Chapter 1
Prehistoric Archaeology on the Continental Shelf: The State of the Science in 2013

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Introduction

Prehistoric Archaeology on the Continental Shelf provides a review of data from submerged continental shelves around the world. In 14 chapters, data on sites, landscapes, analytical methodologies, and management tools from across the globe are discussed and debated. This is a snapshot of a scientific community in the throes of a dramatic phase of ongoing development. The data and analyses outlined in this book contribute to, influence, and, in many cases, drive the analytical agenda of prehistoric archaeology, underwater and terrestrial; the tools and techniques deployed are handled confidently; and the management of such sites is sophisticated and collaborative. Within this, however, it must be recognized that we still have a long way to go and a lot more to achieve; despite the heroic efforts of individuals and teams at work around the world over the past decades, seabed prehistoric research is still an evolving discipline, where, in particular, we have to find more sites. There are significant gaps in space and time where we have no data at all for thousands of years and millions of square kilometers, and we cannot do fully modern integrative and interpretive archaeology without more data and sites. In particular, there is a scalar mismatch between acoustics and signatures of prehistoric sites—that is, of identifying, from a distance, materials like worked lithics, fragments of bone or wood, charcoal, and arranged stones. Much research is at present being devoted to solving that problem. So far, visual inspection by divers or close-up remote sensing (ROV-based photography, etc.) are the only ways to detect lithics unless they have already been found by chance—as is so often still the case—be this the consequence of deliberate survey or industrial happenstance. Large-scale survey and analysis can

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show all sorts of probabilities, but few can afford to search hundreds or thousands of square kilometers visually. Just as still so often occurs on land, predictive modeling enhances probabilities, but not enough to give a reasonable chance of a survey finding lithics except in exceptional circumstances. In the marine zone even more than on land, we are still often in a rather humbling situation of constant iteration between chance finds, modeling, exploitation of known sites, interpolation, and guessing and hoping. Technology helps, but only so far, and technology improves all the time.

Being unafraid to recognize and admit to such methodological issues, and to dedicatedly search for advances on the current situation as the contributors to this book consistently do, is part of the present-day confidence in approach to this subject demonstrated by its practitioners. Such confidence is also the reason for the specific title of this book: It is about prehistoric archaeology that just happens to come from submerged environments on the continental shelf. In the past, such work labored under the niche title "submerged prehistoric archaeology," reflecting a lack of engagement with mainstream prehistoric archaeology. But this book's chapters demonstrate a community that has outgrown that niche to play the right and full place in global-level discussions of the prehistoric archaeology of the human race that the data from such contexts provide—including the unambiguous discussion of the pros and cons of the methodologies and approaches deployed. Prehistoric archaeology on the continental shelf is in the process of rewriting our understanding of key aspects of prehistoric civilization, from our earliest origins and first journeys, to our later exploitation, impact upon and exploration of the globe. The really exciting fact is that this data are merely the tip of the iceberg: as several chapters in this book indicate, the best is yet to come. In many parts of the world, the continental shelf represents an under-explored landscape that was available for exploitation throughout prehistory, but whose stories are missing from the archaeological record. Future discoveries and analyses of prehistoric archaeology from submerged contexts on the continental shelf look set to be genuinely earth-shattering, for example, new evidence, of the earliest arrival of humans in Australia, or of the extent of human activity in Beringia. Technology is also changing relatively faster offshore than on land (for example, the development of data storage in terabytes really changes the way one gathers data, the resolution that is usable, and removes the need for sampling data and plotting them as subsampled grids). Thus, in the twenty-first century the cutting edge of prehistoric archaeological research lies in submerged contexts, and that simply is not up for debate.

Prehistory on the Continental Shelf

Archaeologists have recognized the potential of continental shelves to contribute to our knowledge of the human past for over 50 years. Specifically, data from submerged sites contribute to both site-specific and landscape-level narratives, meaning that these analyses contribute to local, regional, and global-level debates.

Archaeologists study past human behavior, and build patterns by scaling-up data observed at the microscale, or site, to larger trends observed across regional, cultural, or temporal scales. An archaeological site is defined differently depending on the purpose, but generally is defined as a spatially delimited accumulation of cultural material that has sufficient quantity and quality to allow inferences to be made about behavior occurring at that location (after Butzer 1982, p. 259). Sites are critical to reconstructing past human behavior, but nonsites or data occurrences may still provide information needed to inform patterns of available resources (Butzer 1982, p. 260). As a science, archaeology is restricted to the data that have been found, but if archaeologists are ignoring entire landscapes it is undoubted that our current knowledge of prehistoric populations is flawed. This is a critical point to consider, since models are inherently biased by the information and variables used in their construction, and more importantly by the information that is omitted from the model.

Methodologies for the Continental Shelf

The methodology used in investigating sites on submerged portions of the continental shelf is intrinsically tied to technology and the specific environment under investigation. In some parts of the world, survey methodologies have been established for a long time—for example, in Denmark on the many submerged prehistoric sites analyzed there for many years (see Fischer 1995, 1997) or Italy on submerged cave-habitats, in particular (see Bard et al. 2002; Dutton et al. 2009)—but in all regions the methodology for investigating areas on the continental shelf has room for ongoing refinement. Like any aspect of archaeology, there is general agreement in some areas on the "baseline" analytical and methodological frameworks; such frameworks allow for more nuanced investigations that are not restricted to general "landscape survey" and which can consequently undertake higher-level analyses. Advances in methodology also encourage developments in technology. For example, advancements in mapping accuracy offshore (such as the change from Loran coordinates to DGPS or RTK positioning), allow for more precise control of context. Remote sensing data systems and the postprocessing capabilities for interpretation have increased exponentially, and will continue to evolve, and as noted above, such technologies are advancing relatively faster at sea than on land at the present time. These technological changes, however, complement a basic methodology used in many continental shelf contexts: it is not surprising—and nothing to be ashamed of—that a dredger, a bottom trawl net or a diver are more likely to find a flint tool, a bone, or charcoal deposit than a remote-sensing survey. For example, the Chilean site reported by Carabias et al. (this volume) was found by chance while undertaking a commercial contract survey on a jetty. Around the world, this is not an exception at sea any more than it is still on land, and is simply part and parcel of the complexities of how sites are found and how fieldwork is undertaken and paid for. It must be stated here, and repeated often, that no one methodology will work in

all environments or for all types of sites. As the chapters of this book demonstrate, there is both the room and the need for an array of methodological approaches from the "low-tech" to the "high-tech, " from the site specific to the landscape oriented.

As an example, one early attempt to establish a methodology for investigating prehistoric sites on the continental shelf focused explicitly on the northwestern Gulf of Mexico (CEI 1977; see also Pearson et al. this volume). The recommendations produced by this study stated that any investigation of prehistoric resources on the continental shelf take a three-step approach beginning with remote sensing of the area through either small-scale bathymetry or subbottom profiling to resolve the upper 9 m (30 feet) of sediment coupled with acquisition of a grab or drag sample of seafloor sediments (CEI 1977, p. 341). If a probable site was indicated by the data acquired in step 1, then subsequent data should be collected, either in the form of side-scan-sonar imagery of the area, bottom cores, and or additional grab or drag samples (CEI 1977, p. 341). The final step, if warranted, was recommended as underwater photography or videography, box core sampling, and/or diver investigation (CEI 1977, p. 341). The majority of the recommendations, such as bathymetric survey or diver photography, assumed that the feature of interest was exposed at the seafloor, which is not always the case. The basic investigative methodology developed in 1977 for the northwestern Gulf of Mexico assumed the use of a predictive model that correlated identifiable landforms with archaeological sites as observed in contemporary terrestrial settings. The cultural groups included within this specific geographical and chronological landscape were highly mobile hunter-gatherers with scant material culture (Aten 1983; Neuman 1984; Ricklis 2004). The predictive model included geological reconstruction and landscape change modeling, but recognized that a paucity of artifacts would likely exist at submerged sites associated with this specific region. Cultural signatures of human occupation were, therefore, identified that went beyond artifacts, such as potsherds and lithics, to include signatures more likely to be recovered in core samples, such as shells, faunal fragments, black earth, burned rock, charcoal, and pollen (CEI 1977, p. 172). Subsequent studies have been conducted worldwide that add to the theory and methodology of investigating submerged prehistoric sites. The basic methodology outlined by the 1977 study has benefitted from improvements in the technology, but is specifically intended to identify landscape features as opposed to sites, and assumes that large-scale survey will be conducted. This is appropriate for an area undergoing large-scale development by oil and gas industry, but is not appropriate for all environments, or for investigating other scenarios, such as chance finds.

In 1981, in recognition of advances in paleocoastline reconstruction, archaeologists, anthropologists, geologists, and oceanographers were invited to participate in a symposium addressing Quaternary coastlines and prehistoric archaeology; the resulting papers were published in one of the first edited volumes on the subject (Masters and Flemming 1983). The participants in this symposium noted that, at that time, the majority of prehistoric artifacts from the continental shelf were the result of chance finds by recreational SCUBA divers and fishermen, or activities related to offshore construction (Masters and Flemming 1983, p. 611). Intentional site discovery, they maintained, depended on both physical preservation of the site and

ease of detection (Masters and Flemming 1983, p. 622). The participants presented diverse case studies ranging in location from Siberia to Australia, but concluded that a standard framework could be universally applied to site prediction and detection. At minimum, local geomorphology has to be modeled to identify areas of probable feature preservation, recognizable features (such as shell middens) must exist, and basic requirements such as access to fresh water, protection from environmental exposure, and/or availability of food must have existed within the area of interest (Masters and Flemming 1983, p. 623). Recommendations for survey and identification of prehistoric features were similar to those outlined for the Gulf of Mexico: chiefly, bathymetric or subseafloor survey conducted at tight intervals (no greater than 150 m). The authors stressed, however, that this type of survey cannot prove without doubt the existence of prehistoric sites, it can only identify the most probable areas in which sites could be preserved (Masters and Flemming 1983, p. 624). Again, the methodology outlined in the 1983 volume assumes that an investigation of the continental shelf is being driven by survey, and is not immediately applicable to site investigation due to the discovery of chance finds. For example, the Cinmar site off of the US Atlantic coast was discovered by the chance find of a commercial dredging operation (see Stanford et al., this volume)

Methodologies applied to the continental shelf are not restricted to large-scale survey: indeed, if anything the reverse is true, since much of the key work around Europe in particular over the last few decades has been site specific, often the result of chance discoveries of sites. Benjamin (2010) discusses a range of different such projects and gives a noteworthy evaluation of the evolution of attempts to create standard methodology; the SPLASHCOS European Commission COST program (Cooperation in Science and Technology) research network that ran between 2009 and 2013 (http://www.splashcos.org/) includes other such examples. To cite a rather different example, however, Gagliano et al. (1982) published the results of a study that analyzed terrestrial analogues for potential offshore deposits. The results, developed under contract for the United States' National Park Service, analyzed core samples from verified terrestrial prehistoric sites along the Gulf of Mexico coast. Lab analyses of sediment core data indicated that the following variables were credible indicators of modified environment: grain size, pollen content, geochemical composition, point-counts, foraminifera species identification, and radiocarbon dating of appropriate samples (Gagliano et al. 1982). Recognizing that site identification could not be dependent upon the presence of man-made artifacts, the terrestrial corollaries were developed so that landforms could be tested for indicators of prehistoric archaeological site occurrence without the presence of obvious anthropogenic artifacts such as projectile points (Gagliano et al. 1982, p. 115). Numerous studies have been conducted around the world that have employed variations of the continental-shelf methodologies outlined above (e.g., Pearson et al. 1986; Johnson and Stright 1992; Browne 1994; Faught and Donoghue 1997; Momber 2000; Dix et al. 2004; Gaffney and Kenneth 2007; Benjamin et al. 2011).

Some research projects have avoided the complications of working in submerged environments by using evidence from terrestrial contexts to address changes in human subsistence and coastal settlement patterns instigated by changing climate

conditions (e.g., Bailey and Parkington 1988). Although the technologies and environments are different, there are some similarities across many of the chapters that follow, representing locations ranging from Beringia to Argentina. For example, we now know that anthropogenic sites with artifacts can survive stratigraphically in context through several glacial cycles and several marine transgressions and regressions, something that was unthinkable less than 30 years ago. The Fermanville site (again found by chance) shows that a deep Paleolithic site can preserve stratigraphy even though exposed to tidal currents on the seabed and several interstadial sea-level changes (Scuvée and Verague 1988).

The techniques outlined above do not represent a universal methodology to all continental shelf sites, but are well established and constitute different tools and options that the research planner can draw upon in order to obtain data. Critical to this volume is an acceptance that good data are good data, irrespective of where they come from. Good data are defined here as trustworthy data, data underlain by solid, reliable, and repeatable methodological tools and techniques. This is the type of data, and type of approach, now consistently being achieved by those working in submerged contexts. The confidence in the approaches deployed means that the archaeologists involved spend more time asking questions of that data and formulating new hypotheses, and less time worrying about how to collect that data and their potential (un)reliability.

Global Significance of Continental Shelf Prehistory

Beyond discussion of the reliability and significance of the data being recovered lies the reality of the untapped potential of prehistoric sites located on the continental shelf, which is huge in terms of the extent of the potential search area, likelihood of any discoveries being significant either because of their location of detailed content, and possibility of discovery due to the level of industrial activity currently being undertaken or planned on the continental shelves alongside the sophistication of the tools and techniques used to survey these areas. Put more simply:

$$W(\text{area}) + X(\text{potential}) + Y(\text{likelihood}) = Z(\text{significance})$$

Studies conducted in an area where there is a strong understanding of the physical environment (W), combined with a predictive model that identifies the landscape or physical features of archaeological interest (X), and that are conducted in an area with a high rate of preservation potential (Y) are likely to yield results of local, regional, and probably global significance (Z). A good starting point for these analyses is the map first produced by Geoff Bailey for Nic Flemming's (2004) *Submerged Prehistoric Archaeology of the North Sea.* As Flatman (2012) outlines, the untapped potential of the continental shelf of SE Asia is but one example of the conjunction outlined above. Bailey's 2004 map also highlights other locations with high potential for finds, the ultimate theme of this book—the continental shelves of

South and Central America, Africa, the Arabian Peninsula, and the Indian Subcontinent. These are areas with unbridled archaeological potential where discoveries are likely to rewrite our understanding of global prehistory, and crucially, they are all areas undergoing active exploration, primarily for industrial objectives, in ever greater detail (see also Bailey 2011). This exploration may not always be beneficial in terms of the survival of prehistoric remains (see Bicket et al. and Faught, this volume), but it is assuredly beneficial in the identification of such remains.

Continental shelf prehistory has the potential to contribute to fundamental questions in archaeology. For example, one of the most prevalent hypotheses, and for a time the only accepted theory, for the peopling of the New World argued that the first Americans walked across the Beringia land bridge during the last glacial maximum, and populated the New World at approximately 11,000 years BP (Bonnichsen and Lepper 2005; Meltzer 2009, p. 3). Consensus could not be reached in explaining how those early inhabitants spread from what is now mainland Alaska throughout the remainder of the western hemisphere (e.g., Wendorf 1966; Fladmark 1979; Dixon 1999). Further complicating the question of modern human's first arrival in the New World were the increasing numbers of archaeological sites that predated 11,000 BP. Early archaeological sites (older than 11,500 BP) were once considered to be anomalous. Absolute dates, stratigraphy, and site integrity were, and continue to be closely scrutinized. In the case of Monte Verde, Chile, one of the first sites to return anomalously early dates, the occupation dates were highly disputed, and subjected to intensive scrutiny by a multidisciplinary panel of over 40 specialists in 1997 (Bonnichsen 2005, p. 15). The findings of the panel, which included several staunch critics of the site, validated some of the dates for Monte Verde and were cited as evidence that the hypothesis of the Bering land bridge as the first and only migration route was inaccurate (Bonnichsen and Lepper 2005, p. 15). Archaeological sites such as the Meadowcroft rock-shelter (Pennsylvania, USA), Monte Verde (Chile), the Debra L. Friedkin site (Texas, USA), and the Channel Islands of California (USA) have produced absolute dates that indicate the presence of modern humans much earlier than 11,000 years BP (Bonnichsen 2005; Goebel et al. 2008; Erlandson et al. 2011; Waters et al. 2011). Evidence from these and other recently published sites continues to push back the date range for possible occupation of the western hemisphere before 12,000 years BP.

Future Directions, Opportunities and Challenges

The levels of collaboration and cooperation currently witnessed between the marine archaeological and industrial communities in many locations around the world are unprecedented, and would have been unimaginable even a decade ago. While such collaboration is by no means universal—one need only think of the lack of archaeological involvement in current continental shelf exploration and exploitation along the coast of Africa—there is in general a good precedent for both continued and expanding relationships in this regard. As outlined in Flatman and Doeser (2010)

(see also Flemming 2011), there is a simple reason for this: mutual benefit. Successful marine-zone prehistoric heritage projects always involve some or all of the following characteristics, characteristics that are not always shared by ostensibly similar terrestrial projects:

- *Business facing:* Such projects are strategic, timely, and well managed, responding to currently pressing needs to identify, and help mitigate, shared risks. Many marine-zone heritage projects use the same data sets for archaeological site identification as are used in assessing the presence of shallow seafloor hazards, thereby making the archaeological assessment a cost-effective component of the overall project.
- *Proactive:* Such projects are good at showing immediate functionality and use to all partners, such as modeling the locations of sites or seabed and water column dynamics around particular locations. The efficiency of stakeholder partnership projects is often instrumental to this functionality and cost-effectiveness, such as through the use of legacy data or industry platforms, and frequently involves industry provision of in-kind support via the loan of equipment.
- *Communicative:* Such projects see effective local-level, long-term communication and collaboration between individual industry employees, researchers, and curators.
- *Partnership based:* Many projects are partnerships from the outset, with all partners being included in project development and design, data sharing and collection, and/or data processing.
- *Media friendly:* Such projects undertake outreach, including significant public outreach and media potential for all partners through internal industry media and conferences, and the provision of accessible, user-friendly resources.
- *Mutually beneficial:* Such projects assist industry and the planning sector in the acquisition of new data sets (allowing for better preplanning and risk avoidance); provide historic environment professionals with new investment (supporting management-based research into the historic environment as well as the development of analytical techniques); and provide all sectors with collaborative data acquisition, analysis, and management, together with the additional public relations benefit through media-friendly enterprises, data sharing, and sponsorship.
- *Cross-disciplinary:* Such projects have had at their heart cross-management of projects by both natural and historic environment professionals, intermeshing cultural and natural environment research specialisms and data.

The discussion of cultural resource management (CRM) archaeology and the wider management regimes of prehistoric archaeology from submerged contexts raises three additional points of discussion. The first of these points is with regard to the long-term durability of the marine CRM sector. This sector of the CRM community is currently one of the only parts of the wider CRM community that is currently booming in the midst of the sustained economic depression in place globally since 2007. The extent of industrial activities in the inshore and increasingly offshore zones around the world, stretched across the continental shelves, is staggering. Traditional industries and related infrastructures such as oil and gas exploration

and recovery, marine mineral extraction, fishing (including increasingly fish farming), port and harbor development, pipe and cable laying are increasingly being joined by new industries such as wind and wave "renewable" energy development. All of these industries are forecast to grow at an exponential rate over the coming decades, both in traditional areas and also increasingly in new areas of discovery, such as South East Asia, Africa, and South America. But alongside this growth is an increasingly recognized—although not formally analyzed—lack of appropriately trained or experienced archaeologists within marine CRM firms. Anecdotal evidence, such as that discussed at the 2014 Society for Historical Archaeology (SHA) conference forum on capacity building in submerged precontact archaeology, demonstrates a sustained skills gap, with more jobs available than appropriately skilled people to fill them, the inverse of the normal hiring situation within the CRM community. In particular, there is a lack of practical survey data collection and analysis skills among potential new employees. Put simply, postgraduate university programs in archaeology must meet university curriculum standards that do not allow for practical sea time for students. Many students graduate from programs without the ability to run marine surveys and, more importantly, interpret the raw data that such surveys collect. This is a systemic problem, one that is increasingly recognized by the same academic institutions.

A different regulatory issue stems from the management of human remains from prehistoric submerged contexts. So far, such discoveries have been relatively few in number and crucially, have been made in areas with limited or no Indigenous communities involvement in the management of prehistoric sites above or below water. But given the range and intensity of industrial activity discussed in the following chapters, the likelihood is that significant future discoveries of human remains will be made in areas with Indigenous communities who are not afraid to exercise their existing legal rights to the control of ancestral landscapes and material culture. The legal battle over "Kennewick Man" in Washington State (USA) illustrates the potential for ancient remains from submerged contexts, and the complexity of determining legal "ownership" or cultural affiliation (see http://www.nps.gov/archeology/kennewick/). To date, no known legal cases have explicitly addressed archaeological human remains from continental shelf environments. However, in the USA, legal challenges to the proposed Cape Wind offshore wind turbine development illustrate the potential for conflict between indigenous rights and development (Evans et al. 2009). If the types of resource-conflict scenarios outlined in Flatman (2012) become a reality in the resource-hungry mid-twenty-first century, then such claims to legal control and/or ownership of submerged prehistoric sites may become serious issues in their own right, a crucial part of the "politics of the past" debate that has been being played out on land for generations.

A third regulatory issue then concerns the combined protection and crucially public recognition of the significance of prehistoric sites in such environments. At present, such sites are " protected" (when this occurs at all) through different forms of domestic environmental regulation, primarily marine planning regulations in force in many nations' territorial waters, as for example enforced by the Marine Management Organization (MMO) in the territorial waters of the UK, or the Bureau of Ocean Energy Management (BOEM) in the territorial waters of the USA. While this is no different

from countless thousands of comparable prehistoric sites on land similarly managed through similar regulatory frameworks, the "higher level" specifically heritage-related regulatory systems that exist and that are used to protect, acknowledge, and celebrate such sites on land and in the intertidal zone are currently absent in relation to such prehistoric continental shelf sites in the marine zone. For example, in the UK, the 1979 Ancient Monuments and Archaeological Areas Act that formally "Schedules" archaeological sites of the highest national importance could be used to protect such sites underwater, as the Act does for many thousands of prehistoric sites of equivalent significance on land (although the terms of the Act restricts it, both on land and underwater, to sites with identifiable structures, a provision that can limit its protection of prehistoric artefact sites of the type in question here). The Act contains provisions for the protection of marine sites; it is purely a matter of the right sites being nominated for such protection, either as a result of one-off recognition on the basis of significance or threat, or, more usefully, as a consequence of sustained, strategic programs of survey and exploration of the type described elsewhere in this book, and already underway in some locations, for example under the auspices of the National Heritage Protection Plan (NHPP) in England, where an ongoing strategic program of work (with its origins in the Aggregates Levy Sustainability Fund that ran between 2002 and 2011) is currently in the process of identifying and proposing submerged prehistoric sites on the English continental shelf for such statutory designation (NHPP Measure 3A1, *Unknown Marine Assets and Landscapes,* see http://www.english-heritage.org.uk/professional/protection/national-heritage-protection-plan/plan/activities/3a1). The success of books such as Gaffney, Fitch and Smith's (2009) *Europe's Lost World: the Rediscovery of Doggerland* (and related TV shows about such sites), demonstrates that there is a public appreciation of an appetite for such prehistoric archaeology; one next step is thus its more formal recognition in the regulatory system, alongside other such nationally—indeed, internationally—important sites. Advances in international regulatory and celebratory systems might also have a role here in due course, for example, thorough the network of World Heritage Sites, potentially under the auspices of the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage.

Epilogue

It is crucial that the challenges outlined here are not seen as insurmountable for exploration of the world's continental shelves. Offshore development presents opportunities for investigation and research, but requires that archaeologists undertake training appropriate to investigating formerly exposed landscapes that are now submerged on the continental shelf. As demonstrated by the chapters that follow, as well as elsewhere (see for example Fischer et al. 2011), methodological elements already exist that negate the question of whether continental shelf site investigation is even feasible. There is time and room enough for multiple approaches to prehistoric archaeology of continental shelves; what is required now is that more archaeologists engage in this type of research, refining and improving the methodology, thereby expanding the archaeological record. Only in this way will archaeologists uncover data specific to prehistoric

coastal zones, which can in turn lead to new insights about past human migrations, exploration, and adaptations, and ultimately to our understanding of human prehistory.

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