damage	Negligible	Over stress Pipeline	Negligible	Negligible	Negligible
River channels (Buried)	Serious damage	Serious damage	Negligible	Over stress Pipeline	Negligible	Lose control of ditch size	Negligible
Faults	Blow out	Blow out	Blow out	Over stress Pipeline	Negligible	Negligible	Negligible
Gas charged sediment	Blow out	Blow out	Blow out	Over stress Pipeline	Negligible	Minor damage	Negligible
Boulders	Serious damage	Serious damage	Negligible	Damage Pipeline	Negligible	Serious damage	Negligible
Reefs	Serious damage	Serious damage	Foul anchor	Damage Pipeline	Foul anchor	Serious damage	Foul anchor

Table IV-B1: The impact of various marine obstructions on drilling and construction equipment. (prepared by, and reprinted with permission from Oceanonics, Inc., Houston, Texas.)

not recognizable with present survey techniques. Historic inundated sites are therefore best recognized by side-scan records of protruding objects or magnetometer records of large ferrous objects.

Historic shipping remains from before 1860 generally have no massive ferrous cargo or equipment to produce a significant magnetic anomaly. Only a small percentage of ships had steam engines or carried iron cargo before 1860. Location of the wrecks of these ships therefore is similar to that for other historic sites, except that ship sites more often contain iron cannon which produce significant magnetic anomalies.

A dramatic increase in the use of ferrous metals on ships after 1860 was especially marked by the advent of steam engines and iron or steel hulls and super-structures. The remains of these vessels on the CS alter the local magnetic field enough to be easily detected by a magnetometer which passes close by. But as a magnetic anomaly can be caused by other factors, side-scan sonar and sub-bottom profiler data are important in the identification of these anomalies. Many post-1860 sailing vessels are low in ferrous materials. The techniques for locating these vessels are similar to that of pre-1860 vessels--necessitating magnetometer, side-scan sonar, and high resolution sub-bottom profiler to be towed over the survey area.

In present surveys, tow paths across a lease block are standardized at 150 m apart, producing a total data acquisition path, in the approximately 3 x 3 mi square block, of 100-120 miles. Including turns and navigational alignment before each run, a total tow path length of 240 miles is typical.

Accurate navigation is achieved by means of radio position-finding equipment. In sight of land, high frequency systems make navigation to within 1 m possible in ideal conditions (Arnold, 1977). Out of site of land, Loran systems, especially Loran-C, are commonly used to give accuracy to within 30 m. Private "in-house" radio navigation systems are able to produce 1 m accuracy out of site of land. Refinements in Loran-C receiving equipment, and satellite navigation systems promise increased offshore accuracy in the near future.

The swath covered by towed instruments varies with each type. As the mid-range boomer and sparker are not applicable to archaeological survey, it is the other instruments we will consider here. A sub-bottom profiler typically records a beam width of 50°. Thus, if the fish is towed 10 m (33 ft) off the bottom, a 9.4-m (30-ft)-wide swath (4.7 m or 15 ft to each side of the tow line) is recorded at sea bottom, and a 66-m (215-ft) swath is recorded 60 m (195 ft) below sea bottom. Although the swath is less than the 150-m (500-ft) separation between tow paths, sub-bottom profiler data are used more for indicating the local topography than for locating particular sites by their signature.

Side-scan sonar primarily transmits and receives its signal horizontally. Even under less than ideal conditions, its swath can cover the 150 m (500 ft) on either side to the next tow path. Side-scan sonar, therefore, gives 200% coverage of the sea floor topography in a lease-block examination.

Range for a magnetometer varies, as it does not transmit and receive a signal, but measures a magnetic field around it. The effect of an object on the earth's magnetic field is determined by its mass, and the anomaly in the field diminishes by either the square or the cube of the distance, depending on the object's magnetic property (monopole or dipole).

Magnetometers read in gamma units. Survey magnetometers typically are sensitive to one gamma. As interference from sea state and on-board electronics often causes a "noise" of 3 to 5 gammas, anomalies below 5 gammas are not noticed during normal surveys. One kg (2.25 lbs) of iron must be within 2 m (7 ft) of the magnetometer fish to be detected; 100 kg (225 lbs) must be within 10 m (33 ft); and 1,000 kg (2,250 lbs) must be within 23 m (75 ft). Thus, it would take a 78-ton piece of ferrous material to produce a 5-gamma (minimum detectable) anomaly if it were equidistant from 2 tow paths--75 m (250 ft) from each (Breiner 1973).

In terms of the location of different objects, a common iron cannon from an early seventeenth-century inundated site or merchant-ship wreck would have weighed approximately 670 kg (1,500 lbs). Only about one-third of the iron (about 225 kg) may still be present after 350 years of submergence in salt water.

This 225 kg of iron must be within 11 m (36 ft) of the magnetometer fish to register 5 gammas. If the magnetometer is towed 10 m (33 ft) off the sea floor, remains of the hypothetical cannon must be almost directly below the tow path and under little sediment. By contrast, almost all twentieth-century steel-hulled vessels contain more than 78 tons of ferrous material. They can therefore be located with little difficulty by present survey methods.

Until recently, data from the various survey instruments were only displayed and recorded by analog chart recorders. These recorders pushed out graph paper at a set rate while one or more ink needles indicated the quantitative reactions of the recorder's survey instrument. All of the graphs and navigation information were synchronized, by manual or automatic means, to facilitate later analysis. Some recorders used special damp paper and electrostatic charging, instead of dry paper and ink. Graphs produced by either the dry- or wet-paper method are referred to as analog data.

More recently, computers are becoming common in the analysis of survey data. Computers must use "digital," or numeric, data in their computations. For this reason some survey companies are now converting to digital recording equipment for their survey instruments. These recorders electronically convert incoming signals from the survey instruments to numerical values. These values are displayed and then recorded on magnetic tape, which is later fed into a computer for analysis (Fig. IV-B3).

Both analog and digital systems have negative features. Analog records are not as easily converted to digital values for computers as are the original survey instrument signals. This disability can be overcome by recording the original analog signal on magnetic tape. The tape can be played later, and the signal converted to digital values. Analog data, however, are more susceptible to fading in tape storage.

Digital display on board the survey vessel has the serious drawback of not showing a continual picture of its signal to the operator or field director of the survey unless he/she is properly experienced in such data evaluation. It is easier to detect a shallow bump on a continuous graph display than it is to detect the same from continuous observation of a changing numerical display. Immediate recognition of such anomalies may cause the survey director to make variations in a planned tow pattern. It is easier, quicker, and therefore far cheaper to make additional runs with a tow vessel during or directly after a planned survey, i.e. in real time, than it is to do the same a week later when the vessel, crew, and instruments must gear up and travel to the survey area again. An analog chart display is therefore sometimes produced before the signal is digitized and recorded on magnetic tape. As this procedure presents certain electronic problems the signal is sometimes digitized, recorded, translated to an analog signal again, and displayed on a chart recorder.

Once field data have been recorded, they are processed and analyzed. If the data are on analog graphs they are most often analyzed by hand. Contour maps and cross-sectional plans of the geomorphology are made. Magnetic anomalies are indicated on at least 1 map. If an analog tape has been made, a computer can convert the recording to digital values. These values are then plotted onto maps and cross-sectional plans. Although a computer can draw the contour lines and cross-sectional stratigraphy lines, smoother and probably more accurate lines can be drawn between the printed values by a specialist than by the normal computer used in survey work at this time.

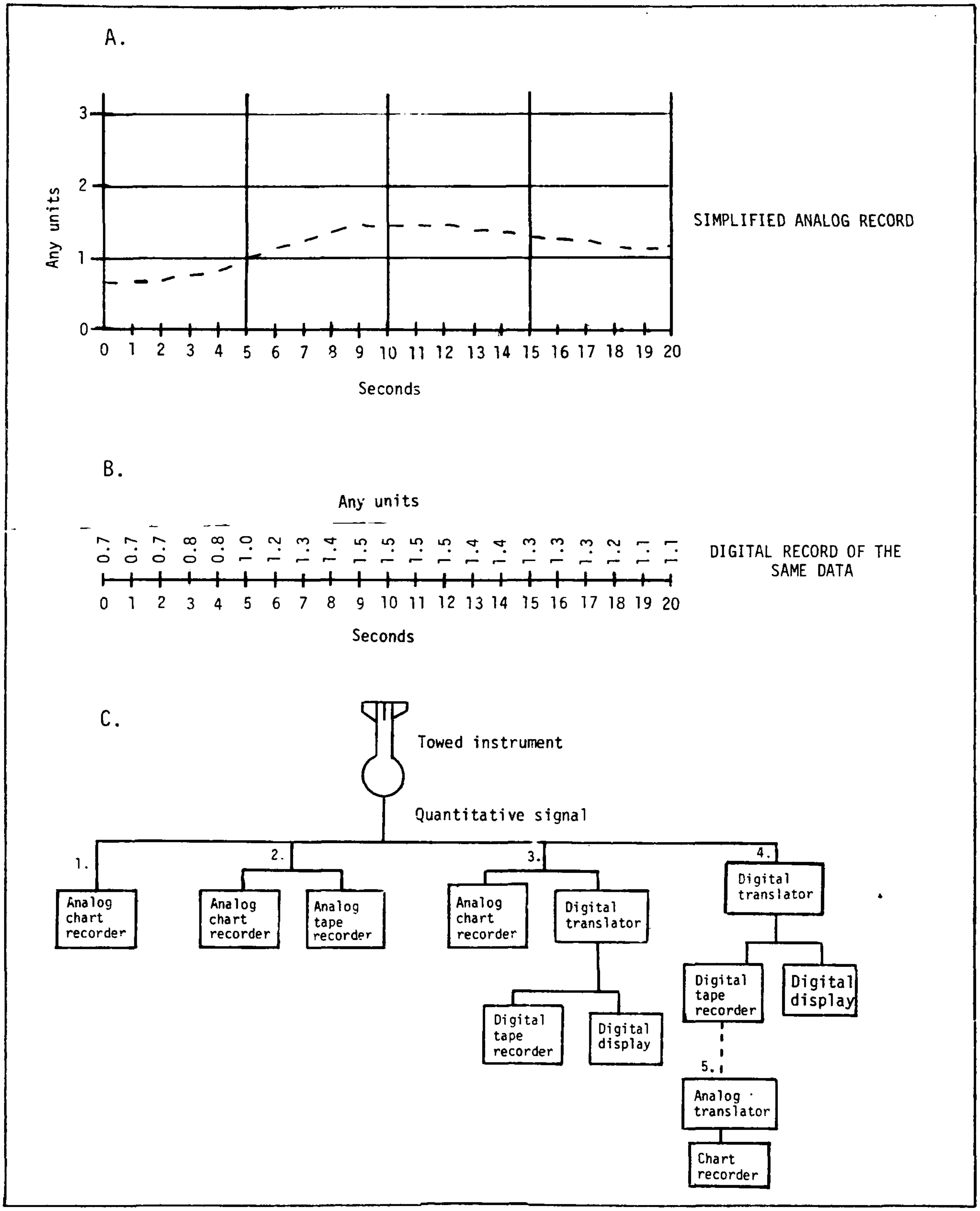

Fig. IV-B3

Analog and digital recording of survey data. (A) a simplified analog chart record of a hypothetical electronic signal from a survey instrument; (B) represents the translated digital record of the same signal; (C) a flow diagram of the five possible on-board data processes.

B.4 INTENSIVE SURVEY (LAND)

In an intensive or location study more intensive field testing is needed. The methods for this more intensive work are similar to those used in the limited testing of a reconnaissance study but are applied at much shorter intervals as defined by the stratification done during the background study. Limited field testing should be used to verify the accuracy of the stratification before intensive field work is begun. In general, however, strata with high potential will be subjected to more intensive testing than those with lower potential. Since an intensive study is designed to find all the properties in a project area, the archaeological consultant must be familiar with the techniques appropriate to the location of buried sites in an eastern woodland setting. The report should document the methodology employed in order to assure the reviewing agencies that everything has been done to insure that the project will not impact any significant unknown properties.

B.5 INTENSIVE SURVEY (NEARSHORE)

In this case, where the object of the survey is to locate any actual sites that may be impacted by underwater activity, it is certainly necessary to have the services of a qualified underwater archaeologist to examine the bottom surface for evidence of prehistoric or historic sites and to probe and take cores in order to help identify cultural resources that may be beneath the surface. It may be desirable to use an air lift, a water dredge, or prop blaster for the purpose of direct identification (see B.8).

B.6 INTENSIVE SURVEY (OFFSHORE)

While it is possible, as has been suggested earlier, that reconnaissance survey can be accomplisehd by the geophysicist in a hazards analysis or other similar process, intensive survey must be done by an archaeologist qualified to deal with the data which may be the evidence for archaeological sites wither of the historic or prehistoric period. Intensive survey in an offshore context generally means survey in the direct impact zone of proposed facilities. These facilities may be platforms (deep disturbance) or pipelines (shallow disturbance). The type of survey required will be a direct function of the expected depth of cultural resources and the proposed depth of construction. Locational techniques offshore are, to say the least, primitive. This stems from the fact that the remote-sensing "signatures" of all prehistoric and most historic sites have not been established. Thus the location of sites must rely on the use of coring, trenching, RCV monitoring of construction activities and other direct identification methods. It will be important then for professional archaeologists

who can identify the typical artifacts of the area's earlier cultures and in the analysis of materials recovered from coring or other operations. It should be noted that in most cases the activities of an archaeologist can and should be directly integrated into the normal activities of the exploration program, or the construction program. The primary impact to exploration or construction activities will come from sites that are located in this process. In general, however, the location of the site will constitute a major step forward in our understanding of the past and will clearly offset the damage form such discovery. Once discovered and evaluated, the site may become eligible for grants that will make possible the extraction of data the likes of which cannot be derived from the excavation of terrestrial sites. It should be noted that the overall constraints of construction are minimal in this process while the public relations benefits from the location of very early sites on the Shelf could be very important to the companies involved.

B.7 SITE EVALUATION STUDY (LAND)

Once sites are found in a location study, each must be evaluated in terms of its potential eligibility for inclusion in the National Register of Historic Places. This process generally takes additional background research and fieldwork. Regulation 36 CFR 63 contains procedures for requesting determinations of eligibility and Appendix A of these procedures gives guidance as to the level of documentation needed for such a determination. These regulations have appeared in the Federal Register and are quoted extensively herewith.

The recommendations concerning documentation come from the most recent version of Appendix A, as developed by the Park Service.

> This appendix gives guidance to Federal agencies in the preparation of the basic documentation (description, statement of significance, maps, and photographs) necessary to evaluate the eligibility for the National Register of districts, sites, buildings, structures, and objects. Where possible this documentation should be prepared by professionals in the fields of history, architectural history, architecture, and archeology. Although in some cases a determination of eligibility can be made on less information, the Department of the Interior recommends these guidelines as a general standard for the amount and kinds of documentation necessary to evaluate properties against the National Register criteria. The categories of information here are those required for nomination of properties to the National Register. Documentation submitted with determination of eligibility requests may be recorded on National Register nomination forms, although such forms are not required. If the information on the property has been compiled through a survey, the agency

should submit the survey report as part of the documentation. Information included in the survey report or in other material need not be recorded in the format suggested in this appendix. As long as the basic categories of information are provided, the agency may use any format for submitting this documentation, which it finds convenient. Each category should be provided:

I. Request for determination
II. Property name
III. Location
IV. Classification: district, site, building, structure, or object
V. Ownership
VI. Representation in existing surveys
VII. Description
VIII. Significance
IX. Bibliography
X. Geographical data, maps, and acreage
XI. Photographs
XII. Individual(s) compiling documentation

Many of these categories require only a very brief statement. Special attention should be given to VII Description and VIII Significance. Much of the guidance under VII and VIII applies to a specific classification of resource. Not all this information is required for each classification (building, site, district, structure, object).

I. Request for determination of eligibility
The name and address of the agency and the agency official making the request should appear in the letter of request or as part of the documentation. Communities requesting determinations of eligibility in accord with the "Environmental Review Procedures for Community Development Block Grant Program" (24 CFR 58) should certify that the request is made as part of planning for a community development block grant project.

II. Property name

C. Archeological site name. Archeological sites are generally named for the project, a nearby geographic feature, an aspect of cultural significance, the owner of the property, etc. For an archeological site with no name, use the numbering system in use in the State. The State site number should also be appended to the designation of a named site for cross-reference.

III. Location
Include the number and the name of the street or road on which the property is located. If the road has a number rather than a name, indicate whether it is a Federal, State, or county road.

If a property does not have a specific address, give the names of the nearest roads. For rural properties and others without specific street addresses, precise location may be specified by indicating the side of the road (North, South, East, or West) and exact distance from nearest intersection (North, South, East, or West). If a property is rural and in the vicinity of a town or city, this should be indicated. In the case of a historic district or similarly complicated property, inclusive street address numbers for all the properties within the district should be given.

IV. Classification

A. Categories. Classify the property in the appropriate category if possible. If it is unclear what category is appropriate, this should be indicated. Agencies may, for example, request assistance in determining whether properties should be considered individually or together as a district.

1. A "district" is a geographically definable area, urban or rural, possessing a significant concentration, linkage or continuity of sites, buildings, structures, or objects which are united by past events or aesthetically by plan or physical development. A district may also be comprised of individual elements which are separated geographically but are linked by associations or history.
2. A "site" is the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure whether standing, ruined, or vanished, where the location itself maintains historical or archeological value regardless of the value of any existing structures.
3. A "building" is a structure created to shelter any form of human activity such as a house, barn, church, hotel, or similar structure. "Buildings" may refer to a historically related complex, such as a courthouse and jail or a house and barn.
4. A "structure" is a work made up of interdependent and inter-related parts in a definite pattern or organization. Constructed by man, it is often an engineering project large in scale.
5. An "object" is a material thing of functional, aesthetic, cultural, historical, or scientific value that may be, by nature or design, movable yet related to a specific setting or environment.

B. Some properties may be most properly classified within two or more of the categories given above.

V. Ownership

Give the name of the owner of the property. Indicate "multiple ownership" for districts.

VI. Representation in existing surveys
Identify local, State, or Federal historic resource surveys that include or refer to the property in question. Include name of survey, date, and person or organization that conducted the survey. Federal surveys other than the National Register include, but are not limited to, the Historic American Buildings Survey, the Historic American Engineering Record, and the National Survey of Historic Sites and Buildings (National Historic Landmarks Program).

VII. Description
Description of the physical appearance and condition of a property is important in making an accurate assessment of its significance. To be useful, the description of the property should use appropriate professional terminology and should be concise, factual, detailed, and well organized.

B. Archeological site descriptions should include the following information:

1. Site type (e.g., midden, rockshelter, flake scatter, historic factory, etc.).
2. A description of the site including its immediate environment, using standard archeological terminology. If local terms are used, they should be defined. The following data should be included.
    a. Boundaries of the site and methods by which these boundaries have been defined.
    b. The immediately surrounding environment, both as it probably was when the site was in use and as it is today.
    c. Any disrupting influence (urban development, roads, agriculture) at work on or immediately around the site.
    d. Descriptions (or summaries) of known data on internal characteristics: stratigraphy, artifact classes and their distribution, structural remains, etc.
    e. Extent and nature of any excavation, testing, surface collecting, etc.
    f. Descriptions of any standing or ruined structures or buildings that might be of architectural or historic importance.
3. A list of pertinent previous investigations at the site, if any, indicating dates, institutions, or organizations responsible, and bibliographic references.
4. Quality and intensity of survey that resulted in recording the site; any limitations this may impose on the data available for purposes of evaluation.

D. District

4. Archeological district descriptions should include:

a. General description of the natural and man-made elements of the district: structures, buildings, sites, objects, prominent geographical features, density of development.
b. A statement of the date, level, and kind of archeological survey that has been done in the district.
c. A list of archeological properties within the district, including their locations. Data on individual sites, as required by section VII.B, should be appended.
d. A statement of the cultural, historic or other relationships among the sites within the district that make the district a cohesive unit for investigation.
e. A summary of the nature and level of damage the sites within the district have received or are receiving.
f. A statement of the extent to which the intersite relationships that give the district its cohesion remain intact.

VIII. Significance

A. Summary statement of significance. A statement of significance identifies qualities of the property that may make it eligible for listing in the National Register. A concise opening paragraph summarizing the possible importance of the property being considered should be followed by a more detailed account of the events, personalities, prehistoric or historic occupations, or activities associated with the property. This concise history of the property should be directed to a whole property, rather than some functional segment. Thus, it is inappropriate to discuss a mound and not an associated village, burial area, etc., or to submit a house and not the associated outbuildings, etc. A statement of significance should attempt to relate the property to a broad historical, architectural, archeological, or cultural context: local, regional, State, or national. For example, if a community has a number of neighborhoods with the same or similar qualities as the one being evaluated, this information should be included in the documentation. Any quoted material which appears in this section or the description should be footnoted. Quotations taken out of context must faithfully represent the meaning of the original source. Supplemental information, such as newspaper articles, letters from professional historians, architects, architectural historians, or archeologists, etc. may also be submitted as appropriate. The statement of significance for properties that are less than 50 years old; moved; reconstructed; cemeteries and grave sites; birthplaces; primarily commemorative in nature; or owned or used by religious institutions should address

the specific exceptions set forth in the National Register criteria.

B. Period(s) and area(s) of significance. Identify the area(s) and period(s) with which the property's significance is associated. This may mean date of construction, major alterations, or association with an individual, event, or culture, etc. For some archeological properties, assignment to a very general time period or periods may be sufficient. The following areas of significance are listed on National Register forms. Agencies may find it helpful to consider these areas in identifying and evaluating properties:

Archeology-Prehistoric: the scientific study of life and culture of indigenous peoples before the advent of written records.

Archeology-Historic: the scientific study of life and culture in the New World after the advent of written records.

Agriculture: farming, livestock raising, and horticulture.

Architecture: the style and construction of buildings and structures.

Art: concerning creative works and their principles; fine arts and crafts. Do not include architecture, sculpture, music, or literature here; specific categories are established for these areas.

Commerce: production and exchange of goods and the social contracts thereby encouraged.

Communications: art or science of transmitting information.

Community Planning: the design of communities from predetermined principles.

Conservation: official maintenance or supervision of natural or manmade resources.

Economics: the science that deals with the production, distribution, and consumption of wealth.

Education: formal schooling or the methods and theories of teaching or learning.

Engineering: the applied science concerned with util zing products and sources of power for supplying human needs in the form of structures, machines, etc.

Exploration/Settlement: the investigation of regions previously unknown; the establishment of a new colony or community.

Industry: enterprises producing goods and services.

Invention: something originated by experiment or ingenuity. (Properties connected with the inventors themselves would be classified here).

Landscape Architecture: the art or practice of planning or changing land and water elements for the enhancement of the physical environment.

Literature: the production of writings, especially those of an imaginative nature.

Military: concerning the armed forces and individual soldiers.
Music: the art of combining vocal or instrumental sounds or tones.
Philosophy: system or principles for the conduct of life; the theory or analysis of the principles underlying thought or knowledge and the nature of the universe.
Politics/Government: an established system of political administration by which a nation, State, district, etc., is governed and the processes which determine how it is to be conducted.
Religion: systems and expressions of belief in a supra-human power that have made a contribution to the patterns of culture.
Science: a systematic study of nature.
Sculpture: the art of forming material into three-dimensional representation.
Social/Humanitarian: concerning human beings living together in a group or the promotion of the welfare of humanity.
Theater: the dramatic arts and the places where they are enacted.
Transportation: concerning the work or business or means of conveying passengers or materials.

C. Additional facts to be included on specific categories of properties, as appropriate:

1. Buildings, structures, or objects.
    a. The architect or builder, if known,
    b. Historically significant events and/or patterns of activity,
    c. Data concerning individuals significantly associated with the property, and
    d. Consideration of any possible archeological significance present.
2. Sites.
    a. A statement of the kinds of information known or thought likely to be present in the property; types of data that might be recovered if the property were thoroughly investigated by archeologists, art historians, architectural historians, or other appropriate scholars. Some categories of information will be directly observable; others can be inferred based on knowledge of similar properties that have been extensively investigated. Reasons for believing that given categories of information are present and have been preserved in the property should be given.
    b. A statement of the relationships between the information believed to be present in the property and topics that might be studied there; i.e., what kinds of research could be done using the information known or thought to be present in the property.

4. Archeological districts.

a. A summary statement concerning the significance of individual properties within the district. (Data on individual properties meeting the standards set forth in VIII.C.2).

b. A concise statement of the characteristics that give the district cohesion as a unit for study; what categories of data might be derived from study of the district that would not be derived from the study of individual properties within it?

c. A concise statement explaining the scientific and/or interpretative yield or potential of the district in terms of the cultural and natural contexts or interrelationships described in VII.D.4.d.

d. Consideration of any possible architectural or historic significance present in the district, above and beyond its value for information purposes.

e. An explanation of how district boundaries were chosen should be included. Considerations may include presence of a natural geographic barrier, such as a river or drainage divide; a project boundary if this delineates a group of resources which conform to the definition of a district given above; man-made features such as a highway or other structure; or decline in settlement density.

D. Federal agencies should attempt to answer the following questions when seeking to determine whether a property meets National Register criteria.

1. Building, structure, object.

d. If a building, structure, or object is submitted for its archeological associations, does it contain attributes that are amenable to study in order to extract useful information about history or prehistory? For example, has it been rebuilt or added to in ways that reveal changing concepts of style or beauty?

2. Site.

a. How does the site relate to the significant event, occupation, or activity that took place there?

b. How have alterations (destruction of original buildings, changes in land use, changes in foliage or topography) affected the integrity of the site? (The site of a treaty signing which took place in a deep woods is probably not eligible if the area is now a suburban development.

c. If the site has been submitted for its archeological significance, has the site contributed or does it have a potential for contributing important information regarding human ecology, culture history, or culture process? What is the potential information yield of the site, and how does this information

potential relate to theories, problems, and research questions that could be or have been addressed in the region or elsewhere? Evidence supporting these evaluations of significance should be provided, including references to specific scholarly investigations.

d. Does an excavated site retain interpretative value or did the information yielded make a fundamental contribution to knowledge of American cultures, such that the act of investigation constituted a historic event? Sites already completely excavated are eligible only if the answers to these questions are positive.

3. District (in addition to the questions on individual buildings, structures, and objects).

d. How has the district affected the historical development of the overall community, region, or State?

e. What effect do intrusions have on the integrity of the district?

f. How were boundaries chosen? (Considerations may include boundaries at specific time in history; the presence of a visual barrier or edge, such as a river, highway or new development; change in character of the area; or decline in concentration of significant properties to the point where the integrity of the district has been lost.)

g. Are the qualities that distinguish the district from its surroundings identified and described?

h. If the district has been submitted for its research value, do the sites or individual resources have cohesion as a unit for study or do they have an identifiable geographical relationship? Questions on individual sites under VIII.D.2 above should also be answered for districts.

i. How does the district compare to other similar areas in the State, region, or locality?

IX. Bibliography

The bibliography should contain a list of sources from which information on the property was compiled. General reference works on architecture, archeology, etc., should not be included unless they provide specific information which is of assistance in evaluating the property. Use standard bibliographical style, listing author, full title, date and location of publication, and publisher. For an article, list the magazine or journal from which it was taken, volume number and date. For unpublished manuscripts, indicate where copies are available. Interviews should also be listed here with the date of interview.

X. Geographical data, maps, and acreage

A map clearly locating the property within a city or broader con-

text must accompany each request. A 7.5 or 15 minute series United States Geological Survey map, State highway map, or other suitable map will be acceptable. Latitude and longitude coordinates or UTM (Universal Transverse Mercator) reference points are useful in identifying the geographical location of properties. Photocopies of maps are acceptable provided they are clear and properly referenced. If the property is a district, a detailed sketch map should be included. The sketch map need not be precise in scale, but it should indicate:

A. All buildings, structures, or sites in the district.
B. Extent of district boundaries, carefully drawn.
C. Street and place names, including inclusive street numbers.
D. Highway numbers.
E. Architectural styles or periods, if appropriate.
F. Pivotal structures and important spaces (parks, squares, etc.).
G. Present type of district (mixed, residential, commercial, public, etc.).
H. Intrusions or other elements not contributing to the significance of the district.
I. North arrow (magnetic or true), if not printed on map.
J. Approximate scale.
K. Land use in rural district--woods, fields, swamps, etc.
L. Significant aspects of the natural environment, if appropriate.

Sketch maps should also be provided for large archeological sites, indicating significant cultural features and intrusions. Maps of archeological districts should clearly indicate the areas within the district boundaries which have actually been surveyed. If portions of the districts have been inspected using different techniques or at different levels of intensity, this should be indicated on maps.

Acreage: The acreage of the property in question should also be given.

XI. <u>Photographs</u>

Along with written documentation and maps, photographs form the basis of the Secretary of the Interior's determination of a property's eligibility for inclusion in the National Register. For this reason, photographs submitted should have an honest visual representation of the property and should illustrate those qualities discussed in the description and statement of significance. Photographs should be identified in detail, giving the name and location of the property, view or detail shown, and direction of photo. Historical photographs may also be useful but are not required. Black and white glossy photographs are preferred since these are required for National Register nominations, but other photo formats are also acceptable. Xeroxed copies of photographs rarely provide sufficient detail to accurately protray a property and should therefore be avoided. The number of photographs

required for a determination varies according to the complexity of the property:

B. Archeological Sites. Photographs should document the condition of the property and, if relevant to the evaluation of significance, show artifacts that have been recovered and features present in the site. Drawings may be substituted for photographs of artifacts or other features where relevant and if it is not possible to take photographs. Site submissions must include at least one photograph, however, showing the physical environment and configuration of the site.

C. Districts...Photographs of important topographical elements should be included, as well as representative types of intrusions in their settings. It is useful to indicate on the sketch map the location and direction of view of photographs. Views of archeological districts should show significant natural and/or cultural aspects of the environment and typical sites, structures, buildings, and objects.

XII. Individual(s) compiling documentation

Names and qualifications of persons directly involved in compiling information on the property should be submitted as this information may be of assistance in the evaluation process. Addresses and phone numbers are also useful so that these individuals may be consulted if questions arise concerning the documentation.

The field methods used to extract sufficient data to document eligibility will vary from archaeologist to archaeologist. In general, however, the dimensions of the site or district must be defined, and enough data must be gathered to support the description of the site's significance.

The important thing to remember is that archaeological sites are fragile and nonrenewable sources of potentially significant data. Thus the amount of testing in a site should be limited to that which will get just enough data to meet the requirements of the documentation without extracting (and thereby destroying) data that are not necessary to support the statement of significance or to define the boundaries.

B.8 SITE EVALUATION (UNDERWATER)

Once a site has been located, an attempt at identification is made. Inundated prehistoric terrestrial sites, like terrestrial prehistoric sites, must be classified by their spatial context and artifact typology. Inundated historic terrestrial sites are usually identified by historical research and/or their proximity to present and coastal terrestrial sites. Considering the minor change in sea level in the study area during the Historic Period, inundated historic sites are likely to be continuations of terrestrial sites. Historical research can often provide some clues to the identification of historic ships but artifacts, including ship remains, are the key to identification. Often historic ships, like most prehistoric inundated sites, can only be classified as being of a certain type, while historic inundated terrestrial sites can most often be identified by name.

Initial investigation of an underwater site begins by remote-controlled photography, remote video, or visual inspection conducted by mini-submarine or diving bell. Artifacts may appear above the sediment or strewn over a rocky bottom. In the former instance, thin steel rods are carefully used as hand probes to help determine the extent of the site. Probes are limited by the length of rod which can be controlled by investigators at each site. Water currents and sediment may vary the length from 1 to 3 m. Type of ocean bottom will also affect the usefulness of probes.

Probing only occasionally reveals remains buried in the bottom; sediment coring may reveal more data about the site. Although coring is destructive to a site, it may be a reasonable means of investigating non-metallic anomalies in deep water, where other means of inspection may be impractical. Coring near a site, conversely, may be helpful in determining the local sediment stratigraphy. This in turn helps archaeologists determine the possible age, typology, and overburden of a site.

Before hand coring is conducted, at least 1 permanent datum point must be established--normally 2 or more pipes driven vertically into the sediment just outside of the suspected site area. If no sediment exists, marks are chiseled into rock. These points are plotted into the local surveying systems such as Universal Transverse Mercator. Locations of cores are then recorded by triangulation or bearing-and-distance from the reference points.

Electronic survey of a site can often provide excellent information. A magnetometer (or gradiometer), metal detector and sub-bottom profiler are moved slowly over the site, usually by hand, along a pre-established grid pattern. Digital results are translated into contour maps of the site.

Fig. IV-B4 presents the results of a hypothetical magnetometer and metal detector survey of a site. Originally noticed only as an anomaly on an electronic survey of a fictional lease block, the site may then be investigated by a detailed electronic survey. The distribution of iron, displayed by the location and shape of magnetometer contours 1 through 8, indicates the shape of a ship outlined by cannon along her gunwales. Anomalies A and B would be the 2 ready anchors on either side of a ship's bow, and C could be a number of anchors typically stored together in the foreward area of the hull. The low-intensity anomaly in the center (D) would possibly indicate the location of the ship's shot locker.

Metal detectors have a shorter range than magnetometers. Therefore metal detector anomalies on Fig. IV-B4 would only indicate metal objects near the sediment-water interface. A metal detector reacts to all metals, unlike the magnetometer which indicates only iron. A further analysis of Fig. IV-B4 could suggest the following possibilities:

1. The hull is non-ferrous.
2. Two guns on the starboard bow (1, cc and 2, dd) are iron and nearer the surface than the other iron guns.
3. The stored anchors (C, ff-gg), if that is indeed the identification of the anomaly, are large and near the surface.
4. Two non-ferrous anomalies (aa and bb) are near the surface at the stern of the ship, and one is near the center.

Anomalies aa and bb could well be small swivel guns, often mounted on the rails of the quarter-deck, or rear-top deck, of a sailing ship. They are easily classified by date and origin. As they are near the surface, these two anomalies would be the most likely targets for a test excavation. Figure IV-B5 represents a contour map of the same fictional site, made by a sub-bottom profiler. The lines indicate the location of a ship's hull under the sediment. The 2 inner circles (A and B) represent the remains of the masts. This information will make it possible to approximate the size of the hull from the remaining depth, breadth, and length.

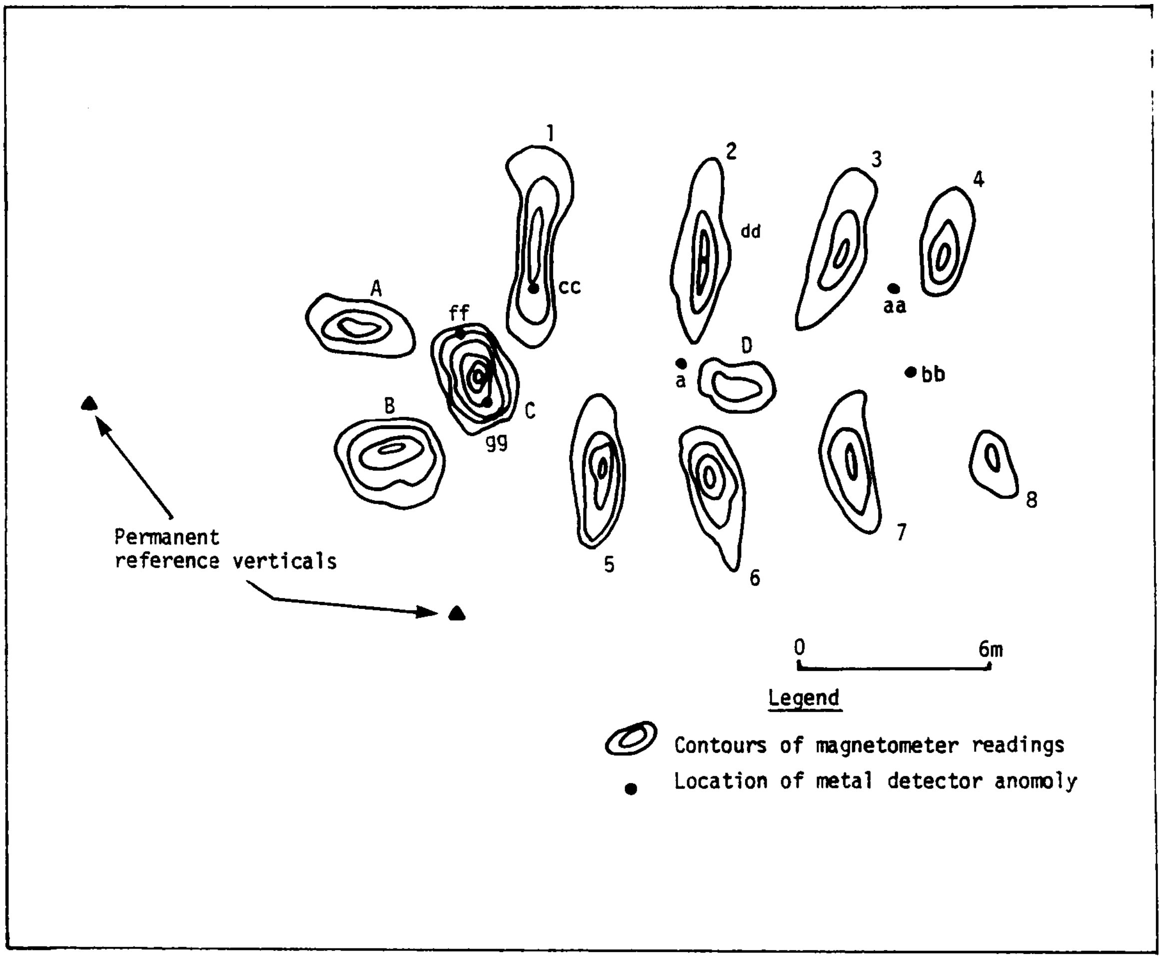

Fig. IV-B4

Hypothetical results of a small scale magnetometer and metal detector site survey.

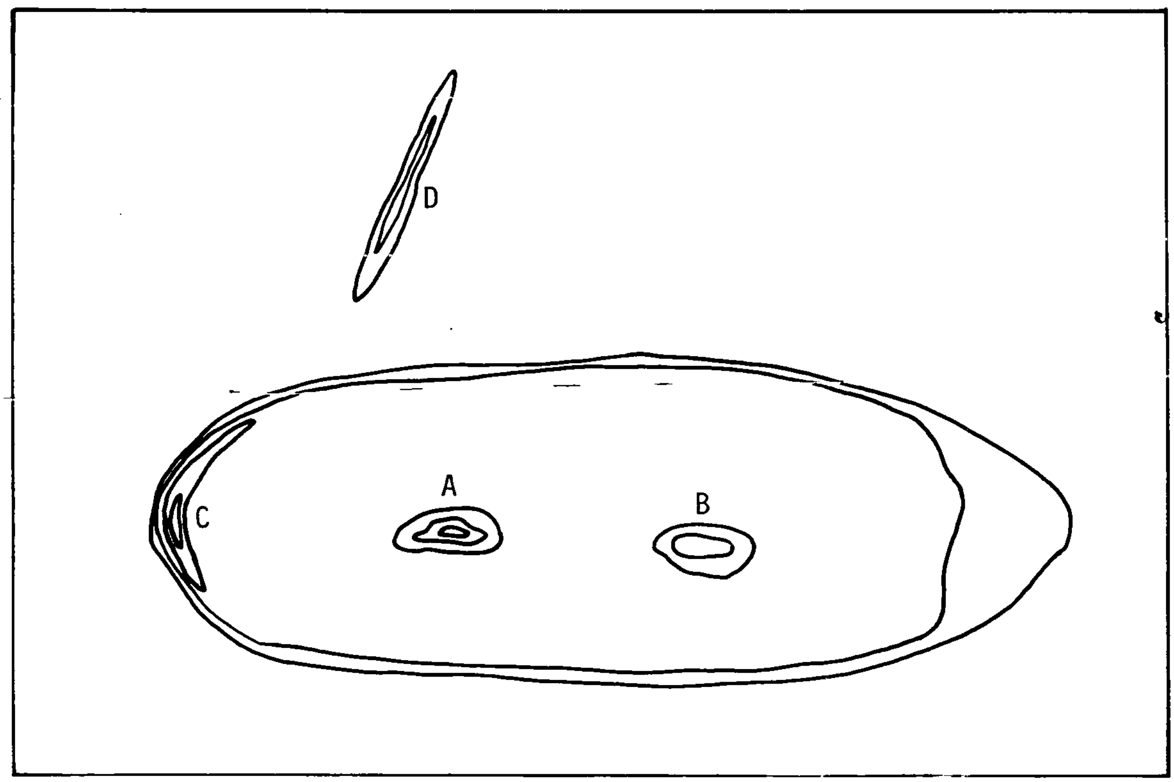

Fig. IV-B5

Hypothetical results of a sub-bottom profile survey of the same site as Fig.IV-B5. Contours are from an arbitrary datum plane below the ship. Contour interval is 1 meter.

Unless identifiable remains exist above the sediment, and if other means fail to provide identification data, it is necessary to excavate test holes on a probable site. Most common of underwater excavations tools is the airlift (Fig. IV-B6). A typical airlift is made of 10-cm (4-in) diameter PVC irrigation pipe set more or less vertically off the bottom (depending on current). An air hose carrying compressed air is inserted into the bottom of the pipe. As the air bubbles rise up the pipe they expand and accelerate, drawing water through the lower open end of the pipe and up the pipe with them. Thus, the airlift becomes an "underwater vacuum cleaner" which will suck sediment up the pipe.

The bottom end of the airlift is typically held 15 to 20 cm (6 to 8 in) off the sediment. The excavator fans his hand over the sediment to draw it up into the airlift, while artifacts are left undisturbed. A sieve bag or box is often attached to the upper end to catch any artifacts mistakenly sent up in the airlift.

The greater the vertical passage of the air bubbles in an airlift, the greater the lifting power. An airlift in water less than 4 m (13 ft) deep does not work well. In these situations a water dredge is used (Fig. IV-B7). Water is pumped at an upward angle into the lift pipe. It carries other water in the pipe along with it--developing a vacuum unit like the airlift. For the same power output, an airlift is generally more efficient in water over 5 m (16 ft) while a water dredge is more efficient in water less than 4 m (13 ft).

To remove large amounts of overburden which may cover a site in shallow water, a "prop blaster" is used in place of less powerful excavation tools (Fig. IV-B8). The prop blaster is a large pipe which redirects the propeller wash of a well-anchored boat. An excavator is able to remain on the bottom in the center of the wash to observe the progress of sediment removal. Because of the wash's tendency to dissipate with depth, a blaster excavates a much larger area than an archaeologist waving sediment into an airlift with his hand. A diving observer may therefore miss a light artifact--such as one made of paper, textile, or leather--which is blown away by a blaster. Whereas a sieve box or bag can be used to collect artifacts which mistakenly get sucked into an airlift or water dredge in murky water, none can be used with a blaster. A blaster does have a number of advantages: 1) in areas of lightly sedimented bottom and little current, the downward flow of clean surface water promotes good visibility in the hole being excavated; 2) it is inexpensive to use the boat's engine instead of an air compressor or water pump; 3) it removes sediment quickly.

Light, unprotected artifacts in the top layer of a site would most probably have been removed by waves or currents before being covered by sediment. Artifacts, which might be disturbed by the wash of a blaster, are generally not found in the first layers of an underwater site. A blaster is therefore sometimes used as a cost-effective means

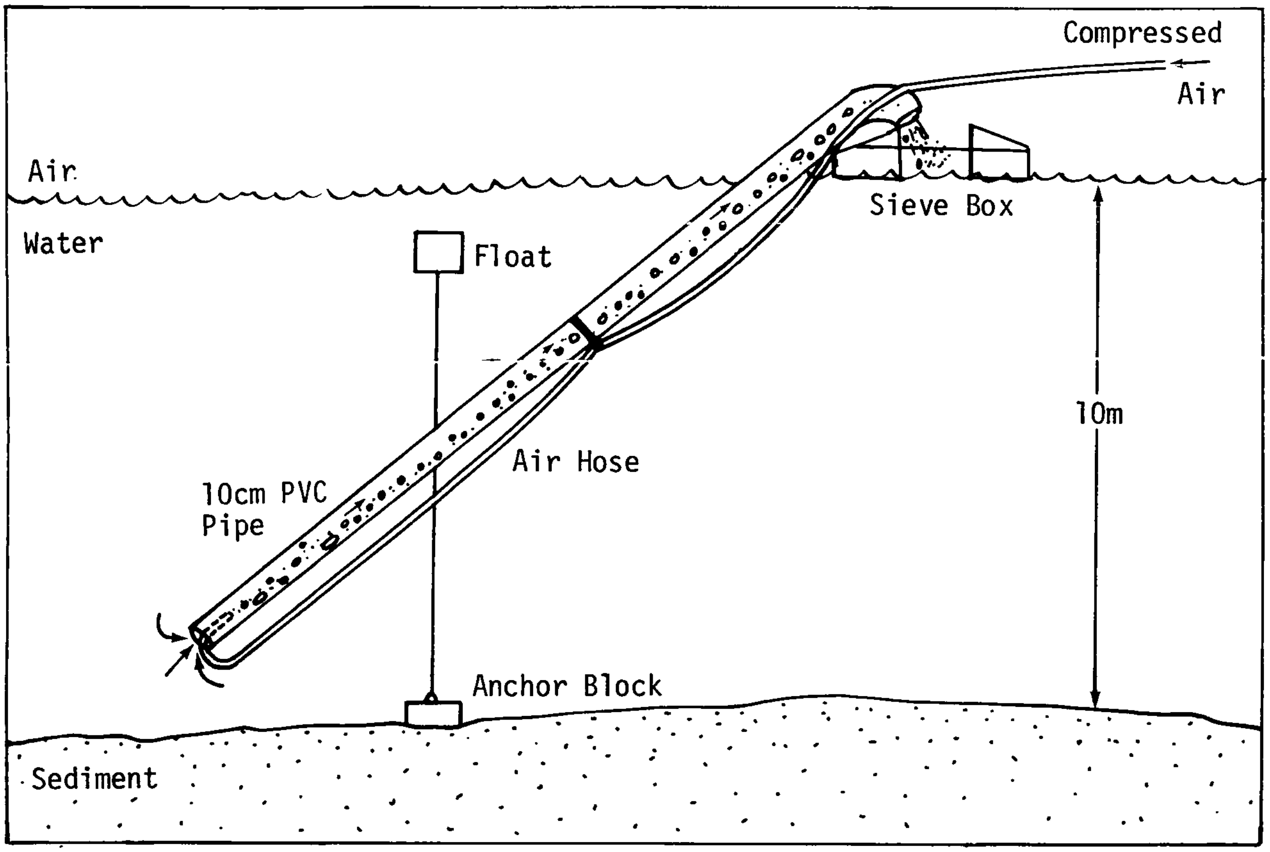

Fig. IV-B6

A typical airlift made of 10cm PVC pipe in 10 meters of water. It transports sediment-laden water away from the site. (Not to scale.)

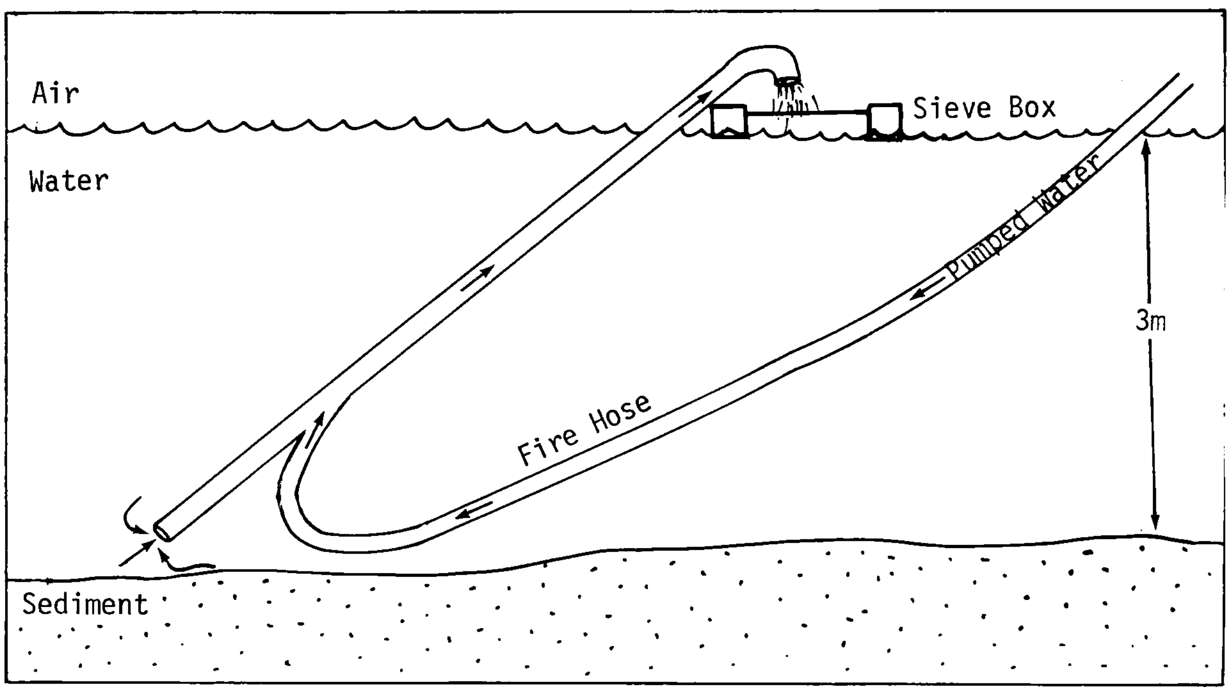

Fig. IV-B7

A typical water dredge used in shallow water. (The pipe diameter varies.)

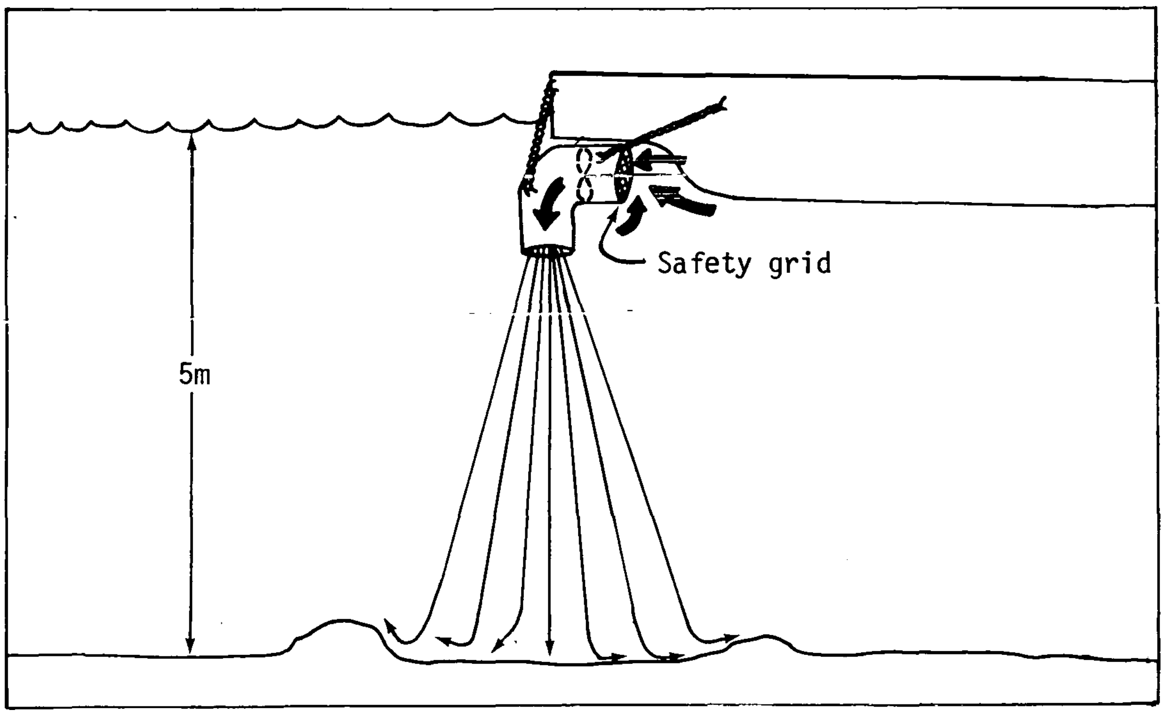

Fig. IV-B8

A prop-blaster showing water direction and dispersion, safety intake grid, and support chains.

of removing large amounts of overburden above a suspected site until the first stratum is reached. Variations on the prop blaster have been devised, including a completely underwater unit which can be placed near the bottom for use on a deep site (Bascom 1976).

A site's physical situation will greatly affect the cost of investigation. The type and amount of overburden, if any, will determine the time, tools, and methods necessary for excavation. As mentioned above, a thick overburden may suggest the use of a prop blaster, while a shallow overburden may suggest more controllable means of moving sediment. Sand can often be moved by making a circular motion with one's arms--creating a current which lifts the sand and moves it to the rear of the excavator. Silty mud, suspended in the water by an excavator's hand, must be removed by a natural current, an airlift, or a water dredge--otherwise visibility is greatly reduced. Although silty mud is more of a problem to remove, it can protect archaeological remains because it is often lacking oxygen to support living organisms which destroy organic material.

Depth of water at an underwater site is extremely important. A shallow site, in water less than 10 m (33 ft), is generally simpler to excavate than a deeper one--but certain problems exist. Buoyancy control, important for accurate excavation and safety of personnel and artifacts, is particularly difficult when moving vertically in shallow water. Shallow-water operations are also dangerous to personnel, who often relax safety regulations even though normal diving dangers, such as entanglement and lung rupture, still exist. In addition, archaeological remains in shallow water are more likely to have been damaged by storms, waves, fishing gear, and treasure-hunting divers.

Testing of deep-water sites, 30 to 45 m (100 to 150 ft), by divers presents a number of problems which are time-consuming and expensive to overcome. Excavators breathing compressed air below 30 m may be affected by "nitrogen narcosis"--a malady caused by the increased partial pressure of nitrogen in the air they breathe. This condition causes a drunkenness which becomes worse as one proceeds deeper. Safety, communications, and accurate work may be adversely affected by this problem.

The increased partial pressure of nitrogen produces another problem. It dissolves in the diver's system quickly but comes out slowly. If it is allowed to remain at too high a level while ascending, a diver will suffer from decompression sickness, "the bends." Decompression sickness can cause permanent damage or death. As the dissolving of nitrogen into one's system is a factor of duration and depth of dive, excavators are required to shorten dives for deeper sites.

Deep diving demands excavators who are mentally and physically in good condition, and advanced training for both underwater and surface

support personnel. Communications and special safety equipment, discussed later in this chapter, are necessary.

Excavation of a very deep site, 45-185 m (150-160 ft), presents problems to the archaeologist which are now being addressed in the field. At depths greater than 45 m (150 ft), nitrogen narcosis becomes very intense, making it almost impossible to conduct safe and accurate excavation. At present, the best technique of overcoming this handicap is to breathe a mixture of helium and oxygen instead of air. Helium does not have the narcotic effect of nitrogen. Special training, extra safeguards to prevent the use of improper mixture, and the purchase of the compressed gasses and the equipment to handle them are necessary.

Helium dissolves into a diver's body and must be allowed to come out of solution on a very deep dive, just like nitrogen. At sites just below 45 m (150 ft), one spends as much time ascending slowly, to prevent decompression sickness, as one spends on the excavation site. Deeper sites demand progressively more relative time for the slow ascent. To overcome this problem, commercial divers routinely stay in a chamber pressurized to the same pressure as their working depth when not in the water. After a while the divers' bodies become saturated with the gas, so that no more can dissolve. They therefore can work for an extended time on the bottom while not increasing their ascent (decompression) time. When they are through with a job, or their turn at the job, decompression takes place in a chamber on board a vessel, or ashore. This technique is termed saturation diving.

The need for trained personnel with great physical and mental stamina, and the cost of equipment and supplies for a proper saturation diving operation is very considerable.

To date, only one archaeological site has been excavated using saturation diving (Frey and others 1978). Commercial divers performed the excavation while archaeologists, occasionally observing from a normal-pressure observation bell or miniature submarine, organized and instructed. Archaeologists were also helped by still photographs taken by the divers and video records taken from the submarine. Communication is difficult in such an operation, even on hard wire intercom, because of the acoustical properties of pressurized gasses, especially helium.

Although the use of commercial divers is necessary at this time for very deep excavations, future work, in saturation oxygen-helium operations, may be conducted by specially trained archaeologists. Because of the deep-water techniques which have evolved over the past few years in the commercial diving business, archaeologists may now be trained to work safely at depths to 185 m (600 ft). The expenses and logistics involved, and the desire of archaeologists to participate in

saturation diving--whose long range effects are not totally understood--must all be taken into consideration for a very deep site.

An over-water operation requires logistical support from the shore, such as transportation to and from the site for personnel and supplies, and the proximity of a recompression chamber (to treat decompression sickness or lung ruptures) in the case of deep-water excavation. Retrieved artifacts, properly packaged at the site, must be transported wet to a proper conservation facility. As most waterlogged artifacts are fragile, special treatment is necessary for them. Finally, an often-overlooked logistics problem is the availability of expert service, advice, and parts for equipment. The effects of salt water and hard use not only mandate constant maintenance but frequently cause equipment failure. Because most underwater excavations include the services of a good deal of personnel and equipment, a long-term failure of a single piece of important equipment can be costly.

Some special staff requirements are unique to the underwater situation. A staff member is assigned to record each artifact as it is excavated. Among others his or her duties measures and quickly sketches each artifact on its individual card, often under the pressure of a backlog of finds which a dive team delivers in large groups. Another member of the staff is assigned to record all dives and other operations.

Underwater photography is one of the major means of recording the progress of an excavation and helps determine the original spatial relationship of artifacts. To achieve consistently high-quality results, a person specializing in underwater photography is usually on the team. This person need not be a professional photographer, but should be one who has shown competency in underwater photography, which not only involves more complex lighting and optical problems than land photography, but also requires the photographer to have very good buoyancy control, an accomplishment that is necessary for handling the camera smoothly underwater, and requires much practice. The photographer is also often called upon to record artifacts, drawings and operations abovewater.

Recording of a site is not considered complete without illustrations of the site and artifacts. Although illustrations of the site are often made on land, after excavation, illustrations made underwater during operations often help archaeologists better understand and plan the excavation, especially on sites with poor visibility where the illustrator can present a composite view which would otherwise not be seen. Artifact illustrations are important as they generally show more detail than photographs, and are the preferred method of recording artifacts for publication.

To insure safety, a divemaster oversees diving operations. The divemaster gives lectures and answers questions on diving particular to

each site, evaluates and remains aware of the health, ability, and attitude of each diver, ascertains the serviceability of diving equipment, and requires safe diving procedures on the site.

As some sites require large costs for transportation of personnel and supplies, these operations require a boat pilot or operator who is placed in charge not only of the transportation but also of the diving barge and its moorings. A mechanic is also needed to maintain and repair the numerous engines, pumps, compressors, and generators normally used.

B.9 DATA RECOVERY (LAND)

Once the Advisory Council's procedures have been applied to a property and the various parties have reached an agreement that data recovery will take place, the recommendations of 36 CFR 66 should be followed. These proposed guidelines have been published in the Federal Register. This situation applies to B.10 below also.

B.10 DATA RECOVERY (UNDERWATER)

Data recovery underwater is a complex proposition. What follows is a discussion of present practice which may serve to make the non-specialist aware of these complexities. These apply after B.9 above.

In discussing excavation techniques, we shall first consider a typical underwater site, either an inundated occupation or a sunken vessel site, where the water depth is less than 30 m (100 ft) and there are no abnormal current or weather conditions. After the site has been located and a preliminary survey has been made, a grid frame is positioned over the site. It is normally oriented to true north or, if the site contains the remains of a vessel, sometimes to the bow of the vessel. The grid frame defines the datum plain unless the site is on a steep slope, where the frame must be stepped to facilitate recording (Fig. IV-B9). In this case, one level section of the grid is the datum plain.

To remove a light overburden, excavators often use their hands alone, especially when working with sand. A water current produced by making sweeping motions above the sand carries the sediment to the side of the site. If a site is on a slope, the whole excavation could theoretically be achieved without equipment.

Airlifts, or water dredges in shallow water, are most often used when sediment must be moved. Sediment is raised off the bottom by a sweep of the excavator's hand. Artifacts, normally heavier than the sediment, will remain in position while the sediment is kicked up and carried away. The sediment-laden water must pass through a sieve

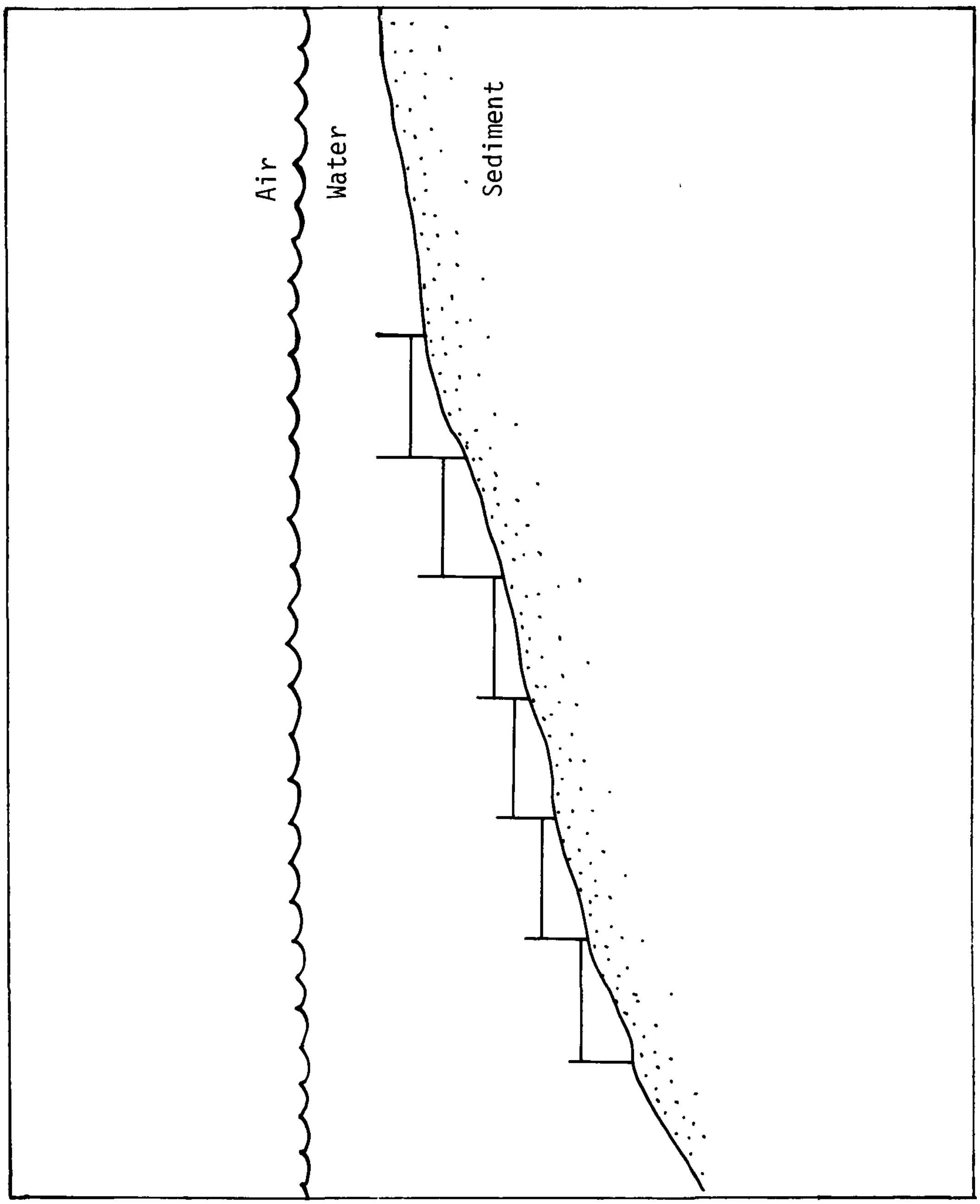

Fig. IV-B9

Profile of a stepped grid frame. One level is arbitrarily chosen as the datum plane.

screen before it is discarded, to insure against accidental loss of artifacts. If the site has clear water, sand, sediment, and good, experienced excavators, a sieve screen is often not used.

Thick clay and mud overburden will not kick up easily. They are therefore picked up in small clumps and softly separated in the excavator's hand while the airlift carries away the particles. A hollow rod, with pressurized air flowing in one end and out the other, is used to loosen sea grass clods when they cover the site.

Once artifacts or structures are encountered, excavating proceeds by levels, whose depth below datum is determined by sediment and finds. At each level a record is made of the 3-dimensional position and orientation of all finds. This is normally achieved by measuring in three perpendicular directions (x, y, and z) with respect to the grid frame (Fig. IV-B10). New methods involve the recording of distances from 3 distinct points to the subject feature (Fig. IV- B11). These distances are converted to x, y, and z measurements by using a graphical method, computer, or programmable hand calculator (Mazel and Smith 1979).

The former method generally requires 2 people and is only accurate to 1 or 2 cm (0.5 to 1 in) at best in water with poor visibility. Measurements taken with 3 semi-permanently attached tapes from 3 points can be taken and recorded by 1 person, and tend to be more accurate, even in poor-visibility water. But the recorded measurements must be converted later.

Besides accurate measurements, detailed scaled illustrations are made of each area at each level. Area illustrations are incorporated into a larger site plan which helps in the interpretation of measurement records, and gives timely information for topside analysis of the excavation in progress. Drawings are made with a number-2 pencil on either "fogged" mylar sheets, or sanded white PVC or plexiglass. Mylar sheets are kept for later reference. When PVC or plexiglass is used, it is photographed after each use before it is erased. The latter is handier underwater, but mylar sheets insure a permanent record of each illustration (S. Smith, pers. comm.).

Adverse conditions affect illustrators more than excavators because of the interpretive nature of their work. Already encumbered by the fact that objects appear a third larger and closer underwater, illustrators are greatly affected by cold water, poor visibility, and limited time (Ryan and Bass 1962).

To insure a complete record, a photograph is taken of each level of each excavation area on a site. Photographs are taken both vertically and obliquely to help in the identification and interpretation of finds. Shadows produced by oblique lighting enhance the readability of photographs. Photographic discussions are not as accurate as those of well made illustrations, but they are often more

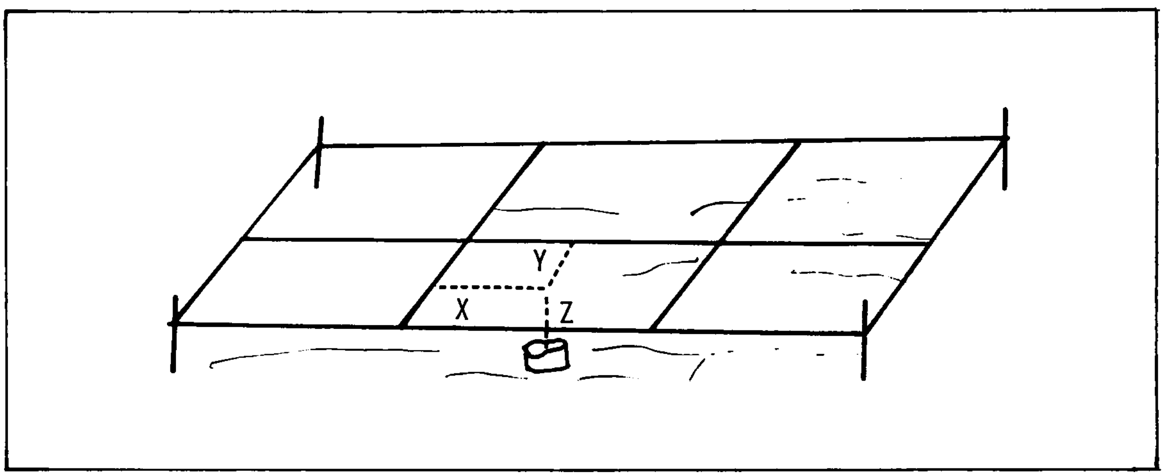

Fig. IV-B10

Measurements in perpendicular directions. X, Y, Z directions are perpendicular to each other. Z direction is vertical.

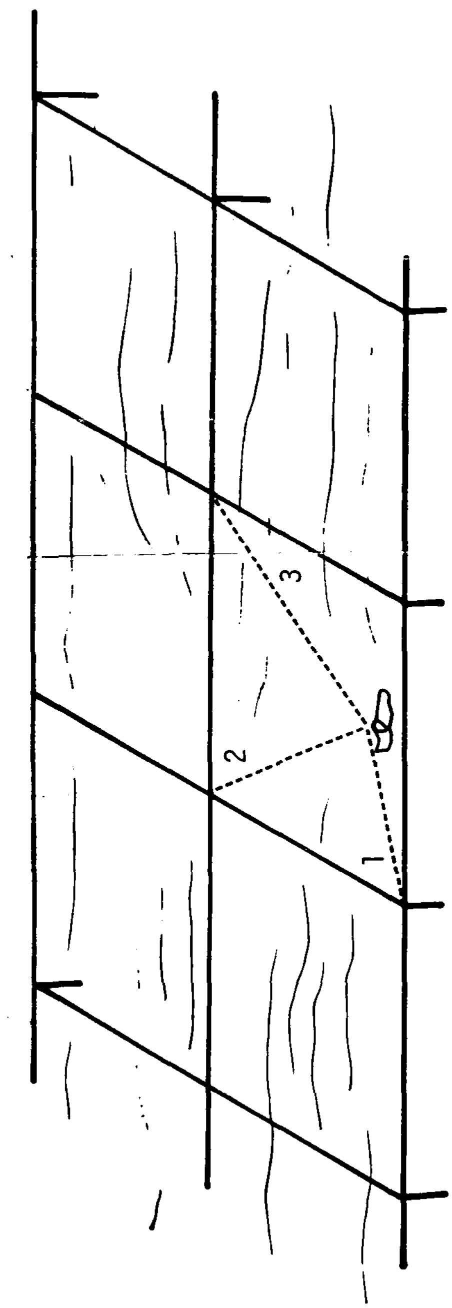

Fig. IV-B11

Measurements from 3 points. Distances 1, 2, and 3 are recorded and later used in computing the X, Y, Z coordinates of the object (adapted from Mazel and Smith, 1979).

complete. Photography is also much quicker underwater than illustration. Problems with poor visibility and field processing of film must be considered at some sites.

Photography is often reserved for the first dive in the morning and again in the afternoon to help eliminate the poor visibility that is generated by excavation processes. Most archaeologists have the entire site photographed in this manner once or twice daily.

Photogrammetry is occasionally utilized to record a site, supplementing or superceding normal measuring techniques. Photogrammetry involves the use of two overlapping photographs taken from different positions. The area recorded in both photographs can be observed or accurately projected in 3 dimensions. The resultant image can then be traced or measured in detail.

The method requires clear water and good optical and processing equipment. Photogrammetry saves some time underwater at the expense of a great deal of time in processing the acquired data. It is therefore rarely preferred for any site except those which have clear water and are so deep that divers' bottom time is at a premium. The photographs can be taken with one or more cameras, by hand or from a submarine.

Curatorial care of recovered artifacts involves both recording and stabilization of finds. When an artifact is brought up, it is immediately assigned a number which will always remain with it, even after treatment. A record is kept of the artifact's number, original location, orientation, measurements, excavator, and date of recovery. If the artifact's type and the material of which it is made are distinguishable, they are also recorded. A sketch is done, and if the find is particularly important, an accurate scale illustration and photographs are made for further study and possible publication. Structural timbers of ship remains are drawn at a one-to-one scale to facilitate theoretical or actual reconstruction.

Due to stabilization problems, artifacts must be kept wet during recording. After recording, they are placed in holding tanks of salt water. If a find is particularly fragile it is first secured in packing material, such as burlap or bubble plastic, before being placed in a holding tank. Material such as clothing fabric, cannon wadding, or rope is first sewn into a nylon mesh to keep the artifact from disintegrating when transported or treated.

Some excavations include material which is brought up, studied, recorded, and replaced in its original position. This is done when resources are not available for proper conservation of the material and vandalism is not a probability. Detailed scale drawings, notes, and photographs are then a necessity for each artifact which is to be redeposited.

Special Circumstances Which Affect Excavation

Most sites have at least 1 special natural problem to overcome. One of the more common is turbid water. Archaeologists have only two senses, sight and touch, to use underwater. Poor visibility slows the pace of an excavation as archaeologists must utilize touch more than sight.

Safety requires that two excavators work near each other on most sites. Since each diver must realize if the other needs assistance, they must either be extremely close to each other or be tended on a line from above when working in poor visibility.

Taking measurements and illustrating are much slower, and prone to mistakes, when one must be only centimeters away from a measuring tape to read it properly. Two people taking measurements as a team must be very well trained if they are to perform their task without seeing the opposite end of the measuring tape or rod. Photography is both difficult and time consuming when a wide-angle lens and lighting unit are used at close range to try to produce a usable photograph in turbid water. Photogrammetry is impractical.

Poor visibility can be caused by a number of conditions. When there is no current to carry away disturbed light sediment particles, the water can become black, offering absolutely no visibility. Airlifts or water dredges will vacuum particle-laden water away from a limited area. But water which replaces it may also carry disturbed sediment. A false current, created by pumping clear water from a perforated pipe across the site, has been used on at least one still-water site (Aime 1979).

Working in a fast current requires some changes in normal procedure. Safety lines are deployed to keep divers from being swept away, and divers often add extra lead to their weight belts to hold themselves on the bottom. But heavy excavators can damage a site if they are not careful to support their weight on the grid frame. Excavators can also have trouble keeping their equipment on in a fast current. Masks and fins are particularly prone to being swept away. Fighting to keep position in a current may lead to frustration and exhaustion, which are dangerous to archaeologist and site alike.

Whereas a light current may actually help by carrying away sediment suspended during excavation, a fast current will often carry sediment over the site from elsewhere. Visibility is then greatly reduced. A fast current may also carry away light artifacts such as paper, leather, or fabric. Further, heavy vessel traffic encountered in harbors and shipping lanes presents a safety problem to excavations, so that work is conducted during low traffic periods. Special signals have been devised to warn off vessels which do not recognize the standard flags and to signal excavators that a dangerous situation

is developing. Local traffic, both commercial and recreational, is advised of the operation and a boat is kept ready for quick evacuation.

Deep-water (30-45 m, 100-150 ft) excavation is a more complex operation than that in shallower water. Nitrogen narcosis, a drunken effect from breathing pressurized air, is first noticed at about 30 m. Its effect is greater for increased depth. At a depth of 45 m, most divers are incapable of making complex decisions correctly. Safety, accuracy, and efficiency are significantly reduced in deep water.

To overcome the effects of nitrogen narcosis, excavators will often write instructions to themselves previous to a dive. They stay in closer communication than normal, and double check most measurements and notes taken of the site. Even with precautions, many mistakes are often made that would not have been made at a shallower site.

Decompression sickness is a consideration for any diving deeper than 10 m (33 ft), but is a special problem to people working below 30 m. At these depths nitrogen dissolves into the body rapidly, and must be allowed to slowly purge itself upon ascent, or bubbles of nitrogen will form anywhere in the body, causing damage and possibly death. An excavator may typically work for 50 minutes at 15 m (50 ft) and take only a minute to ascend to avoid decompression sickness. He will then have a significant safety margin. But 50 minutes of bottom time at a 30 m (100 ft) site requires, with no safety margin, 20 minutes' ascent time to avoid bubble formation. Application of standard safety factors increases the ascent time to 56 minutes, more than double the total time for the dive.

People normally become quite cold after an hour in the water along the Northeast Coast. Typical bottom times are therefore 35 minutes at 30 m (100 ft) and 25 minutes at 45 m (150 ft). Excavators are therefore not only hindered by the drunken effects of nitrogen narcosis but are also able to spend much less time working on a deep-water site.

Standards of health and physical and mental stamina are higher for deep-water excavators. Personnel also require not only training in decompression diving but also in the routines of the deep site they will be working. Living habits must be closely watched as lack of sleep or alcohol in the body may adversely affect the decompression process. In sum, a deep-water excavation is less efficient, more complex, and therefore more expensive than a shallower excavation.

Very-deep-water (45-180 m, 150-600 ft) excavations require a completely different diving procedure from that used in shallower sites. At depths greater than 45 m (150 ft), the intoxicating effect of the nitrogen in air is too great for safe use. Other gas mixtures, usually ratios of helium and oxygen, are breathed instead. Proper mixing of the gases requires careful attendance by well trained

personnel, plus special equipment. One of the effects of breathing a helium-oxygen mixture is a much increased rate of body-heat loss. Very warm diving suits and warm chambers are a necessity. Telecommunications, normally a problem because of mask or helmet acoustics, are even more distorted by the use of helium. Electronic processers are presently being developed to try to correct the signal from the divers.

Decompression procedures with helium-oxygen are similar to those with air. As one works deeper, ascent time increases for every minute spent on the bottom, but if a great deal of time is spent on the bottom, the body will finally saturate with helium, so that staying longer than the saturation point would not increase ascent time beyond that required at saturation point . Thus a diver's bottom-working-time-to-ascent-time ratio would improve when working beyond the saturation time at any depth.

Saturation diving is used for most work deeper than 70 m (200 ft). Excavators live in a chamber maintained at the same pressure as their working depth and work for a few hours on the site each day, not having to decompress because they remain at the same pressure. After a few days, they are slowly brought back to normal pressure in a pressure chamber, often the one in which they lived.

Saturation diving for a very deep site is less traumatic than normal diving on the excavators' bodies, as they only decompress once every few days and stay topside while another team saturates. This type of work demands excellent mental and physical health and a good deal of special training. Although excavation under saturation has only been done by professional divers with observing archaeologists directing, it may in future be conducted by archaeologists trained in saturation work.

Mini-submarines, although expensive and requiring special logistics, can be helpful at a very deep site. The director or other staff, can drop down to the site in a submarine to observe, photograph, illustrate, direct, or help the excavator--always remaining at normal sea-level pressure (Keith, pers. comm.). Although mini-submarines are not cost-effective for shallower sites (Bass, pers. comm.), their use at very deep sites can be rewarding.

Little work has been conducted on very deep archaeological sites. At present, good work can be done, but it is much more time consuming and expensive than shallower work. Systems used are either borrowed from commercial sources or are experimental. As new methods and systems for excavating these sites are developed, efficiency will probably increase.

Equipment

Special equipment is necessary when conducting an archaeological operation on an underwater site. As previously mentioned, reference points, usually marks on vertical galvanized steel pipes which are driven into the sediment, are positioned before the preliminary site survey is conducted. Before excavation begins, a grid system is placed just off the bottom, on the site (Fig. IV-10).

Prehistoric archaeology is performed using the metric system. Historic inundated sites, by contrast, must be squared off in multiples of whatever units were used by the original occupiers of the site, or builders of the ship. When one knows the units used in the construction of a vessel, the grid is constructed in multiples of that unit. An English or American vessel would require a grid in feet--4-ft squares being considered best for wooden ships because of vessel construction techniques. Squares are marked with the alphabet for rows and numbers for columns, with any convenient orientation (Fig. IV-B12). Thus each square is identified by a number and letter, for example "2A" or "6D".

The grid is normally a rigid construction of angle iron or PVC plastic. It is supported outside the site by similar pieces set vertically in the sediment, and within the site by verticals with protective "shoes" of various designs to protect the site's surface. The grid serves 3 basic purposes: 1) as a reference system for measuring the 3-dimensional location and orientation of artifacts and features; 2) as a reference system for discussion of the site, which must be conducted above water; and 3) as rigid support for excavators and their equipment, whose effects can otherwise seriously damage a site. The grid system must therefore be stable, rigid, and accurately constructed and positioned. In special cases, where other means were used for measurements, the grid has usually been placed over a site without attention to accuracy (Steffy, personal communication).

No standard methods having been accepted for measuring a site, new methods are constantly being evaluated. At present, most measurements are taken with plastic or fiberglass tapes, sometimes attached to thin aluminum bars for ease in handling. A number of measuring devices have been tried and discarded. For recording underwater, mylar is often used--a standard number 2 pencil will write and erase on it easily. These and a pencil sharpener are normally attached to a plexiglass board which may have an appropriate grid marked on it. Sanded white PVC or plexiglass is also used, but sketches must then be transferred or recorded after each dive, while mylar sheets can be stored directly.

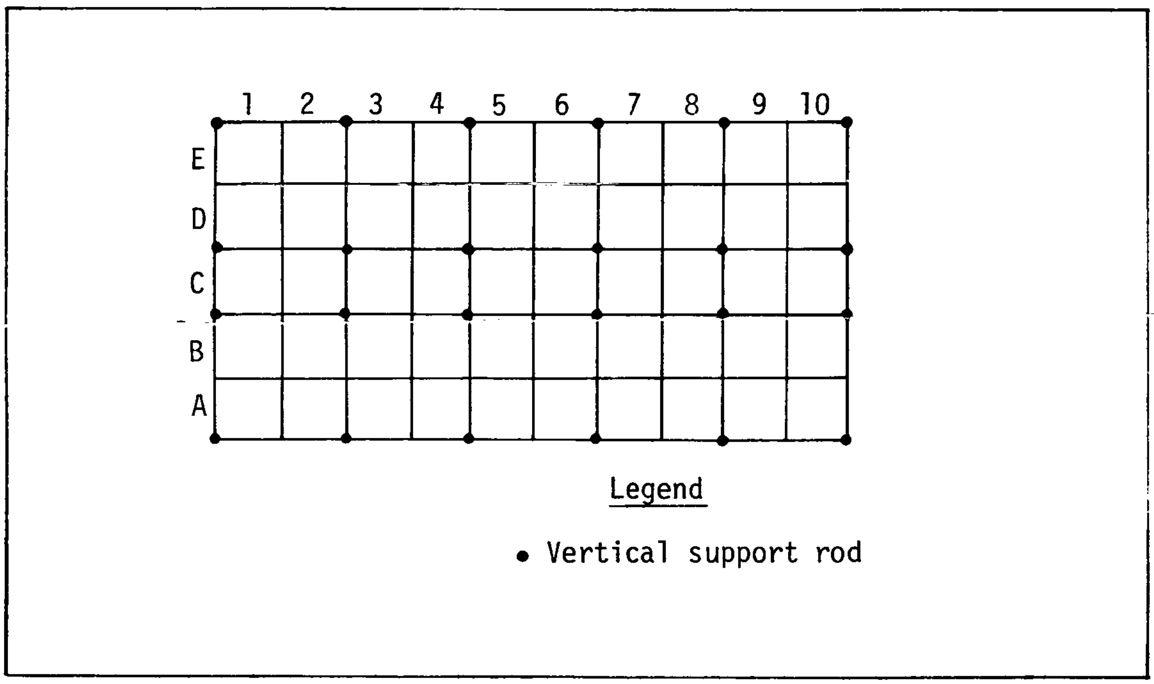

Fig. IV-B12

A grid frame, showing the labeling system and position of verticals. The grid is generally positioned horizontally and is the datum plane.

Photography is used on all underwater excavations where visibility permits. As close-up lenses, such as the 15 mm wide-angel for the Nikonos, have been developed, even sites with poor visibility are becoming photogenic. The most common camera being used by archaeologists is the 35 mm amphibious Nikonos with a 35- 23- or 15-mm lens. Its simplicity and acceptable quality make it suitable for use by other than photographic experts. For most other cameras underwater cases are available, which can offer more versatility to the photographic system. These, especially the larger-format cameras, often provide higher resolution, but also require more maintenance and expertise to use properly.

Black-and-white and color film each offer particular benefits. Black-and-white is cheaper and more easily and quickly developed, especially in a field darkroom, in that development and printing require less training and less control over the temperature of developing chemicals than are necessary for color. Also, the contrast of black-and-white prints can be easily adjusted in a field darkroom to enhance desired features.

Color transparencies offer the advantages of color definition, especially when artificial light is used (most colors being filtered out of natural light during its passage from the surface). Color definition assists in the identification of features for interpretation. Although it is expensive, is generally less sensitive to light, and normally requires more time and expertise to develop than black-and-white film, color film is usually used as a complementary recording material.

Artificial light is helpful with underwater photography, not only for the purpose of adding light and color to the subject, but also to produce helpful shadows which normally do not exist because of the diffusion of natural light in water. Commonly electronic strobes, either expressly-designed underwater units or dry units in special cases, are used. Occasionally, special flood lamps are brought down. These have the advantage of a surface power supply and constant light to help the photographer, but the power cord can be a serious hindrance if the photographer must be very mobile.

Television cameras are being used for underwater sites to help archaeologists maintain observation during excavation and record details of the site. The units typically are common small video cameras in underwater housings, which also include an attached flood light connected to the surface by cable. On the surface, a monitor displays the picture while a half-inch tape records both the picture and the observer's comments. If the camera is hand-held, the diver will often wear a helmet which offers voice communication with the surface. All communications between the surface and diver are also recorded on the tape.

After finds are recorded in situ, they must be carefully removed. Most are fragile and many are small enough to be easily lost or broken by an ascending fully-suited diver. Containers of various shapes and sizes and non-floating packing materials are kept available on the site.

After each level of excavation is recorded, the site, or the area being worked, is excavated further. The size and typology of encountered remains determine the depth of each cut. When sweeping with hands is not possible, airlifts (as previously described) are the most common means of removing sediment. Fig. IV-B6 presents an airlift with its air hose placed in its lower end. Various valves and gadgets have been tried with the aim of making airlifts more efficient, but because of maintenance problems and occasional incidents when accidentally freed airlifts have dug up sites, most excavators have returned to simply placing the air hose in the lower end of the pipe whenever the air lift is to be used.

Water dredges (Fig. IV-B7) can be made of PVC or metal tubing of various sizes. The fact that they do not need a vertical component makes them advantageous to use as they can be attached to the grid frame while the excavator works with a flexible end. Unfortunately, easily maneuverable, flexible vacuum hose is difficult to obtain.

A prop blaster (Fig. IV-B8) is a simple device made of rigid fiberglass or metal which fits around the screw of a boat, extends aft, and turns 90° toward the bottom. A safety screen over the intake guards against sucking in people or objects, and support bars and/or chains complete the apparatus. Three good anchors are set to assure stability and easy shifting of the vessel. Variations on this system have been designed: 1) A propeller may be mounted horizontally below a barge whose sole purpose is to excavate underwater (Methiews, personal communication). 2) An electrically driven unit may be taken near the bottom for deep sites.

Communication has always been a problem underwater. New equipment is constantly being designed and evaluated in an effort to supersede sign language. Simple communication between two divers, or a diver and the surface, is often accomplished by using a nylon line with prearranged signals. More complex communications are achieved by writing on mylar, sanded plexiglass, or PVC. A recent development is a device which will buzz when pushed--allowing divers or surface personnel to use any prearranged code of long and short buzzes. The device has a range of approximately 0.25 miles (Johnson 1978). The clear transmission of speech is of course the most desired communication system, yet it is the hardest to achieve. Units for transmitting speech all include full-face masks, which cover not only the normal eye and nose area, but also that of the mouth. A microphone and earphones are part of the mask. Three major types exist: 1) hard wire, where sound is transduced into electricity and transmitted, as

with a telephone, by wire to the surface; 2) sonic, where sound is transduced into lower frequency sound which is transmitted through the water to a receiver, which transduces the lower frequency to normal sound; and 3) electromagnetic, where sound is transduced into electromagnetic waves which are transmitted as in a normal radio transmitter.

The major problem, though it is continually being alleviated, is achieving quality acoustics in the mask for both talking and listening. Transmission of the signal by wire is excellent, but the diver is encumbered by a wire leading to the surface. Transmission by sound or radio waves is less cumbersome but is subject to some outside interference. Current range limitations are usually not a problem at underwater sites.

Because speech communication is not extensively needed when using experienced excavators, a compromise piece of equipment, the "telephone booth," is used on some excavations (Fig. IV-B13). It consists of a plexiglass dome filled with air, containing a remote unit of an intercom system. The dome is suspended above the bottom allowing divers to stand with their heads dry in the air bubble thus created. The intercom central unit is kept on the barge or float above and is connected by wire to the remote unit. Replacement air is slowly bubbled into the phone booth to keep the oxygen content up. The booth makes possible good communication to the surface when needed, and allows divers to talk to each other, when necessary, at the site. It also serves as an emergency air stop for divers on a deep site.

Special topside equipment is needed to support the underwater operation. A barge or float is moored over the site. Although large vessels are occasionally used as operations platforms, the expense is prohibitive in most cases. The barge deck must be high enough above the surface to protect equipment from waves and spray. It must have enough buoyancy to handle large shifts of weight, as certain procedures require most members of the crew to congregate near an edge or corner. There should also be some protection for the crew from the sun, wind, and weather.

Large storage tanks and smaller transportation tanks filled with salt water are kept available for recovered artifacts. Nonfloating packing material, often burlap, is used to secure transported finds.

Both high- and low-pressure air compressors are needed. The high-pressure compressor is used to fill scuba tanks (pressures required are between 2,000 and 4,000 p.s.i., depending on the system). These compressors are of a special "breathable air" type which minimizes harmful oil vapor in the compressed air. To ensure the purity of the air, special filters are used and the air is tested periodically (by state health officials in most areas). If the high-pressure compressor is at a land base, which is common, connected storage tanks are used to allow quick filling of scuba tanks at the end of the day.

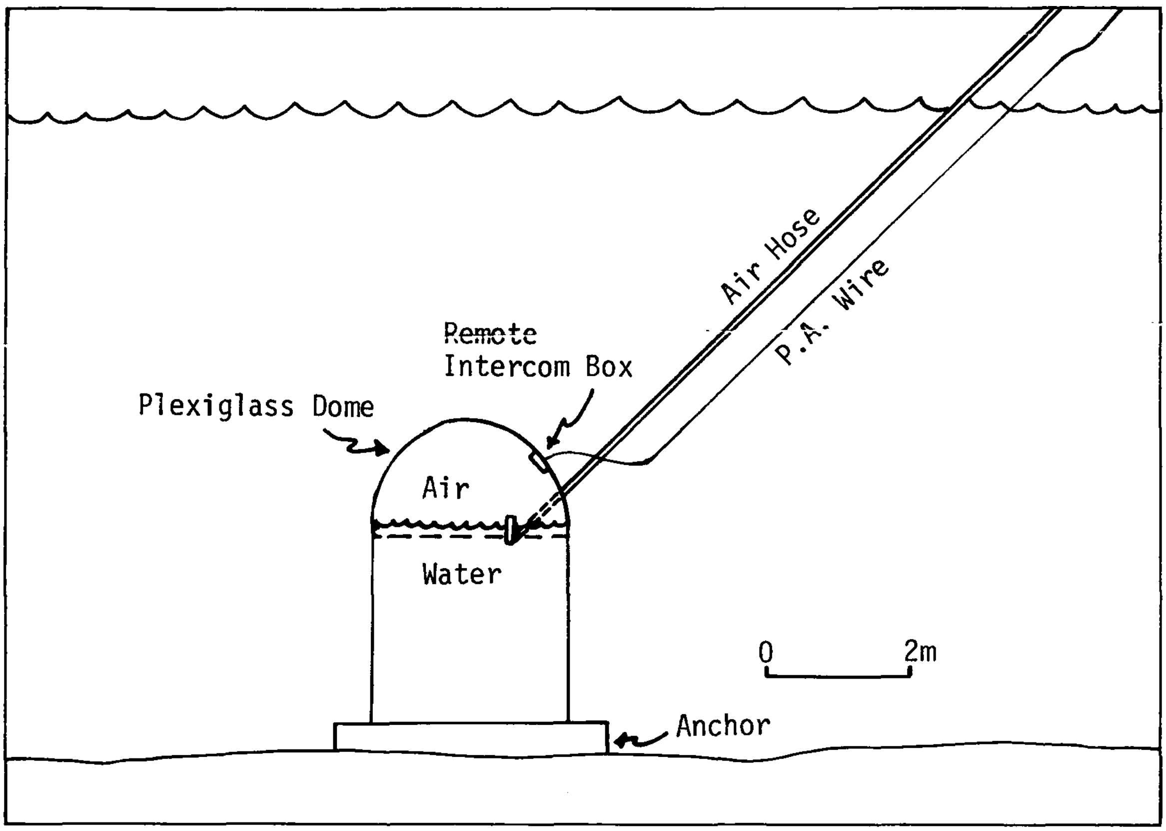

Fig. IV-B13

Cut away view of an underwater telephone booth. It is comprised of an air filled plexiglass dome on stilts, with a remote intercom box in it.

Low-pressure compressors are also needed to supply air to airlifts and to divers using umbilical cords for their air supply, to fill lift bags (discussed below), and to bubble into a phone booth, if any.

As with high-pressure compressors, special designs and filters are used to minimize oil vapor if the air will be breathed. An air reservoir is commonly used to absorb temporary heavy usage, especially when excavators will be breathing from the system. Low-pressure compressors must be near, if not directly above, the site.

Water pumps capable of handling salt water for extended periods of time are needed to power water dredges and water jets if they are used. A pump is also helpful to the conservator for washing artifacts.

Lift bags of various sizes are stored on the barge (Fig. IV-B14). Made of heavy plastic or rubberized canvas, these bags are used for slow lifting or lowering of heavy objects. Once a deflated bag is attached to a heavy object it is inflated with an air hose just enough to allow the object to be lifted. Many have a relief valve on the upper section to allow a diver to exhaust air quickly, thereby decreasing the rate of ascent. Lift bags are used to move heavy artifacts, grid frames, moorings, etc.

Two essential pieces of equipment are a boat for transportation to and from the barge, and a skiff for work and safety around the site.

Radios provide logistic and safety communications with the shore. Citizens' Band radios are now preferred for most purposes as state police and the United States Coast Guard are now monitoring channel 9 for emergencies. The expense is less for CB than for other transmitters, and licenses are easier to acquire. Typically radios are kept on the barge, the transportation boat, and a land base.

Special Equipment

Conditions at a site may require special equipment to overcome difficulties. Three of the most common problems are cold water, deep water, and heavy currents. Most water in the study area is cold enough to require a full wet suit for summer and autumn work. A full wet suit includes pants, jacket, hood, boots, and gloves. Water north of Cape Cod is kept particularly cold by the Labrador Current, which brings northern water south along the coast. North of Cape Cod full cold-water wet suits are normally used; they are thicker and provide two layers of neoprene over the trunk portion of the body.

In winter and spring, before the water has warmed, a dry suit is used in both areas. In fact, dry suits are occasionally worn in the summer north of Cape Cod. Dry suits allow divers to wear insulating

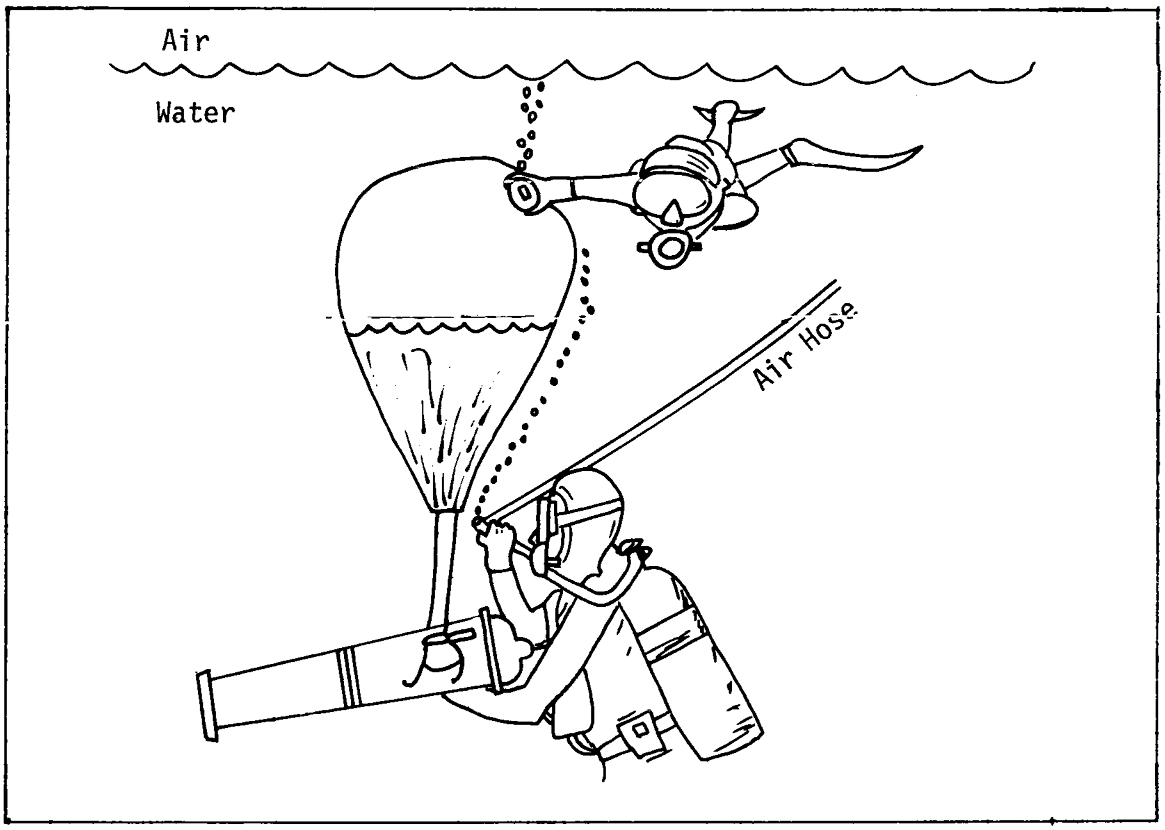

Fig. IV-B14

Cut away view of an air bag being used to lift a heavy object. One diver releases expanding air as the bag rises.

underclothes, and keep water off their skin. They are much warmer than wet suits. Although wet suits are occasionally used in very cold water, most divers cannot long maintain their proper body temperature with them. Even a slight drop in body temperature sharply decreases the accuracy and efficiency of work performance and increases any danger to personnel. A weather-proof area on the barge, and hot drinks or food are normally made available for surfacing excavators.

Deep-water excavation presents physiological problems for the archaeologist. (As above, deep-water sites, 30 to 45 m [100 to 150 ft] and very deep-water sites, 45 to 185 m [150 to 600 ft] are here discussed separately). An excavator at a deep-water site must properly contend with the absorption of nitrogen into his body, or suffer from decompression sickness. Bottom time is limited, and ascent time is extended, by standard tables. A typical dive, using the U.S. Navy tables with a safety margin, would be a bottom time of 25 minutes at 45 m (150 ft) and an ascent time of 32 minutes--a total of 57 minutes underwater.

An excavator working in deep water generally cannot surface directly without suffering decompression sickness. Arrangements must therefore be made to handle emergencies on the bottom. Divers carry extra air, using either 2 air tanks, or breathing from an umbilical hose while carrying a single tank for emergencies. Twin tanks are often fitted with 2 regulators for extra safety. Extra supplies of air, tanks or umbilical hoses, are stationed on the site. The telephone booth, mentioned above, is a particularly good source of emergency air.

As the divers must stop at prearranged depths when ascending, stations with handles and extra air are established on a line hung below the barge. To decrease the ascent time, pure oxygen is sometimesbreathed at the stations. This is normally sent down by an umbilical hose.

Even when all precautions are taken, including training, health, rest, and equipment, decompression sickness can strike a diver, threatening permanent damage or death. Most organizations conducting deep-water diving require that a pressure ("recompression") chamber for the treatment of decompression sickness be readily accessible. A recompression chamber requires a low-pressure, high-volume compressor and storage tanks for compressed air. These chambers are available in a variety of sizes. Because most problems include at least 2 divers, and a trained person should accompany them in the chamber, a 4-man double-lock chamber is often the desired size. "Double-lock" allows for the entrance or exit of personnel or supplies into the treatment chamber. A recompression chamber can also be used to treat a lung rupture, which is an uncommon, but very dangerous, accident which can affect excavators at any depth below 2 m.

A very-deep-water operation (45-185 m or 150-600 ft) is generally conducted with a helium-oxygen breathing mixture to eliminate decompression sickness problems. As mentioned above, a very deep-water excavation would normally require saturation diving, when excavators stay in a pressurized chamber between sorties into the water, and only decompress (ascend) after a few days.

Saturation diving requires a great deal of specialized equipment. A pressurized living chamber, diving chamber, gas mixing equipment, emergency support equipment, and a barge or ship with a suitable lifting capacity. Observation by archaeologists not on a particular saturation team is best achieved by using a mini-submarine with good observation ports, lights, and communications with the working excavators and surface (Keith, personal communication).

Heavy currents at a site are bothersome and can be dangerous. A scuba diver is able to sustain only 1 knot in still water because of water resistance on his body and equipment. Even a half-knot current is a problem to an archaeologist, illustrator, or photographer underwater. Heavier weight belts on the excavators and a stronger-than-normal grid frame are helpful.

When a current becomes heavy enough to curtail normal, free scuba diving, excavators will sometimes work with enough lead on their waists to be 10 to 20 pounds heavy in the water. They are then tended from the surface with a line, with which they communicate and are lowered and hauled in. Safety lines are positioned down-current, in even light currents, to give swept-away divers a boundary. Mooring anchors, for the barge and grid frame, must also be increased.

APPENDIX C

PRESENT PRACTICE IN ARTIFACT CONSERVATION

C.1 INTRODUCTION

Waterlogged artifacts from a saline environment exhibit a range of deterioration conditions. Some appear to have suffered little damage, while others become distorted through immersion. Even though they may appear to be in acceptable condition, drying of artifacts without remedial treatment can disfigure the material (Fig. IV-C1). In organic materials, frequently all that remains are cell walls supported by salt water. Most inorganic materials suffer from the intrusion, and often the corrosive effect, of waterborne salts, especially chlorides.

Until recent years, the need for conservation of waterlogged artifacts was not well understood. Artifacts were not treated or were superficially cleaned. Few examples of these objects exist today. Experimental treatments, especially when nonreversable, damaged or destroyed cultural artifacts. By contrast, if a reversible treatment is in progress, and is discovered to be failing, the processes can be reversed. Conservators and conservation scientists in many countries have devised reversible methods which, if not perfect, are acceptable until better techniques are developed.

This section includes problems and techniques presently encountered in the conservation of waterlogged artifacts, from the U.S. and Canada. For each type of artifact considered, the discussion is general and meant only to acquaint the reader with the work currently being performed.

Conservation treatment of an artifact is dependent on its composition, its state of preservation, and the identity of any foreign substances within it. In the study area, foreign substances will consist mainly of water, the salts found in regional sea water, and compounds formed by an interaction between artifacts and their environment.

C.2 ORGANIC MATERIALS

C.2.1 Wood

Wooden artifacts are found in underwater sites more often than in terrestrial sites. The size, species, and spatial association of wood will help determine its conservation treatment. Wooden artifacts ranging in size from small tool shavings to ships' keels are presently

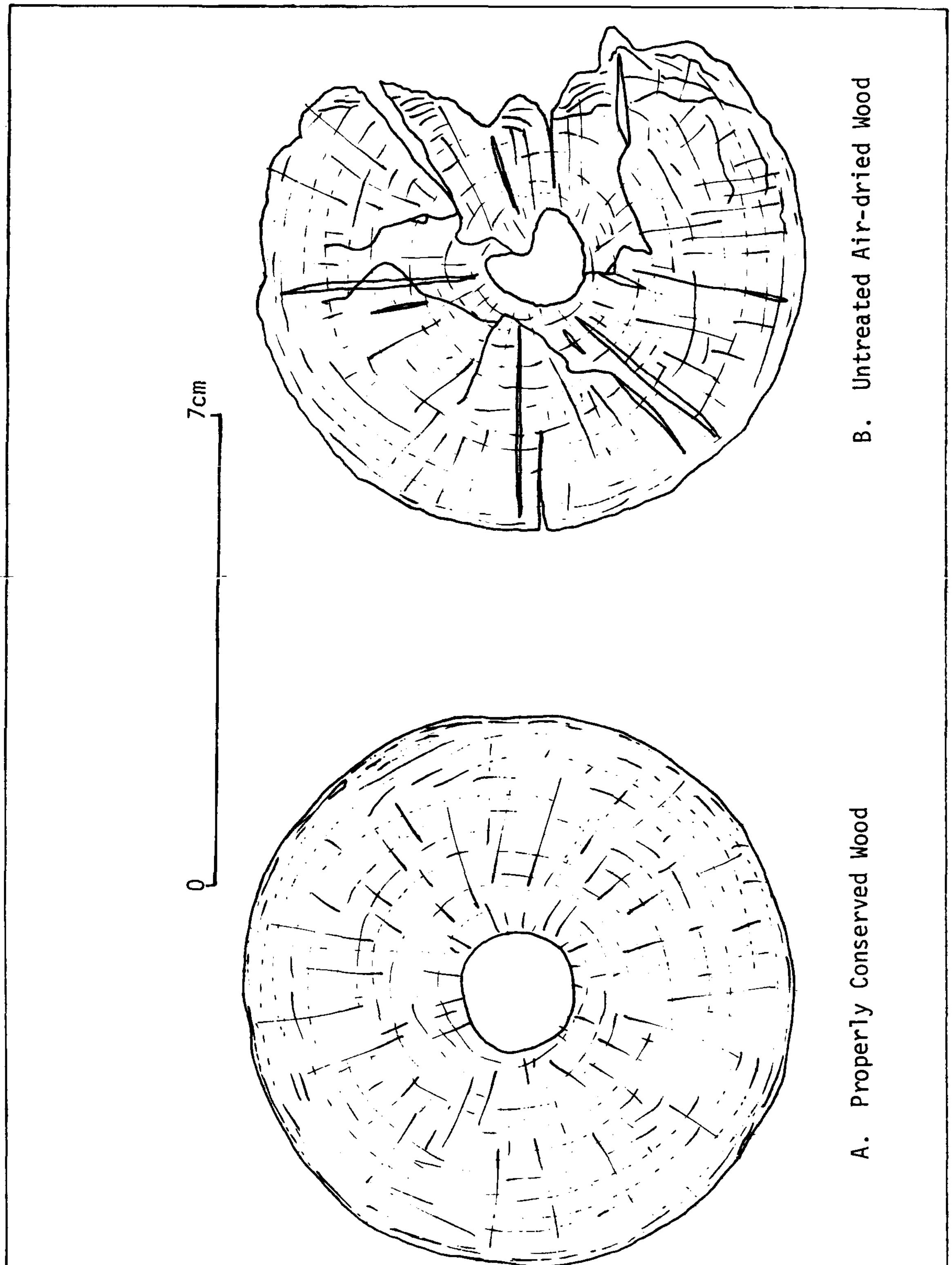

Fig. IV-C1 Orginally identical parts of wooden grape shot stands from an underwater Revolutionary War site. (On display at the Maine State Museum.) Piece A shrank less than 1%. Piece B is also distorted from its original depth of approximately 1cm. Both pieces were made of soft wood.

being excavated within the study area. Soft- and hardwood objects are sometimes found by themselves and sometimes in close association with metal, shell, or bone--all of which may affect the conservation of a particular piece of waterlogged wood.

When wood becomes waterlogged, its microstructure is severely altered. Formerly strong cells become degraded until they are merely cell walls filled and supported by sea water. Excavated wood may look fine, and even feel sound, but be in very poor condition. In the past, excavated wood was simply dried, with the result that the water evaporated, a surface tension problem created by the existing water often collapsed the weakened cell walls.

Sometimes wood which is untreated or improperly treated is apparently undegraded, but its unsupported and weakened cell walls leave the piece vulnerable to any disturbance such as changes in humidity. This is the case with the Philadelphia, a Revolutionary War vessel raised from Lake Champlain, now on display in the Smithsonian Institution. Constant atmospheric humidity, consolidation, and attention from the conservator are required to keep the vessel intact.

When found underwater, old wood can be in any condition--from spongy to hard and relatively strong. Before being moved, its condition must be investigated to insure against harming the artifact. In the past, it was assumed that wood suffered no damage as long as it was kept relatively damp. As research continues, it now appears that even slight drying of surface wood triggers a flow of water in cells throughout the artifact. Associated with this flow are pressures and surface tensions which can distort or destroy the internal structure. Wooden artifacts are therefore kept continually wet, with at least a film of water over the surface.

While awaiting treatment in the conservation laboratory, the wood should be protected against biological attack. This is sometimes accomplished by using chemical biocides or recirculating fresh clean water.

Before the wood is dried, something must be done to protect it from the surface tensions of retreating water. Several methods are presently used. The technique chosen for a particular artifact depends upon the type and condition of the artifact, available resources, and desired appearance of the finished object. The most common techniques are:

1. Slow drying--The object is placed in a container so that drying may take place at a controlled speed.
2. Polyethylene Glycol (PEG)

A. Long Immersion--The wood is placed in a bath of water. The PEG is slowly added to the water and heat is applied. At a given concentration of PEG the wood is removed from the solution and allowed to dry slowly.

B. Freeze-drying--The wood is immersed in an aqueous PEG solution for a given time period. Following immersion, the wood is frozen and then freeze-dried.

3. Acetone-rosin--The wood is first dehydrated in acetone and then bulked with rosin in a warm bath of acetone mixed with rosin.

In each of these methods the consolidant may be removed even after the wood is dry. This allows for new and better techniques which may be developed in the future. Storage of treated wood requires constant temperature and humidity. Some artifacts are quite fragile and therefore should be handled as little as possible.

C.2.2 Leather

Leather artifacts can be found in prehistoric or historic underwater sites. They may be more fragile than wood and must be handled carefully, both underwater and after recovery. It is important to keep leather immersed in water. Any degree of drying can cause irreparable damage to its structure.

Treatment of waterlogged leather involves washing to remove salts, saturation with a bulking agent prior to slow drying or freeze drying, and surface consolidation or restoration. Treated leather can appear to be flexible and strong, but it is actually sometimes quite fragile. Storage with a constant temperature and humidity and a minimum of handling is essential.

C.2.3 Bone, Tooth, Ivory

Bone, tooth and ivory artifacts can survive well underwater. Mammoth and prehistoric human remains have been found underwater in Florida (Cockrell and Murphy, 1978). Problems with waterlogged bone are somewhat similar to those of wood. Treatment includes consolidation and bulking.

Waterlogged teeth and ivory can suffer from delamination of their layered structure. Within the objects' structure, because the pressure associated with a rapid change from salt to fresh water might cause severe damage, tooth and ivory artifacts are desalinated slowly. For the same reason, fresh water is slowly replaced by a consolidant. Bones, teeth and ivory should be stored in an environment of constant temperature and humidity.

C.3 INORGANIC MATERIALS

C.3.1 Glass

Glass artifacts, common on historic sites, present problems similar to those of teeth or ivory. Sea salts, one major cause of deterioration, are trapped between structural layers of glass during its submersion. These salts can cause delamination of the glass if the object is allowed to dry without attention. The salts precipitate into crystals (which have more volume than the salt in solution) and overlapping layers of glass can succumb to the pressure thus created.

Water, evaporating from between outer layers of a glass object, cannot be replaced quickly by water from deeper layers. Salt crystals will therefore quickly form, and a glass artifact will begin to spall, if it is allowed to stay out of water for even a very short time before treatment.

Treatment at this time is similar to that of teeth and ivory. Experimentation and research aimed at discovering the best materials and techniques for treatment and storage of glass are presently continuing.

C.3.2 Ceramics

Often the majority of artifacts found in prehistoric or historic sites are ceramic. If they are allowed to dry without careful desalinization, problems similar to those of glass may arise. For this reason, ceramic artifacts and porous lithics are routinely treated in a manner similar to the one used for glass. If a glaze is present on a ceramic artifact, or the ceramic structure is known to be weak, the object is desalinated slowly like glass, and may even need to be impregnated with a consolidation solution.

C.3.3 Metals

Conservation of metal artifacts depends on the metals involved. Iron is the most common metal found on historic sites. Tools, weapons, monitors, toys, and ship fittings are typical finds. Ferrous material in sea water is corroded by dissolved salts. A large ferrous artifact found underwater will typically have a solid original core surrounded by layers of corrosion. But each artifact, even at the same site, can be in a different state of preservation. Two cannonballs may look exactly alike, and, if carefully handled during excavation and treatment, will both retain their appearance. However, one with a solid core can weigh up to 6 lb while a deeply corroded ball of the same initial dimension will weigh only a few ounces.

Treatment for ferrous objects is started as soon as possible, because oxygen dissolved in the storage water can increase the rate of corrosion. Objects left in the air for only a few minutes have been known to explode, as heat was generated from rapid oxidation.

Treatment of ferrous artifacts must be complete; any salts not extracted from, or immobilized inside the object, will continue corrosion within the artifact while it is in storage. Presently, electrolysis is the most common remedial conservation technique. Corrosion layers are electrolytically reduced, leaving the iron consolidated and expunging foreign salts. Slow drying and a surface consolidant sometime are used to finish the process.

The treatment of all copper-based artifacts, even those alloys such as brass (copper and zinc) or bronze (copper and tin) is nearly identical. Prehistoric native copper and historic copper artifacts are commonly found along the eastern coast of the U.S.

Copper objects found in underwater sites suffer intrusion of and corrosion by sea salts, especially chlorides. Treatment of copper-based artifacts can be conducted more easily if surface corrosion is removed, although this may destroy important surface details. Electrolysis similar to that used for treatment of ferrous artifacts can be used to eliminate chlorides and consolidate surfaces. After electrolytic reduction is accomplished, the object can be immersed in a solution of benzotriazole (BTA)--a chelating agent. Benzotriazole reacts with copper and forms a protective film on the metallic surface. Sometimes BTA is used without first conducting electrolytic reduction, but the stability of the film in this instance is not well established. This method is therefore used only when electrolysis is impractical. Storage of BTA-treated artifacts demands attention to the created protective surface. It if is scratched, oxygen and water vapor can start corrosion.

Pewter (lead and tin) and lead artifacts are also common to historic sites. The inclusion of sea salts is mostly a physical problem, similar to that of ceramics. Treatment involves desalinization by immersion in fresh water. If the object is badly corroded, electrolytic reduction may be necessary.

C.4 COMPOSITE MATERIALS

Composite materials, sometimes known as concretions, are a mixture of organic and inorganic artifacts and rubble encased in a cement-like corrosion matrix.

Treatment of a concretion, which can range in size from 2 in square to several feet in diameter, usually begins with an intensive examination. Because artifacts within the corrosion matrix may be invisible, radiography is a useful investigative technique. Following the

examination, a careful excavation (with small hand tools and care) using radiographs and photographs as a guide can reveal the artifacts within the concretion. Once separated, the organic or inorganic objects are dealt with as separate conservation problems using the previously mentioned treatments.

As of this writing, no contingency plans have been developed for the conservation of newly discovered underwater sites. The present system, or lack of one, is insufficient.

APPENDIX D

30 CFR PART 251 GEOLOGICAL AND GEOPHYSICAL (G & G) EXPLORATIONS OF THE OUTER CONTINENTAL SHELF (PROPOSED)

(Reprinted from the Federal Register 44(29):8302-10)

[4310-31-M]

DEPARTMENT OF THE INTERIOR

Geological Survey

[30 CFR Part 251]

GEOLOGICAL AND GEOPHYSICAL (G & G) EXPLORATIONS OF THE OUTER CONTINENTAL SHELF

Data Acquired Under Exploration Permit

AGENCY: Geological Survey, Interior.

ACTION: Proposed Rule.

SUMMARY: This proposed rule amends the Outer Continental Shelf (OCS) geological and geophysical exploration regulations, contained in 30 CFR Part 251, in response to a policy decision by the Secretary of the Department of the Interior to encourage companies to engage in pre-sale on-structure, as well as off-structure, drilling on OCS lands. The decision to allow on-structure drilling was made in an effort to provide important information about the hydrocarbon potential of an area which cannot be obtained by drilling only off-structure. Providing the flexibility for either on-structure or off-structure pre-sale testing will result in a better estimate of the resource potential of a region than could have been developed with off-structure drilling alone.

DATE: Interested persons may submit written comments on the proposed rule on or before April 10, 1979.

ADDRESS: Comments should be addressed to Director, U.S. Geological Survey, U.S. Department of the Interior, Reston, Virginia 22092. Comments will be available for public review at the above address from 7:45 a.m. to 4:15 p.m. on regular working days.

FOR FURTHER INFORMATION CONTACT:

Bruce G. Weetman, Senior Staff Advisor, Branch of Marine Evaluation, Conservation Division, MS 640, U.S. Geological Survey, Reston, Virginia 22092, (703) 860-7564.

SUPPLEMENTARY INFORMATION:

AUTHOR

The primary author of the revision is Bruce G. Weetman.

BACKGROUND

The Department has redefined deep stratigraphic tests so that the definition includes pre-lease, on-structure drilling. The Department will make every effort to take all drilling results into account in its final determination of sale formats but will proceed with sales as listed on the currently approved OCS Leasing Schedule. In order for the data to be fully utilized in the lease sale planning process, the well should be completed and the test data should be submitted to the Director no later than 3 months prior to the month in which the Proposed Notice of Sale appears on the Secretary's currently approved OCS Leasing Schedule, from which an OCS oil and gas lease may be issued within 50 miles of the test site. If the test is in an area not included in the current planning schedule, the usual submittal procedures should apply.

The following modifications are proposed in the existing regulations.

Section 251.3(l) redefines deep stratigraphic test to allow drilling of test wells on the Outer Continental Shelf (OCS) directly on geologic structures that could contain oil or natural gas. This change is part of an effort to further expand information on the petroleum potential of unleased lands on the OCS.

Section 251.5(a) has been expanded to clarify the Department's position that the issuance of permits is discretionary, to require that the Director state reasons for rejection of a permit application, and to allow the Director to advise the applicant of changes in the application which would render the application acceptable.

Section 251.7 corrections of the addresses of the filing locations have been made.

Section 251.8(c) has been expanded to include "possible discoveries" in the list of items to be reported to the Director immediately upon discovery.

Section 251.9(b)(vi) has been added to require that an Environmental Report be submitted to the Director with the drilling plan. This report shall enable identification and evaluation of the significant environmental consequences of the proposed activities as well as all information available to the permittee at the time of application. The report shall include a description of the proposed action, description of the existing environment, impact evaluation and mitigating measures, alternatives to proposed action, and unavoidable adverse environmental effects of the proposed action.

Section 251.9(c) is expanded to allow a penalty of up to 200 percent of the cost to each original participant after the Supervisor issues a public notice that significant shows or a possible discovery have been encountered in the test. Under present regulations, the permittee may charge a penalty up to 100 percent for late entry. It appears appropriate to allow the penalty to be higher than 100 percent for firms joining the consortium after the announcement of a hydrocarbon show or discovery. An insufficient penalty for post-discovery entrance would encourage firms to wait until wells are completed, joining only those consortia that have shows or discoveries and thus have more valuable information. This could reduce the number of firms willing to incur the risks and costs of being original members and thereby reduce the number of wells drilled. Allowing the original consortium to charge a higher penalty for late participation after a show or discovery is announced would tend to reduce the benefits of late entry and increase the benefits of original membership.

Section 251.9(d) has been modified to bring it into conformance with the existing cultural resource lease stipulation.

Section 251.9(f) has been added to specify that deep stratigraphic tests are to be completed no later than 3 months prior to the month in which the Proposed Notice of Sale appears on the Secretary's currently approved OCS Leasing Schedule. This requirement is necessary to provide sufficient time for Government utilization of the data without causing delays in scheduled lease sales.

This 3-month period allows for interpretation and evaluation of the data for use in the Secretary's decision on the configuration of the proposed sale which is published in the FEDERAL REGISTER and sent to the Governors of affected States for a 60-day comment period. The Proposed Notice of Sale is the first indication to the public and to bidders concerning the specific tracts, bidding systems, lease terms, and stipulations proposed for a sale. The Secretary's tentative decision on the configuration of a proposed sale is made approximately 90 days before the final decision on the sale.

The availability of the data 3 months before the Proposed Notice of Sale will assure that it will be available for final decisions on the configuration of the sale and for evaluation of tracts for purposes of deciding whether to accept or reject bids received. It will also be available for any review of a lease sale conducted by the Attorney General under Sec. 8(c) of the OCS Lands Act as amended.

The proposed regulation provides for extensions of exploration permits beyond the established deadline when such an extension is determined by the Director to be in the national interest. This will avoid the necessity of shutting down drilling operations which have been unavoidably delayed by adverse operating or other conditions. It would also allow shorter lead-times to prepare for sales if it is determined to be in the national interest for near-term sales or sales in areas with short drilling seasons.

Section 251.9(g) has been added to prescribe policy on disposition of a deep stratigraphic test whether on- or off-structure. To assure maximum protection of the marine environment, it is proposed that all deep stratigraphic tests be considered expendable and be permanently plugged and abandoned when all data and information desired have been obtained. This provides not only for administrative convenience but also offers a degree of protection to the environment in the event a tract containing an abandoned test is not leased. All drilling and abandonment will be conducted in conformance with existing OCS Orders and Regulations.

Section 251.11(b)(4) has been expanded to include "possible discoveries" in the final report to be submitted to the Director.

Section 251.12(b)(2) has been rewritten to clarify the deadlines for data submission after its inspection and selection by the Director.

Section 251.12(b)(4) has been expanded to clarify the Director's right to inspect the data and information listed in this section as well as to select the data or information.

Section 251.13(b) and (c) have been rewritten for clarity.

Section 251.14(b)(1) has been expanded to clarify what will be released to the public by the Director in the

event a significant show or possible discovery is encountered in a deep stratigraphic test. When the Director determines that a significant show or possible hydrocarbon discovery has been encountered in a deep stratigraphic test, the Director shall issue a public notice announcing that a significant show or possible hydrocarbon discovery has been encountered. In addition, other nonproprietary data and information as appropriate to the specific situation will be released at this time. Privileged or proprietary data and information, release of which would compromise the competitive position of any party participating in the test, will not be included in the public notice. The public will have access to all data and information from the test, including those which were formerly proprietary, 60 days after the issuance of the first OCS oil and gas lease within 50 geographic miles of the test site, or 5 years, whichever is sooner. Planners, therefore, will have ample time to use the data and information in projecting onshore impacts of future development.

Section 251.14(b)(3) has been changed to clarify the Department's position on disclosure of data after the issuance of an OCS oil and gas lease within 50 miles of the test site. In the event a test is drilled within 50 miles of an existing lease, the disclosure provision is not invoked until 60 days from the issuance of the next OCS oil and gas lease within 50 miles or 5 years after completion of the test, whichever is sooner.

Section 251.14(c)(3) has been added to clarify the position that all G & G data and information submitted with an application for a deep stratigraphic test, except for Common Depth Point (CDP) seismic data, will be made publicly available at the same time as the data obtained from the test. The CDP seismic data are exempt from disclosure because they may reveal structural information on unleased tracts.

Section 251.14(d) has been added to allow the Director to disclose data or information to independent contractors under promise of confidentiality for analysis or processing on the Government's behalf.

It should be noted that the proposed changes incorporated into these regulations that relate to deep stratigraphic drilling are not intended to cause delays in the existing program. Accordingly, any acceptable application received prior to promulgating final modifications of these regulations will be processed according to existing regulations.

ENVIRONMENTAL IMPACT AND REGULATORY ANALYSIS STATEMENTS

The Department of the Interior has determined that the revision of the regulations in 30 CFR 251, as proposed in this notice, will not have a significant impact on the quality of the human environment and, therefore, will not require preparation of any Environmental Impact Statement. The Department of the Interior has determined that this document is not a significant rule and does not require a regulatory analysis under Executive Order 12044 and 43 CFR Part 14.

Dated: February 2, 1979.

JOAN M. DAVENPORT,
Assistant Secretary of the Interior.

Part 251 of Title 30 of the Code of Federal Regulations is amended to read as follows:

AUTHORITY: Secs. 5(a), 11, 26, Outer Continental Shelf Lands Act, as amended (43 U.S.C. secs. 1334(a), 1340, 1352 (1978)).

§ 251.1 Purpose.

The purpose of the regulations in this part is to prescribe policies, procedures, and requirements for conducting geological and geophysical exploration for mineral resources and scientific research on the Outer Continental Shelf without a lease.

§ 251.2 **Applicability.**

(a) *Permits and notices.* The regulations of this part are applicable to permits issued and notices filed after the effective date of this part. The regulations of this part are also applicable to any "Permit and Agreement for Outer Continental Shelf Geophysical Exploration" which, prior to the effective date of this part, is issued pursuant to the notice on Geological and Geophysical Exploration by the Acting Secretary of the Interior, dated August 27, 1975, and published in the FEDERAL REGISTER on September 3, 1975 (40 FR 40563). If the regulations of this part conflict with the terms of Sections 4, 5, or 8 of a "Permit and Agreement for Outer Continental Shelf Geophysical Exploration" which, prior to the effective date of this part, was issued pursuant to that notice in the FEDERAL REGISTER on September 3, 1975, the terms of that section in the Permit and Agreement shall control.

(b) *Leases.* The regulations in this part shall not apply to geological and geophysical exploration conducted on a lease in the Outer Continental Shelf of the United States by or on behalf of the lessee. Those explorations shall be governed by the regulations in Part 250 of this title.

§ 251.3 **Definitions.**

When used in this part, the following definitions shall apply:

(a) *Outer Continental Shelf.* All submerged lands which lie seaward and outside the area of lands beneath navigable waters as defined in Section 2 of the Submerged Lands Act, 67 Stat. 29 (43 U.S.C. sec. 1301), and of which the subsoil and seabed appertain to the United States and are subject to its jurisdiction and control.

(b) *Act.* The Outer Continental Shelf Lands Act, 67 Stat. 462 (43 U.S.C. secs. 1331-1343), as amended, September 18, 1978.

(c) *OCS Order.* A formal numbered order issued by the Supervisor with the prior approval of the Chief, Conservation Division, Geological Survey, that implements the regulations contained in this part or Part 250 of this title and applies to operations in an area of the Outer Continental Shelf.

(d) *Director.* The Director of the Geological Survey, United States Department of the Interior, or a Designee of the Director.

(e) *Person.* A citizen or national of the United States, an alien lawfully admitted for permanent residence in the United States as defined in 8 U.S.C. sec. 1101(a)(20), a private, public, or municipal corporation organized under the laws of the United States or of any State or territory thereof, and associations of such citizens, nationals, resident aliens, or private, public municipal corporations, States, or political subdivisions of States.

(f) *Third party.* Any person other than a representative of the United States or the permittee.

(g) *Notice.* The statement of intent to conduct geological and geophysical exploration for scientific research which does not include the use of solid or liquid explosives or a deep stratigraphic test.

(h) *Permit.* The contract or agreement approved for a specified period of not more than 1 year under which a person acquires the right to conduct (1) geological exploration for mineral resources, (2) geophysical exploration for mineral resources, or (3) geological and geophysical exploration for scientific research which includes the use of solid or liquid explosives or a deep stratigraphic test.

(i) *Geological exploration for mineral resources.* Any operation conducted on the Outer Continental Shelf which utilizes geological and geochemical techniques, including, but not limited to, core and test drilling, well logging techniques, and various bottom sampling methods to produce data and information on mineral resources, including data and information in support of possible exploration and development activity or for other commercial purposes. The term does not include exploration for scientific research.

(j) *Geophysical exploration for mineral resources.* Any operation conducted on the Outer Continental Shelf which utilizes geophysical techniques, including, but not limited to, gravity, magnetic and various seismic methods, to produce data and information on mineral resources, including data and information in support of possible exploration and development activity. The term does not include exploration for scientific research.

(k) *Geological and geophysical exploration for scientific research.* Any investigation conducted on the Outer Continental Shelf for scientific research purposes involving the gathering and analysis of geological or geophysical data and information which are made available to the public for inspection and reproduction at the earliest practicable time.

(l) *Deep stratigraphic test.* Drilling which involves the penetration into the sea bottom of more than 50 feet (15.2 meters) of consolidated rock or a

total of more than 300 feet (91.4 meters).

(m) *Shallow test drilling.* Drilling into the sea bottom to depths less than those specified for a deep stratigraphic test.

(n) *Data.* Facts and statistics or samples which have not been analyzed or processed.

(o) *Analyzed geological information.* Data collected under a permit which have been analyzed. Analysis may include, but is not limited to, identification of lithologic and fossil content, core analyses, laboratory analyses of physical and chemical properties, logs or charts of electrical, radioactive, sonic, and other well logs, and descriptions of hydrocarbon shows or hazardous conditions.

(p) *Processed geophysical information.* Data collected under a permit which have been processed. Processing involves changing the form of data so as to facilitate interpretation. Processing operations may include, but are not limited to, applying corrections for known perturbing causes, rearranging or filtering data, and combining or transforming data elements.

(q) *Interpreted geological information.* Knowledge, often in the form of maps, developed by determining the geological significance of data and analyzed geological information.

(r) *Interpreted geophysical information.* Knowledge, often in the form of maps, developed by determining the geological significance of geophysical data and processed geophysical information.

(s) *Information.* This term, as used without a qualifying adjective, includes analyzed geological information, processed geophysical information, interpreted geological information, and interpreted geophysical information.

§ 251.4 Functions of Director.

The Director shall regulate all operations and other activities under this Part and perform all duties prescribed by this part. In order to do so effectively, the Director is authorized to issue OCS Orders and other written and oral orders and to take all other actions necessary to carry out the provisions of this part and to prevent damage to, or waste of, any natural resource or injury to life and property from any activity hereunder. The Director shall confirm oral orders in writing as soon as possible.

§ 251.5 Requirement of notices and permits.

(a) *Geological or geophysical exploration for mineral resources.* A person may not conduct geological or geophysical exploration for mineral resources without a permit. Separate permits will be issued for geological exploration for mineral resources and for geophysical exploration for mineral resources. Permit issuance is at the discretion of the Director. If the Director rejects a permit application, the statement of rejection shall state the reasons for the rejection. The statement may advise the applicant of changes in the application or other actions which may render the application, if filed again, acceptable to the Director.

(b) *Geological and geophysical exploration for scientific research.* (1) A person may not conduct geological and geophysical exploration for scientific research without a permit if the exploration includes the use of solid or liquid explosives or a deep stratigraphic test. Separate permits will be issued for geological exploration for scientific research and for geophysical exploration for scientific research.

(2) A person may conduct geological and geophysical exploration for scientific research without a permit if the exploration does not include the use of solid or liquid explosives or a deep stratigraphic test. However, the person must file with the Director a notice of intent to conduct exploration which does not involve such explosives or a deep stratigraphic test at least 30 days prior to commencing the exploration. Shallow test drilling may not be conducted if within 21 days of the filing of the notice the Director rejects the notice by sendng a statement of rejection by certified mail to the person who filed the notice. A statement of rejection may suggest changes in the notice which, if filed again, may render the notice acceptable to the Director.

§ 251.6 Forms for notices and permit applications.

(a) *Notices.* A notice shall not be on a standardized form, but shall be signed and shall state:

(1) The name(s) of the person(s) conducting or participating in the proposed exploration.

(2) The type of exploration and manner in which it will be conducted.

(3) The location, designated on a map, plat, or chart where the exploration will be conducted.

(4) The dates, which shall designate a period of not more than 1 year, on which the exploration will be commenced and completed.

(5) The proposed time and manner in which the data and information resulting from the exploration will be made available to the public for inspection and reproduction, such time being the earliest practicable time.

(6) An agreement that the data and information resulting from the exploration will not be sold or withheld for exclusive use.

(7) An agreement to comply with the Act, the regulations in this part, applicable OCS orders, other written or oral orders of the Director, and other applicable statutes and regulations whether such statutes, regulations, or orders are enacted, promulgated, issued, or amended before or after the notice is filed.

(8) The name, registry number, registered owner, and port of registry of vessels used in the operation.

(b) *Permit applications.* An application for a permit shall be on a form approved by the Director. Each application shall include:

(1) The name(s) of the person(s) conducting or participating in the proposed exploration.

(2) The type of exploration and manner in which it will be conducted.

(3) The location on the Outer Continental Shelf where the exploration will be conducted.

(4) The purpose of conducting the exploration.

(5) The dates on which the exploration will be commenced and completed.

(6) Such other descriptions of the proposed exploration as the Supervisor may request of the applicant.

§ 251.7 Filing locations for notices and permit applications.

(a) *Geological or geophysical exploration for mineral resources.* (1) Applications for permits to conduct geological or geophysical exploration for oil, gas, and sulphur shall be filed in duplicate at the following Geological Survey offices:

(i) For the Outer Continental Shelf off the Atlantic Coast—the Area Oil and Gas Suprvisor, Atlantic Area, 1725 K Street NW., Suite 204, Washington, D.C. 20006.

(ii) For the Outer Continental Shelf in the Gulf of Mexico—the Area Oil and Gas Supervisor, Gulf of Mexico Area, P.O. Box 7944, Metairie, Louisiana 70010.

(iii) For the Outer Continental Shelf off the coast of the States of California, Oregon, and Washington—the Area Oil and Gas Supervisor, Pacific Area, Room 7744, Federal Building, 300 N. Los Angeles Street, Los Angeles, California 90012.

(iv) For the Outer Continental Shelf off the State of Alaska—the Area Oil and Gas Supervisor, Alaska Area, P.O. Box 259, Anchorage, Alaska 99510.

(2) Applications for permits to conduct geological or geophysical exploration for minerals other than oil, gas, and sulphur shall be filed in duplicate at the following Geological Survey offices:

(i) For the Outer Continental Shelf off the Atlantic Coast and in the Gulf of Mexico—the Area Mining Supervisor Eastern Area, Suite 204, 1725 K Street NW., Washington, D.C. 20006.

(ii) For the Outer Continental Shelf off the States of Alaska, California, Oregon, and Washington—the Area Mining Supervisor, Alaska-Pacific Area, 345 Middlefield Road, Menlo Park, California 94025.

(b) *Geological and geophysical exploration for scientific research.* Notices and applications for permits to conduct geological or geophysical exploration for scientific research shall be filed in duplicate with the Area Oil and Gas Supervisor as indicated in paragraph (a)(1) of this section.

§ 251.8 General conditions of notices and permits.

(a) *Statutes, regulations, and orders.* Exploration authorized under this part shall be conducted in accordance with the Act, the regulations in this part, applicable OCS orders, other written or oral orders of the Director, and other applicable statutes and regulations whether such statutes, regulations, and orders are enacted, promulgated, issued, or amended before or after the notice is filled or the permit is issued.

(b) *General restrictions on operations.* Exploration authorized under this part shall be conducted so that operations do not:

(1) Interfere with or endanger operations under any lease maintained or granted pursuant to the Act.

(2) Cause undue harm to aquatic life.

(3) Cause pollution.

(4) Create hazardous or unsafe conditions.

(5) Unreasonably interfere with or harm other uses of the area.

(6) Disturb cultural resources, including sites, structures, or objects of historical or archaeological significance.

(c) *Report of hydrocarbon shows, hydrocarbon discoveries, or adverse effects.* Any person conducting exploration under this part shall immediately report to the Director any hydrocarbon shows, possible hydrocarbon discoveries, or any adverse effects of the exploration on the environment,

aquatic life, cultural resources, or uses of the area in which the exploration is conducted.

(d) *No right to a lease.* Authorizations granted under this part to conduct exploration shall not confer a right to a lease under the Act.

§ 251.9 Test drilling under notices and permits.

(a) *Shallow test drilling.* (1) Permits authorizing geological exploration for mineral resources by means of shallow test drilling may be issued by the Director. The Director will also review notices under which shallow test drilling will be conducted.

(2) As a condition of a permit or after receipt of a notice, the Director may require the gathering and submission of, prior to the commencement of operations, high resolution geophysical data, processed geophysical information, and interpreted geophysical information from, but not limited to, bathymetric, side-scan sonar, and magnetometer systems, so as to determine shallow structural detail across and in the vicinity of the proposed test.

(b) *Deep stratigraphic tests.* Permits authorizing geological exploration for mineral resources, or scientific research by means of deep stratigraphic tests may be issued by the Director.

(1) The holder of a permit that authorizes deep stratigraphic tests may not commence any drilling operations unless he has submitted a drilling plan and the Director has approved the plan. Each drilling plan shall include:

(i) Commencement and completion dates proposed for drilling the test.

(ii) A description of the drilling rig proposed for use showing the design and major features thereof, including features intended to prevent or control pollution.

(iii) The location of each deep stratigraphic test to be conducted, including surface and projected bottomhole location for directionally drilled tests.

(iv) An oil spill contingency plan and a description of all equipment and materials available to the permittee for use in containment and recovery of an oil spill, with a description of the capabilities of such equipment under different sea and weather conditions.

(v) High resolution geophysical data, processed geophysical information, and interpreted geophysical information from, but not limited to, bathymetric, side-scan sonar, and magnetometer systems collected across any proposed drilling location so as to permit determination of shallow structural detail in the vicinity of the proposed test, and for stratigraphic tests proposed to depths greater than 1,000 feet (304.8 meters) below the mudline, common depth point seismic data from the area of the proposed test location, and processed geophysical information and interpreted geophysical information therefrom.

(vi) An Environmental Report. At the same time the permittee submits a proposed plan to the Director, he shall submit an Environmental Report. The report shall address all activities included in the proposed plan and shall identify all environmental and safety features required by law, together with such additional measures as the permittee proposes to employ. The report shall be as detailed as necessary to enable identification and evaluation of the significant environmental consequences of the proposed activities and shall include all information available to the permittee at the time of submission. The Environmental Report shall include data and information obtained or developed by the permittee, together with other pertinent data and information available to the permittee from other sources. The permittee shall cross-reference information in the most recent applicable environmental documents and shall summarize pertinent information contained in other published, accredited reports. The report shall clearly identify the source of all data and information contained therein. The Environmental Report may be tiered to other environmental documents or Environmental Reports for the same or adjacent areas. Specific guidelines for implementing this section will be issued by the Director. The Environmental Report shall contain the following sections:

(A) Description of the Proposed Action. This section shall briefly summarize the nature and scope of the proposed action contained in the proposed plan. This section shall include, but not be limited to, the following: Company and operator name, objective of the proposed action, a description and location of vessels or platforms, and time frames for completion of various functions. In describing the proposed action, the report will also include a discussion of equipment, a discussion of oil spill contingency plans, statements of certification of consistency with appropriate coastal zone management programs when applicable, a comprehensive list of new or unusual technologies to be used, a detailed description of these technologies, the location of travel routes for supplies and personnel, the kinds and approximate quantities of energy to be used, and the environmental monitoring systems proposed for use by the

permittee. The proposed action section will also include suitable maps and diagrams showing details of the proposed project layout.

(B) Description of existing environment. This section is to contain a narrative description of the existing environment, and emphasis shall be placed on those environmental values that may be affected by the proposed action. This section shall include, but not be limited to, discussion of the following: Geology, physical oceanography, other uses of the area, flora and fauna, cultural resources, socioeconomics, and existing environmental monitoring systems, other unusual or unique characteristics which may be affected by the drilling.

(C) Impact evaluation and mitigating measures. This section shall contain a narrative description or tabulation of the probable impacts of the proposed action on the environment and existing mitigating measures, as well as measures which have been proposed in the plan, to mitigate the impacts.

(D) Alternatives to the proposed action. This section shall discuss all relevant alternatives to the proposed action or major segments of the proposed action which would result in less risk of adverse environmental impacts.

(E) Unavoidable adverse environmental effects of the proposed action. Any unavoidable or irreversible adverse environmental effects that could occur as a result of the proposed action shall be summarized in this section.

The permittee shall, when required, submit an appropriate number of copies of each Environmental Report to permit the Director to transmit a copy to the Governor and Coastal Zone Management Agency of each affected State and to the United States Office of Coastal Zone Management. The Director shall transmit such copies at the same time he transmits copies of the applicable plan. The Director shall also make copies of the Environmental Report available to the public, in accordance with the Freedom of Information Act.

(vii) Such other pertinent data and information as the Director may request.

(2) After approval of a drilling plan, any modifications must be approved by the Director. A modification including relocation of a drillsite or bottomhole location exceeding 600 feet (182.8 meters) must be approved by the Director.

(3) A deep stratigraphic test authorized by a permit shall be conducted in a manner which prevents blowouts, prevents release of fluids from strata into the sea, and prevents communication between fluid-bearing strata of oil, gas, or water. The permittee shall utilize appropriate protective measures and devices specified by the Director.

(c) *Group participation.* In order to minimize duplicative geological exploration involving penetration of the seabed of the Outer Continental Shelf, a permittee proposing to conduct a deep stratigraphic test shall afford all interested persons an opportunity to participate in the test on a cost-sharing basis with a penalty for late participation of not more than 100 percent of the cost to each original participant. The penalty shall be assessed by the participants. When the Director releases a public notice that a significant show or possible hydrocarbon discovery has been encountered in a deep stratigraphic test, the penalty for subsequent late participation may be raised to not more than 200 percent of the cost to any original participant. A permittee proposing to conduct shallow test drilling shall, when ordered by the Director or when provided in the permit, afford all interested persons an opportunity to participate in the test on a cost-sharing basis with a penalty for late participation of not more than 50 percent of the cost to each original participant. To allow for group participation a permittee shall:

(1) Publish a summary statement of the proposed test in a manner approved by the Director.

(2) Allow at least 30 days from the date of the publication for other persons to consider participation in the program as described by the permit and join as original participants.

(3) Forward a copy of the published notice(s) to the Director.

(4) Compute the cost to an original participant by dividing the total cost of the program by the number of original participants.

(5) Furnish the Director with a complete list of all participants under the permit prior to commencing operations, or at the end of the advertising period if operations begin prior to its close, and submit, on a timely basis, a list of all late participants.

If the Director determines that a change made in the permit or drilling plan is significant, he shall require additional publications. Persons wishing to join as a result of such readvertisements within the time frame allowed will be considered to be original participants.

(d) *Cultural resources.* Any person who holds a permit authorizing a deep stratigraphic test shall, if requested by the Director, conduct studies sufficient to determine the possible existence of any cultural resources, including sites, structures, or objects of historical or archaelolgical significant that may be affected by such drilling, and shall report the findings of the studies to the Director. Any person who holds a permit authorizing shallow test drilling or who has filed a notice for shallow test drilling may be required to conduct such studies at the discretion of the Director. If any study indicates the possible presence of a cultural resource, a full explanation will be included in the report. The person shall take no action that may result in the disturbance of cultural resources without the prior approval of the Director, and if any cultural resource is discovered during a test, the person shall immediately report the finding to the Director and make every reasonable effort to preserve and protect the cultural resource from damage until the Director has given directions as to its preservation.

(e) *Orders and regulations.* All Outer Continental Shelf regulations relating to drilling operations in Part 250 of this title and all OCS Orders relating to the drilling and abandonment of wells apply, as appropriate, to drilling authorized under this Part. Departures from the requirements of OCS Orders shall be permitted as provided in § 250.12(b) of this title.

(f) *Completion times for deep stratigraphic tests.* All permits authorizing deep stratigraphic tests will contain a provision that all drilling and testing shall be completed, with results submitted to the Director, at least 3 months prior to the month in which the Proposed Notice of Sale is listed on the currently approved OCS Leasing Schedule which includes tracts within 50 geographic miles of the test site. If the test site is in an area not listed on the Schedule, submission will be in accordance with terms of the permit of by § 251.12 of this part. The Director may extend the expiration date of the permit if it is determined that such an extension is in the national interest.

(g) *Abandonment of test.* A deep stratigraphic test will be considered to be an expendable well. It will be permanently plugged and abandoned by the permittee according to the regulations in Part 250 of title and applicable regulations prior to moving the rig off location. The permittee will make forms, and time frames for completion of various functions. In describing the proposed action, the report will also include a discussion of equipment, a discussion of oil spill contingency plans, statements of certification of consistency with appropriate coastal zone management programs when applicable, a comprehensive list of new or unusual technologies to be used, a detailed description of these technologies, the location of travel routes for supplies and personnel, the kinds and approximate quantities of energy to be used, and the environmental monitoring systems proposed for use by the permittee. The proposed action section will also include suitable maps and diagrams showing details of the proposed project layout.

(B) Description of existing environment. This section is to contain a narrative description of the existing environment, and emphasis shall be placed on those environmental values that may be affected by the proposed action. This section shall include, but not be limited to, discussion of the following: Geology, physical oceanography, other uses of the area, flora and fauna, cultural resources, socioeconomics, and existing environmental monitoring systems, other unusual or unique characteristics which may be affected by the drilling.

(C) Impact evaluation and mitigating measures. This section shall contain a narrative description or tabulation of the probable impacts of the proposed action on the environment and existing mitigating measures, as well as measures which have been proposed in the plan, to mitigate the impacts.

(D) Alternatives to the proposed action. This section shall discuss all relevant alternatives to the proposed action or major segments of the proposed action which would result in less risk of adverse environmental impacts.

(E) Unavoidable adverse environmental effects of the proposed action. Any unavoidable or irreversible adverse environmental effects that could occur as a result of the proposed action shall be summarized in this section.

The permittee shall, when required, submit an appropriate number of copies of each Environmental Report to permit the Director to transmit a copy to the Governor and Coastal Zone Management Agency of each affected State and to the United States Office of Coastal Zone Management.

The Director shall transmit such copies at the same time he transmits copies of the applicable plan. The Director shall also make copies of the Environmental Report available to the public, in accordance with the Freedom of Information Act.

(vii) Such other pertinent data and information as the Director may request.

(2) After approval of a drilling plan, any modifications must be approved by the Director. A modification including relocation of a drillsite or bottom-hole location exceeding 600 feet (182.8 meters) must be approved by the Director.

(3) A deep stratigraphic test authorized by a permit shall be conducted in a manner which prevents blowouts, prevents release of fluids from strata into the sea, and prevents communication between fluid-bearing strata of oil, gas, or water. The permittee shall utilize appropriate protective measures and devices specified by the Director.

(c) *Group participation.* In order to minimize duplicative geological exploration involving penetration of the seabed of the Outer Continental Shelf, a permittee proposing to conduct a deep stratigraphic test shall afford all interested persons an opportunity to participate in the test on a cost-sharing basis with a penalty for late participation of not more than 100 percent of the cost to each original participant. The penalty shall be assessed by the participants. When the Director releases a public notice that a significant show or possible hydrocarbon discovery has been encountered in a deep stratigraphic test, the penalty for subsequent late participation may be raised to not more than 200 percent of the cost to any original participant. A permittee proposing to conduct shallow test drilling shall, when ordered by the Director or when provided in the permit, afford all interested persons an opportunity to participate in the test on a cost-sharing basis with a penalty for late participation of not more than 50 percent of the cost to each original participant. To allow for group participation a permittee shall:

(1) Publish a summary statement of the proposed test in a manner approved by the Director.

(2) Allow at least 30 days from the date of the publication for other persons to consider participation in the program as described by the permit and join as original participants.

(3) Forward a copy of the published notice(s) to the Director.

(4) Compute the cost to an original participant by dividing the total cost of the program by the number of original participants.

(5) Furnish the Director with a complete list of all participants under the permit prior to commencing operations, or at the end of the advertising period if operations begin prior to its close, and submit, on a timely basis, a list of all late participants.

If the Director determines that a change made in the permit or drilling plan is significant, he shall require additional publications. Persons wishing to join as a result of such readvertisements within the time frame allowed will be considered to be original participants.

(d) *Cultural resources.* Any person who holds a permit authorizing a deep stratigraphic test shall, if requested by the Director, conduct studies sufficient to determine the possible existence of any cultural resources, including sites, structures, or objects of historical or archaeological significance that may be affected by such drilling and shall report the findings of the studies to the Director. Any person who holds a permit authorizing shallow test drilling or who has filed a notice for shallow test drilling may be required to conduct such studies at the discretion of the Director. If any study indicates the possible presence of a cultural resource, a full explanation will be included in the report. The person shall take no action that may result in the disturbance of cultural resources without the prior approval of the Director, and if any cultural resource is discovered during a test, the person shall immediately report the finding to the Director and make every reasonable effort to preserve and protect the cultural resource from damage until the Director has given directions as to its preservation.

(e) *Orders and regulations.* All Outer Continental Shelf regulations relating to drilling operations in Part 250 of this title and all OCS Orders relating to the drilling and abandonment of wells apply, as appropriate, to drilling authorized under this Part. Departures from the requirements of OCS Orders shall be permitted as provided in § 250.12(b) of this title.

(f) *Completion times for deep stratigraphic tests.* All permits authorizing deep stratigraphic tests will contain a provision that all drilling and testing shall be completed, with results submitted to the Director, at least 3 months prior to the month in which

the Proposed Notice of Sale is listed on the currently approved OCS Leasing Schedule which includes tracts within 50 geographic miles of the test site. If the test site is in an area not listed on the Schedule, submission will be in accordance with terms of the permit of by § 251.12 of this part. The Director may extend the expiration date of the permit if it is determined that such an extension is in the national interest.

(g) *Abandonment of test.* A deep stratigraphic test will be considered to be an expendable well. It will be permanently plugged and abandoned by the permittee according to the regulations in Part 250 of title and applicable regulations prior to moving the rig off location. The permittee will make every reasonable effort to ensure that the plug(s) permanently prevents the release of subsurface fluids into the sea and prevent(s) communication between oil, gas, or water-bearing strata. If the tract on which a deep stratigraphic test has been drilled is later leased for exploration and development, the lessee will not be held responsible for the test well, provided the lessee has not reentered the well.

(h) *Bonds.* Before a permit authorizing a deep stratigraphic test will be issued, the applicant shall furnish to the Bureau of Land Management a corporate surety bond of not less than $100,000 conditioned on compliance with the terms of the permit, unless the applicant maintains with or furnishes to the Bureau of Land Management a bond in the sum of $300,000 conditioned on compliance with the terms of the permit issued to him for the area of the Outer Continental Shelf where he proposes to conduct a deep stratigraphic test. The Director may require a bond for shallow test drilling. Any bond furnished or maintained by a person under this section shall be on a form approved by the Director, Bureau of Land Management.

§ 251.10 Observation of exploration conducted under permits.

(a) *Advisor.* A permittee shall, on request of the Director, furnish food, quarters, and transportation for an advisor who is approved by the Director, and the permittee will be reimbursed by the United States for actual costs. The advisor shall observe operations conducted pursuant to the permit and advise the Director on the conduct of the operations as well as on any adverse effects of the operations upon the environment, aquatic life, cultural resources, and other uses of the area. The fees charged by an advisor shall be paid by the United States.

(b) *Federal inspector.* A permittee shall, on request of the Director, furnish food, quarters, and transportation for a Federal representative to inspect operations, and the permittee will be reimbursed by the United States for actual costs.

§ 251.11 Report of operations conducted under notices and permits.

(a) *Weekly reports.* Each permittee shall submit to the Director weekly reports which include a daily log of operations.

(b) *Final reports.* Each permittee and each person operating under a notice shall submit a final report to the Director within 30 days after the completion of exploration under the permit or notice. The final report shall contain the following:

(1) A description of the work performed.

(2) Charts, maps, or plats depicting the areas in which the exploration was conducted and specifically identifying the lines over which geophysical traverses were run or the locations where geological exploration was conducted, including a reference sufficient to identify the data produced during each such operation.

(3) The dates on which the exploration was performed.

(4) A report of any hydrocarbon shows, possible discoveries, or any adverse effects of the exploration on the environment, aquatic life cultural resources, or other uses of the area in which the exploration was conducted.

(5) Such other descriptions of the exploration as may be specified by the Director.

§ 251.12 Inspection, selection and submission of data and information.

(a) *Submission of geological data and analyzed geological information.* (1) Each holder of a permit for geological exploration shall notify the Director immediately, in writing, of the acquisition or analysis of any geological data collected under the permit. At any time within 1 year of receiving a notice of acquisition or analysis from a permittee, or within a longer period if specified in the permit, the Director may select all or part of the geological data and analyzed geological information. The permittee shall keep the geological data and analyzed geological information available for inspection and selection by the Director during such period, and the permittee shall submit geological data and analyzed geological information to the Director within 30 days after receiving a request for submission of them.

(2) Each submission of geological data and analyzed geological information shall, at the direction of the Director, contain all or part of the following:

(i) An accurate and complete record of all geological (including geochemical) data and information resulting from each operation.

(ii) Paleontological reports identifying microscopic fossils by depth (not resulting age interpretations based upon such identification) unless washed samples are maintained by the permittee for paleontological determination and are made available for inspection by the Geological Survey.

(iii) Copies of logs or charts of electrical, radioactive, sonic, and other well logs.

(iv) Analyses of core or bottom samples or a representative cut or split of the core or bottom sample.

(v) Detailed descriptions of any hydrocarbon shows or hazardous conditions encountered during operations, including near losses of well control, abnormal geopressures, and losses of circulation.

(vi) Such other geological data and analyzed geological information obtained under the permit as may be specified by the Director.

(3) A permittee shall not be required to submit interpreted geological information under this Part of Title 30 unless specifically required in this Part.

(b) *Inspection, selection, and submission of geophysical data and processed geophysical information.* (1) Each holder of a permit for geophysical exploration shall notify the Director immediately, in writing, of the acquisition, processing, or reprocessing of any geophysical data collected under the permit. At any time within 1 year after receiving a notice of acquisition, processing, or reprocessing from a permittee, or within a longer period if specified in the permit, the Director may select all or part of the geophysical data, processed geophysical information, and reprocessed geophysical information. The permittee shall keep the geophysical data, processed geophysical information, and reprocessed geophysical information available for inspection and selection by the Director during such period.

(2) The Director shall have the right to inspect the geophysical data, processed geophysical information, or reprocessed geophysical information prior to selection in writing. This inspection may be performed on the permittee's premises or, at the request of the Director, the permittee shall submit the geophysical data, processed geophysical information, or reprocessed geophysical information to the Director for inspection. Such delivery shall be within 30 days after the request for delivery is received. At any time prior to selection in writing, the Director shall have the right to return, without cost to the Government except for reproduction costs, any or all geophysical data, processed geophysical information, or reprocessed geophysical information following either inspection and detailed assessment of quality or establishment of price to the Government for processing or reprocessing. If the Director decides to keep any or all of the geophysical data, processed geophysical information, or reprocessed geophysical information, the Director shall select them in writing. If the inspection has been done on the permittee's premises, the permittee shall submit them within 30 days after receiving a request for submission of them. The Director shall have the right to arrange, by contract or otherwise, for the reproduction of geophysical data, processed geophysical information, and reprocessed geophysical information independently of the permittee and without reimbursement of the permittee for reproduction costs.

(3) In the event a permittee transfers geophysical data or processed geophysical information to a third party, or a third party who has received geophysical data or processed geophysical information directly or indirectly from a permittee, transfers the geophysical data or processed geophysical information to another third party, the transferor shall notify the Director of such transmittal, and the transferor shall bind the third party, in writing, to the obligations of the permittee as specified in this section.

(4) The right to inspection and each submission shall include, at the direction of the Director, all or any part of the following:

(i) An accurate and complete record of each geophysical survey conducted under the permit, including final location maps of all survey stations.

(ii) All common depth point and high resolution seismic data developed under a permit in a format and of a quality suitable for processing; processed geophysical information derived therefrom with extraneous signals and interference removed, in a format and of a quality suitable for interpretive evaluation, reflecting state-of-the-art processing techniques; and other geophysical data and processed geophysical information obtained from, but not limited to, shallow and deep subbottom profiles, bathymetry, side-scan

sonar, and magnetometer systems, bottom profiles, gravity and magnetic surveys, and special studies such as refraction and velocity surveys.

(5) A permittee shall not be required to submit interpreted geophysical information under this part of Title 30 unless specifically required by this part.

§ 251.13 Reimbursement to permittees.

(a) *Reimbursement for reproduction costs.* After the delivery or submission of geophysical data, processed geophysical information, and reprocessed geophysical information in accordance with § 251.12(b)(2), the permittee or third party shall, upon a request for reimbursement and upon a determination by the Director that the request is proper, be reimbursed for the cost of reproducing the geophysical data, processed geophysical information, and reprocessed geophysical information at the permittee's lowest rate or at the lowest commercial rate established in the area, whichever is less.

(b) *Reimbursement for processing and reprocessing costs.* After the Director selects processed and reprocessed geophysical information by written notice to the permittee or third party in accordance with § 251.12(b)(2), the permittee or third party, upon request, shall be reimbursed only for the costs attributable to processing and reprocessing, as distinguished from the cost of data acquisition, as follows: (1) If the processing or reprocessing has been done by the permittee in the normal conduct of his business, the Director shall pay the costs at the lowest rate available to any purchaser for the processing or reprocessing of such data and information; (2) If the processing or reprocessing has been specifically requested by the Director and has not been prepared in the normal conduct of the permittee's business, the Director shall pay the costs of processing and reprocessing such data. If any fraudulent or collusive scheme is utilized by the permittee or by any person in conjunction with the permittee so as to affect the cost determinations under either paragraph (b) (1) or (2) of this section, the Director shall reimburse the permittee only for the actual processing or reprocessing costs which the Federal Government would have incurred had not the fraud or collusion affected the cost determination. Moreover, any person who engages in such fraudulent or collusive activity shall be subject to prosecution pursuant to section 24(c) of the Act.

(c) *Procedures for establishing amount of reimbursement.* Requests for reimbursement will contain a cost breakdown in sufficient detail to allow separation of processing and reprocessing from acquisition costs. Any reimbursement to a permittee or third party shall be conditioned upon a determination by the Director that the request for reimbursement as originally submitted or as revised is proper, and not the result of any fraud or collusion by the permittee or by any person in conjunction with the permittee.

§ 251.14 Disclosure of data and information submitted under permits.

(a) *General.* Except as specified in this section, the United States shall not make available to the public (1) trade secrets and commercial or financial information which are privileged or confidential and which are received from permittees, and (2) geological and geophysical information and data, including maps concerning wells, which are received from permittees.

(b) *Disclosure of geological data, analyzed geological information, and interpreted geological information.* The Director shall disclose geological data, analyzed geological information, and interpreted geological information submitted under a permit as follows:

(1) The Director shall immediately issue a public notice when any hydrocarbon shows, hydrocarbon discoveries, or environmental hazards on unleased lands are discovered during drilling operations if the shows, discoveries, or hazards are judged to be significant by the Director. In the case of hydrocarbon shows or possible hydrocarbon discoveries, the Director will announce that hydrocarbon shows have been encountered or that a possible hydrocarbon discovery has been made. Other data and information pertaining to the permit will be released according to the schedule provided in paragraphs (b) (2) or (3) of this section, as appropriate.

(2) The Director shall make available to the public all other geological data, analyzed geological information, and interpreted geological information, except geological data, analyzed geological information, and interpreted geological information obtained from deep stratigraphic tests, 10 years after the date of issuance of the permit.

(3) The Director shall make available to the public all geological and geophysical data and information, except common depth point geophysical data

and information, obtained from deep stratigraphic tests 5 years after completion of the test well or 60 calendar days after the date of issuance of the first OCS oil and gas lease within 50 geographic miles (92.6 kilometers) of the test site after the completion of the test.

(c) *Disclosure of geophysical data, processed geophysical information, and interpreted geophysical information.* The Director shall disclose geophysical data, processed geophysical information, reprocessed geophysical information, and interpreted geophysical information submitted under a permit and retained by the Director as follows:

(1) The Director shall make available to the public geophysical data 10 years after the date of issuance of the permit.

(2) The Director shall make available to the public processed geophysical information, reprocessed geophysical information, and interpreted geophysical information 10 years after the date it has been submitted to the Director.

(3) The Director shall make available to the public processed geophysical information, reprocessed geophysical information, and interpreted geophysical information submitted with an application for a deep stratigraphic test, or required to be obtained in order to conduct a deep stratigraphic test, according to the disclosure provisions defined for a deep stratigraphic test in § 251.14(b)(3) above, with the exception of common depth point seismic data from the area of the proposed test location and processed geophysical information and interpreted geophysical information therefrom which will be released under the provisions of § 251.14(c)(2) above.

§ 251.15 Termination, suspension, and revocation of authority to operate under notices and permits.

(a) *Termination.* The Director or a person who has filed a notice or who holds a permit may terminate the authority to conduct exploration under a notice or permit, as the case may be, at any time without cause by sending a statement of termination by certified mail to the other party at least 30 days in advance of the date such termination is to be effective.

(b) *Suspension and revocation.* (1) The Director may, by sending a statement of suspension or revocation by certified mail, suspend or revoke the authority to conduct exploration under a permit or notice when in his judgment the exploration or proposed exploration threatens immediate, serious, or irreparable harm or damage to life, including aquatic life, to property, to cultural resources, to valuable mineral deposits, or to the environment. Such suspensions and revocations shall be effective immediately upon receipt of the statement.

(2) The Director may, by sending a statement of suspension or revocation by certified mail, suspend or revoke the authority to conduct exploration under a notice or permit for noncompliance with the Act, the regulations in this part, the terms and conditions of the permit, applicable OCS Orders, other written orders of the Director, including requests for any reports, and other applicable laws and regulations. A suspension shall be effective immediately upon receipt of the statement, and a revocation shall be effective without further notice on the 30th day after receipt of the statement, unless the breach or violation is corrected by that time. Upon receipt of a statement of revocation asserting a breach or violation, the authority to conduct exploration under the notice or permit shall be suspended immediately, and the suspension shall remain in effect until the breach or violation has been corrected or the revocation becomes final.

(c) *Continuing obligations.* Termination or revocation of the authority to conduct exploration under a notice or permit shall not relieve the person who filed the notice or who holds the permit of the obligation to abandon any drill sites in compliance with § 251.9(e), and to comply with all other obligations specified in this Part or in the permit or notice.

§ 251.16 Penalties.

All persons conducting geological or geophysical exploration for mineral resources and exploration for scientific research shall be subject to the penalty provisions of Section 24 of the Act, as amended (43 U.S.C. Sec. 1350), for violation of regulations for the prevention of waste, the conservation of natural resources, or the protection of correlative rights. This is in addition to any penalty which may be prescribed in the permit for noncompliance with its provisions or any action which may be brought by the United States to compel compliance with the provisions of the permit.

§ 251.17 Appeals.

Orders or decisions issued under the regulations in this part may be appealed as provided in Part 290 of this title.

[FR Doc. 79-4442 Filed 2-8-79; 8:45 p.m.]

APPENDIX E

PERSONNEL QUALIFICATIONS

The following qualification criteria are excerpted and collated from the "Directory of Professional Archaeologists," the "Reservoir Inundation Studies Project Diving Certification and Personnel Pre-Field Diving Requirements" (Lenihan 1977), and recommendations from the ICA research team.

SOPA PROFESSIONAL EMPHASES

Field Research: Field and laboratory experience under the supervision of a professional archaeologist (to include 6 months of field and 3 months of laboratory experience), with a minimum of 6 months in a supervisory or other equally responsible role. An M.A. level quality report will be required.

Cultural Resource Management: Understanding and use of the laws, policies, and programs that contribute to the preservation and management of cultural resources. The conduct of archaeological surveys for environmental impact statements or similar documents, and the conduct of salvage or mitigation projects, do not ordinarily qualify as examples of cultural resource management activities, since they are normally in no way different from field research. An exception to this generalization would be a case in which a survey was integrated by the archaeologist into the development of a regional plan for preservation, or some other program that required cognizance of preservation law and policy. Examples of cultural resource management include: preparation of a plan for the protection of cultural resources on a local, regional, or state level; preparation of archaeological overviews or evaluations that are directly linked to management needs; major responsibility in an agency or firm to fulfill such management responsibility.

Marine Survey Archaeology: Background knowledge of coastal geomorphology and marine geology as this relates to cultural resources; training in the principles, proper set-up and operation of underwater remote sensing devices (including magnetometer, side-scanning sonar, sub-bottom profiler, and bathymetric sounder), and ability to interpret the output of these devices; training in navigation. The basic one year experience requirement under supervision of a professional marine survey archaeologist or equivalent, must include 2 weeks' offshore training or the equivalent in the operation of the remote sensing devices; 6 months of the year should be in a supervisory or independent role.

Historical Archaeology: The application of archaeological techniques to sites relating either directly or indirectly to a literate tradition. Historical archaeology is most often devoted to the study of sites that date to the expansion of literate populations since the

15th century. An individual practicing historical archaeology is knowledgeable in the recovery and interpretation of both archaeological and archival data, and is familiar with the history of technology and its material remains including both artifactual and architectural components and their conservation and preservation.

RESERVOIR INUNDATION STUDIES PROJECT DIVING CERTIFICATION AND PERSONNEL PRE-FIELD DIVING REQUIREMENTS

Core-Team Divers

Swimming (no equipment):

1. Swim underwater 75' on one breath with no dive or push-off.
2. Swim underwater 150' on 4 breaths with no dive or push-off.
3. Swim 400 yards, nonstop, in less than 10 minutes.
4. Swim 25 yards, nonstop, at the end of the 400-yard swim using 2 resting strokes.
5. Demonstrate survival swimming for 20 minutes (treading, bobbing, floating, drownproofing, etc.).
6. Tread water, legs only (hands out of water), for 2 minutes.
7. Tow another person of equal size 50 yards; the first 5 yards the victim should be struggling; demonstrate CPR.
8. Recover 10-lb. weight from a depth of at least 8'.

Skin-Diving:

(Note: All skin and scuba-diving skills are to be performed wearing a wet-suit jacket, a weight-belt adjusted for proper buoyancy, and an inflatable vest).

1. Demonstrate swimming with snorkel and fins with and without a mask.
2. Skin dive to a depth of 15' and recover an object.
3. Swim 880 yards, nonstop, in less than 18 minutes (with skin-diving equipment, using no hands).
4. Remove mask, fins, and snorkel under water and surface. After resting, dive and recover mask, fins, and snorkel on 1 breath. All equipment is to be in place, with mask and snorkel clear of water upon surfacing.
5. Complete rescue of another skin-diver. Execute a proper entry; swim 50 yards to another diver; pick up diver on the bottom in a minimum of 8' of water; bring diver to the surface; administer mouth-to-mouth resuscitation in deep water for 1 minute; tow diver 50 yards while administering resuscitation.

Scuba-Diving:

1. Demonstrate a well-controlled scuba ditch and recovery: descend to the bottom in a minimum of 8' of water and remove mask,

snorkel, scuba, and weight-belt (retain fins); shut off air, swim 25' horizontally and recover equipment. The total exercise is to be completed with all equipment in place within 5 minutes.

2. Demonstrate scuba bailout: enter the water carrying mask, fins, snorkel, weight-belt, and tank with regulator attached (air shut-off and regulator purged); settle to the bottom, assume a stationary location and don equipment. During exercise, control and possession of all equipment must be maintained. Upon completion of donning equipment, surface and tread water for 5 minutes without the use of vest, snorkel, or regulator. Exercise must be performed in a minimum of 8' of water.
3. Transport another scuba diver 100 yards in less than 4 minutes. Person being transported may not assist. Both divers are to wear scuba, weight-belts retained; breathing from regulator is not permitted.
4. Buddy-breathe with another diver while swimming horizontally underwater for 10 minutes--5 minutes as recipient, 5 minutes as donor. Divers are not to surface during the entire exercise; masks are not to be worn.

Other:

1. All divers on the core-team must be National Park Service certified, with a current medical examination form on file with the project diving officer.
2. All divers must fill out a project diving questionnaire, and present a log of at least 50 open-water dives. Although a log is preferable, a signed statement of participation in at least 50 dives, along with names and addresses of individuals who can verify (dive buddies or dive supervisors) this participation, would be acceptable.
3. A comprehensive written examination covering all areas of general diving expertise must be passed by all core-team members.

Note: The above water-skills standards represent a combination of National Park Service diving requirements and the National Association of Underwater Instructors (NAUI) assistant instructor skills test, with some additions and variations. National Park Service standards are met or exceeded in all cases.

Visiting Divers

Individuals wishing to participate in official project diving activities on a limited basis for a period not to exceed 2 weeks must meet the following requirements:

1. Must be fully certified by a nationally recognized diver-certification agency.
2. Must have a current medical examination form on file with the project diving officer.

3. Must be diving under the auspices of a recognized state or Federal agency or institution.
4. Must be willing to observe all project rules and regulations.
5. Must be in the company of a core-team diver, who in all cases will be the dive leader.
6. Must have gone through one complete project orientation dive with the project dive officer or his designate. This dive would include training in standardized project signals, self-rescue, and buddy-rescue techniques and accident management procedures.

Note: The above requirements may be modified in special circumstances at the discretion of the project dive officer.

PERSONAL QUALIFICATIONS
RECOMMENDATIONS OF ICA RESEARCH TEAM

The principal investigator (PI) will organize, guide, and report on the findings of the excavation. Whereas the PI on a terrestrial site is normally required to have a graduate degree in archaeology plus experience in the type of site to be excavated, at present those credentials are often not required for an underwater site--especially that of a historic shipwreck.

Archaeological excavation underwater has attracted only a limited number of former terrestrial archaeologists, while formal graduate training in nautical archaeology has only recently been available in this country. At the same time, many people conducting underwater excavations here and abroad have no degree or have a degree in a different field. Some of these people have produced work and reports of acceptable quality. But as formal scholastic and field training continues for new students and established terrestrial archaeologists, it is assumed that a formal graduate degree, experience, and the proven ability properly to record an excavation will be required in the near future for a PI working an archaeological site underwater.

As with any other type of archaeology, a PI must be familiar with the pattern and artifacts to be expected at a particular site. Proper interpretation of a Northeastern prehistoric site requires an archaeologist who specializes in such sites, and the same is true for historic inundated and historic ship sites. Besides being an archaeologist, the PI must have other skills.

To follow the progress of an excavation, and to understand the problems involved with the operation, a PI should be, or have been on previous digs, an underwater diver. If the operation is beyond his or her depth capabilities, he or she must be able to observe the operation at will by electronic devices and preferably from a submersible chamber or miniature submarine. A PI must also have a basic understanding of, though not necessarily possess the skill to use, a number of technologies involved in an underwater operation. The basic concepts

of conservation of artifacts; underwater photography, illustration, and mechanics; first aid, dive organization; boat piloting; and bookkeeping should be familiar to him or her. Because of the time necessary to learn and perform these functions, the PI normally chooses a crew capable of conducting these specialties, although he or she understands them enough to keep them properly organized.

A qualified professional conservator is most often in charge of the preservation of artifacts. Although until recently, few professional object conservators were interested in waterlogged artifacts, new interest in the field is now attracting both very experienced and beginning conservators. Because of the former lack of interest among professional conservators, archaeologists in the past have often been forced to attempt to preserve the artifacts themselves. This is a major undertaking, which only a few archaeologists were formerly able to perform successfully. The state of the art in waterlogged-artifact conservation is changing rapidly with an increase in research. There are therefore no reliable "cook books" available. Archaeologists now present underwater artifacts to professional conservators, or to archaeologists who have specialized in conservation for some years and remain abreast of the latest methods. A conservator may actually control the preservation of artifacts from a number of excavations by using well-trained assistants in the field and laboratory. Most PI's prefer to have at least one well-trained conservation technician at the site who can communicate rapidly with a particular conservator or regional conservation laboratory.

APPENDIX F

SOCIETY OF PROFESSIONAL ARCHEOLOGISTS
CODE OF ETHICS AND STANDARDS OF PERFORMANCE

Each person listed in the Directory has agreed to abide by the following code of ethics, and to be guided by the following professional standards.

CODE OF ETHICS

Archeology is a profession, and the privilege of professional practice requires professional morality and professional responsibility, as well as professional competence, on the part of each practitioner.

I. *The Archeologist's Responsibility to the Public*

1.1 An archeologist shall:
- (a) Recognize a commitment to represent archeology and its research results to the public in a responsible manner;
- (b) Actively support conservation of the archeological resource base;
- (c) Be sensitive to, and respect the legitimate concerns of, groups whose culture histories are the subjects of archeological investigations;
- (d) Avoid and discourage exaggerated, misleading, or unwarranted statements about archeological matters that might induce others to engage in unethical or illegal activity;
- (e) Support and comply with the terms of the UNESCO Convention on the means of prohibiting and preventing the illicit import, export, and transfer of ownership of cultural property, as adopted by the General Conference, 14 November 1970, Paris.

1.2 An archeologist shall *not*:
- (a) Engage in any illegal or unethical conduct involving archeological matters or knowingly permit the use of her/his name in support of any illegal or unethical activity involving archeological matters.
- (b) Give a professional opinion, make a public report, or give legal testimony involving archeological matters without being as thoroughly informed as might reasonably be expected;
- (c) Engage in conduct involving dishonesty, fraud, deceit or misrepresentation about archeological matters;
- (d) Undertake any research that affects the archeological resource base for which he/she is not qualified.

II. *The Archeologist's Responsibility to her/his Colleagues*

2.1 An archeologist shall:

(a) Give appropriate credit for work done by others;
(b) Stay informed and knowledgeable about developments in his/her field or fields of specialization;
(c) Accurately, and without undue delay, prepare and properly disseminate a description of research done and its results;
(d) Communicate and cooperate with colleagues having common professional interests;
(e) Give due respect to colleagues' interests in, and rights to, information about sites, areas, collections, or data where there is a mutual active or potentially active research concern;
(f) Know and comply with all laws applicable to her/his archeological research, as well as with any relevant procedures promulgated by duly constituted professional organizations;
(g) Report knowledge of violations of this Code to proper authorities.

2.2 An archeologist shall *not*:

(a) Falsely or maliciously attempt to injure the reputation of another archeologist;
(b) Commit plagiarism in oral or written communication;
(c) Undertake research that affects the archeological resource base unless reasonably prompt, appropriate analysis and reporting can be expected;
(d) Refuse a reasonable request froma qualified colleague for research data.
(e) Submit a false or misleading application for accreditation by or membership in the Society of Professional Archeologists.

III. *The Archeologist's Responsibility to Employers and Clients*

3.1 An archeologist shall:

(a) Respect the interests of his/her employer or client, so far as is consistent with the public welfare and this Code and Standards;
(b) Refuse to comply with any request or demand of an employer or client which conflicts with this Code and Standards;
(c) Recommend to employers or clients the employment of other archeologists or other expert consultants upon encountering archeological problems beyond her/his own competence;
(d) Exercise reasonable care to prevent his/her employees, colleagues, associates and others whose services are utilized by her/him from revealing or using confidential information. Confidential information means information of a non-archeological nature gained in the course of

employment which the employer or client has requested be held inviolate, or the disclosure of which would be embarrassing or would be likely to be detrimental to the employer or client. Information ceases to be confidential when the employer or client so indicates or when such information becomes publicly known.

3.2 An archeologist shall *not*

(a) Reveal confidential information, unless required by law;
(b) Use confidential information to the disadvantage of the client or employer;
(c) Use confidential information for the advantage of himself/herself or a third person, unless the client consents after full disclosure;
(d) Accept compensation or anything of value for recommending the employment of another archeologist or other person, unless such compensation or thing of value is fully disclosed to the potential employer or client;
(e) Recommend or participate in any research which does not comply with the requirements of the Standards of Research Performance.

STANDARDS OF RESEARCH PERFORMANCE

The research archeologist has a responsiblity to attempt to design and conduct projects that will add to our understanding of past cultures and/or that will develop better theories, methods, or techniques for interpreting the archeological record, while causing minimal attrition of the archeological resource base. In the conduct of a research project, the following minimum standards should be followed:

I. The archeologist has a responsibility to prepare adequately for any research project, whether or not in the field. The archeologist must:
   1.1 Assess the adequacy of her/his qualifications for the demands of the project, and minimize inadequacies by acquiring additional expertise, by bringing in associates with the needed qualifications, or by modifying the scope of the project;
   1.2 Inform himself/herself of relevant previous research;
   1.3 Develop a scientific plan of research which specifies the objectives of the project, takes into account previous relevant research, employs a suitable methodology, and provides for economical use of the resource base (whether such base consists of an excavation site or of specimens) consistent with the objectives of the project;
   1.4 Ensure the availability of adequate staff and support facilities to carry the project to completion, and of adequate curatorial facilities for specimens and records;

1.5 Comply with all legal requirements, including, without limitation, obtaining all necessary governmental permits and necessary permission from landowners or other persons;

1.6 Determine whether the project is likely to interfere with the program or projects of other scholars and if there is such a likelihood, initiate negotiations to minimize such interference.

II. In conducting research, the archeologist must follow her/his scientific plan of research, except to the extent that unforseen circumstances warrant its modification.

III. Procedures for field survey or excavation must meet the following minimal standards:

3.1 If specimens are collected, a system for identifying and recording their proveniences must be maintained.

3.2 Uncollected entities such as environmental or cultural features, depositional strata, and the like, must be fully and accurately recorded by appropriate means, and their location recorded.

3.3 The methods employed in data collection must be fully and accurately described. Significant stratigraphic and/or associational relationships among artifacts, other specimens, and cultural and environmental features must also be fully and accurately recorded.

3.4 All records should be intelligible to other archeologists. If terms lacking commonly held referents are used, they should be clearly defined.

3.5 Insofar as possible, the interests of other researchers should be considered. For example, upper levels of a site should be scientifically excavated and recorded whenever feasible, even if the focus of the project is on underlying levels.

IV. During accessioning, analysis and storage of specimens and records in the laboratory, the archeologist must take precautions to ensure that correlations between the specimens and the field records are maintained, so that provenience, contextual relationships and the like are not confused or obscured.

V. Specimens and research records resulting from a project must be deposited at an institution with permanent curatorial facilities.

VI. The archeologist has responsibility for appropriate dissemination of the results of his/her research to the appropriate constituencies with reasonable dispatch.

6.1 Results viewed as significant contributions to substantive knowledge of the past or to advancements in theory, method or technique should be disseminated to colleagues and other interested persons by appropriate means, such as publications reports at professional meetings, or letters to colleagues.

6.2 Requests from qualified colleagues for information on research results ordinarily should be honored, if consistent with the researcher's prior rights to publication and with her/his other professional responsibilities.

6.3 Failure to complete a full scholarly report within 10 years after completion of a field project shall be construed as a waiver of an archeologist's right of primacy with respect to analysis and publication of the data. Upon expiration of such 10 year period, or at such earlier time as the archeologist shall determine not to publish the results, such data should be made fully accessible for analysis and publication to other archeologists.

6.4 While contractual obligations in reporting must be respected, archeologists should not enter into a contract which prohibits the archeologist from including his or her own interpretations or conclusions in contractual reports, or from a continuing right to use the data after completion of the project.

6.5 Archeologists have an obligation to accede to reasonable requests for information from the news media.

INSTITUTIONAL STANDARDS

Archeological research involving collection of original field data and/or acquisition of specimens requires institutional facilities and support services for its successful conduct, and for proper permanent maintenance of the resulting collections and records.

A full-scale archeological field project will require the following facilities and services, normally furnished by or through an institution:

(1) Office space and furniture.
(2) Laboratory space, furniture, and equipment for analysis of specimens and data.
(3) Special facilities such as a dark room, drafting facilities conservation laboratory, etc.
(4) Permanent allocation of space, facilities, and equipment for proper maintenance of collections and records, equivalent to that specified in the standards of the Association of Systematic Collections.
(5) Field equipment such as vehicles, surveying instruments, etc.
(6) A research library.
(7) Administrative and fiscal control services.
(8) A security system.
(9) Technical specialists such as photographers, curators, conservators, etc.
(10) Publication services.

All the foregoing facilities and services must be adequate to the scope of the project.

Not all archeological research will require all the foregoing facilities and services, but a full-scale field project will. Likewise, all institutions engaging in archeological research will not necessarily require or be able to furnish all such facilities and services from their own resources. Institutions lacking certain facilities or services should arrange for them through cooperative agreements with other institutions.

APPENDIX G

PERSONAL COMMUNICATIONS

Archaeological Conservation, Staff of - National Historic Parks and Sites (Canada), Ottawa, Canada.

Anuskiewicz, R. - U.S.A. Corps of Engineers

Arnold, J. Barto, III - Texas Antiquities Committee, Austin, Texas.

Baker, William A. - Hart Museum, M.I.T.

Bass, George F. - Institute of Nautical Archaeology, College Station, Texas.

Bridges, Sarah - National Register of Historic Places, Washington, D.C.

Broadwater, John - Underwater Archaeologist, State of Virginia.

Cockrell, W.A. - History and Records Management, Tallahasse, Florida.

Canadian Conservation Institute, Staff of - Ottawa, Canada.

Davis, Hester A. - Arkansas Archeological Survey, Fayetteville, Arkansas.

Dincauze, Dena F. - Department of Anthropology, University of Massachusetts, Amherst, Massachusetts.

EG&G, Staff of (Walter Caron) - Waltham, Massachusetts.

Ericson, Jonathon - Peabody Museum of Archaeology and Ethnology, Harvard University.

Geometrics, Inc., Staff of (Neil Hickman) - Sunnyvale, California.

Gifford, John - University of Minnesota, Minneapolis, Minnesota.

Greene, Virginia, conservator - University of Pennsylvania Museum, Philadelphia.

Grenier, Robert - National Historic Parks and Sites, Ottawa, Canada.

Guarino, Joe - H.O. Mohr Inc., Houston, Texas.

Hamilton, Donny L. - Institute of Nautical Archaeology, College Station, Texas.

Johnson, Dr. Sven - Johnson Laboratories, Long Island, New York.

Keith, Donald - Institute of Nautical Archaeology, College Station, Texas.

King, Thomas F. - Interagency Archaeological Service, Dept. of the Interior, Washington, D.C.

Klein Associates, Staff of (Marty Klein, Tom Cummings and others) - Salem, New Hampshire.

Lewis, Robert (conservator) - Maine State Museum, Augusta, Maine.

McGimsy, Charles R., III - Arkansas Archaeological Survey, Fayetteville, Arkansas.

Mazel, Charles - Western Electric, Greensboro, North Carolina.

Miback, Lisa - National Historic Parks and Sites, Ottawa, Canada.

Morris, Ken - Albany, New York.

Murphy, Joseph R. - University of Albany, New York.

Oceanonics, Inc., Staff of (Jack Hill, Peter K. Trabant and others) - Houston, Texas.

Orgon, Robert - Smithsonian Institution, Washington, D.C.

Roberts, Michael - Institute for Conservation Archaeology, Peabody Museum, Harvard University.

Rose, Carolyn - Smithsonian Institution, Washington, D.C.

Ruppe, Reymond - Arizona State University, Tempe, Arizona.

Shaw, Joseph, Dr. - University of Toronto, Toronto, Canada.

Schomette, Don - National Archaeology Association, Upper Marlboro, Maryland.

Spiess, Arthur - Maine State Historic Preservation Commission, Augusta, Maine.

Steffy, Richard J. - Institute of Nautical Archaeology, College Station, Texas.

Switzer, David - Plymouth State College, Plymouth, New Hampshire.

Sytech, Staff of (Kelly G. Robertson) - Houston, Texas.

Thomas, Philip - Bureau of Land Management, Outer Continental Shelf Office, New York, New York.

U.S. Army Corps of Engineers - New England Division, Waltham, Massachusetts.

Watts, Gordon, Jr. - Division of Archives and History, Raleigh, North Carolina.

Wilson, John - Archaeologist, New England District, U.S. Army Corps of Engineers, Waltham, Massachusetts.

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