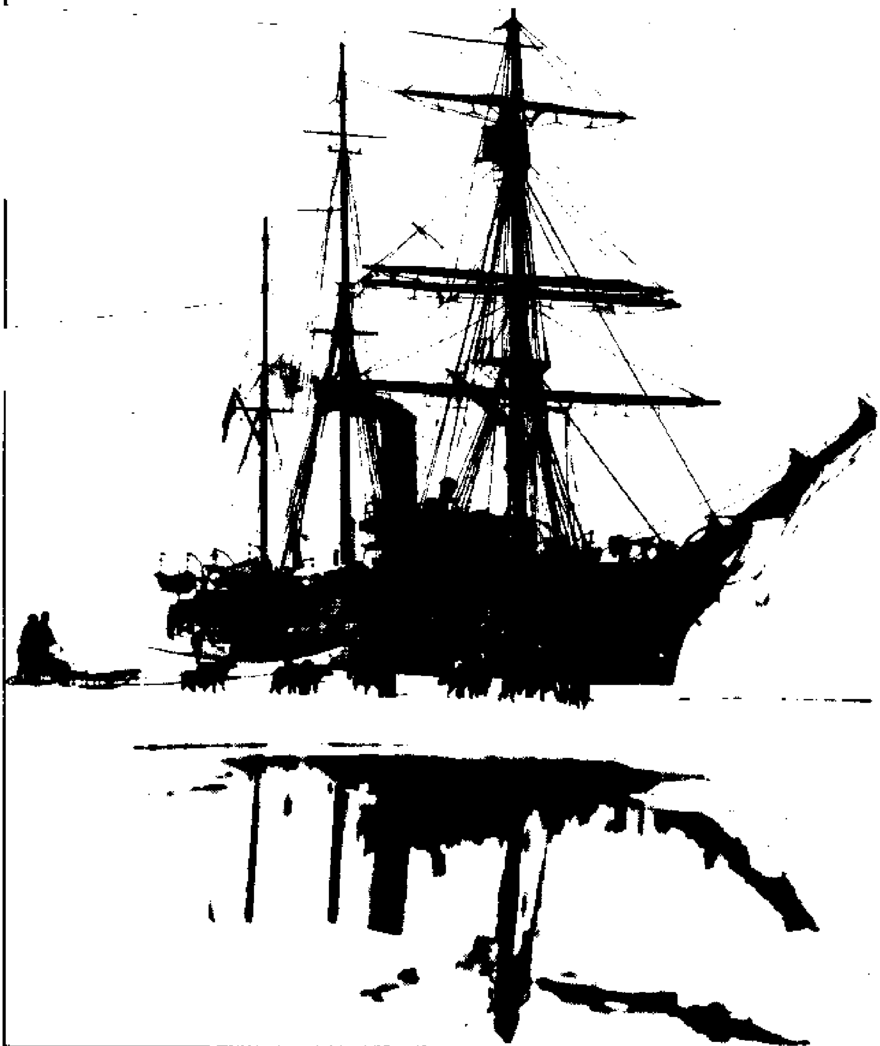

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Proceedings of the Alaskan Marine Archeology Workshop

May 17-19, 1983
Sitka, Alaska

Alaska Sea Grant Report 83-9

University of Alaska
September 1983

Alaska Sea Grant College Program
University of Alaska
Fairbanks, Alaska 99701

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Steve J. Langdon
Editor

Brenda R. Melteff
Workshop Coordinator

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BILL SHEFFIELD
GOVERNOR

STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

May 10, 1983

Dr. Steve Langdon
Chairman, Steering Committee
Marine Archeology Workshop
Department of Anthropology
University of Alaska
3221 Providence Drive
Anchorage, AK 99504

Dear Dr. Langdon:

I am delighted to hear that Alaska's first-ever Marine Archeology Workshop, co-sponsored by the University of Alaska Sea Grant Program, the Office of History and Archeology of the State Division of Parks, and the University Museum, will be held in Sitka from May 17-19, 1983.

Our state's long coastline holds much promise for underwater archeology, and there is a good probability that marine excavations will uncover information of much importance to our rich prehistoric and historic past. Because of this, and because such underwater projects have not yet occurred in Alaska, this conference is most important as a means to address and discuss issues basic to the discipline.

I hope that the workshop is a most rewarding one, and I commend all the participants for their interest in, and dedication to, Alaska's heritage.

Sincerely,

Bill Sheffield

Bill Sheffield
Governor

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Acknowledgments

The workshop program was structured by a steering committee whose members are:

Steve J. Langdon, Chairman
University of Alaska

Peter L. Corey
Sheldon Jackson College

Ty L. Dilliplane
Alaska Office of History and Archeology

Brenda R. Melteff
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Doug Reger
Alaska Geological Survey

Phillip D. Thomas
University of Alaska

The workshop was sponsored by the University of Alaska Sea Grant College Program, the Alaska Office of History and Archeology, the University of Alaska Museum, and Sheldon Jackson College. Facilities for the workshop sessions and participant accommodations were made available by Sheldon Jackson College on their campus in Sitka. Committee members would like to commend Brenda Melteff for her coordination of travel and living arrangements and her facilitation of the workshop.

The proceedings manuscript was edited and prepared for publication by the Department of Anthropology and the College of Arts and Sciences, University of Alaska, Anchorage. Special thanks go to Jayne Johnson and Ralph Courtney for their efforts in manuscript preparation. Final typing of the manuscript for publication was accomplished by Jayne Johnson who the committee would like to thank for her diligent efforts.

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Introduction

The idea for this workshop was conceived in response to the growing interest in marine archeology during the past two decades due to the recognition of the cultural and historical significance of resources under the sea. Alaska, with more coastline than all the rest of the United States combined, offers abundant opportunity for marine archeological contributions to the scientific understanding of a number of questions including the initial settling of the new world and the influence of sea level fluctuations on human settlement and adaptive strategies. In addition to these precontact questions, a substantial amount of interest has recently been shown in shipwrecks in Alaskan waters, particularly those of the Russian-American period.

Given the potential for significant findings, the recent interest in Alaskan marine archeology, and the relative inexperience of Alaskan archeologists in this area, the University of Alaska Sea Grant Program and the State Office of History and Archeology organized this workshop to provide Alaskan archeologists a forum to meet with experts in marine archeology and to assess the potential for Alaskan marine archeology.

Because of its historical significance, Sitka was selected as the location for the workshop.

Executive Summary

Background

The primary objective of the Alaskan Marine Archeology Workshop was to provide Alaskan archeologists an opportunity to explore the potentialities and practicalities of this heretofore virtually unexplored research area. It is hoped that the publication of these proceedings will provide a working document to assist future marine archeological research in Alaska.

Since the late 1970s, hints of interest in Alaskan marine archeology appeared on a number of fronts, and a significant effort was mounted to locate an important historic shipwreck. The prospect of substantial oil exploration and development on Alaska's outer continental shelf has been, and will be, a major impetus for investigating Alaskan marine archeological resources. Three research efforts, primarily documentary, have been funded by the Alaska Outer Continental Shelf (OCS) Office of the Bureau of Land Management (now housed in the Minerals Management Service of the Department of Interior) to identify cultural resources on Alaska's shelf. These studies focused on the Beaufort Sea, Lower Cook Inlet, and the western Gulf of Alaska, and were undertaken as part of the Environmental Impact Statement (EIS) process leading to oil lease sales in these areas (Dixon et al. 1977, 1978, 1979). An earlier research project funded by the OCS program produced a detailed analysis of how evidence of early human occupation of the New World might be obtained from presently submerged lands which, during the last glacial age, formed the Beringian land bridge between the Old and New Worlds (Dixon et al. 1976). Two other reports of the OCS program have also examined marine archeological resources and have provided a preliminary inventory of sunken ships that lie on the Alaskan outer continental shelf that could possibly be affected by oil exploration activities (Tornfelt 1981, 1982).

In addition to this largely anticipatory, documentary, and deductive research, there also appeared in the late 1970s substantial interest in the Russian vessel Neva, sunk off Mt. Edgecumbe near Sitka in 1813. This effort was energetically undertaken by professional divers who themselves had no archeological training although they did make a concerted effort to involve professional archeologists in their endeavor. Even though they were unable to obtain direct archeological involvement, the group worked cooperatively with the state Office of History and Archeology and agreed not to disturb or take any artifacts from the shipwreck if they located it. It is hoped that the close cooperation between public officials and private parties which occurred on the Neva project will set a positive example for future relationships. The unsuccessful search does raise the important question of what would have been done if the wreck had been located. Concern over the answer to this question has also spurred interest in Alaskan marine archeology.

By early 1982, the combination of an environment possibly rich in underwater sites and a history that suggested that marine archeological resources were potentially of great significance along with recent interest in these resources, both analytical and practical, indicated that the time was appropriate for Alaskan archeologists and historians to assess the possibilities for marine archeology in the state. From the beginning a broad, multidisciplinary approach to the topic was proposed by the Steering Committee. Archeologists, cultural anthropologists, historians, conservators, and legal scholars were all perceived as being important contributors to such an assessment. Four topical areas were selected for examination and discussion at the workshop: Marine Archeological Resources, Logistics and Training, Preservation and Housing, and Legal Issues. The committee undertook to identify and invite experts in these fields to summarize recent and important findings in their areas for the workshop as well as to make recommendations on the conduct of marine archeology in Alaska. Presentors were invited from the major North American centers of marine archeology. Canadian and United States federal government professionals, Canadian and United States university faculty, and Alaska State government professionals participated.

Marine Archeological Resources

A primary aim of the workshop was to inventory Alaskan marine archeological resources and research materials. The workshop was divided substantively into sessions on prehistoric materials consisting primarily of submerged archeological sites and historic materials consisting primarily of sunken vessels and accompanying materials. Within each of these topical areas, it was determined that both substantive information on the occurrence, possibility of location and recovery, and significance of the resources as well as methodological information on research approaches and research materials should be presented.

In the session on prehistoric submerged sites, Ruppe's paper presents a deductive approach to preliminary identification of submerged sites. The model builds on assumptions concerning human settlement patterns in coastal areas and examines nearshore geomorphology to locate submerged river channels, estuaries and beaches where human habitation might have occurred. In discussing the applicability of the model developed for predicting and testing the location of submerged sites off the west coast of Florida, Ruppe' suggests that within the Bering Sea, the area south of the Kuskokwim River is likely to be most productive since there is less likelihood of ice gouging. He further notes that siltation from the Yukon and its constantly changing course make site determination at the mouth of this river extremely difficult. Finally, he suggests that the north side of the Alaska Peninsula, which would have been the southern margin of Beringia, should prove productive because bathymetric data indicates that the Kuskokwim River flowed south to join with the Nushagak and Kvichak rivers to form a massive river system. His paper points out the crucial importance at this juncture in the evolution of marine archeology, of ground truthing with remote sensing instruments so that the information they provide can be correctly interpreted for use in future investigations.

In examining the potential importance to New World cultural history of submerged precontact sites off the Alaskan coast, Mauger and Wessen divide Beringian sites into Continental and Maritime regimes. They contend that submerged sites of the former type offer little additional information to terrestrial sites. Submerged maritime sites are potentially of great significance for understanding both the early occupation of the New World and the development of maritime cultures along the entire north Pacific coast of North America. While they note the special additional problems of site integrity posed for submerged sites, they point out that if submerged sites survive inundation, wave action, and in certain areas, ice pack gouging, that wet sites often provide a broader sample of cultural materials due to the anaerobic conditions of submersion.

Mauger and Wessen and, to a lesser extent Ruppe', are generally skeptical about the contribution of submerged sites to our understandings of New World settlement and adaptations in the short run. Their skepticism stems from the difficulties of working in the marine environment, the great costs of such investigations, the limited capabilities of present remote sensing equipment for the fine-grained identification process needed, the difficulties in interpreting materials if found, and the likelihood of continuing degradation of marine archeological resources due to human development. One important suggestion for reducing destruction of marine archeological resources is to increase public awareness of the importance of submerged resources for understanding the past and the need to protect these sites so they will be available for analysis when technology and costs permit effective and efficient investigation.

Marine archeological resources for the period after European contact with Alaska in the 18th century are primarily sunken vessels and materials associated with them. For purposes of the workshop and for inventorying both marine archeological resources and research and archival references, the years 1741 to 1940 were examined by dividing the era into the Russian period (1741-1867) and the American period (1867-1940). Shipwrecks since 1940 were considered contemporary, and therefore were not inventoried.

Identifying both resources and research materials from the Russian period was undertaken jointly by Black and Pierce. They subdivided the Russian period into two periods. Both scholars utilized Russian primary and secondary sources and presented information on Russian, as well as other vessels, sunk off Alaska's coast. Black identified a substantial number of Russian ships wrecked in Alaskan waters in the period from 1743-1799, and indicated that more precise information on the locations of wrecks will be available when extant documents in the Soviet archives are published. Her evidence indicates that the vast majority of vessels sunk were recycled by the Russians, or Aleuts, for building other vessels. Consequently, there may be very little left to find. Perhaps of greatest significance is the finding that there are several Japanese junks sunk in the Aleutians. It is possible that some Dutch vessels from this period may also lay beneath these waters.

Vessels lost during the latter half of the Russian period from 1800-1867 are identified and discussed by Pierce. In addition to the well-known Neva, eleven or twelve other Russian ships were lost during this period. The number of Russian ship wrecks in Alaskan waters declined after 1813. Perhaps the most promising remaining vessel from the Russian period is the Kad'iak which sank off Spruce Island near Kodiak in 1860. Pierce also indicates that remains from these early wrecks are probably limited since their materials were almost always salvaged by Russians or Alaskan Natives for other uses.

Since the purchase of Alaska by the United States in 1867, marine activity has increased dramatically over that of the

Russian period. A diverse variety of ships have plied and sunk in Alaskan waters since that time from smugglers and whalers to tankers and cutters. DeArmond (personal communication) estimates that an inventory of vessels lost in Alaskan water from 1867-1940 (thus excluding the period from World War II to the present) would run into hundreds of vessels, three-quarters of which likely ran aground and broke up on shore. A complete inventory then is a project of several years duration and would require visits to libraries, archives, and museums throughout the nation.

Hanable's essay is a guide to the numerous sources, both primary and secondary, which are concerned with sunken vessels in Alaskan waters after 1867. For those interested in researching a specific wreck, or wrecks in general, it provides a concise, yet detailed, overview of the most important materials pertaining to Alaskan shipwrecks of the American period. Any marine archeological investigation must include extensive examination of the extant historical record of the vessel so that the best possible information for interpretation and explanation of the site is available. Hanable reports that in spite of the substantial documentary base for shipwrecks in Alaskan waters only one vessel in the State's Alaska Heritage Resource File has been proven to have extant physical remains.

One major category of vessels which sailed the Alaskan coasts during the American period were the packers of the canned salmon industry. Haycox's paper provides a case study of how historical sources, in his case the records of the Alaska Packer's Association, can be used to identify particular vessels and their distinctive characteristics. Many other such identifiable fleets operating in Alaskan waters such as Coast Guard cutters, whalers, and ships of the Alaska Steamship Company, could be researched in the manner exhibited by Haycox. His paper goes much farther than that and presents a unique and important episode in Alaskan maritime history. In the future marine archeological research will be able to contribute to this important subject.

It is clear from the presented papers that little actual field investigation has been done on marine archeological resources; that while the potential of important findings in certain domains are limited, in other areas the potentials are very good; and that substantial information is presently available for the investigation of Alaskan marine archeological resources.

Logistics and Training

The conduct of marine archeological research requires trained personnel, appropriate equipment, and large amounts of money. Although similar to terrestrial archeology in areas such as theoretical assumptions, research design, and explanatory aims, marine archeology diverges substantially in areas such as working conditions, necessary equipment, personnel skills, excavation techniques, and conservation procedures. The three papers comprising this session examine the basics of marine archeological research from equipment to necessary training and experience to the actual conduct of an excavation. Lenihan's paper introduces the range of technical devices available to assist in site location surveys, noting that the difficulties in initial location and then subsequent relocation are one reason for the costly high tech approach marine archeology requires. Survey equipment discussed and assessed include aerial remote sensing, positional locators, side scan sonar, magnetometer, fathometer, and sub-bottom profiler. He provides detailed information for the conduct of site testing and excavation on insulating garments, life support systems, decompression techniques, and topside support facilities. Lenihan notes that federal and state agencies with marine responsibilities should be approached for assistance and general information since they can, when it is within their capabilities and mandate, help defray the substantial cost of marine archeological work.

A number of state and federal agencies, as well as the Society of Professional Archeologists (SOPA) and the Advisory Council on Underwater Archeology (ACUA), have created standards for marine archeologists. Cummings discusses the history and evolution of these standards which led to the January 1983 requirements jointly generated and agreed to by SOPA and ACUA. In addition to underwater survey and excavation experience, certified underwater archeologists must also demonstrate familiarity with major remote sensing devices.

The overwhelming majority of marine archeological excavations have taken place in the temperate waters of the Mediterranean Sea or the tropical waters of the Caribbean Sea. Alaskan waters are subarctic and arctic and thus constitute a significantly different set of environmental variables than those normally experienced by marine archeologists. In Canada, however, marine archeologists must also contend with waters similar to those of Alaska. Grenier is one of the few archeologists in the world with experience on several archeological investigations in subarctic waters. The account of the Red Bay Project, Parks Canada's cooperative investigation of a 16th century Basque whaler sunk off the coast of Labrador, provides a first hand account of the conduct of an actual project. Included in this discussion is an account of the organization of the project, a description of the equipment and technique of excavation, and an assessment of the costs and benefits associated with the use of certain systems such as hot water diving units. Noteworthy for nearshore research are the problems posed by fluctuating tide levels for controlling vertical and horizontal locations of above bottom features. The paper is enhanced by background information on Basque whaling and the additional studies on coopering hull design that have been undertaken with project materials.

Preservation and Housing of Materials

Once marine archeological materials have been located and excavated, attention turns to how they are to be preserved and housed. The characteristic milieu of marine archeological materials is immersion in saltwater. This environment poses markedly different problems from that of the terrestrial environment. Hamilton and Jenssen discuss the special techniques and problems associated with the conservation and storage of marine archeological materials of different composition.

Hamilton, perhaps the leading marine archeological conservator in the United States, provides a detailed examination of the effects of the marine environment on metals of different composition, of the types of metal artifacts that are most likely to be encountered, of the techniques of both conservation and preservation, and of the role of the conservator in the marine archeological process. Significant in Hamilton's discussion is his contention that few archeologists are competent in performing basic conservation techniques on site or in the laboratory. He forcefully delineates the necessity for conservation techniques to be employed to insure that the maximum possible information is obtained and retained.

Many sunken vessels of historic interest were of wood construction. Consequently, the problems of conservation and preservation of waterlogged wood once removed from the marine environment has received substantial investigation in the past decade. Jenssen's paper explores this rapidly developing technical topic including the emergence of freeze drying techniques which apparently hold great promise for the preservation of organic materials. Also included in her discussion are conservation techniques for a wide variety of organic artifacts, including leather, skins, textiles, cork, bark and keratinous materials.

The workshop also included a panel discussion on the capabilities of Alaskan museums for storing, preserving, displaying, and analyzing marine archeological materials. Included on the panel were Peter Corey of the Sheldon Jackson Museum, Alan Munro of the Alaska State Museum, conservator Alice Hoveman of the Alaska State Museum, and Dinah Larsen representing the University of Alaska Museum. Robert Shalkopp, who was unable to attend the workshop, sent written remarks on the capabilities of the Anchorage Historical and Fine Arts Museum. In general, panelists indicated that Alaska's museums are in no condition to receive significant quantities of marine archeological artifacts for preservation. No facility in the state has any of the needed equipment, and Ms. Hoveman is the only trained conservator in the state. Neither the Alaska State Museum nor the Sheldon Jackson Museum are capable of storing any additional artifacts. While the University Museum has some storage space and a small conservation lab, it lacks a conservator, the equipment, and space to undertake major marine archeological preservation projects. The Anchorage Historical and Fine Arts Museum is presently undergoing an expansion from 25,000 square feet to 93,000 square feet, which will include a conservation lab and some equipment, but it will still lack the specialized equipment required for marine artifacts. Shalkopp indicates that the Anchorage museum will be able to store materials; but that its primary purpose is as a public-oriented facility of the Municipality of Anchorage. It thus cannot be expected to undertake major commitments to marine archeological projects or to other scientific work without an altered mandate and supplementary funding. Despite the relative incapacity of Alaskan museums to support marine archeological research, all museum representatives indicated both a desire and willingness to work cooperatively with non-Alaskan institutions which might require their assistance on an Alaskan marine archeological project.

Legal Issues

Questions concerning the ownership of marine archeological resources and who has the authority to decide how a given site shall be excavated are obviously crucial to the conduct of marine archeology. Unfortunately, the answers are at present clouded and uncertain. The major problem concerns shipwrecked vessels and the relative authority of federal or state agencies over this particular class of resource. In brief, Admiralty law is the body of legal precedent dating back to 16th century England which provides that those who succeed in raising sunken and abandoned ships or in obtaining cargo from sunken and abandoned ships have a legal right to that which they have saved. Although apparently intended for recently abandoned or sunken vessels, no time limit presently exists for determining when Admiralty law applies to a sunken vessel and when the historic preservation law applies.

Several states have attempted to exert jurisdiction over the cultural resources of their submerged marine waters, but litigation is presently in process on the question. Legislation has also been introduced in the United States Congress to declare sunken vessels federal property and to make provision for transference of title to states when such action would be warranted. No clear solution to this ambiguous and crucial question to marine archeological investigations of sunken vessels is likely to emerge in the near future.

One of the underlying concerns of marine archeologists is that the legalizing of salvage operations on historic shipwrecks will lead to the destruction, or disruption of those archeological remains. That destruction is perceived to be the result of nonprofessional private efforts aimed at personal gain and recreation. One potential approach to head off difficulties such as these is to establish a framework for cooperation and sharing between the archeologists representing the public interests and the private amateurs. Albright's paper describes the framework established by the State of South Carolina for optimizing cooperation between the professional archeologists and amateurs. The system includes several license types, requirements for amateur divers to report their finds, and sharing of the proceeds of a scientifically controlled salvage operation between the state and the person licensed to carry out the operation. The fundamental underpinning of the law, which has been upheld in court, is the state's assertion of ownership of "all objects of archeological and paleontological association which have remained unclaimed for more than 50 years." Albright is convinced that the cooperative route has provided, and will continue to provide, effective long-term protection of the resources. Such cooperation will advance the scientific pursuit of underwater archeology by combining the resources and energies of the amateurs with the guidance and expertise of professionals.

In Alaska, the situation is similar to the 30 or so other states which do not have laws specifically oriented to the management of marine archeological resources. Robertson and Mertz, state attorneys in the Office of the Attorney General, explore the applicability of the Alaska Historic Preservation Act to marine archeological remains. Their review and analysis finds that the act does assert state ownership and management of submerged historic and archeological resources. However, there are several limitations on the state's management authority over those resources. The most important limitations are caused by ambiguity in the wording of the act with regard to (1) rights of access and use by Alaskan Natives, (2) what resources are covered under the act, and (3) the lack of any active efforts to implement the act through identification and pursuit of marine archeological concerns. In addition, Robertson and Mertz also point out the uncertainty surrounding wrecked vessels and their cargo due to the unresolved federal questions concerning the applicability of Admiralty law to these materials.

Alaska law is applicable to marine archeological resources in a broad reading; but since the state has made no active efforts in the field, its utility may be limited if challenged. Furthermore, unlike South Carolina, there is no program in Alaska to monitor or cooperate with private, nonprofessional salvage and sport divers. It is probable that the efforts of such divers directed at marine archeological resources will increase in the future. In order to increase the scientific utility while minimizing the potential destructiveness of these efforts, it is important for the state to develop a framework for monitoring and perhaps cooperating with private, nonprofessional divers interested in pursuing marine archeological resources.

The Future

Alaskan marine archeology is in its embryonic state. The gestation period for the emergence of full-blown marine archeological investigations along the Alaskan coast may be quite long. A number of factors would appear to contribute to this state of affairs. First, the amount of territory to cover is vast, the environment is rugged, the efforts to locate resources -- both archival and on the ground -- have been minimal to date, and personnel with the specific technical skills for such efforts have not been present. Second, the resources needed for such investigations -- monetary, technical equipment, facilities -- are presently unavailable and likely to be so for some time without a major effort to obtain them. Third, there are at present only limited threats to the presently submerged marine archeological resource base.

Although sustained marine archeological investigations are some time in the future for Alaska, this should not be taken to mean that nothing should be done. For example, provisions should be made in the designing of future archeological or museum facilities for the conservation and storage of marine archeological materials. The monitoring and control of private diving efforts on marine archeological resources should be commenced, and a cooperative relationship between the state and the public should be fostered through sharing of information and resources. Finally, legal efforts should be taken to protect the marine archeological heritage of Alaska so that in the future when technology, professional interests, and finances permit sustained investigation, this priceless heritage will still be intact.

Steve Langdon, Chairman
Alaska Marine Archeology Workshop Committee

Acknowledgement: I would like to thank Phillip Drennon Thomas and Ty L. Dilliplane for their helpful suggestions in preparing this Executive Summary.

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Session I

Alaskan Marine Archeological Resources

Predictive models for locating underwater cultural resources on outer continental shelves

Reynold J. Ruppe'
Arizona State University
Tempe, Arizona

Introduction

The post-Pleistocene rise of sealevel and subsequent inundation of terrestrial sites on coastal plains has important implications for a better understanding of the global distributions of early peoples. We believe that coastal zones provided an important subsistence base for early human populations. As sealevel rose, coastal plains were transformed into continental shelves and the former inhabitants of coastal regions were displaced. Present archaeological techniques are not capable of efficiently retrieving information concerning the coastal adaptations of Early Man. Therefore, a methodology to locate inundated terrestrial archaeological sites on the continental shelves has been formulated. Once operationalized, the methodology can be applied to coastlines in many parts of the world to locate inundated sites from many time periods.

The post-Pleistocene melting of ice sheets has resulted in a general rise in sealevel of about 85 meters in the past 17,000 years. The encroachment of ocean waters onto the once-exposed coastal plains has resulted in the inundation of Pleistocene and Holocene coastal geomorphological features and associated evidence of human occupation. Until such time that this material evidence is retrieved, a significant portion of the subsistence patterns of early hunters and gatherers will not be available for study.

Research Design

Stillstands, periods when sealevel remains static, are required for the formulation of characteristic coastal geomorphological features such as barrier islands, lagoons, estuaries, and the tidal reaches of rivers. The rich biota and long food chains associated with estuaries and other coastal features are the result of such characteristics as brackish water, specialized hydrological features that favor aquatic biota, and boundary marshes. Ethnographic analogy and the location of recent prehistoric archaeological sites on coastal water bodies provide the basis for the hypothesis that early humans populated coastal zones in considerable numbers. Also noteworthy in this regard is the fact that present-day concentrations of populations on coastlines around the world primarily are associated with estuaries, lagoons and river mouths.

Development of predictive models for the location of archaeological sites now drowned on the continental shelves has only just begun. A great amount of research must be accomplished in many geographical areas that possess a variety of geological forms because varying geological processes have resulted in a variety of formations and contexts. Equally important are the prehistoric and recent demographies of those areas, all of which may differ. The concepts that are of greatest importance to the establishment of the research parameters are: (1) Coastal geomorphology which has formed and reformed in the past in response to sealevel changes; (2) Coastal adaptations which represent the human exploitation of coastal resources that are primarily, but not exclusively, estuarine; and (3) Sealevel change and its effect on human populations and settlement patterns.

The research design is based on our knowledge of sealevel rise over the past 17,000 years. It is proposed that rising sealevel displaced human populations and their habitation sites all over the world at various times in the past. The west coast of Florida was selected as the research area because of its remarkable geological stability that allowed us to ignore the tectonic variable. Ethnographic analogy derived from the historic Calusa Indians and prehistoric settlement patterns evidenced by the local archaeology provides the basis for testing and validation of the following hypotheses which form the base of our methodology for predictive modeling of site locations.

<u>Hypothesis I</u>

Prehistoric coastal settlement patterns on the west coast of Florida were associated with bodies of water landward of open ocean beaches, generally estuaries, lagoons, and some river mouths.

Test Implications

Distribution maps of indigenous populations and survey maps of prehistoric archaeological sites in the same area should coincide. Both archaeological and ethnological sites should be associated with estuaries, river mouths and lagoons.

Almost no sites will be located on open ocean beaches, except perhaps in the higher latitudes.

Hypothesis II

Sealevel rise displaced coastal populations, drowned their sites, and reworked the coastal geomorphology. New coastal features could be formed only after stillstands of sealevel existed for some time.

Test Implications

We should find a series of contours, each of which will represent a stillstand. Each contour will possess developed coastal geomorphological features and associated archaeological sites. The geomorphological features are the remains of inundated estuaries, river mouths, or lagoons on continental shelves. Other features such as deltas also are apparent on the ocean floors, but are beyond the scope of our interests.

Hypothesis III

Drowned terrestrial sites can be located on and under the ocean by use of remote sensing (acoustic) instruments developed for oil and gas exploration. Scuba divers and coring procedures are necessary to provide verification of anomalous signals caused by archaeological sites.

Test Implications

Characteristic signal anomalies should be recognized by operating the instruments over known underwater sites. Unknown sites should be identifiable by the signals characteristic of the known sites, and should occur with the geomorphological features described above. It should be possible to test the nature of the anomalous signals through examination of their locales by scuba divers, examination of cores taken by scuba divers, and by analysis of the sedimetary environments by physical, chemical, and biological means (Gould 1972:1).

The probable existence of large numbers of archaeological sites on inundated coasts suggests that a significant amount of evidence needed to reconstruct prehistoric settlement patterns and adaptations is underwater and cannot be collected by conventional archaeological methods. We have identified the characteristic underwater geomorphology with which drowned sites will be associated. Those features are unique and identifiable. In the past, we have used scuba divers with "swim lines" to search the floors of continental shelves for geomorphological features and associated archaeological material. The search proved slow, inefficient and ultimately costly because it was not possible to examine a sufficiently large segment of an estuarine feature that we had located. On the other hand, a fathometer allowed us, in a few days' time, to survey the ledges of a river and divers could identify and confirm those ledges. But the fathometer allows recognition only of gross features while the minutia of bottom morphology escapes detection. It is evident that sophisticated remote sensing instruments are needed because conventional archaeological methods are incapable of collecting the relevant evidence.

The remote sensing instruments used in marine surveys are the magnetometer, the side-scan sonar and the sub-bottom profiler. The magnetometer is of little use to our research. Magnetometers are useful to locate shipwrecks and historic sites, or other localities where metals occur. The possibility exists that walls, pits, and fireplaces may be detectable by the use of a magnetometer but that ability is negated by the extremely low level of remnant magnetism in those features. The inability of sea-borne magnetometers, given their mode of application, to detect low levels of magnetism would appear to render them useless in locating drowned terrestrial sites that are pre-metal in age.

Geophysicists have demonstrated that side-scan sonar and sub-bottom profilers can detect the geomorphological deposits characteristic of estuaries, lagoons, barrier islands and river mouths (Nelson and Bray 1970; Rigby and Hamblin 1972; Stuart and Caughey 1977; Van Overveem 1978; among others). The side-scan sonar monitors a wide area of the bottom and produces an image of bottom surface relief. If the bottom is a featureless plain the side-scan cannot produce a significant image. However, it does allow rapid and accurate mapping of the contours of drowned river systems and other geomorphological phenomena faster than a fathometer. A shortcoming of the side-scan sonar is its inability to penetrate sediments that often mask the geomorphological features we seek. Therefore, a sub-bottom profiler is necessary to penetrate the sediments.

The sub-bottom profiler is an instrument that generates an acoustical pulse downward that is reflected back from bottom and sub-bottom layers and sediments (reflective surfaces). The echoes from the various strata are received and printed on a strip-chart and form a profile of the sub-bottom stratigraphy. One difficulty with currently available models of sub-bottom profilers is their inability to produce readable signals in less than about six meters of water. Klein Associates, Inc. has recently developed an instrument that can be operated in water depths as shallow as 30 centimeters. This latter fact is important because part of our methodology requires that known sites in shallow water be tested with the instruments in order to determine the nature of the signals derived from archaeological sites. In addition, large numbers of sites are in less than 10 meters of water. The signal anomalies produced by these known sites can be used as keys to the detection and identification of unknown sites, as discussed under Hypothesis III in the research design. The Klein profiler has the added advantage of being able to be mated to a side-scan sonar and both sensors can be mounted in the same towfish. The system also can be used as a separate profiler or sonar, which makes it extremely versatile. Thus the profiler can be used to identify buried geomorphological features that are associated with archaeological sites. The ability of a sub-bottom profiler to detect submerged archaeological sites has been demonstrated by Goodyear, Upchurch and Brooks (1980), who found an Archaic lithic site in Boca Ciega Bay near St. Petersburg, Florida.

The remote sensing instruments produced a pattern of signal images drawn on strip charts. The signals will illustrate two kinds of phenomena: normal bottom or sub-bottom features and features that differ from the norm and are anomalous. Identification of the sources of the anomalous signals depicted on the strip charts must be accomplished by in situ examination of the bottom deposit (ground truth testing). Ground truthing is the systematic investigation of specific entities sensed by the instruments. It is crucial that we examine the sources of the anomalies in order to create a catalog of characteristic "signatures" that will allow an analyst to identify the signal sources. Anomalous signals from any site will be difficult to interpret unless known sites of various types have been tested systematically. Known sites must be traversed with a profiler to produce representative signal images which can be used to identify potential sites in deeper water. When promising geomorphological features are encountered and anomalous signals like those from the known sites are received, divers can investigate the locus and, if necessary, take a series of cores to test the sub-bottom deposits.

Tests of sub-bottom deposits by examination of cores taken from those deposits have been conducted routinely for years by sedimentologists, palynologists, and marine scientists. Archaeologists have made much less use of core analysis but the methodology has produced significant information when used on underwater sites. Gagliano found that, "systematic analysis of core-type sediment samples provides a basis for distinguishing cultural deposits with a high degree of certainty" (Gagliano 1982:168). In a core taken in Koiladha Bay, Greece, Gifford found mollusc shell fragments, thirty pottery sherds, building plaster, oxidized copper fragments, carbonized wheat grain, charred fish vertebrae, and a small burin 5.5 m below the present bay bottom. The potsherds were markedly angular as compared to sherds from the land site which suggests that they probably were in situ (Gifford 1982:169). At the Venice Beach site and several other drowned sites along the coast of Sarasota County, Florida, it was possible to distinguish between cultural and non-cultural deposits through the analysis of cores that showed heterogenity of shellfish species as well as charcoal (Ruppe' 1978; 1980).

Not all continental shelves and adjacent coasts are equally promising as locations for well-preserved archaeological sites. The choice of Florida as the research area is based on several considerations. Geologists consider the Florida peninsula to be one of the more stable regions on earth (Brooks 1973:11E-17; Missimer 1976:14). That stability insures that the independent variables of earth movements can be ignored safely for the time span considerd in this project. Conversely, the rise of sealevel on unprotected coasts in many areas of the world must have resulted in the destruction or alteration by wave action of coastal features. Coastal marshes, barrier islands and sand bars can provide protection for shell middens and sediments bearing archaeological remains. The west coast of Florida possesses all of those protective features and is therefore well suited to the research.

Another important variable influencing whether or not an archaeological site will survive a sealevel rise is the intensity of wave action along the coast. Coasts can be classified as high, moderate or low energy coasts (Tanner 1960:259). A coast that possesses large waves, long fetch and strong winds is a high energy coast and most likely will have drowned archaeological sites that either are severely damaged or destroyed. In contrast, the west coast of Florida, midway along the peninsula, is classified as a zero to low energy coastline (Tanner 1960:259). Conversely, a coast with a narrow, steeply sloping coastal plain or a fiord configuration will not offer much protection from the wave action of rising seas. Thus, any coast with a broad, gently sloping shelf/coastal plain and a low energy coastline should contain sites that are relatively intact. However, ice movements such as those along the Alaskan coasts present special problems of bottom disturbances.

The hypothesis that former human populations occupied now drowned littoral zones requires that sealevel was static for periods of time during the long, cumulative rise of the sea after 17,000 B.P. Oscillations in the size of the continental ice sheets created periods of sealevel lowerings, stillstands, and subsequent rises. Stillstands are sealevels that remained static at various elevations and dates in the past long enough to allow formation of characteristic coastal formations such as estuaries, barrier islands, and lagoons. The stillstands made possible the occupation of littoral zones by plants and animals whose habitats were estuaries, lagoons, marshes, and the tidal reaches of rivers. That biota was in turn exploited by human populations inhabiting the coastlines. The coastal biota was destroyed or displaced each time sealevel rose. Conversely, when sealevel was lowered a portion of the biota disappeared while the remainder was forced to migrate down the beach slope towards the retreating sea. Today the evidence of several human occupations of the fluctuating littoral zone is associated with, and a component part of, the sedimentary deposits on the continental shelf.

Sealevel change in the past 17,000 years is fully accepted by marine geologists. Evidence from every part of the globe insures that the phenomenon is world-wide. Changes in sealevel depend upon the amount of water locked in ice sheets and the polar ice caps. Climatic fluctuations are the prime movers in oscillations of the ice sheets and consequent raising or lowering of sealevels. However, marine geologists differ in their opinions concerning the rapidity of sealevel response to climtic change. A majority of marine geologists picture the post-Pleistocene sealevel rise as a smooth curve (Blackwelder, Pilkey and Howard 1979). In support of that view, N.C. Fleming (personal communication) suggests that:

> There have been fluctuations of climate during the last 5,000 years, and particular glaciers, mountain glacier regions, or sections of ice cap, have been observed to grow or retreat. However, these events can occur out of phase with each other, so that there is no gross accumulation or melting of ice on a world-wide basis, and therefore, no effect on world-wide sealevel.

Fleming also believes that the past 5,000 years has seen a sealevel rise of no more than half a meter.

A minority opinion is held by Rhodes Fairbridge, among others, that sealevel changed in an oscillating manner and is best illustrated by an irregular curve (1961; 1974). He believes that sealevel rose irregularly and stood higher than the present level several times in the recent past. The issue is of importance to archaeologists because many drowned terrestrial sites so far investigated would have had to be constructed underwater according to the smooth curve hypothesis. The inundated sites were dated by radiocarbon means and archaeological typology based on radiocarbon dates.

A graphic summary of the opinions held by ten marine geologists illustrates the extent of the problem (Everard 1980, Figure 2; this paper, Figure 1). Clearly, the archaeologist who attempts to correlate sites associated with specific contours and dates must attack a major research problem. Conversely, the archaeologist who locates archaeological sites underwater can provide more precise dates for associated geomorphological features than are available by geological means. Several archaeological studies have concluded that the Fairbridge curve provides a better fit than the majority opinion to radiocarbon dates and the age of diagnostic artifacts extracted from coastal sites (Lazarus 1965; Holmes and Trickey 1974; Hurt 1974; Ruppe' 1980; Taira 1980).

Another source of disagreement concerns the magnitude of sealevel change. Recent estimates of the magnitude of change differ greatly from those proposed a few years ago. One conservative suggestion is for a total rise of only 55 meters in the past 17,000 years (Blackwelder, Pilkey and Howard 1979). In the decades of the 60's and 70's a

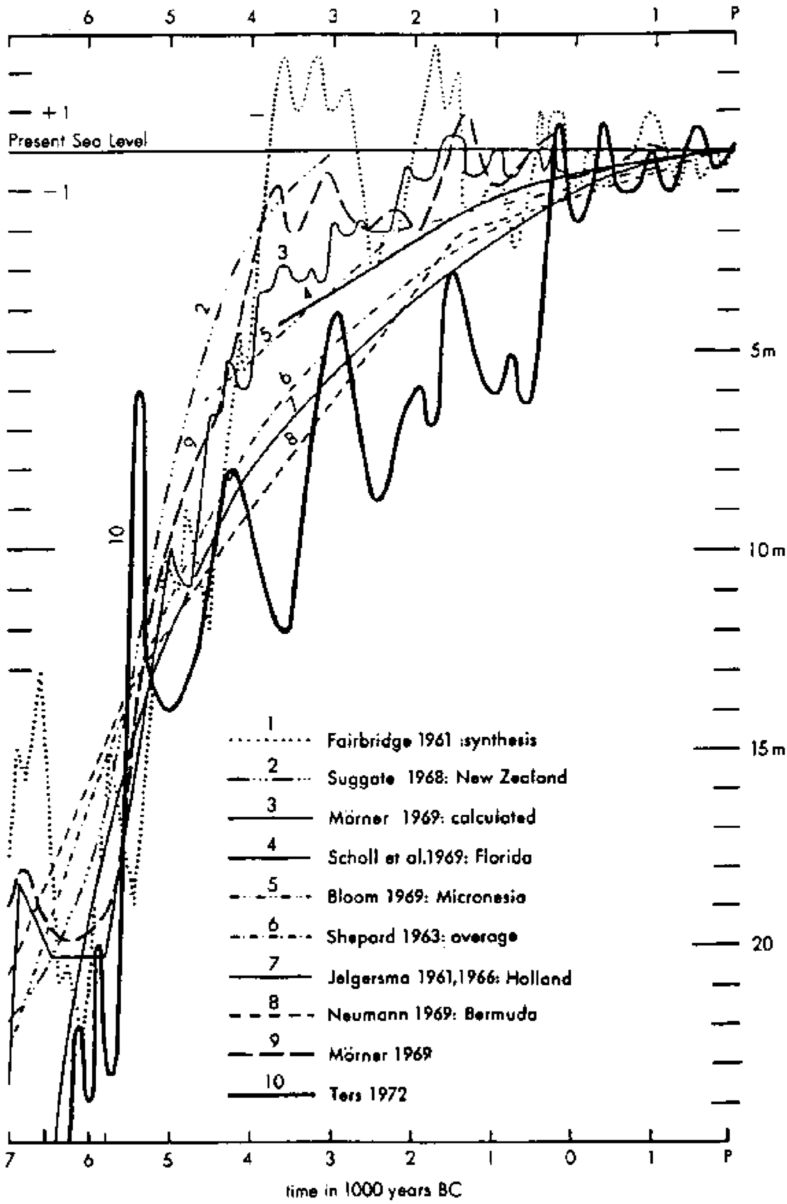

Figure 1. Graphic portrayal of interpretations of changes in sealevel over the past 8000 years. Taken from Everard 1980.

sealevel rise of 130-135 meters was considered a reasonable estimate by many marine geologists (Guilcher 1969; Shepard and Curray 1967). In April 1981 the International Geological Correlation Programme, Project 61, The Sea-Level Project, met at the University of South Carolina where the members informally adopted a figure of 85 meters as a reasonable estimate of sealevel rise in the past 17,000 years. However, they were forced to conclude that no specific world-wide figure was possible. The problem is one of grave concern, as illustrated by a conclusion that, "...the great diversity of opinions about this history of relative sealevel in the Holocene Epoch makes the attainment of the primary project objective highly unlikely" (Bloom 1979).

The differing opinions discussed above create serious problems when archaeological formulations are attempted. A glance at Figure 1 shows that the past six thousand years is the period about which geological thinking is most contradictory and it is the same period that is crucial to North American prehistory. There is general agreement that the Archaic period manifestations are first evident about 8,000 B.P. and exhibit considerable development and expansion by 5,000 B.P. In addition, it is generally agreed that the modern biota also was established by 5,000 B.P. Thus, the specific time period about which the geologists cannot agree is one that has seen enormous changes, growth and development of the prehistoric peoples of eastern North America and is precisely the period for which we have the best evidence of drowned terrestrial archaeological sites. The same situation most probably exists in the Old World in Europe and the Mediterranean region, at least.

Still another geological variable, and one that must never be ignored by the archaeologist, is the problem of crustal movement. Eustatic sealevel change has occurred everywhere and the amount of apparent rise relative to land level differs enormously from place to place because the land also has risen or lowered independently of the sea. Consequently, we must know something about the tectonic and isostatic history of the specific land area in which we are interested. A case in point concerns a geological phenomenon on Antigua where a tectonic tilt of the island raised the "Jolly Beach Site" about ten feet while sites on the other side of the island were being eroded by the sea (Nicholson 1976). The same phenomenon has been documented extensively for the Mediterranean (Fleming 1969; Flemming, Czartoryska and Hunter 1973). Those tectonic movements could easily be mistaken for a change in sealevel by an archaeologist and it emphasizes the need for caution and a knowledge of local geology. In terms of crustal movements in general, the most important factors are tectonic emergence and subsidence, isostatic deflection of continental margins due to ice loading and unloading on the continents, distance of land masses from the location of former ice sheets, coastal deflection due to the weight of sediments in deltas, and the loading of the continental margins by the water column.

The research upon which development of a methodology for predictive modeling is based is ongoing and has been conducted in six field seasons on the west coast of Florida. The research indicates that the methodology is sound and the results to date confirm the initial hypothesis.

More than 30 archaeological sites have been located underwater along the west coast of Florida from Sarasota County north to Levy County for a distance of 210 km. The sites range in time from circa 4,000 B.C. to A.D. 400 for the underwater components. Some of the sites also possess dry land components on the beach or up the beach slope, while others are completely underwater and sometimes a considerable distance from the seashore. With the exception of four Archaic sites, all the sites that were located or excavated are shell middens, a class of sites which are notorious for the paucity of artifacts in the deposits.

The Venice Beach site (8-SO-26) provides solid evidence that an archaeological site can survive ocean waves, currents, and storms on a low energy coastline (Ruppe' 1980). The site is a drowned shell midden on the west coast of Florida. The heterogeneity of shellfish species, some of which have different environmental requirements, demonstrates that the deposit was man-made. The site possesses large areas of undisturbed stratigraphy and the uppermost intact cultural level was two meters below mean sea level. It is probable that some portion of the upper cultural levels of the site were removed by wave action but that cannot be tested.

Judging by the available ethnographic evidence, settlement patterns similar to those of Florida are apparent elsewhere in the world in many geographical locations and climates. The complex food chains of estuaries and river mouths, both in the water and on adjacent dry ground, provide a wide variety of resources which were exploited almost everywhere. Coasts in the vicinity of estuaries and river mouths have been used by human groups for a very long time, but most of the evidence is now underwater. Reports from such widely separated locations as Australia (Bailey 1975; Coutts and Higham 1971), Southeast Asia (Gorman 1971), Africa as far back in time as the Middle Paleolithic (Volman 1978), South Africa (Parkington 1981), Italy (Whitehouse 1971), Mesoamerica (Coe and Flannery 1968; Voorhies 1978; Hubbs and Roden 1964) and northeastern North America (Braun 1974, Salwen 1965), among other locations all over the world, attest to the association of archaeological sites and coastal contexts, almost always on or near estuaries and river mouths. The above list is only a portion of the bibliography that could be cited, but it is sufficient to indicate that estuaries, river mouths and lagoons in many parts of the world will possess evidence of human occupation.

The techniques that are necessary to locate the drowned terrestrial sites are the major problem faced by underwater archaeologists. Until we are able and willing to survey large areas of the ocean floors rapidly and precisely, the study of past human occupations of former coastlines will remain somewhat speculative. Therefore, it is absolutely essential that remote sensing instruments be adopted by the underwater archaeologists, which in turn, entails acquisition of very expensive instruments, learning to operate them skillfully, and development of survey methods to systematically search selected areas of the continental shelves.

The research design and methodology for predictive modeling to locate drowned terrestrial sites was formulated for latitudes much lower than Alaska, but most spects are transferable to Alaska as well as other regions. The first step in the formulation of a predictive model for the location of offshore archaeological sites is the reconstruction of a prehistoric settlement pattern sites on the adjacent land areas. The reconstruted prehistoric settlement pattern can be used as a model to determine what specific geomorphological features underwater would conform to those of the model. Those features will be indicated by the bottom contours that remain as evidence of the former rivers and other geomorphological landforms and will indicate the localities where sites ought to exist.

The methodology involves development of a series of stratified samples from which predictions of site locations are made and which must then be tested for accuracy. Predictive modeling ought to prove successful, but first must be tested by a number of means and in many localities before it can be considered accurate. In that regard, the results of our Florida research cannot be applied directly to the Alaskan situation. The probability of locating drowned sites in Alaska will depend upon a number of physical variables such as sea ice, glaciers, crustal deflection, coastal topography, width of the continental shelves, amount of sedimentation, wave energy, and coastal protection provided by sand bars, barrier islands, shallow shelf slope and coastal marshes.

Crucial coastal geomorphological features have been obliterated along some of the Alaska coastlines by several forms of sea ice and glaciers. From descriptions of the pack ice along the Beaufort Sea coast it would appear that the serious ice-gouging in long furrows parallel to the coast to a depth of 10 m. (Dixon, Sharma and Stoker 1978) would have destroyed sea-floor contours in most areas. A simliar situation perhaps prevails along the coast of the Gulf of Alaska where glaciers have gouged the bottoms of the inlets in which they are located. The coast of the Bering Sea has likewise been acted upon by ice-gouging, particularly from Nunivak Island north to the Bering Strait (Thor and Nelson 1981). The situation from the mouth of the Kuskokwim River to Bristol Bay may be brighter because the ice diminishes greatly to the south in that area (McNutt 1981) and some bottom contours may still be intact. On the other hand, Black (1966) states that, "the Bristol Bay-Alaska Peninsula region was under continuous ice probably several times and as recently as perhaps 10,000 years ago." The prevailing view about the southeast Bering Sea region, as expressed by geologists is that, "Coastal occupation was possible only along the low lying south shore of the land bridge, in areas that are now part of the submerged continental shelf of the Bering Sea" (Hopkins 1979). It is interesting to note that the choice of the southeast Bering Sea region as a locale that presents a high potential for site location on the basis of our methodology conforms to independent geological studies.

Crustal deflection due to ice-loading of the land mass is an independent variable that must be considered, especially in Alaska. It is not possible to use dated stillstands for cross dating because the vertical movements due to deflection vary greatly in magnitude. The problem is compounded by the fact that the crustal movement, depending upon its location, may be up or down. Thus, present sealevel is a relative measure; it is entirely possible that sites of the same time period and cultural content may, in different geological areas, occur at different elevations relative to sealevel. A related problem is the tectonic instability of Alaska which creates the same kinds of problems as coastal deflection.

Coastal topography in Alaska runs the gamut from broad, shallow continental shelves to fiords. As discussed earlier, our methodology cannot be applied to a fiord topography. There is a possibility that some local embayments and coves may have riverine expressions offshore that were like some of the village locations utilized today by Northwest Coast Indians. If such locations were not scoured by glaciers there is a chance that sites might be found, but acoustic instrument surveys are necessary to reach such conclusions. A wide continental shelf is the opposite of a fiord configuration and it offers the best chance of containing archaeological sites. Shallow bottom slopes provide maximum site protection because waves break far from the beach and the development of coastal marshes is made possible. Barrier islands and sand bars are associated with shallow slopes which offer considerable protection from wave action. Heavy sedimentation will mask bottom contours and if archaeological sites are present deep sediments will make it impossible to reach the sites even if they are detected by acoustic surveying.

The amount of wave energy expended on a beach is determined by such factors as length of fetch, angle of slope and breaker height among others. Each segment of coast must be examined and considerable variation can occur in short distances (Tanner 1960). Protection from wave energy is offered by barrier islands, sand bars and coastal marshes. Thus there are a number of variables that act to protect coastal and underwater archaeological sites from destruction by wave action.

A second major consideration in the formulation of a predictive model for the location of offshore, drowned archaeological sites is the reconstruction of a settlement pattern utilizing ethnographic analogy in combination with the distribution of prehistoric sites on the adjacent land areas. Settlement patterns in part are determined by the local geomorphology. Consequently, a river of the size and nature of the Yukon probably is not a likely candidate for our approach because of the great deposits of silt at its mouth and in the lower valley, the volume of outflow and the high degree of meandering that the stream exhibits. Another problem of the Yukon is that given the huge volume of water and the broad floodplain, many sites have probably been washed away as De Laguna (1947) suggests. Thus any settlement pattern reconstruction could not represent more than a few hundred years and would not be a realistic model of patterns that existed several thousand years ago.

The Kuskokwim River differs from the Yukon in many respects. The Yukon has relatively few sites along its lower reaches while the Kuskokwim has many (Petroff 1882). The historic and prehistoric settlement patterns of the Kuskokwim were less affected by the processes of the Yukon River mentioned above. When the lesser amount of sea ice at its mouth is considered, the Kuskokwim River is a likely candidate for offshore acoustic surveying. Even in that location, however, the Coast Pilot reports heavy amounts of silt suspended in the water that probably masks bottom contours under thick deposits of silt. Extensive testing with a sub-bottom profiler must be conducted before further discussion is possible. We should expect to find bottom contours that represent the former channel of the Kuskokwim River when it flowed south and joined the combined Nushagak and Kvichak Rivers in present day Bristol Bay. The combined stream then followed a course parallel and close to the Alaska Peninsula as it flowed across the present continental shelf (Pratt and Walton 1974; Figure 2).

That interpretation of the bathymetric data suggests, perhaps, that Aleutian prehistory might be susceptible to other interpretations, given the fact that a huge river flowed less than 40 km. north of the present Alaska Peninsula. It is well to recall that ca. 8,000 years ago when that large river was extant, the southern margin of Beringia was the mountainous spine we refer to as the Alaska Peninsula which was not a peninsula at that time.

The methodology from which predictive models can be generated was designed to investigate two problems in underwater archaeology that deal with location of drowned terrestrial habitation sites on the continental shelves anywhere in the world. The problems are: 1) the identification of characteristic signals (signatures) obtained by underwater remote sensing instruments from known

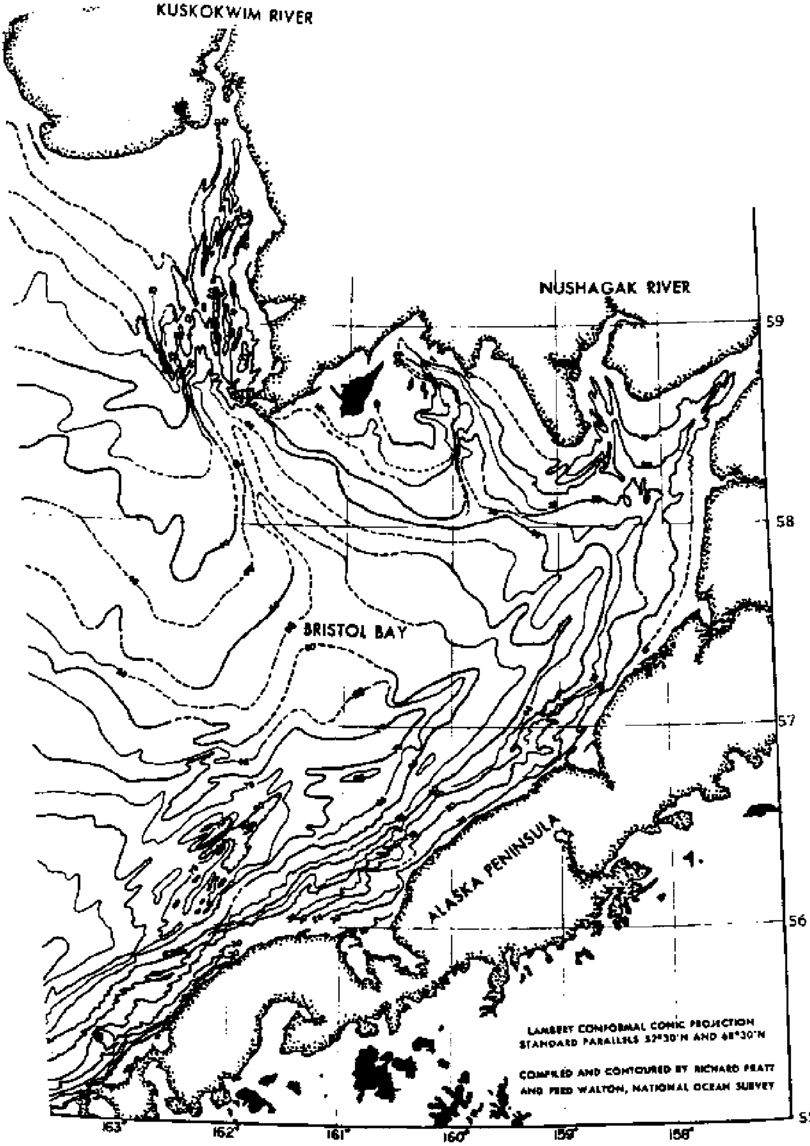

Figure 2. Bathymetry of the southeastern Bering Sea. The prehistoric channels of the Kuskokwim, Nushagak, Wood, and Kvichak Rivers clearly are visible. The channels coalesce in the vicinity of Lat. 56° N, Long. 164° W.

archaeological sites; and 2) the discovery of unknown drowned sites both in shallow and deep water by recognition of the signatures produced when the instrument passes over them. Painstaking care will be necessary in making assessments of the signals obtained from the unknown, geomorphologicaly promising localities. Large numbers of signals will need to be analyzed and compared to the known standards to determine whether or not sites are present. If some signals similar to the standards do not represent archaeological entities, it will be necessary to subject the locality to further intensive testing to learn why the situation exists.

At the present time there is no basis for accurate prediction of the types of signals received from drowned terrestrial sites. A hypothesis that must be tested continuously is that most sites, because of their relatively early dates, will be simple villages with shell middens as the most important components. Midden material consists of shells, ash, organic material and sand, which should differ in density from the natural sediments above and below the cultural deposit. However, the degree of difference between the densities that may be detected on the printouts is not known. Archeological sites in Alaska may have one possibly useful characteristic. Sites in coastal Alaska may have significant numbers of large animal bones that may be easier to detect due to a density different than the surrounding material. That speculation obviously must be tested with instruments in the water.

A critical feature of the research methodology is that each area must be treated as an independent entity because tectonic movements and local environmental conditions may vary greatly over short distances. That caution is particularly important in the case of a geological area as complex as Alaska where the coasts have been acted upon by a variety of geological processes. Therefore, predictive models, if they are to succeed, must be developed on a case-by-case basis. Each river, lagoon or cove will have to be tested with side-scan sonar and sub-bottom profiler to see if old bottom contours have escaped destruction by ice. Another reason to proceed on a case-by-case basis results from the tectonic history of Alaska where the land level relative to sealevel has changed considerably so that correlations with other areas will be difficult.

In summary, the methodology for predictive modeling to locate drowned archaeological sites offers a reasonable chance of success through the use of side-scan sonar and sub-bottom profilers. Gross geomorphological features such as the intersection of river banks and coastal contours can be detected by the side-scan sonar, if the eidence is not buried under silt. When such an intersection is located the sub-bottom profiler can be used in a search pattern of narrow line spacing to search for lens-shaped strata in the profiles. When found, those targets will need to be tested with a coring tool or some other means to examine the composition of the suspect strata.

Beyond the location of drowned archaeological sites the research design has the potential to assist us in the elucidation of several problems currently faced in the study of Early Man. Sealevel rise in the Holocene and the subsequent inundation of terrestrial sites has important implications for our understanding of the settlement patterns and population distributions of early peoples all over the world, and of the study of prehistoric coastal adaptations. The direct results of sealevel rise on prehistoric populations were profound alterations of the environments and settlement areas on coastal plains and sea coasts everywhere. Former inhabitants of coastal plains would have been displaced as sealevel rose and the former coastal plains would have been transformed into continental shelves. The above hypotheses suggest that present estimates of the size of early human populations in the past probably are in error on the low side. The large number of prehistoric archaeological sites along the coasts of most continents, both at sealevel and below, provides evidence that many sites were inundated as sealevel rose and thus have not been figured into the population estimates.

The present state of knowledge is so scanty that it is not possible to document large population movements in the period ca. 17,000 - 10,000 B.P. By influence, however, we can postulate such movements because modern humans are found at the right time in places as diverse as Australia, South Africa, the upper cave at Choukoutien, and of course, Beringia and the New World. For example, when sealevel was ca. 85 meters lower than at present in southeast Asia, the resultnt land mass was enormous. Beringia was a continental-sized land mass more than 1,100 km. across its north-south dimension. Pleistocene land masses as huge as Beringia and Southeast Asia must have exercised a considerable effect on movement and distribution of the biota, meteorology and ocean currents. That in turn suggests that archaeologists must exercise great care in their formulations about prehistoric movements of humans, settlement patterns, and resource exploitation. Few physical barriers existed to impede the movement of early populations. Sealevel stands were never low enough to provide dry-land passages across Oceania or the Caribbean Sea. However, the continental shelves were exposed enought to allow early human groups to travel relatively short distances over water. Passage by simple watercraft was not difficult, and we do not have to invoke long sea journeys to explain the population of the various island chains of the world.

Submerged archaeological sites also offer a great potential for dating the geomorphological features with which they are associated. That will help clear up many controversies concerning the dates of past changes in sealevel. Archaeological sites are complex entities that cannot be transported intact, unlike the natural shell deposits and lumps of peat which are the primary materials used by geologists to date stillstands (Blackwelder, Pilkey and Howard 1979). The Venice Beach site, for example, provides solid evidence of an inundated shell midden off the west coast of Florida. Analysis of the shells from the excavation indicated that of the 35 species represented, oysters and clams comprised between 65% and 87% in each stratum of the midden, but the frequencies of the species varied by levels. Each species has different environmental requirements and they are not found together in natural shell deposits. Pecten occurred consistently throughout the midden and, since it is a free-swimming, bay bottom form, had to be brought to the site by human intervention. The frequencies and varieties of shells led to the conclusion that a shell midden cannot be confused with a natural shell deposit. Such middens, along with other types of archaeological sites, are datable features whose integrity and association with stillstands can be firmly established.

Until archaeologists can develop a methodology to locate drowned coastal sites, we will not have an adequate understandng of the subsistence patterns, migrations and population sizes of prehistoric peoples. This is a problem that is not only global in scope, but pertains to a significant portion of human cultural evolution as well, extending back as far as the Middle Paleolithic.

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Submerged archaeological resources on the continental shelf of northwestern North America

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Introduction

In recent years there has been an increased interest in the location and recovery of archaeological resources from submerged areas of the continental shelf of North America. This interest stems in part from technological developments in underwater exploration and recovery, and the broadening of concerns from submerged shipwrecks to other cultural resources, especially prehistoric, that until recently have been inaccessible. The importance of submerged prehistoric cultural resources lies in the questions that "dry land" archaeology has not, and perhaps cannot, answer; for example, the role of formerly exposed continental shelf areas in the movements of prehistoric population, and many questions concerning the origin and nature of early coastal maritime cultural adaptations.

That submerged prehistoric cultural resources exist has been evidenced by the discovery of such materials in the Old World and the fortuitous discovery of prehistoric archaeological materials off the North American continent; for example, a fish spear fragment brought up on an anchor off Maine (cited in Roberts 1980:57-58) as well as the recovery of numerous stone vessels off the southern California coast (Hudson 1977).

With an increased awareness of submerged archaeological resources, there also has been a concern with their preservation and management. This is the result of both the extension of dry land conservation ethics and the probability of increased impacts through exploitative technologies and technological developments. In addition to the destructive effects of natural agencies such as storms and shoreline erosion, the potential impacts of bottom dragging and shellfish dredging have also been noted (Roberts 1980:57-58). Impacts have always existed in coastal development and construction, and may be increasing on the continental shelf with the exploitation of offshore areas as energy sources. The concern with impacts upon, and the management of, offshore archaeological resources has been witnessed by studies that are not only defining the problems, but proposing management strategies (e.g., Schwartz and Moran 1980; Roberts 1979).

In this paper, the archaeological potential of marine and coastal "wet" sites associated with the continental shelf of northwestern North America are considered. In the following, the kinds of sites and archaeological materials that might be available, the geomorphic processes and phenomena that affect their potential in yielding archaeological data and information, and the case for cultural resources and their potential significance on a gross regional basis are examined. The discussion is constrained in several dimensions however. First, the geographic area of concern is the offshore continental shelf area of Washington State, British Columbia, Southeast and Southwest Alaska, and the Bering Sea. Temporally, the focus is upon prehistoric cultural resources. Culturally, the discussion is limited to archaeological manifestations of Native Americans. Historic archaeological resources, shipwrecks or otherwise, are not considered here.

"Wet" Archaeological Sites

Submerged archaeological resources are considered here to be a variant of a general kind of site that has gained increased attention in recent years: "wet" sites. Interest in these sites derives from the fact that they have been found to often preserve a broader sample of cultural materials and features than dry sites of a similar age; anaerobic conditions created in moist or wet microenvironments may allow the preservation of otherwise perishable organic materials. As a consequence, materials from wet sites can evidence a wider range of cultural behavior than the hard organic or inorganic fractions of past material cultures. That organic materials can persist under the proper moist conditions is attested by such sites as Starr Carr, Swiss Lake dwellings, and Kalambo Falls in the Old World.

The significance of wet sites to our discussion and the concerns of continental shelf archaeology lies in the fact that they do occur in coastal environments, and may provide a unique interface between dry and submerged archaeological resources. To generally qualify as a wet site, moisture must obviously be present. In addition, however, we also offer either of the following two criteria for defining wet sites:

1. Moisture must be present in sufficient quantity and duration to positively affect the preservation of organic materials.

2. The site must be under water, regardless of content. While the preservation of the organic fraction is often associated with wet sites, it need not be present.

We do not find it particularly useful to include frozen sites in our definition, despite the facts that both moisture and organic materials may be present.

Wet sites may be all, part of, or independent of a cultural activity area, either horizontally or vertically. Some sites are wholly wet; others may be wet only in their lower components; some, like river or marine "dump" sites may be locationally distinct from habitation or activity areas.

Wet sites occur in a variety of geomorphic contexts and may be classified according to their present, rather than original depositional, circumstances:

1. Subtidal sites occur below low tide range, either on the continental shelf or within the ocean basins (in the latter case, they are truly "marine").

2. Intertidal sites are within the range of daily and seasonal tidal fluctuations, as well as the reach of high winter storm tides. This classification also includes "tidewater" reaches; i.e., fresh water regimes subject to tidal influence as in the case of river mouths. An important characteristic of these sites are wet and dry cycles, whether daily or seasonal. The range of tsunami effects are not considered here.

3. Lacustrine/riverine sites are basically continental but may grade into intertidal zones. Special situations such as sinkholes would also be included here.

4. Watertable sites are archaeological deposits affected by high or rising watertables, either during or subsequent to deposition.

To summarize, wet archaeological sites are relevant to this discussion for several reasons. First, submerged sites can be viewed as a particular kind of wet site. Secondly, as opposed to dry sites, wet site recovery often requires technologically sophisticated and complex recovery systems with elaborate support in terms of laboratory processing, conservation, and preservation when perishable materials are involved. Third, intertidal, lacustrine/riverine, and watertable sites on the coast may provide an interface between subtidal and coast dry sites. Finally, all wet sites have at least a potential for the preservation of organic materials through the presence of anaerobic conditions. The actual occurrence of organic materials is, however, dependent upon a variety of factors, including the cultural nature of the site and its geomorphic history.

Geomorphic Conditions

Any discussion concerned with coastal archaeological resources must take into account the phenomenon of sea level. Moreover, sea level cannot be considered a static phenomenon with regard to the geographic areas and the time depth with which we are concerned. Therefore, this discussion will emphasize "apparent" sea level; while the factors that determine apparent sea level are too complex to discuss in detail, they are worth reviewing here because of their significance to the subject area.

The position of a beach on a continental margin is basically the function of two sets of effects: (1) the volume of water present in the ocean basins or eustacy; and (2) the vertical movements of at least portions of the continental margin through the processes of isostacy and/or tectonics.

Eustacy is a global phenomenon and is generally understood, at least in broad terms, while vertical crustal movements are more complex and localized, and are generally understood on a local or regionl basis. For our purposes, it is sufficient to regard eustacy as basically a glacial versus interglacial relationship; during periods of glacial maxima, sea levels were lowered as a result of water being locked up in continental ice caps. As continental glaciers receded, however, water was freed and sea levels rose.

Since the last glacial maximum, around 15,000 BP, the basic eustatic relationship has been essentially as follows:

1. At the glacial maximum, sea levels stood between 80 and 100 m. lower than present.

2. Between about 14,000 and 6,000 BP, sea levels rose relatively rapidly, as continental glaciers retreated.

3. By about 6,000 BP, sea levels stood within five to eight meters of their modern positions. While changes continued to the present, they are of a smaller magnitude and rate than previously.

While the raising and lowering of sea level through the advance and retreat of continental glaciers is a relatively simple interaction, the actual relationship between sea level and land surface is greatly complicated by isostatic and tectonic movements. Isostatic movements are crustal deformations resulting from the weight of continental ice; tectonic movements result from the pressure of oceanic and continental plates. Tectonic changes may be abrupt in some cases but over the last 15,000 to 20,000 years, a small increment of geologic time, there probably has been little change in their frequency. In contrast, isostatic changes reflect major climatic patterns; during glacial episodes, glaciated coastlines were depressed and have generally been rebounding in post-glacial times.

During the early and mid post-glacial period, rates of sea rise and isostatic rebound were both relatively great and variable; many portions of the coast experienced some degree of both submergence and emergence. By the late post-glacial period, however, sea rise became minimal and rebound and/or tectonics became the dominant effects.

Because isostatic and tectonic movements are superimposed on the eustatic relationship of the continental margin, local conditions are much more important than continental dynamics in affecting individual archaeological sites. The combination of all of these factors result in coastlines which are either "emergent" or "submergent." Emergent coastlines are ones in which the beach is migrating seaward; i.e., more of the continental margin is being exposed. At present, emergent coastlines are the products of isostacy and tectonic uplift; during the growth of continental glaciers, coastlines were also emergent, but through the eustatic lowering of sea level.

Archaeologically, emergent coastlines are significant if one's interest is with dry land early coastal sites, rather than presently submerged sites. Moreover, submerged archaeological resources are unlikely to be found off coasts that are emergent during and since the temporal period of concern. Examples of emergent coastlines with archaeological resources are Cape Krusenstern in Alaska and Sand Point in the state of Washington; in both cases, sites that were once adjacent to the intertidal zone are presently some distance removed from the modern beach.

In the case of submergent coasts, the beach has been moving landward over time; that is, the continental margin is undergoing inundation. In the simplest situation, dry land is encroached by the intertidal zone until it finally becomes subtidal; i.e., continuously covered by the sea. The matter may be complicated, however, by the fact that the sequence may loop at any point; for example, a coastline that is being transgressed by the sea may be uplifted by a local tectonic disturbance to become dry land again. Most submerged archaeological sites, excepting situations where materials were dumped or disposed of in water, are probably the product of submergent coastlines. Unfortunately for our purposes, such sites have been subject to a major impact; that of intertidal transgression.

While the impact of intertidal transgression on archaeological resources has previously been discussed in a 1976 memorandum by David Hopkins, its importance to our concerns is such that it bears repetition and elaboration. An intertidal transgression presents a number of conditions that are basically unfavorable to the preservation of both the materials and integrity of a site deposit. First, there is the wet/dry cycle inherent in an intertidal zone.

Archaeological materials in such a zone are subject to alternate wetting and drying, a condition most unfavorable to the structural integrity of organic materials. The major impact, however, is on materials rather than site integrity.

A second and perhaps more minor impact than the others discussed here is the biological and/or chemical deterioration of site materials. Intertidal zones possess their own ecology, much of which is deleterious to organic components of archaeological deposits. A third condition impacting intertidal archaeological resources is wave energy. This results in erosion and dispersion, as well as mechanical abrasion and destruction of both perishable and less perishable materials. Because of these effects, it is a major impact on both materials and site integrity.

A final impact that might be mentioned is a combination of the preceding three factors expressed in the duration of intertidal transgression. The impact of these conditions might be less in cases of rapid transgression than in a slower process where an archaeological resource remains in the intertidal zone for a longer period of time. The rate of subsidence, and therefore the duration of intertidal transgression, is the product of a complex variety of geologic and geomorphic factors.

Finally, it should be acknowledged that the impact of intertidal transgression on submergent coastlines might be lessened in protected inner coasts. Again, the precise circumstances will be the result of a complex interplay of various factors and will be highly variable on both a local and regional scale.

Archaeological Considerations

Most archaeological sites presently located on the continental shelf are presently submerged or lie in intertidal zones. In terms of initial deposition, these sites fall into one of three categories:

1. Sites formed on the dry land and wholly or partially submerged since their deposition through eustacy and/or subsidence.

2. Sites initially formed in an intertidal zone and subsequently submerged. Such sites may have been resource exploitation sites expressed in artifact content and archaeological features such as fish traps and even petroglyphs.

3. Sites formed through direct subtidal deposition such as loss, discard, or dumping.

Of these categories, only the first--sites formed on dry land--have the potential for representing habitation sites and yielding large amounts of culturally significant data. This potential, however, is a function of several factors, including dry land conditions prior to inundation, the conditions of intertidal transgression during submergence, and the questions being asked of the data.

The archaeological potential of any site is initially determined by the nature of the site; lithic scatters, for example, yield considerably different information than large midden sites. Once deposition is complete, dry land impacts such as wind deflation, soil creep, and frost disturbance further affect the potential of archaeological deposits. These impacts may result in deposit disturbance and at least partial loss of the organic fraction well before inundation. It is unfortunate that submerged sites that had their genesis as dry sites are subject to all of the processes of disturbance and data loss as dry sites of similar open air duration, before the impact of intertidal transgression.

Given the impacts of intertidal transgression on archaeological resources discussed earlier added to the processes of dry site degradation, it is likely that (1) the organic fraction of such sites is unlikely to persist; (2) the inorganic fraction will probably persist, and 3) the context of the inorganic fraction is likely to be disturbed. As a consequence, it is probable that with submerged archaeological resources that were initially deposited on land, "collections" are more likely to be recovered from such sites than "assemblages." As used here, a "collection" is not relatable to a cultural surface while and an "assemblage" is. Materials in assemblages are more amenable to spatial anaylsis within the context of a site deposit, while those in collections never are; collections may be useful, however, in inter-site comparisons. In our estimation, practical recovery techniques in the present and forseable future are likely to yield collections rather than assemblages of archaeological materials.

While the above comments might be taken as pessimistic, they are generalizations and it is equally safe to predict that submerged archaeological resources will be found that survived the degradation of dry land processes and intertidal transgression, and may be recovered as assemblages, depending upon the local situation. To maximize the information recoverable from submerged continental shelf sites, we must be prepared to ask the questions and apply the analytical techniques most appropriate to material culture analysis rather than the spatial relations between artifacts or components in a site. Upon refection, the situation described here is not so different from many dry archaeological sites in interior Alaska and elsewhere on the continent, where archaeological resources have suffered the ravages of time, disturbance, and attrition yet yielded significant and important cultural information.

Regional Considerations

Two regions of concern have been selected for this discussion: the Bering Sea area and the Northwest Coast of North America. In the following, each is discussed separately and will be considered from two perspectives: (1) the case for existing submerged cultural resources, and (2) the potential significance of those resources.

Beringia

During the Wisconsin glaciation, America and Northeast Asia were linked by a land bridge, the result of globally lowered sea levels and the relatively shallow depth of the Bering Sea. This land mass, Beringia, cannot be considered to be a static entity, but one that expanded and shrunk according to continental glacial events. During the Wisconsin maximum, the shoreline of Beringia extended to the -90 to -100m. isobath; during the mid-Wisconsin transgression, the coastline retreated to about 15 m. lower than present sea level, about 25,000 to 40,000 BP (Sharma 1976:11-12). Stillstands related to continental glaciations resulted in the formation of ancestoral shorelines, the remnants of which are expressed today as broad submerged benches. It should also be noted that at no time was Beingia proper glaciated; consequently, it has undergone no isostatic rebound and the eustatic curve for the Beringian area is probably a truer reflection of events than that of other areas of the northern North American continent.

Geographically, Beringia was a flat plain with occasional high points represented by today's islands such as St. Lawrence and the Pribilofs. The terrestrial climate of Beringia is thought to have been severe, with winters longer and colder than present and with less precipitation (Stoker 1976:56). Until about 10,000 BP, with the opening of the Bering Strait, Beringia had a northern shore bordering the Arctic basin and a southern shore bordering the Pacific basin. The southern coast was more moderate, being subject to Pacific influences, and the marine resources were probably little different than those of today (Stoker 1976:67). The Arctic Beringian coast was probably considerably less attractive and has been described as probably only "marginally inhabitable" (Stoker 1976:81).

Continental Beringia. Interior game hunting economies probably spread across Beringia with the eastward spread of human populations and may have existed contemporaneously in northeast Asia, Beringia, and interior Alaska in a broad belt. Therefore, we might for the moment consider the fact that at least culturally, unsubmerged portions of Beringia exist: i.e., northeast Asia and intermontaine interior Alaska. If so, the archaeological resources and constructs thus far related to the Beringian time period in northeast Asia and interior Alaska are suitable models for whatever continental cultural adaptations that may have existed in Beringia proper. Moreover, these models are probably accurate in terms of technology, site type, site density, and the preservation of organic and inorganic fractions. Site integrity might also be added to the list, except that submerged Beringian sites will have undergone the additional impact of intertidal transgressions.

For these reasons, continental Beringian assemblages or collections that may be recovered are not likely to yield much more information than what could be recovered in interior Alaska and northeast Asia in terms of inter- and intrasite behavior and economy. Less information, however, is likely in terms of stratigraphy and intrasite spatial relationships, while additional and important information is probable in regard to typological dating and distributions.

While we have noted that interior Alaska and northeast Asia might be considered as cultural extensions of Beringia, there are also unsubmerged portions of Beringia proper: the present islands in the Bering Sea. It is in these areas that Beringian archaeological sites might be found that are not submerged and have not undergone intertidal transgression. While the fact is that such materials have yet to be found on these islands, Dixon (1976:192) has noted that there really has been little archaeological survey of their interiors.

In summary, continental Beringian sites are likely to have been similar to northeast Asian and interior Alaskan site deposits of a comparable time period both in nature and content. The fact that submerged continental sites have undergone intertidal transgressions is likely to reduce the data potential of such sites, although the information potential will be dependent upon the technological complexity of recovered materials, the kinds of analyses applied, and the questions asked of the data. As representatives of Beringian collections, the apparently undiagnostic flakes dredged up off of St. Lawrence Island and reported by Hopkins are more likely to reflect chance and the relative ratios of debitage to diagnostic implements than the information potential of continental Beringian sites.

Maritime Beringia. Maritime cultural adaptations involve specific economic orientations toward intertidal and marine resources and are often reflected in material culture and the refuse associated with maritime archaeological sites. While there has been a history of discussion and debate regarding early maritime adaptations on the North Pacific rim in general and the Beringian coast specifically, we take no position in regard to its absolute antiquity here; we do, however, offer some thoughts on its nature, assuming that such an adaptation took place in a Beringian context.

First, the development of any Beringian maritime culture would have occurred on the southern coast, simply because of the relative inhospitability of the northern coast. Given our conviction that productivity and therefore carrying capacity in hunting and gathering economies is generally greater in coastal environments, sites representing any Beringian maritime adaptations are probably larger in terms of communities and more extensive vertically and horizontally than Beringian interior sites. Whether this increased the survivability of such sites during intertidal transgressions, however, is another question.

While we take no position as to whether maritime adaptations did occur in Beringia, we do feel that if such adaptations took place, they are probably genetically related to later North Pacific maritime adaptations. Unlike the situation of interior Beringian cultures relative to contemporaneous interior Alaskan and northeast Asian cultures, we cannot suggest specific analogs to any maritime Beringian cultures that may have existed. Because we lack such analogs, any evidence of a Beringian maritime culture is likely to be highly significant to perceptions of North Pacific culture history.

Potential for future research. Regarding the future prospects for Beringian archaeological research, two limitations stand out: (1) where to look, and (2) the practical constraints of working in the current Beringian environment. Locating underwater archaeological resources has been compared to conducting a terrestrial survey from a baloon when the fog masks the land (Hudson 1977:2). A knowledge of where to look or sample, however, increases the chances of finding anything of significance. With hunting and gathering economies, whether interior or maritime, where to look can be greatly aided by a knowledge of the landscape during the time of interest. Unfortunately, our knowledge of the Beringian landscape is extremely limited; at best, we have a general knowledge of submerged ancestral shorelines and major river courses, and a specific knowledge of high points on the Beringian plain. Therefore, predictive modeling for the occurrence of Beringian sites is extremely limited and any research effort toward locating such sites should be based upon gathering and utilizing as much ancestral landscape data as possible.

With regard to investigating specific cultural adaptations, maritime and continental archaeological manifestations may be recovered from virtually anywhere on the former land mass. With first the shrinking, then the division of the land mass, followed by the expansion of the Bering Sea and Strait, Beringian beaches migrated over interior Beringia until present coastlines wee established. Therefore, we have the possibilities of not only maritime and continental cultural manifestations anywhere in the area, but of maritime materials overlying continental materials, and the potental of mixing the two during recovery. Probably the highest potential for archaeological resources lies in those areas that represented stable coastlines (corresponding to continental glacial stillstands); continental materials may be there in any event, and it is only there that any maritime cultures will have been concentrated.

The practical constraints to the recovery of submerged archaeological resources are extreme in the Bering Sea. One researcher has noted the Bering and Chukchi Seas present wind, weather, visibility, current, and storm problems and the entire continental shelf areas of the two seas is subject to seasonal pack ice (Dixon and Stoker 1976:246). Also, any archaeological sampling is likely to be in conjunction with, or an offshoot of, other research efforts and therefore less intense and spatially dictated by other considerations.

In summary, we are basically pessimistic about the recovery of great amounts of archaeological data from Beringia proper, unless sites are found on some of the present islands. The probable nature of the interior sites, and the intertidal transgression of both interior and any maritime sites that may have existed, coupled with the practical constraints of research in the area mitigates against intense and effective research and recovery. We are, however, optomistic regarding the significance of such materials if recovered, whether as assemblages or collections, especially if they concern maritime adaptations. We must also consider the likelihood of post-Beringian, mid- and later Holocene materials from submerged sites. Such materials, if found, will surely be maritime and probably be significant to the culture history of the area.

Northwest Coast

The Northwest Coast of North America povides some extreme contrasts to the Beringian situation. Unlike Beringia, the Northwest Coast is bounded on one side by mountains with interior access provided only by major river valleys, and on the other side by the ocean. The continental shelf of this coast is narrower, smaller in total area, and much more rugged than Beringia. Because of this latter aspect, this coast contains two basic energy regimes: the exposed outer coast and the protected inner coast.

Late glacial and post glacial sea levels on the Northwest Coast present a complicated situation involving eustatic sea level rise, isostatic rebound as a result of the wasting of coastal glaciers, and tectonic rise and subsidence. During the last glacial periods, when sea level was lower than present, the coastal zone itself was lower due to isostatic pressures. With the waning of continental and coastal glaciers, sea level began rising, but relative to an isostatically rebounding land mass. Fladmark (1975:167) suggests that between 13,000 and 8,000 to 10,000 BP, inner or mainland portions of the Northwest Coast were emergent; between 9,000 and 5,000 BP, however, the northern portion of the coast continued to be emergent while the southern portion was submergent. In the former case, tectonic forces seem to have been a dominant factor while on the south coast, the initial isostatic rebound effect was overtaken by eustatic sea level rise.

Again, there is a history of discussion regarding the existence of early maritime cultures on the coast. The nature of the landscape and resources on the Northwest Coast are such that any prehistoric adaptation there must have been at least partially maritime in its economic orientation; the degree of which, however, is the subject of debate and the presence of early man on the coast figures prominantly in these concerns. Potential representatives for early Northwest Coast maritime adaptations include materials from Groundhog Bay and Hidden Falls in Alaska, Moresby Tradition sites on the Queen Charlotte Islands, and the basal component of the Namu Site in British Columbia, all of which are dry land sites. While the lithic assemblages associated with some of these sites have interior analogs and do not suggest clear maritime or shoreline orientations, it should also be noted that little more is known about their economic functions in interior sites either.

If an early maritime adaptation did exist on the Northwest Coast, it is either an independent development or genetically related to events on the south coast of Beringia; no other possible analogs exist. It seems to us that if an early maritime culture is demonstrated, independent development is less likely than a relationship to a Beringian maritime culture; therefore, if such a culture is found, then the possibility of a south coast Beringian maritime adaptation is strengthened.

<u>Submerged sites.</u> If Fladmark's suggestion regarding an emergent coastline for the northern Northwest Coast and an emergent early Holocene and submergent mid-Holocene southern coast are correct, then submerged archaeological resources are likely only on the southern Northwest Coast (barring local tectonic subsidence in the north). On the south coast, early Holocene sites would have moved seaward as the coastline emerged through isostatic rebound, and then have been inundated as sea level rise increased relative to the slowing of isostatic rebound. While as yet we have no unequivocal evidence of subtidal sites on the Northwest Coast, indications of such sites have been observed in Puget Sound and San Juan Island where shell middens are visible at extreme low tides and fire cracked roces have been retrieved from deeper contexts (reported in Larsen 1972:10). Thus, while the absence of shell middens predating 4,000 to 5,000 BP on at least the southern Northwest Coast might be taken to indicate the absence of a maritime adaptation, the complexity of eustacy and isostacy on the coast may make such judgements premature if not erroneous. Resolution of the problem will come only through surveys for submerged underwater resources and/or investigations of continental shelf areas and fossil beaches dating to the early Holocene that have been raised above present sea level though isostacy or local tectonics.

Intertidal sites. A number of sites on the Northwest Coast have been investigated that are wholly or partially within the intertidal zone. Such sites have been located on the central British Columbia coast at Cathedral Point in the Burke Channel, Kwatna Inlet, Quatsino Sound, and the Bella Bella region. (Lapland (1982:23) lists ten sites representing the Cathedral Phase (1,000-4,000 B.C.) that are intertidal and not associated with other archaeological manifestations on adjacent dry land. Carlson and Hobler (1974:11) suggest that such sites may be chipping quarries and/or washed out habitation sites. Apland (1982:25) feels that beach quarries are less likely explanations for such sites, and suggests that other activities may be represented (Ibid: 62). With regard to such interpretations, it should be noted that if these sites are taken to represent in situ activity areas, rather than former habitation sites undergoing intertidal transgression, then it is implied that sea levels in these areas have not changed since 1,000 to 4,000 B.C.

Other wet sites, water table and riverine, are also known from the Northwest Coast (Croes 1976). These include Ozette and the Hoko River site on the Olympic Peninsula of Washington State, Biederbost, Conway and Fishtown around Puget Sound and the Skagit delta, English Camp on the San Juan Islands, and Musqueam Northeast near Vancouver, B.C. All of these have yielded well preserved organic materials and date around 2,000 BP or less.

Research potential. In summary, the Northwest Coast has already yielded wet sites in at least intertidal, water table, and riverine contexts. The potential for submerged archaeological resources is also high but may be restricted to the southern coast because of the nature of late Pleistocene and Holocene events. While mid- and late Holocene submerged resources will be of considerable interest, the discovery of early Holocene submerged sites could have a significant impact on the question of early maritime adaptations approaching that if such data were recovered from the Beringian area.

The research potential of recovered submerged materials on the coast must be couched in terms of the two energy regimes that presently exist and existed in the past. These are the high energy outer coast, probably similar to Beringian coasts, and the low energy, protected, inner coasts. The fact that protected inner waterways abound on the coast throughout the Holocene suggests that some submerged resources may have suffered less during intertidal transgressions. Recovery of data from submerged inner coast sites is not only possible, but practical, given the logistic situation for location and recovery efforts, and the more compatible weather and water temperatures that prevail in these areas. For these reasons, we feel that (1) there is a good potential for the recovery of submerged resources, particularly on the southern coast, and (2) there is at least some potential for assemblages being recovered from such contexts.

Conclusions

Our discussion has suggested certain generalizations regarding submerged prehistoric archaeological resources on the continental shelf of northwestern North America:

1. Such resources probably exist although those that were formed on dry land suffered the same processes of site degradation as unsubmerged sites, plus the additional destructive processes of intertidal transgression.

2. Although the resources may be in a degraded state, collection or assemblage data recovered from submerged contexts in the subject area may have considerable impact regarding some of the questions troubling dry land archaeologists, particularly those concerned with the antiquity and developmet of maritime adaptations that were in place by late Holocene times.

3. Intact subtidal archaeological resources are most likely to be located in low energy environments, both during and subsequent to their initial deposition. Preliminary efforts should be focused upon identifying these environments and gathering and synthesizing the data to do so. Low energy environments have the greatest potential for preserving site deposits, materials, and relationships, and probably will prove most amenable to systematic recovery of archaeological data.

4. The potential location of archaeological data relating to culture history questions in the subject area may be maximized by the same principles relevant to dry land archaeology: that is, careful consideration of geomorphic processes, geomorphic history, and paleoenvironmental data. Because of the difficulty of access to subtidal areas, environmental constraints on effective recovery of archaeological data from such contexts, and the difficulties of logistic support, careful attention to and synthesis of geomorphic and paleoenvironmental data may be more important to subtidal archaeological research in maximizing the results of survey and location efforts. Control of such data will also significantly enhance the interpretation of such materials if recovered because of the difficulties in relocating, rechecking, and preserving a subtidal archaeological resource once it has been initially investigated. The "further excavation" option available to dry land archaeology will be much more difficult to exercise.

In our estimation, the successful exploitation and interpretation of subtidal continental shelf archaeological resources will be most effective as an adjunct or companion to the investigation of shallow subtidal, intertidal, and other coastal wet and dry sites. We would caution against a conceptual separation between subtidal and other coastal research efforts; while the technologies and support systems may differ, the interpretive and culture historical goals should remain the same.

Because of logistic problems, subtidal archaeological efforts are not likely to be as intense and extensive as we might wish. Also, inevitable human progress and the consequent impacts on subtidal resources will continue. For these reasons, we suggest that public education programs, similar to those offered to some governmental agencies, be developed and oriented toward non-archaeologists whose efforts, economic, recreational, or otherwise, bring them into contact with sea bottom materials. This would allow the generation and preservation of useful data for our purposes, even though it may be inadvertently or fortuitously recovered.

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Record of maritime disasters in Russian America, Part one: 1741-1799

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Introduction

This presentation focuses on the early period of Russian penetration into North America, specifically Alaska, and complements the paper of Richard A. Pierce, which follows. I shall consider separately the Russian vessels lost in Alaskan waters during the laissez-faire trade period, that is from 1743 through 1799, and the foreign vessels lost in these waters during the same period.

The Data Base

Our data base is scanty, especially in respect to direct, primary evidence. This does not mean that such data are not available. On the contrary, I believe that our data base could be considerably expanded if our Soviet colleagues should publish in full all extant logs and ship journals kept by the early skippers and foremen and lasak collectors who participated in the Russian Alaskan fur trade during the period under consideration. I know from the few documents of this sort which have been published (see references cited) that such records often contain directional and locational information pertaining to significant occurrences. Unfortunately, such details much too often are omitted in synthesizing works (such as for example Coxe 1780 and 1787, Makarova 1968 or even J.L.S., 1776). If and when all the extant documents pertaining to the early period of Russian activity in Alaskan waters which are known to be preserved in Soviet archives, not the least the famous Miller's Portfolios (Portfeli Millera), are published in full, our knowledge of the approximate locations of various shipwrecks will become much more precise. At present, however, we are obliged to confine ourselves to identifying the general area or, at best, the island where the wrecks have occurred.

Russan Vessels Wrecked in Alaskan Waters 1743-1799

The number of shipwrecks suffered by the Russian fur trading vessels in Alaskan waters has been grossly exaggerated, as has been, and continues to be, their alleged lack of seaworthiness. The notion that these vessels were unusable after a single voyage must be relegated to the realm of myth. Even the smallest shitik, that is vessels of lashed-plank construction, remained in the trade for several voyages as a rule. They may have been sluggish and slow, as Berkh (1974) maintained, but because of their flexible hulls they withstood the rough seas rather well (Jett 1974). Estimates of the number of vessels launched from Kamchatka and Okhotsk ports and of the number of voyages vary. My own analysis of all available published data indicates that at least 55 vessels were constructed at Bolsheretsk and Nizhnekamchatsk in Kamchatka, at Okhotsk, at the mouth of the Anadyr' River, and at the mouth of the Lena River during the period which concerns us here. According to the estimate by Berkh (1974), quoted by Admiral Afanasiev (1864, also in Divin 1979:298), 90 voyages were undertaken. Divin (1979:287-288) reports that by his analysis 44 voyages were undertaken between the years 1743 and 1763 with a rather small number of ships, of which 18 voyages fall into the decade 1743-1752.

By my count of the 55 ships launched and 90 voyages in a roughly 50 year timespan from all ports or harbors in northeastern Siberia, 22 were lost. This number includes the Sv. Vera, Nadezhda, Liubov' which sailed from the Lena River along the north Siberian coast toward Bering Strait, and perished along this route, the vessels caught in the tsunamis off the Kurile Island chain, and the four vessels destroyed by the military action of the Aleuts at Unimak, Unalaska and Umnak in the eastern Aleutians in 1763.

Of the 18 or so actual wrecks, the majority occurred near Kamchatka shores or off the Commander Islands on the return voyages, usually in autumn, when the weather was stormy. As a rule, the vessels were driven onto the shore or offshore rocks when they attempted to make port. Only seven actual wrecks can be documented as occurring within the present territory of the USA, along the Aleutian chain. This number includes what I shall term here secondary wrecks, that is wrecks of small vessels constructed by survivors of the wrecks of the original larger ships.

In terms of marine archaeology, it should be remembered that any salvagable materials were used by survivors or by mariners who happened to visit the location of any wreck. Floatsam was similarly utilized. If a wrecked vessel could be approached at all, wood and iron, rigging, tackle, and canvass were removed, very often at great risk. Often the wreck was set afire in order to remove the last possible scrap of the most precious commodity: iron. Few wrecks remained for future archaeologists to find.

On Kyska Island

A small craft, the Sv. Kapiton, 17 arshin in length, according to Berkh, was built in 1750/1751 on the Bering Island in the Commandors out of the wreckage of the Sv. Perkup i Zonat, owned by Bakhov, Shalaurov and Co., which had sailed out of the Anadyr' River mouth 1750 (constructed in 1747/48). She carried the survivors of the wreck of the Sv. Perkup i Zonat back home. The Sv. Kapiton sailed again as a government vessel in 1754/1755, to Mednoi Island, carrying aboard a surveyor and ore assessor. When the Sv. Kapiton reached homeport, it was confiscated because iron from the Bering's flagship had been used in her construction without authorization. Later on, the vessel was released to merchant Zhilkin and sailed (1757) for the Aleutians, under skipper Ignatii Studentsov. She was wrecked at Kyska Island, exact location unknown, on the 5th or 6th of September 1758 (see Mararova 1969; J.L.S. 1776:45-48 and Berkh, English language edition 1974:9). According to Berkh (1974), the vessel was cast onto a rocky reef. J.L.S. (1776:46) says that after being battered by the storm and having lost the rudder, which was replaced by a makeshift one, the vessel anchored offshore and came under native attack. During this event, the shore wind, gusting, caused the anchor cable to part and tore the sail. In the fog, the vessel was driven onto a small cliffy island not too far from the larger (Kyska) island and there she broke on a rock. The crew saved themselves by using the mast as a passage bridge to the rocky shore. In the course of their sojourn there, from September 1758 through the summer of 1760, the survivors, only 15 of whom were well enough to defend themselves against attacking Aleuts, built a small craft out of driftwood and whatever they managed to salvage from the wreck of the Sv. Kapiton (J.L.S. 1776:46). In the meantime, 17 men died on the island. The rest made their way to Shemya, where they were picked up by the vessel Sv. Petr i Pavel, Petr Bashmakov commanding, reaching Kamchatka 24 June 1761. According to J.L.S. (1776:48), the small craft they constructed on Kyska broke up again when they were making the harbor presumably at Shemya, and there were only 13 survivors. It should be noted, however, that Khlebnikov (1979:86) believed that the Kapiton was wrecked in the Fox Islands.

On Adak Island

According to the published information, (see Makarova 1968) Adak is the most likely location for the wreck of the vessel Sv. Ieremiia, though Berkh (1974:13-15) claims that it was wrecked on Umnak Island.

The Sv. Ieremiia was built on Mednoi Island either out of the wreckage of the vessel Sv. Simeon and Ioann (Berkh

1974:13-15; Makarova 1969:53-54) or out of driftwood, in order to assist the disabled Sv. Simeon and Ioann (J.L.S. 1776:26-27). Survivors of the latter sailed on her for Kamchatka, arriving safely in the fall of 1752. Refitted, the Sv. Ieremiia sailed again in 1753, Petr Bashmakov, one of the most energetic and able skippers, commanding. Already by August 1753, the vessel made landfall at an island, where the Attuan and possibly Rat Islands dialects were spoken. The wind broke the anchor cable, and the vessel was driven east (J.L.S. 1776:35), she again came to anchor on September 2, 1753. Makarova identifies the locations as AIAKH (Attuan or Rat Island Dialect for ADAK) and states that the wreck took place on this same date. J.L.S. (1776:35), however, states that once again the anchor cable parted, and once again the vessel was driven further by the winds and eventually onto the off-shore rocks at an unknown island on September 3, 1753.

Once again, the survivors managed to construct out of wreckage, driftwood, and other local materials on hand, a smaller vessel, which they named Sv. Petr i Pavel and in which they set out homeward, in 1754 (J.L.S. 1776:36), reaching Nizhne-Kamchatsk in 1755 (Makarova 1969:53). According to Makarova, data on this event are contained in TsGADA, fond 199, delo 539, part I, book 15, folio 7 and verso ff.) and once again I must reiterate that the publication of the full text might aid us in better determining the wreck's location.

In this case, however, we have the vessels Sv. Ieremia, and Sv. Petr i Pavel, which were actually transformed from the Sv. Simeon i Ioann vessel.

On Near Islands

Two shipwrecks are reported in the published sources for the Near Islands, as follows:

Shitik Sv. Petr, originally built in 1743 or 1745, was wrecked on her fourth or fifth voyage, Dmitrii Kakvasin commanding. (The data are contradictory, and information in Berkh and Makarova is irreconcilable. Berkh's constructs find support in Shelikhov's Table of All Voyages, [which dates to 1790 and was published by Efimov (1948)]. Only Makarova claims a fifth voyage for the Sv. Petr.). Exact location of the wreck is not known, though it is known that the survivors were taken aboard the vessel Sv. Boris i Gleb in 1752 (See Berkh 1974:10).

Vessel Sv. Petr i Pavel, Petr Bashmakov commanding, was wrecked on Shemya Island. It was reportedly the fourth voyage for this vessel (owned by merchant Rybinskoy and companions), which commenced in 1762. In view of this report by Makarova, it seems that the little vessel built on Adak (see above), proved extremely seaworthy, unless the owners built a new ship and gave her the name of the sturdy little craft that carried Bashmakov home in 1754/1755. Once again, the wreck occurred close to shore and most of the crew survived. Some of the survivors made their way to Attu in a baidara; eventually, they were picked up in small groups by various vessels, including that of Andrean Tolstykh, while those who remained in Shemya were picked up in 1763 by the Sv. Ioann Ustiuzhskii, Aleksei Vorob'iev commanding. Berkh's attribution of the wreck to Attu Island must be based on the fact known to him that survivors were picked up there.

On Amlia Island

Here, the vessel Sv. Evpl was wrecked in 1785, on her third voyage, with an experienced and able veteran of the Aleutian fur trade, navigator Dmitrii Pan'kov, commanding. The Sv. Evpl was on her return voyage from possibly as far away as the Alaskan mainland having sailed out of Kamchatka in 1780. The skipper put into harbor to pick up the hunting crew he had left on the voyage out. The ship was wrecked close to shore and crew and cargo saved. It may be postulated that the site of the wreck is the Pan'kov Harbor on the Bering Sea side of Amlia Island, called Chunglugix in Atkan Aleut (see Bergsland 1959, no. 114 and maps, and Black 1980:294, no. 84 and map). The crew and fur catches were taken to Okhotsk by other vessels.

Umnak Island

The Sv. Zhivonachal'naia Troitsa, Ivan Korovin commanding, owned by Nikifor Trapeznikov and companions, was wrecked in the night of April 28-29, 1764, driven ashore on northeast Umnak, at a cove or small bay with "soft bottom", that is a sandy or small gravel bottom. The vessel was running during foul weather out of Makushin Bay on Unalaska (I postulate out of Tikhii Bay), escaping the attacking Aleut force under cover of the storm. Beginning April 26 having gained the open sea, she was battered for two days by wind and seas. Most of the wreckage, foodstores and peltries were either salvaged by survivors or drifted ashore. About one pud of iron (taken from Bering Island) was salvaged, but better than a pud (1 pud 5 lbs) was lost.

By July 21, 1764 a handful of survivors (several men died ashore of wounds and illness) set out for modern Nikolski Bay. It took them 10 days to reach it, rowing a small baidara. Thus, even if we take into account that the men were ill and exhausted, and that the conditions at sea were not always clement, the wreck must have occurred not far from the strait that separates Umnak and Unalaska Islands. The location may be determined with some precision, if the native informants of Nikolski, primarily Sergei Sovooff, Aleksandr Cherkashin, and Daniil Kriukoff are consulted.

The Pribylov Islands

Several foreign and at least one Russian vessel were wrecked in the vicinity of the Pribylov Islands, but our data are extremely fragmentary. Berkh (1974:60-62) reports that the vessel Sv. Pavel, owned by Lebedev-Lastochkin Company, sailed out of Okhotsk in 1783 under command of navigator Stepan Zaikov. The vessel was wrecked near the Pribylovs, island not specified, and crew and cargo saved, in 1789. Makarova does not report this wreck, though the voyage is listed in her table of vessels, dated 1783-1790, with destination Kenai Bay.

Vessels Destroyed by Aleuts

It is convenient at this time, before proceeding to discuss the ships belonging to the Shelikhov/Golikov companies which were wrecked in the Aleutians prior to 1799, to discuss the other three vessels which were lost due to military action by the Aleuts in the winter of 1763-1764 (in addition to the Sv. Zhivonachal'naia Troitsa discussed above).

Sv. Ioann, owned by merchant Iakov Protasov and companions, skippered by the apprentice navigator Denis Medvedev, was destroyed at her anchorage in Nikolski Bay on Umnak. After Aleuts took off whatever they deemed profitable, the ship was burned. The account can be pieced together from the reports of Korovin, Korelin, Glotov and Solvo'iev, survivors and rescuers, published by Andreev (1948) and J.L.S. (1776); the Aleut version is given in Laughlin (1980). Laughlin has excavated the grave of Denis Medvedev's men who were killed near the ship's anchorage, including the body of Denis Medvedev himself, identified by the signet ring.

Sv. Zakharii i Elizaveta, Ivan (Petr?), Druzhinin commanding, was secured for the winter in the inner arm of the Illiuliuk (Unalaska) Bay, now known as Captain's Bay. From the description of the site given in Veniaminov on the basis of Aleut accounts, I identify the location as the present-day site of the Wakefield Cannery. It is a good anchorage (the modern floating cannery ship Akutan was able to anchor there close to shore), and there is a creek which fits Veniaminov's description of the Ubiiennaia Rechka (Massacre Creek) (Veniaminov 1840). The ship was burned by the Aleuts in December, 1763.

The vessel Sv. Nikolai, Luka Nasedkin commanding, was attacked and believed to have been destroyed late in 1763 or early in 1764 by the Aleuts. The most likely location, is Issanakh Strait (False Pase), Unimak Island. This location is given by Governor Wrangell (Khlebnikov 1979:90-91) who interviewed a participant or participants. The early observers, beginning with Ivan Soloviev in 1765 (Andreev 1948), Baranov in 1790 (cited in Khlebnikov 1979:97) and Veniaminov (1840) who based himself on Aleut accounts, all believed that the ship had been destroyed. Later on, Berkh (1974:34-35) claimed that the vessel returned safely to home port, though most of the crew had been killed. Makarova (1968) in an effort to incorporate all sources, ends in contradicting herself: in the table of voyages she lists this vessel twice, once identifying it as having sailed for five years, from 1758 to 1763, in the Rat Islands, returning with rich cargo, and on the next page as having sailed in 1763 (no other dates given) to Unimak. In both cases, Makarova identifies Luka Nasedkin as skipper. Moreover, in a different context, and basing herself on a document in the archives (TsGADA, fond 199, delo 534, part 2, book 11, folios 69-81), she states that the vessel was destroyed by the Aleuts (Makarova 1969:65, footnote 39 to ch. 2). I am inclined to credit the earlier sources and assume that, indeed, the Sv. Nikolai was destroyed on Unimak Island.

Vessels Belonging to Shelikhov Enterprises Wrecked Through 1799

As far as I was able to determine, Shelikhov enterprises (that is all the companies in which Shelikhov held controlling interest prior to the establishment of the Russian American Company by Royal Charter in 1799), suffered five major maritime disasters in the period under consideration. These were as follows:

The vessel Tri Sviatitelia... (known popularly as the Three Saints, one of the three vessels used by Shelikhov in 1783 to establish his foothold on Kodiak) broke up in the Kasheega Bay harbor in 1790. She sailed from Okhotsk August 19, 1790, Dmitrii Bocharov commanding, and carried on board the new manager of the Shelikhov enterprises in America, Aleksandr Baranov. Plagued by foul weather, Bocharov decided to seek shelter in Kasheega Bay "contrary to all wishes" (Baranov's decision re. fur hunters' claims and petition for redress of grievances, in Russian-American Company 1976:101). The vessel entered the Bay, on the Bering Sea side of Unalaska Island, September 27th and remained at anchor until the night of October 1st. A severe storm broke from the north, and the vessel was, according to Baranov, "completely broken up," though much of the cargo was salvaged. Baranov calculated the loss, including the vessel, to be 19,101 rubles and 91 3/4 kopeikas, 54 and 7/8 kopeikas to a ruble of original valuation.

It is not clear if the vessel of the same name, wrecked in 1796 in Kamykshak Bay was the salvaged original Three Saints vessel, or a new vessel built in Okhotsk after 1790. In any event, in 1798 an attempt was made to repair the vessel in Kamykshak Bay, but did not prove feasible. Thereafter, the wreck was burnt for iron, and all iron was salvaged (Tikhmenev 1979(2):29).

The vessel Sv. Ioann Predtecha, belonging to the Predtechinskaia Company, a Shelikhov enterprise renamed in 1794 as the North American Company, which then merged with the newly formed Russian American Company in 1799, was wrecked at St. George Island, the lesser of the Pribylov Islands, some time prior to 1792. The exact circumstances of the wreck and extent of damage, not to speak of the precise location of the wreck, are not known. The cargo was salvaged and no loss of life occurred. The wreck is mentioned in a letter from Shelikhov and Polevoi to Ivan Fomich Popov, foreman on St. George, dated 31 July 1794 (Russian American Company 1976:83).

Sv. Mikhail, sailed from Kodiak under navigator Kiselevskoi and as late as July 1797 failed to arrive at her destination (Okhotsk). Baranov presumed that wreckage washed up on Umnak consisting of "bottles of oil, a table from a cabin, and part of a mast..." belonged to this ship (see letter from Baranov to Larionov, Manager at Unalaska, dated March 3, 1798 in Tikhmenev 1979(2):98).

The Phoenix, built by Iakov Egorovich Shilts (Schields) at Voskresenskaia Gavan' (modern Seward) in 1794, was "A three-master with two decks, she was 73 feet long, 23 feet wide, and 13 1/2 feet deep, and of 180 ton capacity (see Figure 1).

In place of pitch and tar Baranov caulked her with a durable compound of his own invention consisting of pitch, sulfur, ocher, and whale oil" (Tikhmenev 1978(1):33). She was lost en route from Okhotsk to Kodiak in 1799 with all hands. She carried 88 men including the newly consecrated Bishop of Kodiak and America, formerly the Kodiak Missionary, Archimandrite Ioasaf and his entourage. The best information on her loss is to be found in a letter by Baranov to Larionov, Manager of Unalaska, dated 24 July 1800 (Tikhmenev 1979(2):116-117). According to a Koniag informant, says Baranov, she was sighted off Cape Chiniak on May 19th. On the 21st, a severe storm broke and continued through the 24th. On the 26th, wreckage was reported washed ashore off Shuyak Island, and later on Tugidak and Sitkinak. Still later on, wreckage was reported on the coast of Alaska Peninsula, specifically near Kuk. Baranov wrote:

> On the 26th, parts of a ship's cabin and some baskets containing a small quantity of rum were found on the northwestern extremity of Shulakh Island. The baskets bore an inscription in Russian --"arak"-- but no other inscriptions or signs. After that pieces of wreckage began to appear in many places, all of them being parts of an upper deck and cabin. Only one large beam was found and because it was made of the local spruce and of the workmanship of our carpenters we believed that the Phoenix was wrecked, although even now we do not know where this misfortune occurred. At Tugidak and Sitkinak some oil, planks from the upper part of the ship, and wax candles were found. All this was delivered here. They write that they later found a flask of water and another with a little of some beverage. They have not been sent here yet. On Ukamak and on Aliaska not far from Kuk parts of the cabin and a door were washed ashore...I cannot figure out where the misfortune occurred. It must be either in Kinai Bay towards Iliamna and Gorelaia Sopka

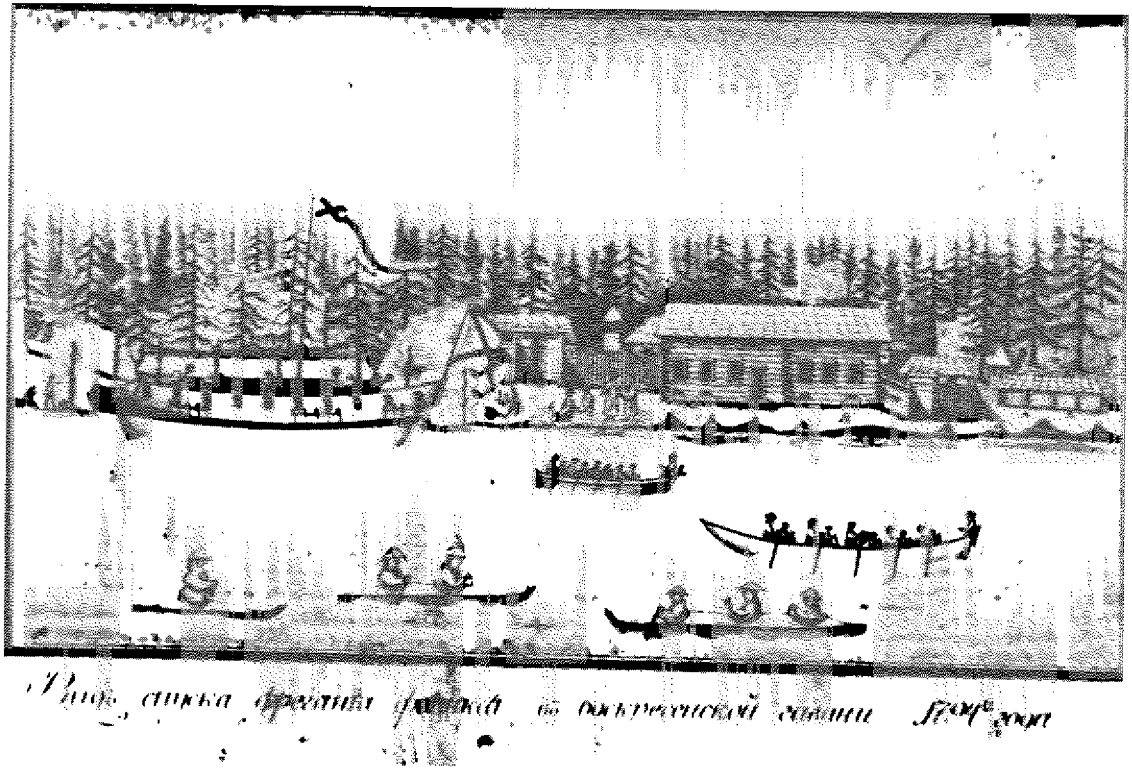

Figure 1. The launching of the frigate <u>Phoenix,</u> the first ship built in Russian America, at Voskresenskaia Gavan (Resurrction Bay) <u>in 1794.</u> The sketch was by her builder, Lt. James Shields, an Englishman in Russian service.

> (Redoubt Volcano) or at sea at the small island which we tried to find many times and could not, and which lies about 170 to 250 verts from Kodiak...(Tikhmenev 1979(2):117).

The loss of Phoenix caused great hardship to the colony, as she carried a large quantity of badly needed supplies. As a result shortages were experienced until after 1800.

With this account, I conlcude my data on Russian wrecks up to the turn of the 18th century, and commence to list the foreign, predominantly Japanese, wrecks.

Foreign Wrecks in the Aleutian Chain Prior to 1799

One of the earliest and most tantalizing reports of a foreign wreck in Alaska is contained in an appendix to the report of Stepan Glotov and Savva Ponomarev about the sailing of the vessel Sv. Iulian to Umnak and Unalaska in 1759-1762. This appendix was compiled by Governor of Siberia Denis Chicherin in 1762 (published 1885 in Arkhiv Admirala P.V. Chichagova, no. 1, pp. 127-134 and reprinted in Divin 1979:320-321).

Under the heading "The Far Islands", Chicherin listed the islands of the Krenitzin group, Unimak, Alaska Peninsula, islands off the Coast of Alaska Peninsula, Kodiak, "Shugach Tany" (Land of the Chugach), and three additional islands: Uligis, Atakhtak, and Chikhmil, which, if we assume that he was listing the islands or regions systematically, are the farthest, counting from west to east or to southeast, but cannot be identified at present. In speaking of the Chikhmil Island, Chicherin has the following to say:

> Not a large/a small/ island. Here a vessel was found cast ashore, a foreign one; by the signs, a two-masted one, but it is not known to what peoples it belonged.

As most "foreign wrecks" in the Aleutian chain at that period seem to have been Japanese, it is tempting to extend this identification to this wreck also. However, the fact that the wreck was two-masted, argues against it. Japanese vessels were single masted (see below). The possibility that some Dutch ships reached the North Pacific coast of America cannot be excluded from consideration. Dutch ships sailed the Pacific, and they were sailing from southeast Asia to Japan. It is not outside of rather strong possibility that some Dutch ships may have reached, or been carried to, the Alaskan coast. After all, the name Dutch Harbor (Gollandskaia Gavan') is of very old origin, and Veniaminov states on the basis of Old Voyagers' reports that the harbor was so named because at some point a Dutch vessel stood there at anchor.

The Dictionary of Alaska Place Names (Orth) does not list any Chigmil Island, but there are Chigmit Mountains (part of the Alaska Range in the Cook Inlet vicinity) and Chignik Island, off the Alaska Peninsula near Cook Inlet. It is possible, that Chignik Island is meant in Chicherin's summary.

Even earlier are the accounts of foreign vessels wrecks from Attu. One is reported prior to 1762 by two observers. One of them, the skipper of the vessel Sv. Zakharri i Elizaveta, Stepan Cherepanov (Andreev 1948:116), speaks in general terms about wrecks from which the Attuans obtained metal. The second observer, part owner of the same vessel and participant in the voyage, Vasilii Kul'kov, in making a statement to the admiralty in 1764, said that on Attu they found

> Among the mass of driftwood on the shore a large piece from the stern of some wrecked foreign vessel, on which were cut out large letters and these were gilded; they were not able to determine in what language /the inscription/ was. This fragment /piece/, just as it was found, was carried by them to the Okhotsk Office, and they expect that it still is preserved there (Liapunova 1979:101).

The second wreck occurred prior to 1757. During the voyage to Attu of the vessel Sv. Nikolai (1755-1757), under the leadership of Rodion Durnev, with Sila Shavyrin as iasak collector, the latter found on the shore three metal (copper or bronze) discs inscribed with foreign lettering (Mskarovs 1968:54-44) and elsewhere described as having designs or embossing. Durnev and Shavyrin postulated that a foreign vessel was wrecked at sea not far from the Near Islands. In 1757, the discs were transported to Kamchatka as "curiosities" (Makarova 1968:55, basing herself on archival materials TsGADA, fond 199. delo 534, part I, book 15, folio 15). Berkh (1974) claims that these discs were described by Pallas, but I was not able to locate such a description.

In the eastern Aleutians, on Unalaska, Ivan Solov'iev reported a wreck of a foreign vessel in 1763. In his report to Captain T. Shmalev in Kamchatka, rendered 28 July 1766 (Andreev 1948:169), Soloviev states:

> I have exported from those peoples and present to Your Excellency evidence of the crafts of the inhabitants of that island: two iron knives; they forge them in the following manner: take the iron, place it upon a stone, and hammer it from above with another stone; they forge it cold; without warming it in fire, but instead frequently wet it with sea brine or water; also one parka of bird skins, two hats, one belt in which they dance, according to their custom, and two iron nails of foreign manufacture about which the residents declared to us that they were found in a kokora /beam/ washed ashore from a broken vessel

In the same year /1/ 763, but I was unable to inspect the same beams as the sea turbulence carried them off.

In none of the above cited cases can we postulate the national identity of the wrecked vessels. By the 1780's, however, the occurrence of Japanese wrecks (and presence of Japanese vessels in the Aleutian waters) was taken for granted by the Russian seafarers. Documented wrecks, however, are few. One occurred near the island HAWADAX about 1780. Rats escaping from this Japanese wreck invaded the island and it has been known ever since as Rat Island (Khlebnikov 1979:166).

Another Japanese vessel in distress also dropped anchor somewhere in the Rat Islands sometime prior to 1787, as the survivors were brought that year to Kamchatka. Our information comes from Lesseps, secretry to LaPerouse (1790(2):246-248).

The Japanese were offered help to unload the vessel by Russians who were on the island, but refused to bring their cargo ashore. In the night, a strong gale arose and their ship was stranded. Very little of the cargo and just some planking of cedar, were salvaged. Brooks (1875:52-53) reports, without citing his sources, that in 1782 a Japanese junk was wrecked in the Aleutian Islands, location unspecified, and that the survivors were taken first to Okhotsk, then to Irkutsk, and finally, in 1792, shipped from Okhotsk to Hokodate aboard the vessel St. Catherine, but the Japanese officials there refused them permission to land. Berg (1946) reports a Japanese wreck on Amchitka in 1783. These two reports may pertain to the same wreck. In general, Berg (1946) takes for granted that Japanese wrecks in the Aleutians were frequent. By 1808, Baranov was to refer, as a matter of course, to Japanese survivors of wrecks in the Rat and Andreanov Islands (Baranov's Instruction to Hagemeister, November 22, 1808, in Documents on the History of Russian-American Company, 1976:197).

I shall leave it to Dr. Pierce to discuss the Japanese wrecks which are reported for the 19th century, and confine myself to reporting The Wreck of the Wakamiya Maru (published in English by Culin in 1926), a vessel out of Sendai, wrecked in 1794 off Unalaska. Fifteen survivors were transported to Okhotsk in 1795. After many travails, four of the Japanese were brought to Nagasaki and from thence to Edo. They were "debriefed" by two court scholars, and the account pieced together from their verbal statements was published in Japanese in 1807. Interestingly, in their report the scholars refer to a sailor from Shirake in Ise, named Daikokuya Kwodayu, who was wrecked in the Aleutian Islands in 1782, resided in Kamchatka, and eventually returned to Japan. It is stated: "There are books concerning this man or one like him. I possess some of them and have a general idea of the geography of the lands he visited. Moreover, I met this Kwodayu several times recently and heard anew many things, of which I took advantage in editing this book" (Shigekata in Cullen 1926:366).

According to the Wakamiya Maru sailor's account, they drifted with the winds and currents for many days and made landfall at a small island dominated by a high snow-covered peak. They went to explore in their small boat, leaving the ship at anchor. At first they failed to find a trace of human habitation. While they were exploring the island, their ship was shattered by the action of the sea so that only some planks remained.

Continuing around the headland in their small boat, they finally sighted smoke. They were aided by Aleuts who "seemed to understand all about us" (Cullen 1926:370). Later on, a Russian arrived with an Aleut escort and questioned them by gestures. The Japanese concluded that most vessels in the local traffic had two to three masts, but Japanese vessels were single-masters, and were thus distinguished by the locals. The Japanese were brought to the Russian outpost at Unalaska. I believe that the wreck must have occurred somewhere in Unalga Pass, and that the island where the survivors came ashore may have been Biorka. However, this is by no means a secure identification of the wreck site, though my Aleut informants, when I suggested the location, agreed that Unalga Pass was a very likely area.

It is unfortunate that no more precise identification of location is possible. However, the occurrence of 18th century Japanese wrecks on Alaska coast is documented and should be taken into account in any future archaeological investigations.

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Record of maritime disasters in Russian America, Part two: 1800-1867

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Introduction

As Doctor Black has indicated, we know very little about most of the shipwrecks which occurred in Alaska during the Russian period. Particularly during the 18th century, there is often uncertainty regarding the date, the place, or even the vessel involved.

From 1790, when the era of Aleksandr Baranov began, there is more information, but still far from what might be desired. Most of the logbooks and reports of voyages prior to 1818 were lost through the destruction of company files after the liquidation of the Russian-American Company. The files of the governor's office in Sitka, containing incoming and outgoing correspondence for the period 1818 to 1867, available in the National Archives, usually lack details regarding misadventures of ships.

Little enough is known, therefore, about maritime disasters during the last half century of the Russian period. The list that follows will be confined to wrecks in the New World, excluding those occurring elsewhere, such as Siberia or the Kurile Islands. It will also exclude accounts of vessels which were somehow repaired, and which sailed again. Details irrelevant to the wreck itself will be kept to a minimum. The names of commanders will be indicated in parentheses.

1801

The Sv. Mikhail (apparently the Arkhistratig Arkhangel Mikhail, the last of Shelikhov's three-vessel flotilla on his voyage to Kodiak), was wrecked on Unalashka Island. Baranov, in a letter to Larionov, manager of Unalashka Island, March 3, 1798, had feared its loss even then: "Please...inquire about the ship Mikhail, which belongs to our partners and which sailed in 1796. Some of our men, and navigator Kiselevskoi, were on it. I have my doubts and misgivings because, first, we know from the letters received July 18, 1797 that the ship had not arrived. Second, on Umnak the sea has cast up bottles of oil, a table from a cabin and part of a mast, while on Ukamak we found a rudder and latticed floor from a baidara made of local wood" (Tikhmenev 1979:98).

However, another source states that the Mikhail returned in 1800 with cargo, and was wrecked in 1801 (Documents 1976:23). If this was correct, the wreckage which Baranov reported seeing in 1798 must have been from some other vessel.

1803, April 10

On this date Davydov wrote "a ship's side, about 4 sazhens in length had been washed up on Tsukli (Montague) Island, and from Ukamok Island they brought a trunk of blue cloth and a straw hat of the kind normally worn in the Sandwich Islands. These last were washed up in the autumn of 1802, which therefore gave us to suppose that around that time some English or United States vessel had been wrecked."

There is no other mention of this wreck in Russian sources, and Howay's list does not indicate any British or American vessel lost during that time in that area (Howay 1973).

1802

The Predpriiatie Sv. Aleksandry (Enterprise of St. Alexander) was wrecked on Unalashka (Documents 1976:24). (This vessel should not be confused with Kniaz'Aleksandr Nevskii, or Aleksandr, in service in Russian America from about 1803, and wrecked in 1813 in the Kurile Islands.)

1803

The transport vessel Dmitrii (Bubnov), enroute from Okhotsk to Kodiak, was wrecked near Umnak Island in October. All cargo and personnel were saved (Documents 1976:24; Khlebnikov 1973:42, 130).

1804

The cutter Ol'ga, or Sv. Ol'ga, "a small vessel with only one mast and one deck," built on Spruce Island in 1795, and either wrecked or condemned as unseaworthy, at Yakutat. Baranov, enroute in 1804 to retake Sitka, stopped there. He forgave the natives for their hostile actions in 1802, and to celebrate the conclusion of peace had the Sv. Ol'ga destroyed by salvos from cannon hidden nearby (Tikhmenev 1978:69, 74).

1805

The Zakhariia i Elizaveta, usually called the Elizaveta, under Midshipman Karpinskii, was wrecked "in a most stupid manner" in December on her return voyage from Kodiak to New Archangel (Tikhmenev 1979:227).

1808

The company tender Avos', launched in 1807 at Sitka (Tikhmenev 1979:176), was used in the expedition against the northern Japanese islands, and was wrecked, under command of Lieutenant Sukin, on her return voyage, enroute from Kodiak to Sitka. One source states that this occurred in the Bay of Islands. The crew were saved but remained on the spot to watch over their belongings. Several volunteered to take the skiff to bring the news to Sitka. The sloop Konstantin (Il'in), sent to the rescue, delivered the crew and salvageable cargo to New Archangel (Khlebnikov 1973:71). Another source, however, says that this occurred near the mouth of Ledianoi (Icy) Strait (Documents 1976:25).

However, yet a third version states that the vessel was lost near Unalaska Island. Sukin was seeking an unknown island rumored to lie between Umnak and the islands of the Four Mountains. The vessel carried cargo and dispatches. The crew was saved, but a party sent from New Archangel to recover the cargo found nothing. Someone, evidently the islanders, had stripped the vessel, and had even dragged the rope and anchor from the water (Tikhmenev 1978:147).

1807

The ship Eclipse (O'Cain). After trading for the company in the Orient, O'Cain took the Eclipse to Petropavlovsk, Kamchatka, and then sailed for Kodiak. Archibald Campbell, crewman, gives a vivid account of her fate. On August 11, near Sannakh Island, she ran into a reef, and sank in three fathoms. With mareshift poles, the crewmen managed to salvage quite a bit of cargo - tea chests, bales of nankeen, and bags of rice. Help arrived from Unalaska, and on November 18, Campbell and others sailed for Kodiak in the longboat. On the way back, however, in January, 1808, their boat was wrecked on the north coast of Kodiak. They tried to make it overland to the Russian settlement at Paul's Harbor, but Campbell lost both feet from frostbite before help finally came.

Meanwhile, on Sannakh Island, the resourceful O'Cain was building a schooner, of about 70 tons, from fragments of his ship which had washed ashore. On February 26, 1809, he put to sea, but strong winds tore off the sails, and drove the schooner into the ice off Unalaska Island. The ice damaged her seriously and knocked out the steering. O'Cain prepared to abandon the vessel and make his way over the ice to the shore, two miles distant. First he sent off Navigator Bubnov, with one Russian and nine Aleut crewmen. When they had reached safety, O'Cain, two American sailors and a Sandwich Island woman set out to follow, but all were drowned. The schooner, heavily damaged by the ice and rocks, was washed up nearby (Khlebnikov 1973:63-64).

That account is from the company official Khlebnikov. However, Khlebnikov also gives another version in his manuscript "Notes on America," recently published in the USSR. In this he states that the crew left Sannakh Island on the small boats, but O'Cain and his Sandwich Island woman companion, one seaman and a dog stayed behind. The seaman died there, and the captain with the help of Aleuts living on the island built a brig from the remains of the wrecked vessel. His chief helper in this was an Aleut, Kuz'kin, a good carpenter, who prior to his death in 1831 informed Khlebnikov of what had happened. Taking what cargo he could, and a large box full of piasters (Spanish dollars), O'Cain went to sea in his improvised vessel in February, 1809, with the intention of reaching Unalaska. But ice forced the brig onto the south shore of Unimak and it was wrecked. The Aleut crew, including Kuz'kin, made it to shore, but the captain, the woman and the dog were drowned (Khlebnikov 1979:143).

1813

The ship Neva, under Lieutenant Podushkin, left Okhotsk at the end of August, 1812 (see Figure 1). On board were 77 people, including women and children, and Collegiate Counsellor T.S. Bornovolokov, slated to replace Baranov as chief manager. Contrary winds delayed the vessel's progress for monhs, until finally she put in for awhile at Voskresenskii Harbor (Resurrection Bay). After ten days of recuperation, on November 27 they put to sea again. Podushkin, either unable or unwilling to command, had given control of the vessel to his second in command, Kalinin, but the vessel continued to be battered by storms. Finally, on 9 January, almost in sight of her destination, an error by Kalinin brought the vessel to her doom. Only 28 people made it to the shore alive, and some of those soon died of exhaustion and exposure; 49 others, including Kalinin and Bornovolokov, met their death in the raging surf.

One of the survivors of the Neva tragedy, Midshipman M.I. Terpigorev, gave the Russian naval historian V.N. Berkh a detailed account of the wreck, which Berkh made the basis of a book. Later, the Russian naval officer and writer V.M. Golovnin, himself twice in Russian America on round-the-world voyages, included a shorter summary of the disaster in his book on Russian shipwrecks, intended to show mariners how to avoid catastrophes and how to conduct themselves if one occurred. Golovnin based his account on the narratives of Lieutenant Podushkin and other survivors recounted to him in Kamchatka a year later. A third

Figure 1. The ship Neva at Paul's Harbor (Kodiak) in 1804, as sketched by her commmander, Lt. Lisianskii. In 1812 the Neva was wrecked on Kruzof Island.

published account, A. Markov's "The Wreck of the Ship Neva near the port of Novo-Arkhangel's" is purportedly based on the recollections of an unnamed survivor whom Markov met in Sitka more than 30 years after the wreck. Markov's version adds nothing to the other two, is inaccurate in some details and embellished to heighten interest.

None of the three accounts gives precise details as to the site of the wreck. The spot must have been known at the time, but was then forgotten, and no one has been able to rediscover it. Only a few items recovered from the wreck are known to exist today. A piece of wood in the Alaska Historical Museum in Juneau, an icon in the cathedral at Sitka, and perhaps one or two cannon may have been salvaged. Rumors of treasure have helped to keep interest in the wreck alive. For example, in 1894 a Sitka newspaper account (Alaska Herald, April 14, 1894) stated: "The sand being constantly thrown up by the action of the waves has hidden the treasure and costly fixtures, comprising handsome paintings, jewels, elaborately decorated crowns, crosses, and vases of gold and silver."

Naturally, any object from that time has historical value, but aside from a few church ornaments, the Neva would not have carried any treasure - these were not Spanish galleons. Ballast, cannon and anchors may remain, but the nature of the shoreline would make any search for the site extremely dangerous.

Translations of the Berkh and Golovnin accounts by Antoinette Shalkop may be found in a booklet published by the Alaska Historical Society in 1979. Translations of the Berkh and Markov accounts were also done by Kay M. Paddon for Dennis A. Cowles and associates who sought the wreck site in the same year.

After the Neva, there were no wrecks in Russian America for a number of years. In the later colonial period there were fewer shipwrecks, owing to surveys which provided better charts and more skillful navigation.

1829

The boat Karluk, sent October 29 from Kodiak to Katmai odinochka (post), was wrecked November 14, in Uganak Bay on the northwest side of Kodiak. The cargo and crew were saved and ship fittings were removed. The cause was allegedly a violent wind, but nagivation error by the skipper may have been partly responsible (Tikhmenev 1978:208-9; RACo Correspondence sent, 4 May 1830:82).

1830

A baidara was sent from Kodiak to Aleksandrovsk redoubt and Sutkhum odinochka under command of Sorokovikov, a baidarshchik known for his long and zealous service to the company. Heavy weather kept the party from its destination.

After two efforts, on February 10, Sorokovikov set out for the strait, disregarding the warnings of local Aleuts. Several days later the Aleuts found in Zhuravlevskaia (Crane) Bay parts of the baidara, clothes, and small objects. Twenty people were lost, including three women and four children (RACo Corresp. sent, 30 April 1830:213).

1831

The Sivuch (Ingstrem), was lost on Atkha Island, in Il'inskaia Bay, possibly east of the modern Wall Bay. The crew was saved and all the cargo was offloaded in baidaras. As she left Korovin Bay, the Sivuch was struck by a strong wind which forced Ingstrem to remain under storm sail and lie to in darkness. Dawn revealed the vessel almost in the surf off Kaniuga Island. The vessel escaped under forced sail, but waves breaking across the deck shattered the washboards. In this condition and with ever increasing wind, there was no chance to round the cape and return to Korovin Bay. Rather than risk striking one of the capes before him, Ingstrem decided to enter one of the coves on the east side of the nearer cape. The vessel escaped the labyrinth of rocks and after a vain attempt to hold offshore with one anchor and a kedge, Ingstrem steered to the sandy beach and ran aground, thereby saving the crew and cargo. The vessel could have been repaired, but lack of men and timber, and the cost led Governor Wrangell to order her broken up and the wood and iron used for local needs (Netsvetov 1980:60-61; RACo Correspondence Sent, 20 July 1831:400).

1837

The schooner Chilkat (Voronkovskii) was lost off Cape Edgecumbe, with its entire crew and a cargo of furs. On 18 January, Sitka Kolosh (Tlingit) who had been fishing in the bay near the cape brought word to Sitka that they had found ship fragments and other wreckage along a considerable distance near the cape and Lazar Island. On the day after that, other Kolosh brought two sheathing boards of fir, with green paint on one side. Lieutenant Zarembo was sent in a whaleboat to examine the Cape Edgecumbe shores, and skipper Lindenberg with two baidarkas to examine Biorko Island in the hope of finding survivors, but none were found. On April 12, 1838 and January 11, 1839 the Kodiak office reported the finding of various objects on the shores of Kochek (?) Island (Tikhmenev 1978:210; RACo Correspondence Sent, 10 May 1837:115, 126, 301, and 1838:102, 205).

1860, 30 March

The ship Kad'iak (I.I. Arkhimandritov), 500 tons, built in Lubeck in 1851, was sent on 27 February with a cargo of lumber to Wood Island. There it discharged its cargo and took on 356 tons of ice to be transported to the American-Russian Trading Company in San Francisco. The superstitious said it sank because Arkhimandritov had failed to say a prayer in honor of Father German (d. 1836), longtime resident on the island. When leaving the island, the ship struck a rock and suffered a hole in the bow. Water poured into the hold, and skipper Arkhimandritov ordered the crew ashore in the boats. He and men sent by the Kodiak office tried to tow the ship into the harbor using launches and baldaras, but the fresh wind and waves prevented this. On the third day the ship sank about 100 sazhen (1 sazhen = 7 feet) from Spruce Island, in water over 10 sazhen deep (Tikhmenev 1978:362-3; RACo Correspondence Sent 1860:24; Otchet RAK za 1860 god, 1861:54-56).

1861

The company steamer Imperator Nikolai I (Kadin), usually called the Nikolai, was wrecked in Keku Strait (see Figure 2). On November 1 the steamer was sent from New Archangel to the Vancouver or Kolosh Straits for trade, to obtain wood and potatoes for the needs of the port. On the eighth they left Asanka Harbor and headed for the Kolosh village of Kek. The weather gradually deteriorated into a storm, and by 11 o'clock at night there was thick snow. They had already gone half way, so the commander decided to continue toward their destination. Suddenly, 2 1/2 miles from Nal'tushkan village, the vessel struck underwater rocks. So violent was the impact that the smoke stack fell down. Pipes leading to the condenser broke and water filled the vessel, stopping the engine. After several hours the skipper and crew had to abandon ship, taking with them provisions, arms, and powder and whatever else they could load on the boats. They went ashore in three trips, and on the last, at 1 a.m., the skipper left the steamer. Two and a half hours after impact, the steamer was hidden in 5 1/2 sazhen of water. Ashore they set up a tent. In the morning they saw that the steamer had broken in two, and at high tide the waves drove it to a point five sazhens from shore. They got the natives to let them have an abandoned barabora, and after negotiation the Kolosh agreed to take word to New Archangel on condition that they be paid three vedro (buckets) of vodka and 20 blankets. On November 21, five Kolosh brought word of the loss to Sitka.

The screw steamer Aleksandr was sent to the spot, with the old schooner Tungus and other boats in tow, for the rescue of the crew and the salvage of the engine of the wrecked Nikolai I. The vessel was found lying on its side in shallow water. Its hull was in bad shape, but the engine parts were found undamaged and were loaded on the rescue vessels, for transport to Sitka and re-use.

The Nikolai I was a paddle-wheeler. The original hull was built in 1839 and fitted with a 60 horsepower engine manufactured in the United States. In 1852 the vessel was rebuilt, with the engine from the old hull reinstalled (Otchet RAK za 1861 god, 1861:28-31; Tikhmenev 1978:354, 363; RACo Correspondence Sent, 1862:6). (The steam tug Politkovskii, completed in 1866, probably was equipped with

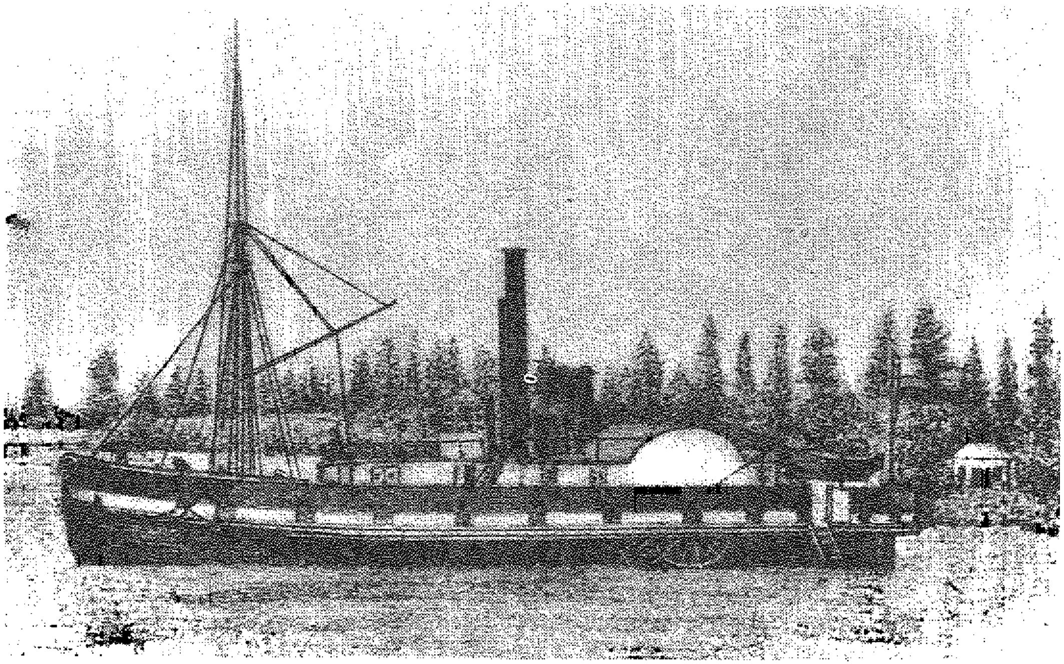

Figure 2. The Russian-American Company steamer _Nikolai I_, passing the magnetic observatory on Japonski Island, near Sitka, in 1844. Sketch by the museum collector, I.G. Voznesenskii. In 1861 the vessel hit a rock and sank in Kake Strait. The engine was salvaged.

some of the parts from the salvaged engine of the *Imperator Nikolai I.*)

This appears to have been the last shipping disaster in Russian America before the sale of the region to the United States in 1867. As in Dr. Black's paper, however, Japanese wrecks should be noted. These were a continuing phenomenon. The first noted by the Russians occurred in Kamchatka in about 1697. Those of the 18th century have been listed. For the 19th century, there was one which occurred sometime between 1800 and 1805, near Sitka, one at Attu in 1862, one at Atka in 1871, and one at Adak in 1872. Others occurred along the coast to the south as far as Acapulco, and one wrecked vessel even was carried to Hawaii (Davis 1872). There were probably more Oriental vessels crippled by storms which appear to have borne them constantly, since prehistoric times, in an easterly direction, strewing them along thousands of miles of coast. Most of the crews probably perished, but the cultural influence of a few survivors must not be ignored. Naturally, any evidence of such cultural infusion through wrecks would be of great importance.

As stated at the outset, however, information is lacking on the location, circumstances, and even the dates of many of the wrecks on this list. And even where the site can be ascertained, it is usually unlikely - except possibly for the *Kad'iak*, that anything will now be found. The ships of that day were small - the total tonnage of all those used in Alaska in the entire Russian period, from the time of Bering, would not match that of a single small modern freighter. And conditions were usually so violent that a wreck usually broke up. Or, if it survived intact, it was generally stripped of usable parts and the remainder burned for the precious iron.

Thus, there is no Alaskan version of the *Vasa*, or of the *Mary Rose*, or of the 1812-ers of the Great lakes to be hoped for from the Russian period in Alaska. This is disappointing, but it is better to know the facts than to pursue myths.

One should not, however, abandon underwater archeology as a tool for the investigation of pre-1867 Alaska. The channels and bays and shorelines near the early settlements offer many spots where such investigation might yield useful results, and should be examined. Sitka and Kodiak have probably been subjected to too much dredging, filling and bulldozing to provide anything, but surveys should be made. Does anything remain, for instance, of the heavy chain which extended across the Sitka channel at the time of the Transfer, to which mooring buoys were attached? It would be interesting to know more about this, and how it was used.

The waters around the Ozerskoi Redoubt might also contain something worth studying, preferably in conjunction with the long overdue excavation of the site itself.

The channel leading to Novorossiisk, at Yakutat, the settlement destroyed by the natives in 1806, might also be worth examination, again in connection with excavation of the site.

At Aleksandrovsk, in English Bay, a map of 1788 shows a small Russian fort in the middle of the spit, where a possession plate was buried. The fort site is covered now with several feet of rock and soil for the airstrip, so it is doubtful if anything survived the construction, but the adjacent waters should be examined to see if any artifacts remain from the early Russian settlement on that spot.

Near Aleksandrovsk is the site of the Russian coal mine, operated for a few years in the late 1850's, the opening of the tunnel still visible. The village where nearly 100 workmen lived for several years, has never been excavated; it might yield interesting material, and it should be routine to examine the adjacent shore.

Underwater archeology might also yield some clue as to the location of the shipyard in Resurrection Bay, where the Phoenix was built in 1794. The Russian maps, and modern investigation indicate that it was near modern Seward, but the exact site is still unknown. These techniques ought also be used if investigations are made of Fort Konstantin and Elena (Nuchek) in Prince William Sound, Mikhailovskii Redoubt, Fort George and Nikolaevskii Redoubt (Kenai) on Cook Inlet, and other early Russian forts and posts.

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Sources for Alaska shipwreck research after 1867

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Introduction

Content

Investigation of possible sources to be used in research of shipwrecks that occurred in Alaskan waters after 1867 is a rewarding pursuit for two reasons. First, as one writer dramatically put it, "the sea adjacent to Alaska...is one of the best-filled marine graveyards in the world" (Ryder-Smith 1946:12). Second, marine disasters, actual or potential, have been of concern to commercial, government, and other interests throughout Alaska's history. Archival materials and publications abound which document, plead for navigation aids to prevent, or recount shipwrecks in Alaskan waters. They include information not only on when, where, and how ships wrecked, but also on the nature of the ships and the cargoes they carried.

One way to sort these materials out is to classify them as: (1) databanks; (2) documents; (3) directories; and (4) descriptions. For the purpose of this paper the following definitions apply. "Databanks" are organized, comprehensive collections of detailed data stored and accessible for rapid retrieval. "Directories" are lists of the names of vessels usually including dates and locations of casualties. "Documents" are unpublished materials that provide substantative data about shipwrecks beyond that included in databanks and directories. "Descriptions" are published accounts of shipwrecks.

Methodology

In preparing this paper, three basic bibliographic works for Alaska history research were searched: Melvin Ricks' Alaskan-Bibliography (Haycox 1977); A Bibliography of Alaskan Literature 1724-1924 (Wickersham 1927); and Arctic Bibliography, Vols. 1-16 (The Arctic Institute of North America 1953-1972). Also, catalogs-- either on microfilm or in-situ --of major Alaska research libraries were consulted. Additionally, automated searches were made of several computer accessible bibliographic tools. These included America: History and Life; Arctic Science and Technology Information System; Automated Wreck and Obstruction Information System; and the Washington Library Network. Several guides to archival collections were reviewed. Principal guides consulted included "Caches of Alaskana," (Frederick 1967); Documenting Alaskan History (Ulibarri 1983); Guide to Cartographic Records in the National Archives (National Archives and Records Service 1971); Guide to the National Archives of the United States (National Archives and Records Service 1974); and University of Alaska Archives Catalog (McCarthy 1982). Information on some of the collections cited in these guides was updated by correspondence in March and April 1983.

Historical Overview

Shipwrecks in Alaskan waters have resulted from strandings, founderings, fires, explosions, collisions, enemy actions, and being crushed in the ice. The larger number of them results from Alaska's character as maritime province, the nature of the seas that give access to Alaska, and the historical phenomena that have attracted people to Alaska and dictated the ways in which they came.

For the larger part of its history, Alaska has been easily accessible only by sea. Overland access from other parts of the North American continent has always been difficult because of mountain barriers. Only the enormous resources available during World War II made construction of the Alaska Highway feasible. Air access from other parts of the North American continent and the world, while technically possible beginning in the 1920's, did not become generally available until after World War II. Thus, the oceans that wash Alaska's shores have historically been the most used routes leading there.

The cost of using those routes has been high. One researcher counted 1,661 vessels of 10 tons or over as having been lost in the inland waters of Alaska, the seas abutting it, the east coast of Kamchatka, and along the northern and western coasts of Siberia between 1741-1953 (Zeusler 1960:23). Another source uses over 40 pages simply to list casualties (from the steamship Ancon to the oil screw Zapora) occurring between 1741 and 1959 in Alaskan waters (Alaska Packers Association 1982). When Alaska was transferred to the United States by Russia in 1867, nautical charts available were compilations of data from various explorers. These charts, according to a superintendent of the United States Coast and Geodetic Survey were "more or less crude sketches, giving a general idea only of the configuration of the coasts and harbors." This same official estimated that in 1918, 51 years after the transfer of Alaska to the United States, more than 91% of Alaskan waters remained unsurveyed (Jones 1918:12). As one sarcastic witness before a 1921 congressional hearing put it, "the submerged rocks in Alaska have been found by being struck by vessels, and these rocks are now known by the name of the vessel wrecked in locating them" (United States Congress 1921:299).

Thus, the fact that water transport afforded the only access to Alaska for many years meant heavy traffic on the routes that were to be the scene of numerous marine disasters. That these water routes were inadequately charted increased the probability of such disasters. Some of the historical phenomena that generated the water transport traffic further increased the chance of shipwrecks.

Among those phenomena were the enticements of the whaling trade that drew many ships into the dangerous waters of the Arctic Ocean and kept some of those ships there to be crushed by ice. In 1871 alone, 34 vessels were crushed in ice off Point Belcher. Similar incidents, althogh involving fewer ships, came again in 1874, 1876, 1897, and 1898. Fishing fleets, although they did not sail into arctic waters, also saw many of their ships come to grief. The Alaskan codfishing fleet lost many vessels. Salmon packets also suffered casualties. Government vessels and commercial passenger ships also were frequently lost. The latter accounted for many of the lives lost in these marine tragedies. On the average, approximately 24 ships were lost in Alaskan waters each year between 1900 and the 1950s (Zeusler 1960:25-27).

Sources

Databanks

Four easily accessible databanks offer information on shipwrecks in Alaskan waters.

The Alaska Heritage Resource Survey is the first of these databanks. This survey is the State of Alaska's official inventory of historical and archaeological sites. In form it is a file of 5 x 8-inch cards organized geographically according to the 153 1:250,000 U.S. Geological Survey maps that cover Alaska. A set of these maps annotated with site locations supplements the card file. A computer-generated index to the card file is available on microfiche. The cards give site name and location, associated dates, physical description, significance, and bibliographic and cartographic references. There are currently over 8,000 entries in the file. These entries are classified as either districts, sites, buildings, structures, or objects. The files are maintained by an archaeologist on the State Division of Geological and Geophysical Survey's Anchorage staff, but currently physically located in the Anchorage office of the State Division of Parks' Office of History and Archaeology.

Some shipwreck entries in the Alaska Heritage Resource Survey are classified as sites. Other shipwreck entries in the survey are classified as objects. Because of these differing classifications, a researcher interested in locating shipwreck data must do a card-by-card screening of coastal map files. Such a search was conducted in March of 1983. The results were disappointing. The files do list several shipwrecks, most taken from literature search but not field-checked. Examples of such entries include the steamer AL-KI wreck (AHRS #JUN-086), the Coldbrook wreck (AHRS #XMI-004), and the Olympia wreck (AHRS #COR-088). In addition to such wreck locations identified from literature search, the Alaska Heritage Resource Survey also includes a number of beached hulks. Examples of such entries include the sternwheeler Bancroft (AHRS #COR-103) and the motor vessel Donaldson (AHRS #NOM-036). At present, the Alaska Heritage Resource Survey includes only one shipwreck entry where physical remains have been verified to exist. This is the entry for the goldrush bark Canada (AHRS #SKG-06) (Alaska Division of Geological and Geophysical Survey 1983).

Despite its current shortcomings, however, the Alaska Heritage Resource Survey appears to be the best potential repository of historic shipwreck information. Most other existing databanks were initiated for other than historical purposes and therefore have built-in restrictions that limit their usefulness as sources for historical research.

The second easily accessible databank for shipwreck research is the Automated Wreck and Obstruction Information System maintained by the National Oceanic and Atmospheric Administration. Developed within the past two years, this databank is a computer-based file currently containing 3,100 records which have been or may be considered for investigation by the National Ocean Survey in connection with charting activities (Stringer 1983:16). Individual files for each vessel or obstruction to navigation entered in this databank include four types of records. These are name records, history records, description records, and survey requirement records. "Name" records have, among other data, vessel names, registry numbers, and latitudes and longitudes of location. "History" records have information relative to the original and revised presentations of information about the wreck or obstruction on nautical charts. "Description" records have a reference source (by numerical designation) and specific descriptive information such as vessel dimensions, age, construction type, date sunk, and other miscellaneous information which may include last recorded owner, present wreck condition, if the wreck is a local diving or fishing attraction, and so forth. "Survey requirement records" indicate the type of additional hydrographic survey needed to complete charting information (National Oceanic and Atmospheric Administration 1982:1-7).

The results of an April 1983 search of this databank, using parameters of 50 degrees N/130 degrees W to 80 degrees N/180 degrees W, produced a 30-page listing. Included in that listing were approximately 25 wreck entries ranging from a World War II Japanese submarine to an awash fishing vessel. Some of the entries did appear to be duplicates. The data in the Automated Wreck and Obstruction Information System is potentially valuable to a shipwreck researcher. The system is, however, for purpose of identifying hazards to navigation. It covers a gradient only to seven fathoms (42 feet) and is of relatively recent origin (National Ocean Survey April 7, 1983). Researchers may request searches of the Automated Wreck and Obstruction Information System by writing to the Hydrographic Surveys Branch, National Ocean Survey, NOAA, Rockville, Maryland 20852. Fees for searches range from $10 to $20 normally, but many run higher. Reports in response to search requests are accompanied by a user's guide to the computer-generated reports. The user's guide includes a substantial bibliography of publications relating to shipwrecks.

The third easily accessible databank for shipwreck research is one now being developed at Prince William Sound Community College at Valdez. That institution's Center for Alaska Studies initiated a Nautical Archaeology Shipwreck Survey in 1982.

By late 1982 the Nautical Archaeology Shipwreck Survey had created a 50-shipwreck databank. At that time the system could provide indexes by record number, date of loss, vessel type, and vessel name. Individual vessel records included all index information, six lines to describe the vessel loss, and five references. There was also the capability to list additional references and photographs. A December 7, 1982 sampling of this databank indicated that most of the entries were drawn from historical newspaper articles. More information about this survey can be obtained by contacting Kevin Hekerdle, The Center for Alaska Studies, Prince William Sound Community College, P.O. Box 590, Valdez, Alaska 99686.

The fourth easily accessible databank for shipwreck research is, unlike the first three, not automated. This fourth databank is the microfiched collection of Alaska Packers Association records. The Alaska Packers Association, formed by a combination of salmon canners in 1893, had a private fleet of vessels. The Alaska Packers Association library and part of its early records were donated to the Alaska State Library in 1970. The second part of the Association's records were later given first to Whatcom (Washington) County Parks and then in 1982 to the Alaska State Library. This second group includes many maritime records.

Selective microfiching of these Alaska Packers Association records resulted in 720 fiche. On these fiche are the Association's Journals 1915-1946, Company assets 1893-1955, Trademarks, Personnel Records (1893-1961), Fleet Books and Maritime Records 1905-1944, Maps 1897-1960, Alaska Shipwrecks 1741-1939, and World Salmon Pack Statistics 1878-1947 (Sullivan 1982).

While all of these records could be of interest to shipwreck researchers, Alaska Shipwrecks 1741-1939 is most pertinent. This segment of the records begins with an alphabetical index giving vessel name, date and location of casualty, and indication if the casualty resulted in total loss of the vessel. About 64 microfiche, organized alphabetically by vessel name, with several wreck or casualty reports per fiche follow. Whether a vessel is listed on a "wreck" or "casualty" report depends on the date when its difficulties occurred. Casualty reports tend to give more detail than wreck reports. Both types of reports give descriptions of vessels, personnel, cargoes, and casualties. Many types of accidents, from personal injuries to total vessel losses are included.

The microfiche of the Alaska Packers Association records have been placed at Alaska state depository libraries located in Alaska and the Pacific Northwest. Additional copies are available by purchase from Commercial Microfilm Service, 14200 N.E. 21st Street, Bellevue, Washington 98007. The cost in 1982 was 25 cents per fiche or $180 for the complete set of 720 fiche.

Documents

"Documents," as defined above, are unpublished materials that provide substantive data about shipwrecks. There is some overlap with databanks. This is because one of the databanks, the microfiche of Alaska Packers Association records, is actually an accumulation of documents--government shipwreck reports. Those reports and other government records offer considerable information about shipwrecks.

Documents in the National Archives. The record groups referred to hereafter are in the National Archives of the United States and in regional federal archives and records centers. Individual vessel documents are among those record groups. In order to understand them, it is helpful to know the basis for their origin.

The Office of the Register in the Treasury Department was originally responsible for maintaining documentation on United States merchant vessels. The records of that office, which begin in 1776, are found in Records of the General Accounting Office (Record Group 217).

In 1884 the Commissioner of Navigation, also in the Treasury Department, assumed the duty of vessel documentation from the Office of the Register (National Archives and Records Service 1974:60). Documents involved include certificates of registry, license, and enrollment. Customs Collectors issued the certificates after receiving information on a vessel's dimensions and proof of ownership and build. The papers proved that a vessel was entitled to the rights and privileges of an American ship. Registers were taken out when a vessel engaged in foreign trade. An enrollment and license were taken out when a vessel of 20 tons or over engaged in fishing or coasting trade. Vessels from 5 to 20 tons engaged in fishing or coasting trade received only a license. Copies of these licenses, which were renewed yearly, were not retained in custom houses until 1906. In 1906, consolidated enrollments and licenses began to be issued.

Contents of registers and enrollments vary with the years. They usually include the name of the managing owner and other owners of a vessel with places of residence and shares owned; name of vessel; home port; rig; net tonnage; date, place, and material of build; dimensions; official number and call letter (in later years); number of decks and masts; stern type and galleries; place, date, and number of previous document (if any); place and date of issuance; and date and reason for surrender of the documents.

These documents were permanent or temporary, depending on whether they were issued at a vessel's homeport or elsewhere. Customs collectors issued new documents when there was any change in type of trade, ownership, rig, tonnage, dimensions, or name of a vessel. The old document had to be surrendered to the Collector of Customs (Holdcamper 1941:276-277).

A full discussion of these documents, covering when and where copies were made and kept, and tables showing the existence of documents for particular United States ports can be found in "Registers, Enrollments and Licenses in the National Archives" by Forrest R. Holdcamper. This article appeared in The American Neptune 1 (3), July 1941. Records of the Bureau of Marine Inspection and Navigation (Record Group 41) include surrendered copies of registers, enrollments, and licenses for American merchant vessels from 1815 to 1942. Headquarters Records of the Bureau of Customs (Record Group 36) include surrendered copies of registers, enrollments, and licenses for American vessels and yachts from March 1, 1942 to December 31, 1956 (National Archives and Records Service 1974:168-169).

A second category of government records useful in shipwreck research is casualty and wreck reports. Copies of some of these, as noted above, are to be found in the Alaska Packers Association records. Originals, copies, and abstracts are to be found in federal archives and on microfilm.

Wreck reports for incidents before 1874 are rare, except for casualties to United States steam vessels which are documented in records of the Steamboat Inspection Service (Record Group 41). The service was established in 1854 and its records continue into the twentieth century (National Archives and Records Service undated:4). Records of the service generated in Alaska, however, contain little if any wreck information (Lautaret 1983).

Government documentation of wrecks becomes more available after 1874. In that year Congress required masters or owners of American vessels to report to the Collector of Customs at the port at which a vessel was documented any casualty to the vessel. A "casualty" could be an incident involving loss of life, serious injury to any person, material loss of property, or damage to a vessel affecting seaworthiness. The Collector of Customs forwarded one copy of a casualty report to the General Superintendent of the United States Life-Saving Service and kept one copy, usually copied into blank volumes containing blank wreck reports. These volumes are among the Records of the United States Customs Service (Record Group 36). Customs wreck reports from 1913 to 1939 are available on National Archives Microfilm T-925, "United States Coast Guard Casualty and Wreck Reports." National Archives Microfilm T-926 is an "Index to U.S. Coast Guard Casualty and Wreck Reports." Also among Goast Guard records (in Record Group 26) there are bound volumes of abstracts of wreck reports received from Collectors of Customs from 1874 to 1975 and original reports from 1908 to 1913 (National Archives and Records Service undated:3-5).

Reports of the United States Life-Saving Service are another source of shipwreck information. This servie began in the Revenue Marine Division of the Treasury Department in 1871 and eight years later came under a general superintendent who reported directly to the Secretary of the Treasury (National Archives and Records Service 1974:523). Regulations required Keepers of Life-Saving Stations to report assistance rendered by their stations to any vessel, crew, or person. These reports went to the general superintendent of the service. The stations retained a copy of the reports (National Archives and Records Service undated:3-4). Life-Saving Service station assistance rendered reports for Alaska include Nome, July 1, 1907-June 30, 1917, and Nome, 1926 and 1927 (National Archives and Records Service undated:35). Annual reports of the Life-Saving Service contain narrative reports of services provided and tables of casualties occurring near life-saving stations. A microfilm copy of these tables is available for the period 1876 to 1914 (National Archives and Records Service undated:4).

An act of January 28, 1915, established the United States Coast Guard by consolidating the Department of the Treasury's Revenue-Cutter and Life-Saving services (National Archives and Records Service 1974:522). Perhaps for this reason, Coast Guard records (Record Group 26) include copies of Life-Saving Service assistance rendered reports for the period 1901 to 1915. These are arranged by fiscal year and thereunder by Life-Saving Service district. With the Coast Guard records there are also microfilmed copies of assistance rendered reports for the period 1916 to 1940. These are arranged by date of casualty in two groups: reports of assistance rendered and reports of miscellaneous services rendered. These 1916 to 1940 reports are available on National Archives Microfilm T-920 and, like the customs wreck reports, are indexed on National Archives Microfilm T-926 (National Archives and Records Service undated:3-4).

Current reports on vessel casualties in Alaskan waters are retained in Coast Guard offices in Alaska for five years. After five years they are sent to the Federal Archives and Records Center in Seattle. There the original reports are microfilmed and destroyed. The microfilms are retained for 10 years before destruction (Whitener 1983).

Other federal records also have shipwreck or associated maritime information. Some shipwreck data can be found in records of the Lighthouse Service (Record Group 26) (National Archives and Records Service undated:4). Records of the Foreign Service (Record Group 84) include information on diplomatic efforts to conserve wrecked American vessels and cargoes. Records of Consular Posts (also in Record Group 84) have, from seaport posts, arrivals and departures of American vessels and their cargoes (National Archives and Records Service 1974:140-141). Records of the United States Army's Office of the Quartermaster General (Record Group 92), Program Records 1818 to 1929, include a vessel file with charters, bills of lading, claims papers, plans, correspondence, and a list of chartered vessels 1834 to 1912. In this same group are Army Transport Service records with registers of officers and passengers, cargo manifests, logs, registers of transport movements, and other records (National Archives and Records Service 1974:245). Records of the United States Maritime Commission have information on merchant marine casualties 1936 to 1947, merchant ship logs, 1917 to 1941, and Cargo, Mail and Passenger Reports for privately-owned vessels carrying non-government cargo (National Archives and Records Service 1974:675-678).

Records of the United States District Courts (Record Group 21) have admiralty case files. The Seattle Federal Archives and Records Center has such files for Alaska for the period 1898 to 1958 (Hobbs 1977:17).

The Federal Records Center and Archives at San Bruno, California, holds 849 cubic feet of Records of the Bureau of Customs (Record Group 36) for the port of San Francisco. These records, which include correspondence on vessel documentation and movement for the period 1848 to 1966 probably have information on ships going to and from Alaska (Federal Archives and Records Center, San Bruno undated:4). The San Bruno archives also has three cubic feet of Work

Projects Administration records (Record Group 69). These files are alphabetically-arranged 5 x 8-inch slips compiled as part of a ship registry file for the port of San Francisco. The slips cover the period 1849 to 1941, but sections "C" through "J" are missing. Each slip that is in the file has, for a particular vessel, information on description, enrollment date, name of master and owners, and date of surrender of vessel documents. Reports of vessels wrecked are interfiled with the registration slips. The wreck reports give a description of the vessel and accident, port sailed from and destination, name and residence of master and owner, nature and cause of accident. The San Bruno archives branch holds Bureau of Customs records on ships identified on the slips for the period after 1899. Prior records are probably in the National Archives at Washington (Federal Archives and Records Center, San Bruno, undated:17).

Thus there are numerous documents held in the National Archives at Washington, D.C. or in regional federal archives and records centers, or available on microfilm that can be of use to shipwreck researchers. For researchers unable to get to Washington and who wish to investigate documents not available on microfilm, the Judicial and Fiscal Branch, National Archives, Washington, D.C. 20408, will make limited searches for documents. The inquirer must provide the name of the ship, date, and place of disaster for incidents (Wolter 1983).

Documents in other repositories. In addition to the thousands of documents relating to shipwrecks that are held in the National Archives many others are in non-federal government or private archives.

For the purpose of this paper, identification of some of these other locations has been limited to holdings in Alaska and to holdings outside Alaska identified in "Caches of Alaskana" (Frederick 1967) and by correspondence with nautical and maritime museums listed in a recent edition of the Official Museum Directory (American Association of Museums 1981). This limited search was very productive but probably reflects only a small portion of the records actually available.

In Alaska, at the Alaska State Library, Juneau, there is the Skinner Foundation Collection. It contains thousands of photographs and negatives which document the many ships, events, and operations of the Alaska Steamship Company. There are files on 73 ships, listed by ship name, and incorporating deck plans, photographs, and ship histories (DeMuth 1982:411). The Alaska State Library also holds customs records for some Alaskan ports which indicate port of origin and give manifests of cargoes (Workman 1982:4). The records are on 131 rolls of microfilm and cover the period 1867 to 1939. There is a draft roll list that describes the origin and contents of each roll of microfilm (Piff undated). There is an experimental index to these records for the years 1867 to 1869 by M. Joseph Leahy. The library also holds a set of maps entitled "Treasures of Alaska." These have wreck information overprinted on United States Coast and Geodetic Survey maps for Southeast Alaska. The maps, once sold commercially, are now out-of-print (Furr 1983). Also at the library are "Letters received by collectors concerning shipwrecks in Alaska, 1898, 1901," a 1916 Seattle Chamber of Commerce map showing "Vessels wrecked in Alaskan waters," a collection of 144 contact sheets and negatives of Alaskan shipwrecks and miscellaneous views accumulated by Robert N. DeArmond of Juneau, and extracts of annual reports, 1898 to 1912, of the Steamboat Inspection Service that include records of vessels stranded along the Alaskan coast. The Lloyd H. "Kinky" Bayers collection on Pacific Northwest maritime history is also in the library. This accumulation of over 400 scrapbooks, photographs, albums, and document boxes of clippings is accessible by an index card file.

Also in Alaska, the University of Alaska, Fairbanks, archives has several collections, such as those of the Alaska Commercial Company and Alaska Steamship Company which touch peripherally on shipwrecks. The University of Alaska, Anchorage, archives hold several microfilms, such as the Alaska File of the Revenue-Cutter Service that relate to maritime history.

Outside Alaska, particularly in New England, there are extensive collections that have in them information on Alaska maritime history.

The Whaling Museum of the Old Dartmouth Historical Society, New Bedford, Massachusetts, is the major such repository with 1,003 items--logbooks and journals for whaling, merchant, and naval voyages. Of these, approximately 25% relate in some way to Alaska. Microfilms are available through item 925 at major research libraries in Australia, Hawaii, and New Zealand (Bockstoce 1983; Old Dartmouth Historical Society 1980:1). There is a published _Checklist of logbooks and journals in the collections of the New Bedford Whaling Museum_ (Old Dartmouth Historical Society 1980). The Kendall Whaling Museum at Sharon, Massachusetts, has a large number of American and foreign whaling manuscript logbooks, journals, and account books. A sampling of the Kendall cross-reference card system, which covers 425 of the 530 items in the collection, showed references to 16 landfalls in southern Alaska and to 33 landfalls in the Aleutian and Fox Islands (Webb 1983). The Naval War College Museum at Newport, Rhode Island, has a few items relating to service of the Revenue Cutter _Thetis_ in Alaskan waters (Nicolosi 1983). The United States Coast Guard Academy at New London, Connecticut, also has revenue cutter material--principally logbooks and a number of diaries and photograph collections--as well as documents on the Alaska Steamship Company (McKenzie 1983). The Whaling Museum at Cold Spring Harbor, Long Island, New York, reports material from vessels engaged in the bowhead fishery, but nothing specifically on shipwreck (Farwell 1983). The Maine Maritime Museum at Bath has 500,000 documents which may include information on Maine-built or Maine-owned vessels wrecked on the Alaska coast or which were later part of the Alaska Packers' fleet. This collection is not thoroughly indexed so general lists are not available, but the museum welcomes inquiries on specific vessels (Lipfert 1983). The Mystic Seaport Museum in Connecticut has a number of Alaska-related items, with many having to do with the Alaska Packers Association but not specifically with shipwrecks (Halttunen 1983). The Whaling Museum of Sag Harbor, New York, has several log books of arctic voyages for which typewritten copies are available in photocopy (Finckenor 1983).

Outside New England the other two concentrations of maritime museums in the United States are in the Middle Atlantic states (where little Alaska material is reported) and on the Pacific Coast.

On the United States' west coast, the Honnold Library at Claremont College in California holds the Pacific Coast Steamship Companies Collection. The 353 manuscript and typescript volumes in this collection are indexed in Rolland Thompson's "Calendar of Archives and Records of Certain Pacific Coast Steamship Companies." Material from the Alaska Coast Company, Alaska Pacific Steamship Company, and Pacific Alaska Navigation Company is in the collection. There are probably also Alaska references in other parts of the collection (Hauser 1978).

The Columbia River Maritime Museum at Astoria, Oregon, has original correspondence about the rescue of passengers of the S.S. Oregon by the lighthouse tender Columbine. The Oregon wrecked near Cape Hinchinbrook in September 1906. The museum also has some photographs of Alaska salmon canneries and cannery vessels (Gilmore 1983). The Maritime Museum Association of San Diego has logbooks of the bark Star of India, which made a yearly trip to Alaska for the Alaska Packers Association from 1902 to 1923 (Kettenburg 1983). The National Maritime Museum in San Francisco has some Alaska Packers Association logs, crew lists, and miscellaneous materials. The national museum also has a large photograph archives indexed by vessel name (Bernhart 1983).

Also on the Pacific Coast, the Maritime Museum of British Columbia in Victoria has a number of ship logs which may have Alaska references but are not yet completely researched (Cameron 1983).

Outside North America, Lloyd's Marine Collection in the Guildhall Library, London, has documents and directories and descriptions. Because of the widespread interests of Lloyd's of London, Alaska-related materials are probably present. Among the more interesting sections of the collection that might be checked for Alaska materials are

Lloyd's List 1740-1970, Lloyd's Weekly Shipping Index 1880-1917, and Lloyd's Missing Vessel Books 1873-1954. Lloyd's List published all vessel movements and casualties reported to Lloyd's, with customs house entries and much other information. There is a microfilm index to the list for 1838 to 1926. From 1927 there is a card for each vessel on which all movements and casualties are reported. Lloyd's Weekly Shipping Index published voyage engaged, date of sailing, and latest report for ocean going steamers and sailing vessels. The Index also reproduced all casualty reports published during the previous week. Lloyd's Missing Vessel Books 1873-1954 are manuscript records of all vessels posted missing by the Committee of Lloyd's, giving details of vessels, masters, crews, voyage, and cargo. For the more recent past, Lloyd's Marine Loss Records 1939-1970 give details of all vessels lost with full reports as received at Lloyd's (Armor April 29, 1983).

Directories and descriptions

In addition to the databanks and documents that provide information on shipwrecks, researchers will also find that there are many directories that give vessel name, date, and general location for shipwrecks; and many descriptions of individual wrecks either based on eye-witness account or reconstructed after the fact for one reason or another.

Directories

A principal directory is Merchant Vessels of the United States, published by various government agencies since 1867 and currently published by the United States Coast Guard. In these annuals, the researcher will find vessel names under type of vessel (sailing, steam, unrigged, yachts, and so forth), with details on rig, tonnage, dimensions, when and where built, home port, and owner. There is also information on abandoned or lost vessels, those sold outside the United States, and on government vessels and shipyards (DeMuth 1982:409). Complementary or similar directories include the American Bureau of Shipping Record, General List of Merchant Shipping, Lloyd's Register, and Registre Veritas. These give name of vessel, date built, builder, owner, size, tonnage, machinery onboard, flag of registry, and--in later years--official number and signal letters. There is also the List of Merchant Vessels in the United States which is a compilation of United States merchant vessels of smaller tonnage, beginning in 1868.

In addition to registers of extant vessels, there are also registers of vessel movements. One such compilation is the New York Maritime Register, a weekly list of vessels arriving in United States ports (primarily on the East Coast). This is arranged alphabetically by vessel name and gives master, flag registry, tonnage, port cleared and date, and port of arrival and date. The publication began in 1869 (Mueller 1983). The Register also includes contemporary reports of maritime disasters (National Archives and Records

Service undated:2). Similar in nature to the New York Maritime Register but of much more limited scope is Alaskan Shipping, 1867-78: Arrivals and Departures at the Port of Sitka (Pierce 1972).

There are also several compilations more directly related to shipwrecks in Alaskan waters, but still in the nature of lists. Among these are a "List of vessels involved in Alaskan disasters during the period July 1, 1878 to June 30, 1911 as shown by wreck reports filed in the Office of the Lighthouse Service under the Act of June 18, 1878." This was compiled by Judge James Wickersham. A copy is available to the public at the Juneau Mining Museum. There is also a 1922 article in The Washington Historical Quarterly, "Marine disasters of the Alaska route" (Andrews 1922). Another such list is "Alaska Commerce. A long list of steamers wrecked in Alaskan waters," published in Alaska Sportsman (Holm 1941). A more recent and specialized listing is "Whaling and Fur Trading Shipping Losses (total, constructive total, and partial) in the Bering, Chukchi, and Beaufort Seas, 1840-1910" (Bockstoce 1979). This manuscript is at the Alaska Division of Parks in Anchorage. A Polar Record article prepared by an official of Lloyd's Register of Shipping Casualty Return, "Shipping Losses Caused by Ice, 1890-1977," overlaps and extends the Bockstoce report in both period and geographic area covered (Littlejohn 1979). Another report on Bering Sea marine archaeological resources is Bering Sea Cultural Resources pubished by the Alaska Outer Continental Shelf Office of the U.S. Bureau of Land Management (Tornfelt 1981). It was followed by a companion report on the Chukchi and Beaufort seas (Tornfelt 1982).

Supplementing listings that focus on Alaskan waters there are directories of wider scope that include Alaskan casualties. Among these are the Encyclopedia of Shipwrecks (Berman 1972). This has a section on the Pacific and Alaska coasts of the United States.

In addition to these lists or directories, there are a few encyclopedia-like publications on Pacific Northwest maritime history. They are a bridge between simple lists and descriptions of individual vessel casualties

Lewis and Dryden's Marine History of the Pacific Northwest covers the period up to 1895 (Wright 1967). The H.W. McCurdy Marine History of the Pacific Northwest in its 1969 edition covers the period 1895 to 1965 (Newell 1969). A supplement covers the period 1966 to 1976 (Newell 1976). Although these are organized year-by-year, they are well indexed and therefore an individual vessel's history is relatively easy to trace.

Descriptions

There are many published accounts of individual shipwrecks in Alaskan waters; far too many, in fact, to identify in this paper. It is possible to identify bibliographic search tools that will lead to these articles. Among these search tools are the bibliographies and automated databanks mentioned in "Methodology" above. Of the repositories in Alaska, the Alaska State Library at Juneau appears to have the most individual items on shipwrecks. A good general guide to periodicals that may include Alaska maritime information is "Periodicals as a source of Alaska maritime history," a paper published in proceedings of _The Sea In Alaska's Past_ conference (DeArmond 1979).

Better use can be made of descriptions of vessel casualties with an understanding of Alaska's maritime history in general. While there is no definitive work on the subject, such as Samuel Elliot Morrison's _Maritime History of Massachusetts,_ a publication of the Alaska Division of Parks, _Alaska and the Sea: A Survey of Alaska's Maritime History_ (Antonson Mohr 1979) is a good beginning.

Good research on shipwrecks will also be a contribution to a definitive Alaska maritime history, and I hope this brief survey of sources for such research is helpful in making that beginning.

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"Starfleet Disaster": Marine safety on the Alaska Packer's Association "Star" Line, 1893-1929

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In the early development of the territory of Alaska, in that period usually characterized as deficient in adequate or proper attention to development by the federal government, one constant complaint was the inadequacy of aids to navigation, and the subsequent danger to shipping in, around, and to and from Alaska.(1) Virtually every commentator on Alaska, its affairs and potential, called attention to the danger, and decried the government's failure effectively to respond to the announced threat.(2) This need was represented as increasingly serious as the tourism trade began in the early 1880's on the southeast Alaska inland passage run, and although the risk remained significant, some limited coast surveys were undertaken at the insistence of marine underwriters, and as a consequence of representations by William Dall.(3)

The expressed anxieties were not without foundation. The steamer George S. Wright went down in 1873 on a trip south from Sitka, with no survivors and precious little information.(4) And the government itself lost both the USS Suwanee and USS Saranac, both on trips between Puget Sound and Alaska.(5) Numerous other vessels were lost in Alaskan waters in these early years, even though the number of ships travelling was fairly limited. Until 1884 the mail steamer from Portland ran only once a month to Sitka. After that date the service was from Seattle, and was twice a month until the Klondike gold rush.(6) The discovery of gold in the Cassiar district in the mid-1870's increased activity at the port of Wrangell, and the development of placer and lode deposits at Harrisburg-Juneau increased traffic to Gastineau Channel after 1880. Before 1884, however, large vessels travelled outside Cape Ommaney at the southern tip of Baranof Island on the trip to Sitka, and only smaller boats used Wrangell Narrows. In that year the US Navy surveyed and buoyed the Narrows so it could be used by larger traffic.(7)

There was no question that shipping to Alaska was dangerous. The toll of Russian vessels had been severe even in the nineteenth century, and American whalers and traders had a large store of horror stories about ice and hidden rocks. And although the US Coast Survey began charting the coast in the mid-1880's, ships continued to go down with distressing frequency: the Los Angeles in Peril Strait in 1881, the Ancon off Point Gustavus in 1886, the Dispatch in Seymour Channel off Point Hugh in 1890, the schooner Hero on Barren Island north of Dixon Entrance in 1896, the City of Sitka off Cape Ommaney in 1898.(8)

As with other government involvement in Alaska, there was significant change in the circumstances as a direct result of the Klondike gold rush, beginning in 1897, and particularly in 1898. Between 60,000 and 100,000 would-be argonauts were lured as far north as Skagway and Haines Mission. Many stayed only temporarily, before the gold fever subsided. But the comings and goings meant a dramatic increase in shipping traffic. Forty-four different vessels entered Skagway in February, 1898, for example.(9) During that year the chronicle of unfortunate vessels becomes too numerous to detail. The toll, with that of other years, led finally to Congressional hearings, which revealed, among other things, that the insurance rates on the Seattle-Skagway run were greater than on the Seattle-Liverpool passage, and that, as late as 1897, the farthest north lighthouse on the Pacific coast was at Nanaimo Bay, inside Vancouver Island.(10)

Alaska governors had, of course, called attention to the dangers and their detrimental effects on Alaska navigation. In 1890 Lyman Knapp had begun to include a list of shipwrecks in his annual report, a practice resumed by John Brady in 1897, and had pointed out the total absence of lighthouses in Alaska, and the desperate need for them.(11)

Other officials had made the same representation. As early as 1879 special treasury agent William Gouverneur Morris had discussed the absence of lights and adequate charts. And in 1898 the US Lighthouse Board, attached to the Department of Commerce and Labor, had recommended the establishment of lights and other navigation aids in Alaska waters.(12) It was not until 1910, however, that the first lighthouse was established, the district of Ketchikan.(13) As late as 1914, following the losses of the Lighthouse Board's own Ameria and the Revenue Cutter Service's Tahoma, both on uncharted rocks, Representative William E. Humphrey of Seattle, in a plea for surveys and navigation aids, read into the Congressional Record a list of 260 wrecks in Alaskan waters, with a loss of 449 lives.(14)

This lack of navigation aids, and the consequent dangers of operation in Alaskan waters, was a matter of concern to all Alaskan shippers; it was a matter of particular and grave importance to volume shippers, those who did a significant and permanent trade in, to, and from Alaska. At the turn of the century, the largest volume shippers were not, as might be suspected, the gold producers, but instead, the salmon packers. The turn of the century, the very time when gold production was beginning to increase significantly, was also the beginning of the hay-day of the canned salmon industry in Alaska.(15)

The canned salmon industry in Alaska did not begin until the late 1870's. The potential of salmon as a commercial venture was not realized until that time, and salmon did not figure in discussions regarding the purchase of Alaska in the 1860's. When William Healy Dall discussed fisheries as an Alaskan resource in his 1870 book Alaska and Its Resources, he said the most important commercial fish was cod.(16)

In 1883 the total Alaska production of canned salmon was barely 100,000 cases; by 1887 this had doubled and by 1891 had soared to 800,000 cases, a figure destined to attract large scale investors and capital development. By 1899 the pack was up to 1.1 million cases; three years later, in 1902, that figure had more than doubled, exceeding 2.5 million cases. It stayed at that level, until 1911, when it took off again, reaching the extraordinary figure of 4 million cases in 1918, from which height it would plummet to 2.5 million cases in 1921, only to soar again to 6.5 million cases in 1926, and with the exception of 1927 when the pack was 3.5 million, would exceed 5 million cases every year thereafter until World War II, reaching 8.5 million cases in 1936.(17)

Obviously, the fleet of ships required to move those amounts of salmon out of Alaska was substantial. In 1904, a year when John Brady complained of the absence of lighthouses in Alaska, about 40 major vessels moved the cannery force and their equipment to Alaska in the spring, and transported a pack of 2.5 million cases of salmon to San Francisco and Puget Sound in the fall, an average of 62,000 cases per vessel, a case being forty-eight one pound (net) cans of salmon.(18)

In the early days of the salmon industry in Alaska, the most important operator was the Alaska Packer's Association, a combine of most of the canneries in the industry. Consolidation was a natural development in the Alaska salmon industry where heavy capital investment was required to begin the enterprize, and competition made problematical the success of small ventures, which were nonetheless attracted because of the abundance of the resorce.(19) The Alaska Packer's Association, whose domination in the industry was nearly complete over its first decade of organization, was first formed in 1892 as the Alaska Packing Association. The country was in recession, and APA gained control of 31 canneries, concentrating operations by closing all but nine. Only six other canneries operated in Alaska that year.(20) Thirty-seven had operated the previous year.

APA organizers were not new to Alaska. Quite the contrary. To some extent APA was an outgrowth of the Alaska Commercial Company (ACC) which had held the controversial fur seal monopoly on the Pribilof Islands from 1870 to 1890. Some members of ACC were among the organizers and principal shareholders of APA. In 1893 APA incorporated as the Alaska Packer's Association.(21) The canneries of the constituent members, valued at $1,033,850, were exchanged in return for capital stock. In its first year of incorporated activity, APA packed 72% of all salmon put up, or 470,630 of 650,650 cases.(22) Using the compilation of Gilbert and Barnes, drawn from Cobb's Pacific Salmon Fisheries and from the Pacific Fisherman yearbooks, averaging at about ten year intervals, APA controlled 80% of the Alaska pack through 1899, 54% in the next decade, 25% between 1910 and 1919, in which latter year the total pack was about 4.5 million cases. Between 1920 and 1929 APA's share of the pack fell to about 14%, the reasons for which we shall return to later.(23) It is noteworthy that while other combinations rose to challenge APA's domination of the industry after 1900, most strongly Libby-McNeil-Libby, Pacific American Fisheries, and Alaska Pacific Salmon Company, APA remained a major force, usually packing a larger percentage of the annual total than any other operator.

From its very first years the Alaska Packer's Association operated a large fleet of vessels between San Francisco and its canneries in Alaska. San Francisco was the location of the corporate headquarters, and, in the early years, the point from which APA marketed most of its share of the pack. During the winter vessels were laid up in Oakland Creek and at the corporation's Oakland docks, for storage, repairs, and refitting, as required. In the spring the vessels were loaded with the tin-plate, cannery equipment and fishing materials needed for the season's work. The ships also took on board the Chinese, Mexican, Filipino and other crews who would work in the canneries. The contracts utilized by APA were highly exploitive, and subject to severe criticism, both by labor organizers and others after the First World War, and by scholars and analysts since then.(24) In this regard, APA would seem to have been no better, nor worse, than other operators.

APA ships normally made just one round trip annually to the Alaska canneries. Most of the vessels went to a single cannery, and stayed there until loaded with the finished cases, usually anytime from late July to late September, and returned south fully laden, including the crew and equipment they had transported north. Some might return south after the spring voyage up, however, and return again to pick up the finished pack and retrieve the crew in the fall. Occasionally, of course, there would be additional stops at other canneries for crew or fish. As a rule, however, the ships stayed at their assigned cannery, playing an integral role in the cannery operation. The canneries were on the shoreline, and closed more than half the year. They had limited power plants, and normally no communications. The ships had steam equipment, refrigeration plants, wireless equipment, and other amenities and necessities. The ships would thus stay on station through the entire run of the operation, from the debarking of the work crews to the final loading of the cased salmon. This might be anywhere from two to five months.(25) It is noteworthy that APA operations did not rely upon independent fishermen. Instead, fishermen and other laborers were employed in San Francisco by the corporation, or its constituent canneries, and transported north on APA ships. Fishing was done with gill nets - both drifting and set - and with seines, which were set by small launches, and tended by the white labor force. Traps were used also, especially after the turn of the century. Both the white fishing force and the Oriental and Mexican workers came north together, a typical crew consisting of 150 Oriental and Mexican men as cannery workers and laborers and 150 white men running the launches, supervising the traps and managing the cannery operation.

APA preferred to own all the vessels it operated, and at the height of its operations in Alaska, it maintained a fleet of 14 major ships, and leased several more. With these, and smaller vessels, the Association serviced 20 canneries in southeast and western Alaska.(27) APA's vessels fell into three classes. The major ships were usually between 1200 and 1800 gross tonnage, though in later years some were bigger than this. It would be normal for such a ship to carry between 50,000 and 70,000 cases of canned salmon. In the early years the corporation maintained as well six to eight vessels of between 500 and 800 gross tonnage. These were usually steam powered, and were used for late season clean-up as well as short trips between canneries during the operating season, for routine business. Finally, the corporation owned a large number of steam and gas launches, from two to six of which were assigned annually to the several canneries. At one period the number of launches exceeded 60. The launches either stayed at the canneries, laid up for the winter, or, more often, were transported to and from the grounds on the larger vessels.(28)

What is perhaps most remarkable about the Alaska Packer's Association involvement with Alaskan waters, however, is that it represents the last hurrah of square-rigged sail anywhere on the seven seas. At the end of the nineteenth century, at a time when the world's shippers were rapidly converting to steam and iron, the Alaska Packer's Association carried on their operation by buying and chartering old wooden sailing ships - most of them three-masted barks - and used them to service one of the most financially successful oceanic trades anywhere. Indeed, it was a trade unlike any other, and particularly in its own time. The mass movement of the canned salmon pack from Alaska is one of the major movements of canned goods anywhere, even today. Within several week's time, in the 1920's and 1930's, between 6.5, and 8.5 million cases were moved from central and southeast Alaska canneries to warehouses in San Francisco and on Puget Sound in lots of 50,000 to 70,000 cases each, in a flurry of activity and tight organization. It is a matter of some considerable interest that the largest shippers during that time shipped nearly all its share of the pack in sailing vessels, which it continued to use until 1929.

Beginning in 1893 APA began to acquire older wooden "Down-easters." The association built no new ships - ever. Instead, they were content to buy old ships at relatively modest prices, preferring, as one annual report said it, "cheap, commodious tonnage."(29) The pioneer ship of the APA fleet was the George Skolfield, of 1276 gross tons, acquired in 1893, and operated for seven years. Other "Down-easters" included the Centennial, 1286 tons, bought in 1896 and not sold until 1927; the Llewellyn J. Morse, 1393 tons, acquired in 1898, retired in 1922, and sold to a film company in 1925, who used her to represent the USS Constitution in the movie "Old Ironsides;" the Bohemia, 1663 tons, acquired in 1897, the Santa Clara, 1535 tons, acquired in 1896, and the Indiana, 1488 tons, acquired in 1898, these latter three also sold to film interests in 1926. There were two additional "Down-easters," which had less glamorous endings. The Sterling, 1732 tons, was acquired in 1896, and the Tacoma in 1898. We shall learn of their fate momentarily.(30)

In addition to vessels it owned outright, the corporation also chartered numerous sailing barks for its Alaska run as the needs of the season required. These included the following ships which were regulars on the Association's annual roster between 1893 and 1920: Occidental, 1469 tons; Prussia, 1172 tons; Gatherer, 1375 tons; Louisiana, 1364 tons; Merom, 1158 tons; Charles B. Kenney, 1072 tons; Harry Morse, 1280 tons; Levi Burgess, 1536 tons; Two Brothers, 1236 tons; Kate Davenport, 1194 tons; Eclipse, 1536 tons; Invincible, 1394 tons; St. Nicholas, 1723 tons; Hecla, 1435 tons; W.H. Macy, 2092 tons; Sintram, 1530 tons; Servia, 1866 tons; Columbia, 1327 tons; John Currier, 1847 tons; Willscott, 1856 tons; Undaunted, 1647 tons; Fresno, 1149 tons; Carondelet, 1292 tons; Reaper, 1358 tons; William Macy, 2038 tons; Alex Gibson, 2043 tons; Balclutha, 1554 tons; Isaac Reid, 1488 tons; Palmyra, 1223 tons; M.D. Grace, 1810 tons; Charles Moody, 1915 tons; James Nesmith, 1633 tons; and the Lucille, 1532 tons, or a total of 34 vessels chartered from time to time, many of them numerous times.(31) There was yet another group of large vessels used by the corporation after 1907, but more of this group later.

Alaska Packer's Association had a great stake, then, in the safety of navigation in Alaskan waters. Not only did the corporation operate annually eight of its own barks and a host of smaller vessels in those waters, but it also operated 34 chartered vessels of over 1,000 gross tons at various times as well. And it operated them in all parts of Alaska - to Loring, Wrangell and Pyramid Harbor in southeast, to the Copper River, to Cook Inlet, to Karluk and Alitak on Kodiak Island, and to Egegik, Naknek, Kogglung, Kvichak, Nushagak and Togiak in Bristol Bay, that is, to a good many of the places people went in Alaska in those days to fish for salmon.(32)

How did they do, these old sailing barks? How did the old "Down-easters" fare when pitted against more coast line than in the rest of the United States combined, and one of the least forgiving gulfs in the northern hemisphere? What was the safety record? How many did they lose? They did pretty well, would seem to be the answer. Of the eight wooden barks APA owned outright, they lost two. The 1732 ton Sterling went down on her third trip to Alaska in 1898, on May 20, after striking an uncharted rock off the entrance to Nushagak Bay. All hands managed to get off before she sank. On her way up at the beginning of the season, of course, she carried no salmon.(33) The Tacoma was acquired in 1898, but before the corporation could get her into service, she was chartered by the government and used for ferrying horses to the Philippine Islands during the Spanish-American War. She began her company service in 1900, and made 18 successful seasons. In 1918, on May 19, however, while making for Kvichak Bay, she was caught in moving ice at lat. 57 degrees-53'N., long. 158 degrees-04'W., southwest of Egegik. She was crushed, and sank. All the crew and labor got off. The company valued her at $25,000, not a high figure.(34)

Of the 34 chartered vessels, a surprisingly small number were lost while operating for APA; just four. On September 10, 1896, the James A. Borland was blown onto Tugidak Island, in the Trinity group, just off the southwest end of Kodiak Island. She carried 27,333 cases of salmon, all lost, though the crew got off. On October 6, 1900, the bark Merom was lost along the north shore of Kodiak Island. One sailor drowned, and 12,572 cases of salmon were lost. On November 6, 1907, the Servia was wrecked at Julia Foard Point on Kodiak island, her cables having parted during a storm. She was unloaded at the time. Finally, the Lucille was lost at the mouth of the Ugashik River on the north coast of the Alaska Peninsula on August 20, 1908, with 4884 cases and 300 barrels of salmon aboard. Altogether, the loss of only these four major vessels chartered, and the two owned outright in nearly four decades of shipping in and out of Alaska seems a remarkable achievement.(35) Before a final assessment, however, there is one last chapter of the APA shipping story - the famous "Star" line.

As wooden sailing barks became increasingly rare, the corporation, after the turn of the century, began to purchase some iron sailing ships, square-rigged vessels with iron hulls. The first of these was the Himalaya, of 1067 tons, acquired in 1901. She was followed quickly in 1902 by the 1001 La Escocesa, and also in 1902, the Euterpe, 1197 tons. All these were small but substantial vessels, and would stay in the trade for some time. In 1907 the corporation purchased the sizable iron-huller Star of Russia, 1892 tons. She was a sleek, maneuverable ship, and larger and newer than other company ships. She became the pride of the fleet, and the company owners decided to acquire more square-rigged iron-hullers, and to name them all "Stars." This was the beginning of the "Star" line, and the Star of Russia became the name ship for the whole fleet of iron and steel full-rigged vessels owned by the packers, which would eventually number 19. In 1907 the Himalaya was re-named Star of Peru, La Escocesa became Star of Chile, and Euterpe was christened Star of India. Soon, in 1907 and 1908, were added 1797 ton Star of Bengal, 1571 ton Star of Italy, and 1569 ton Star of France. None of the wooden "Down-easters" had their names changed. But all iron or steel hulled vessels became "Stars." The 1614 ton British Balclutha became Star of Alaska, and the Blairmore, 1943 tons, became Star of England. Additional ships were the 1570 ton Star of Finland, 2293 ton Star of Scotland, added in 1908, the 2097 ton Star of Greenland, the 2053 ton Star of Holland and the 1981 ton Star of Iceland in 1909, and the 2121 Star of Falkland, acquired in 1918.(36)

None of these vessels were new; all of them had been built in Britain between 1863 and 1896. All had seen continuous service in various oceanic trades before being driven from their routes by the introduction of faster, more reliable steam vessels. All would continue in service to the corporation for long years, and some would be sold into further, though limited, service. Most would be retired, either to be sent to shipbreakers, or in more than one case, to become museums.(37)

The final five "Stars" were U.S. built, four in Maine, and one in Boston, and were acquired between 1909 and 1912. These included four four-masted shipentines: the 3026 ton Star of Shetland, the 3262 ton Star of Zealand, the 3288 ton Star of Poland, and the 3381 ton Star of Lapland. These were considerably larger vessels than the corporation had owned up to that time, and they became the major workhorses of the fleet. Finally, the bark Star of Finland, 1571 tons, was purchased, and, as we shall see, earned a special place in APA history.(38)

In addition to the "Star" fleet of iron and steel hulled vessels, the Alaska Packer's Association continued to acquire some old wooden sailing ships, usually vessels they had customarily chartered on an annual basis. By 1925 the corporation owned 32 square riggers, the largest number of ships it ever owned at one time, though they were not all in service: 17 "Stars," and 15 wooden barks and ships. A brief look at the dispersal of the fleet for that year, even though in the period of decline of APA's domination of the industry, will help convey the nature and extent of the corporation's involvement in Alaskan waters. In 1925 APA packed half a million cases of salmon (510, 404), ten percent of the total pack for that year, far off the maximum APA pack ever, 1.5 million cases in 1915. In 1925 all the APA pack was carried in its own vessels, none in chartered vessels. In that year the Star of Falkland and the Star of Iceland went to Nushagak with two schooners, six launches, and three 336 white men and 287 "Orientals;" the Star of England, the Star of Peru and the Star of Scotland went to Kvichak at the head of Bristol Bay with one steamer and six launches, and with 381 white men and 287 "Orientals;" the bark Centennial went to Alitak on Kodiak Island with one small steamer and three launches, and 50 white men and 112 "Orientals;" the Stars Italy, Holland, Lapland and Zealand went to several canneries at Naknek, clearly the largest operation, with three small steamers and six launches, and with 608 whites and 606 "Orientals;" the Star of France went to Egegik with one steamer and one 127 whites and 102 "Orientals;" the Star of Finland went to Ugashik with two launches, and 104 whites and 70 "Orientals;" the Star of Shetland went to Karluk with one steamer and six launches, and 125 whites and 132 "Orientals;" the Star of Alaska went to Chignik with one motor-ship and four launches, and 57 whites and 67 "Orientals;" the Star of Russia went to Fort Wrangell with four launches, 48 whites and 86 "Orientals;" and the Star of Greenland went to Loring with four launches, and 38 whites and 77 "Orientals."(39) The Bohemia, Indiana, and L.J. Morse were held at the shipyard in San Francisco, to be put up for sale, and the Santa Clara, Star of Chile and Star of India did not operate.

With this level of annual activity, then, what kind of safety record did the iron hulls have, especially when compared with the record of the wooden barks? Only two iron hulls were lost by APA in Alaska. On September 20, 1908, APA suffered its worst marine disaster, one which would enter the annals of Alaska ship disasters along side the George S. Wright and the Princess Sophia. The Star of Bengal was homebound out through Sumner Strait with the season pack from the Fort Wrangell cannery, 52,062 cases, and one 142 on board, including 110 Chinese cannery workers. She was being towed through fog and a half-gale by two tug-launches, the Hattie Gage and the Kayak. The Bengal, remember, was 1877 tons; she was 262 feet long. After midnight, fighting wind and storm, the burden became too much for the little steamers, and they cut the iron bark loose. The Bengal was not far enough clear of the strait to get wind, except in her face, and she was driven slowly backward until she ran aground on the south shore of Coronation Island, at the outer entrance to Sumner Strait. She was broken in half on the rocks. She had got a line ashore, but most of the men aboard were crushed by cases of salmon and empty fuel barrels which swept with them, and over them, as the ship went down and her holds emptied. Two Chinese, seven Japanese and three Filipino survived, and 21 white men with them.(40)

The Star of Falkland, of 2121 gross tonnage, was blown on Akun Head on the outer side of Unimak Pass in the Aleutian Islands in a gale on May 22, 1928 while trying to get through to Bristol Bay for the start of the season. All hands were saved, but the ship was destroyed. Additionally, the corporation purchased the Star of Poland (former U.S. built Acme) in 1912. She was chartered by the government for use during World War I, and was lost in the China Sea in 1918.(41)

Reliance upon sail could only last so long. APA had always hired only experienced sail captains to pilot the barks, most of them Swedes and Norwegians, and had paid them well. But by the 1920's good captains were in increasingly short supply, and experienced hands familiar with sail were even harder to find. And in a time of prosperity, shorter tours on steamers were far preferable from the seaman's point of view. Gradually it became clear to corporate executives that the inevitable could not be put off, and in the late 1920's, the decision was made to convert to steam, a decision signalled by the selling of the L.J. Morse to a film company in 1925. When the Falkland was destroyed at Akun Head in 1928, the company decided that was the last year for sail, and they converted everything to steam for the next season. The remaining barks were laid up and eventually sold. The U.S. built shipentines - Lapland, Zealand and Shetland - were sold to the Japanese, and the little bark Finland, always a favorite, was kept by the corporation and established in San Francisco as the APA Museum. The Greenland became a training vessel for Swedish merchant cadets, and the Star of Alaska became a "Sea-scout" vessel in southern California.(42)

With the disbanding of the APA "Star" line fleet in 1929, the era of maritime sail as a profitable, relied upon form of commercial transport came to an end. Some commercial sail would be used intermittently into the 1930's - there was a sporadic Australian grain trade, for example, capped off in 1939 with a race of 13 windjammers moving 50,000 tons of wheat from South Australia to Europe. But for all practical purposes, the era of sail was over. APA relied exclusively on sail as the foundation of its Alaska trade up to the time of its conversion to steam, and always controlled more of that trade than any other single operator. The low expense of operating sail on the Alaska route probably contributed materially to the financial success of the enterprise.(43)

Whatever the explanation - whether because they made only one round trip a year, or because they utilized only experienced skippers, or because they had very good luck - APA vessels operated for nearly four decades in waters acknowledged by virtually all observers to be among the most dangerous anywhere, with a remarkable record for safety, and with minimum loss of lives and property. Of the wooden "Down-easters" owned by the corporation, they lost two of eight; of wooden sailing ships they chartered, they lost four; of the 19 iron-hulled sailing barks they owned after 1907, they lost two in Alaskan waters. However else the history of the Alaska Packer's Association may be interpreted, their use of sail in the Alaska trade and the record they compiled for safe transport in dangerous climes is at least a unique and interesting chapter in the APA story.

NOTES

(1)Gruening includes navigation as a complaint in his thesis that the federal government neglected Alaska development; State of Alaska (New York: Random House, 1954), pp. 116, e.g. See Sherwood, Exploration of Alaska, 1865-1900 (New Haven: Yale University Press, 1965), pp. 39-44, and pp. 38-39 re: US Coast Survey.

(2)Gruening, State of Alaska, p. 136;Andrews, The Story of Alaska (Caldwell, Idaho: The Caxton Printers, 1953), pp. 133, 177-178.

(3)Dall, Alaska and Its Resources (Boston: Lee and Shepard, 1870), p. 88.

(4) Lewis and Dryden's Marine History of the Pacific Northwest, ed., E.W. Wright (Seattle: Superior Publishing Co., 1967, a reprint of the 1895 edition), p. 204.

(5) Lewis and Dryden's, pp. 169, 229; State of Alaska, p. 219.

(6) Story of Alaska, p. 24.

(7) Story of Alaska, p. 24 ff.; State of Alaska, pp. 235-237.

(8) Lewis and Dryden's, pp. 419, 371.

(9) Story of Alaska, p. 96.

(10) State of Alaska, pp. 136 ff.

(11) Annual Report of the Governor of Alaska, 1890, p. 16; Annual Report of the Governor of Alaska, 1897, p. 35; Annual Report of the Governor of Alaska, 1898 ("Wrecks"), pp. 29-30.

(12) Report of the Lighthouse Board, 1905-10, in Report of the Secretary of Commerce and Labor, 1910.

(13) State of Alaska, pp. 220-221.

(14)State of Alaska, pp. 220-221; Congressional Record, February 11, 1915, pp. 3583-3585; see also C. Andrews, "Marine Disasters of the Alaska Route," Washington Historical Quarterly, Jan., 1916, which reprints the list.

(15)Gold production from Alaska in 1900 was $4 million from the Seward Peninsula (Nome) and over $2 million from southeast Alaska (Treadwell); salmon production for 1900 was about 1 million cases, a case of red salmon (the major product then) selling for just under $10, thus putting the value of the salmon pack close to $10 million. State of Alaska, pp. 114-115; Jefferson Moser, The Salmon and the Salmon Fisheries of Alaska (Washington:

GPO, 1899), pp. 192 ff; Alaska Fishery and Fur Seal Industries (Wn: Bureau of Fisheries, 1905 [and other years]); Pacific Fisherman yearbook, 1902. See also Richard Cooley, Politics and Conservation: The Decline of the Alaska Salmon (New York: Harper and Row, 1963), pp. 56 ff.

(16)Dall, p. 76.

(17)Gregory, Homer and Kathleen Barnes, North Pacific Fisheries, with Special Reference to Alaska Salmon (San Francisco: American Council, Institute of Pacific Relations, 1939 [available in a Kraus Reprint, 1976]), p. 47.

(18)Alaska Packer's Association Records, film collection, UAA (and other Alaska) Library Archive, Administrative Records - History (reel 1) (hereafter cited as APA rec., and specific record group).

(19) North Pacific Fisheries, pp. 89-125 ("Combinations in the Salmon Industry").

(20) North Pacific Fisheries, pp. 93-94; Politics and Conservation, pp. 42 ff.

(21)APA Records, Adm. Rec., History (reel 1).

(22)APA Records, Pack report (reel 4); North Pacific Fisheries, p. 93.

(23)APA Records, Pack report (reel 4); North Pacific Fisheries, pp. 93-94.

(24)APA Records, Cannery Operations (reel 6); L.W. Cassaday, "Labor Unrest and the Labor Movement in the Salmon Industry of the Pacific Coast," unpublished doctoral dissertation, University of California, 1937, an unparalleled study of the labor conditions in the Alaska salmon industry as of 1937.

(25)APA Records, Cannery Fleet (fiche 340); William Armstrong Fairburn, Merchant Sail, Vol. IV, pp. 2707.

(26) Politics and Conservation, pp. 43-52.

(27)APA Records, Cannery Fleet (fiche 340); APA Records, Fleet Record Books (fiche 424 ff).

(28)APA Records, Fleet Records Books (fiche 424 ff).

(29)APA Records, Adm. Rec., History (reel 1); cited in Merchant Sail, p. 2707.

(30)APA Records, Fleet Record Books (fiche 424 ff); Merchant Sail, pp. 2707-08.

(31)APA Records, Fleet Record Books (fiche 424 ff).

(32)APA Fleet Record Books.

(33)APA Fleet Record Books, 1898.

(34)APA Fleet Record Books, 1918.

(35)APA Fleet Record Books.

(36)APA Fleet Record Books; Merchant Sail, pp. 2654-55.

(37)APA Fleet Record Books.

(38)APA Fleet Record Books; Merchant Sail, pp. 2708-10.

(39)APA Fleet Record Books, 1925.

(40)APA Fleet Record Books; Gordon R. Newell, SOS North Pacific (Portland: Binfords & Mort, 1955) has a chapter on the wreck of the Star of Bengal, but with some data in discrepancy with the APA Fleet Records; pp. 140 ff.

(41)APA Fleet Records, 1928; Adm. History (reel 2).

(42) Mechant Sail, p. 2710.

(43)APA Maritime Records and Logs (fiche 434 ff.); Company Assets (fiche 308-311).

Session II

Logistics and Training

Defined professional criteria for underwater archaeology

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Introduction

The title for this presentation was chosen with malice of forethought. It would seem that today there are as many misuses of the term "Underwater Archaeologist" as there are proper uses. The term certainly does conjure up visions of adventure and mystery for the uninitiated, far too often stimulated by the misuses. Individuals without a day's formal academic training in archaeology are adopting the title. Treasure hunters call themselves by the term or hire someone who claims such a title. Even writers and adventurers borrow the term to grab reader attention and increase book sales. After all, when compared against glamor and gold, what is education and science? Therefore, to make perfectly clear where we fit in the scheme of things, let us only discuss "doing archaeology underwater."

Many others have already made this case. George Bass (1966:13) stated that:

> Archaeology underwater, of course, should be called simply archaeology. We do not speak of those working on the top of Nimrud Dagh in Turkey as mountain archaeologists. They are all people who are trying to answer questions regarding man's past, and they are adaptable in eing able to excavate and interpret ancient buildings, tombs, and even entire cities with the artifacts which they contain. Is the study of an ancient ship and its cargo or the survey of toppled harbour walls somehow different? That such remains may lie underwater entails the use of different tools and

> techniques in their study, just as the survey of a large area of land, using aerial photographs, metal detectors, and drills, requires a procedure other than excavating the stone artifacts and bones in a Palaeolithic cave. The basic aim in all of these cases is the same. It is all archaeology.

The same principal was restated from another perspective by Daniel Lenihan (1975:1) when he wrote:

> An archeological or historical site can occur anywhere on the face of the earth--on a mountain, in a desert, in a jungle, or underwater. The fact that a given site exists in some specific environment does not detract from the cultural significance of the material contained therein. All of the legal mandates pertaining to historic preservation (including archeological resources) apply to any given site, without regard to its location. Archeological theory and philosophy encompass all cultural remains wherever they may be found, including material now covered by water. The only difference between an underwater site and a site in any other environment is the techniques and methods required to investigate that site.
>
> It should be emphasized from the beginning, therefore, that underwater archeology for our purpose is simply archeology done underwater and should not be confused with the treasure hunting and marine salvage enterprises which often erroneously adopt that title.

In discussing doing archaeology underwater, all of the appropriate criteria already defined for archaeology in general must first be applied. Only then can you begin talking about those additional requirements for working in a water environment.

<u>The Greater Setting</u>

Until the late 1960's and early 1970's, the discipline of archaeology had no driving need to define a standard criteria as to what constituted a "professional archaeologist." Through the 1960's, employment in archaeology in the United States had been almost exclusively by and through universities and associated institutions. Thus, the various academic criteria maintained in the granting of advanced degrees by universities was sufficient. Individuals were hired for positions in archaeology (based upon a combination of experience, academic attainment and reputation) within a closed system. With the advent and explosive growth of public archaeology in the late 1960's, pushed by the passage of numerous state and Federal preservation laws, two new areas of employment opened to archaeologists. The private contracting firms and various local, state and Federal agencies began hiring archaeologists in tremendous numbers. The controls exerted by the interactive academic system did not apply in these two new employment areas, and a number of problems were perceived, both real and imagined, about the quality and ethics of those doing archaeological work (Cummings 1975). One of the proposed solutions undertaken by the discipline was the formation of the Society of Professional Archaeologists (SOPA) and the definition of professional standards, codes, ethics, and criteria. Specialization in underwater work was one of those areas so defined.

Early Efforts

While archaeology in general was being pressured to establish professional criteria, the need for defined criteria to do archaeology underwater were also developing.

The first push came with the Federal government requiring Cultural Resource Surveys on the Outer Continental Shelf in conjunction with oil and gas exploration and development. By 1974, sufficient survey work had been accomplished on the OCS to generate two concerns--the quality of the reports and the qualifications of the persons doing the work (Ruppe' 1980). It was reasoned that if defined criteria for marine archaeologists were established and adhered to, the quality of the reports would improve. In July 1974, the National Park Service issued the "Standards for Marine Archeologist and Marine Archeological Survey Technician" (Mortensen 1974a).

In December 1974, the National Park Service issued a new standard for "Marine Archeological Surveyor" (Mortensen 1974b) which assumed that those individuals doing the remote sensing surveys on the OCS did not need to be fully qualified to actually accomplish archaeological work underwater (Cummings 1975).

Shortly after the formation of the Society of Professional Archaeologists in 1976, SOPA picked up the certifying of Marine Archaeological Surveyors from the Federal government and continue this certification to date (Ruppe' 1980). Copies of both 1974 standards are contained in their entirety, in Appendix I.

The Current National Standard

At this moment there is only one set of criteria applicable nationwide, those established by the Society of Professional Archaeologists. At the January 1983 Conference on Underwater Archaeology, representatives of the Society of Professional Archaeologists met with the Advisory Council on Underwater Archaeology and agreed to the following requirements, which are in addition to the general requirements for all archaeologists.

SOPA Requirements for Certification in Underwater Archaeology January 1983

Attachment for Underwater Archaeology (Section 3.11)

Underwater archaeology can generally be divided into prehistoric or historic sites and nautical sites (ships and their related harbor structures). Underwater archaeology is not a separate kind of archaeology but is archaeology in a different environment. Field techniques and artifact preservation differ from terrestrial sites thus emphasis is placed on qualitative data retrieval and on preservation methods. For applicants specializing in prehistoric and historic underwater sites, experience and training similar to that specified in Sections 3.1 (Archaeological Field Research) or 3.9 (Historic Archaeology) are expected with emphasis upon underwater sites, water-saturated artifacts, and preservation methods. Applicants specializing in nautical archaeology should be knowledgeable of both archaeological and archival data pertaining to ships.

Training

A. Survey: An Underwater Archaeologist is expected to demonstrate a minimum of two weeks field experience and training in underwater survey technique. While strictly marine survey work is covered in Section 3.8, the applicant must be familiar with the general theory and application of varied remote sensing technology.

Dates* Duration (in weeks)** Supervisor Experience

_________Sum from supplementary sheets, if any

_________Total (must sum to two weeks)

B. Excavation: The applicant must provide documentation of 24 weeks of supervised underwater field work and 20 weeks of supervisory underwater archaeological field work.

Dates* Duration (in weeks)** Supervised Experience

_________Sum from supplementary sheets, if any

_________Total (must sum to 24 weeks)

Dates* Duration (in weeks)** Experienced as Supervisor

_________Sum from supplementary sheets, if any

_________Total (must sum to 20 weeks)

C. Preservation/Conservation: Materials will be preserved at underwater sites that are seldom preserved at terrestrial sites, or the requirements for preservation of material from marine or freshwater sites will be different than the same materials from land sites. An individual seeking SOPA certification in underwater archaeology should demonstrate an awareness of conservation and preservation methods of all materials that might be encountered at underwater sites and know what the short and long term requirements are for each material depending upon composition, burial conditions, and length of time that has elapsed. The applicant must provide documentation of at least 8 weeks of supervised training in the general theory and application of stabilization and conservation methods as they pertain to waterlogged materials, both fresh and salt.

Dates* Duration (in weeks)** Supervisor Experience

_________Sum from supplementary sheet, if any

_________Total (must sum to at least 8 weeks)

D. Data Recovery: The applicant must show experience or training in the recovery and interpretation of both archaeological and archival data and, for nautical archaeology, familiarity with the history and technology of navigation and ship building. The applicant must document the design and execution of an underwater archaeological study as evidence by an M.A. thesis or a published report equivalent in scope and quality. Report citation:

E. Diving Experience: A competent underwater archaeologist must be a competent diver and should provide evidence of formal dive training (a school, military, etc.); in absence, provide documentation sufficient to demonstrate diving competency.

Dates* Duration (in weeks)** Type of Training

* In cases where exact dates are not known, an estimate will suffice.

**As a rule, experience must be acquired in blocks of time of at least 4 weeks' duration. We recognize that this is not always applicable in underwater archaeology. Please explain the reasons or special circumstances for training acquired in blocks of less than 4 weeks time.

There have been two other efforts of national scope in the past year that would further define the criteria for doing archaeology underwater. These are "The Secretary of the Interior's Archaeology Standards" and the Office of Personnel Management's "Archaeologists Qualification Standards." Written into early draft versions of each was the concept that underwater archaeology is simply doing archaeology in an underwater environment. Unfortunately, final versions are not yet available for either, and it is unknown how they will read when issued.

Equally Important

It would be grossly unfair, and untrue, to even suggest that all of the effort to define professional criteria for doing archaeology underwater was at the national level. Equally important has been the definitions and requirements developed at state and local levels. In fact, many of these efforts preceeded and were instrumental in shaping those of nationwide scope.

One such pioneer is the State of Texas. After a single unfortunate experience with a treasure hunting endeavor, Texas passed a strong antiquities law in 1969. Rules and regulations applicable to the Antiquities Code of Texas (Title 9, Chapter 191), as issued by the State Archaeologist contain the following definitions:

Professional personnel - Appropriately trained specialists required to perform an adequate archeological investigation. These personnel include the following:

(A) Principal investigator. A professional archeologist or underwater archeologist with demonstrated competence in field archeology and laboratory analysis, as well as experience in administration, logistics, personnel deployment, report publication, and fiscal management. The principal investigator must have at least three months' full-time experience in a supervisory role involving complete responsibility for a major portion of a project of comparable complexity to that which is to be undertaken under permit. The principal investigator must have demonstrated the ability to disseminate the results of archeological investigation in published form conforming to current professional standards. The principal investigator must remain on-site a minimum of 5% of the time required for the field investigation and must be a coauthor of the project report. When not on on-site, the principal investigator must provide a field archeologist to supervise the field investigation. In the event of controversy or court challenge, the principal investigator shall testify concerning report findings.

(B) Professional archeologist. One who has a graduate degree in archeology or anthropology from an accredited institution of higher education, or the equivalent as approved by the Antiquities Committee, with a minimum of two archeological field seasons under competent supervision and who has published results of archeological investigations in scholarly journals.

(C) Underwater archeologist. One who is a professional archeologist and, in addition, is a competent diver with a minimum of two full seasons in underwater archeological testing or excavation projects. Training and experience sufficient for safe and proficient use of the specialized underwater remote sensing survey, excavation and mapping techniques, and equipment are required.

(D) Underwater archeological surveyor. One who has training and experience sufficient for the safe and proficient supervision of appropriate remote sensing survey equipment operation, as well as for interpretation of survey data for anomalies and geomorphic features that may have some probability of association with submerged aboriginal sites and sunken vessels. This individual may represent the archeological interests on board the survey vessel in the absence of an underwater archeologist, as defined in subparagraph (C) of this definition.

For an example of how Texas implements these definitions see Appendix II - a position description for underwater archaeologist issued by the State of Texas, September 1, 1973. Many other states have similar definitions in their

Antiquities Acts, and have described specific criteria for doing archaeology in their state.

Availability of Training

In spite of the technological advances, the increases in employment opportunity, and the acceptance as a specialty, there are few universities offering specific training and experience in doing archaeology underwater. In the United States only Texas A&M University offers a full academic program. Of all colleges and universities offering advanced degrees in anthropology and specializing in archaeology, a disproportionate few give one or two classes in some aspect of doing archaeology underwater. Examples include: Florida State University, Arizona State University, University of South Carolina, East Carolina University, and the University of Northern Arizona.

As in the past, most archaeologists seeking to specialize in underwater work must obtain that knowledge on-the-job. That leaves the big question of how to gain employment without specific experience.

Conclusion

Doing archaeology underwater is in its infancy in relationship to doing archaeology in other environments, and the technology and methodology is still rapidly evolving. While others have adequately described the history and development of this specialty (Bass 1966:13), several points about that development of relevance to this discussion of professional criteria should be made in closing.

First, while many of the individuals that pioneered work in the underwater environment were not archaeologists, their efforts are the foundation for the evolution from "adventure" to "science" which has taken place in the past two decades. We are now at a point where archaeology underwater can and should be treated just as archaeology in any other environment.

Second, by coping with real world problems, the specialty of doing archaeology underwater is better defined and is ready to proceed into the future.

Third and finally, we are dealing with a fragile and rapidly diminishing resource in all submerged sites, historic and prehistoric. Let us give them the best professional attention possible.

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APPENDIX I

PROFESSIONAL CRITERIA FOR DOING ARCHAEOLOGICAL WORK UNDERWATER ISSUED BY THE NATIONAL PARK SERVICE IN 1974

Office of Archeology and Historic Preservation
National Park Service
Washington, D.C.

STANDARDS FOR MARINE ARCHEOLOGIST AND MARINE ARCHEOLOGICAL SURVEY TECHNICIAN

These standards have been prepared by the National Park Service to identify archeologists qualified to perform underwater archeological reconnaissance surveys and investigations should such services be required. They may be modified, in any particular case, to apply only to historic sites, to prehistoric sites or to both depending upon the qualifications being reviewed. These standards will be reviewed periodically and revised, if necessary, by a committee appointed by the Associate Director, Professional Services.

Marine Archeologist (for historic or prehistoric sites or both).

1.) As set by the Committee on Ethics and Standards of the Society for American Archeology, the recommended minimum formal qualifications for individuals practicing archeology as a profession are a B.A. or B.Sc. degree from an accredited college or university, followed by two years of graduate study with concentration in anthropology and specialization in archeology during one of these programs, and at least two summer field schools or their equivalent under the supervision of archeologists of recognized competence; a Master's thesis or equivalent in published reports is highly recommended as is the Ph.D. degree (see American Antiquity, volume 27, pages 137-138, October 1961).

2.) Two field sessions of training and/or experience in submerged sites archeology, sufficient to qualify the individual for research on historic and/or prehistoric sites.

3.) Certification as a SCUBA (self-contained breathing apparatus) diver, or satisfactory completion of training at a recognized diving school, or equivalent experience; except that a marine archeologist supervising underwater excavation crews must have diving school experience.

4.) Certification for the use of hookah (surface supplied) diving gear for underwater archeology as either Surface Supply Diver (Demand) or Surface Supply Diver (Demand and Free Flow).

5.) Demonstrable training and experience sufficient for safe and proficient use of the following list of specialized equipment:

A.) Hydraulic Dredges
B.) Air Lifts
C.) Down Thrusters
D.) Water Jets
E.) Diver Propulsion Vehicles

6.) Demonstrable training and experience in the following underwater archeological techniques:

A.) Underwater Mapping (Peterson-Fischer System)
B.) Underwater Mapping (Bass-Throckmorton System)
C.) Underwater Photography
D.) Theory and Application of Magnetometry in Underwater Archaeology
E.) Use of Submersible Metal Detectors
F.) Surface Grid Survey Techniques
G.) Patterned Underwater Search Techniques

7.) Demonstrated knowledge of the history, theory, and methodology of underwater archeology obtained either through academic training or individual study.

Marine Archeological Survey Technician.

The category of Marine Archeological Survey Technician has been created to provide means of qualification for individuals with specialized training relating to Items 1, 2, and 6 (above) for purposes of outer continental self reconnaissance surveying. Marine Archeological Survey Technicians may conduct reconnaissance surveys only under the supervision of a Marine Archeologist; they will not be approved to conduct underwater archeological recovery investigations.

APPENDIX II

EXAMPLE OF A POSITION DESCRIPTION FOR UNDERWATER ARCHAEOLOGIST, DEFINED BY THE STATE OF TEXAS SEPTEMBER 1, 1973

UNDERWATER ARCHEOLOGIST

GENERAL DESCRIPTION

Performs advanced professional and specialized archeologist research in a state agency. Work involves the organization, supervision, and participation in research directed at the acquisition, preservation, and analysis of scientific and historical data available in both prehistoric and historical period underwater archeological sites throughout the state. Develops, interprets, and publishes the results of this research within the broad context of the history and pre-history of Texas. Supervision is exercised over contract or student personnel and other personnel involved in the administration of the program. Work is performed within the policy guidelines with great latitude for the application of professional judgment.

EXAMPLES OF WORK PERFORMED

Conceives, organizes, and executes underwater archeological research projects in a state agency.

Supervises the activities and directs the research of assistants, contract personnel and of undergraduate and graduate assistants working in the program.

Works with preservation facilities in the proper methods, procedures, and handling of materials recovered from State owned sites and in the recording and inventorying of these articles.

Arranges as necessary and advisable, for specialized analysis, reports or services to be furnished by qualified individuals, institutions, or agencies in support of the research program.

Participates in historical research and in the acquisition of documents in archives, libraries, and from other sources for analysis and inclusion in reports and publications.

Evaluates recovered artifactual material and other scientific and historical data acquired as a result of the program and prepares reports, if warranted, on the findings for publication as monographs or articles in appropriate scientific and/or historical journals.

Coordinates programs and responsibilities concerning submerged sites with appropriate State and Federal agencies.

Reviews culturally destructive environmental alterations proposed or taken by or through State or Federal agencies or by the private sector.

Provides consultant services in areas of competence to other State agencies and institutions.

Maintains and adds to the file of underwater archeological sites and documentary references to such sites in Texas waters.

Participates in planning and development of public information displays or museums contemplated in the acquisition of underwater sites or materials from such sites.

Performs related duties as required.

GENERAL QUALIFICATION REQUIREMENTS

Experience and Training

Broad progressive professional archeological experience with special experience in underwater exploration and the location, identification, recovery, and preservation of historically and archeologically significant artifacts.

Education

Doctorate in Archeology plus experience in underwater research. A Master's Degree supplemented by very extensive training and experience in deep sea diving and underwater archeological exploration and research may be substituted for Doctorate Degree.

Knowledges, Skills, and Abilities

Extensive knowledge of the specialized subject matter and source material for research in the colonial and national historic sites period.

Experience in and knowledge of archeological field methods, including survey techniques, particularly in the area of historic sites archeology.

Extensive knowledge of the use and fabrication of the specialized equipment and gear used in underwater archeological research and in the operation of specialized electronic equipment.

Knowledge of the field and laboratory equipment used in archeological research.

Demonstratable competency in the use of all types of surface-supplied and self-contained breathing apparatus through a wide range of depths and knowledge of the maintenance of such equipment.

Considerable knowledge of the methods of cleaning and preservation of materials recovered from the marine environment.

General knowledge of the handling and care of vessels and other major equipment associated with underwater archeology.

Working knowledge and experience in archival and library research and in the analysis and employment of historical source material.

Working knowledge of the organization and preparation of manuscripts and attendant illustrative material.

Ability to plan, organize, and successfully carry through to completion large-scale, long-term research projects and attendant field work.

Ability to establish and maintain effective working relationships with subordinates, associates, public and private groups, and the general public.

Ability to express ideas clearly and concisely, orally and in writing.

Special Qualifications

Must be a qualified diver and expert in the methods and procedures of underwater research.

Methods and techniques for conducting underwater archeological investigations in cold water

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Introduction

There are several logical steps to conducting underwater archeology in a resource management framework. When a state or Federal land managing agency or State Historic Preservation Office are confronted with the problem of needing to intelligently manage their submerged cultural resources base, it is first necessary for them to obtain some notion of what they have in the way of submerged sites and where they are located. The initial step should be undertaking a literature search to provide a general understanding of marine disasters and historic coastal activity areas in the region of concern, and to generate information regarding any prior archeological or salvage work conducted in the area. Oral history interviews may be worked in at this stage, and they may also play a significant role after the program is underway.

The next step is to order priorities for field surveys and a general sites inventory. These priorities can be conditioned by several factors but normally the primary considerations are: what the literature search indicated to be the highest probability areas for finding sites and which of those areas are most likely to be subject to eventual impact from natural or cultural pressures, i.e., natural beach migrations, dredge and fill operations, beach front development, vandalism from commercial or sport divers, and other potentially damaging occurrences.

Finally, if justified by impending impact or some other acceptable rationale, a full site investigation may be called for. In some cases, this may include a complete excavation of the site but that is a rare occurrence in underwater archeology for good reasons. A mandatory component of any justification for extensive site disturbance, besides imminent threat, would be development of a comprehensive research design that fully explains why this is the best alternative and which demonstrates definite availability of funds (this means already programmed) to deal with the immense curation and conservation problems that result from the removal of cultural remains from an underwater environment. It is no secret that archeological excavation is the ultimate destructive process for any archeological site and opting to engage in it places a very serious obligation on the responsible agency.

In all cases when state or Federal agencies are involved, an additional mandate exists to ensure public appreciation and understanding of any projects undertaken. In other words, each phase of archeological activity should result in tangible returns such as reports that are written for popular consumption, museum displays or underwater interpretive devices for the diving public.

The purpose of this paper then will be to discuss the actual implementation of the survey, inventory and testing phases with special attention paid to the problems of working in cold water. Excavation will be deemphasized since other papers in this symposium will be discussing excavation in detail. Finally, we will look at how these investigations may be conducted in the most cost effective manner and to the best interest of the public constituency groups that are in the final analysis funding the great majority of submerged sites research in the United States.

Survey

The first questions that must be asked in any survey venture is what are we looking for, how systematic do we want to be, and what kind of a confidence level are we expecting? There is a significant difference between going out and looking for shipwrecks as opposed to systematically covering an area to determine precisely where cultural resources are and where they aren't. The first type of activity is more in line with the objectives of treasure hunters or salvors than the latter which is usually the major concern of a resource management or preservation agency. In many cases it is as important for management purposes to know where sites aren't as where they are. The negative knowledge comprises a de facto archeological clearance for development activities in the area.

Next, we must determine if the survey is to be aimed at a total cultural resource inventory including submerged prehistoric sites and underwater components of land based historic land sites or if only historic shipwrecks are the proposed target of the investigation. Having made that determination, we may look at the state of the art options that are available for submerged sites surveys.

The corollary to visual surveys on land, i.e., a swimmer's survey, is certainly an option but only in a few cases. When large areas are to be surveyed or when sediment cover or cold and visibility problems make this approach unfeasible (which is almost always the case) there are a number of standard tools for the remote sensing of sites in underwater environments.

Aerial remote sensing

Aerial imagery has been utilized in numerous situations as a tool for finding sites in submerged environments but rarely with any startling degree of success. When it has worked, it is usually because an experienced analyst has been able to note straight line disconformities in reefs or flat bottoms, that indicate either the presence of the cultural entity itself or an old scar from impact of a shipwreck, for example. More sophisticated aerial techniques have not proved very effective and would hardly justify any special expenditures until their archeological application is better tested. Infrared photography is next to worthless since its penetration in most water bodies can be measured in centimeters. Further reading on this subject can be found in Richards (1980:331-337) and Arnold (1981:5-12).

Side scan sonar

In those situations where we may expect that substantial evidence of a shipwreck or other type of site will be protruding through bottom sediments, a side scan sonar can be an extremely effective survey tool. It often produces dramatic, photo-like images of material on the bottom and it is sometimes possible to determine the nature of your "contact" before sending divers down to "ground truth." Its application, however, is strongly conditioned by the nature of the bottom terrain. Like some of the other "black boxes" or magical tools available to underwater archeologists, its limitations are often not fully understood. It is critical that the operator of the instrument be experienced in looking for archeological sites underwater rather than pipelines or landforms.

The wide distance of coverage often attributed to this device, e.g., hundreds of yards on either side of the towfish sensor head is largely fantasy unless one is interested only in finding upright oil tankers or a flat bottom. For broken up remains of vessels or other cultural remains on bottom terrain with any kind of variable relief it is necessary to run tight lane spaces at slow speed and pay constant close attention to tuning adjustments on the topside console. It is recommended that the side scan operator, whether in-house or contracted, be familiar with the specific model of machine he is working with if any degree of confidence is to be expected in the returns.

it should be understood that the side scan also has no capabilities for detecting anything under sediment and in most cases it should be run in association with a magnetometer which nicely complements the side scan in an underwater survey instrument package. If budgetary constraints prohibit obtaining access to the high resolution tow fish variety (e.g., Klein, or EG&G units) one may consider outfitting an in-house survey boat with a "through-hull" unit. A final word on side-looking instruments is that several companies have come out recently with machines that are billed as "sub-bottom penetrating side scan sonar." There is a widespread misunderstanding on the part of many that this instrument can extend the side scan capabilities under the bottom; it cannot! It is simply a machine that can combine and interrelate data from a sub-bottom profiler with a side scan. This is a marvelous capability for doing seafloor mapping but, for reasons that should become obvious in the section below on sub-bottom profilers, it adds little to the potential for finding shipwrecks or other cultural remains. The one exception would be in a case where the archeologist is interested in assessing landforms on the ocean floor to predict possible occurrence of prehistoric cultural remains associated with relict geomorphological features. Further information is available from Kozak (1980) and Rosencrantz et al. (1982:257-270).

Magnetometer

The magnetometer is probably still the preeminent tool for conducting underwater surveys. It is also perhaps the one that is most abused in a conceptual sense in research design formulation. A full field magnetometer simply tells you each time it cycles what the magnetic total field intensity is at the moment around the sensor head. Although it has been used in land application to find thermo remnent magnetic features such as clay hearth alignments, etc., its use in underwater survey is almost totally relegated to finding ferrous remains, particularly those associated with shipwrecks. Given most geologic background conditions an anomalous reading on a magnetometer usually indicates that something manmade is present, e.g., portion of a historic shipwreck, Tappan range, 1965 Chevrolet. Geological features can sometimes effectively mask the anomalies caused by submerged cultural remains in certain areas but that problem can be partially mitigated by certain special techniques such as running two separate sensor heads at different depths. Diurnal variation, which is important to keep track of in land applications, is rarely a significant concern when working with the detection of ferrous features underwater.

The biggest operational problem that magnetometers present is related to the concept of "signatures." Although it is true that magnetic data can reveal certain patterned results that are classically associated with certain types of shipwrecks lying on certain types of substrates, this is only useful to a competent underwater archeological surveyor in setting priorities for ground truthing. Some agencies have tried to develop guidelines for general use that outline what sorts of anomalies should or shouldn't be investigated. These are often based on degree of intensity and number of point sources. Without getting into too much detail, suffice it to say that judgements based on any simplistic system are often going to be too spurious to be useful.

By far the best approach is to systematically collect close resolution data on tight lane spacing and have the information reduced by computer to magnetic contours. An experienced archeologist can then make quite refined projections as to where the divers' attention should be directed to locate sources of the readings. In many instances, there is nothing evident above the bottom sediment, and visibility is poor, so the exact placing of the diver is important unless one has unlimited funds and manpower. In cold water conditions, this is even more important. The colder the water the more precise must be the survey methodology since the functional bottom time of the ground truthing divers decreases drastically as the mercury falls. A common fallacy is to assume that wherever the biggest "hit" registers is the exact place of the source of the anomaly. This is usually not true and has been the cause of a lot of frustration to divers digging test pits.

Magnetometry, therefore, is a very important underwater remote survey technique but one which must be applied with a full understanding of its limitations. If a principal investigator is informed by a marine surveyor that he has the ability to select out all the shipwreck signatures on a data tape and distinguish them from the plethora of other sorts of anomalies that might exist in an historic harbor or shipping channel, his credibility should be put into serious question. Also, it should be noted that simply because the aforementioned Tappan range was discovered on the bottom at the location of a strong anomaly, the area is not to be considered cleared until the modern contamination has been removed and the area resurveyed. The heavy magnetic intrusion from the modern material may be masking the more subtle effect of an early historic shipwreck component that is lying in the sediment immediately below. For additional information on the application of magnetometry to underwater archeology, see the following: Breiner (1973), Clausen and Arnold (1976:159-169), Arnold (1977:21-36), Murphy (1980), Murphy and Saltus (1981).

Sub-bottom profiler

The sub-bottom profiler at first consideration seems to hold a lot of promise for detecting cultural remains beneath sediment and in fact has succeeded in a few instances in confirming wreck locations. In most cases, however, its direct application for detection of sites in a survey block is severely hampered by its extremely narrow area of coverage. It is designed to give sub-bottom profiles just as the name implies, and if the investigation isn't lucky enough to pass the towsled directly over a detectable cultural anomaly just when the instrument cycles it will prove of little real utility in archeological surveys. An additional problem with the profiler is that in riverine appliation or places where there are gaseous deposits in the silt the readings can become extremely garbled. As mentioned above, however, it can be used for gathering environmental data that can have indirect bearing on a survey project and is essential for any good sub-sediment seafloor mapping project. The sub-bottom profiler should be low on the priority list of instruments secured for most underwater archeological surveys but would be an important component of any research design that combined natural and cultural resource management goals (see also Edgerton 1964; Rosencrantz et al. 1972:275-270; McKee 1973:185-202; and Coastal Environments, Inc. 1977).

Fathometer

A recording fathometer is an essential device for just about any underwater archeological survey. With many more sophisticated instruments on board it will not be a primary detection tool, however, it provides supplementary data that is of great importance in the interpretation of the magnetometer data. Since the effects of a magnetic anomaly will drop off with the cube of the distance from the source, the depth of water beneath the sensor head should be monitored at all times. Although some tow fish now have the capacity built in, most don't, and the depth of the sensor head must be determined by a formula which takes into consideration the length of cable trailing behind the survey vessel and the speed of the vessel. If possible, that information should be directly interfaced into a computerized positioning system that is recording the magnetic and side scan data along with the locational data.

Recording fathometers also permit the magnetometer and side scan operators to be apprised of radical depth changes in advance of the trailing sensor heads. Additional benefits of the fathometer are that they can detect high profile cultural remains if the boat passes directly over the object and finally they help keep survey boats from ending up on the reefs themselves. Often the reason one is surveying a high probability area for shipwrecks is the fact that the area is not the safest for navigation, and contributing one's survey boat to the wreck population is an expensive way to enhance the resource base.

Positioning systems

Perhaps the most critical element of any underwater survey operation is knowing where one is in the real world. The sea is a very big place and poorly signed. Even very large objects lost in very small coves can elude relocation to an exasperating degree unless an effective system of positioning is employed. As important as it is to be able to relocate sites when found it is equally important to develop a record of where the boat has been when it wasn't finding anything. It is this necessity which has forced underwater archeological survey to be the high tech, equipment intensive undertaking that it is today. For areas of any appreciable size it is almost mandatory to use some electronic ocational system. The most popular units are manufactured by Motorola and Del Norte and they both offer several sets of options and instrument interfaces. They all work on a system that employs one "interrogator" in the boat that "asks" at least two reference stations at known points how far they are from the master unit at any given time. A computer can then display those distances and instantly inform an on-board "track plotter" where the boat is in a particular survey block. The plotter can display graphically to observers the exact position and course of the survey vessel on a sheet of paper that has ideal track lines preplotted on it. In this manner, the boat operator can determine how to steer his course and the archeologist can tell immediately if he is getting inadequate coverage in any lane. The newer systems update the plotter every second and can also store the depth and magnetic intensity at each recorded position if correctly interfaced with a magnetometer and fathometer. It is then possible to have the system develop a magnetic contour map, three-dimensional model of magnetics or to combine depth and magnetic values according to whatever criteria one wishes and indicate "significant" anomalies.

Positioning of course does not have to involve the lease of $80-100,000 worth of electronic gear if the survey area is small enough, manpower is sufficient and it is close enough to shore. Two land based transits have been used very effectively to relocate points on the water. When used in association with radio contact to the boat, it is even possible to use pre-determined survey tracks. Other types of effective but scaled down equipment profiles include the use of infrared distance measuring units from shore with a target on the boat.

Unfortunately what usually proves unacceptable for positioning for archeological purposes in any tight grained survey are the easily available and cheaper fixed station systems like Loran or Lorac. The degree of accuracy is highly variable from region to region but rarely could it be expected to provide a confidence level high enough for archeological survey.

A principal investigator on an underwater archeological survey in Alaska that was concerned with establishing his own fixed points on land for the transponders of his portable system (Miniranger, Autokarta, etc.) should consider short-term lease of a satellite referencing system. The instrument can be left at any point on land for a couple of days where it will be conversing with satellites as they come over the horizon. When you return it will be glad to tell you with an acceptable degree of accuracy where it has been sitting in the real world in UTM, Lat-Long or any other language that makes sense to your survey. Additional information on positioning is available in Arnold (1975:5-12) and Murphy (1980).

Ground truthing

Just as in an aerial remote sensing operation on land, the raw data resulting from underwater surveys has minimal utility until there has been a measure of on site examination or "ground truthing." This can be accomplished in conjunction with the remote sensing survey or if the positioning data is adequate and reproducible it can take place at some point in the future.

If the area being investigated is covered by sediment, some digging devices must be utilized to confirm the nature of remote sensing "hits". Usually side scan contacts can be examined without the digging since they are by definition protruding from the sediment. Although the entire dive team certainly need not be archeologists at least one should be available on the dive boat to assess any remains that are not obvious modern contamination.

Digging operations should employ whatever is necessary to make immediate contact with the source of an anomaly and expose enough of it to be able to make a preliminary assessment of its nature. A circle jet (modified injection dredge) is the best tool for most situations. It is powerful, yet highly controllable by the operator, and its effectiveness is not influenced by water depth. Air lifts are acceptable if the water depth is over 20 feet and they have a fine control at the operator's end. The object is always to remove sterile overburden quickly down to the point that contact is made with the source of a remote sensing contact. Once that contact is made and the object is determined to be related to culturally significant remains (an archeological site) then no further disturbance is justified without introducing full archeological controls.

In extreme situations where there is very heavy sediment, a propwash deflector or downthruster may be used only through the sterile overburden. The wholesale destruction of historic shipwrecks in Florida by treasure hunters is largely a result of their use of this technique for actual site excavation rather than simply making a first contact with the remains.

Site Testing and Documentation

This is the phase of a submerged cultural resources management program in which sites have been definitely located through remote sensing or some other survey process and have been judged worthy of closer examination from the ground truthing information. The latter decision is based on criteria that is variable from agency to agency. In Texas, for example, no further attention might be paid to a shipwreck site which post dates the 1900 cutoff in the State antiquities code. In the National Park System shipwrecks are seen as part of a continuum with chronological age being only one aspect of their significance, even a World War II troopship may be viewed as a significant cultural resource in the making or as a site worthy of interpretation or development for recreational divers.

The objectives in any site-specific investigation would be to obtain as much data as possible that would aid in identifying the nature of the site, and in understanding the range of natural and cultural transformational processes that acted on it to leave it in its present condition. If it was an underwater component of a land based historic or prehistoric activity area, it may be approached somewhat differently than a shipwreck. The primary difference is that an underwater midden associated with a land based activity area or an entire activity area that is now submerged due to changes in eustatic sea level, subsidence factors, for example, can be approached with the same basic research designs applied to terrestrial archeology. This is indeed a case where standard archeological practice can be carried underwater while a shipwreck presents some very different characteristics and problems as an archeological entity. It is not within the scope of this paper to address this issue further except to note that some of the methodological considerations presented here would vary dependent on whether or not a shipwreck was the focus of the investigation.

Site mapping

As on land, different tools can be used depending on the water depth, turbidity, available materials, size of the site, and inclinations of the principal investigator. Due to certain problems inherent in using optical devices underwater, even in good visibility, the most common mapping techniques involve the use of strings and measuring tapes. Turning angles is either avoided by the use of trilateration techniques or a compass or protractor is employed to extend baselines through the site. Complicated physical grids, such as those popularized by work done in the Mediterranean are generally cumbersome and unnecessary although a portable grid big enough to cover a one or two meter excavation unit can be a useful adjunct to the "strings and things" baseline system. In cold water, the methodology employed should be eminently simple and each dive carefully preplanned. National Park Service researchers working in the near freezing waters of Lake Superior actually draw a representation on mylar of the graphic results of each succeeding dive. Key points are identified in the sketches, labelled and a fresh mylar is prepared for the next dive team. It then becomes a procedure of simply filling in the blanks underwater and in no case is data transferred from one slate to another on the dive. The team's scientific illustrator reduces all data to a master site map at night and the project director arbitrarily designates spot checks between points not yet measured to determine closure and ensure accuracy in the mapping exercise.

The reason for these painstaking practices when working in cold water is that one learns quickly that the higher faculties of judgement and reasoning are some of the first that are impacted in a cold water environment. After the initial size up and assessment dives, the dive team should spend its limited exposure time working methodically and not trying to reason or make important decisions while underwater.

Photo documentation

It is advisable that any project have at least two persons capable of taking decent underwater photographs in variable conditions. Lack of contrast, low light levels and flashback from strobes on suspended particles in the water seem to be the biggest recurring problems. For panoramic scenes with divers in view it helps tremendously if their drysuits are not gearbox black. It is advisable that the principal investigator attempt taking pictures personally in whatever environment he is working in. This helps him identify with and internalize the problems his photographer will face which should help in his overall planning responsibilities.

Additional problems related to cold water photography is the loss of dexterity of the photographer from numbness which precludes him making proper setting adjustments on the camera, and the slowing of his reflexes. There is also a tendency for film to tear in the camera, for condensation to develop behind the lens, and for strobes to increase their cycling time.

If possible, the capability for processing film should be taken to the field. This is highly recommended because it can be prohibitively expensive to gear up again, mobilize a boat and return divers to an area after it was discovered in the lab that the photographer held his cold-numbed index finger over the camera lens for those critical shots of feature X.

Perhaps the most significant point that can be made about photo documentation is that it is important, and it is difficult to achieve unless there is excellent communication between the archeologist in charge and the camera technician. It is important that any research operation develop a reliable in-house capability for this function.

Video documentation

The use of video tape has proved to be an extremely effective and cost efficient technique for documenting research on underwater archeological sites. It was first used in a systematic manner for gathering data in this context by W.A. Cockrell at the Warm Minerals Springs project in Florida in the early 70's (see Murphy 1978) and has since become a primary tool for National Park Service underwater operations.

Its advantages include instant feedback, i.e., the researcher knows what returns he has before leaving the field; ease of use and operation without extensive training; good returns in low visibility conditions without backscatter; ability to have non-diving scientists observe operations on the site; ability to reuse and recycle tapes with poor returns; availability of raw tapes that can easily be edited for interpretive purposes or even for broadcast use on television if the right formats are used.

One has the option of choosing a system that leaves the monitor and VTR in the boat and allows hardline communication between the surface support crew and a diver in a lightweight helmet or any one of the new self contained systems that can be operated with no umbilicals to the diver.

Additional Considerations for Cold Water Research Diving Operations

In addition to the specific problems related to the archeological process, there are some general considerations for cold water diving. Two good general references on cold water diving are Somers (1973), and Jenkins (1976).

Insulating garments

Although custom fit special wet suits have been used successfully for short dive profiles even in Antarctica, dry suits and several pairs of heavy thermal underwear are recommended for any serious underwater archeological operation in cold water. Three fingered mitts are always more effective than five fingered gloves in providing insulation, although one must sacrifice a degree of dexterity. Consequently, it is further recommended that the normal items (clips, D-rings) utilized by divers to secure survey instruments to their bodies be replaced by substitutes at least 200% the normal size. Some cold water divers use climbing carabiners which are easily manipulated even with dry suit mittens. The issue of cold water insulating garments for divers has been addressed in some detail by the U.S. Naval Coastal Systems Laboratory (Lippit and Bond 1976, Nuckels 1978).

Life support systems

All single hose regulators have the unfortunate tendency to freeze in very cold water, a problem which increases proportionally with the air supply demands of the diver (usually a function of how hard they are working), and depth. It is recommended that redundancy of first and second stages be required in deep cold water diving operations, e.g., dual manifold that permits attaching two entirely separate regulators to the diver's air supply. Double hose regulators are much more freeze resistant but their breathing characteristics are usually not as good and their utility for buddy rescue in cold water is limited. Particular attention should be paid to providing a dry air source, be it SCUBA or surface supplied. Moisture in the air can increase the likelihood of freezeups of regulators or low pressure suit inflators and may aggravate fogging problems in light weight helmets.

Topside support facility

The single greatest cause of lost time and low effectiveness in cold water research diving operations is the lack of a warm, comfortable shelter stocked with copious amounts of peanut butter and jelly and hot nourishing meals between the dives. It is hard for a non-diver to imagine how fast the core heat can be drawn from a diver's body in cold water, there is simply no equivalent to this process on dry land.

Decompression considerations

Various studies have shown that a chilled diver has a greater predisposition for being stricken by decompression sickness. National Park Service archeologists follow very conservative decompression regimes in cold water work and substitute oxygen for air during in-water decompression stops while following air tables. Teams that are not familiar with cold water operations should also be aware that the inactive period at an in-water decompression stage can bring on extreme chilling problems.

Cost Effective/Public Involvement

These two issues are addressed together since they often end up being interrelated. As in any scientific enterprise, especially one as equipment intensive as underwater archeology, the greatest cost savings are most directly a function of good project design. Defining clear attainable goals for each phase of the work is critical as is the identification of products that are of direct interest to the general public. Underwater archeology has an appeal to a broad spectrum of society that is rarely equalled by any other discipline and this appeal should be capitalized on. The involvement of interested sport divers, amateur historians and the cooperative assistance of other agencies should always be figured in as possible factors in the equation.

Federal and state underwater projects have received very significant assistance from the Coast Guard, Navy, and the private sector in the past. Interested sport divers have contributed thousands of hours to projects and at the same time have been exposed to a conservation philosophy toward submerged resourcs which has long-lasting benefits well after termination of the work. It is foolish to not at least consider the involvement of volunteers when it provides such an excellent forum for ethic building in addition to cost savings.

The National Park Service Submerged Cultural Resource Unit has taught paraprofessional courses for groups consisting of park rangers and local divers. These individuals are then permitted to conduct non-destructive investigations on submerged lands in National Parks. They are given access to government equipment and boats to map and photograph submerged sites and to set up baseline information for monitoring any vandalism or other attrition to the sites. It has been our happy experience that some of the most ardent wreck divers and collectors will be happy to donate time and energy to researching shipwrecks for nothing but the satisfaction of knowing more about them. Some have formed shipwreck preservation societies which take an active hand in helping monitor sites and have kept rangers informed of antiquities violations in large areas which are difficult to adequately patrol using only Service personnel resources.

Finally, the written products must reflect a concern for public understanding. It is important that the benefits of preservation oriented research as opposed to treasure hunting and collecting is demonstrated through tangible products that are of interest beyond the esoteric perspective of the archeological community. One way to accomplish this is to involve various locals in the actual report writing or to at least insure that their efforts are amply acknowledged in print. Although the professional adequacy of the final report is always the ultimate responsibility of the principal investigator, there is an additional obligation to make the report readable to the lay person or to write additional popularized versions of the work.

One interpretive mechanism that has proved particularly successful is the creation of an underwater trail guide and topside brochure for the use of sport divers on particular wrecks. They are openly encouraged to dive the sites and their experience is enriched by increased understanding of what they are seeing, but the brochures also make clear safety considerations and warn them of arrest and prosecution if they are caught removing anything.

Summary

We have examined the range of methods and techniques that are employed in conducting underwater archeological survey, inventory, testing, and documentation. This has been presented in an overview fashion with the intent of identifying the nature and limitations of various approaches to underwater research to potential project planners and principal investigators working on submerged sites in Alaska. Additional references have been cited throughout the paper to permit interested readers to follow up on more specific questions regarding technique, logistics and equipment. The assumption has been made that research will be conducted in a resource management framework so the issues of public involvement and appreciation have also been addressed.

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The excavation of a mid-sixteenth century Basque whaler in Red Bay, Labrador

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Introduction

The Red Bay Project, is a co-operative undertaking between the province of Newfoundland and Labrador and Parks Canada. It involves the archaeological investigation of the submerged remains of a wooden vessel presumed to be the Spanish Basque whaler, the San Juan, which was wrecked in Red Bay harbour, Labrador in 1565 (Barkham and Grenier 1979:61). The wreck was discovered in the fall of 1978 by Parks Canada's marine excavation unit with the help of archival information provided by Selma Barkham, working in Spain for the National Archives of Canada. The project also includes extensive land site excavations of a Basque whaling station. This work is being conducted by a research team from Memorial University of Newfoundland, under the direction of James A. Tuck. To date several oven structures for rendering blubber into oil, associated structures including a cooperage and several thousand ceramic tile and artifacts have been uncovered. These excavations are being carried out on Saddle Island, located at the entrance to Red Bay harbour. The underwater site was located approximately 15 meters out from the north shore of Saddle Island.

The ship was loaded with barrels of whale oil when it was wrecked. The recovery of these containers has led to a major study of 16th century coopering technology. A study of the ship as a unique document of the 16th century has also been started with the precise and detailed mapping of the hull structure and with the three dimensional recording on the surface of loose structural timbers found on the wreck site. A large number of well preserved whale bones were also found around the wreck and indicated the potential of the entire harbour as a major and unique repository of faunal remains which would allow for the study of butchering techniques and carcass disposal patterns utilized by the Basque whalers. Although the ship had been salvaged, as reported in the archival documents, it now appears that enough artifacts will be recovered in and around the ship to possibly reconstruct what life would have been like on board a whaler in the 16th century in Terra Nova.

The Basque Whalers

The Basques are known as the pioneers of large scale whaling, having established the trade as early as the 12th century and probably earlier (Markham 1881:969). The initial area of their whaling exploits was concentrated in the Bay of Biscay along the coastline of the Basque country, which extends from Bayonne in the north to Port Bilbao in the south. The Basque country, although mountainous, is heavily forested and has for many years supplied timbers for use in ship construction. The Baques never lost their forests despite the shipbuilding boom of the 16th century. This was due to strict conservation laws which ensured that for every tree felled a new tree was planted. The effects of this law are most evident throughout the Basque country which today continues to supply timbers for ship construction. The area around Onate is typical, and it was here at the University of Onate that Selma Barkham has conducted much of her archival research. References to the vessel San Juan come from the small port of Pasajes in the parish of San Juan. Throughout Pasajes there is evidence of the importance of shipbuilding with ship's timbers often used in house construction. Intriguing wood technology details such as triangular recesses, found on the Red Bay wreck, can be seen on some 16th and 17th century buildings. Many of the local shipyards still use traditional Basque shipbuilding practices, and it is not uncommon to find oak and eucalyptus timbers seasoning in nearby rivers.

The whalers came from all over the Basque country and literally emptied villages and small cities of all able bodied men. The Basques are generally believed to have hunted baleen whales, specifically the right and bowhead whales. These whales, averaging 12 to 18 meters in length, are characteristically slow swimmers, have a high oil yield and can be found near shore. They are also very buoyant after harpooning and lancing. Together these characteristics enabled the Basques to be highly successful at their trade, so much so that by the 16th century they had to sail as far away as Greenland and North America in search of the large whale herds. The importance of the whale fishery can be seen from the various documents now being studied and which refer to large amounts of money spent on ship construction and in particular insurance coverage.

The south coast of Labrador is not unlike the coastline of the Basque country. The high mountains overlooking the Straits of Belle Isle made for ideal natural watch towers from which to spot migrating herds of whales, while many of the well protected and deep harbors provided excellent locations from which to construct the shore facilities necessary for processing whales. The Basques were involved in whaling all along the south coast of Labrador and by the mid-16th century as many as 2,000 persons were engaged in the whale fishery, which extended from about July to late fall and oftentimes into January. The two main centers of activity were Chateau Bay and Red Bay.

Archaeological Research

Archaeological investigations began in 1979 with an initial strategy to test the site with a series of trenches through which a positive correlation could be made to 16th century ship architecture. This series of tests proved quite successful in locating and identfying the bow, the stern and the two sides of the solid portion of the well preserved structural remains of the ship, flattened on the bottom of the harbour in approximately ten meters of water. Subsequently, a full scale excavation project was initiated in 1980.

Ship's structure

The ship has a keel length of about 15 meters with a stem to stern length around 26 meters and a beam of 8.5 meters. These dimensions have been estimated from the 'as found' design characteristics which include a long overhanging stem and a strongly raked stern post which is linked to the upper extension of the keel by a fore-and-aft scarf, both typical of the 16th century. The transom was a square tuck design with the outside planking in a reversed v-shaped pattern similar to the Henry Grace a Dieu built in 1514. This planking revealed evidence of at least one gun port although no armaments have yet been found in this area of the site. A portion of the ship's rudder has been uncovered with complete excavation of this important artifact planned in the 1982 field season.

Several other interesting parts of the ship have already been raised and are presently undergoing conservation and analysis at Conservation Division. These include: a capstan, a swivel gun or verso, an anchor, and a bilge pump consisting of a square tube of beech, bevelled on the edges with the plunger mechanism still very much intact. The long range objectives of the ship study are to reconstruct the ship and its technologies in plan and ultimately as a model, with the interim step of constructing an 'as found' model of the wreck site.

Technical Operation

Because of the nature of the equipment involved in marine excavation, a natural dichotomy exists between the technical and research aspects of marine archaeology. Research aspects would include such things as the actual excavation, records associated with this excavation, historical research, artifact analysis and data synthesis. On the other hand, technical aspects include the installation of grids and datum lines, equipment maintenance, structural recording, production of plans, photography and remote sensing. This dichotomy between research and technical functions has been formalized in the organization of the marine archaeology unit of Parks Canada. In this organization a portion of the staff is entirely devoted to the technical operations of marine excavations.

This involvement in the excavation of the San Juan has seen refinements made to existing methods as well as the development of new techniques for dealing with underwater sites. Part of the paper will deal with the technological aspects of a marine excavation as utilized on the San Juan site.

To effectively undertake the underwater excavation of a shipwreck site a stable surface platform is required. In Parks Canada's case this is a 150-ton, 30 ft. by 60 ft. steel barge. This barge has been totally redesigned for the sole purpose of underwater excavation. A two-story deck house contains space for an office, drafting room, galley, artifact recording station, washroom and shower. Below deck is a small workshop plus the changing room for the divers. Also below deck is the engine room. The machinery located here includes a 600 cfm low-pressure air compressor which powers the airlifts and other pneumatic tools. The engine room also houses a high-pressure air compressor which supplies filtered air to the on-deck cascade system. Two diesel generators supply power for the barge's electrical systems, underwater lighting and a 12-ton deck-mounted hydraulic crane. This crane has proved to be indispensible in moving equipment, installing the grid system, installing anchors and in raising timbers and other artifacts.

The deck of the barge is the location of most of the structural recording. An addition to the deck accommodates a drafting station. On-deck water tanks are used to hold structural pieces prior to drawing and photography. On-deck tanks are also used to hold the day's artifacts before they are transferred to the field lab.

A double-lock compression chamber has recently been installed on the barge deck. This piece of equipment was originally acquired for the treatment of pressure-related diseases considering the isolated nature of the site. Its future use for surface decompression on deeper sites is now being considered.

The main advantage of the research barge is that it provides a large even platform with all the facilities and equipment to carry out a marine excavation. One of the disadvantages of this barge is that it lacks its own motive power. This required it to be towed to the sites on which it is to be used. Once on site any adjustments to the position requires power boats. Also the barge was designed to be used principally on protected sites, such as in the harbour at Red Bay, Labrador, and may be less than ideal for unprotected open-water sites.

Because of the cold water on the San Juan site, adequate thermal protection for the divers is mandatory. Wetsuits just do not provide enough protection. One of the types of suits used are variable-volume neoprene drysuits. These suits provide reasonable thermal protection but demand a fair amount of maintenance to prevent leaks. In an attempt to reduce this problem Parks Canada is going to experiment this year with a Latex rubber drysuit.

To provide air the San Juan divers use double scuba cylinders connected to full-face masks. The full-face masks provide additional protection against the cold. A hooka system for the divers was deemed impractical considering the number of divers and the potential for tangled hoses.

In the spring and fall on the Red Bay site the water temperature averages 1 to 2 degrees C. At these temperatures a stationary diver, even in a drysuit, rapidly looses intellectual and physical capacity. After approximately 30 minutes precise drawing is no longer possible. In order to facilitate the mapping of the exposed hull structure a hot water diving system was experimented with. The initial results were so successful that a second larger unit was purchased. Using a hot water system is now standard procedure on the San Juan site, not only for mapping but also excavating.

The hot water diving systems are basically open circuit systems in which seawater is heated in a surface boiler then pumped through 150 ft. hoses or umbilicals to the working divers. The suits are basically very loose-fitting wetsuits made from nylon covered neoprene. Water is carried throughout the suit through a network of small perforated hoses attached to the inside of the suit. The surface umbilical is attached to the suit by a quick-connect fastener which also incorporates a diver-controlled on-off valve. The surface units consist of oil-fired boilers with temperature control equipment. Water pumps move the water from the sea to the boilers then through a manifold to the divers' hoses.

The effectiveness of the hot water system can be seen in the dive statistics from the Red Bay project. Between 1979 and 1982 the size of the diving crew increased only slightly with 12 members in 1979 and 15 in 1982. The number of dives through the same period increased 36% from 752 in 1979 to 1029 in 1982. The most revealing statistic, however, is the increase in total number of diving hours over the course of the project. In 1979, 1355 diving hours were logged with 2185 diving hours in 1982. This represents an increase of 61%.

Not only has the time spent underwater been increased but it has resulted in an increase in productivity. In 1979 a total of 16, two meter by two meter grid units were excavated as compared to 50 grid units in 1982. Besides productivity, an improvement in the general quality of work has been noted as well. It is quite apparent that comfortable excavators are more observant, careful and conscientious.

Despite the advantages mentioned above hot water diving systems do have some drawbacks which should be noted. First, these units have a rather high initial purchase cost. Added to the initial price is the cost of fuel oil to operate the system. A large system can burn up to forty gallons of fuel per day. The surface units are large and heavy and require a stable base and reasonable amount of deck space. While the surface unit is operating, a fair amount of time must be spent monitoring and adjusting the controls to maintain the water temperature at a comfortable level for the divers. The unit also requires a fair degree of maintenance to keep it operating efficiently. Beneath the water the divers umbilicals are a source of problems. With up to eight divers using the hot water systems the long hoses become entangled amongst themselves, around the grids, airlift hoses and electrical cables. At the beginning of each dive every diver usually spends five to ten minutes untangling his umbilical. In spite of all these disadvantages, the increased diving time, productivity and increased quality of work has made the hot water diving system indispensible on the San Juan site, and any future cold water sites.

Another piece of new diving equipment acquired for use on the site was a Kirby-Morgan bandmask utilizing surface-supplied air. This system was purchased mainly because of the hard-wire communicaton available with the mask, and was used mainly during videotaping operations. With diver to surface communications, the surface operator could give the diver information on filming coverage, focussing and distance. This system made much more efficient use of the videotape procedure. Using the bandmask, however, requires a surface tender to handle the air and communications umbilical.

In order to establish excavation and provenience control it was decided to divide the site into two meter by two meter squares. The grid was established by first installing a datum line. This line, consisting of surveyor's tape, was suspended fore and aft along the central axis of the wreck. Because the sea-bed over the wreck was not level, the levelled datum line could only be run over a limited portion of the site before reaching too high a level at the north end. Thus the south datum support was set up just above the sea-bed, while some 13 meters away, the north datum support was supporting the datum line more than two meters above the sea-bed. It was felt that further extension of the line would make it too unwieldy to permit accurate use of a plumb bob on the wreck material. When the excavation expanded beyond these points, two additional datum lines were put in as extensions north and south of the main datum line. Following the installation of the datum lines, grids were ready to be set in at any desired location. The basic grid unit consisted of square aluminum tubing, generally in a two meter by four meter format, divided in the center to form a two meter by two meter sub-operation. These units were anchored on the sea-bed through the use of adjustable iron legs placed in each corner of the unit and held in place by lead weights. The grid was then levelled and checked daily for accurate positioning in relation to the datum line.

The basic excavation tool is the airlift. Those used by Parks Canada are generally 30 to 40 feet long and are constructed of four inch diameter aluminum pipe. When in use the airlifts are anchored at both ends so that the tube lies at an angle. This ensures that the discharge will be off the site. When the airlifts are turned off they are kept in their positin by floats attached to the tube. Attached to the intake end are long flexible hoses. These allow the airlifts to be kept out of the excavation areas where they may cause damage.

The other major piece of excavation equipment used quite frequently is the water dredge, operated by a small surface water pump. This system is most appropriate for shallow water use where airlifts are ineffective or in areas away from the main support barge.

Last year, in an effort to speed up the removal of the overburden from the site a surface screening arrangement was tried. The discharge ends of the airlifts were emptied into boxes containing one-quarter inch mesh screen. The contents were then later searched for artifacts. The effect was to greatly accelerate the excavation in the areas where a heavy overburden existed. Surface screening, though, is only practical on shallow sites.

In order to ensure accurate horizontal and vertical control during excavation a good system of datum points, with known elevations, must be established on the wreck site. On the Red Bay site originally brass, but later plastic, numbered tags were affixed to immovable hull structure. Elevations were assigned to these points in the following manner. Measurements were obtained by means of a surveyor's tape with a flat bottomed buoy attached. The zero end of the tape was attached to the buoy while the other, or measuring end of the tape was placed at the point below surface where the depth was to be measured. The tape was then pulled taut, at which point the float began displacing water and considerable resistance to further pulling was felt. Although appearing primitive in method, this technique produced very satisfactory repeatable data and offered the distinct advantage of not requiring high water visibility as an alidade does.

Because of the effect of the tide on depth measurements, all readings were corrected to a common standard; i.e. a datum point was accepted as being at a fixed depth at all times. If, because of the tide, the reading was 10 cm deeper than the standard then a 10 cm correction factor was subtracted from all readings taken. On the other hand, if the reading was 10 cm shallower than the standard, 10 cm would be added to all readings. Every 15 to 30 minutes, two reference depths would be checked to account for changing depths during the recording process and if required a new correction factor would be employed.

Only two people were involved in this recording as a "feel" had to be developed by the measurer in order to obtain consistent data. Comparison of data collected by each recorder showed that variation was very seldom greater than two cm over a ten meter distance. The limitation to this recording method was that it could not be used with a sea running. Waves greater than approximately 30 cm resulted in considerable intermittent jogging of the surveyor's tape and ultimately created spurious data. Fortunately, sea conditions on site were generally adequate to permit the recording described above.

After the datum points had elevations assigned to them, horizontal control was established by having these points triangulated to the main datum line.

A different series of numbered tags were used to identify important structural timbers encountered and removed during the course of excavation. After the tags are attached the timbers are photographed, triangulated and measured. All of this is done before the timber is removed to the surface for drafting. This information is later used to prepare a plan of the recovered timbers from the site.

Photography, cinematography and videotaping play an important role in the recording of the excavation. Still photography, besides providing a visual record of archaeological features and artifacts, also provides material for publications and conference presentation. For still photography the Nikonos 35 mm camera with a 15 mm lens is used almost exclusively. This camera is compact, reliable and easy to use, and the lens produced excellent results.

Since the beginning of excavation on the San Juan Parks Canada has been documenting the entire project cinematographically on 16 mm film. The ultimate aim is to produce a documentary film of the excavation but other end products have been emerging. The footage can also be used to assemble short training films illustrating specific techniques of excavation. The raw footage is also a good means of illustrating to colleagues the various structures and features of the site. Parks Canada uses an Arriflex camera in a Mako housing. The cost of equipment and production of films is an expensive proposition, but it is probably the best way to communicate the history, importance, techniques employed and the meaning of underwater archaeological sites to the general public.

Besides films, another similar method for recording an excavation (which is probably more useful to the archaeologist) is videotaping. Parks Canada uses videotaping extensively to record all important structures, features and artifacts. The videotaping results in a permanent record that can be viewed easily over and over again. The inexpensiveness of the equipment, the ease of operation and editing makes videotaping an almost indispensable tool in marine archaeology.

Other than photographic and video means, site features are also recorded graphically. Most important here is the production of the structural plan and the surface drafting of the recovered timbers. The structural plan is basically an as-found drawing of the ship's structural remains following excavation down to solid structure. To produce this plan the two meter by two meter grid units are accurately drawn underwater using plumb bobs and rulers. All structural details including treenails, spike holes and counter sinks are recorded. Also, molded dimensions and elevational data are noted. All underwater drawings are done at a scale of 1:10. The drawings are redrawn on the surface, photo-reduced and then assembled to form the overall structural plan.

All of the tagged structural pieces raised to the surface are subjected to detailed drafting. As for the structural plans, all fastening data is intensively recorded. This is necessary to determine which pieces originally were fastened together. With this data pieces can be fitted together as paper reconstructions after the field season. Another use of these structural drawings as well as the structural plan is in the production of three dimensional models. As no plans exist to raise and conserve the San Juan the production of as-found and reconstructed models will be important displayable end-products of the project.

Apart from the actual wreck excavation, a harbour survey is also being undertaken. The survey, consisting of free swimming and towed searches, will eventually encompass all of the underwater area of Red Bay harbour. As part of the survey, a trench, referred to as the shore trench, was excavated between the wreck site and the whaling station on nearby Saddle Island. The purpose of this trench was to gain a better understanding of the relationship of the wreck to the whaling station. A secondary aim was to determine the spatial and temporal distribution of whale bone with an outlook of providing the impetus for a comprehensive study of Basque whaling technology. An unexpected find during this excavation was the discovery of a thick concentration of fishbone, all of which appeared to be the discard from a cod-splitting operation. Found within this deposit was an articulated series of caudal vertebrae indicating that whaling and codfishing were contemporaneous operations. The extent of the codfishery however, has not yet been determined. The recording of this information was accomplished through a study of stratification. Stratigraphy can be very much a part of marine archaeology, given the proper site conditions. The study of stratification at the Red Bay site is just one example of how the principles of land archaeology can and should be adopted underwater.

Faunal Analysis

Another important aspect of archaeological research being undertaken at Red Bay is zooarchaeological analysis. The analysis of the whale bone has centered around species identification, butchering practices and carcass disposal patterns. In terms of these objectives, both the right whale and bowhead whale have been identified with many of the bones exhibiting cut marks. The wreck site excavations have revealed whale bone at all levels of excavation particularly in the shore trench area between the wreck and the whaling station. In this particular area there was a proliferation of flipper and tail elements and a comparative absence of skull fragments. However, during the harbour survey a heavy concentration of skull fragments was located on Tracey Beach. This would seem to indicate that flippers and quite possibly tails were being discarded at the processing site while skulls were being towed away to a dump site.

Artifact and Other Related Research

The Red Bay project is also deeply engaged in artifact research, carried out by the Material Culture Research Unit of Parks Canada. The San Juan was loaded with casks of train oil when the ship sank, and while much of the cargo was salvaged at the time of wrecking it now appears that as much as two-thirds of the cargo remained in the wreck. Thus the principal artifacts collected have been cask remains which include thousands of barrel staves, hoops, cants, and other miscellaneous pieces. Most of these casks have been badly damaged by the collapse of the wreck; however, complete casks are being found. The majority of casks were made of oak, although beech was also used. Makers assembly marks can be observed on most staves indicating manufacture, disassembly and reassembly at time of use. Four different sizes of containers have been identified: full barricas, one-third barricas, half barricas, and a smaller bever cask.

Various other research reports have been compiled on a wide variety of artifacts recovered from the site. These include: footwear, coarse earthenware, roofing tiles, ceramic and glass vessel sherds, weaponry (verso), and ship's fittings and rigging. A preliminary study of ballast stones has been completed with emphasis on stowage patterns, the geological and geographical provenience of the stones through lithic analysis, thus providing some indication as to the ship's origin, and finally to identify the cultural use of lithic materials. Other research includes the compilation of reports on 16th century shipbuilding and shipboard life, Selma Barkham's continued studies on the Basque whalers, investigations into the history of the whaling economy and technologies before and after the Basques, a study of faunal remains, literature searches in the Basque Studies Program in Reno, Nevada and in Ottawa, and finally various other researches in Basque whaling technology as the archaeological evidence becomes available.

Finally, another little mentioned but important technical aspect of underwater archaeology is diver safety. The fundamental document is a set of diving regulations to which all Canadian federal employees involved in diving have to adhere. This diving code provides the basis for safe diving. In addition to this, Parks Canada has introduced a certification program for all of it is divers. All divers are required to pass a stringent yearly medical exam before being allowed to dive. At the beginning of the field season divers must participate in training dives. During these dives, divers familiarize themselves with their suits, practice emergency situations, ascents and rescues. Further, all staff divers must have first aid training and yearly cardio-pulmonary resuscitation training. Because of the isolated nature of the site, emergency medical and excavation procedures have been arranged for.

Session III

Preservation and Housing of Materials

Basic conservation requirements for marine archeology: Metals and ceramics

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Introduction

In the past decade there has been increasing activity in all aspects of underwater archeology. One needs only to look at the diversity and number of papers presented at professional meetings such as the Conference on Underwater Archeology and workshops such as this one that is being held in Sitka, Alaska. Almost weekly we read in the newspaper about the finding or the search for a shipwreck. Unfortunately, too many of these projects involving extremely significant shipwrecks and sites are directed by non-research oriented organizations for profit and not for their research value. In addition, too many are not cognizant of the responsibilities that come with excavating a historically significant wreck. They do not have a competently trained nautical archeologist on their staff and are not aware of the complications of marine archeology conservation. The purpose of this paper is to present some of the basic conservation requirements of marine or nautical archeology. Interested readers are referred to Plenderleith and Werner (1971), UNESCO (1968), Dowman (1970) and Hamilton (1975) for a more thorough introduction to the subject. I plan to keep this paper very simple and straightforward; however, a detailed bibliography is included at the end of the paper.

In general, most archeologists do not have the necessary experience or training to handle conservation problems commonly encountered in the field. To compound the problem, few archeology programs or laboratories have adequately trained staff, properly equipped laboratories, or sufficient funds and time available. The question arises, why be concerned with the conservation of artifactual material from marine sites? Partially the concern results from the recognition of the historical and anthropological significance of the material that is recovered, but more importantly it results from the simple fact that if such finds are left untreated they will suffer irreversible damage and possibly complete destruction.

At this point we need to consider what conservation is. This term has become one of the "in words" of the past decade. In the present context, conservation is simply the documentation, analysis, cleaning, and stabilization of an object. The objectives of cleaning and stabilization are to protect artifactual, faunal, and other archeological material and to prevent their reacting adversely with the environment after recovery. The term preservation usually refers only to cleaning and stabilization, but it is often used interchangeably with conservation. In contrast, restoration refers to the repair of damaged objects and the replacement of missing parts. A specimen may undergo both conservation and restoration, but in many cases restorations are not attempted. Regardless, restoration should never be initiated without conservation.

Conservation should not detract fro the natural appearance of the object, nor alter any of its scientific attributes since artifacts are a primary unit of study in archeology. The conservator should strive to process specimens so that they retain as much diagnostic data as possible and yet remain chemically stable. For example, every attempt should be made to preserve as much of the original surfaces, form, and dimensions of the object as possible. In addition, all treatments should be reversible. This last requirement recognizes that a conservation treatment may not last indefinitely nor remain superior to all future techniques. If the treatment is reversible, one always has the option to retreat the object and continued preservation is assured. When objects are treated, the basic attitude and approach should be cautionary and similar to that espoused by Plenderleith and Werner (1971:16-17). Basically, they state that the past history of an artifact may impart features of significance pertaining to age and provenience which can validate its authenticity. Therefore, a preliminary examination of the object needs to be made to determine a course of action that will preserve the integrity of the specimen and maintain any significant attributes or features relating to its manufacture or microstructure. In some cases, a corrosion layer may contain valuable archeological data. If so, the layer should be preserved and not indiscriminately removed. Only in those instances where the corrosion is unstable, conceals underlying details, or is aesthetically displeasing should it be removed. Above all, one should heed the cautionary advice given by Plenderleith and Werner (1971:17), "This work calls not only for knowledge, foresight, ingenuity, and dexterity, but for infinite patience. It should never be hurried."

Role of Conservation in Marine Archeology

A concern for recording basic archeological data from any given piece is essential, and needs to be emphasized by all laboratories processing archeological material. In archeological conservation there is more to consider than the mere preservation of individual artifacts. One duty of the conservator is to stabilize the artifact so that it retains its form and diagnostic data. When treating archeological material that requires documentation of context, as well as preservation, the documentation demands equal emphasis and first priority. The conservation of marine archeological material is a perfect example of the intimate relationship that can exist between archeology and conservation. In marine archeology conservation is important not only because it preserves material remains of the past, but also because it can provide as much archeological data as field excavations and archival research.

I strongly believe that the excavation of marine shipwrecks, underwater, or wet archeological sites is not good archeology unless the recovered material is processed by a conservation laboratory. The trained personnel of the laboratory should have an archeological perspective, a familiarity with the material culture of the period, and an awareness of the problems and complexities of marine archeological conservation. Archeological conservation should be considered an indispensable archeological technique where marine archeology is concerned. Despite all the buck passing, it is the responsibility of the archeologist to see that material recovered from his site is properly conserved. If he is not ready to accept this obligation and make no provisions for conservation before the site is investigated, then work should not begin on the site.

Marine Archeology Conservation Requirements

The cleaning of a silver chalice from an Etruscan tomb is only remotely analogous to the conservation problems of marine archeology. When artifacts are recovered from the sea, especially the warm areas such as the Caribbean and the Mediterranean, they are commonly encrusted with thick layers of calcium carbonate, magnesium hydroxide, metal corrosion products, sand, clay, and various forms of marine life such as shells, coral, barnacles, and plant life. The term "encrustation" refers to the conglomerations that may contain one or more artifacts. Such conglomerations may range from the size of a single coin to masses weighing several thousand pounds containing hundreds of individual objects made of many different materials. The investigation of encrustations with their concealed contents is analogous to the excavation of a structure or a square within a site. Any laboratory that processes archeological material from marine sites should have the responsibility (1) to preserve and stabilize the artifacts as well as conservation technology permits and (2) to recover as much useful data as possible. Considerable information exists in the form of associations recoverable only by "in situ" observations made by the conservator. Extensive records have to be maintained which includes notes on the encrustation, on the objects it contained, and on all the preservation techniques used, as well as color, black and white, and x-ray photographs. Casts have to be made of disintegrated objects and of significant impressions left in the encrustations. Care must be taken of mundane things such as potsherds, cloth fragments, spikes, straps, animal bones. Even less obvious remains like impressions of seeds and insects, such as impressions of cockroaches found in an encrustation from the 1554 Spanish plate fleet, must be detected and recorded. In other words, the conservator is in a unique position to supply the archeologist with valuable evidence and to provide the laboratory with basic conservation data for research.

Let's look at an example. In Figure 1 is one of the large encrustations recovered from the sites of the "San Esteban", one of the three ships of the 1554 Spanish plate fleet wrecked off Padre Island, Texas. This single piece, with two anchors, a bombardetta gun and many smaller objects, is over four meters long and weighs over two tons. A laboratory must have sufficient space and equipment to take a piece like this, mechanically clean it, properly conserve recovered specimens, and possibly cast a number of natural molds of disintegrated objects. It may even be necessary to prepare the encased artifacts for display. The laboratory has to have forklifts, chain hoists, large vats, specialized DC power supplies, hundreds of kilograms of chemicals, thousands of liters of deionized water among other resources to perform the job. In areas such as Sitka, Alaska, where there is an abundance of rain water, this can be substituted for deionized or distilled water for most treatments. The laboratory has to take an array of material such as is depicted in Figure 2 and turn out an array of stabilized artifacts such as depicted in Figure 3.

Conservation should be part of any archeological project, but in marine archeology it is more of a requirement than any other field of archeology, and it is a more complicated problem. It can be quite expensive, in some cases costing more than the field work and taking much longer time to complete. For example, in my experience I have found that it takes an average of two to five years to conserve what is recovered from a single season of shipwreck excavation. More than one project has been initiated with adequate funding for field work, but after the excavation and recovery stage, no funds are left for the equally important conservation stage. For some reason it is very difficult to raise money to complete long term conservation projects. Presently in the Conservation Research Laboratory at Texas A&M University there are ten tons of artifacts from the Molasses Reef shipwreck and three to five years of work.

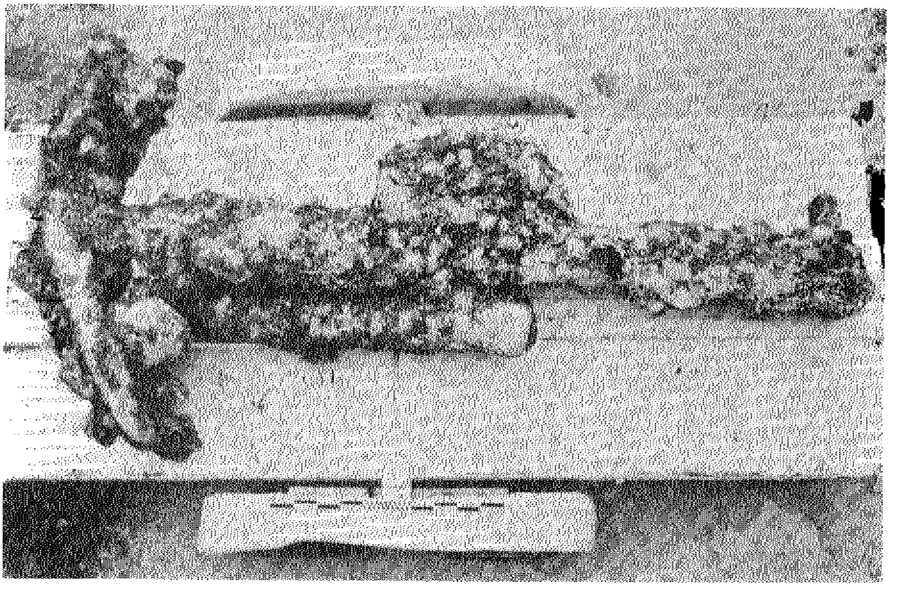

Figure 1. Large encrustation recovered from a marine shipwreck.

Figure 2. Array of encrusted material recovered from a marine shipwreck to be processed in a conservation laboratory.

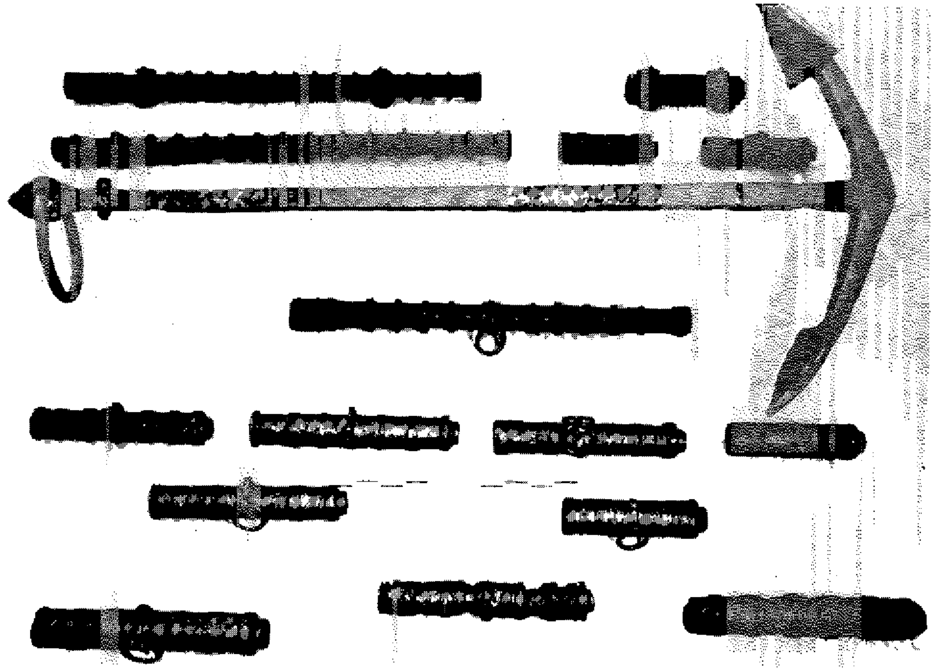

Figure 3. Array of iron artifacts processed in a conservation laboratory.

This is a typical problem confronting conservation laboratories that handle marine archeological materials.

Project Planning Recommendations

Prior to excavating a marine site, the following steps are recommended:

1. Anticipate what you might encounter in the archeological project, be it a survey, testing or a full-scale excavation.

2. Be aware of the types of breakdown, corrosion, and degradation that the recovered material might undergo.

3. Have a person with conservation experience in the field to help with the excavation to insure that the recovered objects are properly treated.

4. Make arrangements for conservation before initiating any operation where artifacts may be recovered. This may mean contracting with an existing laboratory or establishing special facilities for the project. If the latter is the case, be sure that the laboratory is properly equipped and is headed by a conservator with experience in the field of underwater archeological conservation. All the artifacts recovered from an excavation should be under the direct control of an experienced conservator until they are stabilized.

5. Always keep in mind that it is an archeological project and that an archeological project does not stop in the field; it continues in the lab. As much basic archeological data is recovered in the laboratory as in the field. The information and records from both the field and the conservation laboratory have to mesh together in order to interpret the archeological record properly.

Field Recommendations

Many projects set up a laboratory for field conservation. This might be recommended for sites far removed from the main laboratory. However, in most cases the field laboratory can not compare to the main lab and its capabilities. For this reason I recommend that field conservation facilities be used as little as possible, aside from general cataloguing, acquisitioning, and documentation. Proper field conservation procedures can be anticipated by referring to various articles such as Pearson (1977) and Lawson (1978). As a conservator who has worked with considerable material from underwater sites, my recommendations concerning procedures in the field are simple.

1. Record the precise position and orientation of every object -- the ship timbers, encrustations, individual

artifacts -- and number each item, so that there will be no confusion as to how each object related to the site after the material has been delivered to the laboratory for processing.

2. Do not remove any encrustation or layers covering the artifacts; it provides a protective corrosion resistant layer around the material and preserved associations. Also, considerable data can exist in the form of impressions and natural molds of objects which have completely disintegrated.

3. Keep all material wet at all times, either in sea water or, preferably, in fresh water with the pH adjusted to a reading of 10 to 12 with sodium hydroxide. This will inhibit further corrosion.

Laboratory Conservation

The laboratory operations from the time a specimen is delivered to its ultimate storage or exhibition, can be conveniently separated into four basic stages:

1. storage prior to treatment
2. mechanical cleaning
3. preservation procedures
4. storage or exhibition after cleaning

Storage prior to treatment

Generally speaking, all metal objects should be kept submerged in tap water with an inhibitor added to prevent any further corrosion. For long term storage, excellent results have been achieved using a 1% oxidizing solution of potassium dichromate ($K^2Cr^2O^7$) with sufficient sodium hydroxide added to create a pH of 9 to 9.5. Alkaline inhibitive solutions such s a 5% solution of sodium carbonate or 2% sodium hydroxide can also be used, but they are not satisfactory for long term storage (Hamilton 1975:21-25). As mentioned above any adhering encrustation or corrosion layers should be left intact until the objects are treated since they form a protective coating which retards corrosion.

Mechanical cleaning

X-rays are indispensable for determining the content of each encrustation and the condition of any object. They also serve as a guide in extracting the artifacts. The use of chemicals to remove the encrustation is generally a very slow, ineffective process which can be damaging. The use of well-directed hammer blows and ssorted chisels are generally the most used and effective. However, for many objects, especially fragile objects and ceramics, small pneumatic tools are more efficient and less destructive. A larger pneumatic weld-flux chisel is particularly useful for the removal of large amounts of encrustation. Smaller more precisely controlled Air Scribes, with more delicate chisels are ideal for removing the encrustation from small, fragile artifacts, and for getting into tight places (Figure 4). Chisels can be easily fabricated in the laboratory for specific jobs. Combined use of the two tools is often desirable and is quite effective in freeing movable parts on artifacts. Sandblasting can sometimes be used for cleaning the bores of cannons or guns, but should never be used on the surface of any piece.

Conservation of Iron from Marine Sites

Iron is the most difficult of the metals for the conservator to treat, especially if recovered from a marine environment. It does, however, exemplify the basic requirements of metal conservation in marine archeology. Once iron has been removed from a marine environment the corrosion process continues, and even accelerates, unless certain precautions are taken. It is essential that artifacts be properly stored in a inhibited solution to prevent further corrosion. If iron is exposed to the air or placed in an uninhibited solution, the ferrous compounds can oxidize to a ferric state which occupy a greater volume and cause the surface of an artifact to scale off. Just this process can disfigure a piece and eventually destroy it. The greatest damage, however, is caused by various iron chlorides found in iron recovered from marine environments. Hydrated iron chlorides, on exposure to moisture and oxygen, hydrolyze to form ferric oxide or ferric hydroxide and hydrochloric acid. The hydrochloric acid in turn oxidizes the uncorroded metal to ferrous chloride and hydrogen, or ferric chloride and water. This corrosion cycle continues until there is no metal remaining. The specifics of iron corrosion are too complicated to go into here; the interested reader is referred to Argo (1981), Gilberg and Seeley (1981) and North (1982).

Prior to treatment, iron artifacts should be carefully examined and their condition evaluated to determine the most appropriate conservation procedure. Artifacts are generally placed in one of three categories. These are based on weight/size ratio, close visual inspection, testing the surface with a magnet, probing the surface with a dental pick, and occasionally using x-rays. The categories are:

1. Iron objects with a substantial metal core and a consolidated surface capable of withstanding most treatments without significant changes in the form or dimensions of the artifact. Electrolytic reduction, sodium sulfite reduction and hydrogen annealing are the most effective alternatives for conserving iron recovered from the sea.

2. Specimens that are badly corroded, but still retain their overall shape. Little metal may remain and there may be little overall supporting strength. These specimens are delicate, so many treatments might alter

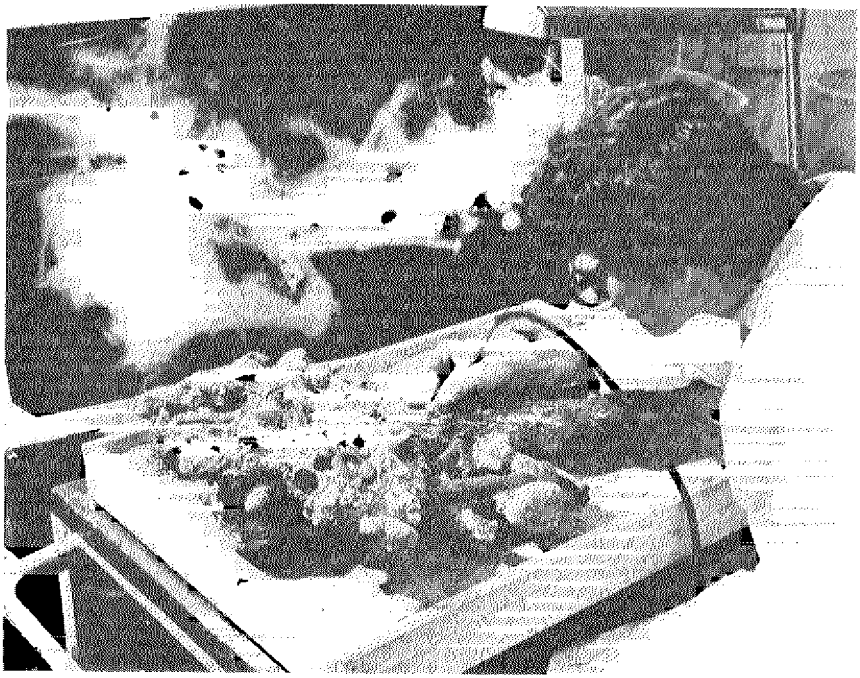

Figure 4. Array of iron artifacts processed in a conservation laboratory.

the original form. In this case, the sodium sulfite treatment has the best chance of success.

3. Metal artifacts that are so badly oxidized and fragile that they cannot be recovered or treated without disintegrating. Consolidating in place, casting the object itself or making a replica from the natural mold that often forms around the piece is often the only means of preservation or recovery.

Only after the objects are placed into one of these three categories should the treatment begin.

Electrolytic Reducting Cleaning

The ease of setting up, maintaining, and the long-run economy of an electrolytic unit, along with the versatility of electrolytic cleaning, makes it one of the conservator's most valuable tools. See Hamilton (1975:30-49) for a detailed discussion of this technique. It can be selected exclusively for the mechanical cleaning action of the evolved hydrogen, for the reduction process or, as usually is the case, a combination of the two. The process can be used for most metal objects, as long as they have a sound metallic core. Efficient electrolytic reduction, however, involves more than wiring up artifacts for electrolysis. One must be familiar with electrode potentials and pH, and how these variables relate to metal reduction, corrosion, passivation, and immunity. These factors are particularly crucial when dealing with chloride-contaminated metals from a marine environment. This is not to say that satisfactory results cannot be obtained by the novice, but rather, that a good knowledge enables the conservator to understand and better control what is going on in the electrolytic cell and to correct adverse conditions.

The essence of the technique involves connecting an artifact to the negative terminal of a DC power supply, placing it in a vat containing an electrically conductive solution called an electrolyte, such as 2 to 5 percent sodium hydroxide or 5 percent sodium and surrounding the object with expanded steel mesh that is connected to the positive terminal of a power supply. In the reduction process, if the amperage rate is controlled, some of the positively charged metallic iron ions in the corrosion compounds are reduced back to a metallic state. In addition, the negatively charged corrosive chloride ions and other anions are eliminated from the specimen as they migrate toward the positively charged anode by electrolytic attraction. Other procedural factors that must be considered are the equipment, such as type of power supply, terminal wires and clips, anode material, and vat and the experimental variables such as the manner in which the electrolytic cell is set up, the electrolyte selected, chloride monitoring, electrode potentials, and current densities. In general, maximum reduction of the ferrous corrosion compounds is achieved if the current density in electrolysis is in the range of .001 to .005 amps/cm^2.

Sodium Sulfite Treatment

The alkaline sulfite treatment was developed by North and Pearson (1975) to stabilize marine cast iron, but is also used on wrought iron. Bryce (1979:21) found that the treatment is effective on iron objects that are moderately to heavily corroded, but they must have a metallic core. Otherwise the iron object breaks up. The procedure is as follows:

1. Once the objects have been mechanically cleaned, they are immersed in a solution of 0.5 M (20g per liter of water) of sodium hydroxide and 0.5 M (126g per liter of water) of sodium sulfite. Tap water can be used for the first one or two baths but deionized or distilled water should be used in the final baths. The container should be filled as full as possible and sealed to prevent any access to air. The solution is mixed and the object placed in it as quickly as possible to avoid any oxidation of the solution. The container is placed in an oven and kept heated to a temperature of 60 degrees C. The object is changed through as many separate baths as required to eliminate the chlorides from the metal; this may take a week or several months and numerous baths. The solution does not attack any residual metal so there is no danger of too many baths. When a marine iron object is immersed in this hot, reducing solution the iron corrosion compounds are converted to magnetite and the chlorides are transferred to the solution where they are discarded with each bath change. The objects come out of the treatment with a very black surface coloration. Since the solution is strongly alkaline, contact with the skin should be avoided.

2. Once the alkaline sulfite stabilization treatment is completed the objects are washed for one or more hours in several baths of deionized water and then placed in a 0.1 solution of barium hydroxide (32g per liter of water). The barium hydroxide reacts with any remaining sulfite by forming insoluble barium sulfite and barium sulfate. Barium hydroxide is slightly poisonous, so contact with the skin should be avoided. If the object is intensely rinsed in several baths of deionized water following the alkaline sulfite stabilization, the barium hydroxide baths can be eliminated.

The alkaline treatment has been very effective for conserving iron recovered from a marine environment. The main drawbacks of the treatment are that it has to be carried out in an air tight container and the solution should be kept heated.

Hydrogen Reduction of Marine Iron

In hydrogen reduction the objects are placed in a special furnace with 100 percent dry hydrogen gas, or a mixture of hydrogen and nitrogen, and heated to a temperature of 300 to 1000 degrees C (Barkman 1977:155-166). During the treatment all the moisture is driven out of the artifact and the chloride corrosion compounds are volatilized. Hydrogen reduces the iron corrosion compounds back to a lower oxidation state or metal and combines with the oxygen in the corrosion products, forming water which is driven off by the heat. This treatment, while successful, has several drawbacks. First it requires rather expensive and sophisticated equipment that is outside the financial capabilities of most laboratories -- especially for larger objects. Second, there is the problem of the changes in the metallurgical characteristics in the metal when heated to high temperatures. Recent information by Tylecote and Black (1980:95) reports:

> The loss of information by the treatment of totally rusted marine cast iron at 800 degrees C will not be great and there seems to be little objection to the use of the hydrogen reduction process at 800 degrees C for this purpose. The reduction of rust on wrought iron is a different matter. The main problem is knowing whether the residual metal contains, either intentionally or unintentionally, enough carbon to give useful information to the archaeometallurgist. If carbon is absent then treatment at 380 degrees C is acceptable although some change will occur. The slag inclusions will suffer very little microscopic change and no macroscopic change. To ensure the removal of chlorides at 380 degrees C the treatment time must exceed 60 hours.

Treatment Following Stabilization

After treatment of sea-recovered iron objects it is imperative that their surfaces be covered with a protective coating to insulate the metal from the effects of moisture, chemically active vapors, and gasses. It is very important to choose the right sealant or coating to provide a protective moisture barrier and prevent corrosion. In general, the sealant selected should be: 1) impervious to water vapor and gases, 2) natural-looking so that it does not detract from the appearance of the artifact, 3) reversible, and 4) transparent or translucent so any corrosion of the metal surface can be quickly detected. Immersion in molten microcrystalline wax such as Gulf 75 Microwax, Witco 180M or Cosmoloid 80H are widely used. Polyurethane coatings are also used (Hamilton 1976:55) as well as a clear drying zinc phosphate based anti-corrosion primer followed by several coats of high durability, clear, matt polymethyl methacrylate acrylic lacquer (North and Pearson 1975:177).

Conservation of Cupreous Metals

For this paper, the nonspecific term cupreous metals is used for copper and the alloys such as brass and bronze where copper predominates. In general it matters little what the specific alloy is, for they are usually treated in the same way. Care needs to be taken only when there is a high percentage of lead or tin, both of which are amphoteric metals and dissolve in alkalies. There are a considerable number of chemical treatments for copper, bronze and brass, and most are not satisfactory for cupreous metals from marine sites. Consult the bibliography at the end of the paper for further information.

In a marine environment the two most commonly encountered copper corrosion products are cuprous chloride and cuprous sulfide. However, the mineral alterations in the copper alloys are more complex than those of just copper. Once any cupreous object is recovered and exposed to the air, they continue to corrode by a process referred to as bronze disease. Cuprous chlorides in the presence of moisture and oxygen are hydrolyzed to form hydrochloric acid and basic cupric chloride. The hydrochloric acid in turn attacks the uncorroded metal to form more cuprous chloride. The reaction continues until no metal remains. Any conservation of chloride-contaminated cupreous objects requires that 1) the cuprous chlorides be removed, 2) the cuprous chlorides be converted to harmless cuprous oxide, or 3) the chemical action of the chlorides be prevented.

Electrolytic reduction cleaning

Electrolytic reduction of cupreous metals is the best and most efficient method of removing the chlorides from the object and is carried out in the same manner as described for iron. The alkaline electrolytes, 2% sodium hydroxide or 5% sodium carbonate or 5% formic acid can be used. If formic acid is chosen, stainless steel must be used for the anode, otherwise mild steel is used. In contrast to iron, electrolytic cleaning of cupreous metals is of short duration.

Sodium sesquicarbonate rinses

The cuprous chloride component of copper and its alloys are insoluble and cannot be removed by washing in water alone. If the artifact is placed in a 5% solution of sodium sesquicarbonate, the hydroxyl ions of the alkaline solution react chemically with the insoluble cuprous chloride to form cuprous oxide and neutralize any hydrochloric acid by-products formed. Successive rinses continue until the chlorides are removd. The object is then rinsed in several baths of deionized water until the pH of the last bath is neutral.

Benzotriazole

The use of benzotriazole (BTA) has become a standard part of any conservation treatment of a cupreous metal, following any stabilization process and preceeding any final sealant. The artifact requiring treatment is immersed in 1% benzotriazole for 24 hours. The BTA is usually dissolved in water, but ethanol can also be used. See Green (1975), Hamilton (1976), Merk (1981), Sease (1978) and Walker (1979) for additional information. The benzotriazole forms an insoluble, complex compound with cupric ions. Precipitation of this insoluble complex over the cuprous chloride forms a barrier against any moisture that could activate the cuprous chlorides responsible for bronze disease. The treatment does not remove the cuprous chloride from the artifact, it merely forms a barrier between the cuprous chloride and the moisture in the atmosphere. For artifacts heavily contaminated with chloride, the treatment may have to be combined with one of the processes described above. Treatment by this method alone is not always successful.

Final Treatment and Sealant

Following electrolytic or chemical cleaning the objects are put through a series of hot rinses in deionized water. Because copper tarnishes in water, Pearson (1974:302) recommends washing in several baths of denatured ethanol. If a water rinse is used any tarnish can be removed with 5% formic acid or by polishing with a wet paste of sodium bicarbonate (baking soda).

After rinsing, copper objects should be dehydrated in acetone and sprayed with a protective coating of clear acrylic. Krylon Clear Acrylic Spray #1301, which is Acryloid B-72 in toluene) is recommended for ease of application, durability, and availability. For additional protection benzotriazole can be mixed with Acryloid B-72 or polyvinyl acetate and brushed on the artifact. Microcrystalline wax can be used, but in most cases has no special advantage over acrylics.

Conservation of Lead and Lead Alloys

Once recovered from the sea, the corrosion products of objects of lead or lead alloys, such as pewter, are stable. They may be unsightly or even disfiguring, but they do not take part in chemical reactions that attack the remaining metal. The objects need to be cleaned only for aesthetic reasons and to reveal surface details under the corrosion layers. Old pewter, being an alloy of lead and tin needs to be treated as tin, which is the more anodic and chemically sensitive metal. Therefore, no acids, or sodium hydroxide should be used on it. Consult the references under lead conservation in the bibliography for additional information.

Electrolytic reduction cleaning

This treatment is carried out in the same way as described for iron; however, considerable care must be taken when alkaline electrolytes are used as lead will dissolve in them unless the DC electrical current is flowing to the artifact. The power must never be turned off when lead objects are in electrolysis. One difference from iron is that in some cases, 10% sulfuric acid and lead anodes are used. In addition, assymetrical AC current is sometimes employed for maximum reduction of the lead corrosion products back to a metallic state. When dealing with pewter, sodium carbonate should be used as the electrolyte.

After treating lead and pewter objects with alkaline electrolytes, they should be rinsed in several baths of dilute sulfuric acid (four drops of 15% sulfuric acid per liter of water) until the pH ceases rising. Any residual acidity from the sulfuric acid rinses is then removed by immersion in successive baths of cold deionized water until the pH remains constant with that of the water (Plenderleith and Werner 1971:269-270).

Chemical treatment of lead

Because of the ease of treatment and the availability of the chemicals, the most widely used treatment for lead from any archeological environment is the acid treatment described by Caley (1955). The lead is immersed in 10% hydrochloric acid which removes lead carbonates, lead monoxide, lead sulfide, calcium carbonate, and ferric oxide. If lead dioxide is present, it is removed by soaking the object in 10% ammonium acetate. The ammonium acetate also acts as a buffer to protect the lead from the action of any hydrochloric acid that may remain. This treatment is good for lightly corroded specimens and it gives lead surfaces a pleasing appearance. However, the process must be carefully monitored to avoid etching the metal. The surface detail that is preserved by this treatment varies with the degree of corrosion when recovered. In practice, Calley's method has been superseded by electrolytic reduction, which has the ability to convert mineral products back to a metallic state.

Sealant

Following the conservation treatment and rinsing, lead and pewter objects should be dried with hot air or dehydrated in a water miscible solvent such as acetone. Then they should be sealed by immersion in hot microcrystaline wax or sprayed with an acrylic spray as described for copper.

Storage of lead objects

Lead is particularly susceptible to organic acids, such as acetic, humic and tannic acid. Lead artifacts, therefore, should not be stored in oak cabinets or drawers. Since vapor from wood can initiate corrosion, lead should be stored in sealed containers or polyethylene bags.

Conservation of Silver

The most commonly encountered corrosion products on silver and silver alloys in a marine environment are silver sulfide and silver chloride. Both compounds are stable mineral forms and do not take part in any further corrosive action with the remaining silver. The only reason to treat silver is to reveal underlying detail, for aesthetic reasons or to reduce mineral products back to a metallic state. In base silver alloys with copper, the copper corrodes preferentially and forms cuprous chloride which continues to corrode the copper component of the silver. In these cases the silver is treated as if it were copper. For marine recovered silver, there are two main alternatives: 1) electrolytic reduction and 2) alkaline dithionite.

Electrolytic reduction

The electrolytic cleaning of silver takes advantage of the reduction action of electrolysis by removing chloride and sulfide ions from silver chloride and silver sulfide, and by reducing the silver in the corrosion compounds to a metallic state. Two methods of electrolytic cleaning of silver have been described in the literature: normal reduction and consolidative reduction. Both techniques require that a metal core be present. Most laboratories use the normal reduction process.

Normal reduction. Normal electrolytic reduction uses a DC power supply that puts out a fully rectified direct current. The same electrolytes as described for copper, 5% sodium carbonate, 2% sodium hydroxide, and 5% formic acid, are used. The current density must be very low. An amperage rate of .01 amp per square centimeter of artifact surface gives good results. Alternatively, the regulated DC power supply can be adjusted to give a cell voltage of approximately three volts (Pearson 1974:299). When using a formic acid electrolyte, only inert anodes such as stainless steel No. 316 or platinized titanium should be employed. Mild steel is recommended over stainless steel when sodium hydroxide is used. Both electrolytes have their application depending upon the nature of the silver corrosion products.

Consolidative reduction. In consolidative reduction, power supplies are used that put out a partially recticfied or an asymmetrical alternative current. In general, 90% of the current is forward current which is characteristic of DC current and 10% is reverse current. During electrolysis there is a rapid succession of reduction and dissolution cycles. During the 90% forward half of the cycle, reduction of metal in the corrosion compound and deposition of metal dissolved in the previous reverse current half cycle takes place. During the 10% reverse half cycle there is a partial dissolution of the previously reduced or deposited metal;

however, the 90% forward current puts the emphasis on reduction and deposition over dissolution as the current reverses 120 times a second. This technique was used by Organ to regenerate the silver on the Ur lyre that was completely mineralized to silver chloride to massive metallic silver, while preserving the surface details of the corrosion layers. Asymmetrical alternating current has several advantages over straight direct current, and should prove to be superior in the treatment of metal artifacts, even iron objects.

Alkaline dithionite

The alkaline dithionite treatment is similar to that of alkaline sulfite described for iron. It is a relatively cheap, simple and rapid method of consistently reducing silver corrosion product to metallic silver (MacLeod and North 1979). The steps in the processing of silver by this method are:

1. Immerse the object in 10-12% hydrochloric to remove the encrustation layer consisting of sand, shell, calcium carbonate, copper and iron corrosion compounds. This requires from 12 hours to a week or until all cleaning action ceases and no more gas bubbles evolve. During this step it is necessary to make sure that the solution remains acidic. If necessary, concentrated hydrochloric acid is added to the solution to keep a working strength.

2. Rinse thoroughly in tap water to remove all residual encrustation and mechanically remove any stubborn spots.

3. Immerse in a solution of alkaline dithionite. Mix up a solution of sodium hydroxide (40g sodium hydroxide per liter of water). Once the sodium hydroxide dissolves add 50g of sodium hydrosulfite and then immerse the silver quickly to eliminate oxidation of the solution in the container. The container should be completely full of solution and have an air tight seal.

4. For one week agitate and turn the container daily to keep the solution mixed and to expose all surfaces of the specimens to the solution.

5. After the week is up, remove and rinse the specimens in water until the pH of the rinse water remains unchanged.

6. The corrosion products on the surface of the artifact will be reduced to a gray, metallic silver which can be polished with a wet baking soda paste or a fiberglass brush.

Rinse and sealant

Following electrolysis or any chemical cleaning, the specimens should be thoroughly rinsed in deionized water.

If an alkaline electrolyte or chemical is used, the rinsing should be more intensive. The silver is dried with hot air or dehydrated in acetone and coated with clear acrylic lacquer such as Krylon Clear Acrylic 1301.

Gold and gold alloys

Gold is a very noble and inert metal that does not corrode; therefore, gold and high gold alloys do not require any treatment. The copper and/or silver corrosion compound of low alloy gold are treated by the same techniques described for those two metals.

Conservation of Ceramics

Generally pottery from archeological sites require only minimal treatment. When recovered from marine sites such as shipwrecks or even submerged or inundated aboriginal sites, certain procedures must be followed to prevent damage to ceramics. Pottery from marine sites become saturated with soluble salts and in many cases the surfaces become covered with insoluble salts such as calcium carbonate and calcium sulfate along with metal compounds. The soluble salts (chlorides, phosphates, and nitrates) must be removed from the pottery to be stable. The soluble salts are hygroscopic and as the relative humidity rises and falls the salts repeatedly dissolve and crystallize. The salts eventually reach the surface of the sherd or pot, exfoliating the surface. In some cases this causes internal stresses which eventually breaks the specimen up. See the article entitled "The Conservation of Ceramics from Marine Archaeological Sources" by Olive and Pearson (1979) for a very succinct discussion of the subject.

Field treatment and removal of soluble salts

The basic field requirement is that all pottery should be kept wet after recovey. Non-glazed earthenware, stoneware and porcelain can be placed directly into fresh water. Glazed earthenware should be placed in sea water that is slowly diluted with fresh water over a period of time. Otherwise the difference in the osmotic pressure of sea water and fresh water might in some cases damage poorly adhering glazes. The various tin enamel wares are especially susceptible to this. The procedure for removing the soluble salts is simple. Just keep rinsing the pottery in a series of water baths until the salts are removed. A running bath is the quickest and most efficient, but it is very wasteful. In most cases tap or fresh water can be used exclusively, but if complete removal of the salts is desired, then carry out the final rinse bath in deionized or distilled water. Monitor the progress with a conductivity meter to insure knowing when the salts are removed to an acceptable level.

Removal of insoluble salts

In most cases, the safest and most satisfactory method of removing insoluble salts from the surface of pottery is by hand. Most calcareous deposits can be removed fairly easily by scraping with a scalpel, dental tool or other similar tools. Small pneumatic chisels and dental burs are also useful. For many sites, the man hours to mechanically clean all the pottery of insoluble salts is prohibitive. Chemical treatments must be applied. The following procedure is abstracted from Olive and Pearson (1979).

Pottery from marine sites are often cleaned of calcareous encrustation by immersing it in 10% hydrochloric acid until all gas evolution ceases. This is usually less than an hour. If necessary the process is repeated. Always keep in mind that the acid may weaken the body and alter the glaze. Therefore, ceramic materials should be left in the acid for the minimum amount of time. Under no condition is pottery with carbonate temper to be placed in an acid bath; otherwise, the tempering material will be removed from the paste, thoroughly weakening it.

Follow hydrochloric acid cleaning, ceramic material should be rinsed in tap water and, if necessary, placed in 10% oxalic acid to remove any remaining iron stains. This may require as much as 24 hours. Oxalic acid is toxic, so care should be exercised when using it. The oxalic acid also adversely affects the iron in the paste and glazes so the process should be monitored very closely, leaving the pottery in the acid the minimum amount of time. Oxalic acid is very effective for removing iron stains from porcelain and stoneware. The pottery is rinsed again and left to dry.

When care must be exercised, a 5% solution of ethylendiaminetetra acetic acid (EDTA), tetra sodium salt can be used for removing calcareous deposits from pottery with minimal effect on the iron content of the paste or glaze. In this process, the iron stains which are bonded with the calcium salts are removed along with the calcium. The EDTA treatment is much slower and more expensive, but is less damaging.

Stain removal

Iron oxide stains are removed with local applications of 10% oxalic acid applied with cotton swabs to the surface of the pottery. The surface should be pre-wetted to prevent the absorption of the acid into the paste. Black iron sulfide stains, which are very common on pottery from marine sites can be removed by immersing the piece into 10-26 volume hydrogen peroxide until the stain disappears. No rinsing is required after treating with hydrogen peroxide.

Consolidation and reconstruction

Quite often pottery is encountered which requires consolidation after treatment because of a very friable or weak paste or because of a poorly adhering glaze. For consolidation, soaking the pottery in a dilute solution of polyvinyl acetate or Acryloid B-72 works very well. Sherds can be reconstructed with a good celluloid or acetate glue that is internally plasticized. See the article entitled "The Restoration of Coarse Archaeological Ceramics" by Mibach (1975) for more information on this subject.

Conclusion

This paper has attempted to present some basic conservation requirements and procedures of marine archaology. However, individuals interested in archeological conservation should consult the referenced sources and consult with a trained conservator before attempting the procedures described herein. The preservation of antiquities should produce objects that are chemically stable with an aesthetically acceptable appearance. All treatments should be reversible in the event that the object should require additional preservation. After an artifact has been completely processd it can deteriorate. Only if stored or displayed under optimum conditions can this be prevented. Since metal artifacts can become chemically unstable from a myriad of causes and may need additional treatment, periodic inspection, and evaluations of the artifacts are necessary. At our present stage of knowledge, perhaps it is most realistic to say that the objective of archeological conservation is to delay reprocessing as long as possible by proper storage and to make any necessary retreatment simple and brief. It is obvious that the conservation laboratory can play a major role in marine archeology, if the objective is to produce the maximum amount of archeological data from the excavation. Close ties between the conservation laboratory and each marine archeology project is necessary. When a strong relationship is established between marine archeology projects and conservation laboratories, increased productivity can be expected.

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Conservation of organic marine archeological materials

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Introduction

In the following review, I intend to familiarize the reader with the current state of organic marine artifact conservation. The two topics which receive the greatest space are field conservation strategies and the state of waterlogged wood conservation. Both are familiar problems to archaeologists and the changing methodologies will be appreciated easily. While other topics like leather and cork receive less space, their cultural importance and conservation problems are in no way less those that of wood! Several recent publications and some yet in preparation directly address the marine archaeologist on the subject of conservation, complementing an already sizeable bibliography.(1)

Natural Preservation of Finds

A large part of our fascination with wet-site and marine archaeology lies in the preserved appearance of the cultural materials. This is particularly true of the wet organic finds, many of which previous to excavation may have been known only from the historical record: footwear, clothing, tool-handles, cordage, ships, etc. These can be rare not only because organic material were likely to be used, patched, recycled, discarded or used for fuel in their day, but also because they are chemically unstable to oxidation and biodeterioration in archaeological contexts. The preserved appearances of these artifacts belie fragile hydrated states requiring professional attention.

The conditions which tend to preserve organic finds underwater include:

- low temperature (deep sites, cold currents)
- anoxic soils (oxygen-depleted, reducing conditions, sealed by clays or fine soils, fine sediments)
- minimal light (deep sites, sedimented littoral sites)
- minimal mechanical disturbance (no waves, ice, icebergs, archaeological investigation)
- undisturbed surrounding environment (no nearby dredging, new harbour town, fishplant, pulp-mill).

Changing any of these conditions can disturb the environmental balance around all classes of organic finds and encourage chemical deterioration through oxidation and hydrolysis, mechanical damage, and also invite biodeterioration of the wood in the forms of boring molluscs and crustaceans, marine fungi (generally soft rot), and bacteria, all able to use this newly-available source of food. Accordingly, archaeologists should understand that even their shortest "survey" of a site can spoil the eventual excavation by disturbing the site's ecological balance. Backfilling with silt and plastic tarps may be necessary to protect wood against renewed borer activity, even in cold waters.

Underwater archaeological sites should be characterized by marine biologists who can apply their findings to their science and to the site's archaeology as well. For example, the datability of your shipwreck may make its subsequent ecology interesting for biological research and may, for example, indicate the wreck's insiltation sequence, as in the case of the Mary Rose's mollusc spat.(2) You should inspect any modern wood in the area for borer damage and also consult marine biological agencies for any studies on the local flora and fauna. While water quality studies are of some interest, silt studies can better characterize the preservation conditions. In particular, the redox potential will indicate to what extent reducing conditions are present, a state conducive to preservation of organics.

Sometimes the conditions which have preserved organic finds can actually damage inorganic materials in the same shipwreck. At Red Bay, Labrador, we feel that the sulphate-reducing bacteria which depleted the oxygen in the silt of the shallow harbour, once created an acid-enough local environment to aid in the total dissolution of iron hardware now lacking in the 16th century wreck.(3) In addition, the surviving iron artifacts found thus far have been surface finds, covered with coralline concretion, and in the case of the wrought-iron swivel gun, severely mineralized.

Some papers exist on the topic of preservation or organic archaeological finds in addition to the more plentiful literature on the inorganic finds.(4)

Excavation and Field Conservation

Conservation begins on the seabed since most organic materials will be sensitive to handling due to their hydrated state. Careful excavation and well-considered lifting is required. Both marine archaeologists and diving conservators have been developing and adapting better strategies to minimize abrasion and fragmentation: airlifts, fanning, soft-brushing, use of siltlifts, rigid supports, even block-lifted pedestals, lifting trays, to mention a few.(5) Between the seabed and the proper conservation laboratory, a number of protective field conservation measures must be carried out. There are several useful articles on marine field conservation.(6) A field conservator is a necessity not only on an excavation, but especially on a survey, since he can provide much valuable advice and service and also save future headaches. There are field manuals for marine conservation, however, they are no substitute for this experienced professional team member.

The artifacts must be kept wet and physically protected from mechanical damage, both for short trips and long hauls. With few exceptions, changes of salt water, being most available, are useable for short-term storage although, if fresh uncontaminated water is available, it is good to start off desalination as early as possible in storage, changing solutions weekly. Plastic containers, from large dustbins to small food containers, are indispensible transport and storage containers. Makeshift field tanks are best made from 40 ml vinyl pool liners, factory-cut and heat-sealed to your size, which are draped in a wooden box frame built to size. Rips may be avoided if the plastic is laid on a soft bed, like sand, spread in the bottom of the box.

Archaeologists will appreciate that they are responsible for registering and tagging the finds directly upon retrieval. Without provenience numbers, conservators have difficulty documenting artifacts and storage inventories become nightmares. Recommended labelling materials are spun-polyethylene or polyester papers (Nalgene Polypaper; Dupon Tyvek) or either Teflon or stainless stripping embossed with a sturdy Dymo gun. Standard Dymo embossing tape can lose its image; varnished paper tags are hopeless. Sometimes waterproof felt-pen numbering on polybags holds up to storage. In this case, and with the spun-polymer papers, we have found that only the Sanford "Sharpie" black waterproof felt pen image consistently survives storage. Recommended methods of attachment are: inclusion of each artifact with its own label in individual closed polybag or tying label to small artifact with synthetic yarn. Large artifacts like timbers and whalebones can have their tags directly attached with Monel alloy tacking staples.

When artifacts are retrieved in remote excavations, they are usually shipped to proper conservation labortories, often in urban areas. Complex field treatments generally are not feasible unless a field lab is established and resident conservation staff can carry out and monitor procedures. Most often, shipping is the cheapest and most ethical alternative. Naturally, transport requires ingenuity and effective packing methods. Some method of damp-packing can be adopted where absorbent materials (cloth, sphagnum moss for example) and waterproof wrappings are used in combination with rigid and/or expanding plastic foam in crates.

The topic of biocides is difficult since we are reluctant to use materials which may endanger our own health and since we'd like to obviate need for storage biocides by commencing treatments promptly.(7) Some labs have luck using fish or snails to clean their tank storage. In addition to regular tank changes and using lids to discourage light-dependent algal growth, Parks has commenced cleaning wood finds in the field with non-ionic detergents. Although this method promotes visual observation of detail, it is done mainly to avoid contact rashes and sulphide odour in the field lab. In cases where growth is a problem, try circulating cold water, some local waters seem to keep growth down. Dilute solutions of 0.1% phenol (carbolic acid), Dowicide 1 (orthophenyl phenol), straight ethanol or even unscented lysol have been used. Safe handling and labelling is required.

Conservation Treatments of Waterlogged Organic Finds

There are at least three major goals of these treatments, namely:

- to bring the artifact to a "dry" state with a minimum of distortion;

- to use materials of known and acceptable conservation properties, if impregnants and the like are required.

- to preserve any scientific information inherent or associated with the artifact for the entire scientific community (not just for archaeologists, historians or museum directors).

Accordingly, your artifacts are unique scientific specimens which should be available for repeated testing of hypotheses for as long into the future as possible. Several considerations can affect your conservator's choice of treatment methods:

- previous experience with similar materials can suggest adaptation of that method to your artifacts. Often empirical testing is necessary: any related discardable material should be included for the conservator's use;

- a repository, usually a museum or a university collection, is necessary to house the items. A stable relative humidity maintained at a steady level ($\pm$ 2-3% RH) in the 40-55% range is required. Organic materials are notoriously reactive to humidity changes and, given a fluctuating environment, can tear themselves apart in storage or display. In addition, display light levels should be kept low: 50-100 Lux. Storage should be in darkness.(8)

- obviously, availability of equipment and supplies will determine whether a conservator will choose one treatment over another, say vacuum freeze-drying or a solvent method.

Waterlogged Wood Conservation

We are very fortunate in the case of waterlogged wood conservation to have a high degree of cooperation between dozens of conservators and wood technologists actively carrying out both research and treatments. It is an international community linked since 1977 by the Newsletter of the ICOM Waterlogged Wood Working Group (Committee for Conservation).(9) This group has published two conference proceedings to date, the most recent of which is a kaleidoscopic textbook of the state of the art and the science.(10)

Reflected in the list of participants and the topics covered are marine archaeology, wood science, the chemistry of polyethylene glycol, case histories of ongoing conservation projects in UK, USA, Denmark, Germany, Norway, Switzerland, Canada, and the teaching of wood conservation as an academic and applied science subject. Frankly, with the publication of this volume there is no longer any excuse for an archaeologist or a cultural administrator not being able to find a waterlogged wood conservator and some sound advice.

Waterlogged archaeological woods have several inherent vices which can make them extremely difficult to dry without distortion. Their cell structures, as well as their shapes as artifacts, are preserved in a hydrated state by the water. Removal of water, whether by air or vacuum drying, can and does cause low osmotic pressures within cells, leading to cellular collapse and finally, visible shrinkage, cracking and warping. In addition, the cellulose chains in the cell structure are chemically satisfied by the water forming hydrogen-bonds at the hydroxyl groups. Apparently removal of water allows adjacent cellulose chains to bond as the cell walls approach each other in collapse. In most air-dried archaeological woods, it is usually impossible to rehydrate the cracked piece because of this irreversible bonding of the cellulose. Biodeterioration, generally soft rot removal of the middle portion of the secondary cell wall (S_2 layer), can lead to different soft and hard conditions in the same piece resulting in differential drying behavior.

Some woods are notoriously difficult to treat. For example, white oak does not permit passage of fluids, even after becomming waterlogged and exhibiting extreme surface decay, due to blockages by tyloses. Hence, the choice of impermeable white oak for casks and ships has caused a common conservation headache.

As in treating any of the other organic materials, the conservator of waterlogged wood has three activities which he performs as best he can:

- assessing the wood's condition

- estimating the appropriate treatment

- assessing the treatment's progress and "final" results.

Waterlogged wood: condition assessment

A conservator can learn much by feeling the wood, identifying the species and carefully probing with a favorite pin. However, to carry out a treatment, he prefers also to know the wood's moisture content (M.C.), possibly at several locations reflecting different detected states of preservation, so that he can predict and monitor drying. This requires sample, maximum of $17cm^3$, however, 1 cm long x 0.5 cm diameter core sections can be used. Microscopical examination will allow one to locate areas of cellulose degradation or depletion, mineral inclusions or outright mineralization.

Recently, Per Hoffman of the Bremen Cog project, Deutches Shiffahrtsmuseum, has encouraged conservators to undertake standard chemical evaluations of their woods(11), as indeed has been done subsequently in Denmark, in South Carolina (the Brown's Ferry Wreck), at Parks Canada and Canadian Conservation Institute. The approach is quite expensive and it is likely that determination of a waterlogged wood's "maximum moisture content" may provide a less expensive method of approximating cellulose-content determinations.(12)

Waterlogged wood: estimating appropriate treatment

Having assessed the wood's condition, a conservator will form an idea of which treatment is most feasible and most likely to succeed. Unfortunately, oversize items can complicate what should now be a rational decision. For example, a small oak fitting may be put through a solvent treatment in a fume hood, while an oak midship section may have to suffer a PEG surface-treatment with air drying. Both may have been assessed as being in the same condition, but for safety, logistical or economic reasons, the treatment choice differed. Obviously, a composite wooden artifact with inseparable iron or brass hardware yet in situ limits the choice of treatment due to incompatibilities of metal-wood assemblies with PEG.

Most current waterlogged wood treatments fall into two large categories: aqueous polyethylene glycol pretreatments followed by either air or freeze drying; or solvent-resin treatments.(13)

Polyethylene glycol (PEG) has been familiar to wet wood archaeologists and conservators since the late 1950's when workers in Sweden, the UK and the USA seemingly simultaneously hit upon the same approach.(14) In the early 1980's it is still proving to be an invaluable drying agent for the wood, as seen throughout the recent ICOM-Proceedings. What is changing is our application of the product and our understanding of how and why it works.

The "classic" approach is still used occasionally: the wood is steeped in an increasingly concentrated heated solution until an optimal penetration or PEG content is achieved. The Kyrenia wreck, degraded Aleppo pine, was treated this way where the PEG acted as a consolidant when it congealed upon cooling and excess water evaporated away. The treatment was chosen in consultation with Richard Steffy, the man responsible for the subsequent reconstruction. The Bremen Cog, constructed with highly preserved white oak, is being tank-treated in this way with PEG 1000.

There are drawbacks to the approach. One to 20 year treatments, often heated, can degrade the PEG, although effects of this degradation on the treatment have not yet been evaluated. Certain well-preserved hardwoods like oak but also degraded softwoods can suffer "implosion" or osmotic shrinkage resulting in "hollow checked" appearance. This occurs when the wood loses its internal water faster to the surrounding concentrated solution than that solution can replace the lost internal water. Artifacts can literally shrink in their baths. Otherwise, while the dimensions of certain wood artifacts can be preserved by this approach, the wood will be filled with a congealed weak polymer which gives little strength to severely degraded items and can attract water and dust, depending on storage conditions.

Another approach to air drying with PEG has involved repeated surface applications with brush or spraying and use of high humidity storage to effect slow drying. In theory, the PEG chemically replaces the water near the surface, bonding to the wood cellulose. During air-drying, less drying stresses are thought to be placed on the surface wood cells minimizing shrinkage and cracking. In cases of very large timbers and structures, this drying method may be the only option. Certainly this was the *Wasa's* treatment. A variant involves application of hot concentrated solutions which may be more readily accepted by the wet wood than the more dilute solutions.

Certainly the most active current area of PEG use involves freeze-drying whether using vacuum apparatus, non-vacuum condensing systems, or even the winter climate. Pioneered by Ambrose in the late 1960's in Australia, freeze-drying wood with PEG pretreatments has enjoyed applications also in waterlogged leather, textile and cordage stabilization as well (see below).

Low, medium or high molecular weight PEG's (or their mixtures) are introduced usually by soaking the wood in 20-30% v/v solutions from six weeks and longer or, rarely, by surface application. The artifacts are frozen down then placed in a drying chamber or area where the water is removed by sublimation. The result is dried wood containing a relatively small amount of PEG (presumably chemically satisfying the formerly-hydrated cellulose); a wood that has little shrinkage and a remarkably natural appearance if not heft. Most remarkable of all is a recently discovered bonus: that PEG pretreated freeze-dried wood appears not to react nearly as violently to drastic changes in relative humidity (between 0-100% RH) as fresh wood.(15) In the case of freeze-dried degraded wood, subsequent resin consolidation may be required to improve its physical strength.

Solvent treatments still require resins and, in most cases, can be viewed as proper consolidative methods. In general, the artifact's water is replaced with another solvent (alcohols, acetone, xylene, toluene, ether, or t-butyl alcohol) and finally steeped in an impregnating bath of the chosen consolidant-resin system, often at elevated temperatures.

Most popular methods are:

Alcohol-ether-dammar (Christensen)
Acetone-rosin; Ethanol-rosin (McKerrell)
t-Butyl Alcohol - PEG 4000, freeze dried (Christensen, Jespersen)
Hard Wax (Christensen)

These methods are, in several cases, time-honoured approaches to smallish, unique display items like navigational instruments. Except in the case of the massive well-accommodated TBA-PEG freeze-dry facilities in Denmark and Japan, these treatments are for safety's sake carried out on a limited basis for smallish artifacts. Muskets and numerous large deadeyes have been treated in acetone, isopropyl, or ethanol-rosin, in heated and cool solutions. The rosin treatment is being widely used for composite wood-metal artifacts, variations occurring in the metal treatments. All practioners are calling for research in this especially difficult area.(16)

The orientation of the artifact's wood to its original trunk or branch will indicate how the piece may distort or crack in drying. Ships' ribs often are made from the juncture of a branch and a trunk, hence a place of potential strain and splitting. A flat artifact, radially cut, like a lapstrake, will shrink less noticeably than a plate cut tangentially or quarter-sawn. Possibly the worst woods to treat are timbers which preserve the entire concentric ring growth, since they are really dressed trunks. In drying, the unrelieved tangential shrinkage will lead to massive deep radial cracks running down the centers of the squared faces. Kerfing, which has been used to relieve this sort of stress in railroad ties and other massive lumber(17), has been suggested, and is to be evaluated on the Ronson ship timbers excavated in lower Manhattan last spring.(18)

Waterlogged wood: assessing treatment progress and results

We appear to be nearing the day when, by monitoring certain aspects of the artifact itself, we may know how far along the proposed treatment course we actually are. At present, we monitor the impregnation solutions and, during drying, the wood's dimensional changes and weight loss. The limiting factor in wood impregnation is diffusion and evidence of success in this area is often gauged by the amount of impregnant a wood has absorbed and to what depth.(19) Only recently, microscopy has begun to show us where the impregnants go. Basic research using thin sections and staining techniques has enabled Young to determine where at least two grades of PEG go in wood: the higher molecular weight polymer, Carbowax 3350, was shown to fill void spaces like cell lumenae while the lower weight, namely Carbowax 400, was shown to occupy only cell walls, as in the manner of true bulking.(20) One awaits the day that "standard logs" can accompany artifacts through a treatment and be cut, cross-sectioned and stained to determine the progress of PEG diffusion. As yet, we don't know what depth of penetration is required for a successful PEG freeze-dry treatment or whether some other aspect of its diffusion or chemistry with cellulose plays a more important role.

To a conservator, treatment of an artifact is never truly completed. Rather, we've delivered it to the next stage. In the case of waterlogged wood, we've delivered it to the influence of our ambient and/or controlled environments. Most PEG-treated finds will need climate-control, but perhaps research will prove that the PEG freeze-dried pieces can withstand less stringent climate control.

Waterlogged Leather Conservation

In contrast to wood conservation which has benefited from association with the advances in wood science and technology, leather conservation has remained, until only very recently, somehow a craft-oriented treatment due, possibly, to our attraction to certain craft aspects of the leather industry. The greatest recent breakthrough in the methodology is adoption of the minimal intervention ethic. In this case, we are getting away from greases, softening agents, and the multitude of attractive commercial and traditional hide preparations. Instead we are attempting to dry our leathers to be acceptable for curatorial study, display and later scientific study. Doubtless in the future, skin studies will come into their own as research methodologies impove: species identification; tanning process; nutrition; geographical source etc.

A recent article best describes the problem with vegetable-tanned leather conservation and provides extremely useful treatment methods.(21) Briefly, wet skin products, by having lost some if not all tanning agents, experience a hydration of their proteinaceous collagen chains, analogous to that hydration of wood's polysaccharide cellulose chains. Loss of tanning agents lowers resistance to heat and water-solubility, opening waterlogged leathers to hydrolysis, embrittlement, and shrinkage from heat. Accordingly, elevated temperatures (say above 40 degrees C) and long immersions should be avoided. Alternatively, approaching leathers like wood seems to be giving acceptable results. That is, a PEG or glycerin pretreatment is supplied to the polymer chains, presumably bonding at available hydroxyl sites, allowing distortion-free drying, whether by vacuum freeze-drying or, in a unique approach, acetone drying. By this latter method, the water-glycerine bath is subsequently replaced with acetone which, being immiscible with glycerine, evaporates leaving small amounts of glycerine within the artifact.

Research in this field is long overdue and recently some promising projects have been launched: the Canadian Conservation Institute has compiled a methodology for microscopy and staining of archaeological skins and is evaluating leather softening agents; Parks Canada is evaluating the use of iron-stain removal agents on vegetable-tanned leathers. As well, the first number of an informal Leather Conservation Interest Newsletter has just been circulated(22) and there now exists a leather conservation institute in the United Kingdom(23).

Waterlogged Textile, Matting, Cordage(24)

While many of the established techniques, particularly those of mounting and restoration, can be adapted to waterlogged texiles, the woolen and vegetable marine fibrous finds share uncommon fragility, especially in drying. While gross specimens like manila cordage may obviously collapse and shrink in drying, individual fibres can also shrink, flatten and even "shatter", ruling out multiple wet-dry cycles.

Depending on the site, textiles may be preserved in silt, requiring only superficial cleaning, while others can be encrusted in concretion or iron corrosion products, requiring chemical cleaning. Obviously the sorts of reagents required to remove these sorts of accretions can damage cellulosic and woolen fibres. Oxidizing agents have been commonly used (oxalic, HCl) while complexing agents and reducing agents, and their combinations, show promise as being less damaging (ammonium citrate, EDTA-2Na, DTPA, sodium hydrosulphite). Since the cellulosic fibrous materials are highly reactive to water, solvent dehydration can be useful, and to avoid further movement once an item is dried, additional consolidants are best applied in non-polar solvents.

Again, this class of organics is benefiting from freeze-drying from pretreatment solutions of PEG with added weak consolidating resins like cellulosic derivitives, polyvinyl pyrrholidone, etc. The Swiss have been using this approach for fibrous finds from their lakes since the mid 1960's, contemporary with the same advance in waterlogged wood.(25) An added bonus of this technique is our ability to articulate these artifacts to the desired shape during the gelling state in the freezing down.

The Archaeology Division of the CCI has been adapting and developing excellent cleaning, consolidation and mounting methods for waterlogged textiles, particularly severely degraded wools from the 16th century Basque bog site, Red Bay, Labrador.(26)

<u>Waterlogged Cork, Bark</u>

In nature, these materials prevent evaporation of moisture from the tree's trunk, due to the polysaccheride suberin. Accordingly, once waterlogged, corks can be extremely difficult to dry without collapse. Bottle corks have responded to soaking in PEG (Carbowax 1000) and slow drying. The CCI is, at present, conducting some basic research into the rheology of birch barks at varying humidity levels, a study which may have applications for waterlogged corky materials.(27)

<u>Waterlogged Bone, Tooth, Ivory</u>

The physical properties of these materials have been studied extensively by physiologists, paleopathologists, zooarchaeologists and even taphonomists.(28) The latter are interested in the physical process of fossilization which, incidentally, requires an initially waterlogged burial environment.

Whole groups of natural history specimens, dinner bones and the like often can be airdried. Human bones are said to be more prone to deterioration in burial and may merit close attention.

Teeth often split upon drying. They are really a composite of more collagenous dentine interior with a mineral-rich, less elastic enamel exterior which combination leads to differential drying rates and stresses. If splitting is to be avoided (or to be reclosed in a split item) often the only answer is liquid or high-humidity storage. While elephant ivory has no enamel, the cross-grain structure can lead to interesting cracking problems.

Walrus ivory with its marbled osteodentine is equally prone to splitting. In short, drying of tooth without distortion may be unfeasible.

On the other hand, wet bone which is suspected of fragile surfaces has responded well to impregnations in aqueous resins or dispersions or in solvent-borne resins (PVA, PVB etc.), often under vacuum.(29)

Waterlogged Keratins (Quill, Baleen, Claw, Hoof, Tortiseshell)

These proteinaceous materials are usually composed of laminae deposited during growth, which, when retrieved from wet sites, tend to delaminate on dryng. As a result, the approach has been to adhere the laminae. An adhesive consolidant is introduced into the laminae of the wet artifact by soaking (drawing vacuum can be tried), then air-drying the artifact under clamp.(30)

Conclusion

Freeze-drying is proving to be an effective drying method for many classes of waterlogged organic artifacts and more studies are needed. However, it is not the answer to all problems. You, as an archaeologist or cultural administrator shouldn't simply get a freeze-drier and try to do it yourself unless you have a conservator as a team mate. It is your responsibility, whether you are an amateur or a professional, to secure a conservator to care for these finds. In addition, you must support your conservator's financial requirements for equipment and supplies. Don't force him to fight your ethical and political battles. Finally, a conservator, even one with a laboratory, can only do part of the job. Proper display and storage must be planned for from the very beginning of your project.(31) Otherwise the whole beastly expensive effort will have been in vain.

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Session IV

Legal Issues

The law and the amateur in resource management

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Introduction

Working with amateurs in the management of a state's underwater archeological resources is a concept, which if used intelligently within the framework of practical considerations, ethical requirements, and long-range goals, can pay dividends far in excess of the money, time, and energy expended. When I accepted the position as Underwater Archeologist on the staff of the Institute of Archeology and Anthropology of the University of South Carolina in July of 1973, I was given the responsibility of discovering, assessing and managing the state's underwater archeological resources using as a guideline a law that had been on the books for six years but almost totally ignored by the sport diving community. The law was written by a lawyer, on behalf of himself, a shrimp boat captain, and a sport diver. Their purpose was to gain legal protection over a Civil War blockade runner they had recently discovered and wished to excavate. What they began, in writing this law, has evolved over the years into a set of practical guidelines for both the State and its citizens to follow in managing South Carolina's underwater archeological resources.

In order for a resource management law to accomplish the aim for which it was written, it is first necessary to establish a philosophy which is compatible with a state's long-range goals. This philosophy becomes the underlying guide in the management of the resources through the law. I use the word philosophy very broadly to encompass such concepts as premises, attitudes and other principles that give thrust, meaning and direction to the law. In the 10 years that I have been involved in resource management, I have become convinced that the philosophy behind the administration of the law is the bedrock on which the law itself should be developed.

It is specifically for that reason that I cannot offer a definitive plan of operation for the development of a law for the management of Alaska's underwater archeological resources. Rather, I will first suggest a philosophy of working with amateurs that can be adapted to your particular requirements and be reflected in your law. A philosophy that stresses education over law enforcement, cooperation over confrontation and has as a goal the acceptance of responsibility by the sport divers for a major share of the management of their own underwater archeological resources. This is accomplished by working within the law under the direction of the state. The premises which follow, when taken together, form a philosophical statement of intent and direction in resource management from which a law can be developed.

Premises

People are basically good and tend to obey the law

Successful societies are built on laws. The news media constantly bring to our attention the results of personal, national, and international lawlessness but seldom give equal coverage to the daily, ordinary, and routinely expected acts of civil obedience that surround us. Most of us will live out our lives with only a few serious encounters with lawlessness. The preponderance of personal activities is non-destructive and within the law.

Cooperation is more effective than confrontation and threats of law enforcement

Cooperation is more effective, economical, and gets the job done better. For the resource manager it is also less taxing mentally, physically and emotionally in dealing with the sports diver to move toward a mutually acceptable goal than to demand compliance through threats of law enforcement. Unfortunately, law enforcement is sometimes necessary. There are always some on whom the message is lost or who choose to ignore and flaunt the law. No system is 100% effective. Perfection is a phenomenon not found in humans or human endeavors.

Ethics can not successfully be imposed on others

This was probably best demonstrated in the 1920s by the rapid proliferation of the illegal speakeasy and the underground alcohol business of bootlegging, the common man's response to the ethical and moral dictates of others. The ethics of one group cannot, through legislation alone, be successfully imposed on another group. The ethical concepts that are an integral part of the education and background of a professional archeologist generally run contrary to the desires and goals of the amateur collector who perceives his avocation of artifact collecting threatened by unreasonable bureaucrats. Ethics is one of the main issues that separates the archeologist, who is generally the resource manager, and the non-archeological amateur. It is, however, the latter, the non-archeological amateur, who historically has been responsible for the major underwater archeological discoveries both numerically and in significance. It was amateurs who discovered such preeminently significant vessels as the Vasa, Mary Rose, Philadelphia, and the Brown's Ferry vessel. The archeologist's position that he should be the sole arbiter of issues pertaining to that body of knowledge of which he has special insight through education, training, and experience is valid, and in the long run must prevail. The amateur, on the other hand, through whose dogged perserverence, special expertise, and hard work, this resource is discovered, should participate in its management. These two opposing viewpoints do not have to remain unreconcilable. They can be brought together but the responsibility for this rests with the archeologist. He must take action through an educational process to demonstrate to the amateur that the best interests of all is served by a cooperative effort under professional guidance, and this can be done.

Education is the key to understanding, and understanding is the foundation of conservation

It is readily obvious that the more I meet with individuals and sport diving groups the more cooperation I receive from them. These meetings generally include a slide talk on artifact identification and history, identification of artifacts they have found, a discussion on the law, and the importance of conserving the state's non-renewable archeological resources. With the realization of the importance of conservation comes acceptance, compliance, and eventually support of the law.

It is sometimes necessary to accept a short-range loss in order to make a long range gain

Advancements in the physical and social sciences do not always progress along a straight path. In resource management it is often necessary to make difficult compromises. For example, information derived from the sport diver is usually more valuable to our long range goals in our quest for knowledge than their surface collecting is harmful to the resource.

People generally want to become involved

Without exception, on every underwater project that the Institute has carried out in public view both sport divers and support personnel have volunteered their services and, under proper supervision, have provided valuable assistance.

Support and opposition are identical emotional responses, travelling parallel paths and only a step apart

In dealing with the sport diving community I have found that the most vociferous opponents of the law regulating their activities become, through time and education, the strongest supporters of our conservation efforts.

People want and need approval

Psychologists call it stroking--the act of giving approval and support. A state official who shows appreciation to a sport diver acting within the law binds him to the law with a moral force far greater than the occasion might normally warrant.

The views of the sport diver should be acknowledged and respected even though they generally run contrary to the ethics and values of the archeologist

This premise is closely linked to the ethics statements made earlier. Disparate groups can not resolve their difference without an acknowledgement by both parties of the right of differing viewpoints. With this right acknowledged they can begin communicating and resolving their differences as equals.

Practical Considerations

The South Carolina program provides the vehicle for the blending of amateur participation under professional guidance in the management of its underwater archeological resource. The law provides for the licensing of sport divers to recover artifacts but requires them to make a written report of their activities to the Institute on a monthly basis. The licensing of sport divers to recover artifacts by the State is a very controversial issue within the ranks of the professional underwater archeological community, most viewing it as the antithesis of ethical archeological resource management. From an academic viewpoint they may be right, but very little of the world we live in is structured along academic lines.

The practical elements of the situation I encountered in 1973 were not those that lend themselves to an academic solution. I discovered that several hundred sport divers were recovering artifacts and fossils on a regular basis from the 12,000 plus linear miles of creeks and rivers of the State. The quality and quantity of artifacts and fossils recovered suggested that on and under the bottoms of the rivers lay a vast repository of information in the form of sunken vessels, artifacts and fossils from the state's historic, prehistoric, and paleontological past. Fossils are included in our management plan because in our river system all underwater archeological sites have yielded fossils and all fossil beds have an archeological component. Utilizing the numbers, energy, expertise, and local knowledge of the sport divers was to me the most practical and reasonable approach to take for a one-man operation with wide responsibilities and very limited resources. Even if I had the capability through law enforcement to compel compliance with the law, I would have chosen the voluntary compliance route as the one most likely to be successful over time.

The program developed in South Carolina for the management of its underwater archeological resources might serve as a guide for consideration by Alaska authorities but should not be adopted verbatim. The program that has evolved in South Carolina over the past 10 years reflects the special needs of a small southeastern state with its particular physical, human, and cultural environment. That has little in common with the special needs of the nation's largest state with its own particular physical, human, and cultural environment. The law, which is actually the resource management plan, is written for the special conditions of a specific environment and, except in unusual cases, is not transferable from one area to another. The philosophy behind the administration of the law, that element that gives it vitality, is transferable. It is not tied to a physical environment, rather it addresses the social aspect of resource management, that part dealing with people.

The Law and Its Application

The authority for the management of South Carolina's underwater archeological resources rests by State law with Dr. Robert L. Stephenson, director of the Institute of Archeology and Anthropology of the University of South Carolina. The day to day management responsibilities, however, rest with me as director of the Institute's Division of Underwater Archeology. I mention resources rather than just shipwrecks because, although shipwrecks are a very visible, media attractive, and attention getting part of the underwater archeological resources, they are only one part of the whole and not the whole itself. Prehistoric man and his water-related activities deserve attention and investigation as well as the water-related activities of historic man. The management plan that covers one logically should also cover the other.

South Carolina, like many states in the nation, with navigable rivers, harbors, ocean coastlines, or large lakes, faces the problem of how to properly manage the resources that lie on the bottom in a manner to achieve maximum acceptable protection to the resources with minimum cost to the state. It is easy to say that state governments have a responsibility to find the money for adequate management, but the realities of budget limitations often dictate otherwise. There are a number of ways to handle this problem. One is to deny its existence and let the free enterprise system take control, excavate a site for private gain, sell and scatter the unrecorded artifacts to parts unknown, and otherwise despoil an important segment of our history. The other end of the spectrum is to pass restrictive laws, authorize and fund a large law enforcement establishment, and then spend a great deal of time and money in law enforcement and defending the system in court. In South Carolina, we have chosen a middle course which we believe affords reasonable protection to the resource, involves those affected by the law in its application, and is cost effective.

South Carolina is one of only 20 or so states that has a law pertaining to the management of its underwater archeological resources. It is one of only four or five states with a state program of underwater archeological investigation and resource management, and is the only state to my knowledge, to have a program of resource mangement that has the general support of the sport diving community. The vehicle through which this is carried out is the "South Carolina Underwater Antiquities Act of 1982." The law, in its several versions, has been in effect since 1968. It was then called "Control of Certain Salvage Operations." The change in title emphasis from "salvage" in 1968, to "antiquities" in 1982, reflects the growth and development of underwater archeology in South Carolina since its inception 15 years ago.

The law does several things; it establishes, assigns, authorizes, and provides, as follows:

1. It establishes title to the river bottoms and ocean bottom out to the three mile limit and title to "all objects of archeological and paleontological association which have remained unclaimed for more than 50 years."

2. It assigns responsibility for the management of this artifact and fossil resource to the Institute, although the curation of the fossils is the responsibility of the South Carolina Museum Commission.

3. It authorizes the Institute to conduct underwater archeological projects and to license others to do the same if it is clearly "in the best interests of the state," said licensee to be guaranteed no less than 50% of the artifacts recovered, "in value or in kind."

4. It provides for law enforcement, license revocation, and judicial recourse for the diver and for the state.

The law authorizes the issuance of three types of licenses: Hobby Licenses, Search Licenses, and Salvage Licenses. These licenses are not diving licenses, they are instead licenses authorizing a person to go onto State property, the river and ocean bottom, and to search for and recover State property, the fossils and artifacts. Each license is for a specific activity and has its own responsibilities and requirements.

The Hobby License is issued to a sport diver for "temporary, intermittent, noncommercial search and salvage operations of a recreational nature requiring minimal equipment, training, and experience." The license is statewide in authority except in the few restricted areas where Search and Salvage Licenses may be in force or where the Institute may have placed off limits for its own research purposes. The hobby diver is required to report his licensed activities on a monthly basis detailing what was found, where, when, and by whom, on forms provided by the Institute. These reports are confidential, are not open to inspection by other hobby divers and are the major source of site locations for the Statewide Inventory of Archeological sites.

The State has 60 days from receipt of the report to exercise its option on a division of artifacts. If no division is made within 60 days, title goes to the licensed diver. The fee is $5.00 per person or husband and wife, and $25.00 for instructors for use in classes in which the recovery of artifacts or fossils is an integral part of the instruction. Fees for out-of-state applicants are double the instate fees. The license is good for one year from date of issue. The hobby licensed diver may not use any powered mechanical lifting or excavating devices or remote sensing devices such as metal detectors under this license. This is a hands only license. Offenses arising out of this license category are heard in a local magistrate's court with a maximum fine of $200 or a jail sentence not to exceed 30 days.

A Search License may be granted to an applicant for the purpose of conducting underwater search operations using electronic remote sensing systems, ranging systems, or other sophisticated methods of search. It is granted for a period of three months, for an area of one square mile in open bodies of water, or one linear mile in a river. The three month time period and one square or linear mile area is called a search unit. Nine search units is the maximum that may be issued under this license to any one applicant. The fee for each search unit is $25.00 for state residents and double that for out-of-state residents. Only the amount of artifacts needed for evaluation of the site may be removed under this license. A written report is required at a frequency specified in the license. A division of artifacts is always made, and the operation is monitored by Institute personnel. The same 60 day option for final ownership of artifacts as in the Hobby License is authorized. Offenses arising out of this license category are heard in circuit court and upon conviction are punishable by a fine not to exceed $10,000 or imprisonment not to exceed two years.

A Salvage License "may be granted to an applicant for the purpose of conducting a well planned, continuing, underwater salvage operation with experienced personnel and adequate financial support." The Salvage License is issued for a specific site and is granted for a period of time not to exceed one year. A fee of $250 is charged, $500 for out-of-state residents. Detailed reports of all activities covered under the license are required including a listing of all personnel and equipment used under the license. Powered lifting and excavating devices are permitted provided they are used in accordance with a plan of operation previously approved by the Institute. A written report is required at a frequency specified in the license. Work under this license is monitored by Institute personnel. Offenses in this license category are handled in the same way as for a Search License.

The law was written in specific terms where precise statements had to be made but in less specific terms where discretionary powers might be desired. For example, the law guarantees to the licensee equity of not less than 50% of the artifacts, "in value or in kind." If it is decided by the Institute that an artifact, or collection of artifacts recovered under a license should remain intact and in State hands, the licensee is compensated "in value" for his share. It is the responsibility of the Institute to find the funds to compensate the diver. The compensation figure is determined by a panel of appraisers. An appraiser representing the diver and an appraiser representing the State choose a third appraiser. The three set the value which is binding on both parties. This has not happened in the 16 years the law has been in effect, but the provision is there if the need arises.

In another example of discretionary power, the law, as mentioned above, guarantees to the licensee equity of not less than 50% but, does not prohibit the Institute from granting more than 50% equity, which it often does. For example, the percentage equity printed on the Hobby License form is 75% for the diver and 25% for the State, and in fact the Institute has never made a division with a hobby diver of his finds. Because of this non-possessive attitude the Institute has never been denied the long-term loan of an artifact for study or display. In contrast with not requiring a division with a hobby diver the Institute always requires a division with a Search or Salvage Licensee and the salvor's equity in the license seldom exceeds 50%.

There are two crucial provisions in the law that give major discretionary powers to the Institute in the granting or denial of licenses. The first authorizes the granting of a license only "as the Institute may deem to be in the best interests of the State." The second provision states "No license for the disturbance or removal of any submerged antiquities which, in the opinion of the Institute, are of primary scientific value shall be granted." Under South Carolina law, therefore, none of the many treasure salvors that have had salvage licenses in other states, could operate in South Carolina because the Institute considers treasure vessels and all vessels sunk in the 18th century or before to be of primary scientific value. The decision on what constitutes primary scientific value is made by Institute archeologists, not by politicians or special interest groups. Licenses for salvors desiring to work on vessels lost in the 19th and 20th centuries are handled on a case-by-case basis. A recognized underwater archeologist wishing to excavate a shipwreck of primary scientific value could not do so under the licensing system. He would instead be appointed an adjunct member of the Institute staff for the duration of the project. The Institute's facilities and equipment would be made available to him if needed.

In order for this law to be made into a workable tool for resource management it was necessary to make some hard decisions. It was decided that using the law as a club to bludgeon compliance would be immediately counterproductive and firmly establish an adversary relationship between the diver and the Institute. Aside from the fact that the Institute could not fund an adequate law enforcement effort it was believed that if we could open up a line of communication with the divers, present the case for conservation with conviction but not from a position of unassailable power, stressing long-range benefits of an educational and scientific nature for the citizens of the State, the divers would respond in a positive manner. And such was the case, but it did not happen overnight.

I sought a close association with the divers and spent many hours in countless dive club meetings and with individuals discussing each other's special concerns. Their opinions were sought and listened to, ours were received and considered. We were open with each other and held nothing back particularly when we had a controversial point to make, or positions to defend. In other words we opened lines of communication, conducted ourselves with courtesy and respect, recognized each other's value and potential contribution, and eventually developed a trust that made mutual cooperation inevitable.

There are a number of qualities about South Carolina that have created a physical environment in which our program has been able to take root and grow. Probably most important, at least to date, is the complete absence of known, or sought after, treasure wrecks in State waters. For this we are thankful. South Carolina is a small state but has a relatively large number of rivers for its size. These fresh water rivers, where most of the diving takes place and most of the discoveries are made, are beneficial to our conservation efforts because they inhibit two major destructive forces to shipwrecks and artifacts, teredos and electrolysis. Organic and inorganic material from river sites tend to be in better condition than comparable material recovered from sea water. Most of the rivers are wide, some are quite deep, and except for the Cooper River, have a high tannin or particulate matter content which limits visibility severely. The Cooper River alone in the state often has 15 feet visibility. Out to the three mile limit in the ocean visibility is almost always very poor.

The general poor visibility tends to quickly eliminate the dilettante divers, and those who perservere do so with a singleness of purpose. This personality type initially tends to oppose regulation but upon learning how the law is applied and why, usually becomes supportive. The small size of the state also works in our favor because it is possible for me to drive from the Institute in Columbia to the most distant part of the state to visit a site or meet with a diver in less than three hours, and to the center of diving activity around Charleston in only two hours.

Results

I do not want to imply that our management techniques have resulted in 100% compliance by the sport diving community, for that is not the case. A number of divers from both in and out of state ignore the law altogether, and take the chance that they will not encounter a law officer while diving. They have not always been successful and arrests have been made. We are also aware that some divers do not list all of their recoveries or sites on the monthly report forms they send to the Institute. Some report to us only objects they have no interest in, or are not saleable, keeping the saleable objects for themselves. This has happened, and will undoubtedly continue to happen, but I believe at an increasingly lower rate as time progresses. Certain divers have tried to circumvent the Institute's licensing authority by working within the State political system or through other agencies such as museums, but in this they have not been successful. We have revoked licenses for cause, and have had our revocations challenged in court. To date, however, all our legal actions have been upheld or the challenges have been thrown out of court before reaching trial stage.

In contrast to the negative response mentioned above the positive side of the program is encouraging. In 1976 a hobby diver discovered a shipwreck in the Black River in South Carolina at a site known as Brown's Ferry. He reported the discovery to the Institute and after a determination had been made that the vessel dated from around 1740 and was of primary significance to the study of early 18th century river craft, he voluntarily relinquished his equity in it and donated his share to the State. This would not have happened in an environment of confrontation. The vessel was raised by amateurs under professional direction and examined in detail. J. Richard Steffy of the Institute of Nautical Archeology, probably the leading authority on ancient ship construction said of the vessel:

> In my opinion, it is the most important single nautical discovery in the United States to date. In the first place, it establishes abundant primary evidence for American shipbuilding nearly 50 years earlier than previous discoveries. More importantly, this was a merchant hull, built without the anxiety, bureaucracy, and inefficiency

often associated with vessels of war. As such, it defines everyday technology in a competitive atmosphere. Additionally, this was a local type - important to any maritime scholar - representing a period and area in which far too little maritime information has been forth coming.

Because of the cooperation of a single hobby diver in donating the vessel, I was able to raise $300,000 for the construction of a conservation laboratory for the Brown's Ferry vessel and other vessels yet to be recovered from South Carolina and other states. It is anticipated the laboratory will be in use well into the next century. This laboratory, resulting from an act of civic responsibility by a sport diver should put to rest the often heard statement that all sport divers are despoilers and looters of our heritage.

Hobby divers have reported to the Institute the location in South Carolina rivers of at least six other sunken vessels of the 18th and early 19th centuries. These vessels may each be as significant to the study of the early maritime history of this nation as is the Brown's Ferry vessel. To our knowledge, and to their credit, not a single vessel has been disturbed by a hobby diver nor has a diver entered a claim for any of the vessels since they were reported to the Institute. The few artifacts that were removed from one wreck, prior to our involvement, are available for examination on request.

Hobby divers and others knowing of our interests, have reported to the Institute the location of over 20 dugout canoes, the majority of which were formed by fire and scraping, in the prehistoric manner. At our request the divers have not disturbed them since their discovery and have expressed their desire to us that the canoes eventually be raised for examination, conservation, and display in a State or county museum.

A number of years ago a hobby diver recovered an intact example of a "Colono-Indian" jug from underwater. It was assumed that this plain, low fired, red earthenware jug had been made by Indians for sale to the colonists for use by slaves. However, an archeologist from the Institute, examining the shape and impressed design found exact duplicates being made and sold in Africa in this century. He further found in examining our site files that "Colono-Indian" ware had never been recovered, at least in South Carolina, from an Indian site and had always been recovered from a slave associated site. This has given a new direction for research on the interpretation of a type of ceramics found in relatively large numbers in the southeast. Many scholars have examined our ceramic collection in order to find parallels in their collections that might be Indian made in name but slave made in fact.

Operating with a diving staff of only two, we are dependent on the voluntary support of hobby divers. On occasions too numerous to mention we have called upon divers for free help on one or two day projects and have seldom been turned down. On two occasions a number of divers have given us, free of charge, their two weeks annual vacation for the privilege of working on a project under Institute supervision. We have more volunteers than we have time or opportunity to use.

At present there is only one salvage license in force for the excavation of a shipwreck. This license was issued to a sport diver from Florida who, while diving in South Carolina under a Hobby License, discovered the remains of the Federal transport U.S.S. Boston lost in the Ashepoo River in 1864. The Boston had been hit by 75 to 80 cannon balls from a Confederate artillery battery. It had caught fire, burned to the water line and sunk. After the war it was salvaged under a Federal contract and undoubtedly picked over by generations of fishermen. The Institute did not consider this vessel to be of primary scientific value. The goal of the salvage operation was to recover the artifacts to sell, a concept anathema to archeologists but reasonable to the layman. Because this site has both Federal and State components, both entities were involved with the licensing process. A mutually agreeable understanding was reached by the three parties involved--Federal, State and the private sector--with the Institute having overall management responsibilities. The salvor submitted a plan of operation which, after modification, was approved. He is conducting his operation in a scientific manner working within a five foot grid system, recovering all objects, and carefully measuring major hull features. Artifacts are given a field catalogue number, recorded on Institute forms, and stored in separate containers at a nearby law enforcement complex. The required divisions are made, at appropriate times, to the proportions, 25% for the Federal government, 25% for South Carolina, and 50% for the salvor. The licensee has conducted himself in a responsible manner, carried out Institute directions to the letter, and is a valuable asset to our program.

Other Amateur Support

Up to this point the only amateur I have mentioned has been the sport diver, who through the years, has played an active and vital role in all of our activities. There is another category of amateur who plays an equally vital but less visible role. This is a person, or firm, whose support is through the loan, or gift of supplies and equipment. The recovery of the Brown's Ferry vessel would not have been possible without this kind of help. For instance, a garden supply store owner loaned us a pump and hose, and later a second pump, a fire department loaned us a hose nozzle, from the Air Force we borrowed lifting straps, from the National Guard an air compressor, a shoe store operator supplied sprinklers to keep the artifacts wet, a hardware store donated heavy rope, prisoners from the county jail moved bricks recovered from the wreck, from a Sears automotive center we borrowed heavy duty batteries, from International Paper Company a 50 ton crane, and from a trucking company a 40-foot flatbed truck. All of this assistance came at no cost to the projet. Engineers and welders from a nearby sawmill on their own time designed and built the large metal frame used to support the vessel, and the paper company union supplied the crew for the crane. This was by any definition, a community project, supported by amateurs.

Another form of amateur support comes from an organization created a number of years ago called the South Carolina Underwater Archeological Research Council. It is composed of an insurance agent with law enforcement, business, and political affiliations, a manufacturer and builder who worked on the Brown's Ferry project, a lawyer, and a publisher and media specialist who currently holds a Hobby License. The purpose of the council is to promote underwater archeology in the state and to assist the Institute in any of its activities relating to the underwater program. Over the years it has developed funding sources but more importantly it has provided me an entree into the business and political structure of the state I would not otherwise have.

Conclusion

The basic goal of the archeologist is the acquisition of knowledge, not the collection of artifacts, although the two are inextricably entwined for a major part of the learning process. South Carolina's resource management program utilizing the amateur in active and supportive roles, as detailed above, has already yielded major new information for the general body of archeological knowledge and has the potential to make new contributions well into the future. In order for a law to be effective it must be enforced, or must engender voluntary compliance. Although enforcement is occasionally necessary, it is always time consuming, expensive, must be continually carried out, and firmly establishes an adversary relationship as the norm. Voluntary compliance on the other hand, a product of education, understanding, and compromise, is less expensive, self-motivating and establishes cooperation as the norm. In South Carolina we have chosen the latter.

The Alaska Historic Preservation Act and submerged cultural resources

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Introduction

The Alaska Historic Preservation Act, Alaska Statutes 41.35.010 -- 41.35.240, is an attempt by the Alaska Legislature to establish a comprehensive body of law to protect endangered resources of cultural significance.(1) The scope of this effort is apparent from the declaration of policy contained in AS 41.35.010:

> It is the policy of the state to preserve and protect the historic, prehistoric and archeological resources of Alaska from loss, desecration and destruction so that the scientific, historic and cultural heritage embodied in these resources may pass undiminished to future generations. To this end, the legislature finds and declares that the historic, prehistoric and archeological resources of the state are properly the subject of concerted and coordinated efforts exercised on behalf of the general welfare of the public in order that these resources may be located, preserved, studied, exhibited and evaluated.

Whether or not this enactment has lived up to legislative expectations is subject to debate.(2) There is no doubt, however, that it has had little impact beneath the sea.

The Language of the Act

Applicability to submerged resources

The Alaska Historic Preservation Act addresses the fate of certain "historic, prehistoric and archeological resources."(3) The definition of these resources, contained in AS 47.35.230(4), does not distinguish between those found on dry ground and those found under water:

> (4) "historic, prehistoric and archeological resources" includes deposits, structures, ruins, sites, buildings, graves, artifacts, fossils, or other objects of antiquity which provide information pertaining to the historical or prehistorical culture of people in the state as well as to the natural history of the state.

The objects identified in this definition are typically located above sea level, but nothing in AS 41.35.230(4) explicitly excludes those which are submerged. Any doubt that submerged objects are covered by AS 41.35.230(4) is eliminated by AS 41.35.020(a). In that section, the State of Alaska "reserves to itself" title to all cultural resources "situated on land owned or controlled by the state, including tideland and submerged land..." Although some relationship to land seems to be contemplated in this context, whether that land is wet or dry does not seem to be a factor.

Resources covered by the act

The definition of "historic, prehistoric and archeological resources" contained in AS 41.35.230(4) is broad enough to cover objects which have not been excavated, objects which have been excavated and lost, and objects which have been excavated and placed in public or private collections. However, substantive provisions of the Act add other limiting factors. As a result, whether or not an object is subject to the Act depends, in part, on which substantive provision of the Act is being applied.

Substantive provisions of the act

The Act as a whole addresses acquisition, excavation and use of cultural resources by the State of Alaska and establishes a mechanism for public recognition of certain cultural resources in private ownership. It assigns primary responsibility for these matters to the Department of Natural Resources. The Act also creates the Historic Sites Advisory Committee.(4) Action by the committee is a prerequisite to use of many protections of the Act. It also serves as the state review board under P.L. 89-665, the National Historic Preservation Act of 1966.(5)

The keystone of the Act is AS 41.35.020. This section asserts state ownership of cultural resources "situated" on land owned or controlled by the state and, on its behalf, declares an "exclusive right of field archeology." AS 41.35.020 also disclaims any diminishment of "the cultural rights and responsibilities of persons of aboriginal descent"(6) and, on recommendation of the Historic Sites Advisory Committee, authorizes use of state owned objects by "local cultural groups."

AS 41.35.030 empowers the Governor, on recommendation of the Historic Sites Advisory Committee, to declare "any particulr historic, prehistoric or archeological structure, deposit, site or other object of scientific or historic interest" which is situated on state or private land to be a state monument or historic site. This designation on private land requires written consent of the owner. The Act assigns administration and support of state monuments and historic sites to the Department of Natural Resources.(7)

The Department of Natural Resources, on recommendation of the Historic sites Advisory Committee, is authorized by AS 41.35.060 to acquire cultural resources by gift, purchase, devise or bequest. If, again on recommendation of the committee, a cultural resource is in danger of "being sold or used so that its historic, prehistoric or archeological value will be destroyed or seriously impaired, or is otherwise in danger of destruction or serious impairment," the department may "establish" its appropriate use. If the owner does not adhere to restrictions imposed by the department, the property may be acquired by eminent domain.(8)

AS 41.35.070 mandates that the Department of Natural Resources "locate, identify and preserve in suitable records information regarding historic, prehistoric and archeological sites, locations and remains" and submit that information to the heads of the principal state agencies. This section also authorizes the department to excavate public construction sites and to require a survey if "historic, prehistoric or archeological sites, locations, remains, or objects" are discovered during public construction.

AS 41.35.080 authorizes the Commissioner of Natural Resources to issue permits for the "investigation, excavation, gathering or removal from the natural site" of state owned cultural resources.(9) However, this section also provides that if the resource, or the site of the resouce, is "sacred, holy or of religious significance to a cultural group" then the consent of that group must be obtained before a permit will be issued.(10)

Excavation of cultural resources on land in private ownership is addressed in AS 41.35.090 and AS 41.35.100. The former requires three months notice to the department before "any construction, alteration or improvement" of a designated state monument or historic site. The latter requires the department to obtain written approval of the owner before excavating "historic, prehistoric or archeological remains" and requires it to compensate the owner for any resulting reduction in the value of the land.

Finally, the Act imposes criminal sanctions for misuse of cultural resources. The unlawful acts are listed in AS 41.35.200:

> (a) It is unlawful for a person to appropriate, excavate, remove, injure, or destroy, without a permit from the commissioner, any historic, prehistoric or archeological resources of the state.
>
> (b) It is unlawful for a person to possess, sell, buy or transport within the state, or offer to sell, buy or transport within the state, historic, prehistoric or archeological resources taken or acquired in violation of this section or 16 U.S.C. 433.
>
> (c) No person may unlawfully destroy, multilate, deface, injure, remove or excavate a gravesite or a tomb, monument, gravestone or other structure or object at a gravesite, even though the gravesite appears to be abandoned, lost or neglected.
>
> (d) An historic, prehistoric or archeological resource which is taken in violation of this section shall be seized by any person designated in §220 of this chapter wherever found and at any time. Objects seized may be disposed of as the commissioner determines by deposit in the proper public depository.

Violation of any of these provisions is a misdemeanor punishable by a fine of $1,000.00, imprisonment for not more than six months, or both. AS 41.35.220 permits persons authorized by the Commissioner of the Natural Resources to enforce the Act, in addition to regular peace officers.

<u>Internal Problems with the Act</u>

The question of coverage

As noted earlier, certain substantive provisions of the Act supplement the definition of "historic, prehistoric and archeological resources" at AS 41.35.230(4). Nonetheless, significant ambiguity remains concerning the basic question of coverage.

The assertion of ownership in AS 41.35.020 applies to cultural resources "situated on land owned or controlled by the state." The principal problem with this language is that it does not describe the connection required between the object and the land on which it is "situated" and for the most part ignores the possibility of competing claims of ownership.(11) For example, the language is arguably broad enough to include objects which have been loaned to the state for display in the Alaska State Museum. As a result, applicability of the Act is not clear when ownership of land does not unambiguously give rise to a corresponding right over objects associated with it.(12)

Perhaps the best illustration of ambiguity covered by the Act's failure to address these questions is provided by vessels that have foundered in navigable waters. In Alaska, maritime tragedies as recent as the 1952 sinking of the Princess Kathleen are considered of historic interest. It is at least arguable that "artifacts" and "other objects of antiquity" within the contemplation of AS 41.35.230(4) can be obtained from wrecks of similar vintage.(13) Since the state holds title to the bed of navigable waters up to three miles offshore,(14) it appears that any vessel that founders in these waters is "situated" on state land. However, any state claim to ownership in these circumstances is subject to challenge by persons exercising salvage rights under federal maritime law,(15) a problem the Act does not address.

AS 41.35.020 contains additional language bearing on the issue of coverage which is also ambiguous. The accommodation of "cultural rights and responsibilities of persons of aboriginal descent," although laudable, does not identify the manner in which those rights and responsibilities are to be determined. Presumably, traditional uses of cultural resources by Alaska natives are subject to proof. However, As 41.35.020 also contains a statement that nothing in the Act "infringes upon their right of possession and use of those resources..." The statute does not expressly limit this right to the exercise of "cultural rights and responsibilities" nor, as we have seen, does it clearly associate "cultural rights and responsibilities" with traditional uses of cultural resources by Alaska natives.

Limitations on criminal prosecution

Ambiguity in a civil setting can often be eliminated through litigation. In the criminal law, however, fundamental principles of due process require that statutes proscribing conduct use terms which are reasonably definite so that persons of ordinary intelligence can conform their actions to what the law requires.(16)

This issue was raised in a setting analogous to the Alaska Historic Preservation Act in United States v. Diaz, 499 F.2d 113 (9th Cir. 1974). In that case the appellant was convicted under the criminal provision of the federal Antiquities Act, 16 U.S.C. §433, with appropriating "objects of antiquity situated on lands owned and controlled by the Government of the United States without the permission of the Secretary of Interior." The United States Court of

Appeals for the Ninth Circuit reversed appellant's conviction on the ground the statute, by using undefined terms of uncommon usage, was so vague as to violate the due process clause of the federal Constitution.(17) It observed:

> We have no doubt as to the wisdom of the legislative judgement (made close to seventy years ago and reinforced by experiences of the present in the despoliation of public lands) that public interest in and respect for the culture and heritage of native Americans requires protection of their sacred places, past and present, against commercial plundering.
>
> Protection, however, can involve resort to terms that, absent legislative definition, can have different meanings to different people. One must be able to know, with reasonable certainty, when he has happened on an area forbidden to his pick and shovel and what objects he must leave as he has found them.
>
> Nowhere here do we find any definition of such terms as "ruin" or "monument" (whether historic or prehistoric) or "object of antiquity." The statute does not limit itself to Indian reservations or to Indian relics. Hobbyists who explore the desert and its ghost towns for arrowheads and antique bottles could arguably find themselves within the Act's proscriptions. Counsel on neither side was able to cite an instance prior to this in which conviction under the statute was sought by the United States.

The "objects of antiquity" at issue in Diaz were face masks made only three or four years previously and deposited by an Apache medicine man in a cave on an Indian reservation. It is possible that the conviction would have been upheld if the objects at issue were more clearly of ancient vintage.

Although the court in Diaz characterized the Antiquities Act as "fatally vague," prosecutions under vague statutes are sometimes upheld where there is no legitimate doubt of applicability in a particular case. The Alaska Supreme Court considered this problem in Stock v. State, 526 P.2d 3 (Alaska 1974), in which the appellant was convicted of polluting state waters in violation of the Alaska Environmental Conservation Act.(18) The court affirmed the conviction, observing that "[c]ourts have often recognized that the possibility of difficult or borderline cases will not invalidate a statute where there is a hard core of cases to which the ordinary person would doubtlessly know the statute unquestionably applies."

The statute at issue in Stock provided somewhat greater specificity than the criminal provision of the Alaska

Historic Preservation Act.(19) Statutes are presumed to be constitutional. While we cannot predict with certainty that it will be upheld, the constitutional validity of the Alaska Historic Preservation Act may turn on the circumstances in individual cases in which it is invoked.(20)

The question of administration

Another limitation on the usefulness of the Alaska Historic Preservation Act concerns the extent to which public resources are made available to implement it. Governor Egan, who wholeheartedly endorsed the need for legislation, allowed the Act to become law without his signature. He did so because of the need for clarification and because of the fact that no funds were appropriated for its implementation. See 1971 Senate Journal 941.

The maritime setting provides additional motivation for active administrative efforts. As discussed below, the relationship between state antiquities legislation and federal admiralty law is unsettled. To the extent states rely upon passive assertions of ownership, they run counter to an activist bias in admiralty which rewards actions actually resulting in the relief of vessels in distress.(21) A state which actively pursues protection and recovery of submerged artifacts is in a far better position to withstand legal challenges in this area than is a state which remains passive.(22)

There has, however, never been a separate, identifiable appropriation for administration of the Act. The Department of Natural Resources has made limited funds available to the Historic Sites Advisory Committee which have enabled it to meet an average of twice yearly, the statutory minimum.(23) The Governor has not designated a single state historic site or monument since enactment of the Act in 1971. The Department of Natural Resources has never distributed funds under the Alaska Landmark Program. It has never attempted to obtain title to cultural resources under the Act's power of eminent domain.(24)

Other Problems in Application

Conflicts with federal admiralty law

Application of the Act, or similar legislation of other states,(25) to underwater artifacts is beclouded by one unsettled question in the law: Is ownership of wrecked vessels and their cargo governed solely by federal admiralty law, or may states dictate other methods of determining ownership? On its face, the Historic Preservation Act lays claim to all cultural resources, including shipwrecks, on submerged state land.(26) A recent line of federal cases, however, indicates that Alaska's claim may be subordinate to that of persons salvaging vessels or cargo under provisions of federal admiralty law.

Admiralty or maritime law is a body of rules developed over centuries of use in seagoing nations which governs most important legal aspects of maritime affairs. Among other matters, disputes over contracts in maritime commerce and personal injuries connected with vessels are determined under admiralty law rather than under the laws of the states within whose jurisdiction the disputes arise. The law of admiralty contains a body of rules governing the disposition of distressed and wrecked vessels and their cargo. These rules -- the law of salvage -- generally determine ownership and right to share in the value of these vessels. In the case of submerged wrecks, the law of salvage may directly conflict with state statutes making ownership claims on behalf of the public.

Under the law of salvage, a person who comes upon a vessel in distress and voluntarily assists in saving the vessel or its cargo becomes entitled to compensation for those efforts, usually as a percentage of the cargo or vessel saved. Most authorities hold that a person who finds and salvages abandoned maritime property can acquire title to it. At the same time, the original owner of a foundered vessel will ordinarily seek to exercise enough control over the vessel to avoid the status of abandonment and subsequent loss of title. Thus, statutes like the Alaska Historic Preservation Act -- which broadly assert "title" to at least some submerged vessels -- may conflict with the rights of at least two types of claimants to the resource: the original owners of the vessel or cargo, and persons claiming title or rights as salvors.

As to the original owners of the vessel or cargo, the Act lacks a clear statement of when a wrecked vessel comes under its jurisdiction or when the state asserts title or control. The remains of an 18th Century vessel of exploration would presumably be an "object of antiquity" under the Act. Would the <u>Princess Kathleen</u> which sank in 1952 also qualify? Would a fishing vessel which ran aground a month ago? The Act itself provides little guidance. It is clear, however, that the state cannot assert ownership of a cultural resource already owned by someone else.

For example, the owner of a fishing vessel which sank a month ago probably has a valid continuing claim to title if, since that misfortune, he has diligently attempted to recover the vessel or its gear. If the owner does not diligently pursue recovery, he may be considered by a court to have abandoned the vessel, in which case it is open to salvage claims by others. The point is this: no matter how a state seeks to exercise jurisdiction over cultural resources in state waters, it cannot obtain title unless the title of the original owner has lapsed, and this will be determined, at least as to wrecked vessels and cargo, under federal maritime law.

Yet federal maritime law may have an even more limiting effect on the Act. In 1982, a United States District Court in Florida declared that the Florida Archives and History Act, which claims title for the state to shipwrecks and other abandoned property on submerged lands, is subordinate to the rights of potential salvors under federal law. In other words, despite Florida's claim of title to abandoned wrecks, a private salvor could legally take possession and remove artifacts. The case, Cobb Coin v. Unidentified Wreck, 549 F.Supp. 540 (S.D. Fla. 1982),(28) is now on appeal, so the legal question is unsettled. While the trial court decision is not controlling in Alaska, it poses a serious threat to any state statute which attempts to protect submerged wrecksites by either a claim of ownership or by requiring permits for excavators or salvors.

The Cobb Coin decision is open to criticism on several legal grounds.(29) It appears to rest on the conclusion that a potential salvor has a right to explore and attempt salvage wherever he chooses. It can be argued, however, that an owner may control and prevent salvage by strangers, and that this prerogative extends to the sovereign claiming ownership through statutory fiat. The District Court did not hold that state ownership itself is improper, but rather that it is subordinate to the rights of salvage. Another criticism stems from the fact that the wreck in Cobb Coin had been buried beneath up to twenty-two feet of sand for centuries. Ships permanently removed from the water and no longer engaged in maritime commerce are arguably not subject to admiralty jurisdiction, and so the law of salvage may be irrelevant. For example, The Francis L. Skinner, 248 F. 818 (W.D. Wash. 1914), held that a wrecked ship which had been beached for years 100 feet above high tide was not a "vessel" for purposes of subjecting it to the maritime law of salvage. It can certainly be argued that a vessel buried below the sea floor for centuries is just as effectively removed from commerce and from admiralty jurisdiction as a vessel beached for years above high tide.(30)

Despite the uncertainty caused by Cobb Coin, is is important to note that certain features of the Alaska Historic Preservation Act are not affected by that decision. First, Cobb Coin is limited to submerged cultural resources which come within the purview of admiralty law, i.e., which have been connected with traditional maritime activity. Inundated communities and gravesites, for example, are not subject to admiralty law, nor are fossil remains or items of geologic significance. Control over these items when found on state-owned submerged lands is therefore a matter for state law.(31) Second, the ability of the state under AS 41.35.060 to acquire cultural resources recovered from the sea (or elsewhere) by eminent domain is not affected by Cobb Coin. Third, while there currently is no requirement that a person recovering cultural resources register them or provide notice to the state before removing them from Alaska, it may be possible for the Department of Natural Resources to establish this requirement by regulation. Since this requirement would not prevent salvage under federal law, nor deprive a salvor of the benefits of his operation, at least not without compensation from the state, it arguably would not infringe on federal salvage rights. Fourth, the state may regulate activities in and around shipwrecks on state-owned land so long as those activities do not constitute pursuit of federal salvage rights.(32) Thus removal or destruction of cultural resources on submerged state lands by sports divers and researchers without a permit could violate the Act, unless the action were part of an exercise of federal salvage rights. Moreover, since a valid claim of salvage rights requires diligence and success in recovering items of value, it is possible that activities falling outside this area could also be controlled under state law.

Finally, other measures may be available which would not be regarded as in conflict with traditional maritime principles.(33) Among these is the actual pursuit of salvage rights at sea and in federal court. This is, perhaps, the most predictable remedy available to states at the present time.

In short, federal admiralty law poses a significant impediment to protecting undersea cultural resources through state legislation. Until the questions raised by Cobb Coin and related cases are resolved in the courts or by Congress,(34) the extent of impediment will remain unknown.

Extraterritorial application

State territorial jurisdiction extends only three miles from the coast.(35) As a result, much of the continental shelf off Alaska is outside the state's border. Ordinarily this would mean that those areas are also beyond the reach of the state's legislative power. There is a theory of law, however, which may enable the state to extend its jurisdiction under the Act beyond the three mile limit, at least for limited purposes.

The strongest protection offered by the Act, assertion of state ownership of cultural resources, applies only on state-owned land.(36) Since the passage of P.L. 83-31, the Federal Submerged Lands Act in 1953, the limit of state ownership of the seabed has been firmly set at the territorial limit of three miles. Thus there is no realistic possibility of a state claim to title to artifacts based on land ownership beyond the three mile limit.(37) However, it is possible -- though by no means certain -- that a claim of state jurisdiction could be made beyond three miles for application of the Act's provisions concerning cultural resources on private lands. For this it would be necessary to invoke the doctrine of extraterritorial application of law.

The doctrine of extraterritorial application of law is well-established in international law.(38) Although normally a nation may enforce its laws only within its own territory, certain recognized exceptions exist. A nation may enforce certain laws against its own citizens travelling in international zones, and it may apply its laws to an activity in an international zone when that activity has a substantial impact on a valid domestic interest. For example it was held to be a valid exercise of Alaska's rights when it prosecuted fishermen from outside Alaska who took crab in international waters in violation of season limits imposed by Alaska.(39) That ruling was premised on the fact that the crab in question annually migrated into state waters, and that regulation of the resource beyond three miles was a necessary step in protecting what is, at least part of the year, a state resource.

This theory may be applicable to protection of submerged cultural resources on the continental shelf. The preamble of the Alaska Historic Preservation Act identifies a valid state interest, preservation and protection of the "historic, prehistoric and archeological resources of Alaska." If a direct connection could be drawn between cultural aspects of Alaska's heritage, justification could exist for extraterritorial application of the Act. For example, gravesites of aboriginal groups ancestral to Alaskan natives, or wrecks of vessels which had significant impact on discovery or development of Alaska, could be sufficiently connected to the concept of "Alaskan heritage" to support a claim of jurisdiction under the Act.(40)

A caution is in order: application of the doctrine of extraterritorial application is rare, and has never been attempted under the Alaska Historic Preservation Act. This discussion has been presented only to point out a possible application. At this point we cannot predict with any certainty its chances of success.

Conclusion

The Alaska Historic Preservation Act is a well-intended piece of legislation, but thus far it has had negligible effect on preservation of the state's submerged cultural heritage. The usefulness of the Act is limited by problems with the language of the Act and by the lack of "concerted and coordinated efforts" to enforce it. Despite near-universal agreement on the need for such protection, effective application of the Act to submerged resources will not occur until there is resolution of the legal conflict over the federal law of salvage. Those concerned with preserving cultural resources could accomplish much by seeking solutions to these obstacles at both the state and federal levels.

NOTES

(1) The Alaska Historic Preservation Act was enacted as Chapter 130, 1971 Session Laws of Alaska.

(2) In a recent report to the legislature, the Alaska State Museum observed that "Alaska's cultural and historic resources, much like its natural resources, have been and remain in great demand nationally and internationally. As a consequence, the state has been stripped of a substantial part of its material cultural heritage. The process continues largely unabated even today." Alaska State Museum, Alaska Heritage Endowment Report, Alaska Department of Education, p. 6, (1983).

(3) This paper refers to "historic, prehistoric and archeological resources" collectively as "cultural resources." Common usage of the phrase "cultural resources" is discussed in Glasier, Cultural Resource Preservation: A Consideration Before Mineral Development, Mineral Law Institute, Vol. 28, p. 635 (1983).

(4) The Historic Sites Advisory Committee is composed of the director of the Alaska State Museum, the state liaison officer under the National Historic Preservation Act of 1966, three persons from the fields of history, architecture and archeology, and two persons who represent indigenous ethnic groups. See AS 41.35.170. The committee is authorized by AS 41.35.190 to employ necessary staff.

(5) The ongoing duties of the Historic Sites Advisory Committee are set out in AS 41.35.180. This section provides that the committee shall:

> (1) develop criteria for the evaluation of state monuments and historic sites and all real and personal property which may be considered to be of historic, prehistoric or archeological significance as would justify their acquisition and ownership by the state;
>
> (2) cooperate with the Department of Natural Resources in formulating and administering a statewide historic sites survey under the National Historic Presevation Act of 1966, Public Law 89-665 (80 Stat. 915);
>
> (3) review those surveys and historic preservation plans that may be required, and approve properties for nomination to the National Register as provided for in the National Historic Preservation Act of 1966, Public Law 89-665 (80 Stat. 915);
>
> (4) provide necessary assistance to the governor and the legislature for achieving balanced and coordinated state policies and programs for the preservation of the

state's historic, prehistoric and archeological resources.

(5) consult with local historical district commissions regarding the establishment of historical districts under AS 29.48.108 -- 29.48.110 and the approval of project alterations under AS 45.98.040; recommend, if appropriate, the formulation of additional criteria for the designation of historical districts under AS 29.48.110(b); approve plans for and evaluate the suitability of specific structures for purposes of loan eligibility and continuance under the historical district revolving loan fund (AS 45.98); and consult with the Department of Commerce and Economic Development relative to the adoption of regulations for historical district loans under AS 45.98.

(6) The Act does not indicate what these rights and responsibilities are or how they are to be determined.

(7) This function is performed by the Division of Parks and is referred to in 11 AAC 10.110 as the Alaska Landmark Program. Financial support of privately owned sites is addressed in 11 AAC 16.100 -- 11 AAC 16.160.

(8) Eminent domain, the right of the government to acquire private property at fair market value, is subject to AS 09.55.240 -- 09.55.460.

(9) These permits are the subject of departmental regulations found at 11 Alaska Administrative Code 16.030 -- 11 AAC 16.090.

(10) The Act does not define eligible "cultural groups."

(11) AS 41.35.020 does, of course, attempt to accommodate "cultural rights and responsibilities" of Alaska natives.

(12) Several other sections of the Act imply that some connection between the object and the land is necessary. See AS 41.35.030, AS 41.35.070, AS 41.35.080, AS 41.35.090, AS 41.35.100, AS 41.35.200.

(13) Indeed, United States v. Diaz, 499 F.2d 113 (9th Cir. 1974), cites testimony by a university professor that, in anthropological terms, "object of antiquity" includes contemporary works if related to religious or social traditions of long standing.

(14) The State of Alaska holds title to the beds of all navigable waters in the state under the Alaska Statehood Act, P.L. 85-508(6)(m), and the Federal Submerged Lands Act of 1953, P.L. 83-31, out to a distance of three miles from the coast, 43 U.S.C. §1312.

(15) This and related issues are discussed in sec. IV A.

(16) In Alaska, the void-for-vagueness doctrine has three components. A statute can be struck down if (1) it is so overbroad as to restrict the exercise of free speech, (2) it does not give adequate notice of what is prohibited, or (3) it gives undue discretion to prosecuting authorities in determining what constitutes a crime. Stock v. State, 526 P.2d 3 (Alaska 1974).

(17) See fn. 13.

(18) AS 46.03. The appellant was charged specifically with violation of AS 46.03.710, which prohibits "pollution".

(19) Among other things, the Alaska Environmental Conservation Act contains a detailed definition of "pollution" which incorporates terms in common usage or with well established meanings at common law.

(20) The Alaska Department of Law has considered prosecution in at least one case. By memorandum of advice dated February 13, 1979, it declined prosecution of an individual who had been seized at the Anchorage Airport with 1,850 artifacts of Eskimo origin allegedly collected from St. Lawrence Island. Prosecution was declined because the origin of the artifacts could not be conclusively established, because of uncertainty over land to which the Act applied, and over the scope of the exception for use by persons of aboriginal descent. We are unaware of any other instances in which prosecution under the Act has been considered.

(21) For example, in Wiggins v. 1100 Tons, More or Less, of Italian Marble, 186 F.Supp. 452, 455 (E.D. Va. 1960), the court rejected the claim of a Virginia Commissioner of Wrecks to an abandoned sailing vessel and its cargo. In favoring a salvor under traditional maritime principles, the court noted that the Commissioner of Wrecks had not inventoried the vessel, obtained actual possession of the vessel, hired guards or laborers, or otherwise treated it as unavailable for public salvage in the 65 years since the vessel foundered.

(22) A state can, for example, go so far as to salvage a vessel under traditional maritime practice.

(23) No meetings were held in 1972.

(24) Telephone interviews with Ty L. Dilliplane, State Historic Preservation Officer, Department of Natural Resources and William S. Hanable, former State Historic Preservation Officer, Department of Natural Resources, April 27, 1983.

(25) Twelve states expressly include shipwrecks within the protection of antiquities legislation, Fla. Stat. §267.011 - 267.14 (1979); Ga. Code §40.813(a)(1978); Ind. Code §14-3-3-3-1(m) (Com. Supp. 1980); La. Rev. Stat. Ann. tit. 41 §§1601 and 1605 (1974); Mass. Gen. Laws Ann. ch. 6§§179-180 (1977); Miss. Code Ann. §39-7-9 (1972); N.C. Gen. Stat. §§121-22-121-28 (1981); R.I. Gen. Laws §§42-45.1-3--42-45.1-4 (1977); S.C. Code §§54-7-210--54-7-280 (Cum. Supp. 1980); Tex. Civ. Code Ann. tit. 9 §§191.001--191.174 (Supp. 1979); Vt. Stat. Ann. tit. 22 §§701, 781-782 (1978); Va. Code §10-145.9 (Cum Supp. 1980). Other states, while not referring to shipwrecks, include submerged or underwater sites in their protection of archaeological resources. See Colo. Rev. Stat. §24-80-401 (1973); Hawaii Rev. Stat. §§6E-2 and 6E-7 (1976); Me. Rev. Stat. Ann. tit. 27 §§371 and 373 (1969); Minn. Stat. §§138.31 and 138.37 (1980); Or. Rev. Stat. §§273.705(a), 273.722, 273.728, 274.005(7), 274,025 (1979); Wash. Rev. Code §27.53.040 (1979); Wis. Stat. §§27.012(1)--27.012(9) (1975).

(26) States hold title out to three miles from the coast. See fn. 14.

(27) A critique of admiralty law is beyond the scope of this paper. For a more detailed discussion of admiralty law in this context, see Lawrence, State Antiquities Law and Admiralty Salvage: Protecting Our Cultural Resources, 32 Miami L. Rev. 291 (1977).

(28) See also, 525 F.Supp. 186 (S.D. Fla. 1981).

(29) Other arguments also exist and will likely be argued on appeal. See fn. 27.

(30) It is similarly arguable that excavation of maritime artifacts is not a traditional subject of admiralty jurisdiction. From a marine archeologist's viewpoint, application of maritime law to ancient shipwrecks has its logical lapses. Consider, for instance, whether any functional difference exists between an ancient wrecksite where the vessel itself has disintegrated and only scattered cargo lies on the seabed (maritime salvage laws probably apply); and an ancient village site, now inundated, where scattered remains lie on the seabed (maritime salvage laws probably do not apply).

(31) There is some authority to the contrary. Compare, Maritime Law and Practice, The Florida Bar, §5.8 (1980) with G. Gilmore and C. Black, The Law of Admiralty, 2nd ed., The Foundation Press, Inc., p. 538 (1975).

(32) Methods of pursuing federal salvage rights are discussed in Maritime Law and Practice, Id. and The Law of Admiralty, Id.

(33) See generally Lawrence, supra, pp. 324-337.

(34) For example, H.R. 132, introduced in the 97th Congress by Congressman Charles E. Bennett of Florida, would make all abandoned shipwrecks in navigable waters the property of the federal government. Under this bill the Department of the Interior could let contracts for their "salvage" or other disposition.

(35) There are various technical rules for determining the exact location of the three mile limit when the coastline consists of bays and coastal islands, as in much of Alaska. The state is currently engaged in litigation with the federal government over location of the boundary in several such areas.

(36) See AS 41.35.020.

(37) The federal government claims title to the seabed to the edge of the continental shelf and in some areas out to 200 miles from the coast.

(38) See e.g., Restatement (Second) of Foreign Relations §§18, 30, and 33 (1965).

(39) F/V American Eagle v. State, 620 P.2d 657 (Alaska 1980), appeal dismissed, 454 U.S. 1130, 102 S.Ct. 985, 71 L.Ed.2d 284 (1982); see also Bundrant v. State, 546 P.2d 530 (Alaska 1976), appeal dismissed sub nom, Uri v. State, 529 U.S. 806, 97 S.Ct. 40, 50 L.Ed.2d 66 (1976).

(40) It is not clear whether "private" property, as used in the Act, includes federal or international submerged lands. If not there would be little point in attempting an extraterritorial application of the Act, since little of the continental shelf would fall outside these categories. If extraterritorial application were to be attempted, we believe it should be preceded by amendment of the Act to make clear a legislative intent to apply it to resources beyond the three mile limit.

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