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Watercraft, People, and Animals: Setting the Stage for the Neolithic Colonization of the Mediterranean Islands of Cyprus and Crete

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WATERCRAFT, PEOPLE, AND ANIMALS: SETTING THE STAGE FOR THE
NEOLITHIC COLONIZATION OF THE MEDITERRANEAN ISLANDS OF CYPRUS
AND CRETE

By

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Bachelor of Arts in Anthropology
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A thesis submitted in partial fulfillment
of the requirements for the

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ABSTRACT

One of the most significant developments in human history was the “Neolithic Revolution,” which first began around 11,000 years ago in mainland Southwest Asia. It resulted in not only the economic reorientation from hunting and foraging to herding and farming based on domesticate resources, but also significant changes in human technology, demography, society, political organization, ideology and human relationships to the environment. In order to understand this momentous process, however, it is important to understand the events that set it in motion. This is particularly the case when dealing with oceanic Mediterranean islands, specifically Cyprus and Crete, where there is a known Pre-Neolithic presence. The purpose of this literature-based thesis research will be to address both the Pre-Neolithic and Early Neolithic on these two islands. Four main questions will be examined: 1) What were the climatic conditions faced by the earliest seafarers/explorers?; 2) What were the earliest types of watercraft used?; 3) What is the evidence for an early human presence?; 4) Is there ethnographic evidence cross-culturally that documents how wild and domesticated plants and animals, but animals in particular, were transported between landmasses using watercraft technology? The purpose of this thesis is to provide the necessary framework for my subsequent dissertation, which will examine more specifically the zooarchaeological remains at the site of Ais Giorkis. Furthermore, it will also allow these two islands (but particularly Cyprus) to be placed within the broader Neolithic context of both mainland Southwest Asia and the Mediterranean Basin.
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I would like to dedicate this thesis to my mom and dad. Your constant support and encouragement, helped me to continue to pursue my dreams. Who knew a dining room table covered in books and papers for months would lead to this! Thank you both. You mean the world to me!
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CHAPTER 1
INTRODUCTION

Since the beginning of the twenty-first century, the International Organization for Migration has estimated that at least 22,000 people have died while attempting to cross the Mediterranean Sea. In 2014 alone, more than 4,000 people lost their lives—making it one of the deadliest migration routes in the world. Most of these individuals are from Northern Africa and the Middle East. In fact, in recent years, the Mediterranean has served as the front line for Europe’s border crisis. Conflict in Egypt, Libya, Syria, Gaza and now more recently Iraq, has triggered a large volume of people from these areas who are willing to risk their lives to seek asylum in other countries. To emphasize the dangers of attempting sea voyages across the Mediterranean, one of the most recent crises occurred in February of 2015. More than 4,200 people were rescued in a period of 5 days, which is more than one person every two minutes. These individuals were all on vessels that were attempting to make a successful journey to Italy (Ball and Legorano 2015; Lavanga and Jamieson 2015).

These crossings are extremely dangerous due to the crowded nature of the watercraft as well as the watercraft themselves, many of which are flimsy, old, and/or broken. The challenges of crossing the Mediterranean are not only a modern global problem; rather, they extend into prehistory when people first began plying the Mediterranean Sea. The question is: when did people first attempt seafaring voyages in the Mediterranean? The purpose of this thesis, which is primarily based on a review of the
currently available literature, will be to address this issue, in hopes of emphasizing the humanness of prehistoric seafaring.

**Theoretical Perspective**

This study seeks to explore the evidence for seafaring in the Pre- and Early Neolithic on the Mediterranean islands. The Mediterranean basin was chosen because recently a greater number of archaeological sites from islands in this region have yielded remains that arguably date to the Pre-Neolithic, contrasting conventional wisdom that islands were inhabited only by the Late Neolithic (some 9,000 years ago) (Simmons 2009a, 2009b, 2014). Recent reviews of the archaeological evidence for Pre-Neolithic seafaring by John Cherry (2004) and Cyprian Broodbank (2006, 2013, 2014) have argued that the evidence is scant. Thus, both conclude that existing data are not strongly in favor of such activities. Yet, I disagree, particularly given the volume of information that is coming from the Mediterranean islands.

Recent research from many of the Mediterranean, but in particular Cyprus and Crete, are now demonstrating that there was a substantial human presence by at least the Early Neolithic (around 11,000 years ago). This has profound implications for early seafaring, including people’s ability to navigate the sea and travel to islands with cargo, including animals. This is particularly important for addressing broader questions related to the ‘Neolithic Revolution,’ which first began on mainland Southwest Asia around 12,000 to 11,000 years ago. This momentous development resulted in changes not only in economic reliance on wild resources to domestic resources, but also substantial changes to all aspects of human life (Simmons 2007, 2014; Vigne 2011a; Zeder 2008, 2012). It was often assumed that when aspects of the Neolithic were brought to the Mediterranean
islands, they were adopted and utilized in the exact same manner as that on the mainland. Yet, recent research on the mainland is emphasizing the importance of regional and local variation in the exploitation of wild and domestic resources (e.g., Arbuckle 2013, 2014; Simmons 2007, 2014; Vigne 2011a; Zeder 2008, 2012). Thus, this variation is an aspect that I would like to further explore for Cyprus and Crete specifically in this thesis.

Given that this thesis addresses two slightly different but interrelated time periods, the Pre- and Early Neolithic, two theoretical perspectives will be examined in Chapter 2. The first focuses on island visitation and colonization as well as whether early seafaring was accidental, intentional, or a combination of the two. This is important given that Cyprus and Crete will be used as case studies; as the two are oceanic islands, meaning that they have never been connected to the mainland by a land bridge throughout human history. Thus, the nature of how people reached these islands should be explored. The second theoretical perspective will examine different theories on the diffusion of both domesticated and wild animals during the Neolithic.

The study of early seafaring in the Mediterranean is important because there is evidence from around the world that implies seafaring began quite early in hominin history. For example, the earliest evidence for global seafaring, thus far, comes from the island of Flores in Indonesia. Stone tools have been found in association with faunal remains that date to at least 800,000 years ago, implying that Homo erectus might have been the earliest seafarer (Anderson 2010:5; Bednarik 2011:92; DiBenedetto and Simmons 2014:26-27; Erlandson 2001:324, 2010:22; Erlandson and Fitzpatrick 2006:8, 12; McGrail 2010:96; Simmons 2012b:895).
Besides this evidence, there has recently been the discovery of “the hobbits” from Flores, also known as *Homo floresiensis*. Physical remains of these hominins’ were found at the cave site of Liang Bua, dating to at least 18,000 years ago, and were associated with a simple core and flake assemblage and faunal remains. Their tiny stature and small brain size (of some 380 cm$^3$, roughly the same size as a chimpanzee’s) has given them the nickname, “the hobbits.” In fact, there has been some debate as to whether this small brain size would have enabled them to make these tools. The lack of evidence for the presence of *Homo sapiens* on Flores until the Holocene, which began around 11,700 B.P., makes this hominin species the only likely candidate (e.g., Brown and Maeda 2009; Brown et al. 2004; Dennell et al. 2014; DiBenedetto and Simmons 2014:27; Morwood et al. 2004, 2009).

A contentious debate has surrounded how these hominins fit into the overall scheme of human evolution. Of particular importance is: who were their ancestors and how do they relate to modern humans? While not doing justice to this debate (see Brown and Maeda 2009 and Dennell et al. 2014), it seems that, at the very minimum, *Homo floresiensis* is an endemic human species that evolved on Flores. It is still unclear whether they are dwarfed versions of *Homo sapiens*, *Homo erectus*, or descended from a small-bodied and more primitive pre-*erectus* lineage. Others argue that they are modern humans afflicted with microcephaly or some other similar disease, although many disagree with this hypothesis (e.g., Baab and McNulty 2009; Dennell et al. 2014; DiBenedetto and Simmons 2014:28; Falk et al. 2009; Jungers et al. 2009; Morwood et al. 2009).

Similarly, modern humans are thought to have reached modern-day Australia by at least 60,000 B.P, although some archaeologists are skeptical of dates earlier than 45,000 B.P. for the first human arrival (DiBenedetto and Simmons 2014:32; Erlandson 2001:324,
While the Mediterranean islands are the focus of this thesis, Flores and Australia emphasize that seafaring in the Mediterranean basin was not an isolated experience. Instead, seafaring appears to be a global phenomenon. Thus, study of seafaring in the Mediterranean is not just important for the Mediterranean cultural heritage, but also for the broader global cultural heritage.

**Research Questions and Methodology**

In order to begin to better understand the role played by islands in the broader Neolithic process, it is first important to understand when people first began traveling to them, how these early people traveled to the islands, and the climatic and environmental factors that they faced. This will provide a necessary foundation to examine the evidence of occupation in the Neolithic for Cyprus and Crete, in particular how animals (and also plants) were transported to the islands, the role human choice might have played in the adoption of these wild and domesticate resources, and how these inhabitants were beginning to construct their own identities. This study seeks to address four research questions: 1) What were the climatic conditions faced by the earliest seafarers/explorers to Cyprus and Crete?; 2) What were the earliest types of watercraft used?; 3) What is the evidence for an early human presence on Cyprus and Crete?; 4) Is there ethnographic evidence cross culturally that documents how wild and domesticated animals were transported between landmasses using watercraft technology?

Cyprus and Crete are used as case studies because they are both oceanic and far enough from their respective mainlands that most of the animals brought to the islands could not have swam there on their own. This implies that some type of watercraft
technology was used. Furthermore, as will be discussed, both currently have the strongest evidence for a human presence starting at least by Late Paleolithic in contrast to the other oceanic Mediterranean islands. Each of the research questions and respective methodologies will be outlined below; along with which chapters the questions will be addressed in.

1) What were the climatic and environmental factors faced by the earliest seafarers?

In order to better understand early seafaring in the Mediterranean basin, it is important to have an accurate reconstruction of the climatic and environmental context, including sea levels, tides, currents, weather, and the configuration of the Mediterranean islands and coastlines, within which early seafaring occurred. Systematic observations of these variables have been only conducted in the recent past, raising the question of whether modern oceanographic, physiographic and meteorological data can be applied to the past. More recently, these observations have been coupled with insights from both the geological and archaeological record from around the Mediterranean Basin, demonstrating that the environment in the Mediterranean during the Late Pleistocene and Early Holocene can be reconstructed with a fair degree of confidence (e.g., McGrail 2009:88–89; Murray 1987; Lambeck and Purcell 2005; van Andel 1989). Thus, in order to address this question published data on these variables are synthesized.

In regards to past sea levels and climates, the discussion begins with the Last Glacial Maximum (LGM) which started about 26,000 years ago. The global model argues for a drop in sea level by 120-130 meters. Deglaciation is thought to have occurred after 18,000 years ago. The LGM marks the transition from the cold and arid environment of the Ice Ages to the warmer, interglacial conditions of the Holocene (ca. 11,700 cal B.P to
This was a critical time period since the Mediterranean basin was slowly reaching its present configuration, which was attained by about the tenth millennium B.P (Cherry 2004; Farr 2010; McGrail 2009; Shackelton et al. 1984; van Andel 1989; Wasse 2007). Because evidence from Crete and Cyprus suggest seafaring exploration occurred prior to the Mediterranean basin achieved its current configuration, it is important to discuss the transition from the LGM to the early Holocene; since these early seafarers were interacting with this environment. Sea level data are synthesized from published sources that have examined numerous variables known to affect the continental shelf and thus sea-level, including added (or decreased) glacial ice weight on the continental shelf and deep-sea floor and the tectonics acting on the mainland (e.g., Lambeck 1996; Lambeck and Chappell 2001; Lambeck and Purcell 2005; Shackleton et al. 1984; van Andel 1989). Furthermore, in regard to the Mediterranean, recent studies have also begun to focus on particular parts of the basin to determine if earlier models proposed for global sea-level stands can be used for the Mediterranean basin in general. These are discussed to determine whether there is local variation in sea-level stands between the LGM and the early Holocene or whether the global model holds relatively true for the basin (e.g., Ferentinos et al. 2012; Lambeck 1996; Lambeck et al. 2004). Climatic data are synthesized from published reviews of recent data from pollen, geomorphology, and oxygen isotopes by Rosen (2007), Wasse (2007), and Robinson and colleagues (2006). All of these sources summarize the environmental conditions in the eastern Mediterranean from the LGM to the early Holocene.

Data on tides winds and weather conditions are summarized mostly from McGrail (2009) who focuses on these variables specifically for the Mediterranean. Other sources, however, are also utilized. While much of these data are summarized from the current
conditions of the Mediterranean, as they are more difficult to reconstruct, sources from Classical Antiquity and the Middle Ages are discussed to demonstrate that there is at least some history to these variables (e.g., quoted in Murray 1987; Pryor 1988). Ultimately, the main goal is to emphasize that early seafarers would have had to be acutely aware of all of these variables, regardless of whether or not they are similar to the present.

The configuration of the Mediterranean islands and coastlines is also examined using published sources. The discussion is broken into two parts: the eastern Mediterranean and the western Mediterranean. The former denotes anything east of the east coast of Italy and the latter is anything west of the west coast of Italy. While particular focus will be given to Cyprus and Crete since these are two islands part of the wider Mediterranean basin, it is important to place them within the broader context of the changes that were occurring in the configuration of the islands and coastlines from the LGM through around the tenth millennium B.P., when the basin approximately reached its present configuration.

All of these data will be presented in Chapter 3, which has been extracted from Simmons’ (2014) *Stone Age Sailors: Paleolithic Seafaring in the Mediterranean*. I was the first author for Chapter 3 (DiBenedetto and Simmons 2014b:40-75) in the book in which the information is found.

2) *What were the earliest possible types of watercraft used?*

This question will be examined in Chapter 4. Similar to Chapter 3, it has been extracted from Simmons (2014) as I was first author on Chapter 4 (DiBenedetto and Simmons 2014c:76-101) where the data are found. Multiple lines of evidence, including ethnographic, iconographic, historical and archaeological (direct and indirect) evidence, are used to address this issue. An examination of all of these lines of evidence is necessary
because due to the organic nature of the construction materials of watercraft, few dating to the Early Holocene have been recovered such as at La Marmotta (Farr 2006:90, 2010:183; Fugazzola Delpino 2002; Fugazzola Delpino et al. 1993; Fugazzola Delpino and Mineo 1995; Rowley-Conwy 2011:436) and H3 at As-Sabiyah (Carter 2006:52–3, 2010a:192, 2010b:1, 89–91).

In regards to the thesis, the watercraft categories that will be investigated are based on McGrail’s (2009) calculations for the possible watercraft technology that could have been used in the Pre- and Early Neolithic (discussed in Chapter 3); however, they will be broader. Thus, the focus will be on log raft/ log boat, buoyed raft/ float, bundle raft, and hide boat since these represent the major types of watercraft technology used prior to the Bronze Age. Furthermore, it is much more difficult to get at the specific types of craft embedded in these broader categories since we rarely have the physical remains preserved; and even when this is the case, these remains are usually heavily fragmented. Two experimental studies will also be discussed that have been conducted in the Mediterranean Basin: one by Robert G. Bednarik (1999) and the other by Harry Tzalas (1988).

3) What is the evidence for an early human presence on Cyprus and Crete?

This question, addressed in Chapter 5, has two components. The first explores the earliest evidence and occupation from both of these islands, which is the Pre-Neolithic, using published research. The purpose of this is twofold. For one, it will allow us better insight into why these islands were visited in the first place. While the answer to this will of course never definitely be known, an examination of the two islands might help in the creation of stronger theories, including: were the inhabitants only utilizing local material; is there evidence for differences from the mainland(s) which they most likely originated
from; and could social status play a role in why some individuals chose to become seafarers?

The second part will focus on the Neolithic on Cyprus and Crete and compare the different faunal exploitations. It is important to emphasize that the Neolithic involved a change in reliance from both wild plant and animal resources to domestic plant and animal resources. Greater focus, however, is given to the animal exploitation in this thesis since the author will ultimately use primary data from *Ais Giorkis* to address human and animal relationships at the site in her subsequent dissertation. These data will of course be placed into the broader context of the other archaeological material at the site to provide a holistic interpretation of the site and its inhabitants. Furthermore, faunal remains are also better preserved on both islands than botanical remains. This focus, then, is one of practicality as well.

4) *Is there ethnographic evidence cross culturally that documents how wild and domesticated animals were transported using watercraft technology?*

This question will be addressed in Chapter 6 using the electronic Human Relations Area Files (eHRAF). Remarkably, there does not appear to be a rigorous, systematic attempt to assess animal transportation using watercraft technology in a cross-cultural perspective. Some studies have used ethnographic evidence to build experiments to estimate the main parameters (e.g., space and load capacities, speed, and superstructures) necessary for watercraft to transport animals (e.g., Vigne et al. 2013); however, this was not conducted using eHRAF. The key words that will explored include: ‘water transport,’ ‘animal transport,’ and ‘boats.’
A Note on Chronology and Use of the Terms ‘Pre-’ and ‘Early’ Neolithic

In terms of chronology, dates are usually presented as B.P. (“before present”) rather than B.C. The major exception will be when referring to historic references and documents. In these cases, “A.D.” or “B.C.” may be used depending on the context. Calibrated dates are used when possible. Unfortunately, there is a lack of consistency in the literature on the use of calibrated dates, which are often not provided. Furthermore, dates are usually specified when presenting the archaeological evidence for the different Mediterranean islands given that major time periods such as ‘Epipaleolithic’ and ‘Neolithic’ have different dates depending on the island and region in the basin. This is largely why the terms ‘Pre-Neolithic’ and ‘Early Neolithic’ are used. They are both general enough to encompass all the data discussed for the Mediterranean islands. The former refers to dates prior to the Neolithic on the islands, which is at least before 10,000 years ago. The latter is used when the Neolithic is established on the islands. When the Neolithic is discussed, the particular dates are provided.

The cultural periods ‘Lower,’ ‘Middle,’ and ‘Upper’ Paleolithic are also occasionally referenced in this thesis. As it will be demonstrated, absolute dates for early human occupations are near non-existent on the islands. Thus, early sites are often assigned to a particular cultural period based on general characteristics associated mostly with lithic technology. On mainland Southwest Asia, in general, the Lower Paleolithic, Middle Paleolithic, and Upper Paleolithic date to: 1.4 million years ago to 250,000 B.P.; around 250,000 B.P. to 45,000 B.P.; and around 45,000-24,000 B.P, respectively (Shea 2013:7, Table 1.1; Simmons 2014:103, Table 5.1). When available, more specific dates will be given for sites. These three cultural periods, along with the Epipaleolithic and Mesolithic
(discussed below) fall under the Pleistocene, the geological epoch which extended from 2.5 million years ago to the start of the Holocene.

In regards to Cyprus and Crete, the terms ‘Epipaleolithic’ and ‘Mesolithic’ are used. The former is used on mainland Southwest Asia and on islands near this geographic region (i.e., Cyprus). It begins substantially earlier on the mainland than on any of the islands, including Cyprus, ranging from around 24,000 to 12,000 B.P. The Mesolithic is the preferred term to use on the European mainland and nearby islands. It begins later than the Epipaleolithic, from around 12,000 B.P. to 7,000 B.P, and often continues into the time range that is generally used for the Neolithic on the Southwest Asian mainland (Simmons 2014:103; Table 5.1). In essence, both terms refer to the cultural period right before the Neolithic.

**Significance of the Thesis**

This thesis examines four critical issues for the Pre-Neolithic and Early Neolithic of the Mediterranean islands: environmental/ climatic conditions from the LGM through the Early Holocene; earliest types of watercraft technology; an early human presence on the Mediterranean islands, with a focus on Cyprus and Crete; and how animals were transported using traditional watercraft. It is becoming clearer that seafaring has played a central role throughout human history. Seafaring is still an important means of transportation throughout the Mediterranean today, although with dire and sad consequences for many refugees trying to seek political and economic asylum. As a result, it should not seem overly controversial that there has been a long history of movement across the basin using the sea; yet, there continues to be. This thesis reviews the literature on early seafaring in order to provide a new perspective. It is also hoped that this research
will add to our understanding of how animals might have been transported. This topic represents a major gap in our literature, particularly using a systematic, cross-cultural approach. The eHRAF study will allow me to fill this gap and propose stronger models for how animal transportation was possibly accomplished in the past. Ultimately, the main goal is to humanize the earliest seafarers—to emphasize that the past was peopled; a reality often overlooked for Mediterranean island archaeology.
CHAPTER 2

METHODOLOGICAL ISSUES AND THEORETICAL CONTEXT AND PERSPECTIVE

This thesis focuses on documenting the earliest human presence on islands, particularly oceanic islands, which implies seafaring and watercraft technology during the Pre-Neolithic and Early Neolithic. It also examines the diffusion of the Neolithic from the Southwest Asian mainland and the role that Mediterranean islands, particularly Cyprus and Crete, played in this process. Oceanic islands are islands that, during this time frame, were permanently separated from the mainland. This means that they were not connected by a land bridge. In contrast, continental islands are defined as being close or attached to the mainland (Reyment 1983). Two interrelated theoretical contexts will be utilized: island colonization and diffusion of both domesticated and wild animals and plants; although animals will mostly be the focus. The former examines the nature of peoples’ use of islands, specifically the difference between visitation and colonization. The latter discusses one aspect of the spread of the Neolithic economic suite and whether it involved land routes, sea routes, or a combination of the two. In order to frame these two theoretical perspectives, a brief background is provided to examine how seafaring possibly arose. This section is extracted from Simmons (2014) as I was first author on Chapter 2 (DiBenedetto and Simmons 2014a:21-39) where the information is located.

**The Possible Predecessor to Seafaring and Methodological Considerations**

How did hominins gain an interest and then the knowledge and skills to undertake open sea voyages? Of particular interest is the relationship of hominins with other aquatic
environments, specifically inland bodies of water and coastal areas. Since this thesis predominantly addresses seafaring, a focus is given to coastal aquatic environments. Nonetheless, inland aquatic environments, such as lakes and rivers, also would have played a major role in the development of the skills and knowledge necessary to conduct voyages on the open sea (Anderson 2010:6; DiBenedetto and Simmons 2014a:22).

Conventional wisdom has held that humans have begun only adapt to and exploit coastal environments within the last 15,000 years (Bailey 2004:39-40; Bailey and Milner 2002/3:131; Erlandson 2001:288, 2010:19–20; Erlandson and Fitzpatrick 2006). There are many reasons for this bias, several of which are discussed below. For a detailed discussion of this, however, as well as aquatic adaptations more broadly, there are numerous sources that can be consulted (e.g., Bailey 2004; Bailey and Milner 2002/3; Erlandson 2001; Erlandson and Fitzpatrick 2006).

One reason for this bias is sea-level variation and/or coastal erosion over the past two million years. These phenomena have eradicated elements of the archaeological record along coasts where evidence for early use of aquatic resources would occur. For example, sea levels during the Last Glacial Maximum (LGM), which is discussed in Chapter 3, were between 120 and 130 m below present levels. This drop in sea level resulted in the exposure of large coastal plains; however, much of this land has been inundated as sea levels have risen to their current elevation over the millennia. Events similar to the LGM have occurred throughout the Pleistocene, resulting in changes to the global coastal geography (Bailey 2004:42–43, 2010:30; Bailey and Millner 2002/3:132–133; DiBenedetto and Simmons 2014a: 23; Erlandson 2001:300–302, 2010:20; Erlandson and Fitzpatrick 2006:6). The current sea level is among the highest of the Quaternary
Period (ca. 2.6 million years ago to present). It is only exceeded by the Last Interglacial sea stand, around 130,000–125,000 years ago, when it was approximately 6 m higher. Re-deposited marine terraces located in coastal areas provide evidence for the destruction of sites. Today, coastline erosion continues to impact archaeological sites. This results in the current destruction of many of the earliest coastal sites, including Pinnacle Point (South Africa), Gorham’s Cave (Gibraltar), and Klasies River Mouth (South Africa) (DiBenedetto and Simmons 2014a:23; Erlandson 2001:300–301, 2010:20).

Variation in marine resource preservation also adds to this bias against early coastal exploitation (DiBenedetto and Simmons 2014a:23; Erlandson 2001:302, 2010:20). Marine resources primarily consist of vertebrates (e.g., marine mammals, fish, sea turtles, and marine birds) and invertebrates (e.g., bivalves, gastropods, cephalopods, scaphopods, polyplacophorans, crustaceans, and sea urchins). Of these, mollusks and fish are the best known from the Late Paleolithic in the archaeological record (Bar-Yosef Mayer 2013:84). Erlandson (2001:302–303) has shown that when shells and bones are exposed to dilute acid solutions, the former deteriorate at a faster rate than the latter. The higher calcium carbonate content of shells coupled with lower lipid or collagen content as compared to bone, partially explains this likelihood. If the soil has high acidity, there will thus likely be a large difference in the volume and type of marine faunal remains preserved and recovered (DiBenedetto and Simmons 2014a:23; Erlandson 2001:302). When shells, and particularly shell mounds, are preserved it usually receives substantial attention from archaeologists. An explosion of shell mounds located on many coasts is seen in the archaeological record from 6,000 to 7,000 years ago, representing a global phenomenon. There are far fewer examples prior to this date (Bailey 2010:30; Bailey and
Milner 2002/3:133–134; DiBenedetto and Simmons 2014a:24). This has led to the assumption that the first intense global exploitation of marine resources dates only to the seventh to sixth millennium B.P.

There are, however, several problems with this assumption. For one, some areas do not have productive shell beds. The absence of shell mounds at a coastal site, thus, does not mean that marine resources were not exploited at all (Bailey 2010:31; Bailey and Milner 2002/2003:134; DiBenedetto and Simmons 2014a:24). Social customs, such as those dealing with waste disposal, also play a significant role. Some groups might have used the same location for regular shell disposal over a long period of time, resulting in the creation of shell mounds (Bailey and Milner 2002/3:134; DiBenedetto and Simmons 2014a:24). Others may have disposed of their shells differently, perhaps away from the site or back into the sea; neither of which might not have left an archaeological trace. Finally, these mounds from the remote past could have been destroyed due to the variation in sea levels and coastline configuration (Bailey 2010:30-31; DiBenedetto and Simmons 2014a:24). The early shell mounds that have been preserved are usually in elevated positions, which have protected them. They are often also located on shorelines with a narrow continental shelf or where the offshore topography is extremely steep. The latter results in minimal differences between the coastline configuration of current and past sea-level stands. The increased visibility of these mounds could be the result of sea level stability, which starts in the middle Holocene and continues until today (Bailey 2010:30–31; DiBenedetto and Simmons 2014a:24).

In regard to the Mediterranean, the presence of shells and shell mounds varies by area. In the Levant, mollusks are rarely recovered as a food source. Furthermore, no shell
mounds have been recovered (Bar-Yosef Mayer 2013:88). In contrast, mollusks have been found in connection with subsistence remains at Paleolithic sites at Gibraltar, Sicily and the Italian mainland coasts. Shellfish was also exploited on the Italian mainland and in the Iberian Peninsula at least as far back as the Middle Paleolithic. For sites in Sicily, which date to the Upper Paleolithic, oxygen isotope analyses of the marine mollusks illustrate that collection occurred when sea surface temperatures were lower from the end of autumn to the beginning of spring. This demonstrates that these were a seasonal resource (Bar-Yosef Mayer 2013:90). In the Central Mediterranean, the most detailed and long-term record of exploitation comes from the late Upper Paleolithic site of Franchthi Cave (discussed in Chapter 4). Marine mollusk exploitation is first observed at this site around 12,000-10,000 cal B.P. There are limited data from Turkey; however, the cave sites of Üçağızlı, Öküzini, and Karain in Southern Turkey all have mollusk remains dating to around 20,000 years ago. Only the former, however, is a coastal site; the latter two are located some distance inland. This perhaps suggests exchange between inland and coastal groups (Bar-Yosef Mayer 2013:90).

Bone density is also an important factor in preservation. Aquatic vertebrates, in contrast to terrestrial vertebrates, usually have a lower bone density, making them more prone to deteriorate. The bones of aquatic mammals are also usually porous, which increases their susceptibility to destruction from chemical and mechanical processes (DiBenedetto and Simmons 2014a: 24; Erlandson 2001:303). Some marine animals, such as sharks and rays do not have any bones, being composed of cartilage. Others, such as sardines, anchovies, and other small bony fish, are often consumed whole. Thus, the
absence of marine resources does not necessarily mean coastal resources were not exploited (DiBenedetto and Simmons 2014a:24; Erlandson 2001:303).

Finally, the recovery methods used at archaeological sites also plays a major role in this marine resource preservation bias. Recovery techniques can skew the interpretation of a site. For example, faunal recovery studies have demonstrated that large percentages of fish bones and shellfish are not recovered when the mesh of the screen is too large (DiBenedetto and Simmons 2014a:24-25; Erlandson 2001:303, 2010:20). This is particularly problematic when evaluating early excavation reports, where recovery techniques were not as refined as the present. Many early archaeologists were also not particularly interested in subsistence issues; thus, faunal remains were not often systematically recovered. When there was an interest in subsistence, greater emphasis was placed on studying the scavenging and hunting of large terrestrial game animals (DiBenedetto and Simmons 2014a:25; Erlandson 2001:303–304, 2010:20).

All of these issues have resulted in the bias that coastal environments were not exploited until the last 15,000 years. Recent archaeological evidence, however, is radically altering this view. For example, sites from South Africa (e.g., Pinnacle Point Cave, Blombos Cave, Klasies River Mouth Cave, Die Kelders Cave, Hodjies Punt, Sea Harvest, Ysterfontein II, and Boegoeberg II) and elsewhere demonstrate that coastal foraging began around 165,000 years ago, during the middle Pleistocene (Anderson 2010:5; DiBenedetto and Simmons 2014a:25; Erlandson 2001:314, 2010:21). Research along the Red Sea coast at the Abdur Reef Limestone (ARL) suggests that humans there exploited rich oyster beds and other shallow water marine resources at least by 125,000 years ago. The former were cemented to the substrates, requiring strong and heavy tools,
such as Acheulean bifacial hand axes and cores, for their procurement. Smaller tools were then used to extract the edible parts. As the environment changed, the number of large oysters diminished. This resulted in other marine resources, including mollusks and crustaceans, being exploited in shallow coastal waters. Smaller tools, specifically obsidian blades and flakes, were used in their harvesting (Bruggemann et al. 2004; DiBenedetto and Simmons 2014a:25).

Marine fishing appears to have begun around 75,000 years ago. Evidence for this comes from Blombos Cave where bone points and fish bones have been recovered. Barbed bone harpoons at Katanda, located on a river in what is now the Democratic Republic of the Congo, have also been recovered and possibly date to 90,000 to 80,000 years ago. This implies that freshwater fishing began even earlier than marine fishing (Anderson 2010:5; DiBenedetto and Simmons 2014a:25; Erlandson 2001:315, 2010:21; Erlandson and Fitzpatrick 2006:11). Evidence from the Mediterranean for freshwater fishing pushes this date back even further to about 800,000 years ago. Freshwater fish have been recovered from Gesher Benot Yaakov (Israel) and Amud Cave (Israel) (Bar-Yosef Mayer 2013:85).

The first remains of large pelagic (or open-sea) fish, such as tuna, currently first appear around 25,000 to 30,000 B.P., from sites such as Gorham’s Cave (Gibraltar). Recent excavations from Jerimalai Cave on East Timor have recovered the remains of fast-swimming, deep-water fish, including tuna and sharks dating to 42,000 B.P. (Balme 2013:69–70; Balter 2007, 2011; DiBenedetto and Simmons 2014a:25; O’Connor 2010:42; O’Connor et al. 2011). A fishhook made of a mollusk shell was also recovered, which dated to 23,000 years ago. It is argued to be the oldest definite evidence for line
fishing (Balme 2013:69–70; Balter 2007, 2011; DiBenedetto and Simmons 2014a:32; O’Connor 2010:42; O’Connor et al. 2011). Not everyone, however, agrees with the interpretation of these findings. The tuna found at Jerimalai are small, with a length of only 50 to 70 cm, implying that they were juvenile fish. These could also have been caught close to shore without watercraft technology. The offshore topography surrounding East Timor is deep which causes the deep water to be nearer to the shore. This means that shore-based fishing could be done to catch deep sea fish from this type of offshore topography. Rock platforms on the coast that were next to the deep water could have been utilized (Anderson 2010:5; Balter 2011; DiBenedetto and Simmons 2014a:32-33). Until recently, deep sea fishing from the coast could still be found in Australia and South Africa, prior to the commercial destruction of the marine life stocks. Thus, it cannot be assumed that once pelagic fish remains are found in the archaeological record, watercraft must have been invented. This does imply, however, at the very least the use of cordage and hooks and/or spear points (Anderson 2010:5).

In sum, there is evidence for coastal exploitation through time, although in some parts of the world this is relatively sparse, but may be due more to preservation biases in the archaeological record. It seems highly likely though that hominins would have needed to learn to be familiar with the sea’s conditions first near the coast, before attempting an open sea voyage. Furthermore, it is also clear that our means of investigating potential sites needs to include underwater archaeology, given the reality that many sites may now be submerged. As Bailey (2013:107) notes, the key question here is not how to recover the material in a practical sense, since this is relatively straightforward including mapping of the subsurface and geology using acoustic instruments, vehicles with cameras for
documenting the site, diving use SCUBA gear for shallow conditions or more technical suits with deeper dives (e.g., mixed gases), and using various types of coring methods to recover artifacts. The more important question is where to look so that there might be a high probability of success of recovering archaeological material. This involves four layers of investigation: 1) the reconstruction of landscapes now submerged as they would have been during the time in questions; 2) use of predictive modeling of where people might have lived on the reconstructed landscape or where they might have stayed long enough to leave a visible signature in the archaeological record; 3) an assessment of where deposits could be preserved; and 4) discovery of locations where the archaeological material is visible and accessible using current technology (Bailey 2013:107). It is clear that more attention needs to be paid to coastal archaeology, which leads to the next area of investigation: the nature of island colonization (or visitation) and whether such undertakings were intentional, accidental, and/or a combination of both.

**Island Colonization**

In order to understand both the earliest human presence on Mediterranean islands as well as their role in the diffusion of the Neolithic, the nature of this initial visitation and/or colonization must first be understood. These terms are often defined differently in the literature, with the term ‘colonization’ still equating to permanent settlement. Recent research is demonstrating that this dichotomy is not useful as people used islands in different ways; thus, there are different forms of colonization (Dawson 2014; Simmons 2014). These data imply that, in contrast to the mainland, colonization may not take the form of permanent settlement (Dawson 2014:42). The following review outlines several older theories of island colonization and then focuses on theories currently being proposed.
During the 1960s and 1970s, islands were considered discrete entities, which displayed unique characteristics. Fosberg (1963:5) described an island as “a dry-land of less than continental size surrounded and isolated from another dry land by water.” Vayda and Rappaport (1963:134) explained the development of the unique characteristics of an island ecosystem in terms of the ‘founder effect’ principle. This theory postulates that species that colonized an island developed differently from the parent population (human or animal), which is due to only a portion of the gene pool being brought to the island (Dawson 2014:43). While they did display these unique characteristics, they could also be studied to better understand mainland processes. MacArthur and Wilson (1967:3) note, “…by studying clusters of islands, biologists view a simpler microcosm of the seemingly infinite complexity of continental and oceanic biogeography.” These biogeographical approaches led to the development of the laboratory analogy, which views islands as closed microcosms since they have definite borders in contrast to the continental landmass (Keegan and Diamond 1987:50). This approach became popular in studies of the Mediterranean islands (and Pacific islands).

As a result of the focus on biogeography, this model has been termed the biogeographic approach. Proponents of this model do not deny that human colonization poses unique issues of its own; however, problems faced among plant and animals during island colonization vary widely. An overall framework was developed by zoogeographers and phytogeographers for understanding the varied solutions that species have found to face many of these problems, including demographic bottlenecks, intergroup competition, and overwater dispersal. Since humans colonizing an island faced similar issues, it is argued that the overall framework of island biogeography can provide some useful
perspectives to explaining colonization events (Keegan and Diamond 1987:50-51). Important geometrical variables in this model include island distance, configuration, and area (Keegan and Diamond 1987:51).

Four effects of distance on animal and plant colonization have been identified by biogeographers. The first, emphasized by MacArthur and Wilson (1967), is that the likelihood of successfully reaching the island decreases as distance between the source and target increase. The reason is that colonists are exposed to greater risks of death over longer distances. The second effect is known as the “rescue effect.” The closer an island is to the source, the less likely it is for the colonizing population on the island to go extinct, since they can easily move back and forth between target and source. The third effect is that islands too small to support self-sustaining populations could still be inhabited if the island is within traveling distance of the mainland or another island which offers useful resources. This effect is known as the “commuter effect.” The final effect is that consumer species face greater survival challenges if there is a reduced diversity in subsistence resources (Keegan and Diamond 1987:58-59). Distance effects are modified by ocean current and wind patterns occurring between source and target island. These factors could either positively or negatively impact the voyage, depending on timing of the dispersal and means of dispersal (Keegan and Diamond 1987:60).

Distance effects can also be mitigated depending on the configuration of the island. One major factor is the presence of stepping-stone islands between the source and target island. Their presence could shorten a voyage or make it easier to cross. Another factor is if an island is part of an island chain. This is particularly beneficial if the chain is arrayed perpendicular to the place of origin as it results in a more easily located target; in contrast
to a single island. These islands could be detected by seabirds, altered wave patterns, and cloud screens, all of which contribute to the appearance of a continuous target (rather than separate, isolated islands) (Keegan and Diamond 1987:60-61).

Similar to distance effects on colonization, there are also several area effects. The first is that a larger island is more likely to be seen by colonists since it presents a more visible target. A larger island also offers a greater variety and quantity of resources and habitats, resulting in colonizing groups being more likely to stay on large islands as compared to small islands. Third, populations are more likely to go extinct on small islands since they are already small. Finally, populations experience higher levels of risk on smaller islands since smaller islands have an impoverished variety of animals and plants, making them more susceptible to catastrophic disturbances (Keegan and Diamond 1987:62).

The effects of these three biogeographical variables can be gauged through geographical and mathematical formulae, which were originally calculated by MacArthur and Wilson (1967). Held (1989a, 1989b) also devised a target/distance ratio (T/D). This model incorporates island target size (measured in degrees) on the horizon, rather than the actual size of the island, and relates it to the likelihood of an island being discovered. Thus, the higher the T/D value, the greater potential for the island to be found (Dawson 2013). Held’s model is discussed in more detail in Chapter 3. The focus on biogeographic variables clearly simplifies the reality of colonization and more importantly the true experience of the voyage. For example, the T/D ratio varies not just depending on the distance from the staging point, but also on the actual visibility from that point. Visibility also depends not just on distance, but also altitude, vegetation, and weather conditions (e.g.,
cloud cover). These may vary seasonally or daily. Many have argued that T/D ratios are misleading in the Mediterranean given the islands’ configurations (Dawson 2013:44).

Another issue with an island biogeography approach more broadly is that embedded in this theory is the idea that water was a barrier to constant communication between source and the newly colonized island (Dawson 2013; Fosberg 1963; Keegan and Diamond 1987; MacArthur and Wilson 1967; Simmons 1999, 2014). Beginning in the 1980s, there was a move toward humanizing the sea within archaeology, meaning that the sea was no longer seen as a barrier. Held (1989a, 1989b) argued that distance, morphology, palaeocoastlines, island size, and presence of stepping-stones should be incorporated into examining whether an island was insular. One of the earliest studies was by Broodbank and Strasser (1991) who examined the colonization of Crete. They emphasized that maritime movement had to be calculated based on minimum distance between landfalls (1991:233). These examples emphasize the change in paradigm from viewing islands as isolated units with the sea as a barrier to viewing islands and their configuration in relation to other nearby islands and the mainland(s) (Dawson 2014:45).

Due to the geographical configuration of the Mediterranean islands, which are located relatively near to one another (see Chapter 3), they cannot be considered isolated units. Thus, the use of the term ‘laboratory’ has likewise becoming increasingly less popular (Dawson 2014:45). This shift from micro- to macro-scale of observation of course depends on the questions being examined. Focusing on individual island units can still occur, but should be carried out with a comparative framework. It is no longer acceptable to reject or embrace an island’s isolation, unless rigorously tested (Dawson 2014:45). While it has become increasingly clear that islands in the Mediterranean cannot be viewed
as isolated units, the issue of colonization still remains today (Dawson 2014:47; Simmons 2014:10-12)

One of the earliest researchers to examine island colonization was John Cherry (1981, 1990, 2004). His seminal article ‘Pattern and Process in the Earliest Colonization of the Mediterranean Islands’ (1981) aimed to establish what had led to an island’s first occupation through an examination of any regularity within the archaeological record. He also sought to demonstrate the advantages and limitations drawn from the island biogeography theory. He laid out his theoretical framework, making a distinction between colonization and utilization or visitation. Cherry (1981:48-49, 1990:198-199) argued that actual colonization would have resulted in permanent, year-round habitation, where resources from the island become the principal subsistence provider. Short term or seasonal trips away from the island can still occur with a ‘colonized island.’ Utilization, in contrast, refers to the seasonal or temporary utilization of an island's resources. The people’s home base lay elsewhere. It can also refer to accidental and unsuccessful colonization attempts. Cherry did acknowledge that this dichotomy is too simplistic, noting that "colonization" might be a misleading term, since it implies planned expeditions with the intent of establishing a permanent base in an unexplored area. Cherry postulates that a more realistic perspective is many tentative, short-distance reciprocal movements between the mainland and island by a small number of individuals (Cherry 1981:60; Simmons 2014:10).

Cherry argued (1981:48) that the apparent lack of pre-Neolithic occupation on Mediterranean islands is due to the fact that these islands would generally have been unsuitable for hunter-gatherers. His view is based on the belief that small islands provided insufficient resources. Islands only became suitable for permanent habitation with the
inception of farming, improved climatic conditions, and the extinction of the mainland megafaunas. Cherry mostly argued this for the Western Mediterranean islands (e.g., Balearics). Interestingly, he noted that there was still a chance for pre-Neolithic occupation in the Eastern Mediterranean; although he noted that the earliest evidence of a permanent occupation on the majority of the islands occurs in the Bronze Age (1981:48). More recently, Cherry (2004) remains skeptical of a Pre-Neolithic occupation on any of the Mediterranean islands.

Researchers still have yet to agree upon a single definition of “colonization” and continue to use dichotomies to discuss the permanent and less permanent settlement of an island. For example, Bernard Knapp (2013:265) distinguishes between migration and colonization. The former refers to the movement by people from one geographical entity to another. This can sometimes include large groups or over long distances. In contrast, he defines colonization as the establishment of permanent colonies, trading posts, settlements or the like by foreign groups in an area some distance from their homeland. Individuals within these entities often, but not always, have the intent of economically exploiting and/or politically dominating the local inhabitants or resources of the area. Thus, he argues that migrants are not always colonists, but colonists are always migrants. While Cyprus has received many migrants throughout prehistory and the early historical period, Knapp concluded that it was only first colonized by the Romans (Knapp 2013:265).

Other scholars, however, are moving from away from this dichotomy. For example, some argue that initial colonization now entails a process of ‘landscape learning.’ Various forms of knowledge are acquired depending on the nature of the area, including whether it was void of people or already inhabited (Dawson 2014:54). In regard to the first case, the
main obstacle faced by early colonizers would be the acquisition of knowledge about the physical environment, in particular resources. On the other hand, in the second instance, colonizers would also have to deal with cultural and social differences. For both cases, overcoming these problems would largely depend on the primary resource needs of the newcomers (Dawson 2014:55). Rockman (2003:19) argues that subsistence systems based on large animals with larger ranges of adaptation are more easily transferable. In contrast, those based on plants are difficult to transfer since plants are more greatly affected by small variations in topography and climate. Finally, those systems based on non-organic resources, such as lithic material acquisition, are the hardest to transfer since location affects geological properties. This means that existing knowledge systems might have to be heavily modified to adjust to material properties newly discovered. All of these processes may only be potentially visible in the archaeological record (Dawson 2014:55).

Dawson (2014:55) notes that there are challenges to matching archaeological evidence with past activities. This is especially the case when so-called diagnostic correlates overlap. For example, burial clusters are often used to demonstrate permanent settlement and thus, colonization (Cherry 1981:48). Repeated visitation, however, can result in people developing attachments to places. The initial visitation of an area would be challenging to document due to the ephemeral nature of these newcomers. One way of possibly overcoming this challenge is to document resources on the mainland or other islands that had to have come from a particular island. Obsidian is one case in point, which can be sourced (see Dawson 2014:55). Islands with obsidian sources include: Melos and Lipari, both of which are discussed in Chapter 4. Caution must be taken, however, in
assessing visitation based on only one category of material. For some periods, there may be a lack of markers which indicate an early human presence (Dawson 2014:55).

This discussion emphasizes two key points. The first is that the overall colonization process is made up of different phases, which are specific to the reasons that led to the colonization of the island (Dawson 2014:57). The second is related to terminology. It is clear that the definition for the term colonization is highly contentious. Dawson (2014:57) suggests that this is due to its literal definition, which is ‘the founding of colonies.’ It stems from the latin word *colonus* (English word ‘colony’), or ‘tiller of the soil or farmer’ (Kohn 2014). This definition implies permanent and well-planned settlement ventures. Some argue that ‘colonization,’ using its true definition, began in the Neolithic; although others, similar to Knapp (discussed above), believe it occurred much later. Clearly, this term is not particularly useful when examining the earliest seafaring voyages to islands. In fact, Dawson notes that it adds nothing to our understanding of these first explorers and continues the circular argument for how to describe them (2014:57). Focus instead should be given to how human activity on island spatiotemporally changes. She argues that ‘colony’ should be replaced with ‘place’ and ‘colonization’ with ‘place-making.’ The latter means that there is an enduring human presence (Dawson 2014:54). If, however, ‘colonization’ is viewed as a process that comprises various activities, then the term can be used to describe initial visitations of an island or ‘visitation colonization’ (Dawson 2014:57). Ultimately, it is clear that when the terms ‘visitation’ and ‘colonization’ are used, they need to be defined due to the contention surrounding them.

For the purpose of the thesis, the terms ‘visitation’ and ‘colonization’ will be used for the Pre- and Early Neolithic onwards, respectively. Visitation is similar to ‘landscape
learning,’ in that the current archaeological evidence suggests that the earliest inhabitants of the islands were acquiring knowledge about the physical spaces rather than focusing on settling the landscape permanently with relatively large groups. Colonization is similar to ‘place-making.’ There is greater evidence of a more substantial and permanent human presence.

One other important aspect that needs to be considered in regards to visitation and colonization of the Mediterranean islands in the Pre-Neolithic, in particular, is whether seafaring was accidental or planned. With regard to the former, it suggests that individuals are accidentally swept out to sea, perhaps by a tsunami or flash flooding from a river system, and wash up on an island. This would also include fishermen in boats who were caught in a storm and accidentally swept out to sea to an island. Thus, watercraft technology might have been used, but the intention was not to end up on an island. For the latter, it implies a level of coordination and cooperation for both the construction of the watercraft and the actual voyage itself (Ruxton and Wilkinson 2012:509). Planned voyages by the Early Neolithic is less contentious since it involved the introduction of both wild and/ or domesticated plants and animals amongst substantial habitation on the islands, including Cyprus and Crete (Chapter 5). Ruxton and Wilkinson (2012, 2013) examine how likely it would be that the initial landing of people on a previously uninhabited island would result in a self-sustained population. They also explore how the nature of the colonizing group might influence this likelihood (Ruxton and Wilkinson 2012:507, 2013:392). To address both questions, Ruxton and Wilkinson relax two important assumptions that are inherent in computer-simulated demographic models. The first assumption relates to age structure and sex ratio of the founding population. Demographic models assume that the voyage was
planned; thus, the group would be comprised of a balanced sex ratio of young adult individuals. In contrast, Ruxton and Wilkinson (2012:507-508) test a more variable age-structure and sex-ratio group, occurring if colonization was accidental. The second assumption relates to the number of groups that immigrate to the target island. Conventional demographic models argue for a single founder group. Instead, the two explore multiple arrivals that occurred irregularly and infrequently. For a colonization event, accidental or planned, to be considered successful, Ruxton and Wilkinson wanted one of two conditions to be met: the population survives for more than 500 years or the population size reaches 500 individuals (Ruxton and Wilkinson 2012:508).

In regards to planned colonization events, their results aligned closely with other demographic models, which predict that the probability of success increases with the initial colonizer group size. This increase is dramatic for groups with few individuals and saturates by around 20 individuals. Interestingly, these numbers are similar to empirical studies of programs dealing with non-human mammal reintroductions to islands. A global review of this literature suggested a minimum of 12 individuals, but a review of studies specific to New Zealand suggest the reintroductions were more successful when there were ten or more individuals (see Ruxton and Wilkinson 2012:508).

For unplanned colonization events, there is not a strong effect against success when the group was comprised of broader sex ratios and age ranges. This suggests that so long as the threshold is exceeded for initial group size, then the demographics of the population size are less important, except when extreme age structures and/or sex ratios are generated (Ruxton and Wilkinson 2012:509). The addition of individuals (group size larger than 10)
arriving periodically (around every 50 years) helps contribute to the overall success of a population with an initial unplanned colonization (Ruxton and Wilkinson 2012:509).

Interestingly, while Ruxton and Wilkinson’s models imply that both unplanned and planned colonization events could lead to a viable population on an island, they ultimately focus on the greater likelihood of these events being unplanned:

We accept that the chain of events required for natural events to deposit a number of live hominins on previously uninhabited island means that it would be highly improbable in any particular year for any particular island. However, evidence from Flores suggests that to evaluate the importance of this mechanism we must think in terms of hundreds of thousands of years, and even for cases of colonization by *H. sapiens* we need to be thinking of tens of thousands of years (as in the Australian example) (Ruxton and Wilkinson 2012:510).

Their final conclusion takes away from the importance of their findings, especially since it appears to be tinged with the notion that our ancestors prior to *Homo sapiens* did not possess human characteristics, including language and the ability for coordination and cooperation (Ruxton and Wilkinson 2013:392). Simmons (2013a:393) points out that it would be challenging to document these unplanned voyages. Thus, since we do have archaeological evidence from around the world for early seafaring, it seems more likely that at least some of these were planned trips. He also calls into question the likelihood of there being enough female and male individuals to both survive the drift and then create a viable population (2013a:393). Ultimately, this still represents a major point of contention amongst island archaeologists globally. This is particularly attested for the most recent edition of *Journal of Mediterranean Archaeology* (2014:27.2), where several
Mediterranean island scholars took up this issue. Runnels (2014a, 2014b) argued in favor of planned colonization attempts, particularly for Crete and several of the other Greek Islands. In contrast, Leppard (2014) and Broodbank (2014) concluded that the current evidence does not imply any seafaring in the Mediterranean, planned or unplanned, until the Epipaleolithic. Phoca-Cosetatou and Rabet (2014) and Galanidou (2014) are more cautious in concluding that the early evidence for seafaring from the Mediterranean is both real and represents planned events; however, they do not outright dismiss either of these ideas. I believe that it seems more plausible that in order to have a sustained, viable population on an island, particularly one some distance from the mainland, planned voyages would have been necessary. While unplanned voyages might have happened, it would be challenging to discuss this given the nature of the archaeological record.

**Diffusion of the Neolithic**

The second theoretical framework that will be examined in this thesis relates to the broader diffusion of the Neolithic, with a particular emphasis on the diffusion of both wild and domesticated animals. It is important to first discuss what is the ‘Neolithic.’ It represents one of the most momentous developments in human history, first occurring around 12,000 to 11,000 years ago on mainland Southwest Asia. It resulted not only in the economic reorientation from hunting and foraging to a greater reliance on domestic resources, but also in significant changes in human technology, demography, society, political organization, ideology and human relationships to the environment (e.g., Bar-Yosef 1998, 2001a, 2001b; Bar-Yosef and Belfer-Cohen 1989, 1992; Belfer-Cohen and Goring-Morris 2011; Cauvin 2000; Simmons 2007, 2012b; Vigne 2011a; Zeder 2008, 2012). The conventional term to describe this formative period is the ‘Neolithic
Revolution,’ first coined by V. Gordon Childe (1981 [1956]). While this term implies a rapid transition, it was in actuality a gradual development encompassing a range of relationships between humans and animal and plant populations. In fact, Childe (1981[1956]:94) emphasizes the Neolithic Revolution was in fact the climax of a series of long processes; thus, not a revolution. He perhaps chose the term ‘Revolution’ as he strongly believed that archaeologists could only look at the results of the long-term developments and not the processes themselves.

These processes include low-level management, commensalism, and intentional and direct control over reproduction. This process did not progress in a unilineal fashion from wild to domestic. There is in fact a broad middle ground between the two states as evidenced by the phenomenon of feralization (Arbuckle 2014; Dobney et al. 2013; Larson et al. 2014; Vigne 2011a, 2013a; Zeder 2006, 2008, 2011, 2012). Furthermore, not all experiments with plant and animal management led to morphological domestication. For example, gazelle were heavily exploited in the southern and northern Levant during the Epipaleolithic. This exploitation has led to debates over whether the animals were hunted or herded. The consensus seems to be that they were hunted. Faunal analyses from several sites in the succeeding Pre-Pottery Neolithic A (PPNA) does document rising numbers of juveniles, implying a more intensive system of culling or management. Despite this, gazelle were never morphologically domesticated, partly due to their behavior, which is not suited for this process. This should not undermine the fact that they were brought under some degree of human control (Barker 2006: 123-125, 135; Rowley-Conwy and Layton 2011: 856; Zeder 2008: 11599).

The term ‘domestication’ has already been mentioned several times; thus, it is
important to briefly discuss its definition. Similar to most other terms used by scholars, there is no one unifying definition for ‘domestication’ (e.g., Bökönyi 1989; Clutton-Brock 1994; Ducos 1978; Zeder 2006, 2012, 2014). Zeder (2006, 2012) notes that most approaches to domestication in both animals and plants recognize that this process involves some type of relationship between humans and the target animal or plant populations. The differences between definitions comes from the where the balance of power in the relationships is emphasized. Some approaches, in particular for animal domestication, focus on the dominant role than humans play in assuming control over all aspects of reproduction, movement, distribution, subsistence, and protection (e.g., Ducos 1978; Ingold 1996; Zeder 2006:105, 2012:162, 2015). A key part of definitions that place humans in control of all aspects of this process is the notion of intentionality, specifically that humans had foresight to intervene in the life cycle of the target plant and animal population to fulfill human needs (Ducos 1978; Ingold 1996; Zeder 2006:105, 2012:162). Within this focus on the human dimension is the idea that the process comprises a change in socioeconomic organization where human society begins to integrate successive generations of domesticates as objects of ownership (Ducos 1978; Ingold 1996; Zeder 2006:105, 2012:162).

Other scholars, in particular those operating within an evolutionary biology framework and those studying plant domestication, reject this anthropocentric approach since it views the plants and animals as passive players in this domestication process. They instead argue that domesticates also gain benefits from this process, including expanded ranges and enhanced reproductive fitness. The relationship between humans and the animal and plant domesticates is, thus, similar to other mutualistic and symbiotic relationships in
the natural world. Such relationships bring together different species into partnerships where co-dependency increases through time (e.g., Anderson 1952; Blumer 1996; Rindos 1984; Zeder 2006:105, 2012:162, 2015). It is also argued that as this relationship moves towards a focus on the domesticate and away from a balanced mutualistic relationship, the role of human intent decreases. In fact, some see the domesticate as manipulating the human partner to increase its own evolutionary advantage—this is of course the extreme of this position (Rindos 1984; Zeder 2006:105, 2012:162).

Others focus on the genetic and associated morphological changes that are seen to occur between wild and domestic animal and plant populations (e.g., Harris 1996; Hillman 2001; Hillman and Davies 1990; Moore and Hillman 1992; Rindos 1984). This is particularly common for those who focus on plant domestication due to the fact that genetic changes occur quite rapidly under human intervention, particularly with large-seeded annuals. This then results in observable phenotype changes (e.g., Harris 1996; Hillman 2001; Hillman and Davies 1990; Rindos 1984). Some argue for animal domestication as well that genetic isolation and attributable quick-onset changes in morphology are essential to define an animal as ‘domesticate’ (e.g., Moore and Hillman 1992; Uerpman 1996; Zeder 2006:105, 2015). The importance of genetic and morphological changes has increasingly come under scrutiny and is no longer widely accepted. For animals in particular, morphological changes are often delayed in regards to the beginning of the process and challenging to attribute conclusively to this process. For example, in vertebrates there are a number of constant modifications, such as a decrease in sexual dimorphism and aggressiveness, increase in fertility, shortening of the face, the appearance of a new coat, and the braincase volume becomes smaller. These modifications can be the result of stress
of captivity or environmental conditions; thus, not due to human intent (Zeder 2006:105; Vigne 2011a:173). Thus, animal domestication is often defined in terms of causal human behavior meaning that domestication involves a process where human intervention increases from predation to genetic engineering. Along this continuum, there are various degrees of human investment in altering the natural behavior of an animal, including population structure, breeding schedule, and herd movement (Hecker 1982; Ingold 1996; Vigne 2011a; Zeder 2006:106, 2012:162-165, 2015). This represents a middle ground between the three different definitions presented above (Zeder 2012:162).

For the purpose of this thesis, the human factor is emphasized since humans had to bring animals (as well as plants) to the islands. Thus, humans must have had substantial control over these groups by at least the Epipaleolithic, which will be discussed for Cyprus and Crete in particular (Chapter 5). Throughout this thesis, particular emphasis is given to the economic aspect of the Neolithic because it is hoped that a thorough analysis of the animals exploited will then allow the less archaeologically visible aspects of the Neolithic (e.g., animal-human relationships, social structure, and ideology) to be determined for both of these islands. In contrast to many sites on the mainland, the material culture on Cyprus and Crete does not easily allow one to get at these other, arguably more important, aspects of the Neolithic.

The last half century has witnessed the rise and fall of a number of models related to the diffusion of domesticates from mainland Southwest Asia throughout the Mediterranean basin, some of which are summarized below (Zeder 2008). V. Gordon Childe used his demographic/Malthusian concept of population pressure and territorial expansion to the study of the Neolithic in Europe. He proposed that domesticated plants
and animals did not reach Europe by means of trade or exchange but through the migration and colonization of people from Southwest Asia (Childe 1981 [1956]; Pinhasi et al. 2005).

Clark (1965a, 1965b) examined the Neolithic dispersal by looking at the spatiotemporal pattern of radiocarbon dates in Southwest Asia and Europe. The few carbon-14 dates available at the time were allocated to three temporal classes: Group 1 (dates equal to or earlier than 7150 BP), Group 2 (dates between 7150 and 5950 BP) and Group 3 (dates between 5950 and 4750 BP). Ultimately, he showed a trend similar to Childe’s idea that the spread of domesticates was from east to west for the early Neolithic in Europe (Clark 1965a, 1965b; Pinhasi et al. 2005).

Ammerman and Cavalli-Sforza (1971, 1984) conducted a quantitative analysis of the spread of farming into Europe. Their research ultimately framed their ‘wave-of-advance’ model, which attributed the westward spread of domesticates into Europe to colonists from mainland Southwest Asia who were driven by agriculture fueled population growth. These colonists pushed aside and ultimately replaced hunter-gatherers at a predicted rate of one kilometer per year (Ammerman and Cavalli-Sforza 1984; Pinhasi and Pluciennik 2004; Pinhasi et al. 2005; Zeder 2008). This model is clearly problematic in that it assigns a very passive role to local populations (Zeder 2008:11599). Furthermore, it assumes that the diffusion of domesticates took place only via overland routes. The role played by sea routes and Mediterranean islands was not discussed; however, this is largely in part due to the paucity of evidence for a Neolithic occupation on most of the Mediterranean islands at this time.

More recently, this wave-of-advance model has been reevaluated (Pinhasi et al. 2005). The results were similar to the original study with the average rate of the spread of
domesticates being between 0.6 to 1.3 km/year (Pinhasi et al. 2005). The dataset in this recent study is more robust than the study thirty years ago and includes early Neolithic sites on several of the Mediterranean islands. Pinhasi and colleagues still view the indigenous peoples of the Mediterranean basin as passive players in this diffusion process, although they do note that this spread was a relatively slow process as it took more than 3,000 years, which is equivalent to 100 human generations, for the Neolithic transition to reach northwest Europe from mainland Southwest Asia (Pinhasi et al. 2005).

In more recent years, focus has turned to the role that the indigenous people of an area might have played, a reaction to the passive role assigned to them by the demic diffusion models. Early models within this perspective proposed that there was indigenous domestication of animals and plants in Europe, independent of the domestication process in Southwest Asia (e.g., Barker 1985; Dennell 1983; Higgs and Jarman 1969; Zeder 2008). For example, in Upper Paleolithic and Mesolithic (similar to Epipaleolithic) levels at Franchthi Cave on the eastern coast of the Greek mainland, wild oats, lentils and barley were recovered. This was followed by the presence of domesticated lentils and barley in later Neolithic levels, leading to the interpretation of autochthonous crop domestication (Hansen and Renfrew 1978; Zeder 2008). Recent genetic studies, however, have ruled out an independent domestication in Europe; rather, they have confirmed ancestry in Southwest Asia (e.g., Edwards et al. 2007; Tresset et al. 2009; Wilcox 2002; Zeder 2008).

Although the indigenous domestication of animals and plants in Europe has been ruled out, this did not lead to an increase in support once more for demic diffusion models. Rather, most scholars now argue for a hybrid between population movements and the spread of knowledge and technology for domesticates. Focus is also being given to inter-
regional variation in animal and plant exploitation patterns, both before and after the appearance of domesticates in the archaeological record (e.g., Arbuckle 2013, 2014; Arbuckle and Makarewicz 2009; Conolly et al. 2011).

Since the thesis discusses early seafaring, one important question is whether there is any evidence that this activity might have played a role in the spread of the Neolithic. A recent ancient DNA analysis by Fernández and colleagues (2014) suggests this is the case. The study used three archaeological sites in Syria located in two different geographic locations where early agriculture has been documented: the oasis of Damascus (Tell Ramad) and the middle Euphrates valley (D’jade al Mughara and Tell Halula). All of the sites date to between 10,650-8,550 cal B.P., or the Pre-Pottery Neolithic B when animal husbandry and domesticated plants first appear (Fernández et al. 2014:1-2). Ten complete and five partial haplogroups were reconstructed from individuals. Nine different haplotypes were identified; two of them were shared between 2 individuals at Tell Halula and among 3 individuals at Tell Ramad. The complete haplogroups were compared with a database of 9,821 mtDNA profiles from 59 modern populations from Southeastern Europe, the Near East, and two Early Neolithic populations from Central Europe and North Eastern Iberia. Two of the PPNB haplotypes were not represented in any of the ancient or modern populations of the database. Only one of the remaining haplotypes (the basal node of haplogroup K) was shared with the other two ancient populations. This haplotype is still found today in the Near East and Southeastern Europe with an average of 4%. Some populations, including Cyprus, Crete, Ashkenazi Jews, and Csángó (Hungary) display frequencies higher than 10% (Fernández et al. 2014:5). The remaining ancient haplogroups had a limited geographic distribution being only documented from: 4 Iranian, Karakalpak,
Bedouin, and Turkish individuals; three Druze from Israel; and 3 individuals from Yemen, Qatar, and Turkey (Fernández et al. 2014:5).

This study demonstrates several key points. The first is that while mitochondrial variability of the PPNB individuals is within the limits of Near Eastern, Southeast European, and Caucasian populations, both the haplotype and haplogroup PPNB frequencies deviate from the modern successors. This implies that the mtDNA make-up of modern populations in the Near East might not be an accurate reflection of those during the Early Neolithic (Fernández et al. 2014:9-10). It also suggests that certain populations have isolates of these early mtDNA components, such as the Cypriots and Ashkenazi Jews. This might be due to cultural isolation and/ or endogamous practices (Fernández et al. 2014:10). This means that the current distribution of mitochondrial haplogroups occurred due to demographic processes from the Late Neolithic onwards (Fernández et al. 2014).

More relevant to the discussion is the findings from Cyprus and Crete. The strong genetic affinities of modern populations from these islands with ancient PPNB ones coupled with the current lack of similar modern genetic pattern in Southwestern Anatolia implies that seafaring might have played a role in the movement of some people from at least the Early Neolithic onwards (Fernández et al. 2014:11). There are of course issues with ancient DNA analysis including concerns of contamination and small sample-sizes; the former is addressed by the authors (Fernández et al. 2014:6-9). Minimally, this study provides some genetic evidence supporting seafaring in the Mediterranean by at least the Early Neolithic.

In sum, this discussion has outlined two different theoretical contexts: island colonization and the spread of the Neolithic. Both are important in understanding the evidence for a human presence on the Mediterranean islands during the Pre- and Early
Neolithic. Before the physical evidence of these human occupations can be discussed, it is necessary to understand the physical environment that these early seafarers might have faced.
CHAPTER 3
THE PHYSICAL ENVIRONMENT OF THE MEDITERRANEAN BASIN

The body of water that extends west to east from the Strait of Gibraltar to the Levantine and Anatolian coasts, and north and south from the southern European coast to the North African coast is known today as the ‘Mediterranean Sea’ (Figure 3.1).

Figure 3.1. Map of the Mediterranean Basin, showing some of the major seas and islands. *(Drafted and modified by Russell Watters from Simmons 2014: Figure 1.1).*

It has a maximum length and breadth of around 3,800 km and between 400 and 750 km, respectively (Bradford 1971:28; Broodbank 2013:55; Cavaleri 2005:255; DiBenedetto and Simmons 2014b:41; McGrail 2009:88). Over the last several millennia, however, it has been known by many names. From at least the first millennium B.C., this sea was known as the ‘Great Sea’ in the Semitic languages of the Levant. The term is thought to have then
diffused to the Greeks by around 500 B.C., as attested in the writings of the philosopher and pioneer of geography, Hecataeus of Miletus. During the time of Plato and Aristotle, the Greeks referred to it as the ‘Sea over by Us.’ The Romans called it *Mare Nostrum*, or ‘Our Sea. The ancient Egyptians might have named it the ‘Great Green’ (Abulafia 2011:xxiii; DiBenedetto and Simmons 2014b:40; Horden and Purcell 2000:10–11). More recently, the Mediterranean has been known as the ‘White Sea’ (*Akdeniz*) for the Turkish people, the ‘Middle Sea’ (*Mittelmeer*) for the Germans, and the ‘Great Sea’ (*Yam gadol*) for the Jewish people. In the romance languages, it is known as the sea ‘between the lands.’ Modern writers have added to this list by coining labels such as the ‘Inner Sea,’ the ‘Friendly Sea,’ the ‘Bitter Sea’ of WWII, the ‘Faithful Sea’ of several religions, the ‘Liquid Continent,’ and the ‘Corrupting Sea’ (Abulafia 2011:xxiii). Several of these names have been the source for book titles regarding the history of the Mediterranean Basin, including Horden and Purcell’s *The Corrupting Sea* (2000), Abulafia’s *The Great Sea* (2011), and Broodbank’s *Making of the Middle Sea* (2013). All of these names emphasize the central and vital role played by the Mediterranean from prehistory through modern times; however, the sea itself came into existence many millennia prior to humans entering the scene (DiBenedetto and Simmons 2014:40). As noted in Chapter 1, much of this information is extracted from DiBenedetto and Simmons (2014b:40-75).

**The Birth of the Mediterranean Basin**

The form and properties of the Mediterranean are largely due to plate tectonics; thus, there is no real ‘birth,’ or beginning to its geological history. During the Mesozoic Era (250 to 65 million years ago), a primordial sea, referred to as Tethys, covered the entire area. In Greek mythology, Tethys was the daughter of the earth and sky as well as the
consort of Oceanos, the powerful ocean god who was thought to have encircled the entire globe. In fact, the Tethys Ocean extended over nearly half of Earth during this time frame, linking the proto-Indian and Atlantic oceans and dividing Eurasia from the African and Arabian plates, the latter were attached to one another (Figure 3.2). The basin began to take on its current shape around 25-15 million years ago when the African and Arabian continental plates collided with the Eurasian plates in the area of modern Iraq; in fact, by at least this time frame, the Mediterranean would have been recognizable from space. This resulted in the formation of the Mediterranean Sea as a more or less isolated body of water. The western portion became the proto-Mediterranean and the eastern area endures as the Aral, Caspian, and Black Seas (Abrantes 2012:18; Bradford 1971:28; Broodbank 2009:679, 2013:63, 65; DiBenedetto and Simmons 2014b:40; Schüle 1993:400; Trump 1980:4).

Figure 3.2. Before the Mediterranean Sea: an approximate geography of the Tethys Ocean. (Modified by Russell Watters from Broodbank 2013:Figure 2.3).
The continental plates continue to clash today resulting in Africa moving 2 cm a year into Europe. This means that the Mediterranean is growing smaller—in essence, a disappearing sea. This tectonic activity accounts for the fundamentals of the Mediterranean’s form and properties. At the main point of contact between the two plates, the denser African plate slides beneath the Eurasian, raising and breaking it into fragments, which gyrate separately. The sharp distinction between the Mediterranean’s generally smooth, straight southern shore (the diving plate) and the complexity of its center and north shores (the broken, upthrust plate) is due to this activity. The bucklings of the Tethys seabed created the abrupt, high mountain ranges found around the basin. These include the Rif and High Atlas on the African side and the Sierra Nevada, Alps, Pyrenees, Apennines, Pindos, Dinarics, and Taurus in the north. The latter grade into the Anti-Taurus, the Caucasus, and the Zagros. This continuous wrinkle culminates in the Himalayas. Much of the land in the basin is also uplifted as well. Three-quarters of Italy and two-thirds of Greece consist of hills or mountains. Much of the Maghreb east of the Rif also comprises high plains and the central plateau of the Iberian Meseta is some 500 m above sea-level (Braudel 1995:25-26; Broodbank 2009:679, 2013:63).

There are also large lowland plains, particularly on the northern side, which are caught between the uplifted areas and the sea. Prominent examples include the Po Valley, the Tavoliere, and Campania in Italy, Languedoc in France, Thessaly in Greece, and much of Macedonia and the Turkish Amuq. Areas where plates either move away or run alongside each other creates the valleys and deep inlets of the basin. The longest valley is that running from the Red Sea through the Wadi Arabah, Dead Sea, Jordan Valley, Sea of Galilee, and Beqaa Valley, petering out in the Amuq. This area follows the contact between
the two plates and forms the northern extension of the Great Rift Valley in Africa. Most other lowlands are considerably more modest (Broodbank 2013:64).

This tectonic activity also explains why the Mediterranean is so earthquake prone and punctuated by extinct, dormant, and active volcanoes. The worst afflicted areas are the northeast and central regions of the basin, with the Aegean, in particular, representing one of the most active parts of the world’s crust. It is believed that the fault in the Gulf of Corinth will eventually rival that of the Californian San Andreas fault; however, this will not be for many ages (Broodbank 2013:64). This combination of volcanic and tectonic activity also explains the numerous islands (Broodbank 2009:679, 2011:27, 2013:65; Schüle 1993:400).

Figure 3.3. Reconstruction of the Mediterranean Basin during the Messinian Salinity Crisis. *(Modified by Russell Watters from Broodbank 2013:3.1).*
Between 12 and 5 million years, the African plate was propelled into the area now known as Iberia and Morocco, which cut-off the flow of water from the Atlantic Sea into the basin; an event known as the Messinian Salinity Crisis. Morocco was then conjoined to Iberia. Deprived of this flow, the evaporation rate became greater than the input of water, causing sea levels to drop by as much as 1300 m. This reduced the basin to desert-like conditions with small pockets of water by at least 5.9 million years ago (Figure 3.3). Approximately 5 million years ago (with Garcia-Castellanos and colleagues [2009:778] arguing for the exact date of 5.33 million years ago), the Atlantic waters breached the land barrier that had linked modern-day Morocco with Spain and refilled the basin. This event is known as the Zanclean or post-Messinian flood. Once this occurred, it is believed that the basin filled up with water relatively quickly. While the flood initially started as low levels of water discharge that probably lasted several thousand years, Garcia-Castellanos and colleagues (2009) argue that 90% of the water was transferred back into the basin within a period ranging from several months to two years. Sea levels were thought to have risen by at least 10 m per day (Abrantes et al. 2012:20-25; Abulafia 2011:xxvii; Broodbank 2013:82-83; Cherry 2004:237; DiBenedetto and Simmons 2014b:41; Garcia-Castellanos et al. 2009; Knapp and Blake: 2005:6; Trump 1980:4).

**Physical Features of the Mediterranean Basin**

The Mediterranean, with a surface area of around 2.5 million km², is an extensive, semi-closed sea. It is the world’s largest inland sea, even when compared to the Caribbean and the Gulf of Mexico. Due to it being a body of water surrounded almost entirely by land, it is often described as a peninsula in reverse. Its form has also been referred to as a horizontal seahorse. Throughout at least the last five or six millennia, it has been subject to
a very distinct climate regime with long, dry, and hot summers and mild, wet, and short winters, making it one of the most favored in the world. It also consists of high biodiversity—half of the 25,000 plant species that grow in the region are endemic and exist nowhere else in the world—and environmental variability. These features are comparable only with several other places on the planet, all of which are at similar latitudes, including: the southern and western regions of Australia and South Africa, Chile, and California.


The combination of the nearly land-locked sea, high temperatures, and large surface area result in high levels of evaporation, which in turn corresponds to high salinity. Both small and large river systems flow into the Mediterranean, but these, even with precipitation, manage to replace only between one-quarter and one-third of the water lost to evaporation. This is particularly pronounced in the summer, where rainfall is generally insignificant. The small rivers that feed into the Mediterranean include the Arno and Tiber rivers and the rivers of Sicily and Sardinia. Larger river systems include the Po, the Nile, the Ebro, and the Rhône. The Danube and Russian river systems also make an indirect contribution due to the Black Sea drawing in water from several of these rivers (Abulafia 2011:xxvii; Bradford 1971:34; Cunliffe 2008:48; DiBenedetto and Simmons 2014b:42; Morton 2001:37; McGrail 2009:90; Pryor 1988:12–13).
This massive net loss of water is primarily compensated by the inflow of water through channels that link the Mediterranean to other bodies of water, specifically the Bosphorus and Dardanelles Straits and the Strait of Gibraltar. The former allows surface water from the Black Sea to flow into the Aegean. The upper level of the water flowing out from the Black Sea is brackish and cold. The lower current that flows inward from the Mediterranean is, in contrast, warmer, denser salt water, explaining why the water from the Black Sea floats on top of it. The sixth century A.D. historian Procopius noticed this phenomenon while watching fishing nets being cast into the Bosphorus. The upper portion of the nets floated toward the Mediterranean, whereas the lower parts floated back toward the Black Sea since they were caught in a deep countercurrent. Though the influx of water from the Black Sea actually produces a relatively fast current of up to 4 knots, famed in antiquity and the Middle Ages, it replaces only approximately 4% of the basin’s water loss (Abulafia 2011:xxvii; Bradford 1971:34; Cunliffe 2008:52–53; DiBenedetto and Simmons 2014b:42; Lionello et al. 2012:1vii; McGrail 2009:90; Morton 2001:37; Pryor 1988:13).

In contrast, the continuous inflow of water from the Atlantic Ocean through the Strait of Gibraltar offsets slightly over 70% of the total amount of water lost from evaporation, representing the primary source of this compensation. The water at this channel, similar to that at the Bosphorus and Dardanelles, is stratified, with the colder water from the Atlantic Ocean flowing at surface level on top of the denser, more saline water from the Mediterranean. This surface current averages 3 knots; however, it can reach up to 6 knots, particularly in the summer when evaporation in the basin is at a maximum. The fact that the Mediterranean is open at this strait has ensured its survival as a sea (Abulafia 2011:xxvii–xxviii; Bradford 1971:34; Cunliffe 2008:48, 57; DiBenedetto and Simmons
There is no real consensus on how to divide the Mediterranean. Some prefer to divide it into two basins: an eastern and western basin that are of similar size and connected by a seabed ridge that extends from Cape Bon in Tunisia to Sicily; known as the Strait of Sicily whose width and depth are approximately 35 km and 250 m, respectively. Though now underwater, this was once a land bridge that connected Europe to North Africa. The western Mediterranean is triangular in shape, extending from the Strait of Gibraltar to Sicily with the Ligurian Sea at its apex. The islands of Sardinia and Corsica separate the Tyrrhenian Sea from the Balearic Sea, but the two seas join in the south in passage between Sardinia and Sicily. This leads to the Strait of Sicily and the eastern basin. The eastern Mediterranean extends from the eastern coast of Italy to the Levantine coast. Its form is more complicated, with more complex, irregular topography created by a succession of ridges, deep valleys, and localized pits. Within this two basin division, there are four further sub-basins: the Levantine, the Aegean, the Ionian, and the Adriatic Seas (Bradford 1971:28–30; Braudel 1995:108-109; Broodbank 2013:73; Cherry 2004:238; Cunliffe 2008:48; Malanotte-Rizzoli 2001:605; McGrail 2009:88). Others, particularly Broodbank (2013:73), divide the Mediterranean into three basins: the western Mediterranean, extending from Gibraltar to Sardinia and Corsica; the central Mediterranean, the seas around Italy; and the eastern Mediterranean, extending from the Aegean to the Levantine coast. This division will be used in this thesis. Finally, others see it as a series of interlocking seas, specifically the Aegean, Ionian, Adriatic, Tyrrhenian, Ligurian, and Balearic Seas, that are partially separated by landmasses (Cunliffe 2008:48).
The continental shelf is generally narrow, from out to around 74 km in some areas to less than 9 km in others. In addition, the seabed reaches depths around 900 m (over 500 fathoms); however, only one-fifth of the entire basin is deeper than 200 m (Broodbank 2013:73; DiBenedetto and Simmons 2014b:42; McGrail 2009:88).

There are also some 370 islands, all larger than 0.1 km² in size, throughout the Mediterranean Basin, many of which are clustered together allowing for high intervisibility between some islands and some islands and the mainland; at least under optimal weather conditions (Broodbank 2000:40-41, 2009:679, 2010:250, 2011:27; DiBenedetto and Simmons 2014b:43; Horden and Purcell 2000:126; McGrail 2009:98). This configuration is actually quite distinct globally making it challenging to compare with other island regions. For example, the Pacific islands are much farther from one another and more challenging to reach. Similarly, in Island Southeast Asia, the main islands are substantially larger. Sumatra alone measures almost half the length of the basin. In the Indian Ocean and southcentral Atlantic, the islands are also more thinly scattered. The regions which the Mediterranean is most similar to in scale are the Caribbean and southwest Oceania. These areas, however, are not perfect comparisons, as they have very different features, such as: being bordered by islandless oceans and having greater clusters of tiny islands, several large islands, and a linear pattern among many of their islands. Furthermore, they are also tropical and better watered, contrasting with the semi-arid Mediterranean. Their tidal regime is also far greater than in the Mediterranean, discussed below (Broodbank 2000:38–41; Cherry 2004:237–238; DiBenedetto and Simmons 2014b:43).
To illustrate the high degree of intervisibility between the islands, McGrail (2009:98–99, table 4.1, fig. 4.2) lists the theoretical distances high ground can be seen at sea level. At a height of 30 m, 61 m, 152 m, and 305 m, the distance that can be seen at sea level is 21.3 km, 30 km, 47.6 km, and 67.2 km, respectively. These data serve as the basis for his visibility map (McGrail 2009: fig. 4.2) (Figure 3.4). Comparable methods have been used to estimate whether a particular island is visible from another island or from the mainland. Based on these calculations, almost all of the islands can be seen from another land mass or from a watercraft that has not yet lost sight of already known land. Many of these islands are presently visible from another landmass, emphasizing that this would have been even greater during times of lower sea level (McGrail 2009). Thus, some islands today were connected to other islands or to the mainland. McGrail notes that this conclusion is based on optimal meteorological conditions. If refraction occurs, high ground could be seen at even greater distances than the theoretical ones. Visibility would be less under poor weather conditions (Cherry 2004:238; McGrail 2009:98). These conclusions illustrate that many of the Mediterranean islands, but particularly those along the north coast, were accessible by watercraft that could have used pilotage methods, as opposed to the more complex techniques needed for open-sea voyages, when land was not in sight. These include relying on the migration path of land birds or unintentional drift voyages (Braudel 1995; Broodbank 2000:40-41; Cherry 2004:238; DiBenedetto and Simmons 2014b:43-44; Horden and Purcell 2000:126; McGrail 2009:98–99).
Reconstructing Paleoenvironmental Contexts

In order to have a greater understanding of prehistoric seafaring in the Mediterranean, it is necessary to have some idea of the environmental context within which early seafaring occurred, specifically sea levels, paleoclimate, tides, currents, weather, and the layout of the basin (e.g., configuration of the Mediterranean islands). These variables have only been systematically observed in the recent past, raising the question of whether modern meteorological, physiographic, and oceanographic data can be applied to deep time (DiBenedetto and Simmons 2014b:44). More recently, however, these observations have been coupled with archaeological and geological data from around the basin, demonstrating that the environment during the late Pleistocene and early Holocene can be reconstructed with a fair degree of confidence (e.g., McGrail 2009:88–89; Murray 1987;
Lambeck and Purcell 2005; van Andel 1989). In the following sections, each variable is explored in some detail to provide an idea of the environmental context faced by the earliest seafarers.

*Sea Levels from the Last Glacial Maximum (LGM) to the early Holocene*

Sea level is defined by the position of the sea surface relative to the nearby landmass and changes in sea level are a measure of the relative shift in position of these two surfaces. Throughout geological time, sea levels have fluctuated. Changes in the relative position of sea and land surfaces are due to changes in ocean volume, vertical movement of the land, or a combination of the two. Evidence of past changes can be seen in the form of submerged or raised shorelines, indicated by submerged tree stumps in situ and fossilized coral reefs above their current growth positions. These observations generally form only limiting values: sea level must have been higher than the reef at the time of its growth or lower than the tree roots at their time of growth. The deposition of peat and sediment can also be used to identify past sea levels, particularly when they are found in shallow elevated basins. Transitions from freshwater to marine deposits illustrate marine flooding of the basin; thus, a relative sea level rise. The reverse sequence indicates a sea level decrease. Series of these isolation basins at elevations today can be used to reconstruct patterns of regional sea level changes. Radiometric dating of the material deposited helps to establish the timing of the regressions and transgressions. The use of oxygen stable isotopes can also estimate water temperature and the amount of water evaporated from the ocean and stored as ice sheets. During the Quaternary period (2.6 million years ago to the present), sea level change has predominantly been the result of the exchange of mass between oceans and ice sheets. Glacial periods result in low sea level stands with the inverse relationship for interglacial

The last 25,000 years have witnessed a transition from the last major cold and arid glacial phase, the Last Glacial Maximum (LGM), to the warmer, interglacial conditions characteristic of the Holocene. Changes in sea level during this time frame are, thus, due primarily to the melting of ice-sheets that covered North America and northern Europe (Abrantes et al. 2012:41; DiBenedetto and Simmons 2014b:44; Lambeck 1996:588; Robinson et al. 2006:1517). There is some disagreement about the exact onset of the LGM (Shackleton et al. 1984:309). It was originally thought to have begun 18,000 years ago (e.g., Bailey 2004:42; Bailey and Milner 2002/2003:132; Lambeck 1996:588); however, recent studies have suggested around 26,000-27,000 years ago (e.g., Farr 2010:179; Rosen 2007:45; Shackleton et al. 1984:309). The Holocene began around 11,700 cal B.P., continuing into the present (DiBenedetto and Simmons 2014b:44-45).

During the LGM, sea levels were generally between 120 and 130 m lower than today, due to much of the earth’s water being frozen in ice sheets that sprawled across North America and northern Eurasia. In the center of the basin, sea temperatures averaged 5-9°C and 2-6°C in the summer and winter seasons, respectively (Bailey 2004:42; Bailey and Milner 2002/2003:132; Broodbank 2013:120-121; Cunliffe 2008:63, 67).

Deglaciation began around 18,000 cal B.P. with the seventeenth through the thirteenth millennium B.P. representing times of lowest sea levels. During the fourteenth to the twelfth millennium B.P., sea levels continued to rapidly rise. In fact, it is estimated that within 500 years, sea levels rose by approximately 20 m, roughly 4 cm per year. This would have dramatically affected the coastline, since the plains that had been exposed were

The change in sea level discussed above was by no means uniform throughout the entire Mediterranean Basin. For example, Ferentinos and colleagues (2012) examine the insularity of the southern Ionian islands, specifically Lefkada, Ithaka, Zakynthos, and Kefallinia, from the Greek mainland, their configuration, and the paleo-shoreline migration from the Middle Paleolithic to the Epipaleolithic. This was achieved through use of hydrographic charts and by plotting the palaeo-sea levels using the sea level curve, mathematically modelled for the Aegean. The model takes into account the glacio-hydrostatic effect on the earth’s crust, but it does not compensate for local and regional vertical tectonic activity. The authors found that the transgression surfaces for the Killini Peninsula, Zakynthos shelf, and the southern and northern Kefallinia and Zakynthos shelves are at depths of 110 m, 85 m, and 105 m, respectively. The differences between the LGM transgression surface around the Ionian islands as compared with the expected one of between 120 and 130 m is due to differences in vertical movement, which range from 1.8 m/ka (uplift) to -2.4 m/ka (subsidence) (DiBenedetto and Simmons 2014b:45; Ferentinos et al. 2012:2171–2172). This point demonstrates the necessity of understanding the local layout of the land (e.g., degree of tectonic activity) as this influences local sea level changes within the Mediterranean, which might not always match the expected levels (Broodbank 2013:90; DiBenedetto and Simmons 2014:45).
The general deglaciation and warming trend between the LGM and the early Holocene was also by no means a uniform process. In fact, ca. 12,700 cal B.P, there was a return to cold, dry periods, known as the Younger Dryas. This important but short-lived event lasted approximately 1,200 years until ca. 11,700 cal B.P. (Broodbank 2009:685; Cunliffe 2008:63; DiBenedetto and Simmons 2014b:45; Knapp 2010:102; Robinson et al. 2006:1517; Rosen 2007:45; Simmons 2007:38; Wasse 2007:44). Its onset is most likely linked to the collapse of ice sheets in the north Atlantic, which suddenly increased the input of fresh, cold water disturbing oceanic circulation. As the climate began to improve, the Atlantic currents readjusted themselves creating the warm Gulf Stream. This ultimately resulted in the large volumes of melt-water from the glaciers, which destabilized the Gulf Stream and possibly stopped it altogether. The Younger Dryas globally signaled a return to glacial conditions (Broodbank 2013:146; Cunliffe 2008:63; DiBenedetto and Simmons 2014b:46; Robinson et al. 2006:1517; Wasse 2007:44). Its end marked climatic amelioration, resulting in sea levels beginning to rise once more.

During the early Holocene, sea levels continued to increase rapidly. By the late eleventh to tenth millennium B.P., sea level was some 40 m lower than present levels. It was around the latter period, that the Mediterranean coastline began to roughly assume its present configuration. (Cherry 2004:237; DiBenedetto and Simmons 2014b:47; Farr 2010:180–181; McGrail 2009:88–89; Özbek 2012:164; Shackleton et al. 1984:309; van Andel 1989:736). Sea level rise slowed by the seventh and sixth millennium B.P., being within 5 m of present levels. This was probably due to the northern ice sheets having fully melted; however, as the West Antarctic ice continued to melt, sea levels persisted in slowly rising. Though outside the scope of this book, it is important to note that from the fifth

**Paleoclimate**

Around the LGM, year-round snow lay at elevations as low as 1500 m throughout Europe with 3 to 6 month snow cover over lower elevations (Broodbank 2013:120). In some areas of northern Europe and the northwest Mediterranean, temperatures were about 20°C lower than today. Glaciers floated west of Gibraltar. For the eastern Mediterranean and the Levant, temperatures dropped at least 4° C. Evidence for these dry, cool conditions is attested by the occurrence of gypsum from precipitation in the Dead Sea and erosion in the Negev Desert in Israel. Forest vegetation throughout southwest Asia also retracted, most likely due to decreases in rainfall during the summer. This can be seen in Syria where there is higher non-arboreal pollen values at this period (Robinson et al. 2006:1533; Wasse 2007:45; for other lines of evidence, see Robinson et al. 2006; Rosen 2007; Wasse 2007). Large glaciers covered the Alps with smaller ones found in the Apennines, Atlas, Pyrenees, the Anatolian, Lebanese, and Balkan mountains, and even on Corsica, Sardinia, and Crete. Steppe spread over vast areas, merging inland into tundra in the North African temperate desert and northern Levant. Along stretches of the African coast, the Sahara was close to the shore. The Nile was greatly reduced, often dry in parts. These landscapes were largely due to the dry climate and constant winds, reflecting global conditions under which polar steppe and tundra tripled. Temperate, desert, and steppe conditions were on the retreat (Broodbank 2013:120).
Not all parts of the Mediterranean, however, were similarly impacted by the LGM. Sheltered areas, usually coastal microclimates, occurred and ensured the survival of many Mediterranean animals and plants. There were also refugia in the north. Pollen and charcoal evidence from the Po Valley demonstrate that it became a dusty plain with some trees along the river. At the mouth of the Arno, oak, elm, birch, pine, and walnut trees survived. In the Madonie Mountains of Sicily, laurel and holly both grew. The two largest refugia were in the western part of the basin: Iberia and on the seaward flank of the Atlas Mountains (Broodbank 2013:120-121; Cunliffe 2008:68). Olive, evergreen, almond, oak, and terebinth continued to grow in the hills of the Levant, in spite of much of this area being dominated by steppe and grasslands. Woodlands might also have survived in the Jordan Valley. The cooler temperatures, which reduced the evaporation rate, also enabled some Levantine lakes to survive or even expand. This can be seen in particular with Lake Lisan in the Jordan Valley, the predecessor to the Dead Sea. It ultimately expanded to a length of some 220 km. (Broodbank 2013:121; Robinson et al. 2006:1536; Rosen 2007:68–69; Wasse 2007:45).

The return to interglacial conditions began around 20,000-19,000 B.P. By about 16,000-15,000 B.P., year-round ice and snow could no longer be found on most of the mountains in the basin. The return of rains and the first pronounced acceleration in temperature dates to around 15,000-13,000 cal B.P.; this is called the Bølling-Allerød. During this phase, temperatures were similar and rainfall greater than the present. This phase witnessed a surge in sea level rise, peaking at 1.5 to 2.0 cm per year (Broodbank 2013:130). Increased temperature and rainfall lead to the expansion of forests in the Mediterranean zones of both the southern and northern Levant. Forests spread hundreds of
kilometers inland, including to the nearby steppe and around the Fertile Crescent up to the Zagros. Botanical remains from the earliest levels at Abu Hureyra and pollen diagrams from the Ghab Valley in Syria provide evidence of this expansion. Results from the latter include oak, which needs at least 500 mm per year of rainfall. This assessment of rainfall is further supported by estimates from speleothems of 550–750 mm per year. Lake Lisan, due to higher evaporation rates, began to shrink after 17,000 cal B.P. In North Africa, increased precipitation and a more seasonal climate occurred due to the northward shift in the monsoon belt. The Nile was revived. Some parts of the Mediterranean, however, took longer to recover. In the Sahara, lakes still had not formed. A bare, dry steppe also continued to cover much of the Anatolian steppe. Overall, plants burst from the refuge areas to retake much of the basin and cold-weather faunal species retreated. Aurochs, boars, and roe deer, which inhabit forests, reemerged in the northern and eastern parts of the basin (Broodbank 2013:130; Robinson et al. 2006:1536; Rosen 2007:68–69; Wasse 2007:45).

As discussed above, the Younger Dryas, however, reversed this trend of climatic amelioration and replaced it with dry, cold conditions. It was named after the tundra plant that first helped identify its occurrence. Its affect could be felt all over the Mediterranean, and aridity in parts of the Aegean and northern Levant might have been worse than during the LGM. In contrast, however, the event appears to have been less severe in the southern Levant, as supported by isotopic data from the Soreq Cave in central Israel. Forests retreated throughout the basin being replaced by steppe environments. Lake Lisan dropped some 200 m, which is below the levels of the Dead Sea today (Broodbank 2013:146; Robinson et al. 2006:1535–1536; Rosen 2007:69; Wasse 2007:45–46; Simmons 2007:36).
Some scholars argue that the Younger Dryas played a critical role in the domestication process. It forced hunter-gatherer populations to return to more mobile lifestyles, but also forced the cultivation systematically of some cereals. The latter was due to the reduced availability of subsistence resources in general; thus, it provided the hunter-gatherers with a coping mechanism (e.g., Bar-Yosef 1995:517-519; 1998:168-169; Hillman et al. 2001; Simmons 2007:59). This is, however, not a universally accepted view largely because it is currently unknown whether the Younger Dryas conditions were universal or if there were warmer and cooler oscillations within the event (e.g., Bottema 2002; Simmons 2007:39; Watkins 1998).

The end of the Younger Dryas marked a return to warm, wet conditions. The early Holocene, in fact, represents one of the wettest phases in the last 25,000 years. For example, in the eastern Mediterranean, evidence for this increase in rainfall can be seen in the increase of oak and Pistacia found in the Ghab, among other areas. These two trees are also indicative of mild winters. Some parts of this region even may have received summer rain. The Dead Sea was also 100 m higher than it is today. Lakes also formed in North Africa and Arabia (Abrantes et al. 2012:47; DiBenedetto and Simmons 2014b: 47; Robinson et al. 2006:1536–1537; Rosen 2007:70–80; Wasse 2007:46).

**Tides**

The Mediterranean today is, in general, a near-tideless sea. The tidal range (e.g., the difference in height between low and high tides) is generally minimal, around 20-30 cm, except at Gibraltar and around the Jerba island (Tunisia). The former is 1m; the latter up to 3m. The tidelessness likely persisted in the past due to the vertically compressed nature of much of the Mediterranean coastline and the fact that it is virtually land-locked.
(Bradford 1971:33; Broodbank 2000:40, 2009:679, 2010:250, 2013:73; Cherry 2004:238; Cunliffe 2008:58; Dawson 2014:25; DiBenedetto and Simmons 2014b:47-48; Knapp and Blake 2005:7; McGrail 2009:92; Morton 2001:45; Pryor 1988:12). There are some areas, however, where the tide has an appreciable effect. This is particularly the case where there are narrow channels (McGrail 2009:92). One is the Strait of Gibraltar, which is presently 14 km wide at its narrowest point, between Point Cires (Morocco) and Point Marroqui (Spain). Since the Miocene, around 5.3 million years ago, it has been open to the Atlantic Ocean (Bradford 1971:33–34; Broodbank 2009:682; Cunliffe 2008:56; Derricourt 2005:122; DiBenedetto and Simmons 2014b:47-48). Derricourt (2005:122) suggests that the central channel, even at times of low sea level, would have remained open, around 5 km wide. Tidal flows oppose and reinforce the inflow of water through the strait, which flows at around 3.5 knots. This causes the flow midstream to often be easterly, reaching up to 4 to 6 knots. When there are westward flows, however, the water moves only at 1 to 2.5 knots. This flow direction occurs on some areas of the African coast. In general, this tidal effect is weaker near the shore, even ceasing along parts of the European coast (McGrail 2009:90–91).

Another area is the Strait of Messina, which separates Sicily from the Italian mainland and connects the Ionian and Tyrrhenian Seas. At the narrowest point today, the strait is 3.5 km wide. Tides flow at up to 4.5 knots. Winds blowing from the mountains can also disturb the seas, at certain times causing up to a 1.5 m high tidal bore. A bore is a natural phenomenon in which the leading edge of the tide forms a wave of water that travels to the coast, opposing the current (Alpers and Salusti 1983:1800, 1803; Broodbank 2009:683; DiBenedetto and Simmons 2014b:48; McGrail 2009:92; Morton 2001:44–45;
Pryor 1988:13, 15). Alpers and Salusti (1983) demonstrated that this tidal bore can be identified on a SEASAT SAR (synthetic aperture radar) image, which was the first Earth-orbiting satellite designed for remote sensing. It conducted four microwave experiments, one of which entailed SAR taking images of the coastal regions, polar ice caps, and ocean surfaces (Alpers and Salusti 1983; Evans et al. 2005). This tidal phenomenon was probably more pronounced prior to the nineteenth century, before natural changes occurred to the seabed. In fact, they may well have led to the legend of Scylla and Charybdis, two immortal and irresistible creatures in Greek mythology. Homer writes that they beset the waters traveled by Odysseus during his wanderings. He used these characters to poetically express the dangers encountered by Greek seafarers in this part of the western Mediterranean, which was largely uncharted at the time of the Odyssey (Alpers and Salusti 1983; Broodbank 2009:683; DiBenedetto and Simmons 2014b:48; McGrail 2009:92; Morton 2001:86–87; Pryor 1988:13, 15).

The Strait of Messina continued to be regarded as one of the most challenging passages in the Mediterranean well into the medieval period. Ibn Jubayr, a geographer, poet, and traveler writing in the late twelfth and early thirteenth centuries, records that “[t]he sea in this strait, which runs between the mainland and island of Sicily, pours through like the ‘bursting of the dam’ and, from the intensity of the contraction and the pressure, boils like a cauldron. Difficult indeed is its passage for ships” (quoted in Pryor 1988:15). Ludolph von Suchem, author of Description of the Holy Land, and of the Way Thither, written in A.D. 1350, similarly states that, “between Calabria and Sicily . . . the sea runs so hard that no sailor dares to sail through without a special pilot” (quoted in Pryor 1988:92). Records from Greek authors to at least the Middle Ages all emphasize that only seafarers
with knowledge of this area would have attempted its navigation (DiBenedetto and Simmons 2014b:48-49).

The Strait of Evripou, which is separates the island of Euboea and the Greek mainland, is approximately 40 m wide and can also have significant tidal streams, reaching up to 8 knots. In addition, there are significant tides with a range greater than 1m in the Gulf of Gabès on Tunisian’s eastern coast and the northern Adriatic. Tides are also notable in the Corinthian Gulf, even causing changes in the direction of the currents, as well as the Thermaic Gulf in the northwest Aegean and in the Thermopylai region in the Euboean Sound. (DiBenedetto and Simmons 2014b:49; McGrail 2009:92; Morton 2001:45).

**Currents**

The general direction of the main Mediterranean current is set by the inflow of Atlantic water through the Strait of Gibraltar and the Black Sea, intensified by following winds (Cunliffe 2008:48; DiBenedetto and Simmons 2014b:49; Horden and Purcell 2000:138; Lionello et al. 2012:lix; McGrail 2009:91–92; Pryor 1988:13). From the Strait of Gibraltar the main current flows eastward along the Algerian coast, part of it then flowing in a general counterclockwise direction around the western basin. Islands within this area do have local circulations. It continues eastward through the Sicilian channel to the eastern basin. From here, a current generally circulates to the Nile Delta east to southeast. There is some diversion in the Gulf of Sidra, where the current circulates clockwise. It is affected by the outjutting head of Cyrenaica, the eastern coastal region of Libya. This causes it to be deflected back toward the Gulf of Gabès and the eastern Tunisian coast. From the Nile Delta, the current generally flows counterclockwise, passing north of Cyprus, along the southern coast of Turkey, and to the Rhodes Channel. Within the Aegean
Sea, there is sometimes a northerly flow from Rhodes along the west coast of Turkey. In general, however, there is a southerly flow. This is due to the inflow from the Black Sea, which itself has a counterclockwise circulation. Within the Adriatic, there is also a general counterclockwise current (Abulafia 2011:xxviii; Bradford 1971:36; Cunliffe 2008:48, 55; DiBenedetto and Simmons 2014b:49; Heikell 2001:35; Lionello et al. 2012:lviii-lix; Malanotte-Rizzoli 2001; McGrail 2009:92; Morton 2001:38–39; Papageorgiou 2008:204–209).

In sum, the main Mediterranean current flows counterclockwise (Figure 3.5) following the North African coast eastward from Gibraltar, turning north by the Levantine coast and going around Cyprus up the Turkish coast, and counterclockwise around the Black Sea. The current then flows counterclockwise around the Aegean, Adriatic, and Tyrrenian Seas, and along the French and Spanish coasts back to Gibraltar (DiBenedetto and Simmons 2014:49).

In addition to these main, deep-sea currents, there are also “nearshore” currents. These are found in shallower coastal waters and are created by the action of waves hitting the coast at an angle. A breaking wave casts water upon the shore, preventing it from flowing straight back out to deeper water by the next set of incoming waves. This results in the water then escaping by moving along the shore towards the incoming waves, ending only in deeper water. The main Mediterranean current dominates so long as the water remains deep enough to prevent the incoming waves from breaking on the shore (DiBenedetto and Simmons 2014:50; Morton 2001:39).
Nearshore currents are often strongest around headlands since all of the water accumulating in the bay can only escape by rounding the headlands (Morton 2001:39–41). For example, the three southerly promontories in the Peloponnese, Malea, Tainaron, and Akritas, were the meeting place for currents and winds of the Adriatic, the Ionian, and the Aegean Seas. As a result, all of the southern Peloponnese, but in particular the area around Malea, has currents that are less predictable and stronger than in other places in the basin (DiBenedetto and Simmons 2014b:50; Morton 2001:41, 82.

In general, the strength of the main Mediterranean current averages less than 2 knots (Broodbank 2013:74; Cunliffe 2008:49; DiBenedetto and Simmons 2014b:51; Heikell 2001; McGrail 2009:92). Variation in strength occurs in several areas of the Mediterranean basin. The main current ranges from 6 knots through the Strait of Gibraltar, 2-3 knots off the coasts of the Levant and Egypt, 4 knots through the Dardanelles and
Bosphorus Straits, 3 to 6 knots through the Sicilian Channel, 2 knots around Crete, and up to 6 knots or more through the Strait of Messina depending on the tide strength (Broodbank 2013:74; DiBenedetto and Simmons 2014b:51; Heikell 2001:42, 75; Morton 2001:42–45; Pryor 1988:13). Currents are generally stronger through straits due to their shallow and narrow nature (DiBenedetto and Simmons 2014b:51; McGrail 2009:92; Morton 2001:44).

Furthermore, several of the straits have alternating currents. Two well-known examples include the Euripus, the narrowest point in the Euboean Sound, and the Strait of Messina. The current for the former has the potential to change direction at unpredictable intervals throughout the day with speeds up to 8 knots. This is largely due to the different state of the tide north and south of this area. The massing of water in the channels by winds also affects the direction of the current (DiBenedetto and Simmons 2014b:51; Morton 2001:45).

The currents at the Strait of Messina can flow in different directions simultaneously, which causes rough conditions. This is partly due to tidal force and atmospheric conditions, causing currents along the shore to run in opposition to the main current (Broodbank 2009:683; DiBenedetto and Simmons 2014b:51; Morton 2001:44-45).

An important consequence of this basin-wide circulation coupled with its near lack of tides, the flow of nutrient poor oxygenated Atlantic surface water into the basin through the Strait of Gibraltar, and hot and dry climate is that marine resources are relatively poor. In fact, the Mediterranean Sea is globally considered an oligotrophic, or low production system, becoming more severe from west to east. Exceptions to this condition mainly occur along coastal areas where river mouths and lagoons inject nutrients and around the Dardanelles and Gibraltar Straits. Fish usually inhabit the upper levels of the open sea and are notoriously hard to catch, unless they move inshore for their annual migrations or to
feed. As a result, fishing is often shore-based due to its unpredictability in open waters (Broodbank 2013:73; Lionello et al. 2012:lx).

While currents are important in the Mediterranean since they provide its underlying rhythm, they are often overpowered by the winds. Depending on their direction and intensity, winds could have either helped or hindered early seafarers (Cunliffe 2008:49; DiBenedetto and Simmons 2014b:51; Heikell 2001; Papageorgiou 2008:200–203).

Weather

Of the natural and physical processes faced by early seafarers, weather, which refers to atmospheric conditions including cloud cover and winds, was probably the most noticeable factor (McGrail 2009:92). It can affect numerous variables, including navigational abilities, the movement and speed of watercraft, the success of a journey, and the safety of the crew and cargo. As a result, even the earliest seafarers had to be familiar with general weather patterns for a particular area and how to tell when these conditions were changing, as with the onset of storms. They also would have needed to understand how different factors, such as season, affected these conditions (Cunliffe 2008:51; Johnson and Nurminen 2007:32). In the Mediterranean, cloud cover differs between the summer and winter seasons. Meteorologists measure cloud coverage by the number of “oktas” (eighths) of the sky occupied by cloud. The summer and winter seasons average 1/8 to 2/8 and 4/8 to 6/8, respectively. There is, thus, a greater chance of a cloudy night sky in the winter as compared to the summer. This might have impacted seafaring as it would have made winter navigation by the stars extremely difficult, if not impossible. Additionally, more frequent storms and greater precipitation in the winter reduced visibility and caused
unpredictable wind directions; adding to navigational challenges, particularly in coastal areas (DiBenedetto and Simmons 2014b:51-52; McGrail 2009:92; Pryor 1988:19).

Seafarers from the more recent past predict weather patterns using a combination of natural phenomena and signs as well as knowledge gained from oral tradition, making it likely that this also occurred in more deep time. Indeed, descriptions of weather conditions have been passed down in rhymes, such as “A red sky in the morning is a sailor’s warning; but a red sky at night is a sailor’s delight” (quoted in Johnson and Nurminen 2007:32). Rhythms not only make information easier to retain, but they also tended to be reasonably accurate (DiBenedetto and Simmons 2014b:52; Johnson and Nurminen 2007:32–33).

In the Mediterranean, winds are a critical component of weather conditions, as they can overpower currents and are often varied and complicated. They are largely determined by depressions that form within the basin itself or move in from the Sahara Desert or the Atlantic Ocean. In the Mediterranean, prevailing seasonal winds are the most influential, and probably have been for thousands of years. These winds are usually the strongest and most reliable through the seasons, particularly in the “open season,” which occurred from early May to mid-September, although it can include April and October depending on weather conditions. Furthermore, they appear most frequently in seafaring accounts from at least antiquity onwards (Braudel 1995:232–233; Broodbank 2000:92; Cavalieri 2005:256; Cunliffe 2008:49; DiBenedetto and Simmons 2014b:52; Leidwanger 2013:3303; McGrail 2009:94; Murray 1987:140, 145; Pryor 1988:15–20).

As noted in Chapter 1, the following discussion is extracted from DiBenedetto and Simmons 2014b (53-59), which is summarized predominantly from McGrail (2009:92–
It is broken down by season. It is important to note that McGrail’s discussion uses current wind data, raising the question of whether these data can be extrapolated back onto the Paleolithic and early Neolithic. While not focusing on these earlier time periods, Murray (1987) conducted a study of how wind observations recorded by Aristotle and Theophrastus in the fourth century B.C. compared with modern data. During the fourth century B.C., the Mediterranean is thought to have been slightly cooler and wetter than today. Murray wanted to determine whether this slightly different climate would have affected the direction and time of year that the winds blew, since prevailing winds are created by large-scale pressure systems. Ultimately, he examined the validity of the research assumption that modern wind patterns equaled ancient ones. The results demonstrate that the winds of Classical antiquity and the present were similar. Murray also argues that some of the discrepancies between Classical observations and modern data might be due to the Greek authors’ own biases, specifically their desire to create a “balanced order.” While his conclusion is mainly valid for the time frame of Classical antiquity and later, it suggests the possibility that some of the wind patterns have had a long history (Abulafia 2011:xxix). Since there are currently no studies that have yet been undertaken to determine wind conditions during the Late Paleolithic and early Neolithic, modern wind data are summarized below with the caveat that these conditions might not have exactly matched those in the more remote past.

*Summer Winds.* During the main summer months from June to August, characterized by long daylight hours, up to 20% of the days have little or no wind, a relatively high percentage (DiBenedetto and Simmons 2014b:53; Braudel 1995:234; McGrail 2009:92). Nevertheless, a northwest wind predominates throughout the
Mediterranean, particularly in the eastern basin (around 90%). This dominance decreases as one moves westward to the Strait of Gibraltar (around 25%). There is also some local variation for other wind directions. In the Aegean, north winds often prevail (35%). A southeast wind in the Adriatic sometimes occurs. Around Sicily (25%) and the Gulf of Sidra (30-35%), north and northwest winds occur at relatively equal frequencies. A west wind can also prevail in the Sicilian Channel (15%). A southeast wind in the Adriatic sometimes occurs. Along the North African coast, west of Cape Bon, west (15%) or east winds (25%) both blow at roughly equal frequencies, with a 20% chance of a northeast wind. Near Corsica, west (25%) and northwest (20%) winds occur. Wind directions are more evenly distributed in the Gulf of Lyons, being in the sector of southeast through south to northwest (DiBenedetto and Simmons 2014b:53; Heikell 2001:29; McGrail 2009:93-94).

It appears that similar to today, these summer winds were highly predictable given that they were called the Etesian (or annual) wind in antiquity. Today, these winds are known as Meltemi. In fact, due to its predictable nature, it is sometimes thought of as a “monsoon” wind (Figure 3.6). In the Aegean, however, these winds can blow quite violently from any direction between northwest and northeast, depending on variation in atmospheric conditions and local topography. They have been known to close the sea for days, even during the summer months, particularly for travel in the northern Aegean (Bradford 1971:31; Braudel 1995:257; Broodbank 2000:92–94; DiBenedetto and Simmons 2014b:54; Heikell 2001:29–30; Lionello et al. 2012:lxvii; McGrail 2009:93–94; Morton 2001:48). Archaeologist Brian Fagan recounts his own experience with this wind:
I remembered Homer’s Phaeacian ship when a powerful summer meltemi, the Etesian wind out of the north, thrummed in our rigging. We pitched violently in the following sea, mainsail well out to starboard, tightly secured fore and aft to stabilize the boom. The rough water sparkled in the effervescent sunlight, the horizon and the Greek mainland sharp against the cerulean sky. Kea’s dark peak loomed on the horizon, a precipitous island some 12 miles (19 kilometers) off Cape Sounion, the southeastern tip of Attica, on the Greek mainland. We drew close to land at sunset. With startling abruptness, the meltemi switched off, leaving us becalmed. Short, wicked Aegean seas beset our stationary boat—from bow and stern, from either side. Mainsail and jib slatted violently. Fortunately, we had a reliable diesel engine to take us into port. But I thought of Homeric sailors equipped with only oars being beset by the same seas, moving more up and down than forward, waiting patiently and uncomfortably for the calm water of nightfall (Fagan 2012:75–76).

This passage is illustrates that even modern seafarers find themselves at the mercy of the natural elements. The situation would have been considerably more perilous for the earliest seafarers since, without a diesel engine, they would have had to rely on strength and chance to help them back to the mainland (DiBenedetto and Simmons 2014b:55).

Land and sea breezes, which are localized coastal winds, are also significant features. This is particularly true during the summer, although they can occur in other seasons when there are calm periods. Their occurrence is the result of different rates at which the sea and land both heat up during the day and cool off at night; a process called diurnal heating and cooling. A sea breeze occurs in the morning as the land warms, causing air to flow from the sea toward land. In favorable conditions, it usually lasts from the late
morning to right around sunset, reaching a wind speed of up to 5 or 6 on the Beaufort Scale, which is an empirical measure that correlates wind speed to observed conditions on land or at sea. The effects can reach out to some 37 km from land. Land breezes, in contrast, occur as the land cools in the evenings, causing a lighter breeze to blow from the land to water. It can be felt out to around 9 km from land throughout the early hours of the morning. In some areas, such as Greece, however, it can reach out to around 25 km or more. This is particularly the case when strengthened by winds from the mountains. Both occasionally could overpower the Etesian winds, enabling voyages in the northern Aegean (DiBenedetto and Simmons 2014b:55; McGrail 2009:94-95; Morton 2001:51–53).

*Spring Winds.* Spring is considered the early part of the seafaring season, occurring from late April to May. There is a greater risk of both variability in wind direction and gale-force winds. The northwest wind is not as predominant in the eastern basin; rather, there is a 30% to 35% probability of a wind from between northeast and southeast. This enables a greater change of a fair wind for voyages westward from the Levant, as compared with the summer. There are also a greater number of calm days, including around Turkey (DiBenedetto and Simmons 2014:55; McGrail 2009:93–94). In the Aegean, the occurrence of a wind between north and west is reduced to 55% in the spring, as compared with 85% in the summer. There is also a 20% chance of a southeast to southwest wind, in contrast to the 2% probability in the summer. These differences are important because they provide greater opportunities for sailing northward in the Aegean during this early part of the sailing season, which is challenging in the summer as discussed above (DiBenedetto and Simmons 2014b:55-56; McGrail 2009:94). This results in a greater chance of a fair wind
in late spring for a voyage westward from the Levant, as compared with the summer (McGrail 2009:94).

Figure 3.6. Map of major wind patterns in the Mediterranean Basin. (*Permission from Left Coast Press*).

Autumn Winds. Autumn, from September to early October, is the latest part of the seafaring season. These winds, similar to those in the spring, have greater variability in wind direction. A northwest wind also does not predominate, which is supported by the occurrence of wind patterns from any quarter in the northern parts of the western basin. Along the North African coast, winds from the east and west are both equally possible. The chances of a wind in the Adriatic between the north and west sectors in October are less than that in the summer: 35% as compared to 53% (DiBenedetto and Simmons 2014b:56; McGrail 2009:94). In the eastern Mediterranean, north or northeast winds are more frequent; the latter particularly for the Aegean. Most importantly, throughout the
Mediterranean during this season there is a much higher risk of gales in comparison with the summer (DiBenedetto and Simmons 2014b:56; McGrail 2009:94).

*Severe Coastal Winds in Spring and Autumn.* The most severe of coastal winds occurs in spring and autumn, rarely occurring in the summer (Abulafia 2011:xxviii; Cunliffe 2008:49; Grant 1969:49; McGrail 2009:94–95). For example, dry and warm winds from the North African deserts, called the Sirocco (also known in the eastern Mediterranean and Egypt as Leveche and Khamsin, respectively), reach a force of 6 to 8 on the Beaufort Scale. They raise large volumes of sand and dust, decreasing visibility in the North African coastal waters. As the winds pass over the water and absorb moisture, they can bring fog to northern coastal areas in the Mediterranean Basin, including from Gibraltar to the Adriatic and Aegean. A similar wind from the Arabian Desert can blow northwest across the Levantine coastal waters. Furthermore, the Mistral, originating in the Atlantic, can also decrease visibility and increase gales around the northwest Mediterranean coast (Cunliffe 2008:49; DiBenedetto and Simmons 2014b:56; Lionello et al. 2012:lxvii; McGrail 2009:95; Morton 2001:50–51; Pryor 1988:20) (Figure 3.6).

*Winter Winds.* Winter can be a dangerous, if not impossible, time for sea voyagers, largely due to the addition of offshore local gale-force winds, formidable seas, and thunderstorms; all of which develop quickly with little warning. While there are some ancient records that document winter sea travel, this was usually due to food shortages or war. Seafaring did not become a regular feature during this season until the sixteenth century A.D. It can be assumed that the earliest seafaring in the Mediterranean, likewise, took place at least during the summer months, but perhaps also spring and autumn (Ammerman 2010:85; Braudel 1995:248–255, 257; Broodbank 2000:92, 2010:250;
DiBenedetto and Simmons 2014b:56-57; McGrail 2009:93). The fiercest winds are those blowing offshore into the Gulf of Lion (Mistral), at the head of the Adriatic (Bora), and off the coasts of Dalmatia, the Aegean (Vardac), Malaga, and southern Turkey (Figure 3.6); the last of which currently is home to the world’s earliest shipwreck, the Uluburun. In contrast, the North African coast, especially the extreme eastern end, usually is the calmest region (Abulafia 2011:xxviii; Bradford 1971:30–31; Braudel 1995:248; Broodbank 2013:74; Cavaleri 2005:256; Cunliffe 2008:49; DiBenedetto and Simmons 2014b:57; Grant 1969:49; Lionello et al. 2012:lxvi; McGrail 2009:92, 94-95; Morton 2001:49-50; Pryor 1988:19).

**Wind-Generated Waves.** Waves, an important component of the basin, are predominantly the result of strong winds blowing over the basin, including the Bora, Sirocco, Etesian, and Mistral. The highest waves are generally found in the western Mediterranean, caused by the Mistral wind. Other areas of notably high waves include the southern Ionian Sea and the Levantine basin; the latter is particularly the case in the summer due to the Etesian winds (Lionello et al. 2012:lxviii-lxix).

**Hazardous Areas in the Mediterranean**

While some hazardous areas have already been discussed, several examples are difficult to pigeonhole into the above categories as they are due to a combination of variables. For example, travel between the Mediterranean and Black Seas can be impeded by winds regardless of the time of year. Passage is not usually excessively hazardous due to the generally favorable current and wind conditions; however, if icy winds blow from the north, which can reach speeds up to 50 knots, the journey becomes impossible (Cunliffe
2008:56 DiBenedetto and Simmons 2014:57-58). “…All a vessel could do was heave-to and wait for favorable conditions” (Cunliffe 2008:56).

Passage from the Strait of Gibraltar to the Atlantic Ocean was another challenging area to navigate in the Mediterranean. The Phoenicians are believed to be the first to have made this passage possibly by 1000 B.C, with more definitive evidence by 800 B.C. By the later date, they had settled the offshore island of Gadir (Cadiz). This passage remained challenging even through the Middle Ages (Cunliffe 2008:56; DiBenedetto and Simmons 2014b:58; Pryor 1988:13). Although outside the time frame of this book, it might explain why such crossings were not made in prehistory with less complex watercraft technology. Currents did not pose as great an obstacle for early voyages. The main surface current that flows into the Mediterranean occupies most of the width of the strait; however, to the north there is a countercurrent flowing out of the Mediterranean. This provided a route to the Atlantic so long as there were favorable winds. In addition, there were also two lesser coastal currents: one flowed along the African coast and out into the Atlantic and the other hugged the Spanish coast flowing into the Mediterranean (Figure 3.7). These both were best avoided, however, given their nearness to the rocky coastlines (Cunliffe 2011:57-58; DiBenedetto and Simmons 2014b:58).
Figure 3.7. Flow of currents at Gibraltar between the Mediterranean and Atlantic. 
(Modified by Russell Watters from Cunliffe 2011: Fig. 2.12; DiBenedetto and Simmons 2014b: Figure 3.4).

In sum, the currents did not inhibit passage made in either direction at all times of the year. The completion of the crossing, rather, was entirely dependent on the winds, in particular their strength and direction. A following wind, which is a wind that blows in the same direction as the waves are moving, allowed for a quick and safe journey; but, when this was not the case, the waters became extremely dangerous (Cunliffe 2008:57–8, fig. 2.17; DiBenedetto and Simmons 2014b:58). An easterly wind also generally predominates in the months of March, July through September, and December, with a westerly wind the rest of the year. This pattern allowed a crew to plan their voyage accordingly; however, weather patterns are extremely unpredictable in this area and can upset attempted voyages (Cunliffe 2008:56–57 DiBenedetto and Simmons 2014b:58).
Additionally, the southeastern Aegean, in particular the Ikarian Sea, is especially turbulent and challenging to cross, though there can also be favorable currents and winds (DiBenedetto and Simmons 2014:58; Fagan 2012:87). Local wind conditions can also make a voyage between Cyprus and Anatolia risky at times, as illustrated by the number of shipwrecks that have been found along this path (Mantzourani and Theodorou 1991:50). The south Tyrrhenian Sea can also be problematic due to local winds, which are often unpredictable in strength and duration (Castagnino Berlinghieri 2011:121; DiBenedetto and Simmons 2014b:58-59).

Reconstruction of the Mediterranean Basin between the LGM and the early Holocene

The above discussion provides the context for reconstructing the physical conditions (e.g., sea level, climate, tide, currents, and weather) that the earliest seafarers might have faced in the Mediterranean Basin. It is clear that in order for a voyage by watercraft to be successful, the complex relationships and interrelationships of all of these variables would have to be understood. If they had not, then the present discussion on seafaring in the Late Pleistocene and Early Holocene would not even be taking place. There is, however, one final component to the physical features of the basin that is arguably the most important: the configuration of the Mediterranean islands and coastlines, since it determines the distances to be traveled by seafaring voyages. There are two key variables. The first is whether the islands were oceanic, connected with other islands, and/or connected to the mainland. ‘Oceanic’ islands are islands that are permanently separated from the mainland during this time in question. The second variable is the distance between an island (or islands) and the mainland (DiBenedetto and Simmons 2014b:59-60). The following discussion is broken down into the eastern, central, and western Mediterranean.
Basins, focusing on the major islands and/or mainlands within each. Focus will be given to the islands with evidence for a human presence during the Late Paleolithic to Early Neolithic. These data will be discussed in chapter 4. Table 3.1 presents most of the Mediterranean islands discussed in this chapter. The information in the table, which includes the location of the island (eastern, central, or western Mediterranean Basin), the size (square km), and distance to the nearest mainland today (km), has been adapted from Broodbank (2000: table 1), Cherry (1981: tables 1, 2), Dawson (2010: tables 16.1-16.5; 2011: tables 2.1, 2.2), and DiBenedetto and Simmons (2014b: table 3.1). Not all of the islands in the Mediterranean are discussed; for a comprehensive list, consult Dawson (2011: tables 2.1, 2.2). Tables 3.2-3.4 present only the islands with possible evidence for early seafaring activities for each basin, specifically their estimated distance to the mainland during the LGM and whether they were oceanic or connected to the mainland or another island.
Table 3.1. Major islands in the Mediterranean (discussed in thesis).

<table>
<thead>
<tr>
<th>Name of island chain</th>
<th>Name of Island</th>
<th>Eastern (EM), Western (WM), or Central Mediterranean (CM)</th>
<th>Size (km²)</th>
<th>Distance to nearest mainland today (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Cyprus</td>
<td>EM</td>
<td>9251</td>
<td>69</td>
</tr>
<tr>
<td>The Cyclades</td>
<td>Andros</td>
<td>EM</td>
<td>380</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Ios</td>
<td>EM</td>
<td>109</td>
<td>147</td>
</tr>
<tr>
<td></td>
<td>Kea</td>
<td>EM</td>
<td>131</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Kythnos</td>
<td>EM</td>
<td>100</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>Melos</td>
<td>EM</td>
<td>151</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>Naxos</td>
<td>EM</td>
<td>430</td>
<td>132</td>
</tr>
<tr>
<td></td>
<td>Paros/ Antiparos</td>
<td>EM</td>
<td>196</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>Seriphos</td>
<td>EM</td>
<td>75</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>Sifnos</td>
<td>EM</td>
<td>74</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>Thera</td>
<td>EM</td>
<td>76</td>
<td>180</td>
</tr>
<tr>
<td>North Aegean islands</td>
<td>Lemnos</td>
<td>EM</td>
<td>478</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>Gökçeada</td>
<td>EM</td>
<td>279</td>
<td>17</td>
</tr>
<tr>
<td>South Aegean islands</td>
<td>Crete</td>
<td>EM</td>
<td>8259</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>Gavdos</td>
<td>EM</td>
<td>30</td>
<td>192</td>
</tr>
<tr>
<td>East Aegean island</td>
<td>Lesbos</td>
<td>EM</td>
<td>1633</td>
<td>12</td>
</tr>
<tr>
<td>Sporades</td>
<td>Euboea</td>
<td>EM</td>
<td>3684</td>
<td>0.5</td>
</tr>
<tr>
<td>Ionian Islands</td>
<td>Ithaka</td>
<td>CM</td>
<td>96</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Kefallinia</td>
<td>CM</td>
<td>781</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Lefkada</td>
<td>CM</td>
<td>303</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Zakynthos</td>
<td>CM</td>
<td>402</td>
<td>18</td>
</tr>
<tr>
<td>Dalmatian Islands</td>
<td>Brač</td>
<td>CM</td>
<td>395</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>Korčula</td>
<td>CM</td>
<td>276</td>
<td>34.5</td>
</tr>
<tr>
<td>Adriatic islands</td>
<td>Palagruža</td>
<td>CM</td>
<td>0.3</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>Corfu</td>
<td>CM</td>
<td>593</td>
<td>9.2</td>
</tr>
<tr>
<td></td>
<td>Sicily</td>
<td>CM</td>
<td>25,708</td>
<td>3.5</td>
</tr>
<tr>
<td>Egadi Islands</td>
<td>Favignana</td>
<td>CM</td>
<td>19.4</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Maretimo</td>
<td>CM</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>Maltese Archipelago</td>
<td>Malta</td>
<td>CM</td>
<td>246</td>
<td>80</td>
</tr>
<tr>
<td>Aeolian Islands</td>
<td>Lipari</td>
<td>CM</td>
<td>37.6</td>
<td>30.2</td>
</tr>
<tr>
<td></td>
<td>Elba</td>
<td>WM</td>
<td>220</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Sardinia</td>
<td>WM</td>
<td>24089</td>
<td>205</td>
</tr>
<tr>
<td></td>
<td>Corsica</td>
<td>WM</td>
<td>8722</td>
<td>87</td>
</tr>
</tbody>
</table>
The Eastern Mediterranean. This region, following Broodbank (2013:73), extends from the Aegean to the Levantine coast. The discussion will move from east to west beginning with Cyprus and the Levantine and southern Anatolian coasts; the islands in the Aegean Sea and western Anatolian coast follow (Table 3.2).

Cyprus is the third largest of the Mediterranean islands and is the only island located in the easternmost region of the basin south of the Anatolian mainland and west of the Levantine mainland (Broodbank 2006:208). Currently, Cape Ovacik and Cape Anamur at 81 km and 69 km, respectively, are the nearest points on the Anatolian mainland from the island’s northern coast. For the Levantine mainland, Cape Râs Ibn Hâni (101 km) and Cape Râs al Basit (108 km), both located in modern-day Syria, are the closest areas. Cyprus also lies approximately 400 km north of Egypt and 500 km east of Rhodes (DiBenedetto and Simmons 2014b:66-67; Held 1989a:12, 1989b:73; 1993:26; Knapp 2013:3; Simmons 1999:6).

In regard to its position and distance to the Anatolian and Levantine mainlands in the past, extensive geological research demonstrates that from the Late Miocene onwards, it has always been oceanic. There has, thus, not been a land bridge connection between the island and the southeast Asian mainland. Submarine reliefs demonstrate its separation from the surrounding Anatolian and Levantine coasts: the continental shelves are narrow with steep slopes dropping to depths of approximately 1,500 m in the Latakia Basin (separates Cyprus from the Levant) and Adana Trough (separates Cyprus from Anatolia) and 2,613 m in the Antalya Basin (which separates Cyprus from Anatolia) to the east, north, and northwest of the island, respectively. The only landmass near Cyprus are the igneous Hecataeus Ridge and the Eratosthenes Tablemount. The former would have created a long
peninsula extended from the island’s southern seaboard east to southeast towards the Lebanese coast, whereas the latter would have formed an oceanic island some 80 km off the southern coast of Cyprus. In both cases, however, the sea level would have had to drop at least 800 m for the two landmasses to be revealed; an event that has not occurred since the Late Miocene. The only areas that are of significance between Cyprus and the mainlands during the LGM and Early Holocene comprise the Cilician Basin, northeast of the island, and the Gulf of Iskenderun, which forms the easternmost embayment at the southern Turkish coast near its border with Syria. The continental shelf at both areas and the orientation of the island’s panhandle, the Karpass Peninsula, combined with a drop in sea levels of only 100 m would change the configuration of this area. There would be a greater seaward displacement of the mainland littoral, meaning a greater exposure of southern Anatolia’s coastline, and the formation of a short arc of offshore islands off the northeastern coast of Cyprus, due to the exposure of the now-submerged extension of the Karpass Peninsula (DiBenedetto and Simmons 2014b:66-67; Held 1989a:12, 1989b:66–69; Hsü 1977; Knapp 2013:4; Simmons 1999:6; Sondaar 2000:203, 207; Sondaar and van der Geer 2000:68; Swiny 1988:1-2).

Based on these data, what then was the distance from Cyprus to both the Anatolian and Levantine coasts? Stanley-Price (1977a:29) argued that during the LGM, there always was a gap of at least 60 km between Cyprus and Anatolia. Both Held (1989a:12) and Swiny (1988:3), however, have calculated slightly lower distances of about 30–40 kilometers separating a now-submerged northern Levantine coast and northeastern Cyprus. This would have been via the so-called Klidhes Strait, the area separating the now-submerged island arc, created by the extension of the Karpass peninsula, from the mainland (Simmons
Held notes, however, that this might not have been the easiest route due to the fact that the paleocoastline of Cyprus could not be seen from the mainland. The distance advantage might then have been offset by this blind crossing (Held 1989b:73). Distances between the Karpass Peninsula and the Gulf of Iskenderun would have decreased to around 40 km; whereas a crossing from Cape Ovacik and Cape Anamur would have been around 64 and 65 km. Similarly, the distance between Cyprus and Cape Rās Ibn Hāni and Cape Rās al Basit would have shrank to approximately 81 km (DiBenedetto and Simmons 2014b:67; Held 1989a:12, 1989b:73).

Distance is not, however, the sole variable involved here; rather, the difficulty or relative ease of reaching an island is also a significant factor for island colonization (DiBenedetto and Simmons 2014b:67). Held (1989b:66–104) has dealt with this issue in great detail, drawing largely upon, and refining, the approaches advocated by MacArthur and Wilson's *Theory of Island Biogeography* (1967) (see Chapter 2). In order to address the difficulty of reaching an island, Held examines variables such as island size (which is understood as target size and not the areal coverage), topographic relief, distance, existence of stepping stone islands, and altered coastline morphology (DiBenedetto and Simmons 2014b:67; Held 1989b:66-104). In order to establish a common denominator for comparing these distinct geographic parameters, he developed the Target-Distance Ratio (T/D ratio) since the possibility of reaching an island depends on both its target size and distance which must be overcome for the voyage. He argues that neither variable alone can provide an accurate measurement for feasibility of reaching an island. To illustrate this point, he compares Cyprus and Madagascar because both form large targets similar in size for watercraft voyages from the mainland. The former lies at 105° on the horizon in relation
to the southern Anatolian coast and the latter at 98° from the direction of the Mozambique coast, with values of 117° and 104°, respectively, at times of glacial maximums. Based on target size alone, it appears that Madagascar is only slightly more challenging to reach than Cyprus; however, this does not factor in distance of the two islands to their respective mainlands. Madagascar is considerably farther than Cyprus from a mainland and would presumably present a more substantial challenge. When the two islands are compared in terms of T/D ratios, Madagascar is shown to be approximately seven times more remote and less accessible than Cyprus at present sea levels and about four times less during periods of glacial maximums (DiBenedetto and Simmons 2014b:67; Held 1989a:13, 1989b:66-104).

It is important to note that not all scholars agree with Held’s notion that target width is a more meaningful variable than size. For example, Broodbank (2000:136-137) does not denounce its use entirely; however, he argues that for areas with high inter-visibility amongst islands, such as the Aegean, T/D ratios are less useful than in areas where long-range over-the-horizon sea voyages are required. Since there are no islands near Cyprus and an over-the-horizon voyage might have been necessary at certain times of the year, his values for T/D ratios for Cyprus in comparison with the Anatolian and Levantine mainlands will be provided. The results of his analysis during the Holocene are 1.52 for Cape Anamur, 1.29 for Cape Ovacik, 0.32 for Cape Râs Ibn Hâni, and 0.22 for Cape Râs al Basit. These figures change to 1.80, 1.82, 0.63, and 0.44, respectively during the LGM. He also calculates the T/D ratio from the “Klidhes Strait” to be 1.02 during low sea level stands (DiBenedetto and Simmons 2014b:67; Held 1989a:12–13, 1989b:72). Higher score values correlate to greater accessibility. Thus, these values demonstrate that with sea levels at
present elevations, Cyprus was four to five times more accessible from southern Anatolia than from the northern Levant. During times of maximum marine regression, including the LGM, it was three times more accessible (DiBenedetto and Simmons 2014b:67; Held 1989a:13, 1989b:72, 1993:26).

Given these data, what would be the voyage duration? Held (1993:27) suggests that the counterclockwise currents around the island favored voyages from the northeast. From Cilicia, it could take around 30 hours at an average speed of 2.7 knots, which would not have involved strenuous paddling. He does suggest a slightly shorter time of 28 hours from Cape Ovacik due to more favorable currents. Held has also found that even though the distance between Cape Anamur and Cyprus is the shortest, thus initially appearing to be the most feasible, this route would have been highly unlikely until the invention of the sail. A craft would have to be paddled vigorously against the current at a speed of 1.2 knots or more over a period of 30 hours, yet even then, there was no guarantee it would have reached the island (DiBenedetto and Simmons 2014b:73-74; Held 1993:27). It is important to note that Held’s calculations do not take into account weather or the prevailing southwesterly winds of the summer months. The latter might actually have helped these voyages, potentially shortening their duration (Held 1993:27). It seems, however, that Held’s basic time approximate holds, as McGrail (2009:100) also notes that the voyage would have taken slightly longer than a full day.

According to Held and his T/D ratio, Cyprus is actually one of the most challenging of the Mediterranean islands to reach, in spite of its relatively short distance from the mainlands. This is partially due to a lack of stepping-stone islands. It is important to note that in clear weather, Cyprus is visible from both southern Turkey and Syria (Stanley-Price
Held (1993:26) asserts, however, that this circumstance occurred mostly in the winter months. While a voyage from the mainland to Cyprus was not necessarily an easy task, Held (1989b:90, 104) concedes that:

In the Mediterranean, of course, boat voyages—even where primitive watercraft are involved—are unlikely to exact endurance records from the occupants, and oceanographic conditions around Cyprus are generally favorable...All in all, the prevailing atmospheric and oceanographic conditions around Cyprus are therefore unlikely to have foiled attempts to reach the island from the surrounding coast (Held 1989b:104).

Moving to the north Aegean and northwest Anatolian coast, during the LGM, as in the Mediterranean Basin in general, the sea level was at least 120 m below present shorelines. This would have greatly affected this area, particularly the Gallipoli Peninsula, located between the modern towns of Enez and Kavak. Currently, it has a coastline around 80 km long, but a much greater area of land would have been exposed during low sea level stands (DiBenedetto and Simmons 2014b:62; Özebeck 2012:164). The north Aegean islands of Lemnos (Limnos), Samothrace, Ayos Evstratious, Gökçeada, and Bozcaada were all also likely connected, except for deep gullies. The consensus for this situation continues until the beginning of the Holocene. By 10,000 B.P., when sea levels were about 45 m below present, the islands would have begun to separate (Özebeck 2012:164, 170). At this time, coastal bands would have shifted 1 to 10 km inland due to their inundation by the rising sea level (Özebeck 2012:170–171, 173).

Southeast of Lemnos, still in the north Aegean Sea, lies the island of Lesbos. It is separated from the Anatolian coast by two sea straits: Mytilene and Mouselim. During a
sea level drop of just 50 m, it would have been connected to the mainland. This is reflected in the paleontological sites, with some fauna characteristic of the mainland (DiBenedetto and Simmons 2014:183; Galanidou et al. 2013). Thus, during all of the LGM and into much of the Early Holocene, the island would have been connected to the mainland.

One final island in the north Aegean that has yielded claims important to this discussion on early seafaring is Ikaria. It would not have been attached to the mainland during the LGM to Early Holocene (DiBenedetto and Simmons 2014b:197; Sampson et al 2012).

The Greek peninsula currently has a scarcity of Pleistocene and Early Holocene hominin sites (Efstratiou et al. 2013c; Tourloukis and Karkanas 2012:1–2). Tourloukis and Karkanas (2012) recently carried out a landscape-scale approach to analyze whether the current lack of archaeological evidence during this time frame was a result preservation bias in conjunction with accessibility of potential sites. They examined sea level changes, climate changes, tectonic activity, and landscape-modifying processes (e.g., landslides), concluding that this scarcity of early prehistoric sites is related to the inundation of the Aegean Sea over land exposed during the Pleistocene and Early Holocene (Tourloukis and Karkanas 2012:9-10). This landmass could have critical for hominin dispersal out of Africa up until the middle Paleolithic, as our early ancestors could have dispersed from Africa, passed through the Levant, continued along the southern coast of Africa, and moved across the Aegean into Europe. The authors argue that this provides an additional route to the traditional dispersal model where hominins pass through the Levantine corridor continuing across mainland Turkey and either reaching Europe via the Bosphorus Strait or going through the Caucasus via a palaeo-Euphrates passage (Tourloukis and Karkanas 2012:12).
Much of the exposed Aegean would have been a “terrestrial wetland” for most of the early and middle Pleistocene, meaning that there would have been lakes (as large or even larger than the size of Crete), lagoons, ponds, moors, marshes, rivers, estuaries, and ephemeral streams where there is now open sea water (Tourloukis and Karkanas 2012:9–10, 12–13; Lykousis 2009:2043). This would have looked like a radically different landscape in comparison to today’s configuration of individual islands. This wetland environment, with brackish and fresh water sources, coupled with the proximity of marine resources, would likely have contributed to a high level of biodiversity, potentially providing an ideal habitat for hominin occupation and serving as a refuge area during times of climatic stress (Tourloukis and Karkanas 2012:9, 13). This is relevant to the earliest seafaring because it demonstrates that the Greek peninsula and the Aegean Sea likely have had a long history of human occupation, but the evidence for it may be submerged or destroyed. As the sea levels slowly rose, inundating the greatly extended landmass, these hominins would have had to adapt to the changing environment. At some point, they would have noticed landmasses out in the distance on the open water. It is no stretch to speculate that perhaps curiosity or some type of stress eventually propelled them to explore these landmasses, such as Crete (DiBenedetto and Simmons 2014b:62).

For the time frame from the LGM up to the early Holocene, the Greek peninsula and surrounding Aegean islands would still have looked radically different from today’s configuration. For example, the Sporades, located in the northwestern Aegean Sea, would likely have been connected with mainland Greece from the last interglacial, around 118,000-128,000 years ago; prior even to the LGM. They probably remained attached up until the Early Holocene. There is some evidence, however, that several of these islands
might have been separated from the mainland by 2-3 km gaps, including Alonnisos (northern Sporades) (Cherry 1981:45, 1990:167; Broodbank 2006:204; Runnels 2014a:216).

Table 3.2. Estimated Proximity of Islands in the Eastern Mediterranean Basin to the Mainland during the LGM to Early Holocene. (Adapted from Dawson 2011: Tables 2.1, 2.2; DiBenedetto and Simmons 2014b: Table 3.2).

<table>
<thead>
<tr>
<th>Name</th>
<th>Oceanic or connected to the mainland/other island during LGM to Early Holocene</th>
<th>Estimated distance to nearest mainland during LGM (in km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyprus</td>
<td>Oceanic</td>
<td>30-40</td>
</tr>
<tr>
<td>Lemnos</td>
<td>Connected to other north Aegean islands of Samothrace, Ayos Evstratious, Gökçeada, and Bozcaada</td>
<td>Distance not great</td>
</tr>
<tr>
<td>Samothrace</td>
<td>Connected to other north Aegean islands of Lemnos, Ayos Evstratious, Gökçeada, and Bozcaada</td>
<td>Distance not great</td>
</tr>
<tr>
<td>Ayos Evstratious</td>
<td>Connected to other north Aegean islands of Lemnos, Samothrace, Gökçeada, and Bozcaada</td>
<td>Distance not great</td>
</tr>
<tr>
<td>Gökçeada</td>
<td>Connected to other north Aegean islands of Lemnos, Samothrace, Ayos Evstratious, and Bozcaada</td>
<td>Distance not great</td>
</tr>
<tr>
<td>Bozcaada</td>
<td>Connected to other north Aegean islands of Lemnos, Samothrace, Ayos Evstratious, and Gökçeada</td>
<td>Distance not great</td>
</tr>
<tr>
<td>Lesbos</td>
<td>Connected to the mainland</td>
<td>N/A</td>
</tr>
<tr>
<td>Ikaria</td>
<td>Connected to the mainland</td>
<td>N/A</td>
</tr>
<tr>
<td>Sporades (most of them)</td>
<td>Connected to the mainland</td>
<td>N/A</td>
</tr>
<tr>
<td>Alonnisos</td>
<td>Possibly connected to the mainland (?)</td>
<td>2.3 km from mainland if not connected</td>
</tr>
<tr>
<td>Cycladia</td>
<td>Connected to Cycladic islands</td>
<td>Multiple crossings of 10 km</td>
</tr>
<tr>
<td>Euboea</td>
<td>Connected to the mainland</td>
<td>N/A</td>
</tr>
<tr>
<td>Crete</td>
<td>Oceanic</td>
<td>90</td>
</tr>
<tr>
<td>Gavdos</td>
<td>Connected to Crete (?)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

In the southern Aegean, the Cycladic islands form the central island cluster, which consists of around 30 islands all located in close proximity of one another. Distances
between islands are less than 30 km, but more frequently closer to 10 km (Broodbank 2000:41; DiBenedetto and Simmons 2014b: 64; Phoca-Cosmetatou 2011:79). During the LGM, most were connected as one large island-mass; termed ‘Cycladia.’ It extended from Andros in the north to Ios in the south, a distance of some 160 km. It remained an island for much of the Pleistocene and could have been reached from the mainland by multiple crossings that were around or greater than 10 km (Bednarik 1999b:277; Cherry 2004:237; Lambeck 1996:601; Phoca-Cosmetatou 2011:79; Runnels 2014a:217; van Andel 1989:737). The major exceptions are Euboea and several of the western islands. Euboea, located on the northern edge of the Cyclades, most likely was connected to the mainland, as the two are now barely separated (Cherry 1984:9; Broodbank 2000:68). The western Cycladic islands of Melos (Milos), Seriphos (Serifos), Sifnos, Melos, and Kythnos (Kithnos) were not connected as one large landmass or to the mainland (Cherry 1992:33; Lambeck 1996:601). Cycladia began to separate around the onset of the Holocene. By the Late Neolithic, the Cyclades approximated their modern configuration (Broodbank 2000:71; Lambeck 1996:606; Phoca-Cosmetatou 2011:79).

Directly south of the Cyclades lies Crete, the largest of the Aegean islands. Similar to Cyprus, it has been oceanic since at least the Miocene (Bednarik 1999a:560, 1999b:277; Bower 2010:14; Broodbank and Strasser 1991:233, 235; Dawson 2011:39; DiBenedetto and Simmons 2014b:65; Ferentinos et al. 2012:2167; Knapp 2013:46–47; Strasser et al. 2010:145, 2011:553). It is thought to have been around 90 km from the mainland during the LGM. Under optimal weather conditions, both the island’s mountain chain and the cloud mass above it are visible from higher ground on Melos and Thera; the latter is located east of the former. This visibility would most likely have been maintained during at least
the LGM, since the two islands would have been closer under lower sea level stands. The island would also have been a favored landfall for seafarers swept off course, due to its configurational properties. For example, Crete occupied 58% to 63% of the southern horizon of Thera during the Late Pleistocene and Early Holocene. If watercrafts had been carried south of Thera, it is probable they would have made landfall on Crete. This likelihood increased during the summer, due to the currents and northerly winds that were dominant in the southern Aegean (Broodbank and Strasser 1991:235; DiBenedetto and Simmons 2014b:65-66).

Approximately 38 km from the southwestern Cretan coast lies the island of Gavdos, currently the most southeastern European landmass, which is located in the Libyan Sea. Travels between Crete and Gavdos is quite challenging today, as the crossing involves open and unpredictable sea. In poor weather conditions, it can take an oar-propelled watercraft up to 10 hours. This is even with the use of a small islet between the two islands, called Gavdopoula (Little Gavdos). It is important to note that Gavdos and Crete would never have been connected, even at times of lower sea level, due to the depths of the basin that separates the two (DiBenedetto and Simmons 2014b:66; Kopaka and Matzanas 2009).

*The Central Mediterranean.* This region, following Broodbank (2013:73), comprises of the seas around Italy (and their respective islands), specifically the Adriatic, Ionian, and Tyrrhenian Seas. During the LGM, the Italian coast bordering the northern Adriatic was occupied by a large coastal plain. It was crisscrossed by numerous rivers, which carried meltwater from glaciers located farther inland. Along the eastern edge of Croatia, there were steep-sided hills, which are islands today. The coast of Italy that borders the southern Adriatic also had a large coastal place that extended east. Due to this area
having been well-watered, it is thought to have been one of the richest environments in all of the central Mediterranean. This perhaps rendered it unnecessary for populations during the late Pleistocene to migrate to the uplands, which is proposed for other areas of the Mediterranean. This extended coastal plain along the Adriatic, however, shrank considerably by 9000 B.P. (DiBenedetto and Simmons 2014b:70; Shackleton et al. 1984:310–312; van Andel 1989:737).

The Adriatic islands that are possibly relevant to the discussion on early seafaring are: the Dalmatian Islands of Brač (Kopačina špilja) and Korčula (Vela špilja) and Palagruža. The first two are thought to have been either connected to the mainland or were separated from it only by small water gaps (Broodbank 2006:213; Farr 2010:181). Palagruža, on the other hand, is the most remote island in the Adriatic—located in the middle of the sea. From the LGM onwards, it was never connected to the mainland or to another island. The closest landfalls in any direction are at a distance of approximately 45 km, with the closest point on the Italian mainland, Torre di Calunga on the Gargano Peninsula, being slightly greater at around 54 km (Dawson 2011:37; DiBenedetto and Simmons 2014b:68-69; Forenbaher 2009:79; Forenbaher and Kaiser 2011).

South of the Adriatic, lies the Ionian Sea and its islands. Corfu, in the north, was joined to the mainland even prior to the LGM, around 118,000 to 125,000 years ago. It was still either connected or separated only by a narrow channel at the beginning of the Early Neolithic (Broodbank 2006:204-205; Cherry 1981:45; Farr 2010:181).

The southern Ionian Island chain consists of four large islands: Lefkada, Kefallinia, Ithaka, and Zakynthos. They are separated from each other by distances of around 8.5 km to 15 km. Due to their proximity to each other and their location along the edge of the
Greek mainland, they form what almost looks like a landlocked sea some 100 km long and 45 km wide between the islands and mainland (Ferentinos et al. 2012:2167–2168). During the LGM, Lefkada was connected to the mainland. Kefallinia, Ithaka, and Zakynthos formed one large landmass, separated from the mainland by narrow straits between 5 and 7.5 km long. New islets also emerged at this time (Bednarik 1999b:277; Broodbank 2006:205; Cherry 1990:171; 1992:33; Ferentinos et al. 2012:2172; van Andel 1989:737).

In contrast to the Italian coast bordering the Adriatic, its shoreline bordering most of the Tyrrhenian Sea, except in the northwest (discussed below), would not have differed much between the LGM and the present due to its steep and narrow shelf (Shackleton et al. 1984:310; van Andel 1989: fig. 3). Sicily, located at the crossroads of the Tyrrhenian and Ionian Seas, most likely was connected to the Italian mainland by a narrow land bridge during the LGM. Even if this was not the case, the Strait of Messina would at most have been only a few kilometers wide. Thus, the two landmasses would not have been extremely close to one another (Broodbank 2006:206; Cherry 1981:45, 1984:10, 1990:189; Demand 2011:4; Farr 2010:179; Shackleton et al. 1984:310; van Andel 1989:737).

Off the western coast of Sicily, lie the Ègadi Islands, most of which were connected to the larger island from the LGM up to the Early Holocene. The only possible exception is Marettimo (Mannino et al. 2012; Simmons 2014:194).

In the southern Tyrrhenian Sea lies the Aeolian island chain. Of particular interest is Lipari, presently some 35 km north of Sicily. Little information is available on the configuration of the island from the LGM to the early Holocene; however, given its present distance from Sicily, it seems likely that at lower sea level stands, the two would have been connected (Castagnino Berlinghieri 2011; Farr 2006:86–87, 2010:184).
Table 3.3. Estimated Proximity of Islands in the Central Mediterranean Basin to the Mainland during the LGM to Early Holocene. (*Adapted from Dawson 2011: Tables 2.1, 2.2; DiBenedetto and Simmons 2014b: Table 3.2*).

<table>
<thead>
<tr>
<th>Name</th>
<th>Oceanic or connected to the mainland/other island during LGM to Early Holocene</th>
<th>Estimated distance to nearest mainland during LGM (in km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brač</td>
<td>Connected to mainland (?)</td>
<td>If not connected to mainland, then minimal distance to mainland.</td>
</tr>
<tr>
<td>Korčula</td>
<td>Connected to mainland (?)</td>
<td>If not connected to mainland, then minimal distance to mainland.</td>
</tr>
<tr>
<td>Palagruža</td>
<td>Oceanic</td>
<td>45</td>
</tr>
<tr>
<td>Corfu</td>
<td>Connected to mainland (?)</td>
<td>If not connected to mainland, then minimal distance to mainland.</td>
</tr>
<tr>
<td>Lefkada</td>
<td>Connected to the mainland</td>
<td>Distance not great</td>
</tr>
<tr>
<td>Kefallinia</td>
<td>Connected to Ithaka and Zakynthos</td>
<td>Multiple crossings of 5-7.5</td>
</tr>
<tr>
<td>Ithaka</td>
<td>Connected to Kefallinia and Zakynthos</td>
<td>Multiple crossings of 5-7.5</td>
</tr>
<tr>
<td>Zakynthos</td>
<td>Connected to Ithaka and Kefallinia</td>
<td>Multiple crossings of 5-7.5</td>
</tr>
<tr>
<td>Sicily</td>
<td>Connected to mainland (?)</td>
<td>If not connected to mainland, then minimal distance to mainland.</td>
</tr>
<tr>
<td>Lipari</td>
<td>Connected to Sicily (?)</td>
<td>N/A</td>
</tr>
<tr>
<td>Égadi Islands</td>
<td>Connected to Sicily</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*The Western Mediterranean.* This region, following Broodbank (2013:73), extends from the islands of Corsica and Sardinia to the Strait of Gibraltar. For much of the Pleistocene, these two islands were attached, forming the 35,000 km² mega-island of ‘Corsardinia.’ Its northeast shore was only approximately 15 km from the mainland during the LGM, because at this time a coastal plain extended along the northwest Italian coast and included the island of Elba. As sea levels rose, the distance between the “mega-island” and the Italian mainland increased: around 15,000 years ago, the width of the channel between the two landmasses was around 33 km, increasing to 55 km by the Early Holocene.

Farther west are the Balearic Islands, located in the Balearic Seas. They were not likely colonized until approximately the late fifth millennium B.P., when sea levels were near present levels (e.g., Alcover 2008; Guerrero 2001; Ramis and Alcover 2001; Ramis et al. 2002). Thus, they are outside the scope of this thesis, although it is important to note that they represent the last substantial islands in the Mediterranean to be settled (DiBenedetto and Simmons 2014b:71).

At the most western end of the Mediterranean Basin is the Strait of Gibraltar; discussed above. Much debate surrounds the role this channel might have played in the hominin dispersals out of Africa and their arrival into the Mediterranean (e.g., Derricourt 2005; Rolland 2013; Straus 2001).

Table 3.4. Estimated Proximity of Islands in the Western Mediterranean Basin to the Mainland during the LGM to Early Holocene. (Adapted from Dawson 2011: Tables 2.1, 2.2; DiBenedetto and Simmons 2014b: Table 3.2).

<table>
<thead>
<tr>
<th>Name</th>
<th>Oceanic or connected to the mainland/other island during LGM to Early Holocene</th>
<th>Estimated distance to nearest mainland during LGM (in km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corsica</td>
<td>Connected to Sardinia</td>
<td>15</td>
</tr>
<tr>
<td>Sardinia</td>
<td>Connected to Corsica</td>
<td>15</td>
</tr>
<tr>
<td>Elba</td>
<td>Connected to mainland</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Putting the Pieces Together: Why Physical Conditions of the Mediterranean Basin Matter for a Discussion on Early Seafaring?

Archaeologist Brian Fagan demonstrated that even today, the physical conditions of the Mediterranean Sea (winds specifically in his case) can have a profound impact on watercraft technology and the success of a voyage. While he and his crew were able to fall back on a diesel engine to take them to port after losing the Meltemi wind (2012:75-76), the earliest seafarers would not have had this benefit. A seafaring voyage most likely involved preparation and forward planning (Bednarik 2011:91; DiBenedetto and Simmons 2014b:74); however, the most important variables our ancestors faced—the physical conditions—could also be the most unpredictable. In spite of this, it is absolutely essential when discussing early seafaring to provide some understanding of what these conditions might have been (DiBenedetto and Simmons 2014b:74). Determining past sea levels can be challenging, since there are numerous variables involved, particularly when trying to calculate local rather than global sea level stands. Some of these variables include the effect of tectonics acting on the mainland or the added (or decreased) glacial ice weight on the continental shelf and deep-sea floor (for a more in-depth discussion, see Lambeck 1996; Lambeck and Chappell 2001; Lambeck and Purcell 2005; Shackleton et al. 1984; van Andel 1989). As van Andel (1989:733) notes, however, “Complex as this subject is, we know the history of sea level over the last 125,000 years well enough to enable us to take its chronology and its impact on late Quaternary shoreline positions into account in a reasonably precise manner.” In regard to the Mediterranean, recent studies have also begun to focus on particular regions of the basin to determine if earlier models proposed for global sea level stands can be used (e.g., Ferentinos et al. 2012; Lambeck 1996; Özbeck 2012).
Though there does seem to be some local variation, as discussed by Ferentinos and colleagues (2012), overall it seems that the model generally holds true. Future studies that focus on local regions will continue to refine our knowledge on changes in sea level stands from at least the LGM onwards. For now, there is little doubt that there was a significant change in sea level stands over the last 25,000 years, which impacted the configuration of the basin. Coastal plains extended much farther, decreasing distances between islands and the mainland or resulting in some islands becoming attached either to other islands or to the mainland. Of course, there were still some islands—in particular Crete, Cyprus, Kefallinia, and Zakynthos—that would have been oceanic even with these lower sea-level stands (DiBenedetto and Simmons 2014b:74-75).

Similar to sea level stands, paleoclimates can be reconstructed with a fair degree of accuracy, due to data from oxygen isotopes and from pollen and geomorphology studies; to name just a few. On the other hand, weather (wind and atmospheric conditions), tides, and currents are more challenging to project for the remote past. Archaeological data, such as written records, are helping with this issue. It is probably reasonably safe to assume that if certain tidal conditions, weather patterns, and currents were at least known and recorded by scholars in antiquity, then there must be some deeper history to them (DiBenedetto and Simmons 2014b:74-75). While it is important to be accurate in our reconstruction of the past physical environment of the Mediterranean Basin, this chapter demonstrates that, more importantly, the earliest seafarers would have had intimate knowledge of all of these environmental conditions. They would have needed to know the signs of approaching bad weather, the location of treacherous waters, the time of year they could participate in seafaring activities, and/or the duration of specific journeys. The earliest of these journeys
probably involved many trials and errors. Yet, from these failed attempts, the early seafarers would have gained the necessary knowledge about their environment to ultimately succeed in their sea voyaging efforts (DiBenedetto and Simmons 2014b:75). A key question now is: what was the watercraft technology that early seafarers used to make these crossings?
CHAPTER 4
MISSING WATERCRAFT AND ARCHAEOLOGICAL SITES: THE
CHALLENGES OF DOCUMENTING EARLY SEAFARING IN THE
MEDITERRANEAN BASIN

Thus far, a summary has been provided of the physical and environmental conditions likely faced by early seafarers within the Mediterranean. Before turning to two specific case studies that are arguably the strongest contenders for both pre-Neolithic and Early Neolithic seafaring activity, three issues of the utmost importance in documenting early maritime activity need to first be addressed: how early seafarers traveled to the islands, the evidence (or lack of evidence) for this activity, and the challenges of documenting a human presence on an island. This translates to a practical deliberation of the earliest types of watercraft that could have been used and to the nature of small sites. To address both issues, empirical data and theoretical considerations must be examined (DiBenedetto and Simmons 2014c:76).

The majority of this chapter outlines the watercraft technology most likely used during the Pre-Neolithic and Early Neolithic, drawing on a variety of sources due to the elusive nature of their physical remains. The second part discusses the indirect archaeological evidence for early seafaring, specifically evidence for a human presence on the islands. The final part of this chapter addresses some of the archaeological concerns that have plagued the documentation of these early sites on the Mediterranean islands. As noted in Chapter 1, much of this chapter is extracted from DiBenedetto and Simmons (2014c:76-101).
Determining Types of Watercraft

Ethnographic evidence of traditional watercraft usage has been collected from all over the world for the recent past. Reed rafts were used by Hungarian fishermen on lakes until relatively recently (DiBenedetto and Simmons 2014c:77; Johnstone 1980:12). Log rafts have been documented in New Zealand. Bundles boats and plank canoes were used by the Chumash Native Americans off the southern coast of California. The former were also used on the rivers and marshes of Iraq. Both areas have natural sources of easily accessible bitumen, used for waterproofing the vessel (Carter 2006:57, 2010b:99; DiBenedetto and Simmons 2014c:77; Gould 2011:93; Hornell 1946:46, 56–58; McGrail 2009:59–60, 320, fig. 3.4, 2010:99). Bark boat use was documented amongst the indigenous inhabitants of Australia and North and South America by the first Europeans to come into contact with these groups. This type of craft was also used in Eastern Siberia (McGrail 2010:100). Basket boats used on the sea and rivers have been documented in Southeast Asia. Pottery boat usage was also recorded on the rivers of Eastern India (Casson 1995:7; DiBenedetto and Simmons 2014c:77; Hornell 1942:34; 1946:34–35; McGrail 2009:294–295, fig. 8.3, 2010:100). Early twentieth century biologist H. H. Brindley noted the use of rafts made of ambach logs for crossing the Nile in the Bari region of Uganda (Johnstone 1980:7; McGrail 1981:49–50). Hide boats have also been documented in Iran, Central Asia, and Northern India (Hornell 1942:37–39, 1946:9–13). This is by no means a comprehensive list of all the different types of watercraft documented globally as entire books are written on this subject (e.g., Johnstone 1980; McGrail 2009). However, the above examples emphasize the variation in type of technology utilized, raising the question of how to categorize the types of craft that people used for water transport in prehistory.
The classification used in this study follows that of McGrail (2009), who has been one of the leading researchers of watercraft technology both for prehistory and history (e.g., McGrail 1981, 1998, 2006a, 2006b, 2009, 2010). He has divided units of water transport into three major categories: floats, rafts, and boats. These categories were derived first by looking at how buoyancy is applied. In floats, buoyancy is directly applied, whereas the opposite is the case for both rafts and boats. Thus, floats are delineated into their own category. Rafts and boats are further divided based on how buoyancy is derived. For the former, buoyancy comes from the individual elements of the craft, since minimal effort is used to make it watertight. For the latter, the hollow hull displaces water, creating buoyancy (McGrail 1998:5, 2006a:9, 2009:8, 2010:98).

These three categories are further subdivided based on raw material. There are four types of floats (log, bundle, sealed pot, and inflated hide), three types of rafts (log, bundle, buoyed by sealed pots, or inflated hides), and seven types of boats (log, bundle, hide, bark, basket, pottery, and plank) (Casson 1995:3–10; Johnstone 1980:7–9, 17, 26, 45–51; McGrail 1981:5, 2009:8, table 1.1, 2010:98, table 1.2). While these categories are useful in that they standardize how to discuss watercraft technology, enabling comparisons to be made at local, regional, and global levels, a major question is whether these types can be physically documented. This is particularly the case for log and raft crafts that are made out of perishable material, which would only preserve in the archaeological record under very specific conditions. In fact, several types support the use of this technology, specifically: ethnographic documentation, iconographic evidence, documentary evidence, and archaeological evidence (direct and indirect). Experimental studies have also been conducted using these types of craft to determine their realistic probability of use in the

**What Were the Earliest Types of Watercraft in the Mediterranean?**

For the Mediterranean, McGrail (2009:Table 1.2) hypothesizes that a range of watercraft types were used in the Paleolithic through Neolithic. For the Paleolithic, these include: log float, bundle float, hide float, simple log raft, and simple hide-float raft. During the Epipaleolithic, complex log raft, multiple hide-float raft, bundle raft, multiple hide boat, and basket boat might possibly have been utilized. Finally, by the Neolithic, the craft possibly available include: pot float, pot-float raft, pot boat, stabilized logboats, paired logboats, and extended logboats (McGrail 2009:5, Table 1.2). McGrail’s assessment is based on an examination of the stone tool technology available for each period in question. He then correlates these data with information concerning the earliest use of these tools in other artifact construction. Finally, he deduces whether the technology available could have possibly been used to construct the different types of watercraft (McGrail 2009:10-12).

Thus, these theoretical assessments raise the question of whether there is evidence for any of these types.

There is some iconographic, documentary, ethnographic, and archaeological (direct and indirect) from the Mediterranean basin, which suggests broader categories of these crafts were used. These include: log rafts and boats, bundle rafts, buoyed rafts, and complex hide boats. All of the evidence, however, postdates the time frame in question. In spite of this, these data are still important to discuss since it demonstrates that there is history to these types of technology in the Mediterranean. The focus is on seagoing crafts; however, evidence found inland on lakes and rivers is also discussed since this is where remains of
all of the physical crafts have been recovered. These provide insight into the tool technology, raw material, and construction techniques that were available and used in watercraft construction. Indirect evidence (e.g., sites) will also be examined. While these data document a human presence, they are also mired in controversy. Two experimental studies are also discussed that examine the use of particular craft for sea voyages (DiBenedetto and Simmons 2014c:82).

*Log Rafts and Boats*

The Old Testament (1 Kings 5:23) provides the earliest literary reference to seagoing log rafts. The passage discusses King Hiram of Tyre sending cedar and juniper logs by sea to Solomon in the sixth century B.C. The Greek historian Diodorus (19.54.3) also documents the transportation of elephants via log rafts in 316 B.C. across the Saronic Gulf from Megara to Epidaurus. The former is now in Attica, Greece; the latter in the Argolis region. A fourth-century A.D. coin is also thought to depict the sea goddess Isis Pelagia on board of what seems to be a log raft (DiBenedetto and Simmons 2014c:83; Johnstone 1980:58, fig. 6.2; McGrail 2009:103, fig. 4.5). Ceramic models at Tsangli, Thessaly might also represent log boats; though this is subject to debate (Marangou 2003; Vigne et al. 2013:168).

One of the earliest known log boats recovered is from the now submerged Neolithic site (ca. late seventh millennium B.P.) of Lake Marmotta on Lake Bracciano, some 40 km north of Rome. The vessel was constructed from oak and its length was less than 10 m. It is interpreted as a dugout canoe. Though this boat was recovered from a lake context, it seems likely that similar vessels would have been used along the coast and possibly to make short sea voyages (DiBenedetto and Simmons 2014c:83; Farr 2006:90, 2010:183;
Fugazzola Delpino 2002; Fugazzola Delpino et al. 1993; Fugazzola Delpino and Mineo 1995; Rowley-Conwy 2011:436). To test this hypothesis of the craft’s seagoing abilities, a modern reconstruction of the La Marmotta vessel (with a length slightly over 9 km) experimentally traveled along the coasts from Italy to Portugal, some 800 km. It was propelled by a ten-member crew using oars and was able to travel up to 30 km in a single day. There was enough also enough space for cargo (Rowley-Conwy 2011:436; Vigne et al. 2013:168). Other excavated log boats, dating to around the tenth millennium B.P., were recovered from Noyen-sur-Seine in northern France and Pesse in the Netherlands. Both were constructed of pine (Gould 2011:95–96; McGrail 2006a:32, 2009:173, 2010:99). Wooden boat remains were also recovered from Despilio Lake in Thessaly, which dates to the late 8th millennium B.P. (Marangou 2003; Vigne et al. 2013).

Evidence for boats made from timber has also been found at two sites in Egypt. One was el-Lisht where material believed to be boat timbers was reused in building a causeway. These were found around the pyramid of Senusret (built ca. 3900 B.P.). The hull was unfortunately not preserved. The second example was found by construction workers at Mataria, a suburb of Cairo. It is believed to be a Late Period (712-332 BC) riverboat (Cooper 2011:344; DiBenedetto and Simmons 2014c:83). Timber is relatively scarce in Egypt, impacting not only shipbuilding but for also any sort of construction that required wood. Local timber includes acacia, date palm, sycamore fig, tamarisk, sidder, date palm, and persea. Those that have been documented in watercraft construction include acacia, sycamore fig, sidder, and tamarisk. Acacia or tamarisk was used for the el-Lisht boat (Casson 1996:13, 15; Cooper 2011:354; Kapitan 1995:225–229; Polzer 2011:353). The former was actually challenging to work with, due to its short length; in spite of this,
however, it was often a major component of hull-planking for Nile boats (Cooper 2011:354).

Given the ubiquity of wood in most places around the Mediterranean, it likely was a significant element of many early watercraft; as attested by the fact that it is the main raw material for log rafts and boats and for bundle rafts. It is also used in the framework of hide boats and buoyed rafts. Wood products might have been used in the lashings to hold the craft together. Tree resins and tars were also likely waterproofing agents (DiBenedetto and Simmons 2014c:84; McGrail 1998:23). McGrail (1998:24), among other scholars (e.g., Burnet 1997:62–63; Crumlin-Pedersen 1997:186–187), notes that timber has several general properties that make its use for advantageous for watercraft construction. For one, while it is weak in tension, it is usually strong relative to its weight and resilient to shock loading. Many wood species also have a density less than one, enabling them to float. Even those with a greater density can be cut in a particular way during their growth period that causes them to float once dried. Wood, when properly ventilated, is also usually durable. Furthermore, it is relatively water resistant. This property is enhanced through use of different waterproof agents. Wood can also be easily worked using a simple tool kit. Finally, depending on strength requirements, different parts of a tree can be matched to use for the different watercraft elements (DiBenedetto and Simmons 2014c:84; McGrail 1998:24).

Given both the importance of wood and its advantageous properties in watercraft construction, two questions arise: what types of wood were used and were some types preferred over others? Data from the preserved watercraft remains at La Marmotta, Noyen-sur-Seine, and Pesse indicate that pine and oak were both used as construction materials,
implying that there is history to use of these two types from around the Mediterranean and Europe. The lack of preserved watercraft remains apart from these three examples make it challenging to discuss wood types used and preferred in the Mediterranean Basin. Evidence from Northern and Western Europe, where there is greater preservation of watercraft remains, demonstrate that a wide range of species was both available and used. These include elm, ash, alder, hazel, oak, beech, birch, yew, willow, lime, and pine (DiBenedetto and Simmons 2014:84; McGrail 1998:26). By the mid-fourth millennium B.P., oak, when available, generally appears to be the preferred wood type used for the main structural elements. This preference for oak might be due more to its own physical properties: it preserves better than most other species. Documentary references by classical sources onwards, however, support this observation. For example, Caesar and Strabo both record that the Veneti Celtic tribe, living in what is today Brittany, France, preferred oak for watercraft construction (DiBenedetto and Simmons 2014c:84-85; McGrail 1998:26). John Evelyn, a 17th-century diarist, also noted that oak is “tough, bending well, strong and not too heavy, not easily admitting water” (quoted in McGrail 1998:26). While oak was possibly preferred, it seems likely that, regardless of oak’s availability, if other wood species had better qualities for particular structural elements, then they would have been used (McGrail 1998:26).

Bundle Rafts

Iconographic evidence documents the use of bundle rafts in the Mediterranean. Two stones incised with a number of incised figures, dating to around 4000 B.P., from the megalithic temple at Hal Tarxien in Malta, are possible representations of bundle rafts (DiBenedetto and Simmons 2014:87; Johnstone 1980:59; McGrail 2009:103, fig. 4.7;
Bundle rafts might also be depicted on both a ring from Tiryns, Argolid and a gold signet ring from Mochlos, Crete; both dating to the Bronze Age. A graffito of Roman date has also been recovered from excavations at Bet She’arim in Israel. It is similar to the Tiryns craft in that both have vertical lines across the hull, which are suggested to represent the bundle bindings (DiBenedetto and Simmons 2014c:87; Johnstone 1980:59; McGrail 2009:103). Another possible example is found on a Lesina ceramic-style vase from the Dalmatian island of Hvar. It dates to around 5450 B.P., corresponding to the Middle to Late Neolithic. The profile and cross-hatching of the hull have led some to conclude that it might either depict a reed-bundle boat or a woven-basket boat (e.g., Bonino 1990:113-115). Unfortunately, the image is subject to interpretation and might have actually been scratched on the vessel at a later date (Farr 2010:183). Strabo also records that he used a bundle raft known as a pacton to cross the Nile to the island of Philae, above Aswan (McGrail 2009:20–21).

Numerous iconographic depictions of reed-bundle rafts have been found in Egypt alone. They often depict hunting, fishing, and fowling scenes within marshlands of the Nile Delta, around the lake in the Faiyum, and wherever floodwater happened to be trapped after the yearly flooding of the Nile. Examples can be seen from tomb paintings from the early dynastic period onwards. Several of these also show the actual sequence of reed-bundle raft construction. Documentary evidence by Isaiah in the Old Testament (18:1, 2) also notes that Egyptian envoys traveled in bundle rafts made out of papyrus to the Levant (Casson 1996:14-15; DiBenedetto and Simmons 2014c:87-88; Hornell 1946:46–48; McGrail 2009:21-22, fig. 2.8).
Within the Mediterranean, reed-bundle rafts were still being built and used until recently (McGrail 2006a:9). For example, in the Oristano swamps of Sardinia, fishermen used one-man rafts consisting of reed bundles tied together (Farr 2010:183; Johnstone 1980:12). Rafts known as *papyrella* were also used to tend lobster pots in deep seawaters from Corfu. They had a wooden framework, were paddle propelled, and could carry two individuals (Farr 2010:183; Johnstone 1980:59–60; McGrail 2006a:9, 2009:103). Local fishermen emphasize that these rafts were unsinkable (Johnstone 1980:60). Two such vessels could also be hooked together, forming a larger, more stable craft. These were used for lengthier trips and for cargo transport (Farr 2010:183; Johnstone 1980:60). A reconstruction of one of these vessels is discussed below.

One final site where there is possible evidence of reed bundle raft comes from the Late Neolithic site of H3 at As-Sabiyah in Kuwait, dating to the eighth to seventh millennium B.P. While outside the focus on this thesis, the discoveries found at the site could have significant ramifications for our understanding of early seafaring in the broader region; which is why it is included in this discussion. Excavations uncovered a ceramic model of a reed-bundle boat, 50 pieces of bituminous amalgam, and a painted ceramic disk that depicts a sailing boat (Carter 2006:52–3, figs. 3, 4, 2010a:192, fig. 15.2, 2010b: 1, 89–91, figs. 5.1, 5.2). This model is particularly important as it provides specific information on reed-bundle boat construction, not seen on any other models dating to this period in both the Mediterranean (discussed above) and farther inland on the Southwest Asian mainland. For the latter, possible clay reed-bundle models dating to the seventh millennium B.P. are also found at Tell Mashnaqa, Syria and Eridu, Iraq (Carter 2006:53, 55, 2010a:192, 2010b:89–91; McGrail 1981:45, 2009:56–57, fig. 3.2, 2010:98).
The bituminous amalgam consists of reed impressions and/or barnacle encrustations, leading the excavators to suggest they are the remains of the waterproof coating for the hull of seagoing reed-bundle boats. Prior to these finds, it was held that reed boats coated in bitumen dated back only to the Early Bronze Age. Late fifth and fourth millennia B.P. cuneiform texts record that reed-bundle vessels were coated with bitumen in the boatyards of southern Mesopotamia. These archaeological finds from H3, however, push this date back several thousand years. These bitumen pieces also currently represent the oldest fragments of a seagoing watercraft, which possibly was a reed-bundle craft (Carter 2006:53, 55–58, fig. 5, 2010a:192, 2010b:91–100, figs. 5.1–5.10; DiBenedetto and Simmons 2014c:80; McGrail 2010:99).

The ceramic disk depicts a boat with what seems to be a two-footed mast. This is important because it currently represents the earliest known evidence for the use of a mast and sail (Carter 2006:55, 2010b:91). Previously, the oldest, undisputed evidence for use of the sail came from a sixth millennium Egyptian painted pot (Carter 2006:55; 2010b:91; Farr 2006:90). The clay model from Eridu has also been interpreted as representing a sailing boat (Bourriaud and Oates 1997; Carter 2010b:91), although this interpretation has been called into question (Casson 1995:22; Strasser 1996); regardless it is still later than the H3 example.

Buoyed Rafts

The earliest depiction is found on a series of sixth-century B.C. Etruscan gems; one of which depicts Hercules floating on the watercraft. Pliny (Natural History 8.16) also notes that elephants were transported on buoyed rafts made buoyant by sealed pots from
Calabria to Sicily in 252 B.C (DiBenedetto and Simmons 2014c:86; Johnstone 1980:58; McGrail 2009:103, fig. 4.6).

The Roman satirist Juvenal and Strabo also both note the use of this ceramic-pot vessel on the Nile (Cooper 2011:346; McGrail 2009:20). The former, in fact, mocks Rome’s Egyptian subjects and this craft: “…useless, warlike rabble/Who rig scraps of sail on their earthenware feluccas/And row with diminutive oars in painted crockery skiffs” (in Cooper 2011:346). Curiously, references to these rafts disappear after Classical antiquity; not resurfacing until the 18th century A.D. It is currently unknown whether their use continues throughout this perceived absence (Cooper 2011:346). The Danish naval captain Frederik Ludvig Norden describes this craft in 1737 while on the Nile: “In order to cross the Nile, the inhabitants have recourse to the contrivance of a float, made of large earthen pitchers, tied closely together, and covered with leaves of palm trees. The man that conducts it has commonly in his mouth a cord, with which he fishes as he passes on” (quoted in Cooper 2011:346). Norden also illustrates the vessel. Based on this, the structure of the raft seems complex. It had a triangular base that consisted of 44 pots, which were arranged in 11 rows with the width decreasing from seven pots to one at the stern and bow respectively (Cooper 2011:347, fig. 2). The pots all seem to be standardized; supported by the fact that in more recent times, pots for these rafts were sold in Cairo (Cooper 2011:347; McGrail 1998:188). The pots were roped together and the deck was constructed of palm leaves. This type of craft could accommodate either one or two people, based on the illustrations. There is also, however, illustrations depicting substantially larger ceramic-pot rafts, but their usage is most likely modern (Cooper 2011:347). There is no archaeological evidence for this type of watercraft. To explain this lack of evidence, Cooper suggests,
“one might speculate that archaeologists may indeed have unwittingly handled potsherds which once formed components of such rafts” (2011:346).

Rafts stabilized by ceramics would not have been used in the Mediterranean until the Ceramic Neolithic, when this technology was invented (DiBenedetto and Simmons 2014c:86-87). This craft could have been made buoyant by other types of material, such as gourds (Hornell 1946:37–38; Cooper 2011:351). Writing in 1639, the traveler and soldier, Jean Coppin documents:

While we rested beside the river, we saw a man fishing on a raft that he had made from a mesh of reeds placed over several dry gourds bound together. He propelled it with a palm branch, and went thus to the middle of the current, because the Nile, after the inundation has passed, is not fast-flowing in the plains of Egypt. The Arabs told us that one was obliged to have recourse to such industries because, there being hardly any wood in this country, boats are very rare (quoted in Cooper 2011:351).

The above passage seems to imply that these types of craft were used as a last resort when other, better construction material, such as wood, was not available. Interestingly, while there are some iconographic representations of buoyed rafts being used at sea, most evidence records their use on rivers (DiBenedetto and Simmons 2014c:87). Johnstone (1980:58) suggests that in their simpler form, buoyed rafts probably would not have been used in seafaring voyages. This is due to their lack of stability, as compared to other types of watercraft.

Hide Boats

Evidence for use of hide boats in the Mediterranean region is relatively scarce.
Lucan (*Pharsalia* 4.131–132) documents their use in the Po Valley of Classical Italy (Bonino 1990:115; DiBenedetto and Simmons 2014c:88; McGrail 2009:104). A clay model, with a pronounced bow, “eyes” (oculi) on each side, vertical lines painted on its side, has been recovered from the site of Phylakopi on Melos. Bulges between the lines have led to the suggestion that this is the artist’s attempt to represent ribs with a hide hull bulging out. Consensus, however, is that this is not a hide boat representation, as it involves too much speculation (Johnstone 1980:57, fig. 6.1).

Greater evidence for hide boat usage, comes from the Nile. In fact, it seems local Egyptians would use inflated animal skin to cross the river (Cooper 2011:355; Hornell 1942:39). This is described by the 19th century Scottish traveler James Bruce, who “…procured a servant of the governor of the town to mount upon his goatskin filled with wind, and float down the stream to El Gournie, to bring a supply of these (fruit), which he soon after did” (quoted in Cooper 2011:355 and Hornell 1942:39). This watercraft highlights the resourcefulness of the Egyptians in using locally available raw material, in order to remain connected along and across the Nile network (Cooper 2011:355-357).

Johnstone (1980) suggests this lack of evidence for hide boats in the Mediterranean, especially in comparison with Northern Europe, could be due to differences in clothing and its associated techniques. Due to the warmer Mediterranean climate, he argues that there would not have been the need to develop the technology associated with tanning, cutting, and sewing pieces of hide for warm clothing; which was critical for survival in Northern Europe (1980:57). There is evidence, however, for an early use of leather in the Mediterranean Basin. For example, the Badarians in the Egyptian Early Pre-dynastic stage buried their dead in skin outer garments. Athenian warship sails had both leather corners
and hide coverings; the latter to protect against ocean spray. Sumerian texts and the *Odyssey* also describe different methods of leather preparation (Johnstone 1980:57). A larger role might be given to preservation issues, since these boats are constructed of timber and hide; neither of which preserve well, particularly in a Mediterranean climate (Gould 2011:91; Johnstone 1980:57; McGrail 2006a:31). Even in Northern Europe, there are very few preserved hide boats; possible exceptions include the remains used for burials from two Scottish sites: north Lincolnshire (Roman) and in Dalgety, Fife (Early Bronze Age) (McGrail 2006a:31). A tenth century A.D. site in Ireland, also has a preserved timber that seems to be an appropriate size for a hide-boat frame; but, this is highly speculative (McGrail 2006a:31).

In sum, the strongest evidence for types of watercraft used in the Mediterranean Basin come from iconographic, documentary, and ethnographic evidence. Unfortunately, much of this evidence dates to the later part of prehistory and early historical periods. Direct archaeological evidence, or the physical remains of the watercraft, is seriously lacking not just for the period in question but even for much of prehistory. La Marmotta provides tantalizing evidence that log rafts might have been one of the earliest watercraft types. Whether or not this vessel was used at sea is currently known, and probably will remain so. The bituminous amalgam from H3 also suggests that reed-bundle rafts were used at least in the Arabian Peninsula and perhaps in the broader Mediterranean. These data, however, are similarly of a later date than the pre- and Early Neolithic. While the direct evidence might not suggest a strong case for early seafaring, the same cannot be said for indirect evidence; or the physical remains of humans on Mediterranean islands. Evidence for a human presence mostly from the Late Paleolithic will be discussed briefly for those
islands that are applicable, excluding Crete and Cyprus as greater detail will be given to these two islands (Chapter 5). Discussion will be divided by region. In regards to Figure 4.1 and Figure 4.2, it is important to note that they are divided into Eastern and Central and Western Mediterranean, respectively. It must be noted, however, that Zakynthos and Kefallinia appear on Figure 4.1. While they are part of the Central Mediterranean, due to the scale of the maps, it was not possible to place them with the other islands in the Central and Western Mediterranean. They will be discussed with the Central Mediterranean section.

**Indirect Archaeological Evidence for Early Seafaring**

*Eastern Mediterranean*

Minimal evidence of Paleolithic and early Neolithic occupations have been recovered from the north Aegean and northwest Anatolian coast; however, recent research has called this into question. The palaeoceanographic data demonstrate that early occupation sites would have been inundated along the Gallipoli Peninsula as well as the coastlines of the north Aegean islands. This means that many sites could be buried underneath several meters of sand. This is illustrated by the recent discovery of two early sites: Ouriakos, Lemnos and Uğurla, Gökçeada (Figure 4.1). The former is located about 3 m from the islands southeastern coast, dating to around 12,000 B.P., and consists mainly of chipped stone assemblage with a few unidentifiable bone fragments. The microlithic finds reflect a hunter-gatherer assemblage. It is now partially located on a Pleistocene calcarenite marine terrace and was buried under 60 to 80 cm of sand deposit (Efstratiou in press; Efstratiou et al. 2013c, 2014; Özbeck 2012:164-165). The latter is located in the western part of Gökçeada, presently about 17 km from the Gallipoli Peninsula. The site
dates back to at least the Early Neolithic, around 8,500 cal B.P. There are two possible occupational levels. The earliest does not have any architectural structures, but there is a dense concentration of animal bones. A single-room earthened-floor building has, thus far, been recovered from the later layer. Within this small-scale household, the recovered artifacts include: a stone axe, a pottery sherd with human motif in relief, and broken bone tools (Erdoğan 2011, 2013, 2014; Özbeck 2012:171).

These two islands might actually have been connected around the mid-thirteenth millennium cal B.P. Bathymetric data from northeast Lemnos and southern Gökçeada indicate that the waters between the two would have been shallow, never exceeding 40 m. Definitive conclusions for this situation, however, are awaiting further geomorphological studies. There also seems to be some evidence that the two islands were connected to the Anatolian mainland (Efstratiou in press). By 11,500 B.P., the two islands would have separated from the mainland, but substantial seafaring voyages would still not have been necessary. This does not mean, however, that watercraft technology would not have been in use (Özbeck 2012:173).

Southeast of Lemnos, the site of Rodafnidia has recently been found on the island of Lesbos (Figure 4.1). It is an open-air site, possibly dating to both the Lower and Middle Paleolithic. Many of the artifacts recovered are argued to be Large Cutting Tools (LCTs) and Prepared Core Technology (PCT); the former being associated with Lower Paleolithic tool technology and the latter with the Middle Paleolithic (Galanidou et al. 2013; Simmons 2014:183). Studies are still ongoing with only a few short reports (e.g., Galanidou 2013; Galanidou et al. 2013); thus, little consensus has been reached about the authenticity of this site.
One final site in the north Aegean that has yielded Epipaleolithic claims is Kerame 1 on Ikaria (Figure 4.1). Its chipped stone assemblage is similar to that of Maroulas on Kythnos, discussed below. There appears to be remnants of a stone ring structure; however, erosion has significantly impacted the site. Organic material and faunal remains have not been recovered. The age of the site has been determined from obsidian hydration on the small amount of obsidian recovered. This obsidian is from Melos, which is important, because, as discussed below, it appears that by the Epipaleolithic a significant obsidian network exchange was in place between some of the Aegean islands and the mainland. Five other Epipaleolithic sites have been recorded on the islands; however, none have yet been systematically investigated. A handful of Neolithic sites have also been recorded, unfortunately many are located on eroded capes along the northeastern coast; thus, little information can be extracted from them (Sampson et al 2012; Simmons 2014:197).

Moving west to the Sporades, currently, evidence for early seafaring comes from Cyclops Cave on the islet of Youra, some 32 kilometers from Alonnisos (Figure 4.1). Obsidian from the island of Melos (discussed below) has been found in levels argued to date to the Epipaleolithic (Sampson 1998, 2008, 2011; Simmons 2014:127); however, some question this interpretation arguing that the obsidian tools are intrusions from the Neolithic levels above (Kaczanowska and Kozlowski 2008; Phoca-Cosmetatou 2011:80; Simmons 2014:127). There are also Paleolithic claims for Alonnisos. A survey found 14 sites with some 4,000 artifacts, dated to the Middle Paleolithic, some of which were associated with paleosol contexts (Runnels 2014a:217).

For the Cycladic islands, Melos is particularly important as it provides some of the most concrete evidence for early seafaring for this island chain, dating to at least 13,000
B.P (Figure 4.1). There are some claims for Lower and Middle Paleolithic material on the island; however, this is not widely accepted (Simmons 2014:117). Tournoukis and Karkanas (2012:3) note that the material were surface finds with no demonstrable association with a secure geological context. Their assessment is, thus, based on typological considerations and cannot be verified by radiometric dating. Obsidian from the island appears on the mainland site of Franchthi cave in the Argolid among the raw materials represented in the lithic assemblage. A few pieces date to this time frame; however, by around 12,000-11,000 B.P. the amount of obsidian found at Franchthi increases to 3% of the total assemblage. Two possible routes have been deemed possible for this voyage. The first is a direct route, although the more hazardous of the two, from Franchthi to Melos, which involved a crossing of around 120 km. This distance would have been broken up into several increments of 20–35 km due to islets. A longer, indirect route could have been taken from Attica via hops through the western Cyclades, crossing sea-gaps of up to 15–20 km (Bednarik 1999a:560, 2003:46; Broodbank 2000:41, 2006:208–209, 2013:153; Broodbank and Strasser 1991:235; Cherry 1981:45, 1992:33, 2004:239–240; Demand 2011:1-3; Farr 2006:88; Laskaris et al. 2011; McGrail 2009:99; Phoca-Cosmetatou 2011:80; Simmons 2014:).

Evidence is also mounting from Naxos, where current investigations at Stelida by T. Carter have uncovered an assemblage described as Middle Paleolithic. This site would have been located roughly in the middle of Cycladia, discussed above. It includes sidescrapers, flakes, several large blades, discoidal and recurrent cores, denticulates, and marginally retouched flakes. Some were made with the Levallois technique (Runnels 2014a:217).
Recent excavations at Maroulas on Kythnos have also documented evidence of early seafaring, roughly contemporaneous with Franchthi Cave (Figure 4.1). Obsidian from Melos has been found on the island in relatively large quantities, around 30% of the total lithic assemblage. Cores were found, suggesting that the material was worked on at the site. Several circular or ellipsoid structures were also recovered as well as around 25 human burials, emphasizing some degree of permanent human occupation (Phoca-Cosmetatou 2011:80; Sampson et al. 2010; Simmons 2014:194-197). This site, along with Kerame I and possibly Cyclops Cave, demonstrate that there was some type of obsidian exchange network in place by at least the Epipaleolithic. It might explain the small amount of obsidian at Franchthi as it seems that the mainland site lay at the end of an obsidian transport route (Demand 2011:2-3).

The final evidence for an early hominin presence in the eastern Mediterranean comes from Gavdos. Excavations from the 1990s recovered chipped stone tools, all of local material, that are argued to date from the Lower Paleolithic through the Epipaleolithic (Kopaka and Matzanas 2009). There are three major problems with these data: identification is based only on morphological classification; the artifacts are all from open-air sites with no absolute dates; and the configuration of Gavdos and Crete are currently unknown. The latter point is important as there have not been studies on whether the two were connected during low sea level stands, particularly since the distance between them today is not substantial.
Evidence for seafaring comes relatively later in the Adriatic. The earliest evidence, thus far, dates to the Early Neolithic and is known from the Dalmatian Islands of Brač (Kopačina špilja) and possibly Korčula (Vela špilja) (Figure 4.2). As previously noted (Chapter 3), both are thought to have been either connected to the mainland or were separated from it only by small water gaps. Thus, sea voyages might not have actually taken place (Broodbank 2006:213; Farr 2010:181).

Palagruža has also yielded several ceramic sherds diagnostic of the Early Neolithic in the central Mediterranean (Figure 4.2). Stronger evidence comes from the Middle
Neolithic, which is related to the Liparian obsidian trade network (discussed below) (Dawson 2011:37; Forenbaher 2009:79; Forenbaher and Kaiser 2011). Interestingly, Palagruža was never colonized, partly due to its rugged terrain and limited arable land for agriculture (Farr 2010:184; Forenbaher and Kaiser 2011:99). Furthermore, it was a challenging island to reach. Farr (2006) calculated that at a speed of 2 knots (3.7 km/hr.), it would take between 24 and 60 hours just to reach Palagruža from Italy using paddled watercraft, depending on weather conditions (Farr 2006:95, 2010:186–187). As she notes, “The Sirocco wind regularly blows in the summer months with strong hot winds, whilst the Bora can blow from the northeast with fierce cold winds funneling down the Adriatic with speeds of up to 60 knots. Both of these winds bring bad weather and can last for several days at a time. For a small paddled vessel the risks would have been considerable (2006:95).” Even once the island became visible, paddling toward it actually causes the watercraft to drift off course. This is due to the currents, which reach up to 6 knots (Farr 2006:95).

Moving southeast from the Adriatic to the Ionian Sea, a total of six Middle Paleolithic sites have been found on Kefallinia and Zakynthos (Figure 4.2). Similar to other early sites discussed, there are issues with these sites, specifically all are open-air sites lacking absolute dates. Thus, identification is based solely on artifact typology based on comparisons with nearby mainland sites. An Epipaleolithic site has also been found on each of the islands, but both were also open-air sites. Only the site from Zakynthos yielded a radiocarbon date, which placed it in the Epipaleolithic for this region (ca. 7770 cal. B.P.) (Ferentinos et al 2012; Runnels 2014a:216).
Many claims of human occupation spanning much of the Paleolithic and onwards have been made for Sicily. Since it was not really an island between the LGM and Early Holocene, it will not be discussed (see Simmons 2013 for a summary and references). Evidence for an Epipaleolithic presence comes from the site of Grotta d’Oriente on the present-day island of Favignana in the Ègadi Island chain (Figure 4.2). While the island was likely connected to Sicily, which in turn was likely connected to the Italian mainland, the site is interesting in that genetic studies from 3 burials at the site reveal that the inhabitants originated from mainland groups on the Italian peninsula during the LGM. This
is perhaps not surprising. It was the first study to reveal these data, which means more broadly that at least some individuals from Sicily came from the Italian mainland. It remains to be determined whether this was by a land bridge or short sea voyage (Mannino et al. 2012; Simmons 2013:194).

Lipari, an Aeolian island, has well-documented evidence for human exploitation of obsidian; however, it does not occur until the Middle Neolithic (Figure 4.2). Although outside the scope of this thesis, it is important to recall that this obsidian was found on Palagruža. As previously stated, this island was incorporated into the obsidian trade network, enabling obsidian to move from Lipari throughout the Adriatic during the Neolithic. The entire length of such a crossing was around 185 km, emphasizing by this time frame that substantial sea voyages were possible (Castagnino Berlinghieri 2011; Farr 2006:86–87, 2010:184).

Western Mediterranean

Limited evidence for early seafaring is found in this region, specifically from Corsica and Sardinia. Until recently, the case for a Paleolithic human presence on either of these two islands was mired in controversy. Little has changed for Lower and Middle Paleolithic claims; however, excavations at Corbeddu Cave in eastern Sardinia have yielded a human phalanx associated with a cold-weather plant pollen indicative of the LGM. The underlying and overlying strata are dated to around 32,000 B.P. and 20,000 B.P., respectively (Klein Hofmeijer 1997:18-20; Sondaar et al. 1995). This lends some credence to the notion that humans might have reached Corsardinia around the LGM (Broodbank 2013:128), but this claim is not unanimously agreed upon in part because it is largely based on a single human bone (Cherry 1992:31; Simmons 2014:123). The site also
perhaps has an Epipaleolithic occupation, based on scattered human remains, butchered and burnt faunal remains, and evidence for the construction of a well (Simmons 2014:125-126; Sondaar and Spoor 1989; Spoor and Sondaar 1986). Even this claim, however, is questioned due to the challenges of ruling out that this was part of the Neolithic layer (Simmons 2014:125). The evidence from Corbeddu might be bolstered by a find from Santa Maria is Acquas, located in the southern part of Sardinia, where bladelets and blades were recovered in a stratified aeolian context dating to around the LGM (Melis and Mussi 2002; Mussi and Melis 2002; Simmons 2014:123). Unfortunately, very little information is published. More robust data comes from both islands dating to the Epipaleolithic in the form of multiple sites with absolute dates. The largest of these sites, which has produced the most data, is Monte Leone. It is a rock shelter on Corsica, dating to the tenth millennium cal B.P. (Simmons 2014:126).

In sum, we are steadily gaining more and more substantial indirect evidence, which documents early seafaring long before we have watercraft remains. There are of course numerous issues with many of these sites, as briefly mentioned, which will be discussed below because they are key to determining whether people began seafaring in the Mediterranean by at least the Pre-Neolithic. This gap in physical remains is equally important and still raises numerous questions: what types of vessels were first used?; what were their construction techniques?; what tool technology was used?; who were the earliest seafarers?; what problems did they encounter?; and how did they maximize their survival rates? Conclusive answers to these questions will likely always remain out of reach; however, experimental studies allow us to test some of these questions, forming and/or
discarding hypotheses. Two experimental studies are discussed below: one by Robert Bednarik and the other by Harry Tzalas.

**Experimental Studies in the Mediterranean**

Bednarik established the First Mariners Project to use replication experiments to determine the practical limits of sea crossings. He notes that, “such experiments cannot produce true replicas, but by using in the construction of such watercraft the materials and tools available at the time and in the region, the range of possibilities is narrowed down very considerably…” (2011:95; Figure 4.3).

Figure 4.3. First Mariner’s experimental raft at sea. (*Courtesy of R.G. Bednarik*).

The ultimate goal was not to establish at what technological level a crossing would fail; but how it would succeed. Since 1996, the project has thus far constructed eight seagoing vessels, six in Indonesia and two in Morocco; the latter two will be discussed below (Bednarik 2003:50, 2011:95–96)
As briefly mentioned in Chapter 3, there is much contention over whether hominins could have made the journey from North Africa to Gibraltar using watercraft technology. The First Mariners experimental study, undertaken in September and October of 1999, was the first of its kind in this area. It examined both the maritime conditions and the availability of local materials that might have been of interest to people in the Lower Paleolithic (Bednarik 2001:18). Bednarik emphasizes that the point was not to prove whether such a voyage could have taken place: “As a scientist I do not ‘prove’ hypotheses, I test refutable propositions by seeking to falsify them, and I have no patience with archaeologists who, not understanding the scientific process, falsely assume that my work is confirmation inspired” (2001:13).

Two types of watercraft were constructed: one made from inflated animal skin and the other a pontoon raft constructed of cane (Bednarik 2001:18, 2011:98). Both were made at a sheltered beach on the northern coast of Morocco. Only stone tools were used for the experiments; modeled from Lower Paleolithic types from the Maghreb and southwestern Europe (Bednarik 2001:14, 2011:98).

The animal-skin raft was constructed of goatskin. It was obtained using traditional methods. A small incision was made below the knee of one of the hind legs directly after the animal is killed. The skin was then lifted away from the incision. Air was blown into the opening between the skin and the carcass, causing the skin to be inflated off of the carcass. This is similar to blowing up a balloon (2001:14–15; DiBenedetto and Simmons 2014c:90). The limb extremities and head were removed once all of the skin is free. From the initial incision below the knee, a line was cut to the other knee of the hind leg, enabling the carcass to be removed. This also produced two openings in the skin where the forelegs
were: one where the head was and the other across the rear (Bednarik 2001:15). The skin was then checked to see if there were any defects (e.g., small holes). If any were found, they needed to be sealed, which was achieved by applying a sealant, such as beeswax, and placing a small piece of cork or equally light material on it. The skin was then tied over this using cord-like material, including sinew (Bednarik 2001:15; DiBenedetto and Simmons 2014c:90). It was found that beeswax was inadequate. Vegetable or bitumen resin mixed with brain tissue or animal fats was more effective. Once all of the small holes were sealed, the openings at the back and forelegs were then sealed, allowing the skin to be turned inside out. In doing so, all of the sealants were moved onto the inside surface because the skin was passed through the opening at the neck (Bednarik 2001:15; DiBenedetto and Simmons 2014c:90). This was important because once the skin was inflated, the sealant would be pressed against the openings that they were supposed to close. The neck opening was then be tied. The skin was then placed underwater to see if any air bubbles escape. If this occurred, the whole process needed to be repeated again to seal the leaks (Bednarik 2001:15; DiBenedetto and Simmons 2014c:90). Once the skin was determined to be water proof, sealant was applied to the inside of the skin at the upper neck. String was then tied around (Bednarik 2001:15; DiBenedetto and Simmons 2014c:90).

The skin was cut using chert flakes once the sealant is dried. Those with thin edges were found to be high effective tools (2001:14). It was then attached to a frame constructed of cane; which, similar to the skin, was relatively easy to work with using stone tools. Bednarik (2001:15) noted that it takes only several seconds to cut a 30 mm piece. The most difficult part of the watercraft construction process was attaching the units (cane and skin)
securely into their intended positions so that they would maintain this position once actual weight (e.g., humans) was put on them. This ultimately pushes the craft underwater. The study determined that it takes roughly six goat-sized animal skins per human passenger. Inflated animal skins were likely among the most buoyant of all flotation devices available to hominins in the Pleistocene (Bednarik 2001:15); however, using the experiment’s calculations, it seemed like it would have been a costly device to construct.

The other craft was made entirely from cane, which grows along the Moroccan northern coast. The buoyancy of this material allows it to carry a load that is nearly equal to its own weight. Due to this property, it is superior as a raw material compared to most types of timber (Bednarik 2001:16). The experiment found that cane can be harvested with minimum effort using Lower Paleolithic stone tools. For example, a 40 cm diameter bundle of cane took less than 5 to 10 minutes to cut at its base using either a hand ax or a chopper. The leaves on the cane were not yet removed. They were actually easier to take off once dried. It takes 5 to 6 months for the cane to be cured to achieve maximum buoyancy. When green, it was actually too heavy to float well. The leaves were removed once the cane was cured. Bundles were then made from these stalks, which weighed and measured between 20 and 30 kg and 5 m long, respectively. Greens stalks were used to tie them together, since they were more flexible than when dried. These bindings were known as “split cane bindings,” and took considerable skill to make (Bednarik 2001:16–17; DiBenedetto and Simmons 2014c:91-92).

Four bundles, with a total diameter of 30 to 35 cm, were assembled to form a pontoon raft. The length and width of the watercraft was approximately 5 and 1.4 m, respectively. It weighed 120 kg. Two men assembled the vessel in under three hours from
already cut and cured cane. It was then launched by four men in calm water (Bednarik 2001:17; DiBenedetto and Simmons 2014c:92). Bednarik made the following observations:

Its draft of only 14 cm did not increase substantially after placing one man on board, but a doubling of the payload pushed the top of the vessel almost down to water level. A second sea trial, two days later, demonstrated the craft’s stability, even under quite turbulent conditions, despite its relative narrowness. A coastal swell, choppy sea and several collisions with rocks had no adverse effect, and it was clear that a broadening to, say, 2 m would result in a craft capable of withstanding all but the most extreme maritime conditions (2001:17–18).

It is important to note that both the animal skin raft and the cane raft were only tested at sea. A crossing from the North African coast to Spain was not attempted (Bednarik 2001:14, 2011:98). This study nevertheless demonstrated four key findings. The first was that the tool technology available to hominins in the Paleolithic was sufficient for constructing inflated animal-skin rafts and rafts made from cane. The second was that the raw material needed for these crafts’ construction would have been available as well. It was also demonstrated that the inflated animal-skin raft was more complex to make than the cane pontoon-like raft. This was particularly the case with the process that renders the skin airtight, implying it was culturally learned. A skin raft does offer a higher ratio of vessel weight to carrying capacity. This means that it could carry several people and be carried by one person. It would, however, have been more susceptible to a fatal mishap once in the water, particularly with rocks and marine creatures; as compared to the cane constructed raft. Finally, it was clear that proper sealants were a necessity to make the craft...
waterproof (Bednarik 2001:18–19; DiBenedetto and Simmons 2014c:92). Ultimately, Bednarik and the First Mariners Project did not prove whether or not hominins crossed the Strait of Gibraltar but demonstrated the feasibility of such a scenario occurring (Bednarik 1999b:281, 2001:19, 2011:95).

The second experimental study was conducted by Harry Tzalas in 1988 (1995), who created a reconstruction of a papyrella, briefly mentioned above. The goal was to use this reconstructed craft in a voyage from Melos to the Greek mainland. It was originally held that by the late twentieth century the papyrella was no longer constructed or used in Corfu. The only known examples had been made in the 1970s for museums both on Corfu and on the mainland. Tzalas and his colleagues, however, found what they considered to be the last papyrella still in use in Palaiokastritsa, a bay in northwestern Corfu. Its frame had been constructed in 1965. This discovery, along with the museum examples and ethnographic literature, enabled generalities to be made about this craft’s construction techniques. (DiBenedetto and Simmons 2014c:93; Tzalas 1995:442–443). The frame was made out of six young cypresses that were cut and bent while still green. At their thinnest points, they were bundled together by rope. They were then bent in such a way as to form a raised stern. The main portion of the papyrella was composed of bundles of papyrus. These were cut from the nearby Kavourolimni Lake. The bundles of papyrus were replaced every two to three years (DiBenedetto and Simmons 2014:93; Tzalas 1995:442–443). The length of the boat depended on the length of the papyrus, but could reach approximately 2.5 m. Rope was the only material used to keep the craft together. Nails, pegs, and other fastenings were neither used nor needed (DiBenedetto and Simmons 2014c:93; Tzalas 1995:442–443).
Local tradition referred to double-ended *papyrellas*. Two crafts were joined together stern to stern; however, Tzalas did not find clues as to how these crafts may have been joined. In spite of this, Tzalas decided to try to replicate this craft. In order to do so, he enlisted the help of several people, including the son of the last *papyrella* builder as well as the owner of the last *papyrella* in use. Construction of this craft took three full months, but Tzalas believes with the experience gained from this reconstruction, 12 days would be more than sufficient to build a similar craft (DiBenedetto and Simmons 2014:93; Tzalas 1995:444–445). Tzalas notes that the craft “…has a total length of 5.48 cm, the beam amidship is 1.50 metre. The thickness of the body averages 50 cm and the height of the bulwark bundles is of 13 cm…” (1995:445). It seems, however, that the length should be 5.48 m rather than 5.48 cm. Twelve young cypress trees were used in the double-ended craft’s construction (Tzalas 1995:445).

Before embarking on the voyage, Tzalas tested several crews. The first crew consisted of non-seafarers. They were all young, strong men, but lacked previous knowledge of rowing or paddling. After paddling a distance of some 2 km, they quickly became exhausted (Tzalas 1995:447). The experiment then switched to using well-trained, physically fit seafarers. This improved performance; however, it became apparent that to propel such a craft required special training. As a result, Tzalas ultimately looked for “kayak” athletes for the crew. Once this crew was formed, 12 short sea trials were performed during the summer of 1988 in the Lavrion area. This allowed the crew to gain experience moving the craft under varying weather conditions and with different wind forces coming from different directions (Tzalas 1995:448–449).
The voyage started in early October of 1988, taking advantage of the calmer seas during this season. The crew consisted of four paddlers and one steersman. Occasionally, there would be an additional paddler. The craft was stable and buoyant, easily accommodating the crew as well as around 30 kg of fresh water and food provisions. It was paddled via the Western Cyclades from Lavrion in Attica, southeast of Athens, to Melos. Lavrion was chosen as the departure point because it is the nearest mainland to Melos. The craft was ultimately paddled over a total distance of some 134 km for 51 hours and 45 minutes. It was found that a modern-built reed raft at sea in fair conditions could be paddled for some distance at 1 to 2 knots, with an average speed of 1.65 knots per hour. In fact, Tzalas determined that 1 knot was the minimum speed required in order to complete the voyage to Melos (DiBenedetto and Simmons 2014c:94; Farr 2010:183; McGrail 2009:103, 105, fig. 4.8, 2010:102; Tzalas 1995:446–448, 451, 453).

It took eight days to cover the distance, though in fact it was really only seven since paddling only occurred for 1.5 hours on the first day due to bad weather. This forced the craft to remain in Seriphos for eight days. The craft encountered different weather conditions throughout its journey: from flat calm to 5 to 6 on the Beaufort Scale, with the height of the waves in some cases rising to 1.2 to 1.5 m. The predominant wind was north–northeast. There was also a northeast current, which often caused the craft to drift off course. Besides the final day when it rained, the voyage was mostly made in clear and warm weather. The craft was usually only paddled in the daytime (DiBenedetto and Simmons 2014c:94; Tzalas 1995:453).

The crew, during the voyage, was equipped with electronic sensors, which recorded heart performance. After each day, they underwent a medical examination, including a
check on their blood pressure, heart activity, and general physical condition. This enabled specialists to determine that only approximately 50% to 60% of a crew member’s physical capability was used (DiBenedetto and Simmons 2014c:94; Tzalas 1995:454). This experiment provides interesting insight into the human behavior that would have been involved in these early seafaring exploits. Similar to Tzalas and his crew, early seafarers would have had to pay attention to the weather, amount of daylight remaining, sea conditions, and other crew members. It also seems to support the idea that seafaring must have been conducted by true specialists, due to the arduous nature and length of these crossings. This most likely carried a great deal of social prestige (DiBenedetto and Simmons 2014c:94; Farr 2006; Tzalas 1995:450).

Both of these experimental studies illustrate the valuable and useful information that can be gained from replicative studies. In particular, both demonstrated that an adequate tool technology, raw material availability and accessibility, and an understanding of maritime conditions are all critical for the successful performance of both the craft and crew. As has been stressed throughout this section, these studies do not prove a particular scenario; rather, both demonstrate the minimum circumstances that were necessary for early seafaring to have been both possible and ultimately successful (DiBenedetto and Simmons 2014c:94).

Missing (Invisible?) Archaeological Sites: The Problems of Documenting Early Seafaring in the Mediterranean

It seems highly likely, based largely on the experimental studies of Bednarik and Tzalas, that people during the Paleolithic were able to make some type of sea-worthy craft given that they had the technology as well as natural resources critical for their construction
accessible to them. The availability of knowledge for watercraft construction does not equate to whether sea voyages were actually attempted. As discussed above, there are Paleolithic claims from several islands throughout the basin, potentially supporting early seafaring activities, and include: Youra, Ikaria, Melos, Kythnos, Gavdos, Kefallinia, Zakynthos, Corsica, and Sardinia. The majority, however, consist of open-air sites in poor geological context with small collections of poorly dated lithic artifacts. These stone tools are often crude-looking and could actually represent geofacts, which are not human-made. The identification of these tools as Paleolithic is based on typological comparisons with the nearby mainland where assemblages are in stratified and dated deposits (Runnels 2014a:214). Such comparisons might not be best given the seemingly more expedient nature of many of the lithic artifacts on islands as compared to the mainland, which introduces biases against the former representing early human visitation. These sites also often lack association between the lithic artifacts and Pleistocene faunal remains (Runnels 2014a:214). It is for these reasons that many scholars, such as Cherry (1981; 1990) and Broodbank (2006; 2013), still question whether there were Paleolithic seafarers in the Mediterranean.

Should these challenges with documenting sites in stratified geological contexts with artifacts and faunal remains, some of which are dateable, equate to lack of evidence for a Pre-Neolithic presence on the islands? The answer is simple: No! Part of the problem is in fact due to the nature of pre-Neolithic people, who were typically not fully sedentary; in part explaining the ephemerality of their remains. This is complicated by the fact that Mediterranean island archaeologists have only recently begun investigating these earlier periods. Greater scholarly focus was given to sites dating from Classical antiquity and
onwards, which are often archaeologically more visible. This research was in fact the
dominant paradigm for nearly a century. The Mediterranean islands were one of the
world’s first major island groups to be explored by archaeologists. Recent on most other
groups began after World War II. For example, Sir Arthur Evans began the first season of
excavations at Knossos, Crete, which essentially established a new field of Minoan
archaeology, in 1900. While focuses, such as Sir Arthur Evans’, contributed greatly to our
understanding of the more recent past for Mediterranean islands, it has hindered our
understanding of earlier periods. An increasing number of archaeologists, however, have
begun working in the Pre- and Early Neolithic periods. Many are trained in “small site
archaeology,” which has increased the number of site findings; as attested by the data
provided above (Cherry 2004:235-236; DiBenedetto and Simmons 2014c:99-100).

Adding to this research bias, is the reality that there are also personal biases when
dealing with early hominin behavior and seafaring capabilities. It is still widely held that
our species, Homo sapiens sapiens, were the only hominin capable of such a feat (Phoca-
Cosmetatou and Rabett 2014:256). While evidence suggesting otherwise is still relatively
weak in the Mediterranean, the same cannot be said for other parts of the world (see
Chapter 1). Thus, it is perhaps time for archaeologists to remove their blinders when it
comes to the uniqueness of our own species.

Scholars are slowly coming to recognize that there will most likely never be a
robust dataset for a Pre-Neolithic presence on the Mediterranean islands due to a
combination of these early inhabitants’ lifestyle as well as long-term human use of many
of the islands; the latter which has most likely destroyed more substantial evidence. Thus,
it is clear that our research designs needs to change to accommodate the challenges
associated with small-site archaeology. This point was made by Simmons (1999) and Knapp (2013:43-48) for Cyprus. Research designs will need to differ from other surface surveys for later periods where sites have a more dense concentration of material. In contrast to architecture and some ceramics, which are more visible, lithic scatters can be more challenging to recognize, particularly when the material occurs in less obvious locations (e.g., ravines or isolated geological deposits) (Runnels 2014a:222-223).

Ultimately, these Pre-Neolithic claims, while not yet proving an early human presence on the Mediterranean islands, are demonstrating that a pattern is emerging. By the Early Neolithic, many of these same islands and others, such as those in the Adriatic, have substantial evidence for a human presence. These data bolster the notion that humans have been conducting sea voyages prior to the Early Neolithic.

More substantial evidence for Pre-Neolithic (as well as Early Neolithic) seafaring comes from two islands that have not yet been discussed: Cyprus and Crete. These will provide the subject matter for the ensuing chapter.
CHAPTER 5
EVIDENCE FOR AN EARLY HUMAN PRESENCE ON THE MEDITERRANEAN ISLANDS OF CYPRUS AND CRETE

The spread of the Neolithic from mainland Southwest Asia throughout the Mediterranean Basin, in particular the role played by Mediterranean islands in this process, is still debated. Discussion in Chapter 2, however, demonstrates that ancient DNA analysis, amongst other lines of evidence, is suggesting that people might have used some of the islands (i.e., Cyprus and Crete) as a staging point to travel to other parts of the basin (Fernández et al. 2014). Part of this controversy is that many of the islands were thought to have been relatively late recipients of a substantial human presence that first occurred late in the Neolithic, around 9000 cal B.P. (Simmons 2009b, 2011, 2012b, 2013b). Recent research on several of the Mediterranean islands, as discussed in Chapter 4, has changed this view pushing the date back for the first arrival of humans to at least the Late Paleolithic. There are still controversies surrounding many of these early sites (see Chapter 4); however, archaeological excavations from two islands not yet discussed, that of Cyprus and Crete, have much stronger evidence for an early human presence by at least the Epipaleolithic, around 12,000 years ago, if not earlier (Simmons 2014). These islands were both oceanic since at least the Miocene, implying that some type of watercraft technology was needed to reach them. Both of the islands also have the earliest Neolithic presence as compared to other Mediterranean islands. This suggests that people colonizing the islands in the Early Neolithic came into contact with inhabitants that were already on the island. At the very minimum, the earliest colonizers of both islands in the Early Neolithic had contact with people who had visited the islands in the Epipaleolithic to exploit resources.
This is particularly the case for Cyprus where the archaeological data for both Epipaleolithic and Early Neolithic presences are more substantial (Horwitz 2013; Peltenburg et al. 2000; Simmons 1998, 1999, 2009a, 2009b, 2012a; Strasser et al. 2010, 2011; Tomkins 2008; Tomkins et al. 2004). This chapter will examine the early human presence for both Cyprus and Crete, demonstrating several points: 1) the reasons why there are stronger cases for at least a Paleolithic presence on both islands; 2) the need to understand variation in the adoption of the Neolithic on the Mediterranean islands, something which is still not done today in contrast to the mainland; and 3) the need to have a greater understanding for how people on Cyprus and Crete during both the Pre- and Early Neolithic moved around the landscape.

**A Brief Note on Chronology**

Before delving into the archaeological evidence for both islands that support both a Pre- and Early Neolithic presence, it is first important to briefly discuss the chronological framework that will be used particularly since cultural periods for the two islands do not have the same date ranges or names. On Cyprus, the Epipaleolithic presently consists of a late phase which dates from 12,950-10,950 cal B.P. The Early Neolithic is divided into three phases, all of which lack pottery: the Cypro-Pre-Pottery Neolithic A (PPNA), the Cypro-Pre-Pottery Neolithic B (PPNB) and the Khirokitia Culture. The Cypro-PPNA is from 10,950 to 10,450/10,350 cal B.P., the Cypro-PPNB extends from 10,450/10,350 to 8,950/8,750 cal B.P., and the Khirokitia Culture is from 8,950/8,750 to 7,150 cal B.P. Thus, the early Aceramic Neolithic spans approximately four thousand years (10,950-7150 cal B.P.). Although my discussion will mostly focus on this time frame, the Ceramic Neolithic, also known as the Sotira Culture, (7,150/6,950-6,450/5,950 cal B.P.) and the Chalcolithic
(5,950/5,850-4,450/4,350 cal B.P.) will all also be mentioned since these dates correspond to the Neolithic on Crete (see discussion below; Knapp 2013: 27, Table 2; Table 5.1).

Table 5.1. Chronology of Prehistoric Cyprus. (Adapted from Knapp 2013: 27, Table 2)

<table>
<thead>
<tr>
<th>Periods</th>
<th>Cultural Phase</th>
<th>Dates Cal B.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Epipaleolithic</td>
<td>Akrotiri phase</td>
<td>12,950-10,950</td>
</tr>
<tr>
<td>Early Aceramic Neolithic</td>
<td>Cypro-Pre-Pottery Neolithic A (PPNA)</td>
<td>10,950-10,450/10,350</td>
</tr>
<tr>
<td></td>
<td>Cypro-Pre-Pottery Neolithic B</td>
<td>10,450/10,350-8,950/8,750</td>
</tr>
<tr>
<td>Late Aceramic Neolithic</td>
<td>Khirokitia Culture</td>
<td>8,950/8,750-7,150</td>
</tr>
<tr>
<td>Ceramic Neolithic</td>
<td>Sotira Culture</td>
<td>7,150/6,950-6,450/5,950</td>
</tr>
<tr>
<td>Chalcolithic</td>
<td></td>
<td>5,950/5,850-4,450/4,350</td>
</tr>
</tbody>
</table>

On Crete, absolute dates for the Epipaleolithic are not as well established as on Cyprus, in part because these are cave and surface sites with limited excavations. As a result, the sites based on material remains are tentatively dated to the Early Holocene around 9,000-11,000 years ago (Simmons 2014; Strasser et al. 2010). The Neolithic period is divided into five phases: Initial (8,950-8,450/8,350 cal B.P.), Early (8,450/8,350-7,850 cal B.P.), Middle (7,850-7,250 cal B.P.), Late (7,250-6,450/6,350 cal B.P.) and Final (6,450/6,350-4,950 cal B.P.). The Initial Neolithic is the only Aceramic phase. The Neolithic on Crete, thus, spans roughly four thousand years (8,950-4,950 cal B.P.). (Tomkins 2008: 22, Table 3.1; Table 5.2). It is important to note that this chronological division is really based only on one site: Knossos. While there are several other Neolithic sites, they are currently not as well published or as fully excavated as Knossos, which will be discussed in more detail below. In sum, the Epipaleolithic and the Neolithic begin.
approximately one thousand and two thousand years respectively after the corresponding periods on Cyprus.

Table 5.2. Chronology of Prehistoric Crete. (*Adapted from Tomkins 2008:22, Table 3.1*).

<table>
<thead>
<tr>
<th>Periods</th>
<th>Dates Cal B.P. (unless otherwise specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesolithic</td>
<td>9,000-11,000 years ago (?)</td>
</tr>
<tr>
<td>Initial</td>
<td>8,950-8,450/8,350</td>
</tr>
<tr>
<td>Early</td>
<td>8,450/8,350-7,850</td>
</tr>
<tr>
<td>Middle</td>
<td>7,850-7,250</td>
</tr>
<tr>
<td>Late</td>
<td>7,250-6,450/6,350</td>
</tr>
<tr>
<td>Final</td>
<td>6,450/6,350-4,950</td>
</tr>
</tbody>
</table>

Documenting an Early Human Presence on Cyprus: The Archaeological Evidence

*The Epipaleolithic*

Figure 5.1. The Epipaleolithic of Cyprus. (*Map courtesy of Levi Keach*).
There is currently one definitive site that dates to the Epipaleolithic, that of Akrotiri Aetokremnos (Vulture’s Cliff) or Site E. There are three other possible contenders: Nissi Beach, Akamas Aspros, and Vretsia Roudias, all of which will be discussed (Figure 5.1). A brief note must be given to the naming convention for sites on Cyprus. Sites generally have two names: the first refers to the closest village and the second, which is always italicized, refers to the actual site and is usually based on a local feature or toponym (Simmons 2014:12). Sites are usually called by the second name once both the first and second name are introduced; thus, Akrotiri Aetokremnos will be hereafter known as Aetokremnos.

Aetokremnos was first found by David Nixon in 1961, the son of a British Royal Air Force (RAF) serviceman who was stationed on the base on the Akrotiri Peninsula, the southernmost part of the island. He recovered several bones and a few chipped stone artifacts and noted the site’s location, referring to it as ‘Site E.’ He took the material back with him to Great Britain and brought them to the British Natural History Museum in London. The late Kenneth P. Oakley looked at them and surmised that the chipped stone was human-made and appeared ‘Neolithic’ in origin. He also identified the bones as coming from the Cypriot endemic pygmy hippopotamus (Phanourios minutus); now extinct. Over 30 paleontological sites have been documented on the island, many of which include both pygmy hippopotamus and pygmy elephant (Elephas cypriotis) remains. They have never been found in association with cultural materials; which is ultimately why Aetokremnos is controversial (discussed below). The site ultimately lay forgotten for another twenty years, until an amateur archaeologist and British flight lieutenant, Brian Pile, conducted a survey of portions of the peninsula. He rediscovered the site and
interestingly as named it “Site E.” Local officials contacted several archaeologists and ultimately, it was realized that the site had a lot of potential for rewriting the prehistory of Cyprus and the broader Mediterranean for the time (Simmons 2011:58-59, 2014:133-135).

Figure 5.2. Overview of Akrotiri. (Courtesy of Dr. Alan Simmons).

The site is now a collapsed rockshelter presently located about 60 m above the Mediterranean Sea (Figure 5.2). There is some debate over whether or not the Akrotiri Peninsula would have been an island during the time of the site’s occupation. It is agreed upon that at times in the past when there were lower sea levels this would have been the case; however, paleogeography studies for the peninsula are relatively rare. If there was a separation, it would have been minimal, particularly since sea level was rising by the time of the site’s occupation (Knapp 2013:52; Simmons 1999:329, 2013b:142, 2014:133). Stanley-Price (1979:8-9) argues that the peninsula may have been “…no more than a
shallow gulf between the mainland and the offshore island of Cape Gata” until the Roman period, when the gulf was filled in by silt. Ultimately, a consensus has not yet been reached on this issue, illustrating more geomorphological studies need to be conducted (Simmons 2014:133).

Four seasons of excavation were conducted at the site: three between 1987 and 1990 and the final one in 2009. These all demonstrated that the rockshelter had substantial in situ deposits, about a meter in-depth. In fact, the rockshelter, which was approximately 50 m², and the cultural deposits were sealed by the collapsed rock debris over the millennia. In spite of this, the site has remained controversial since its discovery in the 1980s due to the excavator, Dr. Simmons and colleagues, arguing for evidence of human-induced extinction of the pygmy hippopotamus (e.g., Simmons 1998, 1999, 2009b, 2013b, 2014:138); a point which will be returned to below. Four strata have been identified. From most recent to earliest, they are: Stratum 1, Stratum 2, Stratum 3, and Stratum 4. Stratum 1 is comprised of mixed content, since it is located at the top of the strata. Stratum 3 is a sterile layer of windblown sand and limestone. It separates Stratum 2 from Stratum 4 and it is 15-30 cm thick across most of the site. Towards the back and front of the shelter, however, it is much thinner or absent entirely (Knapp 2013:52; Simmons 1999, 2013b:147). Thus, the greatest attention is given to Strata 2 and 4 due to the presence of cultural material and faunal remains in association with one another. Stratum 2 ranges in thickness from 10-50 cm. (Knapp 2013:52; Simmons 1999, 2013b:145, 147). Stratum 4 is 10-50 cm thick and is found throughout most of the interior of the rockshelter (Knapp 2013:52; Simmons 1999, 2013b:147).
Material culture recovered from the site includes a formal chipped stone assemblage (total is 1,021), dominated by thumbnail scrapers. Stratigraphically, the majority of the assemblage (61.5%) occurred in Stratum 2, with 11.8% in Stratum 4 (Knapp 2013:52; Simmons 1998:233, 1999:126, 2009b:179, 2014:138-139). The raw materials for the assemblage are all locally available, pointing to an expedient technology. Ground stone pebbles, fragmentary cobbles, and four complete cobbles showing slight use-wear were also recovered (Swiny in Simmons 1999:146-149). Other artifacts included a piece of worked bone, a fragmentary, pierced, and incised calcarenite disk, over 100 shell beads, and six worked picrolite objects (Reese in Simmons 1999:149-151, 188-191; Simmons 2014:138-139). Eleven features were also recovered, of which 8 were found in Stratum 2 and the remaining 3 in Stratum 4. These mostly comprised of burned bone concentrations (Simmons 2014:139).

A huge and well-preserved faunal assemblage was also recovered with over 222,000 bones; the majority of which came from the remains of the indigenous pygmy hippopotami (98.3%). In fact, the minimum number of individuals estimated at the site is at least 505. Other faunal remains included: 3 pygmy elephants, over 70 birds, in particular great bustards, and over 70,000 fragments of shell. The latter represented over 21,000 individuals. Curiously, given the sites location next to the Mediterranean Sea, only one fish bone (a gray mullet) was recovered, implying that only some marine resources (e.g., shell) were relied upon (Simmons 2014:138). Eighteen pieces of wild boar (*Sus scrofa*) remains have also been recovered (Simmons 2014:138; Vigne et al. 2009), which are particularly interesting to the question of animal transportation using watercraft technology and will be discussed in greater detail below. Stratigraphically, the majority of the pygmy hippopotami
(88.1%) were recovered from Stratum 4, with only 4,000 bones found in Stratum 2 (1.8%). There is a clear shift between Stratum 4 and Stratum 2 in regards to subsistence acquisition. In Stratum 4, the primary focus is on the pygmy hippopotami; but by Stratum 2, the focus is on marine shells and avifauna (Simmons 2014:139). This, in combination with the differences in cultural material between the two strata, is at the heart of contention over the site: are the two strata close to one another in time and does the evidence support a human-induced extinction of the pygmy hippopotami; thus, supporting Simmons’ findings (Simmons 1999, 2014:141-153).

Opponents argue that the dates for Stratum 4 in particular are from C-14 dates run in the 1990s, which have large measurement errors; thus, they should be ruled out (Ammerman 2013a:21). The logic behind this argument is first and foremost quite foolhardy given that it implies that all C-14 dating conducted in the prior to the 2000s, when AMS dating was introduced, should be ignored (Simmons 2014:146). Furthermore, the site has been extensively dated, including using more refined and recent methods. A total of thirty-six radiocarbon determinants from the site have been used, which come from a variety of sources including: pygmy hippo bone, wild boar bone, shell, sediment, and charcoal; the latter is of course the most reliable material (Simmons 2014:146). Of these 36, 9 are on pygmy hippopotamus bone, 4 are on wild boar bone, 10 are each on shell and charcoal, and 3 are on sediment. Three of the hippo bone were discarded given that they were surface finds and less reliable than the in situ material; thus, there are a total of 33 determinants (Simmons 2014:146). Most cluster around 11,775 cal B.P. with a range of 11,652-11,955 cal B.P. Thus, it appears that the site was occupied for around 300 years. There is some contention over the original 9 dates for the site, all of which came from
pygmy hippopotamus bone, and represented a much wider range of dates. Critics argue that these bone dates are unreliable and that Stratum 4 is significantly older than Stratum 2 (Ammerman and Noller 2005:539-540). Interestingly, however, the bone revealed younger dates, rather than substantially older ones. If the dates had indeed been older, it would have been easier to argue that the two strata are not related. In this case, Stratum 4 would have represented a separate event that occurred prior to human arrival on Cyprus (Simmons 1999, 2009b:179, 182, 2013b:147-148, 2014:146).

Recently, however, Simmons attempted to date additional bone samples, including 11 pygmy hippopotamus, 2 elephant, and 9 bird, using the more precise refinements in the radiocarbon process. The bone samples did not, unfortunately, yield any radiocarbon dates, but a charcoal sample was successful. It was from Stratum 2 and was precisely where it should have been at 12,135 cal B.P. Four other samples were taken on pig and yielded 4 ages. Two of these were rejected due to contamination, and the remaining two exhibited a range of 11,700-11,400 cal B.P. at two standard deviations (Simmons 2013b:149; Vigne et al. 2009). Ultimately, it has not yet been shown that the pygmy hippopotamus bones found in Stratum 4 are significantly older than Stratum 2, implying that humans were responsible for the disappearance of the animals. This idea is further supported by the fact that the pygmy hippo remains are associated with cultural material, including chipped stone and hearths. It is also important that as the size of the population of hippos’ decreases, human occupants at the site changed their subsistence focus (Simmons 2013b:148, 2014:146).

Regardless of whether one wants to continue to argue against a human role in the disappearance of the pygmy hippopotamus from Cyprus, Aetokremos clearly supports a human presence on Cyprus by the Epipaleolithic; which in fact, many critics agree with.
The final point of interest in regards to this site is the possible presence of wild boar. Eighteen bones have been recovered and include one incisor and 17 metapodials and phalanges. These remains initially do not support the notion that the entire animal was brought to the island; however, an osteometric study concluded that these bones are 10 to 20 percent smaller than roughly contemporary wild boars found on the Levantine mainland. They are also significantly smaller than the PPNB domestic suids from Anatolia and the Levant. Their size is most similar to the small domestic Pottery Neolithic pigs from the Upper Euphrates valley (Vigne 2013; Vigne et al. 2009, 2011, 2013). The bones were directly radiocarbon dated and found to be contemporary with site occupation. This combined with the osteometric study implies that by at least the 12th millennium BP there was considerable watercraft technology and knowledge to transport animals, since there is no evidence of wild boar in the Cypriot Pleistocene fauna record (Simmons 2014). Furthermore, these animals were brought to Cyprus some twenty centuries prior to the earliest evidence of their domestication on the mainland, illustrating that humans had significant control over certain animals thousands of years before their domestication (Vigne 2013; Vigne et al. 2009, 2011, 2013). A key question raised by these data is how the animals were transported.

As noted above, wild boar are not endemic to the island. In fact, there are thought to only be a handful of species that successfully crossed the sea between the mainlands and Cyprus before the Holocene. These are considered ‘endemic’ to the island and are: the pygmy hippopotami, the dwarf elephant, two types of mouse (murid), and a shrew (soricid) (Steel 2004:5). All other animals discussed in the thesis are, thus, brought to the island by humans.
Besides *Aetokremnos*, two other possible Epipaleolithic sites include Nissi Beach and Akamas *Aspros* (Figure 5.1), both located on aeolianite formations (fossilized sand dunes) on the coastlines (Figures 5.3, 5.4). The former is west of Agia Napa on the southeast coast of the island and the latter is on the Akamas peninsula along the central west coast. Both sites would have been farther from the shoreline than today given that sea level was still around 70 m below present levels. This is supported by the fact that part of *Aspros* now currently lies underwater. Both sites are adjacent to sandy beaches where drainage or a river reaches the coast; thus, Albert Ammerman, the primary excavator of the site, argues that they would have provided landing spots for the early inhabitants. It is hard to see this today, given that the entire area of at least *Aspros* comprises the aeolianite formation; which would have been rough to both walk on and land some type of watercraft (Figure 5.4). The sites also do not appear to have been suitable for a winter occupation given that they would have been exposed to the strong, cold winds from the Mediterranean (Ammerman 2010:86, 2011:36-37; Ammerman et al. 2006, 2007, 2008; Knapp 2013:60; Simmons 2014:162).

Figure 5.3. Overview of *Aspros*. Figure 5.4. Aeolianite formations near *Aspros*.
Excavations at both sites have recovered chipped stone artifacts, seashells, avifauna remains, hand stones, and ground stone. The lithic specialist for the site, Carole McCartney, argues that the chipped stone assemblage is similar to those from Stratum 2 at Aetokremnos. At all three sites, however, the raw material used and the tool type frequency all differ. For example, the number of tools at Nissi Beach (316) and Aspros (288) outnumber those found at Aetokremnos (128). It is important to note, however, that almost all of the raw material was locally available. The one exception comes from Nissi Beach, where a small piece of obsidian, not native to Cyprus, was recovered (Ammerman 2011:37; Ammerman et al. 2006:11-17; Ammerman et al. 2007:5-6; Ammerman et al. 2008:25-26, Table 8; Knapp 2013:60; Simmons 2014:163-164, Table 7.1). Thus, the inhabitants of the sites were either familiar enough with the surrounding land to exploit local raw material sources or interacting with individuals who were familiar with the island’s resources. While there are differences between the assemblages, they all reveal a broad homogenous flake-based and microlithic tradition of tool production (Ammerman 2011:37; Ammerman et al. 2008:24-26; Knapp 2013:61; Simmons 1999:137-138, 2014:164, Table 7.1). This tradition differs substantially from the blade-oriented tradition that is typical of sites of the subsequent Early Aceramic Neolithic. Thumbnail scrapers were also found at Nissi Beach and Aspros and appear to be very similar to those from Aetokremnos (Knapp 2013:61; Simmons 1999:245-246, 2014: Table 7.1).

While the chipped stone assemblage is suggestive of an Epipaleolithic date for both Aspros and Nissi Beach, the issue comes with the absolute dates. Two marine shells from Nissi Beach have produced AMS dates that fall around the tenth millennium cal B.P. or
the Cypro-Pre-Pottery Neolithic B (PPNB); substantially later than the Late Epipaleolithic. Interestingly, the presence of the obsidian piece might support this PPNB date given that obsidian is not found at either *Aetokremnos* or *Aspros*. Furthermore, several long blades were also recovered from the site, which also supports a PPNB occupation (Ammerman et al. 2008:15; Knapp 2013:61; Simmons 2014:164). The excavators propose that the reason behind this phenomena is that the material excavated at Nissi Beach represents a stratigraphic inversion, meaning that in situ sub-surface remains have a younger date than the chipped stone collected from the surface, which is characteristic of an Epipaleolithic assemblage. This stratigraphic inversion is argued to be the result of tsunamis. The large tsunami blocks near the site and the scattered presence of small pieces of dark-colored beach rock, perhaps support this notion (Ammerman 2013b:127-129; Ammerman et al. 2008:15; Knapp 2013:61). Ammerman and colleagues ultimately argue that the material collected from the surface of the site are not in their primary context, but instead are derived from a submerged area in front of the excavated part of the site (Ammerman 2013b:127; Ammerman et al. 2008:15). It is important to note, however, that cultural material was not recovered from underwater surveys surrounding Nissi Beach (Simmons 2014:165); thus, raising the question of whether there actually was material underwater that was moved over time to the surface.

Absolute dates for *Aspros* are currently lacking. Ammerman and colleagues argue, however, for a similar situation as at Nissi Beach, since material was recovered from underwater reconnaissance at depths of 6-15 m below current sea stands. This material was at distances of 50-200 m off the present coastline and includes 38 pieces of chipped stone and 2 possible ground stone tools (Ammerman et al. 2008:18-19; Knapp 2013:62).
Simmons proposes that instead of the underwater material representing tsunami activity, they simply represent erosion from the surface; particularly as there is limited evidence of this phenomena at the site (2014:165). There are clearly issues with both sites, in particular surrounding the absolute dates (or lack of); however, if indeed both sites were occupied during the Epipaleolithic, then the data suggest that similar to Akrotiri, they were seasonal occupations (Ammerman 2011:38). Ammerman (2010:88) proposes that a natural resource that might have been highly sought after by the sites’ inhabitants, particularly if they were occupied during the summer, was salt. It would have been available right along the coastline bordering the sites. In fact, today patches of salt can be observed at Aspros in the small irregular depressions of the aeolianite. While aeolianite formations are not unique to Cyprus, as they are found throughout the Mediterranean Basin, they are apparently more prominent on the island than elsewhere (Knapp 2013:60). Whether or not this attracted the early inhabitants is of course not currently answerable given the available data. Continued investigations at both sites will hopefully provide more substantial data for AMS dating, better stratigraphic context, and more in situ material.

In contrast to Aetokremnos, Aspros, and Nissi Beach, the final site on Cyprus with a possible Epipaleolithic human presence is Roudias, located in the foothills of the Troodos Mountains (Figure 5.1). It is an ongoing investigation by Nikos Efstratiou and his team; thus only limited information has been published (e.g., Efstratiou et al. 2012). As a result, the following information will be summarized from Simmons (2014: 165-175) as he provides the most update summary on the site and includes material currently still unpublished. Initially, a small collection of surface chipped stone was analyzed by McCartney in 2008. She determined that it had some affinities with the assemblage from
Aetokremnos. The team returned to the site in 2009 and conducted extensive fieldwork, included systematic, gridded collection as well as excavation of two test units. Both resulted in the recovery of numerous pieces of chipped stone; which represents the main material culture found to date (Efstratiou et al. 2012; Simmons 2014:165-166). While the analysis of the lithic material is ongoing, McCartney suggests that two different industries are present: a Late Epipaleolithic one and an Early Neolithic one. The former are comparable with those from Aetokremnos. Similar to the other three Epipaleolithic sites, excluding the obsidian from Nissi Beach, the assemblage is made from locally available raw material. Tools were primarily made on flakes, although blades are also present, supporting the presence of an Early Neolithic tool industry (Efstratiou et al. 2012; Simmons 2014:166-167). Simmons (2014:167-175, Tables 7.1-7.3) compares the lithic material from all four sites and concludes that the material from Roudias is most similar to Aetokremnos than are the materials from Aspros and Nissi Beach.

The main issue with Roudias is that it lacks absolute, radiocarbon dates. Attempts have been made to date bone recovered from the site; unfortunately, these samples did not contain enough collagen to return any dates. Optically stimulated luminescence (OSL) has also be used, which indicates an 11th to 10th millennium B.C. date (Simmons 2014:167). It is hoped that ongoing excavations will clarify the chronology of the site, because currently all that can be concluded is that there is a lithic assemblage at Roudias that suggests a Late Epipaleolithic date, due to the parallels with that found at Aetokremnos. If indeed the site does date to this time period, it will be incredibly important given that it will be the only inland Epipaleolithic site. This implies that people had moved around the
island at far greater breadths than previously held (Efstratiou et al. 2012; Simmons 2014:167).

In sum, *Aetokremnos* and possibly the other three Epipaleolithic sites discussed are important as they establish a firm human presence on a Mediterranean island by 12,000 cal B.P. This makes Cyprus one of the earliest islands with substantial evidence for a Pre-Neolithic human occupation. Evidence from *Aetokremnos* in particular also demonstrates that not just people, but also wild boar, was transported from the mainland to the island. Clearly, the watercraft technology and broader seafaring knowledge was substantial during the Pre-Neolithic. It also demonstrates that watercraft technology was sophisticated enough to transport people between the mainland and the island (Simmons 2011:59).

*The Cypro-Pre-Pottery Neolithic A (PPNA)*

Turning to the subsequent cultural phase, or the Cypro-Pre-Pottery Neolithic A (PPNA), there are currently only two excavated sites dating to the Cypro-PPNA: Ayia Varvara Asprokremnos and Ayios Tychonas Klimonas (Figure 5.5). The former is located in central Cyprus bounded on the west by the Yialis River, with easy access to the Troodos Mountains. It is strategically located in a resource zone with abundant local cherts and ochre outcrops. McCartney (2011:187) notes that its position between the open plain and the forested mountains would have been an ideal location for foragers, but its position near a river could also suite more permanent occupations as well.

Three different stratigraphic phases have been identified, all within the Cypro-PPNA (Knapp 2013:85). There are currently limited publications on the site (e.g., Manning et al. 2010; McCartney et al. 2006; McCartney et al. 2008), as excavations were completed only in the summer of 2013. There is currently evidence of one, semi-subterranean shelter.
More than 800 kg of chipped stone have been recovered from the site. Most notable is the discovery of 100 complete and fragmentary projectile points, which are missing from the subsequent PPNB period. The assemblage is made entirely on local chert sources (Knapp 2013:86-87; McCartney et al. 2008:71-73; Manning et al. 2010). Other material culture that has been recovered includes abundant ground stone, which implies that the inhabitants were processing plant resources. Many of the pieces also had traces of ochre on them, suggesting that they were also used for grinding this raw material. Other notable finds include the head of a baked clay figurine, known as ‘Babs,’ which is the earliest known on the island, two decorated shaft straighteners, one bone point, and dentalium shell and picrolite ornaments (Knapp 2013:85; McCartney et al. 2006: 45-47, 2008: 73-75; Manning et al. 2010).

Figure 5.5. Cypro-PPNA sites. *(Map courtesy of Levi Keach)*
In regards to the faunal assemblage, pig remains dominate, comprising nearly half of the material. There are also the remains of bird and freshwater crab (Knapp 2013:67; Manning et al. 2010:698). Greater attention will be given to the pig remains below.

*Klimonas*, in contrast, is located near Amathus, approximately 3 km from the south central coast (Knapp 2013:68). It appears to be larger than *Asprokremnos*, but there is again limited published material as excavations are ongoing. It also has a substantial chipped stone assemblage, including projectile points, as well as substantial architecture; the latter which includes a large (10 m in diameter) circular structure. This has been suggested to represent a communal structure, similar to those seen on the mainland during the PPNA (Knapp 2013:68; Simmons 2014:177; Vigne et al. 2011).

Similar to *Asprokremnos*, wild boar are the main faunal component at *Klimonas*. Morphological analyses illustrate that these remains are similar to those from Akrotiri, supporting the notion that a pig population was established on the island by the Late Epipaleolithic. There are a wide range of slaughtering ages represented. Coupled with the large number of projectile points from the site, these data imply hunting or herd control, rather than husbandry (Knapp 2013:68, 84; Vigne 2013; Vigne et al. 2011, 2012, 2013). There are also remains of domestic dog, mice, cat, several species of birds, mollusks, lizards, snakes, one fish vertebra, fresh water turtle, and possibly genet. Dog perhaps helped with wild boar hunts and/or management. The remains of cat predate any known interaction with humans from the mainland by 1,500 years and might have been used for controlling pests, possibly supported by the presence of rodent-gnaw marks on some of the bones (Knapp 2013; Vigne et al. 2011, 2012, 2013).
There is one other possible site that dates to the PPNA, which is Ayios Tychonas Throumbovounos. This site is located near Klimonas. It has not yet been excavated; thus, there little is still currently known about the site (Simmons 2014:177; Vigne et al. 2012).

The Cypro-Pre-Pottery Neolithic B (PPNB)

Moving to the Cypro-PPNB, there are presently five excavated sites, that of Kalavassos Tenta, Kissonerga Mylouthkia, Akanthou Arkosykos (Tathsu-Çiftlikdüzü), Parekklisha Shillourokambos and Kritou Marottou Ais Giorkis (Figure 5.6). Of the five, four are coastal or located within five kilometers of the coast. Ais Giorkis, however, is unique in that it contains a large faunal assemblage and lithic assemblage and it is located in the foothills of the Troodos Mountains (Simmons 2009a:4, 2009b:183). Greater emphasis will be given to the last three sites given that they are the most recently excavated, have substantial evidence for occupation, and have cattle; the importance of the latter will be discussed below.

In regards to Tenta, there is only a small portion which dates to the PPNB; the majority of the site dates to the subsequent Khirokitia Culture (KC). It is represented by a series of postholes as well as several pits and hearths. Chipped stone and faunal remains are the two major material cultural categories recovered. The former has similarities with the PPNB assemblage on both the island and the broader Near Eastern mainland. The latter is dominated by Mesopotamian fallow deer and then sheep/goat. Pig becomes important, but not until the KC (Croft 2002:175, 2005:358; Knapp 2013:104).
Mylouthkia is located 100 m from the current shoreline, north of Paphoos and is comprised of a series of six wells, three pits, and one semi-subterranean structure over an area of some 400 m²; all of the features were cut into the havara bedrock. While it is often described in the literature as representing a coastal site (e.g., Knapp 2013:96), there is currently no evidence of some degree of occupation at the site given that all of the material culture was found in the wells. For example, over 745 pieces of ground stone have been recovered from the wells, such as hammerstones and limestone vessels. Most of these artifacts were produced from soft, calcareous rock, including limestone or chert. Interestingly, ground stone used for food processing (e.g., mortars, pestles, and querns) are absent (Knapp 2013:98; Peltenburg 2003:40). One of the most spectacular pieces of ground stone recovered was a macehead that was deposited near a human skull in one of the wells.
The number of chipped stone recovered from Mylouthkia is limited, totaling 836 pieces. The majority are manufactured from local chert; however, 22 pieces of obsidian was recovered. Three projectile points were also found (Knapp 2013:99).

Similar to the chipped stone assemblage, the faunal assemblage at *Mylouthkia* is quite small. Twenty-three whole caprine carcasses from a single well were recovered. Apart from this, the assemblage consists of only sixty-three identified specimens, which is roughly divided equally between caprines, deer, and pig. There were also large quantities of both endemic and non-endemic mice, which is attributed to the PPNB phase (Croft 2003:56; Vigne 2013a:119).

Akanthou is located on the northern coast of Cyprus and may have been up to 4 hectares. The site is situated atop a marine terrace at a height of 10-15 m with limestone cliffs on the seaward side and a small pebble beach. A small spring is located near the site. Due to the current political situation, only limited excavations and surveys have been conducted at the site. There are also only a few available publications. In spite of this, the site has already revealed a wealth of information. More than 5,000 pieces of obsidian have been reported from the site, including complete tools and debitage (Knapp 2013:113; Şevketoğlu 2006). This is an incredible amount given that the most other Early Neolithic sites on the island have less than one hundred pieces of obsidian! Thus, clearly Akanthou played some role in the obsidian exchange network on the island. Other notable artifacts include stone pendants, shell and stone beads, worked bone (e.g., fish hooks, needles, and awls), and around 500 pieces of ground stone. Furthermore, both round and semi-rectangular shaped architecture occurs at the site (Knapp 2013:113; Şevketoğlu 2006).
The faunal assemblage includes sheep and goat, which dominate at around 50%. The former is three and a half times as common as the latter. Mesopotamia deer and pig occur nearly 37% and 13% respectively. There are also notable remains of dog at 9% as well as marine remains (e.g., dogfish, shark, tunny, and hake) and marine turtles. These are particularly interesting especially given that bone fish hooks have been recovered from the site. This site represents one of the only sites on Cyprus during both the Epipaleolithic and Early Neolithic which has marine resource remains. Currently, it is unknown whether the inhabitants at Akanthou fished from the shore or actually on the open-sea. In addition, there are also a small number of cattle remains preserved (2-3% of the total faunal assemblage), which is in contrast to the two previous Cypro-PPNB sites discussed (Frame 2002:236-237, table 2; Knapp 2013:113-114; Şevketoğlu 2006; Simmons 2009a:4).

*Shillourokambos* is located 5 km from the coast, northeast of Limassol. It has been assigned four chronological phases, all of which fall within the Cypro-PPNB. It is, in fact, one of the earliest of the 5 sites. Current consensus is that the site did not exceed more than 1 hectare in size. In the early phases, distinct features that have been recovered include circular dwellings defined by postholes and a few long, narrow enclosures, which have been suggested to represent livestock pen or domestic activity areas. During the later phases, they continued with circular dwellings; however, they were now made out of *pisé*. There are also areas of densely packed cobbles, which might represent dwelling foundations (Guilaine and Briois 2006; Guilaine et al. 2011; Knapp 2013:88).

Several burials were recovered from the site, including one with an intentionally placed cat burial 40 cm away. The cat was only eight months old and did not display any signs of butchering, perhaps suggesting that it was killed intentionally for the deceased. A
human-feline carved head on serpentine was also recovered from the site (Knapp 2013:93-95; Vigne et al. 2004). This figurine and the cat burial demonstrate that the cat played an important role in the life of the inhabitants at the site; whether this role was ritual in nature or practical (e.g., commensal control) is currently unknown.

Numerous pieces of ground stone were recovered from the site, including cooking and serving vessels. The chipped stone assemblage totals several thousand pieces. Interestingly, obsidian makes up 2% of the total assemblage with more than 500 small bladelets. The use of obsidian decreases towards the later phases, with a greater reliance being placed on locally available chert (Guilaine and Briois 2006; Knapp 2013:90-91).

The faunal assemblage at Shillourokambos is particularly interesting given the excavators’ ability to document phases. This has allowed them to document the different introductions of the animals as well as any lineage die-offs and reintroductions. In general, the assemblage totals 32,500 bone fragments, of 9,225 number of identified specimen (NISP) are taxonomically determined. It consists of dog, fox, sheep, goat, pig, Mesopotamian fallow deer, cat, and cattle. The fauna from the early phase of the site was dominated by wild boar; similar to Asprokremnos and Klimonas. There were also small quantities of caprine, wild cat, dog, and domestic cattle. In comparing the faunal remains from one of the wells from Mylouthkia, which is roughly contemporary with this early phase, it appears that between 10,700 and 10,300 cal B.P., goat, cattle, the domestic mouse, and cat were introduced to the island (Vigne 2013a:119). Domestic sheep, Mesopotamian fallow deer, fox, and possibly a new variety of domestic pig are introduced slightly later between 10,200 and 10,000 cal B.P. (Vigne 2008, 2013a:119; Vigne et al. 2011, 2013).
Vigne and colleagues (e.g., Vigne 2013a:119-123; Vigne et al. 2013) argue that these animal lineages do not all remain constant throughout the site’s occupation. For example, the early lineage of sheep seemed to have died out and been replaced by a new population based on changes in both size and horn core morphology (Vigne 2011, 2013a:121; Vigne et al. 2013:164). This implies that there is still contact between the inhabitants of Cyprus and the mainland. The morphology of the goats during the earliest phases of occupation imply domestication as they are smaller than wild bezoar goats on the mainland. Interestingly, the size of the female goats decreases slightly through time, whereas males decrease to such an extent that sexual dimorphism also decreased. A new type of horn core also occurs in the late phase. The sex ratio of adults did not vary in the early phases, but in the later phases the proportion of males decreased substantially. Vigne (2013a:123) argues that this represents local domestication of the goats; which is curious given that they were already domesticated upon arriving on the island. The argument is slightly clarified when they suggest that the goats were allowed to roam; thus, resulting in their feralization. They were then subsequently re-domesticated. The more detailed version of this argument is currently unavailable; however, it will hopefully better explain their position and the evidence supporting it (Vigne 2013a:121-123). Finally, similar to the zooarchaeological analysis of the sheep, the morphological analyses of the dentition of the domestic mice also suggest contact between the mainland and island. The morphology remains stable during the tenth and ninth millennia. If contact had stopped, the morphology would be expected to diversify, given that the gene flow from the continent has stopped or slowed down. Modern data on the rate of morphological drift in isolated populations of these species implies that at least two successful arrivals of new mice individuals occurred.
per year. These data are important as they demonstrate that there was relatively high traffic between the mainland and Cyprus, contradicting conventional wisdom (Vigne et al. 2013:166).

The final PPNB site discussed is *Ais Giorkis*, located some 25 km northeast of Paphos in the foothills of the Troodos Mountains. It was originally recorded by the Palaiopaphos Survey as a small Khirokitia Culture hamlet, which was possibly related to pig and deer exploitation. Test excavations by the University of Nevada Las Vegas under the direction of Simmons were first conducted in 1997. More extensive summer seasons occurred from 2002 to 2008 with a limited survey conducted during the summer of 2009 (Simmons 1998, 2009b, 2010, 2012a). Excavations resumed in the summer of 2013 and 2014, with another season planned for this summer. I have worked as a crew supervisor at the site and ultimately, primary data from *Ais Giorkis* will be used in my dissertation.

As of the present, approximately 300 sq m have been excavated. The site is located on two parallel terraces that were created by modern agricultural activities (Figure 5.7). The upper terrace, however, has not been disturbed in many years. It was initially believed that the majority of the site was located on the lower terrace. As a result, there was concern that *in situ* deposits would not be located due to modern farming activities. It is now known that most of the intact material occurs in the upper terrace and thus, there are *in situ* deposits (Simmons 1998, 2010, 2012a). The site is well dated by over 25 radiocarbon determinants. Based on 15 of the determinants, the main occupation occurred around 9450 cal B.P., or during the mid Cypro-PPNB (Knapp 2013; Simmons 2007, 2009b, 2010, 2012a).
The site contains several architectural features that consist mainly of cobbled “platforms” and large pits. In regards to the former, there are no similarities found at any other Neolithic site on Cyprus. Furthermore, these types of features are also not apparent on the mainland. The nature and function of these structures are unclear. It has been hypothesized that they functioned as house bases or as platforms where communal activity occurred (Simmons 2009b, 2010, 2012a). The latter architectural features are all located upslope of the stone platforms. In addition, the chipped stone assemblage currently consists of approximately 300,000 pieces mostly manufactured on locally available Lefkara basal cherts. Forty-two obsidian bladelets were also recovered. There is also an abundant amount of ground stone with a current number of 448 (Figure 5.8). Finally, numerous rare artifacts have been recovered, such as obsidian, several picrolite ornaments, one carnelian bead, a
small limestone figurine and a large, female figurine made out of limestone (Simmons 2007, 2009b, 2010, 2012a).

Figure 5.8. Ground stone *in situ* at *Ais Giorkis*.

Both botanical and faunal remains are also well-preserved. Some of the earliest domesticated emmer and einkorn wheat in Southwest Asia is found at *Ais Giorkis* (Lucas et al. 2012; Simmons 2009b, 2010, 2012a). Thus far, the total number of identified faunal specimens (NISP) is 14,841. The majority of the assemblage is comprised of Mesopotamian fallow deer, which represent over 50% of the analyzed fauna, followed by pig at slightly less than 30%, and caprines made up 16.9% of the assemblage. Dog and cat are also represented in very small numbers and are presumably domesticated. Their presence is important because it implies some degree of sedentism at the site (Simmons 2010, 2012a). Of particular interest is the discovery of limited quantities of cattle remains.
So far, the total number of identified specimen (NISP) is 252, which is approximately less than 2% of the total faunal assemblage. A wide-range of body parts have been recovered, which is similar to *Shillourokambos*, implying that cattle were also kept at or near the site. Recall that cattle are represented by similar low percentages at *Shillourokambos* and Akanthou (Şevketoğlu 2006; Simmons 1998:237, 2009b:184, 2012a:96; Vigne 2011).

The material culture and subsistence focus (particularly with animals) during both the Cypro-PPNA and Cypro-PPNB illustrate that from the very beginning, the island was incorporating various elements of the Neolithic and beginning to shape its own local and island-wide culture (Knapp 2013:69; Kotsakis 2008). In regards to the Cypro-PPNA, pig dominates the faunal assemblages for both *Asprokremnos* and *Klimonas*. It seems highly plausible that the introduction of pig to the island occurred in the Epipaleolithic. It is has been proposed that they filled the ecological niche left by the hippos. Thus, the heavy reliance on this fauna during this time period illustrates that there was a long period of human management, prior to morphological changes attributable to domestication. Wild boar were also introduced to other Aegean islands prior to their corresponding Neolithic, demonstrating that substantial control over wild ungulates occurred in other areas of the Mediterranean (Vigne 2013a:117; Vigne et al. 2009). Furthermore, the heavy reliance on a single taxon is actually quite unique in the Mediterranean and Near East (Knapp 2013:69). The similar dominance of pig is known at only a handful of sites on the mainland, such as the PPNA site of Cayönü in southeastern Anatolia (Manning et al. 2010:698).

During the Cypro-PPNB, while pig remains an important component of the diet, the dominant taxon at the majority of the five sites discussed is Mesopotamian fallow deer. This dominance continues on Cyprus throughout the Neolithic and into the Chalcolithic,
with deer at some sites amounting to a high of 70% of the total faunal remains. This
considerable reliance on the exploitation of deer by the inhabitants represents a distinctly
Cypriot adaptation, without parallels on the mainland (Button 2010:326; Croft 1991:63,
2002). Similar to gazelle, deer are never morphologically domesticated, attributed to their
behavior. Yet, they continue to be exploited throughout the Neolithic and into the
Chalcolithic, amounting to a high of 70% of the total faunal remains at some sites (Croft
prompted early suggestions that they were domesticated on the island. Croft argues against
this interpretation, emphasizing that it is not supported by the zooarchaeological evidence.
He proposes instead that they might have been controlled under a system of game
management (Croft 1991, 2002). Thus, similar to the situation on the mainland with
gazelle, while deer were not necessarily morphologically domesticated, it is clear that they
were brought under a degree of human control and played an important role in the lives of
the early inhabitants.

The presence of limited quantities of cattle remains at Shillourokambos, Akanthou
and Ais Giorkis is also of great significance to understanding the unique process involved
in the adoption of domesticates on Cyprus. Prior to these three sites, cattle were thought to
have been absent from the Neolithic. In fact, the earliest evidence for cattle was not until
the early Bronze Age. Curiously, cattle disappear by the Late Neolithic, roughly two
thousand years after their first introduction (Broodbank 2013:178). Only a single
metapodial fragment has been recovered from the Ceramic Neolithic at Khirokitia, which
is primarily an Aceramic Neolithic site that has no evidence for cattle (Davis 2003:263;
Simmons 2009a:2). Several cattle bones might also have been recorded from the Ceramic
Neolithic site of Philia *Drakos A*; little information is available about the context (Knapp 2013:171). This absence of cattle for some four thousand years, until the early Bronze Age, is curious since cattle remain economically and ritually significant on both the mainlands and many of the Mediterranean islands, including Crete (discussed below), from the time of their introduction onwards. A number of hypotheses have been put forward to explain this disappearance including: the island could not sustain a cattle population (Simmons 2009a:6); the inhabitants were tired of maintaining such large creatures and allowed them to die-off (Davis 2003); disease (Davis 2003); and it was part of an island-wide decision to form an identity distinct from the mainland (e.g., Ronen 2000; Simmons 2009a:6). All of these hypotheses still need to be tested, but what these data demonstrate from the Epipaleolithic through the Early Neolithic is that the inhabitants of Cyprus were playing an active role in their identity formation and what resources were being brought to the island and exploited.

**Documenting an Early Human Presence on Crete: The Archaeological Evidence**

*Pre-Neolithic Human Presence*

In regards to a Pre-Neolithic occupation on Crete, the Plakias Survey in the Plakias region is currently the first and main, albeit controversial, project to have identified cultural material possibly of Paleolithic and Mesolithic dates in geological contexts. This region is located on the southwestern coast of the island (Figure 5.9). It is geologically dynamic. It was created due to the collision of the Eurasian and African plates and the warping of the Hellenic forearc. Crete is, in fact, one of the few places in the world where the arc is exposed above sea level. The coast is bordered by limestone mountain ranges that are
uplifted. River systems are also found throughout the region. Marine terraces (cemented sedimentary beach deposits), paleosols (fossil and/ or buried soils), and erosional planation surfaces comprised of bedrock are found along the coast corresponding to sea level high stands in the Upper Pleistocene (130,000-10,000 years ago). Their preservation is due to the slow and continual uplift of rock in the region (Strasser et al. 2010:152; 2011:553, 555). This uplift has also created steep slopes that have potentially accelerated the destruction of rockshelters and caves; which Strasser and colleagues (2010:152) note might have been attractive to Mesolithic peoples.

Figure 5.9. Selected Sites/ Regions from Crete. (Map courtesy of Levi Keach).

The survey, conducted by Strasser and colleagues, located 28 different areas associated with rockshelters and caves. The team collected 2,100 lithic artifacts that are attributable to at least three lithic industries: one consists of microlithic artifacts of the Mesolithic type found at 20 sites and the others are of Lower and Middle Paleolithic types.
found at 8 sites (Strasser et al. 2010:146). The original intent of the survey was to recover Mesolithic material as until this survey, there was limited evidence for a human presence during this time frame; yet, nearby Aegean islands as well as Cyprus were providing evidence for a Pre-Neolithic human presence (Strasser et al. 2010:151). A Mesolithic site-location model, developed for the Greek mainland and the Aegean islands, was used on Crete. This model focused on rockshelters, caves, and proximity to coastal wetlands (past and present) since this was where evidence for Mesolithic inhabitants on the mainland and other islands had been found. As a result, the Plakias region on Crete was chosen as the survey area due to the fact that it contained all of these features (Runnels et al. 2013:130; Strasser et al. 2010:151).

The eight sites that Strasser and colleagues argue date to the Paleolithic range from a few lithics to around 300 pieces. Altogether the sites contain more than 400 artifacts. Five of the eight sites are associated with paleosols in alluvial fans and marine terraces, with the remaining three either being from reworked or disturbed contexts. One of the most important sites is Preveli 2, located on the eastern side of Prevelo Gorge. It is comprised of marine terrace deposits at 59 and 96 m above sea level (m a.s.l.) and with paleosols which formed in alluvial fans at 125 m a.s.l. They record the terrace formation that spans the Upper Pleistocene Marine Isotope 3 to 5 stages. Artifacts were found in both marine terraces and in the paleosol (Runnels 2014a:218; Runnels et al. 2013:130; Strasser et al. 2010:172-173, 2011:553-554). Artifacts were also found on marine terraces located between Preveli and Schinaria. Dates obtained for these sedimentary deposits are around 45,000 and 50,000 cal B.P. on two of the lowest-level terraces, both of which are at stands of 14 and 21 m a.s.l., respectively (Strasser et al. 2011:553). Unfortunately, none of these
sites have been able to document true ‘occupation’ sites or sites with anthropogenic deposits that extend beyond lithics. It is likely that if these sites once existed, they are now gone; possibly destroyed by erosion (Strasser et al. 2011:554).

Figure 5.10. Hand axes from Preveli Gorge. (Courtesy of Hesperia).

According to Strasser and colleagues (2010:178, 2011:554; Runnels et al. 2013) the lithic artifacts belong to both the Lower and Middle Paleolithic industries based on the reduction techniques. Many of the lithic types are classified more specifically as Acheulean type and include bifaces (handaxes) and scrapers (Figure 5.10). It seems that they had easy access to raw material as many of the artifacts were discarded after only a few uses. Quartz appeared to be the preferred raw material used. The blocky structure of quartz makes it challenging to determine conchoidal fractures and flake removals, both indicate of flint-knapping. This causes problems for archaeologists when trying to identify whether the
object was culturally-made or an ecofact (Runnels et al. 2013; Strasser et al. 2010:161-162, 181). It is also challenging to make comparisons between the assemblages found on Crete and those from the mainland, largely due to the fact that bifaces are rare on the latter during the Paleolithic (Strasser et al. 2010:184).

While the morphological and technological aspects of the assemblages enable a case to be made for Palaeolithic dates, more concrete dating presents a considerable challenge. Several approaches to dating have been attempted, but it is important to note that research is ongoing. One major technique is using geological data derived from both the study of the marine terraces and the paleosols. Thus, the lowest threshold age of the artifact assemblage is estimated by means of its associated geological contexts. Radiometric dating is first conducted on the marine terrace deposits using mollusk shells. The alluvial fans are also dated using optically stimulated luminescence (OSL). This is then correlated to an established Late Pleistocene global sea level curve, which allows the coastal rock uplift rates to be determined and averaged over the period of time (Runnels et al. 2013:130; Strasser et al. 2010:185-186, 2011:553). Strasser and colleagues note, “A rising coastal landmass is like a strip chart that records and uplifts the geological record of each successive sea-level high stand. The important observation is that the land is rising steadily (although perhaps in discrete jumps during earthquakes) while the sea level is varying widely over glacial-interglacial cycles (2011:556).” It is assumed that the marine terrace platforms along the southern Cretan coast were created during sea level maximums at surface level with a uniform elevation. The subsequent emergence of the individual terrace means that the rock mass has risen above sea level. The rates and amounts of rock uplift through time are defined by the age and current elevation of each marine terrace with
respect to the global sea level at the time the terrace was formed (Strasser et al. 2011:556). Based on using this technique, it is argued that minimum age for several of these sites is at least 130,000 years ago (Runnels et al. 2013; Strasser et al. 2010:186).

Most of the Mesolithic sites were found in front of rockshelters and small caves. They are typically small in area and the assemblage size usually consists of less than 500 lithic pieces. Debitage, retouched tools, and cores have all been recovered. Furthermore, the industry was a microlithic one with reduction techniques similar to other contemporary assemblages on the Greek mainland, including Franchthi cave (Chapter 4). The raw material utilized was locally available, with quartz being the most abundant followed by quartzite and chert. The authors correctly use caution, however, in concluding that these sites are absolutely Mesolithic in age given the fact that they are all surface collections. Excavations have only been conducted at one of these sites, but little information has of yet been published (Simmons 2014: 200; Strasser et al. 2010:161-162, 164).

Another issue with these sites are absolute dates. The chronological boundaries for the Mesolithic on both Crete and the nearby Greek mainland are not well fixed. In Greece, a range of 9,000 to 11,000 years is used to define the Mesolithic (Strasser et al. 2010:166). This has been applied to Crete, given that radiometric dates are lacking for all of the sites. Thus, the assignment of these twenty sites to the Mesolithic is based on morphological and technological grounds. The authors argue against cultural mixing at any of the sites due to the lack of lithic types and/ or technologies that would be indicative of earlier and later periods, such as: prismatic blade reduction for the Upper Paleolithic and prismatic cores for the Neolithic or Bronze Age (Strasser et al. 2010:171).
All material at each site was examined for evidence of water damage, including polishing, rounding, abrasion of the edges, and rounding; all of which are usually associated with post-depositional modification to the lithic artifacts, particularly their re-deposition far from their original place of deposition. Strasser and colleagues conclude that none of the material collected provided evidence for high energy transport over long distances due to water movement (2010:159). This is particularly important for the Paleolithic material as it emphasizes their in situ nature. One other feature used to support the in situ nature of the lithic assemblages was the range of sizes. If the assemblage had been moved by water, its material would be more homogenous in size (Strasser et al. 2010:160).

Almost all of the raw material for both the Mesolithic and Paleolithic artifacts were manufactured mostly on quartz with more limited use of quartzite and chert. Each site used material locally available. Quartz and chert cobbles are still visible on the beaches and along the streambeds in the region today. The former is more readily available and of higher-quality than the latter.

In sum, there are still challenges to the notion of a Paleolithic presence on the Crete, particularly given the lack of absolute dates for the artifact assemblages specifically and lack of excavations, Strasser, Runnels, and colleagues, however, do present a relatively strong case. The fact that eight sites from one part of the island have been uncovered is interesting and suggests that a pattern is forming for a human presence. This is especially intriguing when combined with the evidence from Gavdos (Chapter 4), where excavators argue for a Lower Paleolithic human presence based similarly on tool technology. The fact that distance between the two islands is minimal today, suggests that they might have been
connected; strengthening the case that hominins were using watercraft technology far earlier than previously held in the Mediterranean. More studies need to be conducted, however, to better understand the relationship of these two islands at lower sea level stands. For both the Paleolithic and Mesolithic sites, excavations need to take place in order to see if any material is in situ. Such activities would also hope to find data that can be used for radiometric dating to provide absolute dates for the sites and material culture.

A Neolithic Human Presence

Most Mediterranean archaeologists are familiar with the Bronze Age palatial site of Knossos, located in the Herakleion Basin. Fewer know that it also has a Neolithic component, discovered more than a century ago by Arthur Evans. It has remained pivotal to the understanding of the Cretan Neolithic for two main reasons. It is still one of the best dated, best defined, and best known Neolithic sequences for Crete and the broader southern Aegean region. It was also thought to be the only Initial Neolithic site and the best evidence for Early Neolithic occupation, although there had been claims for several other sites dating to the latter time frame. It is important to remember that only the Initial Neolithic does not have pottery, as compared to the rest of the Neolithic phases. None of these, however, were substantiated (Broodbank and Strasser 1991:236; Sherratt and Sherratt 2008:291; Tomkins 2008:22-23; Tomkins et al. 2004:51). Thus, many studies have emphasized both the isolation of Knossos from surrounding areas in the Aegean, but also from the rest of the island. It was thought to have been the only substantial settlement on Crete with temporary occupation of the surrounding land until at least the Late Neolithic, but more definitely until the Final Neolithic (Tomkins 2008:23; Tomkins et al. 2004:51).
Recent studies have altered this scenario, although a lot of detail is still not yet available. For example, a reanalysis of the ceramics at Knossos have demonstrated that some of the vessels were made in a number of different locations on Crete. While the number of sherds with nonlocal clay sources occurs in relatively low numbers, the fact that material comes from locations all over the island, even the north-central part, demonstrates that Knossos was not an isolated community. Rather, it was one among at least several from the Early Neolithic onwards. Unfortunately, many of these sites have yet to be recovered archaeologically. This is changing especially for the Late and Final Neolithic; however, very little has been published. Thus, only Knossos will be discussed in this paper given the greater number of publications and information available (Kotsakis 2008:60; Tomkins 2008:28; Tomkins et al. 2004).

A recent volume (Efstratiou et al. 2013b) was just published on the site from the most recent excavation season that occurred in 1997, which was primarily a salvage operation that lasted for five weeks. Thus, only a limited area was excavated. Initially, two trenches were going to be excavated. With one of the trenches, it was quickly realized that the area had been heavily disturbed by previous excavators at the site, who had used it as a dumping ground for other archaeological material, including broken pottery and stone. As a result, only one of the trenches was investigated, which measured 3.0 m by 2.0m (Efstratiou et al. 2013b:1). It is important to note that the Neolithic occupation levels occur in the Central Court of the Bronze Age palace, partially explaining their disturbance. The volume only contains information on the faunal and botanical analyses, the stratigraphy and cultural phases, and the sediments at the site. No other material culture is included, as a result this section will briefly discuss the features found at the site and the faunal analyses.
Several structures and features were able to be isolated at the site during excavations. Given the limited scale of the excavation, it was difficult for the excavators to make definitive interpretations of the findings, although they did compare J.D. Evans earlier campaigns at the site. Based on this comparison, they believe that they found several walls, which denote occupation areas. Hearths and pits were also recovered, but their relationship with the walls (e.g., interior vs. exterior space) could not be discerned. Ultimately, much larger excavations need to take place at the site to better understand its spatial distribution (Efstratiou et al. 2013a:19-23).

Two recent faunal analyses have been conducted on the remains from Knossos. One was conducted by Valasia Isaakidou (2008) and was actually a reanalysis of the faunal remains from previous excavations. This reanalysis focused on the major domestic taxa (MDT). The other analysis was conducted by Manuel Pérez Ripoll (2013) on the faunal remains from the most recent excavation, which occurred in 1997. Both analyses concluded with similar results; thus, the overall patterns will be presented rather than specific percentages as was given for the faunal remains at the sites on Cyprus.

In regards to animal-subsistence, a relatively different situation occurs at Knossos than at any of the early Neolithic sites on Cyprus. The domesticated animals found at Knossos from the Initial Neolithic through the Final Neolithic include pig, sheep, goat and cattle (Harris and Hamilakis 2014:99; Isaakidou 2008:94-95; Pérez Ripoll 2013:152). Deer are not introduced to Crete until at least the Late Neolithic but more likely slightly later (Horwitz 2013:180-181; Pérez Ripoll 2013:162, Table 8.20). This is interesting as deer have been found in the Pleistocene faunal record of the island (de Vos 1992; Horwitz 2013:174; Lax and Strasser 1992:205). It is clear that they died out; however, the reasons
behind this extinction are currently unknown. Several hypotheses have been suggested including climatic change, human predation, and habitat destruction and resource competition (Lax and Strasser 1992). Currently, there are no Pre-Neolithic sites with Pleistocene fauna remains and human cultural materials, weakening the human role argument at present (Harris and Hamilakis 2014:99).

Sheep and goat decrease through time, but they remain the dominant taxa at Knossos. This is followed by cattle whose presence increases between the Initial and Late Neolithic, although they decrease slightly in numbers by the Final Neolithic. Pigs are also an important component of the diet, but they occur in the lowest frequencies (Isaakidou 2008:94-95, Figure 6.2; Pérez Ripoll 2013:160). Sex, age and metrical data for sheep, goat and cattle demonstrate that throughout the Neolithic, husbandry practices were stable and consistent with a meat strategy of production in which males were culled as juveniles or sub-adults and females as adults (Isaakidou 2008:94).

Similar to Cyprus, the animals exploited at Knossos demonstrate that the inhabitants of this site and more broadly Crete were manipulating the different elements of the Neolithic to fit their own culture and environmental needs. In regards to the dominant taxa, sheep in particular would have been beneficial to the inhabitants at Knossos because they consume straw and stubble from the fields as well as waste from the grinding of grain. Thus, they are considered a complement to agriculture since they transform by-products, which cannot be used by humans, into meat proteins (Pérez Ripoll 2013:160). This could partially explain why caprines were not as important in the early Neolithic on Cyprus (and into the Chalcolithic as well) as it seems that the inhabitants were relying more heavily on deer and pig exploitation than other faunao.
The exploitation of cattle at Knossos is particularly interesting because it appears that a more complex economic scenario seems to exist than for any of the other domesticated taxa at the site. Both faunal analyses discovered osteoarthritic pathological conditions on the bones. They are manifested as development of osteophytes, remodeling of the articular surfaces and grooving of the articular surfaces, particularly on the phalanges, distal metapodials and hip joints. These conditions are a result of repetitive trauma or stress. Examination of modern cattle carcasses with known life histories that had similar conditions were the result of injuries incurred in traction. While it is not definitively known whether the pathologies found on the cattle from Knossos were due to traction, both zooarchaeologists believe it is highly plausible (Isaakidou 2008:96; Pérez Ripoll 2013:158, 160-161). These pathologies are well represented in the faunal remains from the Middle Neolithic through the Final Neolithic. The scarcity of these conditions in the Initial and Early Neolithic could be due to the small size of the cattle bones. Since a number of these pathological conditions occurred on the hip joint (pelvis), they were able to be sexed. Curiously, these were, with one exception, from adult breeding females (Isaakidou 2008:96; Pérez Ripoll 2013:159). Isaakidou (2008) does stress that the pathological evidence from Knossos offers no definitive conclusion on whether the cows were used for transport or plowing or both. She emphasizes, however, that neither would have required any significant technological breakthroughs, concluding that there is no reason why the cows could not have been used for both tillage and transport at Knossos (2008:101).

These data from the cows are significant for two reasons. For one, if this conclusion that these marks were from stress caused by traction is correct, then this represents the earliest evidence for use of draft cattle in both the Mediterranean and Near East; extending
the date back by two millennia (Evershed et al. 2008; Isaakidou 2008:109). Furthermore, oxen, which are castrated males, have traditionally been viewed as the draft cattle in the Mediterranean. The use of female cows, however, has been documented ethnographically across southern Europe into modern times. The explanation offered by farmers was that cows were multi-purpose animals, able to provide calves, milk, and labor. Oxen, on the other hand, could only provide muscle power. Thus, cows were more suited for small-scale, largely self-sufficient agriculture that was practiced by many households until recently in the Mediterranean. Since the inhabitants of Crete in the Neolithic would most likely have had similar agricultural practices, it makes sense that cows over oxen would have initially been used as draft animals (Isaakidou 2008:98-99).

The early use of draft animals on Crete might be due to the island’s sharply seasonal climate, which results in an extremely short time period for autumn ploughing and sowing. The severity of the summer drought means that tillage and sowing cannot start until the ground has softened enough from autumn rains. Without cows, farmers would have had to manually till the ground. Depending on how dry the ground was, however, this could have been an impossible task and further delayed the planting process. If this occurred, the farmers would have been dependent on the unreliable spring rains. Thus, the use of cows from early on at Knossos would have minimized sowing crops too late; hence, helping ensure the survival of the community. Elderly Cretan farmers note that use of draft animals, including cows, helped to minimize risk of sowing crops too late or on an insufficient scale as compared to manual tillage. Perhaps, then, the use of cows in the Neolithic on Crete served as a risk reduction strategy (Isaakidou 2008:99). This notion is slightly confounded, however, given that pollen cores suggest that the climate of Neolithic Crete was less arid
than the present. Knossos is located at one of the driest parts of the island, which was not where the pollen cores were taken. It presently receives a third of the rainfall of other parts of the island. Perhaps, then, Knossos was still relatively dry and draft cattle might have benefited the community (Sarpaki 2013:65).

In regard to the wild fauna, wild goats, marten, and badger have been recovered from Knossos; none of these animals are believed to have been endemic to the island. It is currently unknown whether the goat was introduced in its wild or domestic form. If the latter occurred, then it implies that it became feral, similar to Vigne’s argument for the some of the goat remains at Shillourokambos (Horwitz 2013:177; Pérez Ripoll 2013:162). Today, similar wild goats are found on Crete, called *agrimi*. They are smaller in body size compared to the mainland bezoar goat, but they resemble them in coat color and patterning, behavior, and horn form. A genetic study was conducted on mtDNA from the modern *agrimi* and found that they are closer to domesticated than wild goats, which perhaps supports the idea that some of the domestic goats introduced to Crete did become feral (Harris and Hamilakis 2013:101; Horwitz 2013:177). It might also suggest that both wild and domestic goats were introduced to the island and that interbreeding occurred between the two (Horwitz 2013:177). This situation has been documented on Corsica and Sardinia with the modern free-ranging boar population that is thought to have their origins in the interbreeding of wild and domesticated pig in the ninth millennium B.P. (Horwitz 2013:177).

Ultimately, the site of Knossos, similar to the Early Neolithic sites on Cyprus, demonstrate that a human presence by this time frame cannot be disputed. More interesting
perhaps is the differences in how people exploited faunal resources, further emphasizing the importance of variation in the spread of the Neolithic.

**Sailing Forward: New Directions for Studying an Early Human Presence on Cyprus and Crete**

The above discussion demonstrates that while there is relatively substantial evidence for a human presence on Cyprus and Crete from the at least the Late Paleolithic onwards (although a case can also be made for a Lower and Middle Paleolithic presence for the latter), many more questions remain unanswered. Three major questions include: 1) how often did people move back and forth between the island and the mainland; 2) how did the earliest inhabitants move around the landscape; and 3) how were animals transported to the islands? Each of these will be examined below.

*How often did people move back and forth between the island and the mainland?*

As noted in Chapter 2, there are many issues surrounding the nature of an early human presence on islands, particularly whether these phenomena were accidental or planned. Traditional demographic models that mathematically compute the likelihood of a voyage occurring, often make two basic assumptions: one deals with the age and sex structure of the group and the other with the notion that only one founder population was involved. It is this latter assumption that relates to the proposed question, because a single founder group also implies limited or no contact back and forth between the mainland and the island. Even within Mediterranean island archaeology, conventional wisdom has emphasized the so-called ‘isolation’ of people once they arrive on islands, thought to have originally been the Late Neolithic (e.g., Knapp 2013; Simmons 2009b, 2011, 2012b, 2013b). This notion seems truly incredulous, given that people on islands were not living
in isolated laboratories. The evidence from the zooarchaeological analysis of the domestic mice from Shillourokambos suggest that contact between the island and mainland was far greater than previously assumed with at least two successful arrivals of new mice individuals on Cyprus (Vigne et al. 2013:166-167). Such a high rate is also a testament to the skill of those making the voyages, emphasizing that by at least the Early Neolithic (though most likely earlier) they had incredible skill and knowledge. This in itself raises interesting questions about the people who were making the journeys. Was it families or entire communities? Were those who made the voyages specialists at seafaring and watercraft building technology or becoming specialists? How was knowledge passed down? How large were the social networks? Did the social networks extend just to the coast of the mainlands or did it include more interior areas? The questions related to social networks are particularly interesting given that ethnographic studies have demonstrated that foragers and some farming communities have social networks that extend over large areas. In fact, many foragers often speak more than one language or dialect (Bar-Yosef 2013:70). On Cyprus, given the obsidian at several of the PPNA and PPNB sites, we know that at least some inhabitants on the island had contact with people on the mainland who either were near the obsidian sources in Anatolia or part of a larger exchange network. These are all challenging questions to document archaeologically, but studies such as the one conducted at Shillourokambos demonstrate that we can begin to address the number of times at some portion of the population on the islands made trips back and forth to the mainland and island. It is important that we continue to explore this topic as it emphasizes the people in prehistory; rather than the sites or artifacts, which are often the focus for Mediterranean island archaeology.
The question of the number of trips made between the mainland and island also raises the question of where the inhabitants were originally from. This has been studied rather extensively for Cyprus in particular, with little or no consensus on the issue given that different material culture suggest different places on the mainland. For example, some argue that the lithic *chaînes opératoires* seen at several of the PPNB Cypriot sites are similar to those from PPNB inland Levantine sites. Others suggest that they are more similar to sites in eastern Anatolia, which is also supported by imported obsidian from an Anatolian source (see Knapp 2013:77-78 for sources and extended summary of the arguments). In my view, this question is not as interesting given that it is likely that people did not come from one single place on the mainland. Thus, the fact that the material culture from Cyprus has connections with sites all over mainland Southwest Asia makes logical sense. What is more interesting is that several of these mainland sites are located 200 or more km inland, suggesting that perhaps people living on the coasts were not the only ones interested in seafaring. It might also imply again that social networks extended much farther inland than many Mediterranean archaeologists would like to believe.

This question of origin is slightly more interesting for Crete given the age of some of the Paleolithic sites. Runnels and colleagues (2013) currently argue that at least the Lower Paleolithic finds from Crete might be part of a third “Out of Africa” event, which occurred around 1.0-0.8 million years ago. This is largely due to the similarities of the material on Crete with those from the African Acheulean Industrial Tradition. Galanidou (2014:24) suggests a similar hypothesis. She also notes that it is plausible that hominins reached Crete via an open sea route given that the distances between North Africa and Crete at this time would have been smaller; rather than the traditional land route from
Africa. Both Runnels and colleagues and Galanidou note, however, that there is currently not enough material from both Crete and the surrounding mainlands to test the plausibility of the data from Crete representing another “Out of Africa” event. There is also very little evidence to conclude whether the hominins arrived on Crete via an open sea route from North Africa or an open sea route from the Greek or Anatolian mainlands.

*How did the earliest inhabitants of the islands move around the landscape?*

One major critique of Mediterranean island archaeology, particularly for Cyprus and Crete where there is more substantial evidence of a human presence for both the Pre- and Early Neolithic, is that the focus is on individual sites and the material culture; rather than the inhabitants. Very little scholarly work is being done on the interaction of people across the islands, specifically how they moved around the landscape. The ceramic analysis from Knossos are steps towards answering this question as it demonstrated that the inhabitants were at least getting material from elsewhere on the island, but for Cyprus I have not heard of any studies trying to address this issue specifically. For a hunter-forager population, there is plenty of literature on the different ways that the landscape might be being used. Binford (1980, 1982), for example, has been a distinction between residential and logistical mobility. The former refers to movements of all members of a camp from one location to another. The latter refers to movements of individuals or small groups from a residential location. It can take the form of one-day long forays from a site or task-specific journeys of lengthier duration, including hunting expeditions. Both of these mobility types raise interesting questions for the earliest inhabitants of Cyprus and Crete. Did all members of a particular camp or community make the initial journey to the two islands? Which individuals or groups choice to make the journeys and why? How long did they remain on
the islands for? Was their length of habitation year-round, based on seasonal exploitation of resources, or a combination of the two? It is of course nearly impossible to engage with these questions using archaeological evidence; however, they raise important issues regarding the earliest inhabitants of the two islands that need to be kept in mind as researchers analyze sites.

Based on his studies with the Nunamiut Eskimos, Binford has also demonstrated that hunter-foragers practice a pattern of extensive land use. Furthermore, as they are moving around the landscape, besides collecting or hunting the sought-after resources, they are also monitoring the area. This means that they are gathering information in places where they might not be living or exploiting from at the given moment in time, which makes possible incorporating these areas into their ranges or shifting their ranges to focus on these new-found areas (Binford 1982, 1983:49). Kelly (1983) also notes that monitoring will be continuous when the occurrence of a particular resource is unknown, but the general area of where it will be is known. The earliest inhabitants on both Cyprus and Crete would not have known what to expect when they first arrived on the islands. They would have known that they had left their homeland, given that they had to cross pretty large areas of the sea. Thus, their initial visits must have consisted of some type of monitoring or scouting of the available resources. Initially, some of the individuals must have had to stay on the island for more extended periods of time to monitor the resources, particularly when they would occur. The fact that we have archaeological deposits implies that people either stayed on the island to exploit its resources or people began to incorporate particular resources into their seasonal mobility patterns. The latter emphasizes both the movement back and forth between the island and mainland and that people began to have a clearer
understanding of the general area and time that a resource would be available. For both islands, the type of resources that these early inhabitants were interested in is not really known. Evidence from Aetokremnos suggests that it likely was pygmy hippos. This situation is particularly interesting, because even as this potentially sought-after resource disappeared, people continued to use the site. Thus, they shifted their focus as needed. Ammerman argues that inhabitants at Nissi Beach and Aspros were attracted to the salt sources. Ultimately, it is clear that people found some aspects of Cyprus (and Crete) particularly beneficial as over time more substantial occupations occurred until at least some of the population was permanently living on both islands by at least the Early Neolithic.

One way of addressing movement across the landscape is to incorporate stable isotope analyses into research agendas. Research from the European and Southwest Asian mainlands has demonstrated the incredible wealth of information that can be gained from these methods, which include mobility as well as diet, herding strategies, and seasonality of birth. For example, Viner and colleagues (2010) conducted a study using strontium isotopes on second and third mandibular teeth from cattle from a late Neolithic site in Britain. Their goal was to investigate the patterns of mobility in the animals that were eventually slaughtered at the site, in order to provide insights into the function of the site as well as cattle husbandry practices in Late Neolithic Britain more broadly. Results demonstrated most of the cattle appear to have originated in a geological domain farther from the site (Viner et al. 2010).

I do not know of any stable isotope research has been utilized at all on Crete. For Cyprus, the author knows only of two studies; one of which is conducted by Dr. Angelos
Hadjikoumis and collaborators who have successfully applied stable isotope analyses on early Neolithic sheep and goat dental material. The ongoing study involves oxygen stable isotopes to investigate the seasonality of birth, which is explored through the patterns in oxygen values. They collected samples of mandibular third molars of sheep and goat from *Ais Giorkis* and sheep from *Shillourokambos*. The logic of exploring seasonality of birth through oxygen stable isotopes is that oxygen values in meteoric water vary mainly according to temperature. This means that animals born around the same time of year would show maximum and minimum oxygen values around the same height along their teeth (e.g., Balasse et al. 2003). Studies such as this one can allow us to better understand whether the season of animal birth was manipulated by humans (Angelos Hadjikoumis, pers. comm., Sept. 2014).

I would like to use stable isotopes, specifically strontium and oxygen, to address patterns of mobility using primary data from *Ais Giorkis* for her dissertation research. Establishing the base line data alone will provide valuable information that will hopefully encourage other researchers to incorporate stable isotopes into their agendas for all time periods. It is important to note, however, that due to the current political situation on Cyprus, determining how people and animals moved across the landscape will be incomplete. Due to the conflict between Turkey and Turkish Cypriots and Greek Cypriots in 1974, one-third of northern part of the island is inaccessible to non-Turkish Cypriot archaeologists. Under international law, it is considered illegal to work in this part of the island, unless one is Turkish Cypriot (Knapp 2013:31). Hopefully, in the near future this conflict can be resolved so that we can all gain a better understanding of the prehistory of Cyprus in its entirety.
How were animals transported to the islands?

This is a challenging question to answer archaeologically, particularly in prehistory where we lack a written record. It seems more logical that people would transport young animals, rather than adult animals given the size and weight differences and the constraints of the watercraft technology. Vigne notes, however, that un-weaned young animals could not have been introduced unless there was knowledge of how to give them milk without the adult females, which is unlikely (Vigne 2013b:52). He concludes that the watercraft must have been large enough to carry animals that were weaned; thus weighing in the range of 120 to 150 kg, depending on the animal. Furthermore, there is the issue of how the animals were transported. Vigne (2013b:52-53) suggests that they must have tied them up and laid them down in the bottom of the boat. This occurs in Indonesia with deer. An apparent issue with this, however, is that after several hours, ruminants are subject to “downer cow syndrome.” This pathology includes necrosis of the hind limbs, myoglobinuria (myoglobin in the urine), nerve inflammation, and inflation of animals’ stomach due to gas build up from the bacterial digestion of cellulose. One wonders how truly severe this might have impacted ruminants because if this pathology was as severe as Vigne implies, it seems quite a feat that populations were ever established on Cyprus and Crete.

In sum, there is no consensus on how animals were transported to islands. As a result, I sought to look cross-culturally to see if there was any more information on this topic. The following chapter discusses this attempt using the electronic Human Relations Area Files (eHRAF).
CHAPTER 6

DOCUMENTING ANIMAL TRANSPORT AND WATERCRAFT TECHNOLOGY:
AN EHRAF STUDY

As demonstrated throughout this thesis, there are still many unanswered questions in regards to early seafaring both in the Mediterranean Basin and from around the world. One particularly interesting question is how animals were transported using watercraft technology. It was hoped that using the electronic Human Relations Area Files (eHRAF) might shed some light on this issue. This chapter outlines first the history of eHRAF and then discusses the study. It concludes with a brief discussion on ideas for re-conducting the study, which might be more successful.

The History of eHRAF

eHRAF first became available online in April of 2008. It now contains over a million pages of indexed information on approximately 400 different national, ethnic, cultural, and religious groups from around the world. The HRAF Collections first began to be developed in 1937 at the Institute of Human Relations at Yale University, under the supervision of Professor George Peter Murdock, the Institute’s Director Mark A. May, and a small team of researchers. They attempted to design a system in a way that allowed cultural, behavioral, and background information to be accessed about a given culture. A key part of this system was the universal classification scheme, termed the Outline of Cultural Materials (OCM), still an integral component to using eHRAF today (Ember and Ember n.d.:1-2).
In 1949, other universities began to have access to the Human Relations Area Files (HRAF), including Connecticut University system, Harvard University, the University of Pennsylvania, the University of Washington, and the University of Oklahoma. Today, hundreds of universities, museums, libraries, colleges, and research institutions both in the U.S. and around the world have either full or partial access to the HRAF Collection of Ethnography (Ember and Ember n.d.:3).

Until 1958, the HRAF Collection was produced and distributed as paper files. Source materials were manually printed on sheets of paper called File pages and these were filed by OCM and culture. After this date, wider distribution occurred with the development of the HRAF Microfiles Program. The paper files were processed into microfiche. An annual installment was then sent out to institutions that had access to the material (Ember and Ember n.d.:3-4). The electronic version of HRAF began to be developed in the 1980s. The first result of these efforts was the Cross-Cultural CDs, which provided researchers with ten collections on topics such as marriage, religion, human sexuality, and old age. These were taken from the HRAF’s 60-Culture Probability Samples Files. Additional installments were added each year. By April of 2008, all of the CD collections were moved online, with currently 165 cultures available (Ember and Ember n.d.:4).

It is important to note that eHRAF is mostly comprised of primary source materials. These include both published articles and books and unpublished dissertations and manuscripts (Ember and Ember n.d.:3). This also means that the material within the database is largely descriptive, rather than theoretical given that the majority of the primary documents are from field observations (Ember and Ember n.d.:4). Each culture is first
placed within a unique alphanumeric code according to the Outline of World Cultures (OWC) or their geographical regions, specifically Asia (A), Europe (E), Africa (F), Middle East (M), North America (N), Oceania (O), Eurasia—cultures located in the former Soviet Union and Russia—(R), and South America (S). One exception to this system is that predominantly Muslim societies in North Africa are classified as being in the Middle East. They are organized under Africa, but they retain the same OWC code as those in the Middle East (Ember and Ember n.d.:3). Ultimately, this is not problematic as the OWC code is de-emphasized in eHRAF. The focus instead is on the geographic region (e.g., Africa and Asia), and the cultures located within. This is further demonstrated given that several thousand cultures are listed in the OWC, but many of these are not included in eHRAF. The cultures within the database have been chosen based on several key criteria. Both maximum cultural diversity and geographical dispersal are important. The former ensures that the cultures should represent a range and variety of cultural types with regards to economy, social organization, history, and language (Ember and Ember n.d.:4). The latter enables the cultures to be representative of all major geographic areas and ecological settings. Adequacy of literature is also a significant factor. The culture needs to have adequate coverage for both qualitative and quantitative research. Special kinds of collections are also part of the database, in particular subcultures within North America have been included (Ember and Ember n.d.:4).

Every page within each document is both indexed and assigned a number that is specific to the subject category of codes according to the classification scheme of the OCM. There are 710 subject categories, plus a category labeled “000” for material that is not classified. These subject categories are then grouped into 79 major subject divisions, each
of which is assigned a three digit code. Within each major subject division, there can be up to 9 more specific categories (Ember and Ember n.d.:5). For example, Water, air, and space transport (500) represents the major subject. This category is then broken down into boats (501), navigation (502), waterways improvement (503), port facilities (504), water transport (505), aircraft (506), aviation (507), airport facilities (508), and air transport (509).

There are three major ways to conduct research using eHRAF; all of which depend on the question being examined. The first is the Probability Sample Files (PSF), representing a subset of cultures from the database. It is a particular kind of random sample known as a stratified random sample. The world was divided into 60 culture areas. One case/culture from each area was randomly selected from a list of societies that upheld specific criteria, including that the ethnography consisted of more than 1,000 pages and that the ethnographer resided with the cultural group for more than a year (Ember and Ember n.d.:5; Lagacé 1979; Naroll 1967). This means that the OCM codes chosen for the search only focus on these 60 cultures.

The second type of research method is the Simple Random Sample (SRS). This, however, is in the process of being built. The only criteria for cultures within this sample is that they had to be represented by one ethnography. Since cultures are added randomly to the database, the cultures found within this sample can be considered representative of most cultural groups worldwide. As of January 2014, there were only 28 cultures; thus, this is not a large enough sample. As a result, it is combined with the PSF to increase the sample size (Ember and Ember n.d.:7-9).
The final way to utilize the database is to examine all cases where the trait or custom might occur. Researchers would have to choose OCM codes and then scan through all the cultures found within them. This is particularly useful if the question involves a trait or custom that rarely occurs or is rarely described (Ember and Ember n.d.:7). Due to the specific nature of my interest in animal transport using watercraft technology, which is a rather obscure topic, this method was adopted.

**The Study to Find Cross-Cultural Evidence of Animal Transport Using Watercraft**

Three different sets of OCM codes were used to investigate whether any evidence for how animals were transported using watercraft technology could be found in the database. The first set of codes were ‘animal transport’ (OCM 492) and ‘water transport’ (OCM 505); both are subcategories under the major category of ‘land transport’ (OCM 490) and ‘water, air, and space transport’ (OCM 500), respectively. These codes were applied to all geographic regions (discussed above) and cultures within these areas. There were no hits from any culture. The author used ‘animal transport,’ even though it fell under ‘land transport,’ in hopes that perhaps it might have coded any type of transport (land or water) for animals. Unfortunately, this was not the case.

The second set of OCM codes utilized were ‘animal transport’ (OCM 492) and ‘Boats’ (OCM 501). The latter is a subcategory under ‘water, air, and space transport.’ Similar to the first study, these codes together were applied to all geographic regions and cultures within these areas. Similarly, there were no hits from any culture.

The final set of OCM codes used were ‘boats’ (OCM 501) and ‘water transport’ (OCM 505). This proved to be a bit more successful than the two previous studies. Appendix I comprises tables by major geographic region (e.g., Africa and Asia). The table
lists the subregion, culture, OWC for the culture, subsistence type, number of documents, and number of paragraphs within the documents that were coded with both OCMs. For Asia, there were 31 paragraphs in 21 documents in 14 cultures. Similarly, Europe yielded 30 paragraphs but in 8 documents in 6 cultures. Oceania had the highest number of paragraphs at 47. They were found in 27 documents in 12 cultures. Africa and Middle America and the Caribbean had similar paragraph numbers at 14 and 15, respectively. The former, however, were found in 11 documents in 11 cultures and the latter in 9 documents in 4 cultures. For South America, there were 19 paragraphs in 14 documents in 9 cultures. The Middle East had the fewest hits. The OCM codes together were found in 5 paragraphs in 2 documents in 2 cultures. This initially looks very promising. Unfortunately, upon reading through all of the paragraphs, most did not discuss animal transport using watercraft technology. Africa yielded two cultures and Asia, North America, and Oceania each had one culture that were somewhat relevant to the interest on documenting animal transport using watercraft technology. Each will be discussed below. Only portions of the relevant paragraph will be provided in this chapter; however, Appendix II has the entire paragraph, along with the citation for the ethnographer and ethnography where the information is pulled from.

Africa

The two cultures from Africa are the Banyoro (Eastern Africa) and Nupe (Western Africa); both are considered horticulturalists. For the Banyoro, Ethnographer John Roscoe notes, “…Canoes of this type on the Nile were sometimes large enough to take six cows at a time over the river…” For the Nupe, Ethnographic Mike Mason records, “…These canoes, which were commodious enough to carry cattle, donkeys and horses, probably
came originally from the south, although after many repairs by the eyadinci, they had become very much indigenized. Like Nupe weaving, Nupe canoe-building was the end product of a great deal of cultural and technological borrowing...” Interestingly, a footnote adds a bit more information to what these canoes could actually carry: “It is estimated that 41 large canoes at Raba carried 1,000 horses, donkeys and cattle across the river. A single canoe could ferry six to eight donkeys together with their drivers across the river at one time.” The passages from the Banyoro and the Nupe simply record what the watercraft could carry across rivers. Neither ethnographer discusses how these animals were transported, including whether they had to tie them up or give them some type of herbal remedy that would soothe them—ultimately, making it easier to transport the animals.

Asia

The Koryak, which are primarily hunter-gatherers from North Asia, were the only cultural group to provide relevant information. Ethnographer Waldemar Jochelson records:

The Koryak skin boat can carry fairly heavy loads. In the autumn of 1900 we crossed in two boats from the settlement of Paren to Kuel. As the former place is about seven miles from the mouth of the Paren River, the boats entered the river at high tide, and with the ebb-tide we sailed out into the open sea. We carried about two thousand pounds of cargo, and our party consisted of twenty-five members, — myself with four companions, and ten Koryak to each boat. In each boat there were eight oarsmen, among whom were women and lads. In addition, each boat carried eight dogs in harness, which lay in the stern. Notwithstanding this heavy load, the boats were not more than half in the water.
This paragraph is particularly interesting because it notes that dogs were harnessed and laid at the stern of a skin boat. As noted in Chapter 5, several sites from Cyprus have dog remains. Perhaps these animals were similarly harnessed and transported to Cyprus.

**North America**

The Ojiba are the other culture within North America that provided information relevant to the topic at hand. This group are hunter-gatherers from the Artic and Subarctic. It is important to note that the paragraph does not discuss use of a traditional watercraft. Rather, Basil Johnston records, “On this voyage there was installed at each corner of the vessel a five-foot birch stave. Three strands of wire connected the staves, thus forming a floating corral... The scow and its cargo would be towed by the Iron Boat, so called because its entire structure was of metal.” While the corral appears to be made mostly out of birch with some wire, ultimately it was towed by a boat made of iron. Thus, caution needs to be emphasized when attempting to use this group to provide some analogies for how animals were transported, given that traditional watercraft technology is not really used. The Ojiba were included in this discussion; however, because how they load the cattle onto the boat is particularly interesting:

By this time heifers and steers had slaked their thirsts and, while wading in the river, had lost some of their fear of water and were ready for more grazing. Even though the drovers conducted their roundup in a calm manner, with such reassuring comments as, “Come on, Ursula! It's okay, Wiltrud!”, the heifers' eyes opened wide in fright as they mounted the dock, heard their hooves clatter on the boards and felt the framework shudder; their eyes bulged and they tossed their heads in worry as they boarded the scow; they mooed as if remembering another voyage made by
their ancestors in another age. La Marr and Angus, who were both as strong as oxen, pushed a reluctant heifer on board. When all the heifers had been shepherded onto the deck, Brother Grubb bound the makeshift gate.

This passage suggests that the cattle were first waded in the water to get them comfortable with the environment and then loaded onto the floating corral. Perhaps cattle and other larger animals were transported to islands using a similar pacifying strategy. It raises the question, however, of how the animals were kept calm throughout the duration of the voyage.

**Oceania**

Similar to the Banyoro and the Nupe from Africa, William Davenport only notes the animal that the Santa Cruz Islanders, a group of horticulturalists from Melanesia, transported on their boats: “…Traditionally, Taumakoans have built puki, loaded them with cargoes of paddling canoes (te alo), sago flour, and pigs, and transported these to the Reef Islands where all, even the puki, were sold.” In spite of not noting how the pigs were transported, this case is particularly useful since it involves transporting pigs to an island. All of the previous examples were discussing river transport; thus, the Santa Cruz Islanders at least demonstrate that animal transport to islands was still occurring in the more recent past using traditional watercraft technology.

**Discussion**

Ultimately, this study did not shed a lot of light on the question of animal transport using watercraft technology. The Banyoro, the Nupe, and the Santa Cruz Islanders provided information on the types of animals that were transported. The latter are interesting, given that they emphasize that pigs were still being transported to islands in
the more recent past. The Koryak provide one hypothesis for how dogs were transported. It seems logical that they would also have been harnessed by the earliest seafarers in the Mediterranean. The Ojiba are the only group found that discusses how animals, specifically cattle, were actually brought onto the watercraft. While the watercraft itself is not ‘traditional,’ perhaps there is a precedent by other groups of getting large terrestrial mammals comfortable with the water first, before loading them onto the craft. Unfortunately, it is not discussed how the animals are kept calm throughout the voyage. In fact, Johnston notes in the passage that the corrals ultimately capsize and both the cattle and crew are swept into the river (Appendix II).

**Moving forward: ideas for how to improve the study**

My ultimate intention was to find some cross-cultural data on how animals might have been transported using watercraft technology. The goal was to be able to create hypotheses that then could be tested with the available archaeological evidence. As Wobst (1978) correctly emphasizes, the ethnographic record cannot be used to prove human behavior in the past. Even the hypotheses that are formed from it, must be treated with caution since they also reflect the ethnographers’ own biases in what is being recorded. The major way that the study can be expanded upon is to make it less confined. Instead of using the terms ‘water transport’ and ‘boats,’ I think that the search should instead be ‘water transport’ or ‘boats.’ Most of the information will most likely not reflect what the author is attempting to examine; however, combining the two terms together might also be restricting the information that could prove useful. This study might also illustrate simply that ethnographers were not interested in examining how animals were transported using watercraft technology. In sum, the current study does provide some information on the
types of animals transported and that some of these might have been harnessed or forced to wade in the water prior to getting on the watercraft. It is still useful data, given that we currently have a serious gap in our knowledge for this incredible feat of transporting animals to islands.
CHAPTER 7

CONCLUSION

The goal of this thesis, which was predominantly a literature review, was to examine the time frame of the LGM to the Early Holocene. Four questions related to seafaring in the Pre- and Early Neolithic were the main focus: 1) What were the climatic conditions faced by the earliest seafarers to Cyprus and Crete?; 2) What were the earliest types of watercraft used?; 3) What is the evidence for an early human presence on Cyprus and Crete?; 4) Is there ethnographic evidence cross culturally that documents how wild and domesticated plants and animals, but animals in particular, were transported between landmasses using watercraft technology? Each of the major points from these four questions will be summarized below.

Summary of the Major Findings

What are the climatic conditions faced by the earliest seafarers to Cyprus and Crete?

The main physical conditions of the Mediterranean Sea that would have impacted the earliest seafarers are sea levels and the layout of the basin (e.g., configuration of the Mediterranean islands), paleoclimate, tides, currents, and weather. Determining past sea levels globally can be difficult given that there are a number of different variables involved, including the effect of tectonics acting on the mainland or the added (or decreased) glacial ice weight on the continental shelf and deep-sea floor. In spite of these complex interrelationships of variables, sea level stands since the LGM can be calculated with a degree of confidence. For the Mediterranean Basin, regional studies have helped to increase this knowledge base. Ferentinos and colleagues (2012) have demonstrated that
there is some variation in the basin, but overall it seems that the global model generally holds true in the Mediterranean: during the LGM sea level was approximately 120-130 m below present levels. Ultimately, sea levels stabilized at roughly present levels by the Early Holocene with continued slight oscillations to the present. Future studies that focus on local regions will continue to refine our knowledge on changes in sea level stands from at least the LGM onwards. For now, there is little doubt that there was a significant change in sea level stand over the last 25,000 years, which directly impacted the configuration of the basin. Coastal plains extended much farther, decreasing distances between islands and the mainland or resulting in some islands becoming attached either to other islands or to the mainland. Of course, there were still some islands—in particular Cyprus, Crete, Kefallinia, and Zakynthos—that would have been oceanic even with these lower sea-level stands.

Similar to sea level stands and the configuration of the Mediterranean Basin, paleoclimates can be reconstructed with a fair degree of accuracy, due to data from oxygen isotopes and from pollen and geomorphology studies; to name just a few. Around the LGM, year round snow lay at elevations as low as 1500 m throughout much of Europe. Temperatures were significantly cooler in some areas of the basin with glaciers extending over the Alps, as well as in the Lebanese, Anatolian, Pyrenees, Atlas, and Apennine Mountains. Steppe-like conditions could be found in vast areas in North Africa and the northern Levant where they merged into tundra farther inland. The Sahara was also closer to the African coast as compared to the present. The return to interglacial conditions began around 20,000-19,000 B.P. and by about 15,000 B.P. year-round snow and ice could no longer be found in on most of the mountains in the basin. While there was a return to cold,
dry conditions for approximately 1,000 years, known as the Younger Dryas, the Early Holocene marks one of the wettest phases in the last 25,000 years.

In contrast to sea level stands, the configuration of the basin, and paleoclimate, weather (wind and atmospheric conditions), tides, and currents are more challenging to project for the remote past. Archaeological data, such as written records, are helping with this issue. It is reasonably safe to assume that if certain weather conditions, tidal conditions, and currents were at least known and recorded by scholars in antiquity, then there must be some deeper history to them. While it is important to be accurate in our reconstruction of the past physical environment of the Mediterranean Basin in its entirety, it was ultimately demonstrated that, more importantly, the earliest seafarers would have had to have intimate knowledge of all of these environmental conditions. They would have needed to recognize signs of approaching bad weather, the location of dangerous waters, the time of year they could participate in seafaring activities, and/or the duration of particular journeys. Like many other aspects of human invention, the earliest of these journeys probably involved trials and errors. It was from these failed attempts that the early seafarers would have gained the necessary knowledge about their environment to ultimately succeed in their seafaring efforts.

*What were the earliest types of watercraft used?*

For the Mediterranean, McGrail (2009:Table 1.2) hypothesizes that a range of watercraft types were used in the Pre-Neolithic through Early Neolithic. His assessment is based on an examination of the tool technology available for each period in question, which is then correlated with information concerning the earliest use of these tools in other artifact construction. Finally, he deduces whether the technology available could have possibly
been used to construct the different types of watercraft (McGrail 2009:10-12). Thus, these theoretical assessments raise the question of whether there is evidence for any of these types. As was demonstrated, there is some iconographic, documentary, ethnographic, and archaeological (direct and indirect) from the Mediterranean basin, which suggests broader categories of crafts were used, specifically: log rafts and boats, bundle rafts, buoyed rafts, and complex hide boats. Most of this evidence, however, comes from the later part of prehistory and early historical periods. Direct archaeological evidence, or the physical remains of the watercraft, is particularly lacking not just for the period in question but even for much of prehistory. Tantalizing evidence from La Marmotta suggests that log rafts might have been one of the earliest watercraft types. Whether or not this vessel was used at sea is currently known, but the technology was at least available. The bituminous amalgam from H3 also suggests that reed-bundle rafts were used at least in the Arabian Peninsula, but perhaps in the broader Mediterranean as well. H3 is also important given that there is evidence for use of sails, which pushes the first use of this technology back several thousand years.

What is the evidence for an early human presence on Cyprus and Crete?

In regards to Cyprus, Aetokremnos and the three other Epipaleolithic sites, that of Nissi Beach, Aspros, and Roudias, establish a firm human presence by 12,000 cal B.P. This makes Cyprus one of the earliest islands with substantial evidence for a Pre-Neolithic human occupation. Evidence from Aetokremnos is particularly interesting as it demonstrates that not just people, but also wild boar, might have been transported from the mainland to the island. Clearly, the watercraft technology and broader seafaring knowledge
was substantial during the Pre-Neolithic, even if we cannot find physical evidence for it in the archaeological record.

The material culture and subsistence focus (particularly with animals) during both the Cypro-PPNA and Cypro-PPNB illustrate that from the very beginning, the island was incorporating various elements of the Neolithic and beginning to shape its own local and island-wide identity. In regards to the Cypro-PPNA, pig dominates the faunal assemblages for both Asprokremnos and Klimonas. This adds support to the hypothesis that wild boar were introduced to the island during the Epipaleolithic. Cyprus would not be a unique case, as wild boar were also introduced to other Aegean islands prior to their corresponding Neolithic. This ultimately demonstrates substantial control over wild animals throughout the Mediterranean prior to their morphological domestication.

During the Cypro-PPNB, pig remains an important component of the diet; however, the dominant taxon at the majority of the five sites discussed is Mesopotamian fallow deer. This dominance continues on Cyprus throughout the Neolithic and into the Chalcolithic. This considerable reliance on the exploitation of deer by the inhabitants represents a distinctly Cypriot adaptation, without parallels on the mainland. The discovery of cattle at three of the sites is also particularly interesting, especially since they disappear by the Late Neolithic and are not reintroduced to the island until the Bronze Age. Reasons behind this disappearance are one aspect that I would like to explore in my dissertation.

In regards to Crete, there are still challenges to the notion of a Pre-Neolithic presence on the island, particularly given the lack of absolute dates for the artifact assemblages specifically and lack of excavations. In spite of these issues, Strasser and colleagues do present a pretty strong case, particularly since they have located twenty eight
sites from one part of the island, suggesting a pattern in the earliest human presence. The Paleolithic data are especially intriguing when combined with the evidence from Gavdos (Chapter 4), where excavators argue for a Lower Paleolithic human presence based similarly on tool technology. The fact that distance between the two islands is small today, suggests that they might have been connected. This might add support to the case that hominins were using watercraft technology far earlier than previously held in the Mediterranean. For both the Paleolithic and Mesolithic sites, excavations need to take place in order to see if any material is in situ. Such activities would also hope to find data that can be used for radiometric dating.

The Neolithic site of Knossos, similar to the Early Neolithic sites on Cyprus, demonstrate that a human presence by this time frame cannot be disputed. The differences in exploitation of animals between the two islands, particularly for deer and cattle, are interesting. The former are not reintroduced to Crete until at least the Late Neolithic. The latter are found in the earliest levels of site occupation and they remain part of the economic package for all of the Neolithic onwards. It is especially intriguing that they might have been used for draft animals.

Both Cyprus and Crete (former in particular) provide fairly substantial evidence for Pre-Neolithic seafaring, particularly since both islands have multiple sites dating to this time frame. By the Early Neolithic, there can absolutely no longer be any question of people’s occupation on both islands. The focus should instead be on these inhabitants adopt and utilize various aspects of the Neolithic package, emphasizing the importance of variation in the spread of the Neolithic; which is already a major research focus throughout mainland Southwest Asia and Europe.
Is there ethnographic evidence cross culturally that documents how wild and domesticated plants and animals, but animals in particular, were transported between landmasses using watercraft technology?

Ultimately, this eHRAF study did not shed a lot of light on the question of animal transport using watercraft technology. Use of the terms ‘water transport’ and ‘boats’ did yield some information from five different cultural groups. The Banyoro, the Nupe, and the Santa Cruz Islanders provided information on the types of animals that were transported. The latter are interesting since they emphasize that pigs were still being transported to islands fairly recently. The Koryak provide one hypothesis for how dogs were transported. It seems logical that they might also have been harnessed by the earliest seafarers in the Mediterranean. The Ojiba are the only group found that discusses how animals, specifically cattle, were actually brought onto the watercraft. Although the watercraft itself is not ‘traditional,’ perhaps there is a precedent by other groups of getting large terrestrial mammals comfortable with the water first, before moving them onto the craft.

**Putting All the Pieces Together: Why the Study of Early Seafaring is Important to Both the Past and Present**

Ultimately, this research has demonstrated that there are still many more questions than answers when it comes to early seafaring in the Mediterranean. Yet, continued research on this topic is important as it relates directly to us and our ancestors. For example, probably for many people who have been on the open sea or any major body of water, the use of sails is tied into their experience. In fact, it is difficult to imagine present-day seafarers having to battle the elements without this technological innovation. The invention
of the sail is a highly contentious issue for those interested in the earliest seafaring, as was discussed in Chapter 4. The data from H3 in particular does not prove that sailing occurred at other places outside of eastern Arabia; however, we should no longer deny outright that this is a possibility. In fact, Vigne (2009b) has suggested that the introduction of plants and animals to Mediterranean islands during at least the Neolithic would have required the use of a sail. Furthermore, he has created an illustration of what this vessel might have looked like (Vigne 2009: fig 7; Figure 7.1). While speculative, it at least provides the starting point for discussion on the possible use of this technology (DiBenedetto and Simmons 2014c:95).

Figure 7.1. Reconstruction of a Neolithic boat with a sail. (*Courtesy of Left Coast Press*).

The earliest evidence for the use of the first sail is associated only with modern humans. Yet, we know that our hominin ancestors have been using watercraft technology,
as suggested by Flores, Australia, and even Crete. A recent paper by Soressi and colleagues (2013) provides food for thought on the potential of our ancestors in manufacturing sails. They discuss whether Neanderthals had the ability to make *lissoir*, a specific kind of standardized bone tool. These tools are predominantly used in working hide. They are very effective at making animal skins tougher, more lustrous, and more impermeable. These tool forms are very distinct from stone tool forms, which is important because Neanderthal bone tools had previously been found. They mimicked, however, stone tool forms (Soressi et al. 2013:14186, 14188). Nearly identical fragments of four bone tools were recently recovered from two Neanderthal sites in southwest France. The authors conclude that these bone fragments were identical to *lissoirs* that have been found at modern human sites starting in the early Upper Paleolithic (Soressi et al. 2013:14186–14188). Thus, “The bones reported here demonstrate that Middle Paleolithic Neanderthals were shaping animal ribs to a desired, utilitarian form and, thus, were intentionally producing standardized (or formal) bone tools using techniques specific to working bone” (Soressi et al. 2013:14188).

It is important to note that the following discussion is based on my own ideas, which I have written about in DiBenedetto and Simmons (2014c:95-97) as well. Soressi and colleagues (2013) did not relate Neanderthals or *lissoirs* to sail construction. Of particular importance are two ideas: (1) that Neanderthals were capable of producing standardized tools, and (2) that some of these tools were used for hide-working. Sails were often composed of woven fibers; however, parts could have been made from hide or skin (Casson 1995:48; Johnstone 1980:57). The fact that Neanderthals were able to produce technology that could be used in hide-working implies that they might have had the capacity to make sails; although this is very speculative. Greater evidence from the Mediterranean islands,
in particular on Crete and the Ionian islands, is demonstrating that Neanderthals might have been early seafarers in the Mediterranean (Chapters 4 and 5). If they had the technology to work hide, then they perhaps could also have constructed sails. While this is a very hypothetical connection, it is still worth considering, given that, as seems more and more probable, *Homo sapiens* are not as unique as many of us believe. This particularly seems to be the case when it comes to early seafaring. Thus, by beginning a dialogue on the potential of our hominin ancestors, coupled with future archaeological evidence, we can begin to gain a greater understanding of the earliest seafarers in the Mediterranean (DiBenedetto and Simmons 2014c:96).

Regardless, with or without sails, watercraft are among the most complex and largest machines produced by hominins up to the start of the Industrial Revolution in the nineteenth century. They required very specific skills to construct and to navigate; thus, representing a highly specialized endeavor (Carter 2010b:102; DiBenedetto and Simmons 2014c:96-97). Furthermore, the Neolithic Revolution is often regarded as the earliest evidence for domestication of the natural world; yet, Bednarik (2011:102) notes that seafaring is truly the earliest example. It harnesses four major forces of nature: wind, currents, waves, and buoyancy. Given these implications, it is important to continue to study early seafaring as it clearly played a role in how our ancestors moved around the Mediterranean Basin (DiBenedetto and Simmons 2014c:96-97).

Study of early seafaring also raises the question of why people first began to navigate the open seas. The answer(s) to this will most likely never be known and will probably vary by place and people. Perhaps it was changes in the environment that pushed people to seafaring in order to acquire food resources. Population pressure could also be
an important factor. If the hinterland and coastal regions were becoming overpopulated, people might have turned to the sea as a means of escaping the situation and looking for other places to settle (DiBenedetto and Simmons 2014a:26). The idea for seafaring might have been sparked by examining naturally formed vegetation rafts. Hominins could have witnessed animals riding on such rafts after floods or tsunamis. It is believed that some islands were colonized this way—unintentionally, of course—by animals. Obviously, the earliest seafarers might have just been curious. In some cases, particularly in the Mediterranean, one can see islands from the mainland. They might also have seen smoke from naturally occurring fires, watched the movement of bird flocks, witnessed animals (such as elephants, known for being excellent swimmers) heading toward something unknown to humans at that specific point in time, or were intrigued by a strange cloud formation that occurred over mountaintops on islands (DiBenedetto and Simmons 2014a:26). The earliest seafarers might also have been simply daredevils who wanted to explore the sea because it was unknown. Regardless of their reason(s) for beginning seafaring, it must be kept in mind that this phenomenon is truly an incredible feat. It most likely became a specialist activity given the different types of knowledge required for a journey to actually be successful (DiBenedetto and Simmons 2014a:26). This knowledge might have been passed down to people via oral tradition (Farr 2006), similar to today with rhythms such as the one discussed in Chapter 3. Ultimately, in my view, seafaring should be seen as a social process, particularly since it involved coordination, knowledge, and specific skill sets.

Seafaring is also not just an issue relevant to the past. As discussed in Chapter 1, thousands of people are dying each year in the Mediterranean Basin, attempting to cross it.
This emphasizes the dangers associated with seafaring in general—past or present—given that technology is arguably more complex today. Thus, the study of seafaring and watercraft technology is timeless as it continues to impact our global community.
APPENDIX I

INTIAL HITS FROM EHRAF SEARCH

OCM Codes: Boats (501) and Water Transport (505)

Asia (31 paragraphs in 21 documents in 14 cultures)

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<td>Primarily Hunter-gatherers</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Southern South America</td>
<td>Yahgan</td>
<td>SH06</td>
<td>Hunter-gatherers</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
APPENDIX II

EXCERPTS OF RELEVANT PASSAGES FROM EHRAF SEARCH

Africa

*Bunyoro (East Africa)*

Roscoe, John


To make the dug-out canoes a suitable tree was felled and the required length marked and cut off. It was then shaped outside so that the two ends sloped inwards from the top to the flat bottom. The upper surface of the tree was smoothed, and the work of chipping out the wood to form the boat begun. This was a tedious task, for as a rule only native adzes were used, though some men declared that fire was at times applied to hasten the work. The tree was hollowed out until the sides were from three to four inches thick and the bottom generally somewhat thicker. Canoes of this type on the Nile were sometimes large enough to take six cows at a time over the river. The carpenter who made the canoe was often the owner and made his living by ferrying people over the water (p. 232).

*Nupe (Western Africa)*

Mason, Mike


Specialists in the field of woodworking were the eyadinci, who built small canoes
from tree trunks hollowed out and then laced end to end, and also repaired the larger ones, (eyako). As Crowther noticed,

\[\ldots\text{Very large trading canoes are constructed of broken pieces of canoes and rough boards, put together by iron nails}\ldots\text{the crevices or joints of the boards are stopped by the soft cotton of the bombax fruit.}\ldots\text{From the rudeness of this imperfect construction, the canoe is always leaky.}\]

Travelling by the eyako, a man spent ten days on the journey between Nupe and the Delta. These canoes, which were commodious enough to carry cattle, donkeys and horses\(^1\), probably came originally from the south, although after many repairs by the eyadinci, they had become very much indigenized. Like Nupe weaving, Nupe canoe-building was the end product of a great deal of cultural and technological borrowing (p. 56).

Asia

Koryak (North Asia)

Jochelson, Waldemar


AMS Press.

The Koryak skin boat can carry fairly heavy loads. In the autumn of 1900 we crossed in two boats from the settlement of Paren to Kuel. As the former place is about seven miles from the mouth of the Paren River, the boats entered the river at high tide,

\[\text{\footnotesize\(^1\)Ibid., p. 148, estimated that 41 large canoes at Raba carried 1,000 horses, donkeys and cattle across the river. A single canoe could ferry six to eight donkeys together with their drivers across the river at one time.}\]
and with the ebb-tide we sailed out into the open sea. We carried about two thousand pounds of cargo, and our party consisted of twenty-five members, — myself with four companions, and ten Koryak to each boat. In each boat there were eight oarsmen, among whom were women and lads. In addition, each boat carried eight dogs in harness, which lay in the stern. Notwithstanding this heavy load, the boats were not more than half in the water. We went on fairly fast, and covered a distance of twenty miles in three hours and a half. When we had turned the islets and the rocky shore at the mouth of the river, and had reached a low strip of coast covered with sticky clay, which had run dry with the receding tide, the skin boats approached the shore. The dogs were taken ashore and harnessed to the sides of the boats. They were driven by two lads, who ran behind them on shore. The oars were laid along the sides of the boat inside. The steersmen alone directed the boats so as to keep them within from six to nine metres from shore. Whenever a stone or a drift-log would catch the traces, the drivers would clear them (p. 538).

North America

Ojiba (North America)

Johnston, Basil


On this voyage there was installed at each corner of the vessel a five-foot birch stave. Three strands of wire connected the staves, thus forming a floating corral. A member of the crew equipped with a short pike was consigned to each corner to keep the passengers amidships. For this expedition Eugene, Angus, La Marr, and Shaggy were to
man the corners, while Cigar Butt was delegated to operate the pump, if operational, or to man the bucket.

The scow and its cargo would be towed by the Iron Boat, so called because its entire structure was of metal. It was said that it had formerly served as a lifeboat on an ocean liner; but since its overhaul two years before by Gerry Labelle, it now served the institution as a kind of all-purpose vessel, for transporting boys and equipment and “liddle cows.” Because of its shallow draught it was a much more useful craft than the larger Garnier. The Iron Boat, painted a dull red, was already putting, having been cranked into life by Brother Manseau, captain, engineer and navigator. Henry Tenniscoe was at the tiller.

“Ready?” Brother Grubb inquired.

“Anytime.”

“Okay, boys. Get liddle cows on scow. Nice an' easy. No make it scared. No make run … just walk.”

By this time heifers and steers had slaked their thirsts and, while wading in the river, had lost some of their fear of water and were ready for more grazing. Even though the drovers conducted their roundup in a calm manner, with such reassuring comments as, “Come on, Ursula! It's okay, Wiltrud!” the heifers' eyes opened wide in fright as they mounted the dock, heard their hooves clatter on the boards and felt the framework shudder; their eyes bulged and they tossed their heads in worry as they boarded the scow; they mooed as if remembering another voyage made by their ancestors in another age. La Marr and Angus, who were both as strong as oxen, pushed a reluctant heifer on board.
When all the heifers had been shepherded onto the deck, Brother Grubb bound the makeshift gate.

All the boys were at their stations.

“Okay, Brother!”

Brother Manseau eased the throttle forward from slow to full speed until the Iron Boat was fishtailing, roaring and throwing up a rooster tail of foam.

Nothing happened.

“The scow, she's stuck there somewheres,” Brother Manseau informed his fellow Jesuit after he had put the Iron Boat into neutral.

“You, Ankus, and Shaggy! Get these push poles and when boat starts, push hard.”

Brother Grubb himself laid his hands on a third push pole, part of the scow's emergency equipment. He nodded to Brother Manseau.

Eugene and La Marr were perched like koala bears on top of their stakes, their legs wrapped around the shafts. They called out cheerfully, “Okay, Brother!”

When the Iron Boat surged forward and her bow was uplifted in strain, Angus, Shaggy and Brother Grubb leaned into the poles. The scow creaked while the liddle cows mooed.

Perhaps the “polers” pushed too hard or perhaps a heifer broke ranks. Whatever the cause, the scow's stern lifted, throwing all the heifers and steers forward and pitching both them and the crew into the current. But even before the first heifer slid into the water, Eugene and Cigar Butt abandoned ship by diving into the water away from the herd; La Marr, too, escaped by leaping onto the dock. But Angus, Shaggy and Brother
Grubb slithered down the deck of the scow and vanished in four feet of Spanish River murk amid a welter of heifers and steers.

Brother Manseau brought the Iron Boat to a full stop and was instantly on his feet, cursing: “Maudit! Zhoopitaire! G--d d----d,” and other expletives designed to restore order at once. In between curses he shouted instructions to the writhing tangle of swimmers, animals and humans — “Get to shore, you danged fools! Swim! Swim! Get out of the danged water! Don' stay there! Don' drowns!” — and rendered what other aid and encouragement he could provide to the shipwrecked.

Fifteen of the heifers made straight for the river bank and, on gaining dry land, fled in all directions, with most of them stampeding up the road toward the village of Spanish pursued by three waterlogged but laughing and shouting cowboys, Angus, Shaggy and Eugene. Three heifers, swept by the current away from the disaster, floated downriver, all the while valiantly trying to change course for shore and safety. Immediately behind one of the heifers was Brother Grubb shouting “Help! Help!” but unwilling to let go of Trixie's tail long enough to wave for fear he would sink and drown.

La Marr, who had been watching the spectacle from the dock, espied Brother Grubb. “Haw! Haw! Haw! Hey, Beedj,” he managed to blurt out. “There's Brother Grubb goin' with the cows.” He pointed to four swimmers all drifting at the same nautical pace and bearing for the open waters of the North Channel and, beyond that, Lake Huron. “Haw! Haw! Haw!”

Brother Manseau sped off to the rescue.

Directly across the channel, five hundred metres away, were two truant heifers standing chest deep on a sandbar calmly feeding on reeds. How they had got there by
swimming at right angles against a port current was the subject of much speculation at the school for some years after the incident. Not even Father Dufresne, whose platform perch afforded him a bird's-eye view of the disaster unfolding below him, could give a rational account of the passage of Ursula and Erna. All he could recall with any clarity were the outrageous blasphemies uttered by Brother Manseau (pp. 120-122).

**Oceania**

*Santa Cruz Islanders (Melanesia)*

Davenport, William

1968  *Social organization notes on the Northern Santa Cruz: the Duff Islands*  

Throughout the Santa Cruz Group Taumakoans are justifiably noted for their fine canoes, and particularly for their great cargo-carrying craft called puki. Traditionally, Taumakoans have built puki, loaded them with cargoes of paddling canoes (te alo), sago flour, and pigs, and transported these to the Reef Islands where all, even the puki, were sold. With the proceeds they purchased staples and other products that they needed and paddled back to Taumako in one of the small canoes that they carried on the puki.

Purchasers of the large puki-type canoes in the Reef Islands (mainly the Polynesian-speakers of Pileni and Matema in the Outer Reefs) used them to make trade voyages further south to Santa Cruz Island, Utupua and Vanikoro. This inter-island trade system and the special currencies used in it have been briefly described already by this writer (p. 146).
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