Digging for DNA: A Genomic Approach to the Sea People Phenomenon

Vitek Weijland

S1715828

BA-Thesis

Supervisor Dr. S.A. Schrader

Leiden University, Faculty of Archaeology

December 15 2018

Contents

Acknowledgements

First and foremost, I would like to thank Sarah Schrader for guiding me towards the essence of the questions I wanted to investigate as my focus frequently derailed from one facet of research towards another. I would not have been able to maintain my focus on the essence of the thesis without Sarah's help.

I would also like to thank Ina Burema for always providing me with valuable insights with regard to style and word use. Without her help I would not have been able to put the words together that make up this thesis.

Abstract

The destruction of many of the great Near Eastern and Aegean states at the hands of the sea peoples during the 12th century B.C.E. has long been a contentious topic subject to controversy and speculation. Due to the absence of decisive archaeological evidence as to the identity of the sea peoples, countless researcher has speculated about the sea peoples' identity on the basis of the archaeological and historical evidence that was thus far available. These sources of evidence are, however, far from decisive as evidenced from the countless competing theories regarding the identity of the sea peoples and the part they played in the destruction of the great states that defined the Near East and the Aegean during the 12th century B.C.E.

In this thesis, I will investigate how the application of ancient DNA studies may help us to broaden our insight into the sea peoples' identity and origin. The limitations and opportunities of ancient DNA analysis will be outlined and the prospects it provides will be highlighted. The available DNA studies of interest will be examined and studied to shed new light on the identity of the sea peoples the role thy played in the wide dynamics of the 12th century Aegean.

Introduction

When Gordon Childe first set out the first comprehensive methodological framework for the nascent discipline of archaeology in the early 20th century B.C.E. he emphasized the link between material cultures and peoples. The study of material cultures was thought to be the primary avenue through which the peoples and cultures of the past may be approached. While how archaeologists approached the past evolved as paradigms shifted, the aim remained the same; learning about the peoples of the past, the cultures underlying the artefacts we find throughout the material record.

The processual archaeologists quickly deduced that more might be learned from the individuals behind the artefacts than we do from the artefacts themselves. The introduction of isotope analysis allowed archaeologists to reconstruct the diets of the people of the past while osteological approaches to the human record allowed for a broad reconstruction of lifestyle. Together, these approaches allow the archaeologist to scrutinize what an individual's diet comprised, what motoric movements defined a person's life as well as determining whether the individual suffered from disease or illness. Through the study of human remains alone, archaeologists could increasingly reconstruct the lives of the individuals they uncovered. The study of material culture was no longer, the sole avenue to understanding the societies of the past.

The latest tool with which the archaeologist may tackle the past has proven to be ancient DNA (often abbreviated as aDNA) as the analysis of ancient DNA is increasingly utilized within archaeological research. Ammerman and Cavalli Sforza made the first comprehensive attempt at incorporating DNA analysis within the study of archaeology in their work 'Neolithic Transition and Genetics of Populations in Europe' (1984) which spearheaded the application of aDNA analysis in archaeological research. In their book, the researchers argue that the spread of agriculture and domestication throughout Continental Europe resulted from emigration from the Near East rather than the previously accepted hypotheses that agriculture was gradually embraced by the indigenous hunter and gatherers of Europe.

The potential to apply ancient DNA studies to shed light on the significant events which define the human past is considerable as the nature of contentious topics such as the interaction between different peoples, migratory events, the process of domestication, and even evolution over the long term may be approached through the study of ancient DNA. The critical advantage of ancient DNA studies is that they allow us to verify or falsify many of the hypotheses that have long been grounded in speculation and doubt as the results of ancient DNA studies are believed to be quite absolute.

A series of recent aDNA studies published over the last few years uprooted long enduring hypotheses regarding relationality, ethnicity and evolutionary ancestry (Bolongino et al. 2013, Leonardi et al. 2016). These contemporary studies illustrate the potential ancient DNA studies

may have for the furthering of our understanding of the past as DNA stores information otherwise inaccessible.

Unearthing histories' lost peoples

It is only appropriate that the 'sea peoples', one of history's most enigmatic and mysterious peoples are approached through ancient DNA analysis. The sea peoples are shrouded by speculation and controversy as descriptions by their enemies and the layers of destruction they left in their wake are the only definite testament to their existence. With the absence of concrete evidence as to their identity and origin, ancient DNA studies may allow us to separate fact from fiction and reality from speculation as the findings derived from ancient DNA studies will allow us to tackle the 'sea people phenomenon' through means previously inaccessible

A multidisciplinary approach which integrates historical, archaeological and archaeogenetic sources of information will remove the uncertainty that has long shrouded the sea peoples and gives us a more complete and verifiable approach through which we may approach the sea peoples' identity and origin.

Defining the limits of ancient DNA analysis

Before approaching the application of ancient DNA and the ancient DNA studies presently available to us I will first discuss the most plausible hypotheses concerning the origin and identity of the sea peoples. After exploring the hypotheses that researchers before me have levelled at the sea peoples I will explore the historical and archaeological evidence available and use these as the outset from where we may guide our exploration of the archaeogenetic record.

Several elements pertaining to ancient DNA analysis are significant when considering whether ancient DNA analysis is a suitable avenue to follow if we are to attain more information about the sea peoples, their origin and their identity. The critical elements I will look into are the following:

- **What do the historical and archaeological records tell us about the sea peoples?**

- Is the recovery and analysis of ancient DNA a suitable avenue through which we may approach the identity and origin of the sea peoples?

- How do the findings from the presently available ancient DNA studies concerning the Late Bronze Age Near East relate to the archaeological and historical evidence?

- What does ancient DNA tell us about the possible origin or identity of the sea peoples?

Chapter 1: Present Hypotheses about the Sea Peoples

One of the most enduring 'lost people' mysteries concerns the inscrutable sea peoples whom we know only from a few historical sources and epigraphs dated to the 13th and 12th centuries B.C.E. Their arrival within the historical record coincides with the collapse of many kingdoms including the Mycenaean and the Hittite civilizations and with the abandonment of many cities throughout the Mediterranean (Kaniewski et al. 2011, 1; Cline 2014, 9). Because of this correlation, many historians and archaeologists believe that the entrance of the sea peoples in the Eastern Mediterranean is inextricably intertwined with the collapse of many of the great empires which had defined the political landscape of the Near East for much of the LBA (Kaniewski et al. 2011; Killebrew and Lehmann 2013; Cline 2014).

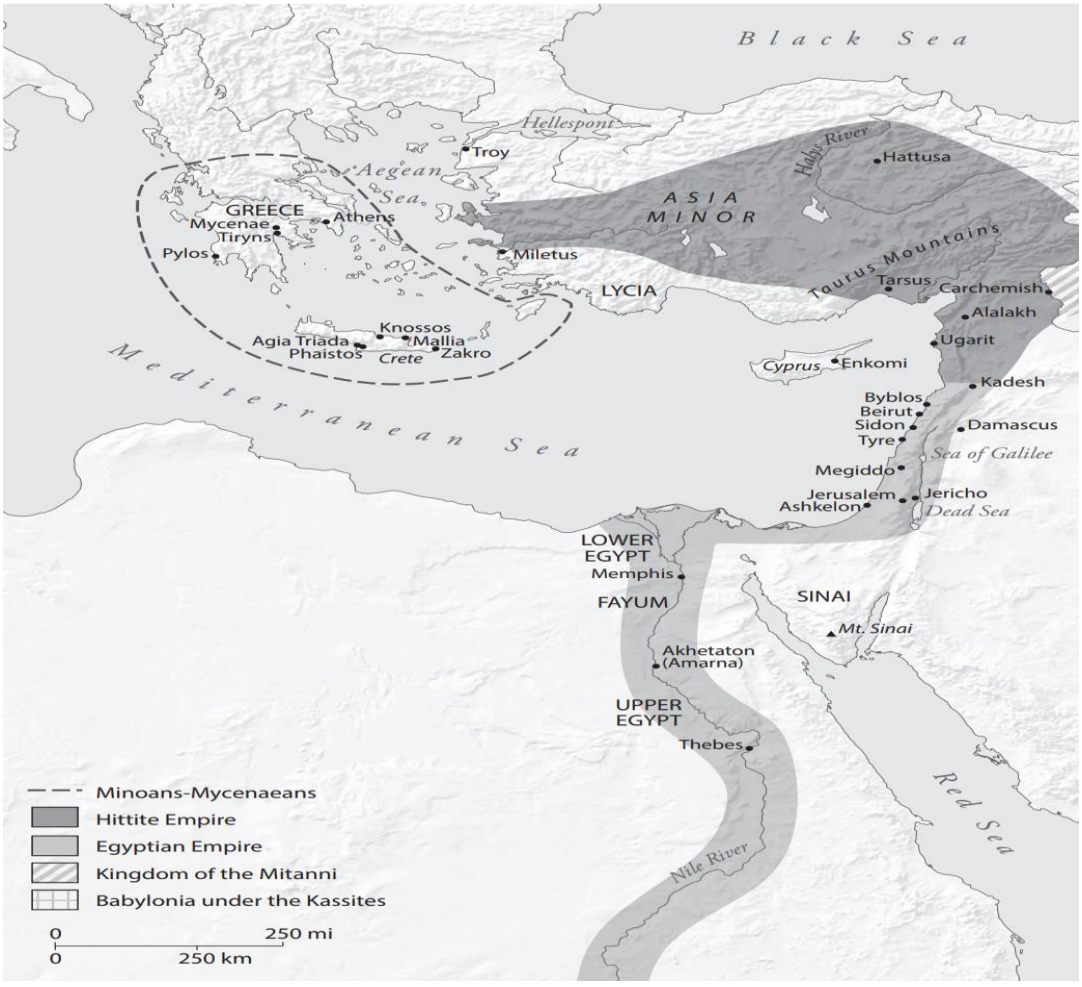

Figure 1 Map of the Late Bronze Age ca. 1200 B.C.E. from (Cline 2014, Frontispiece)

Our knowledge about the Sea Peoples remains limited as cuneiform tablets and epigraphs form our only source of 'reliable' information about the sea peoples and their entrance into the Near East (Cline 2014). The most informing historical sources concern the epigraphs of the Egyptian Pharaoh Ramses III inscribed throughout his mortuary temple. The epigraphs contain texts and depictions of the Sea Peoples and describe the sea peoples as a destructive and intrusive force that vanquished everything in its path.

"No land could stand before their arms: from Haiti, Qode, Carchemish, Arzawa and Alashiya on, being cut (destroyed) at one time." –Ramses (Wilson 1969).

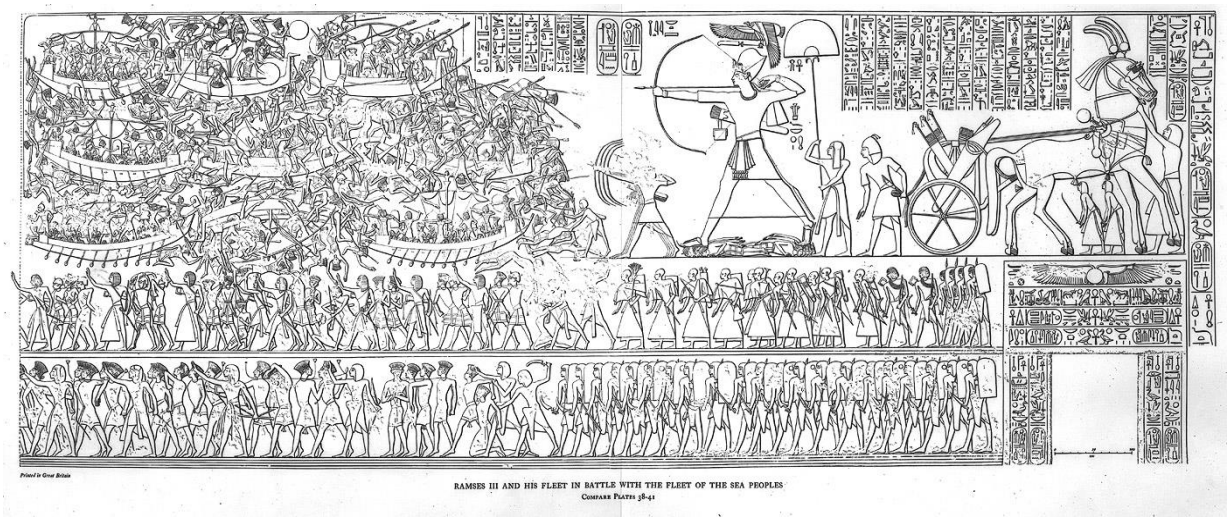

Figure 2 Depiction of Ramses III and his fleet in battle with the 'Sea Peoples' (Cline 2014, 5)

The destructive nature of the sea peoples' entrance into the Near East is evident from this epigraph and reflected by the archaeological record as the presumed entrance of the sea peoples in the 12th century B.C.E. coincides with the widespread destruction and abandonment of cities throughout the Levant (Kaniewski et al. 2011). Although their influence in reshaping the Eastern Mediterranean is unquestionable, we know little about their identity and origin due to the absence of any conclusive evidence regarding their origin (Cline 2014, 159. In fact, the only reason we know that the sea peoples existed at all is due to one of the epigraphs in Ramses III's mortuary temple where the sea peoples are described by name (Cline 2014, 3).

"Their confederation was the Peleset, Tjeker, Shekelesh, Denen, and Weshesh, lands united. They laid their hands upon the lands as far as the circuit of the earth; their hearts were confident and trusting as they said, "Our plans will succeed!" -Ramses III*, Inscription at Ramses III' mortuary temple (*Wilson 1969 in Cline 2014, 3*).*

Since Ramses describes a confederation of five different, peoples we may assume some form of either a political, ethnic or cultural division between these peoples. On the depictions related to the epigraphs, we see differences in the way in which the sea people warriors are depicted

compared to one another. Some researchers have interpreted this as a confirmation that the differentiated sea peoples each descend from a different locale.

Past Hypotheses about the Sea Peoples' origins

Over the last century, researchers have levelled countless hypotheses at the identity and origin of the sea peoples. With the absence of concrete evidence, researchers filled the void of uncertainty with speculation resulting in numerous competing hypotheses about the sea peoples' origin. Yet despite the sheer number of competing hypotheses the sea peoples' identity and origin remain shrouded in mystery.

Due to the absence of decisive evidence, researchers have drawn to typological similarities in material culture, 'linguistic conjecture', biblical tales and even the works of Herodotus to theorize about the origin of the sea peoples (Drews 1992, 14; Cline 2014, 4).

Theorized Sea People Origins

Many researchers have drawn upon the depictions throughout Ramses III' mortuary temple to hypothesize a possible origin for the sea peoples. Some have argued that the attires some of the sea peoples are adorned with are reminiscent of the material culture we know from the Nurargic civilization in Bronze Age Italy and Sardinia (Bar and Shirley 2011, 350). The main argument concerns the fact that the helmets the sea peoples wear in the Egyptian depictions are highly similar to the helmets we know from the Nurargic civilization.

A competing theory draws upon the same depictions to conclude that the sea peoples descend from Greece as some of the depictions we see throughout Ramses III' mortuary temple are reminiscent of the equipment the ancient Greeks utilized (Sanders 1978).

More speculative still are the numerous theories that utilize historical sources of questionable veracity to speculate about the sea peoples' origin. One of the most peculiar historical hypotheses concerns 'Anatolian Famine Hypothesis' which argues that the sea peoples descend from Anatolia (Maspero 1928 in Drews 1992, 21). The researchers quote a passage from the ancient Greek historian Herodotus:

"*In the days of Atys, the son of Manes there was a great scarcity through the whole land of Lydia ... So the king determined to divide the nation in half ... the one to stay, the other to leave the land. ... the emigrants should have his son Tyrrhenus for their leader ... they went down to Smyrna and built themselves ships ... after sailing past many countries they came to Umbria ... and called themselves ... Tyrrhenians."* (Herodotus 1, 94, 3.).

Interestingly, recent environmental and climatological studies lend some circumstantial credibility to reveal that the Mediterranean indeed experienced climatic change, which ultimately manifested itself in droughts (Kaniewski et al. 2010, 211). The droughts that resulted from changes in climate may have precipitated the sea people phenomenon as we know it as

diminishing resources increased population pressure and ultimately pushed peoples throughout the aridifying locales to relocate.

There are some hints within the archaeological and historical record that imply that the sea peoples who invaded the Near East in the 12th century B.C.E. descend from the Aegean (Yasur Landau 2010; Killebrew and Lehmann 2013; Cline 2014). The first hint concerns the spread of a 'humble analogue of Mycenaean pottery' throughout the coastal region of what today constitutes Israel, Palestine, and Lebanon (Yasur Landau 2010). The second hint is found on King Ramses mortuary temple where it is stated

'The foreign countries made a conspiracy in their islands.' -Ramses III, inscription on Ramses III' mortuary temple (Wilson 1969).

Since the only islands within the vicinity of the Near East are situated throughout the Aegean one may conclude that the 'Islands' Ramses alludes to must be situated somewhere within the Aegean. In light of this allusion, one could conclude that there is a reasonable case to be made to attribute an Aegean descent to the sea peoples.

The Philistine people are frequently perceived as being 'one of' or 'the' sea peoples we know from the historical sources. The Philistine sea people connection was initially founded upon linguistic similarities between the 'Peleset', one of the peoples named on the epigraphs describing the sea peoples in Ramses III' mortuary temple and the Philistines as they are described in the Bible (Cline 2014, 4). Some researchers have hypothesized a possible Aegean origin for the Philistinians on the basis of rough similarities between the material culture of the 12th century B.C.E. Aegean and the material culture uncovered throughout the Philistine sites (Aja, 2009, Meiberg et al. 2011, Killebrew and Lehmann 2013).

Not all hypotheses about the sea peoples' origin perceive the entrance of the sea peoples into the Near Eastern theatre as a migratory event. Hitchcock fields one of the most intriguing and thought-provoking hypothesis as he asserts that the sea peoples may not have been a people in the ethnic sense at all. Instead, Hitchcock argues, that the sea peoples are an early phenomenon of large-scale piracy where individuals descending from the entire Mediterranean partook (Hitchcock and Louise 2016). Hitchcock and Louise' hypothesis is mimicked by Sherret's hypothesis where she asserts the sea peoples constitute groups of 'powerful freelance sea merchants' rather than ethnic groups (Bauer 1998; Sharett 1998 in Killebrew and Lehmann 2013, 185).

The wide array of theories and hypotheses researchers have levelled at the question pertaining to the origin of the sea peoples attests to the inconclusiveness of the historical and archaeological evidence as 'big climate' induced migrations, 'biblical peoples', 'pirate confederations' and even 'merchant cartels' are all linked to the sea peoples (Bauer 1998; Sharrett 1998; Killebrew and Lehmann 2013; Hitchcock and Louise 2016).

A Comprehensive approach to the Sea Peoples' Identity.

To determine which of these hypotheses is correct I will examine the available archaeological and archaeogenetic evidence. The appearance of the Philistine material culture in the 12th-century B.C.E. will be explored and related to the other relevant material cultures found throughout the 12th century B.C.E. Aegean to narrow down which hypotheses may be correct in light of the archaeological evidence available to us.

Ancient DNA studies will also be utilized to narrow down the nature of the sea people phenomenon as the elements that are integral to the many hypotheses that have been levelled about the sea peoples are most accurately ascertained through the application of aDNA studies. Since the Arid environment that defines much of the Near East is conducive to the preservation of burial remains and aDNA, archaeogenetic studies should be a viable avenue that supplements the archaeological evidence available to us. Although none of the archaeogenetic, studies that have been conducted up to this point focused exclusively on the sea, peoples they do provide us with archaeogenetic data that is relevant to the sea people phenomenon.

By integrating the results derived from historical, archaeological and archaeogenetic sources the true nature of the sea people phenomenon may be assailed and the speculative may be separated from the solid.

Chapter 2: Reconciling Historical and Archaeological Evidence

The historical sources of the 12th century B.C.E. inform us of a large-scale invasion where mysterious peoples descending from various islands invaded the Near East. The violent nature of this invasion is attested by the ruins and destruction layers that may be found in the 12th century B.C.E. sites situated along the littoral zone of the Near East (Kaniewski et al. 2011, 1; Cline 2014). During this frame of time, a foreign ceramic category appears in Israel, Lebanon, and Palestine which shares many elements with the material culture found throughout the 12th century B.C.E. Aegean (Meiberg et al. 2011). This ceramic category has been identified as Philistinian as the sites throughout which this material category was first uncovered were described by the Bible as Philistinian sites (Cline 2014, 122). Some archaeologists have argued that the appearance of the Philistine culture in the Near East during the period of collapse in the 12th century B.C.E. implies that the Philistines themselves are 'the' or at least 'one' of the sea peoples who struck the Near East in the 12th century B.C.E. The earliest indication for a possible Philistinian descendance from the sea peoples is found in the historic record where it was argued that the "Peleset" Ramses III mentions on his mortuary temple is linguistically similar to the "Philistinians" the Bible describes many centuries later (Cline 2014, 4). According to some archaeologists, the 'foreign' origin of the sea peoples is reflected in their material culture which is believed to be more closely related to the material cultures of the Aegean than to those indigenous to the Near East (Aja 2009; Assaf Yasur-Landau 2010). Many other archaeologists, however, argue that the appearance of this new material culture typology throughout Israel and Palestine results from acculturation processes where the indigenous Levantine population embraced Aegean elements into their own material culture (Evian 2017).

The Philistine material culture

The 'Philistine' material culture is commonly identified under the CIII:1 typology and is first found throughout Philistine settlements in Israel during the 12th century B.C.E. (Meiberg et al. 2011, 32) On the basis of pronounced similarities between the CIII:1 Philistinian ceramic typology and the Mycenaean Late Helladic IIIB typology and the stark differences between the Philistine CIII:1 typology and the indigenous ceramic typologies found throughout Israel, researchers have argued that the CIII:1 typology is an iteration which is derived from the Late Helladic IIIB ceramic typology (Meiberg et al. 2011).

The Philistine CIII: 1 ceramic typology is decorated by motifs reminiscent to the motifs found throughout the vessels of the Mycenaean LIIIB typology (Meiberg et al. 2011, 11). Although petrographic analysis has shown that the vessels were constructed locally, the vessels are evidently inspired and constructed by Mycenaean conventions concerning pottery (Ben-Shlomo

2006: 191-192 in Meiberg et al. 2011, 189). The high degree of similarity and continuity between the Mycenaean IIIB typology found throughout the Aegean and the Philistinian IIIC: 1 typology implies that those who created the Philistinian vessels were either of an Aegean descendance or highly familiar with Aegean material culture.

The Aegean features constitute a variety of decorative motifs that often depict abstract geometrical shapes, but also symbolic figures such as fish or birds (Meiberg et al. 2011.). This is a sharp contrast with the 'indigenous Canaanite wares' which seldom feature such decorations (Meiberg et al. 2011, 197). These geometrical shapes and symbolic figures form the essence to the LHIIIC:1 typology and analogues to the IIIC:1 typology we find throughout the Israel and Palestine are found throughout much of the Aegean (Meiberg et al. 2011).

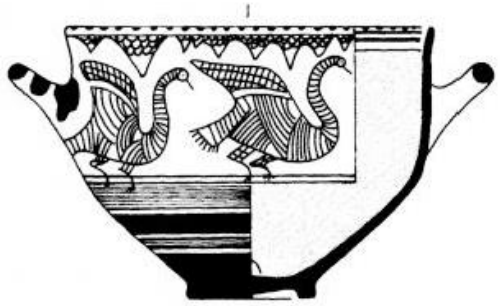

Figure 3: LHIIIC Category bowl. The bowl depicts two birds alongside geometrical decorations. Recovered from Mycenae, Crete.

Figure 4: LH IIIC Kalathos fragment, fragment depicts a bird. Recovered from Mycenae, Crete.

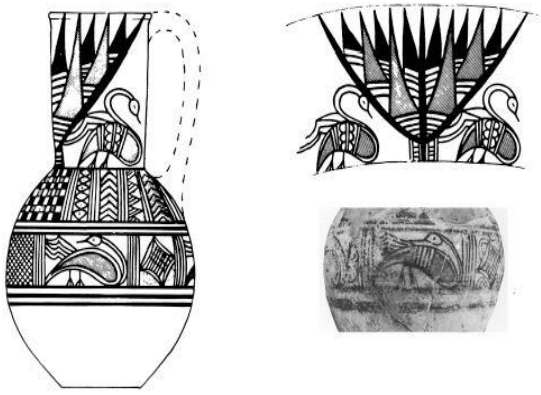

Figure 5: ICIII:2 Philistinian Stirrup vessel. Recovered from Azor Israel.

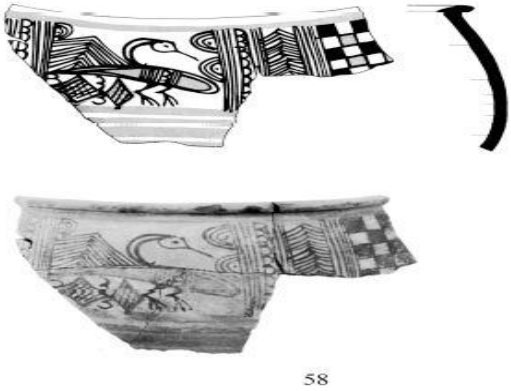

Figure 6 ICIII:2 Philistinian ring-based krater. Recoved from Ashdod, Israel.

The many elements that LHIIIC material culture found throughout the Aegean and the ICIII:1 and ICIII:2 material cultures share with one another make the material cultures remarkably

similar. It must, however, be noted that the decorations of the Aegean LHIIIC often possessed more intricate and intricate decorations than the Philistinian vessels. This has led some scholars to name the Philistinian ICIII:1 category as the humble Helladic category.

Absolute Chronolog	Crete	Mainland	Israel/Palestine
2000-1625 B.C.E	Middle Minoan Phases IB to IIIB	Middle Helladic phases I-III (MH I-III)	Middle Bronze Age (MBA)
1650-1450 B.C.E.	Late Minoan IA	Late Helladic I (LH I)	
	Late Minoan IB	Late Helladic IIA (LHIIA)	Late Bronze Age (LBA), Indigenous Canaanite Wares
1450-1400 B.C.E.	Late Minoan II (LM II)	Late Helladic IIB (LH IIB)	
1400-1300 B.C.E.	Late Minoan IIIA (LMIIIA)	Late Helladic IIIA (LHIIIA)	
1300-1200 B.C.E.	Late Minoan IIIB (LM IIIB)	Late Helladic IIIB (LH IIIB)	
1200-1000 B.C.E.	Postpalatial LMIIIC:1	Postpalatial LHIIIC:1	ICIII:1 Ceramic Category

Figure 7 Chronology of the Aegean and Israeli/Palestine Ceramic Typologies. Made by Author after data from Yasur-Landau 2010.

Unique or iterative?

It would be presumptuous to claim that the presence of material culture confirms the presence of a people. Numerous researchers have identified trade and exchange dynamics or acculturation as possible explanations for the sudden appearance of the IIIC:1 ceramic typology throughout the Near East (Drews 1998.). The Philistine phenomenon, however, transcends material culture alone as the Philistinian beliefs and culture were disparate from the Canaanite beliefs and culture (Tamar 2015 et al.).

This is evident considering that *Sus scofa* (pig) remains are frequently found near Philistine sites while the Semitic Canaanite peoples who inhabited the Levant before the Philistinians avoided the consumption of Sus scofa entirely out of religious reasons (Tamar et al. 2015.). The arrival of the IIIC:1 Aegean ceramic typology occurs contemporaneously with the influx of *Sus scofa* as the species appeared to have reentered Israel and Palestine during the 12th century B.C.E. (Meiri et al. 2017). Trade, exchange, and acculturation are unsatisfactory explanations for the sudden appearance of European *Sus scofa* haplogroups in Israel and Palestine as one would not expect peoples with an aversion to *Sus scofa* to import these into their territories. Acculturation is unlikely given the fact that the Canaanite and the other Semitic peoples who inhabited the region during the arrival of *Sus scofa* and IIIC:1 ceramics continued to avoid *Sus scofa* for long periods after the Philistine arrival (Tamar et al. 2015). This is further attested by the fact that the relative frequency of *Sus scofa* remains near a site is a good predictor for a site being either Philistinian or Canaanite/Semite with the presence *of Sus scofa* being an indicator for a Philistinian site while the presence of other domesticates but absence of Sus scofa being an effective indicator for a Canaanite site.

Philistinian Architecture

Architecture constitutes another element through which we may shed light on the origin of the Philistinians. Unlike ceramics, which may be transported, traded and exchanged over long distances, architecture is an element of an archaeological culture which follows its associated archaeological people (Aja 2009). The architecture of the structures found throughout the Philistine settlements the Philistines founded upon their arrival in Israel and Palestine is dissimilar to the architecture we know from the indigenous peoples who inhabited the Canaan before the arrival of the Philistines (Aja 2009).

Instead, the Philistine architecture appears to be defined by several distinctive Aegean elements. The most distinctive of these elements include rectilinear dimensions of the foundations which are reminiscent of the dimensions of the ‘megaron’ type foundations that are found throughout much of the Bronze-Age Aegean. Other possible Aegean elements include the presence of central hearths, bathtubs, and the use of axial pillars (Aja 2009).

In his 2009 dissertation about Philistine architecture attempts to establish a connection in architecture between Philistine architecture and Aegean and Anatolian architecture. Aja notes that the Philistinian architecture is most reminiscent to the architecture found throughout mainland Greece.

'The strongest parallels for the tradition, stretching into the early history of the Eastern Mediterranean, could be found in the Greek mainland, and not in the lands of Crete, Cyprus, or Anatolia, regions previously suggested as the possible cultural homeland of the Philistines.' (Aja 2009)

This hypothesis goes against most of the established origin hypotheses which argue for either an origin on the Aegean islands such as Crete or Cyprus or the competing hypothesis that the Philistinians ultimately descend from Anatolia. Aja does, however, provide very convincing arguments in favor of his hypothesis. The frequent utilization of axial pillars in Philistine structures may descend from the Greek mainland as mainland Greece was the only Aegean territory where axial pillars were integrated into structures at a similar frequency as they are found in Philistia (Aja 2009).

Historical sources on the Philistinian origin

As discussed in one of the preceding chapters, the Philistinians are presumably encountered in a variety of historical sources. The historical sources tell us remarkably little about the Philistinians themselves as the Philistinians' rivals and enemies our only historical sources about them. The oldest possible allusion to the Philistines is the Egyptian description of the invading Sea Peoples where the Egyptians name the *Peleset, Tjeker, Shekelesh, Denen*, and *Weshesh* as the invading peoples. Many scholars have linked the Peleset to the Philistinians because of linguistic similarities between the names '*Peleset*' and '*Philistine*'. Although such a linguistic connection is speculative, many have found this to be convincing, and it has long been the only way through which a culture known may be linked to the sea peoples as described by the Egyptians.

For centuries, little if anything is found in the written record about the Philistinians or '*Peleset*'. The first time they are encountered after the Egyptian descriptions of the '*Peleset'* is in the Old Testament where the Philistinians are described as the antagonists of the Israelite people. According to the Bible, the Philistinians descend from '*Caphtor'*, a place which biblical scholars have identified as Crete on the basis of linguistic similarities (Finkelstein 2002, 133). It should be noted that the Old Testament does not describe the sea peoples or the destruction associated with them; it only links the Philistinians with a place which is presumably unfamiliar to the Israelites. The Bible also provides us with several other statements that allude to a foreign descendance of the Philistinians as the names of many of the Philistinian encountered throughout the Bible are dissimilar to those of the Semitic peoples encountered throughout the Bible (Finkelstein 2002, 137; Uziel 2007, 167).

Some researchers have argued that the Philistinian names are of an Indo-European rather than a Semitic origin which would lend credence to the idea that the Philistinians are foreign to the

Near East (Sandars 1978). It is important to emphasize, however, that some Philistinian characters we find throughout the Bible bear names of a Semitic origin. This may be interpreted as the indigenous Canaanite population integrating with the newly arrived Philistinian population where both sides of the equation adopted elements of the other party. The fact that many Canaanite vessels are also found throughout the earlier layers of the Philistinian settlements attests to the multiform nature of the Philistine society.

Converging the findings

In light of the available archaeological and historical evidence, there are strong indications to believe that the Philistinians constitute one of the sea peoples we know from Ramses' inscriptions. The Aegean influences in the Philistinian material culture, as well as their diet, provide us with a strong indication that the Philistinians emigrated from the Aegean although an Anatolian origin cannot be ruled out entirely. The Egyptian inscriptions allow us to link the appearance of the Philistinian culture in the Near East to one of the peoples, which Egyptian sources describe as the sea peoples that wrought destruction throughout the Near East during the 12th century B.C.E. Since the text mentions islands, the historical sources give more credence to an Aegean origin than they do to an Anatolian origin. The linguistic link between the Philistinian names we find throughout the Bible and known Aegean names attests to a possible linguistic link between the two making an Aegean origin for the Philistinians likely from a linguistic point of view.

The exact origin of the Philistinians in the Aegean remains uncertain, however, as the historic and archaeological evidence do not allow us to definitely conclude that the Philistinians originate from mainland Greece as other locales throughout the Aegean and possibly Anatolia remain plausible locations of origin as well. The acculturation hypothesis, however, find little support in the historic and archaeological records presently available to as the acculturation hypotheses fail to explain the 12th century B.C.E. appearance of *Sus scofa* in the Near East.

Another question concerns the other four sea peoples the Egyptians describe. While the Philistinians have been hypothesized as being the 'Peleset', the other four peoples Ramses III names are harder to find within the archaeological record. It is of my opinion that the four other 'sea peoples' the Egyptians describe represent distinct factions within the same overarching Philistine culture. This view is alluded to given that the Philistinians settled Israel and Palestine by founding five presumably independent cities Ashdod Ashkelon, Ekron, Gath, and Gaza. It is likely that each of the five factions founded their own settlement. Support for this hypothesis may be found in the varied and eclectic nature of the Philistine material culture (Uziel et al. 2018).

Areas of further research

More research will be required to determine the exact region in the Aegean whereto we may trace the origin of the Philistinians and the nature of the other sea peoples. Ancient DNA studies will be a suitable avenue to shed more light upon these questions and as to how the Philistine migration relates to the collapse of the great civilizations that defined the Aegean and the Near East during the 12th-century B.C.E.

Such an inquiry may be realized by a comparative ancient DNA study where DNA recovered from the Philistinian sites is compared to ancient DNA recovered from layers dated to the 13th and 12th century B.C.E. in Mycenaean sites throughout the Aegean. Sites in mainland Greece and Crete would be of particular interest considering the material evidence available to us. The second area of interest would be a comparison of ancient DNA between the different Philistine sites as this would give us a more comprehensive insight as to the dynamics and origin between the Philistinian sites. If there would be a relatively high genetic dissimilarity between the inhabitants of the different Philistinian sites this would lend credence to the hypothesis that the five sea peoples Ramses describe concern five different 'Aegean' factions who founded their own and independent settlements following their takeover of Israel. A high degree of genetic uniformity would imply, however, that one founder group rather than multiple founder groups founded the settlements in the Philistines.

Further material studies

Another avenue to narrowing down the origin of the Philistinians and possibly the relationship between the different Philistinian peoples would be to study a comparative material study where material culture found throughout the Philistinian sites is compared to the material culture found in the 13th and 12th century B.C.E. Mycenaean sites. Aja and Stager already did a prelude to this in 2009 in their study of Philistinian architecture and its relation to the architecture we find throughout the Mycenaean world. The application of such a method to conduct comparative studies on the ceramics recovered from Philistinian and Mycenaean sites may allow us to trace the development of the Philistinian wares through the material record.

Chapter 3: Ancient DNA and Haplogroups

Deoxyribonucleic-acid, often abbreviated as DNA underlies all archaeogenetic research as an organisms constitution and haplogroups are ultimately coded by and legible through DNA. Advances in DNA recovery and DNA analysis techniques make the analysis of DNA recovered from archaeological contexts an increasingly viable avenue through which archaeological questions can be approached as little can be more informing of individuals long deceased than their DNA.

What is DNA?

Deoxyribonucleic-acid is a molecular structure which underlies and codes for all eukaryotic organisms on earth. Deoxyribonucleic-acid is a double-helix like structure which consists of two linked strands we know as polynucleotides. The polynucleotides consist of four separate nucleotides we know as (A) Adenine, (T) Thymine, (G) Guanine and (C) Cytosine. The two polynucleotide strings form the double helix through the bonding of the individual nucleotide groups with one another.

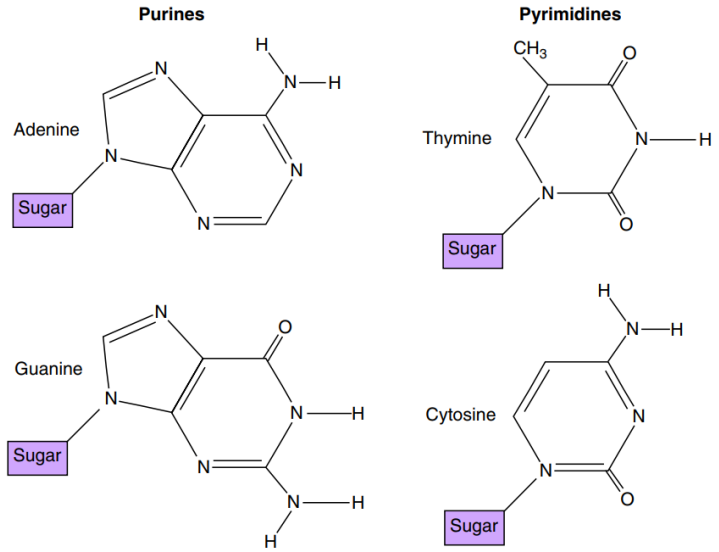

Figure 8: The four bases of which the DNA helix constitutes from https://beonline-bg.com/tru/uchebnici/27.VMF-LSotirov-TcvKojnarski/27.VMF-LSotirov-TcvKojnarski-html/moit-4.html consulted on 1-10-2018

To ensure regularity within the double helix (A) Adenine will always bind (T) Thymine while (G) Guanine will always bind (C) Cytosine. The sequence in which the nucleotides are bound ultimately codes for an organism's genotype. Each molecule of DNA codes for a number of genes. For example, Human DNA codes for approximately 30,000 ≈ genes (Hartwell et al. 2018). Genes express themselves through the creation of proteins which govern an organism's metabolism. Genetic differences will consequently result in diverging metabolisms with different organisms as a result. Variability in DNA is what makes one individual stand out from

another. By studying one's DNA we may thus get to know more information about an individual's appearance, health, and sex as an individual's phenotype is heavily influenced by its genotype. The genotype of an individual is legible through DNA sequence analysis (Hartwell et al. 2018).

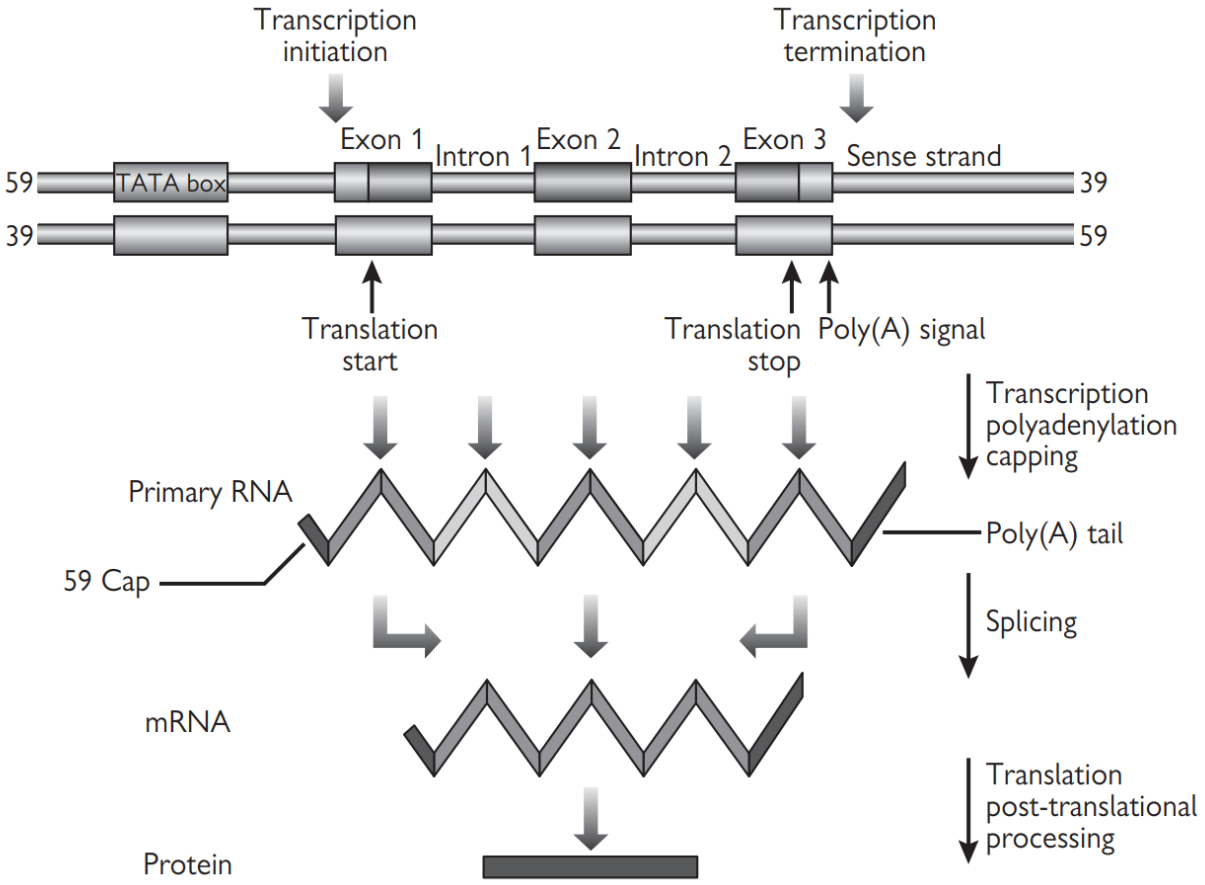

Figure 9 Schematic depiction of the process of Gene Expression (Wilkins 2016, 195)

Through a series of complicated reactions which include the transcription and splicing of a DNA strand, proteins will be created. The proteins are essential to an organisms metabolism and ultimately realizes the 'intrinsic ideal' DNA codes for. Proteins may be of some interest for archaeological research as their structures are more stable than DNA and consequently are likely to preserve to a greater extent than DNA does. Nevertheless, the amount of information that may be recovered from a protein is generally more limited than DNA as DNA codes for thousands of genes while a protein only mirrors one particular gene. When approaching questions pertaining to past diets or material artefact use, protein analysis may be of great use.

DNA Haplogroups in Archaeological Research

When interpreting human relationality through DNA studies, geneticists focus on so-called haplogroups, a series of alleles linked to one another due to them being on the same chromosome. In genetic studies, Y- chromosome-DNA and the Mitochondrial DNA are utilized as both genes are inherited from a single parent (Y-chromosome is inherited from the father while mitochondrial DNA is inherited from the mother). Because haplogroups do not derive from DNA recombination haplotypes experience greater continuity and stability than the DNA in the other chromosomes that undergo DNA recombination. Despite their stability, haplogroups gradually branch out in sub-clades over time due to mutations in either the Y-Chromosomal or mitochondrial chromosomal DNA. These random mutations within haplogroups are particularly useful for archaeologists as the degree of genetic proximity can be identified through the study of haplogroups.

The application of aDNA analysis in archaeology is founded on the premise that the DNA of two closely related individuals is more similar than the DNA of two distantly related individuals. This same principle may be utilized when we seek to relate different archaeological peoples to one another as peoples may be identified and related to one another on the basis of their haplogroups. Since the advent of aDNA studies in archaeology, researchers have linked archaeological cultures with haplogroups so that past events and the processes that resulted in changes in material cultures may be interpreted more thoroughly and the uncertainty inherent to the approach where peoples are equated to pots may be overcome. The study of haplogroups is well suited to shed light on migratory events as the spread of haplotypes and haplogroups mirrors the spread of the people who carry them (Ammerman and Cavalli-Sforza 1984). The migration of a people will thus be mirrored by the migration of haplogroups associated with them. Researchers have already used aDNA analysis to define prehistoric European peoples and relate or contrast these to one another (Ammerman and Cavalli-Sforza 1984; Montserrat et al. 2012).

The linking of a people with a material culture as envisioned by Gordon Childe can now be verified through the study of aDNA. Similarly, the proximity between the peoples underlying different material culture groups can now be measured. Since most of the hypotheses about the sea peoples focus on foreign migrations, aDNA studies will be a viable strategy to investigate the nature of the events which defined the Near East in the 12th century B.C.E. and to shed new light on the identity and origin of the sea peoples.

There are three sources of aDNA we may use to approach to explore the sea peoples' identity through the archaeogenetic record. These sources include human aDNA, zooarchaeological aDNA, and plantal aDNA. In this thesis, only human and zooarchaeological aDNA studies have been incorporated as no relevant plantal aDNA studies had been conducted on plantal remains that have been dated to a period that is relevant for the sea peoples' identity.

Chapter 4: DNA Preservation in Archaeological Environments and artefacts

Limitations of aDNA research

The primary limitation for the application of ancient DNA analysis is the degradation of DNA over time as DNA is inherently unstable without enzymatic repair processes found within living cells (Hofreiter et al. 2001). Once an organism ceases to live, the enzymatic processes which stabilize and repair DNA seize, DNA will degrade as several chemical reactions break DNA down (Hofreiter et al. 2001). The reactions which degrade DNA can be roughly subdivided into substitutive and destructive reactions.

The substitutive reactions alter the DNA strand's base pair sequence through the substitution of one base pair for another base pair. These substitutive reactions naturally occur within a living cell and are usually undone by repair-enzymes (Richter 2014). In DNA situated outside of a living cell, these substitute reactions are no longer undone resulting in a changed DNA sequence. The changed DNA sequence may inhibit DNA analysis as certain substitutes may interfere with DNA polymerase.

The second type of degradation involves the splitting of a DNA strand into several smaller strands as the bonds between two adjacent bases breaks. Once DNA is exposed to the environment, it will inevitably break up into smaller fragments since DNA is inherently an unstable molecule (Hofreiter et al. 2001). The rate at which DNA splits into smaller fragments is affected by numerous variables such as temperature and PH (Hofreiter et al. 2001, Richter 2014).

Empirical research has determined that the absolute limiting factor regarding ancient DNA preservation is its half-life of 521 years (Allentoft et al. 2012). The half-life of 521 years places a rough limit to the recovery of aDNA as DNA older than a million years will preserve in such minute quantities that DNA Polymerase is impossible. The DNA's half-life of 521 years is, however, rarely if ever the primary limiting factor as far as ancient DNA preservation concerned as several taphonomic processes break down DNA at rates which exceed DNA's half-life of 521 years (Allentoft 2012 et al.).

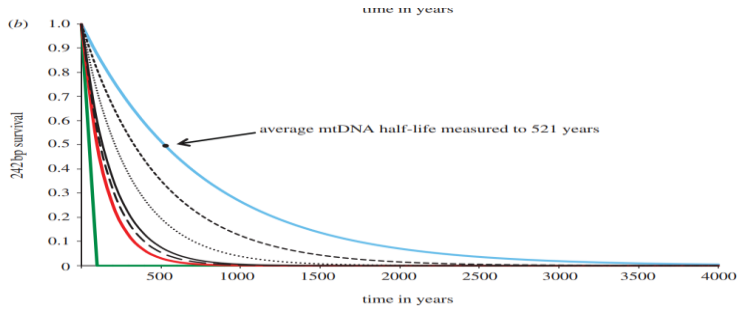

Figure 10: Half-life of DNA at various PH values (Allentoft et al. 2012)

Taphonomic processes

The first threat to a DNA strand's integrity arises when an organism dies as the body will no longer maintain an internal environment which keeps DNA and its associated enzymes stable (Richter 2014). The enzymes which repair damage to DNA will seize to function resulting in damage accumulating over time. Concurrently, the series of enzymes we categorize as 'nucleases' will start to degrade the DNA within a cell following an organism's death at a high rate. In serendipitous conditions, however, the nucleases may be destroyed or deactivated by certain environmental conditions thus limiting the degree of DNA degradation occurring immediately after an organism's death (Hofreiter et al. 2001). Conditions which result in the deactivation or destruction of these nucleases include low temperatures, high salt content, rapid desiccation, and a lack of oxygen (Hofreiter et a., 2001).
If the degradation by nucleases is averted a series of slower but persistent chemical reactions will start to gradually break down the DNA molecule into its constituent parts. Hydrolysis and oxidation are the main initiators of DNA degradation (Hofreiter et al. 2001). The rate at which these processes occur is generally determined by the environment. (Hofreiter et al., 2001)

Oxidative reactions

In oxidative type reactions, free radical atoms or molecules will alter one of the DNA strand's base pairs. Oxidation reactions typically target Guanine (G) and are executed by oxidative agents such as (O2, H2O2, and OH) reacting with Guanine to form 3-Hydroxyguanine which binds with Adenine rather than Cytosine resulting in the incipience of an alteration within the DNA. Since the reactive agents of O2 and OH are frequently found within natural environments, we may assume that these types of reactions will frequently alter DNA strands situated in natural environments.

Hydrolysis

Hydrolysis based reactions unbind molecules through the addition of H2O. Within DNA, the most common hydrolytic reaction removes amino groups from the four main bases which make up DNA. Deamination of the bases will result in the creation of different base pairs such as Uracil and Xanthine. The presence of these alternate base groups problematizes DNA polymerase and partially compromises our ability to interpret the DNA sequence. Since H2O is an element commonly found throughout most archaeological environments, the probability of Hydrolytic reactions occurring in ancient DNA is high. A Hydrolytic reaction may also initiate the separation of a base from the DNA strand through the breaking of the bond between a base and its bonded sugar.

Environmental conditions conductive to DNA preservation

Ultimately, the degree to which these reactions are initiated or averted is determined by the environment and the degree of exposure to the environment. DNA situated within protected environments such as bone or seeds will naturally preserve better than DNA exposed to the

environment directly as there's several barriers which separate DNA from reactive agents, radiation and microbial organisms which prey on DNA (Hofreiter et al., 2001).
The main variables which affect the degradation of ancient DNA are temperature, PH, heavy metals and oxygen content. The ideal circumstances for the preservation of ancient DNA would be cold and dry circumstances with the lower temperatures slowing down the chemical reactions which degrade ancient DNA. This bias towards colder environmental conditions is evidenced by the successful recovery of countless ancient DNA samples from frozen or permafrost sites. It is perhaps no coincidence that some of the oldest and most complete ancient DNA samples have been recovered originate from either arctic or near arctic climates (Willerslev and Cooper 2005). Warmer temperatures adversely affect DNA preservation as they increase the reaction rate of a number of degrading reactions.
Environments defined by wet conditions and warmer temperatures are very conducive to aDNA degradation as the warmer conditions increase the rate at which the degrading reactions occur (Richter 2014).

Variability in DNA preservation

All Eukaryote organisms contain two types of DNA. One is the familiar Nuclear DNA also known as nDNA which we find throughout eukaryote cells. The second type we know as mitochondrial DNA (mtDNA) which is situated within the Mitochondria of each a cell. Each of these types of DNA is unique for each individual although nDNA and mtDNA are passed down differently. Where an individual's nDNA results from the combination of both parent's DNA, mtDNA is only passed down through the maternal bloodline.
Mitochondrial and nuclear DNA appear to preserve differently as mitochondrial DNA is less degraded over similar periods of time (Allentoft et al. 2012; Campana et al. 2012). It has been hypothesized that mitochondrial DNA preserves better than nuclear DNA due to its different shape (it's circular, rather than linear) and because it's found within the mitochondria of the cell which adds another layer of protection to mitochondrial DNA. Since mitochondrial DNA is situated within the mitochondria, it does not suffer degradation at the hand of nucleases and other enzymes following the organism's death as the mitochondria forms a barrier to shield off the degrading nucleases (Hofreiter et al. 2001).

Retrieving ancient DNA from sediments

Sediments are a new potential source of ancient DNA as a number of studies succeeded in the recovery of ancient DNA from sediments (Oonk et al. 2012). DNA recovery may be a potential avenue to the reconstruction of past environments as faunal DNA is likely to be omnipresent. Recovery from sediments may also be extended to certain arid archaeological sites as the drier conditions allow for the preservation of DNA.
The immediate downsides to the recovery of DNA from sediments pertain a lack of knowledge regarding source, chronology, and contamination. Unlike recovering DNA from fossils or artefacts which would allow us to estimate or verify the DNA's probable source, sediments accumulate a wild variety of DNA over and proteins. Without contextual information, recovering DNA from sediments is akin to playing darts blindfolded; recovered DNA from an unknown origin will be sequenced leaving little room for interpretation of the results. The

downward leaching of DNA into soils presents another obstacle to interpreting chronology as the 'leaching' rate is highly variable and at present poorly understood (Oonk et al. 2012).
If nothing else preserves, however, the amplification and sequencing of human DNA found from such sediments may at the least provide information about the site's inhabitants or a sediment's past biosphere if macro or microfossils are absent from the sediment.

Interpreting archaeological contexts through DNA analysis

The application of biochemical approaches to archaeology precede DNA studies as the surveying of soils based on their chemical compositions has been conducted since the second half of the last century. These biochemical approaches utilized phosphates as a proxy for human presence as certain human activities are known to leave increased concentrations of phosphates.
Along the same line, aDNA recovered from sediments may attain a rough approximate about an area's past and present biosphere. Since DNA can generally be identified to genus level an area's ecology may be approached on the basis of aDNA present (and absent). Since DNA has a tendency to leach into soil or sediment contexts, a schematic chronology may be established based on stratigraphy although its accuracy is uncertain and often unverifiable. Researchers applied this methodology in New Zealand as they

sought to determine its applicability in archaeological research. New Zealand was suited in particular for this methodology due to its isolation from the rest of the world. The introduction of new genus' at known chronological dates allows for approximate dating within a soil as the presence of the introduced species DNA provides terminus post quem as said genus' DNA could have only made its way into the soil after the genus' arrived.
The study DNA and proteins recovered from sediments and soils may be extended to archaeological sites as an avenue to a more elaborate interpretation of site division and land use. The presence of proteins and DNA related to certain plant types and animals informs us about the sources of sustenance, even if no readily visible seeds or bones remain, or when the bones or seeds uncovered are damaged to a degree in which genus or species identification on the basis of morphology is impossible.
The primary concerns regarding the recovery and analysis of DNA recovered from sediments, soils, and archaeological contexts concerns uncertainty with regard to DNA leaching and a high variability with regard to DNA preservation. Only a limited number of contexts will preserve DNA to the extent it is legible over historical timespans thus severely limiting the possibility of aDNA application (Hofreiter et al. 2001). Due to leeching of DNA situated in archaeological contexts establishing a chronology may be difficult due to the rate of DNA leeching being variable and improperly understood.

Assessing the degree of DNA preservation

For archaeological research, the assessment of DNA preservation may be attained through a number of approaches ultimately depending on the nature of the archaeological site and finds. The environmental conditions are the primary variables which govern aDNA preservation. The nature of the environment should thus be the first thing one consults when contemplating aDNA recovery. In conditions believed to be conducive to the preservation of DNA, a number of proxy studies may be performed to attain insight into the degree of aDNA preservation (Poinar et al. 1996).
The preservation of collagen, an intricate molecularly structure found in bone is often seen as a proxy for aDNA survival as both break down under similar conditions (Sosa et al. 2013).
An alternative approach to assessing the degree of DNA degradation is provided by the process of amino acid racemization (Poinar et al. 1996). The process of amino acid racemization describes the gradual equilibrium reaction where L- optical isomers, which concern all-natural biological isomers, gradually react into D- optical isomers until an equilibrium between the two has been reached. The rate of racemization is affected by the temperature, the presence of water, and chelation (Poinar et al. 1996). The racemization rate is thus affected by the same variables which also affect the rate of ancient DNA degradation. The degree of DNA racemization, being the ratio between the L- and D- isomers, may be seen as a proxy to the degree of DNA degradation.

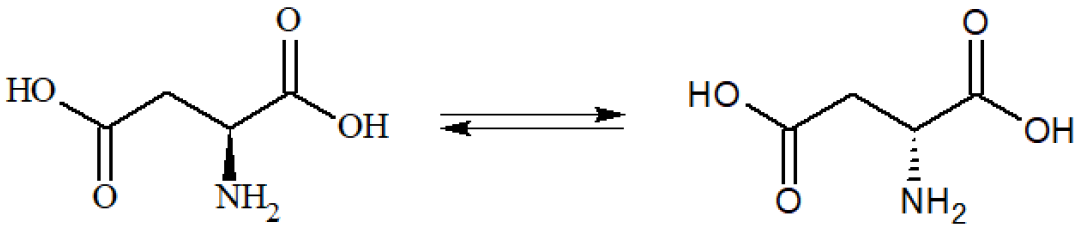

Figure 11 Racemization reaction Aspartic Acid L to Aspartic Acid D. The reaction is an equilibrium meaning that the balancing reaction occurs at a faster rate than the opposite reaction. Made by Author

Empirical research has shown no aDNA may be recovered when the ratio D/L isomer ratio surpasses 0.08. In light of this, we may assume significant and legible amounts of aDNA are irrecoverable from samples where the racemization between D and L isomers is close to or exceeds 0.08 (Poinar et al. 1996).

DNA recovery from artefacts

Few studies have looked into the possibilities of DNA recovery from artefacts even though artefacts may be a potential source of ancient DNA as human DNA is readily transferred to objects. Within forensic sciences, the presence or absence of human DNA on certain objects or items has become an integral aspect of criminal inquiry. For the archaeologist, artefacts would be a serendipitous source of ancient DNA as they would provide us with a verifiable avenue to interpret human-object relations in past societies.

The main limitation to DNA recovery from artefacts are the lower quantities of ancient DNA found on artefacts when compared to bones or seeds. Touching artefacts leaves minute quantities of DNA which may be too few for even DNA polymerase. Since DNA will be 'deposited' on the exterior of an artefact it will not be shielded from the environment like DNA found within bones or seeds is. When approaching artefacts, we thus ought to contemplate the environmental conditions in which the artefact was found as the degree of DNA preservation is primarily a function of environmental circumstances.

Artefacts of particular interest to ancient DNA analysis are those which are frequently touched, wielded or adorned meaning baskets and clothing are potential sources for aDNA extraction when they do preserve (Richter 2014). Ceramics may also yield proteins and DNA in both the interior as well as the exterior as foodstuffs are prepared in a ceramic's interior while ceramics are handled from the exterior thus potentially leaving DNA on the exterior (Hansson and Foley 2008).

Other objects such as pieces of flint as well as swords, arrows, spades, and ploughs could intuitively be seen as potential sources of ancient DNA as they preserve well in circumstances which typically preserve DNA. However, their metal-based composition increases the rate of DNA degradation thus significantly reducing the degree of DNA preservation making such metal artefacts unsuited for DNA recovery.

In light of the relatively low quantities of ancient DNA present on artefacts as well the fact that DNA situated on artefacts will generally be poorly shielded from the environment artefacts and artefacts are easily contaminated by modern DNA during excavation archaeologists may not be an ideal source for ancient DNA. In serendipitous circumstances, however, ancient DNA may be recovered from artefacts with a high possibility of success. Such ideal circumstances include caves and tombs as these locale's limit degradation due to the absence of H2O and degrading microorganisms.

Excavations at a cave near the Great Salt Lake, USA, recovered and successfully sequenced human DNA from the cordage found in the site (Richter 2014).

In fortuitous circumstances, artefacts may indeed be utilized as a source for ancient DNA although this utilization of artefacts for ancient DNA is only applicable to a limited number of environments and archaeological contexts. Due to the minute quantities of ancient DNA, we will generally encounter on artefacts avoiding contamination is integral to the successful application of ancient DNA analysis.

The Viability of an archaeogenetic approach in Israel and Palestine

Ancient DNA analysis of Philistinian remains constitutes the most direct means through which we may determine whether the Philistinians are one of the sea peoples as some have argued. Before discussing the possibilities of an aDNA study, we will first have to discuss the feasibility of recovering aDNA from Philistinian sites.

The five Philistinian sites of Ashdod, Ashkelon, Ekron, Gath, and Gaza situated in Israel and Palestine are the most suitable target for aDNA analysis as we know that the Philistinians occupied these sites for long periods of time. While the dynamics that govern ancient DNA preservation in open environments are too complex to allow for a definite forecast regarding the degree of aDNA preservation. Environmental changes occurring between the end of the Philistine occupations and the present are another concern as the precise environmental conditions during the Philistine occupation of Israel and Palestine are not fully understood. On the basis of soil continuity and ecological continuities, I believe that we may presume that the environmental conditions which defined the Millennia between the end of the Philistine occupation of Israel and Palestine are similar to the environmental conditions we know now.

Israel and Palestine are defined by a relatively warm and dry climate with comparatively low soil moisture concentrations. The soils found throughout Israel and Palestine are predominantly calcareous and contain relatively high concentrations of salts. In light of this, one could assume that the conditions throughout Israel and Palestine are conducive for the preservation of aDNA as they are predominantly dry, basic and saline; conditions conducive to the preservation of most bioarchaeological remains and aDNA. The primary variable that negatively affects the of aDNA would be the high temperatures that define Israel and Palestine over the summers.

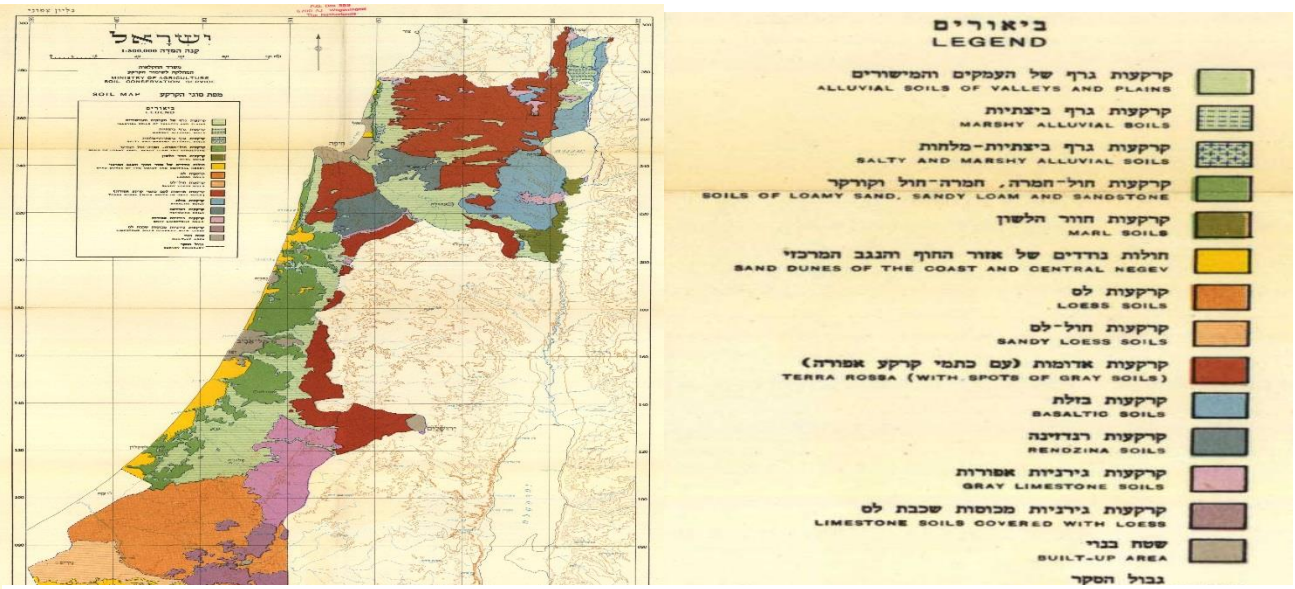

Figure 12 Soil Chart of Israel with legend. The Laamy Sand soils and Sand Dune soils are likely to lend us the greatest degree of aDNA preservation in light of their calcareous composition and coarseness. The sites of Ashdod, Ashkelon are situated within these two favorable soils making them ideal sites for aDNA recovery.

In comparative terms, the environmental conditions throughout Israel and Palestine will be relatively conducive to the preservation of aDNA although the variations throughout the territories are immense as Israel and Palestine contain a great diversity of soil types with unique characteristics.

While the Philistine sites of Ashdod, Ashkelon, and Gaza are situated along the Mediterranean littoral zone and overlie sandy dune and brown soils (Dan et al. 1970). The inland settlements of Ekron and Gath overlie the dynamic vertisols. Vertisols are perceived as being unfavorable to the preservation of bioarchaeological remains because the clayey vertisols draw in large quantities of water which may start hydrolysis reactions with aDNA which will ultimately result in the degradation and diminution of aDNA (Hofreiter et al. 2001).

The brown soils along the littoral zone of Israel and Gaza would technically be more conducive to the preservation of aDNA as they are calcareous and moderately basic with PH values of approximately 7.5 ~ 8.0 on average (Dan et al. 1970). Since they do not absorb water to the same extent as vertisols do, the damage derived from hydrolysis reactions is limited. Long enduring irrigation practices conducted on the dark brown soils near the littoral zone may have precipitated hydrolysis reactions, resulting in DNA degradation through hydrolysis (Dan et al. 1970). One element of interest concerning soil humidity is the fineness of the soil itself. Since water infiltrates through coarse soils at a faster rate than it infiltrates through fine soils, excess exposure of aDNA or organic remains to water is likely to be more limited in soils defined by finer particles. The most promising environmental conditions for the preservation of aDNA throughout Israel and Palestine are likely to be found in locales with calcareous soils defined by coarse particle textures of a saline disposition.

Conclusion

Although the environmental conditions in Israel and Palestine are not ideal for the preservation of aDNA due to the rainfall that comes with being a littoral territory it must be noted that most other variables are conducive to the preservation of aDNA as most of the soils throughout Israel and Palestine are calcareous, relatively saline, and on the lower end of the humidity scale. The successful recovery of aDNA from more 'degrading' environments than the environments that define Israel and Palestine provides us with an indication that the environment of Israel and Palestine does not present us with an obstacle that may not be overcome.

Some recent aDNA studies conducted throughout Israel and Lebanon attest that aDNA studies are a viable methodology as aDNA has been successfully recovered from several contexts that significantly predate the 12th century B.C.E. In light of this, there is no reason aDNA analysis will not be a viable method to tackle the sea people phenomenon as the Philistine phase falls within the window of time within which aDNA preserves in meaningful quantities and the conditions that define the environments of the Philistine sites are more benign to the preservation of aDNA than the conditions of many sites where aDNA has already been successfully recovered.

Chapter 5: Exploring the Dynamics of the 12th century Collapse through aDNA

Since aDNA is well posited to illuminate questions about past migrations, domestication and relationality, it would be an ideal methodology through which the current hypotheses about the sea people's origin and their role in the events of the 12th century B.C.E. may be verified or falsified. The avenues through which aDNA and archaeogenetic approaches may shed new light onto the sea peoples phenomenon will be explored and the aDNA and archaeogenetic studies available will be utilized to verify or falsify the present hypotheses about the sea peoples or to reach a new hypothesis altogether.

Uncovering the sea peoples' identity through haplogroups

If the 'migration hypotheses' are correct and the sea people phenomenon constituted a migratory event where the sea peoples invaded and subsequently settled the Philistia, we should be able to discern such a migration by an influx of 'foreign' haplogroups into the Near East. A comparative analysis where the 'Philistinian' haplogroups are compared to known haplogroups throughout Anatolia and the Aegean may allow us to narrow down the exact origin of the sea peoples as the prevalent haplogroups in the Aegean and Anatolia are known to us.

In the first chapter, I described the two migration hypotheses which find support in the historical and archaeological records. These hypotheses, the 'Aegean Migration Hypothesis' and the Anatolian Migration Hypothesis' identify the appearance of the Philistine IIIC: 1 material culture in the Near East as evidence of a migratory event where peoples from either the Aegean or Anatolia entered and settled the Near East. The appearance of the foreign IIIC: 1 material typology into Israel and Palestine forms the foundation for the migration hypotheses as the proponents argue that the appearance of the IIIC:1 typology can best be explained through migration (Dothan et al. 1992; Barako and Stager 2001). The proponents of these hypotheses have identified Natural Events, Climate Change and political unrest throughout the Aegean and Anatolia as push factors that underlie the migrations of people from the Aegean or Anatolia (Barako and Stager 2001, Cline 2014, 142).

Other researchers disagree, however, as they assert that the appearance of the IIIC:1 ceramic category does not attest to the arrival of foreign peoples into the Near East (Evian 2017; Hitchcock et al. 2017). They emphasize the existing differences between the LHIIIC: 1 ceramic category and the IIIC:1 ceramic and argue that trade and exchange initiated a process of acculturation where the indigenous population of Philistia adopted elements of the Aegean material culture into their own material culture.

The application of aDNA analysis will allow us to categorically verify or falsify each of these hypotheses, as each of the outlined hypotheses will manifest itself differently in the archaeogenetic record.

The Aegean and Near Eastern Archaeogenetic Record

While no aDNA study about the sea peoples or the Philistinians has been published as of 2018, several aDNA studies tangentially related to the sea people phenomenon have been published. These studies will help us establish the criterion through which the sea people identity may be approached and provide us with new clues to the sea people phenomenon. In the interest of data visualization, I have categorized the various haplogroups that were found in the aDNA studies on their regional origin. Sometimes, however, a subclade of a haplogroup cannot be evidently linked to one region in particular in which case I have classified the subclade under the region of the origin of the main haplogroup it is derived from. Another issue that arises is the distinction between Caucasian haplogroups and Anatolian haplogroups as the population of ancient Anatolia frequently carried haplogroups that are presumed to be of a Caucasian origin. Since the Anatolian and Caucasian haplogroups are so closely intertwined in the ancient populations of Anatolia and the Aegean I have categorized the Caucasian haplogroups as Anatolian in this study as they can be related to the Anatolian peoples.

The Aegean

Several aDNA studies have been conducted throughout the Neolithic and Bronze Age Aegean. The 2017 aDNA study by Lazaridis which examined the haplogroups the Aegeans and Minoans carried is the most relevant of the studies due to the large number of samples that were taken (19) and the chronological proximity of the studied remains regarding the sea people phenomenon. The study included samples taken from the Greek mainland, Crete, and Anatolia, and sought to determine the origin of the Minoan and Mycenaean civilizations (Lazaridis et al. 2017).

Lazaridis' 2017 study revealed an Anatolian descendance for the Mycenaean and Minoan individuals they studied as the majority of the sampled individuals carried haplogroups of an Anatolian origin (Lazaridis et al. 2017). Three out of the four male individuals found in the Aegean sites carried sub-clades of the 'J2' Y-haplogroup, a haplogroup associated with Anatolia while the fourth individual carried Haplogroup G2a2b2, a haplogroup of a northeastern-European origin. All of the individuals carrying the 'J2' Y-haplogroup could be dated to the period between 2000 and 1200 B.C.E. The individual carrying the g2a2b2 Y-haplogroup was dated to sometime between 2900 and 1900 B.C.E. The individuals recovered from sites throughout Anatolia have not been included in the results, as they will be discussed in the section concerning Anatolia.

The mitochondrial haplogroups exhibited a greater degree of diversity as 12 unique sub-clades were uncovered throughout the 16 samples recovered from mainland Greece and the Aegean. Twelve of the sixteen mitochondrial-haplogroups could be related to Anatolia or the Aegean while four of the mitochondrial haplogroups were found to be of a northeastern origin.

Anatolia

Only a very limited number of aDNA studies of Neolithic or Bronze Age Anatolian remains have been published as of 2018. Lazaridis' 2017 study analyzed the remains of three Anatolians recovered 100 km north of modern-day Antalya. The remains have been dated to sometime between 3000 B.C.E. and 1800 B.C.E. Since only one of the three studied individuals was male only one Y-haplogroup could be sampled. The Y-haplogroup was identified as 'J1a', a haplogroup thoroughly associated with Anatolia and the Near East. The mitochondrial haplogroups could all be related to Anatolia but were not dissimilar to the ones found in the Aegean as the peoples who constituted the Bronze Age Aegeans ultimately descend from the Anatolians (Lazaridis et al. 2017).

The Levant

A 2017 aDNA study recovered and analyzed the aDNA from five Canaanite individuals dating to the approximately 1700-1600 B.C.E. from Bronze Age Sidon (Haber et al. 2017). The two male Canaanite individuals carried Y- haplogroups 'J1' and 'J2'. Haplogroup 'J1' is assiduously associated with the Near East while haplogroup 'J2' is more commonly associated with Anatolia and the Caucasus.

The studied individuals carried a diverse set of mitochondrial haplogroups as each individual carried a unique subclade. All of the mitochondrial haplogroup sub-clades could, however, be categorized as 'Near Eastern'.

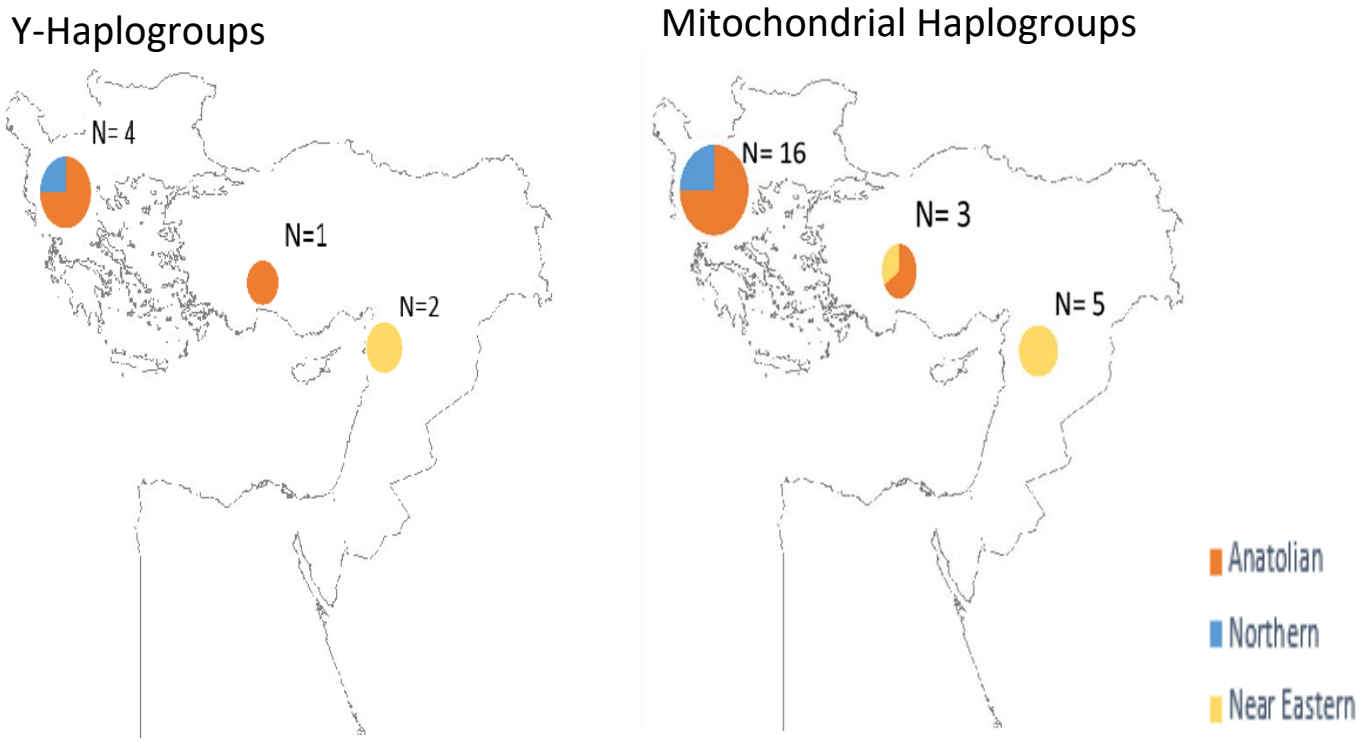

Figure 13 Data visualization of Y-haplogroups and mitochondrial Haplogroups uncovered through aDNA studies. Note how the Near East is completely devoid of Northern and Anatolian Haplogroups. The absence of Anatolian and Northern haplogroups throughout the Near East prior to the Philistinian arrival allows for the differentiation between Near Easterners and Aegeans/ Anatolians. Haplogroups identified as Caucasian have been identified as Anatolian in this graphic in light of their relatively close relation. After (Lazaridis et al. 2017; Haber et al. 2017). Raw data can be accessed in Appendix 1.

The External Migration Hypotheses

The Aegean and Anatolian migration hypotheses may be verified if an influx of foreign haplogroups is identified and this influx of haplogroups can be dated to the 12th century B.C.E. If the 'invasive' haplogroups can be related to the peoples who inhabited the Aegean region during the 12th century B.C.E., there would be a strong indication that the sea peoples' invasion of the Near East constituted a migratory event where peoples from the Aegean settled the Near East. Identifying an influx of haplogroups associated with the peoples inhabiting Anatolia during the 12th century B.C.E. would lend credence to the hypothesis that peoples descending from Anatolia invaded and settled the Near East.

An issue of concern when testing the migration hypotheses concerns the Anatolian descendance of the Aegeans. The aDNA studies on the remains of Neolithic and Bronze Age Aegeans and Anatolians has shown that the Y-haplogroups the Aegeans carry are derived from the Anatolians. Distinguishing between Aegeans and Anatolians on the basis of the Y-haplogroup may thus be problematic since they are relatively interchangeable. To differentiate between a possible Aegean or Anatolian origin we will have to look at the mitochondrial haplogroups as the Aegeans and the Anatolians carry unique haplogroups from one another. Lazaridis also classified these Anatolian-Caucasian haplogroups Anatolian-Neolithic haplogroups in his study and I am inclined to agree that this is an appropriate description for these haplogroups (Lazaridis et al. 2017)

The study of mtDNA haplogroups provides us with the most appropriate means to differentiate these two groups as aDNA studies have shown that the Aegeans living throughout mainland Greece and Crete bear different mtDNA haplotypes than the Anatolians (Lazaridis 2017 et al., 20, 26).

The Aegean individuals whose aDNA was recovered and analyzed carried several mitochondrial haplogroups associated with Eastern Europe and the Eurasian steppe. These mitochondrial haplogroups include AfontovaGora3, EHG, and MA1 (Lazaridis 2017 et al., 26). These mitochondrial haplogroups are conspicuously absent in aDNA recovered from individuals in Anatolia. We may thus differentiate Aegeans from Anatolians on the basis of the presence or absence of these mitochondrial haplogroups.

Since we can differentiate between Aegeans and Anatolians through the comparison of mitochondrial DNA haplogroups, we may discern whether the invasion and settling of the sea peoples of the Near East are linked to an influx of haplogroups associated with either the Bronze Age Aegean or Bronze Age Anatolia.

The Acculturation hypotheses

Although numerous 'acculturation' hypotheses of a different nature have been forwarded by researchers, they all postulate that the influx of new material cultures in Israel, Palestine, and Lebanon bears no relation to an external migratory event. Instead, they argue that the

appearance of new material cultures reflects trade and exchange or perhaps more appropriately, the replication of foreign wares.

The acculturation hypotheses could be verified if aDNA postdating the sea people invasions of the Near East in the 12th century BC.E. shows a genetic continuity with the aDNA recovered from remains predating the invasions and destructions that defined the 12th-century B.C.E.

The indigenous population of the coastal areas of the Levant during the 12th century B.C.E. was primarily composed of a number of Semitic peoples we generally identify as Canaanite (Evian 2017). A 2017 aDNA study of the remains of five Canaanite individuals dating to approximately 1700 B.C.E. revealed that the ancient Canaanite population carried haplogroups derived from both the Y 'J1' and 'J2' haplogroup families (Haber 2017 et al.). These Y-haplogroups are similar to those we find among the Anatolians and the Aegeans. The mitochondrial haplogroups the Canaanite individuals carried are, however, different from the mtDNA haplogroups the Bronze Age Anatolians and Aegeans carry. We can thus easily distinguish the autochthonous Canaanites from the foreign Anatolians and Aegeans.

A continued presence of the Canaanite mitochondrial haplogroups alongside a continued absence of the mitochondrial haplogroups associated with the Aegeans and the Anatolians would lend credence to the acculturation hypothesis. If the acculturation hypothesis is confirmed through archaeogenetic, studies the mysterious sea peoples will remain mysterious as the most probable material and historical link to the sea peoples we find in the Philistinians may not be related to the sea peoples at all.

Deficiencies inherent to the present human aDNA studies

The data derived from the aDNA studies conducted throughout the Neolithic and Bronze Age Aegean, Anatolia, and the Near East allow us to establish parameters through which the sea people origin hypotheses may be proven or disproven. The possible unrepresentativeness of the archaeogenetic dataset presents a concern, however, as the low number of individuals that were sampled are unlikely to be representative of the populations of their respective sites let al.one regions.

This does not mean, however, that the available data cannot substantiate hypotheses as the presence of absence of certain haplogroups can still be used to differentiate between different peoples. It must, however, be noted, that there is a high probability that the haplogroups that have been identified in the dataset do not accurately represent the respective populations completely as certain haplogroups are certain to be missed. It may be argued that the presence of specific haplogroups in specific locales provide us with strong inclinations rather than absolute truths.

The absence of an aDNA study on the Philistine remains complicates the testing of these hypotheses to a further extent as the parameters cannot be used to verify or falsify the hypothesis. Nevertheless, the uncovering of a Philistine cemetery near Ashkelon would

theoretically allow for a comparative study where the various hypotheses levelled at the 'sea peoples' may be tested. Presently, the Philistine cemetery provides us with the most obvious avenue to understanding the 'sea people phenomenon'. There are, however, also other meaningful sources through which the sea people phenomenon may be approached with zooarchaeological aDNA studies being the most promising.

Animal aDNA as a proxy for the sea peoples

Human DNA is, however, not the only avenue for approaching the movements of past peoples as the movement of domesticated plants and animals mirror the movement of peoples. If the entrance of the sea peoples into the Near East did constitute a migratory event as the sea peoples settled throughout the Near East there is a distinct possibility that animals accompanied them into the Near East. Studies into the genotypes of plants and animals throughout the Near East could thus be utilized as a proxy for the possibility of sea people migration and may even provide hints about the origin of the sea peoples. One recent comparative study between pig (*Sus scofa*) remains recovered in Greece and Israel confirms the migration of the European pig haplogroup from Greece to the Near East in a time frame which roughly coincides with the invasion of the sea peoples (Meiri et al. 2017). In their article, the authors also briefly highlight the possibility that the pigs were transported by the sea peoples on their boats.

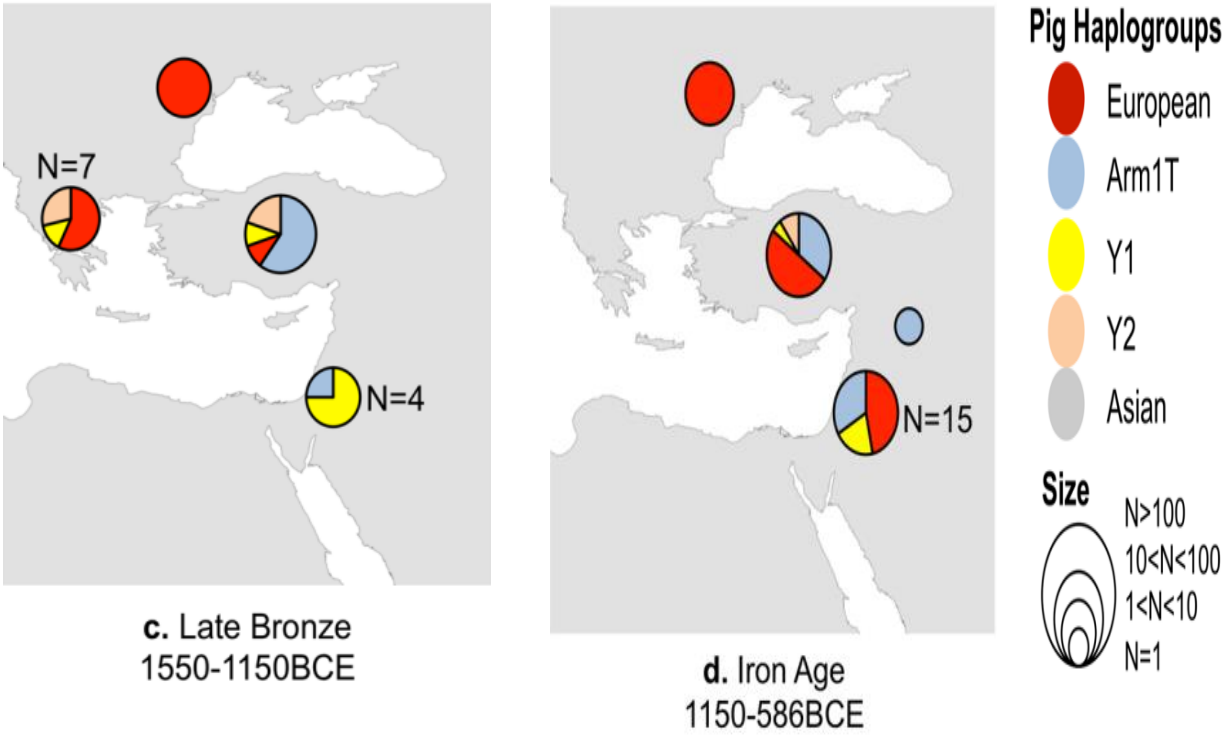

Figure 14 Distribution of pig (Sus scofa) haplogroups throughout the Aegean and the Near East. Note how the European pig Haplogroup substantially increases in frequency within the Levant following the 12th century B.C.E. which saw the invasion of the Sea Peoples and the collapse of the Bronze age kingdoms (Meiri et al. 2017, 5)

This may lend further credibility to the Aegean migration hypothesis as we now know that pigs of a Greek and Aegean origin reached the Near East in significant numbers as none of the tested samples dated to the period of 1550-1150 B.C.E. was of the Greek haplogroup whereas half of the sampled pigs dated to 1150-586 B.C.E. were of the Greek haplogroup (Meiri et al. 2017).

The entrance of Greek *Sus scofa* haplogroups throughout the Near East mirrors the entrance of the IIIC:1 material culture associated with the Philistinians. In light of this evidence, there is a possibility for an Aegean descendance for the Philistine people. Based on the time frame within which they entered as well as the locale where they settled we have good reason to believe that the Philistines may be one of the sea peoples, we see mentioned throughout the historic texts. The results of the DNA analysis of the uncovered Philistine remains will confirm or deny this hypothesis but in light of the evidence uncovered there is a high probability of an Aegean descendance for the Philistine people.

The other Sea Peoples

On the basis of historical, archaeological and archaeogenetic evidence there are good reasons to believe that the Philistines constitute one of the sea peoples we know from Ramses III' text. His text, however, mentioned four other 'sea peoples' by name as well: *The Tjeker, Shekelesh, Denen, and Weshesh* (Cline 2014). Researchers have speculated to their origins on the basis of linguistic similarities to other places or locales although such arguments are rather unconvincing (Killebrew and Lehmann 2013). An alternative possibility may be that these concern distinct factions of a culturally and ethnically uniform people. The fact that the Philistines would later live in five separate city-states attests that the uniformity of the Philistine material culture does not translate to political uniformity on a social scale. In this light, the five different 'peoples' Ramses describes in his epigraphs do not have to indicate five unique archaeological cultures as is often presumed, but rather five different factions of one people.

Further Archaeogenetic study of remains uncovered throughout Philistia dating to the 12th and 11th centuries B.C.E. may improve our understanding of the relation between the sea peoples themselves. If the sea peoples did constitute several ethnic groups, it will be discernable in an archaeogenetic study as several unique haplogroups should enter the Levant during the 12th and 11th centuries B.C.E. If, however, we find the influx of only one haplogroup, it would appear that the sea peoples only constituted one people, which Ramses apparently subdivided, based on cultural or political dimensions rather than ethnicity.

Preliminary conclusions

It is evident that DNA studies have the potential to reshape our understanding of the past, particularly with questions related to the movement of peoples and interregional dynamics. Whereas the question of the sea peoples was long shrouded in speculation one DNA study concerning zooarchaeological remains alone already gives us a far clearer resolution of what

has transpired than much of the unsubstantiated speculation which has defined research into the sea peoples over the course of the last century. Given the Near East's arid environment which is particularly conducive to the preservation of human and zoological remains, DNA analysis may be particularly suitable to approach the past dynamics of the Near East.

DNA studies focusing on the human remains dating to the 13th and 12th century B.C.E. will allow us to draw a more comprehensive and substantiated interpretation of the events of the 13th and 12th centuries B.C.E. and may even allow us to unravel the identity and the origin of the sea peoples. The DNA study of the remains uncovered from the Philistine site near Ashkelon takes the first step in unravelling the mystery surrounding the origin of the sea peoples as it will allow for the definite adoption or rejection of the 'Philistine Aegean origin hypothesis' and through proxy, the rejection or continued relevance of many of the competing narratives. Successful application of DNA studies on the remains uncovered at the Ashkelon cemetery may push archaeologists to expand the scope of DNA studies throughout the region to attain an even more comprehensive and corroborated understanding of the sea people, their origin, and their role within the collapse of 13th and 12th-century B.C.E system which had governed the dynamics of the Near East for centuries

Conclusion

On the basis of the historical, archaeological and archaeogenetic evidence available to us there are strong indications that the sea peoples we know from the Egyptian inscriptions originate from the Aegean and ultimately settled what is now modern-day Israel and Palestine during the 12th century B.C.E. Since the appearance of the Philistinians in Israel and Palestine is accompanied by the appearance of material culture, customs and animal haplogroups we know from the Aegean. A particularly strong case may be made for mainland Greece being the center of origin for the sea peoples on the basis of shared architectural conventions that are found throughout both Mainland Greece in the Philistine sites.

This still leaves the question whether there was one only one 'sea people' we identify as the Philistinians or whether there were multiple 'ethnic sea peoples' as Ramses implies on his mortuary temple. Thus far, no new material culture unique from the Philistinian material culture has appeared concurrently to the Philistinian culture. A high degree of material diversity within the Philistinian material culture between the five Philistinian settlements which make up the Philistine 'Pentapolis' may provide an indication that the five sea peoples Ramses III mentions on his mortuary temple constitute several factions which share ethnicity and general cultural attributes while simultaneously being somewhat independent of one another. In this light, the sea peoples may be interpreted as a confederation of Aegean polities that invaded and settled the Near East in the 13th and 12th century B.C.E.

The absence of any ancient DNA studies of Philistinian DNA still leaves us with a degree of uncertainty as the archaeogenetic evidence that presently supports a genetic link between the Aegean and the Near East is derived from zooarchaeological aDNA rather than human aDNA as there is presently no data concerning the genome and haplogroups of the Philistine population.

The analysis of human aDNA would be a preferable approach as zooarchaeological aDNA is solely a proxy for the movement of peoples, it tells us little about the people they accompanied. The analysis of aDNA derived from human remains would not only allow us to verify the movement of Aegeans from the Aegean to the Near East, but it may also allow us to narrow down the exact locale from which the Philistinians originated through comparative aDNA studies of 12th century B.C.E. sites in Philistia and sites throughout the Aegean.

Due to the favorable environmental conditions for aDNA preservation throughout much of what once made up Philistia, aDNA analysis is a particularly suitable approach to decisively unearth the nature of the 'sea people' phenomenon. Work has already started on the sampling and analysis of aDNA samples from remains uncovered at the Philistine cemetery near Ashkelon. The results derived from the study may verify or falsify the 'Aegean Origin Hypothesis' depending on the haplogroups that are identified from the recovered Philistine aDNA.

Ancient DNA in Archaeology: Assailing the Unassailable

Archaeologists, Historians, and Biblical scholars have long argued and hypothesized about the identity of the sea peoples and the Philistinians. In the past, the available archaeological and historical evidence left a void of uncertainty that was filled by a vast array of competing theories and hypotheses concerning the identity of the sea peoples and the 12th-century collapse that would come to shape the Near East and the Aegean for centuries to come. With the absence of decisive evidence, the nature of the sea peoples and the Philistinians became a product of the researcher's imagination as uncertainty left a lot of space for speculation and fantasy.

By applying new methodologies such as aDNA studies, the void of uncertainty within archaeological research diminishes as the findings of aDNA studies are verifiable and have the potential to decisively verify or falsify a theory or hypothesis. The certitude aDNA studies provide when approaching contentious topics such as past migrations, artefact use-life, and the process of domestication make ancient DNA analysis a useful tool within archaeological research to further our understanding of the past. The application of aDNA studies has already reshaped how we interpret the dynamics of prehistoric Europe and it is bound to reshape how we approach and interpret the human past.

The conclusions I have drawn on the sea peoples are not entirely new as some others before have hypothesized the Aegean origin for Philistinians. In fact, there is little that has not been hypothesized by archaeologists and historians when it concerns the identity of the sea peoples as researchers have interpreted the Sea Peoples as being everything from 'Bronze Age Pirates' to 'Merchant Cartels'. Some have even gone as far as looking for the origin of sea peoples in mythical legends as 'Trojan connection hypothesis' and the 'Anatolian famine hypothesis'.

The strength of absolute approaches such as aDNA to such contentious and interpretative topics of research is that it allows us to separate fact from fiction and reality from speculation. The Archaeological record will always leave us with voids we are inclined to fill with our imagination. More absolute approaches such as aDNA analysis allow us to significantly limit the void of uncertainty inherent in interpreting the archaeological record and base our interpretation of the archaeological record in a firm and absolute foundation.

Discussion

I believe that the application of aDNA studies provides us with a valuable avenue through which we may advance our understanding of the human past. Particularly where the historical and archaeological records are inconclusive and subject to speculation rather than veracity. One question that dawned upon me was whether the aDNA studies in their own right would yield the same or more conclusive hypotheses than the archaeological and historical sources do. Could the influx of Sus scofa from Europe into the Near East be discerned as reflecting a migratory event? Would the discovery of an influx of European haplogroups into the Near East in the 12th century B.C.E. be interpreted as a migratory event from the Aegean to the Near East, even if no sources of a historical or an archaeological nature accompany it. I feel like the answer here is objectively positive.

Yet despite its veracious basis, there are still a number of shortcomings to aDNA analysis. The most substantial deficiency in present aDNA is the low number of samples that have thus far been taken. I cannot help but feel like there is a great possibility that many meaningful haplogroups are missed when archaeologists conduct aDNA analysis on a very limited number of samples. This is particularly evident given the diversity in mtDNA haplogroups that were uncovered in the studies. The risk for unrepresentativeness is a risk that underlies nearly every aspect of archaeological research as not everything preserves. Interpreting the archaeological record often feels like putting together a thousand-piece puzzle with only a handful of puzzle pieces and only a vague idea of what the puzzle is supposed to represent.

For aDNA to become a truly effective medium through which the relation between past peoples may be explained larger and more representative samples have to be taken so that the relative frequencies of haplogroups a ‘people’ carries can be established. The relative frequencies we identify from a people together can then come to define a people and may be compared and weighed against other peoples to allow for differentiation of past peoples on the basis of their haplogroup constitution.

As more aDNA studies will be published the past movements of peoples and haplogroups will be better understood. The uncertainty that has long shrouded our interpretation of the past will start to recede as the movements of past peoples and the relation between the peoples of the past may be understood. While the historical and archaeological record give allow us to puzzle about the past, aDNA studies give us an impression of what the past is likely to resemble.

Bibliography:

Aja, A., & Stager, Lawrence E. (2009). *Philistine Domestic Architecture in the Iron Age.* Harvard University. PhD Dissertation.

Allentoft, Morten E.; Collins, Matthew ; Harker, David ; Haile, James ; Oskam, Charlotte L. ; Hale, Marie L. ; Campos, Paula F. ; Samaniego, Jose A. ; Gilbert, M. Thomas P. ; Willerslev, Eske ; Zhang, Guojie ; Scofield, R. Paul ; Holdaway, Richard N. ; Bunce, Michael. 2012 The Half-life of DNA in bone: measuring decay kinetics in 158 dated fossils*. Proceedings of the Royal Society*. 279 (1748) 4724-4733

Ammerman., and Cavalli-Sforza, L.L. *The Neolithic Transition and the Genetics of Populations in Europe*. Princeton, N.J. Guildford: Princeton UP, 1984. Print.

Barako, T., & Stager, Lawrence E. (2001). *The Seaborne Migration of the Philistines*. Harvard University. PhD Thesis.

Bauer, Alexander A. “Cities of the Sea: Maritime Trade and the Origin of Philistine Settlement in the Early Iron Age Southern Levant.” Oxford Journal of Archaeology, vol. 17, no. 2, 1998, pp. 149–168.

Ben-Shlomo, D. 2006. *Decorated Philistine Pottery: An Archaeological and*
Burgess, C.; Shennan, S. (1976). "The Beaker Phenomenon: some suggestions". *In Burgess, C.; Miket, R. Settlement and economy in the third and second millennia BC* University of Newcastle upon Tyne. Oxford: British Archaeological Reports 33. pp. 309–331.

Callaway, E. 2018. The Battle for Common Ground. *Nature*. Vol 555 pp 573-576

Campana, M. G. Lister, D. L. , Whitten, C. M. ; Edwards, C. J. ; Stock, F. ; Barker, G. ; Bower, M. A. 2012. Complex Relationships between Mitochondrial and Nuclear DNA Preservation in Historical DNA Extracts. *Archaeometry*, February 2012, Vol.54(1), 193-202

Cline, Eric H. *1177 B.C: The Year Civilization Collapsed*. Princeton and Oxford: Princeton UP, 2014. Print. Turning Points in Ancient History.

D, M., Master and A.J,. Aja, 2017. The Philistine Cemetery of Ashkelon. *Bulletin of the American Schools of Oriental Research*. 377, 135-159.

Dan, J., Yaalon, D. H., Koyumdjisky, H. & Raz, Z. (1970). The soil association map of Israel (1: 1,000,000). Israel Journal of Earth Sciences, 21, 29-49

Davis, Brent, 2018. What Language(s) Did the Philistines Speak? *Near Eastern Archaeology. 81*. (1), 22-23.

Dothan, Trude and Moshe, 1992. *People of the Sea: The search for the Philistines*. New York: Scribner.

Drews, R. (1998). Canaanites and Philistines. *Journal for the Study of the Old Testament, 23* (81), 39-61.

Drews, R., 1992. Herodotus 1.94, The Drought C. 1200-BC, And The Origin of the Etruscans *Historia-Zeitschrift Fur Alte Geschichte* 41 (1), 14-39.

Evian, S. (2017). Ramesses III and the "Sea-peoples': Towards a New Philistine Paradigm. *Oxford Journal Of Archaeology, 36*(3), 267-285.

Finkelstein, I. (2002). The Philistines in the Bible: A Late-Monarchic Perspective. *Journal for the Study of the Old Testament, 27*(2), 131-167.

Haber, Doumet-Serhal, Scheib, Xue, Danecek, Mezzavilla, Tyler-Smith, Massimo ; Youhanna, Sonia ; Martiniano, Rui ; Prado-Martinez, Javier ; Szpak, Michał ; Matisoo-Smith, Elizabeth ; Schutkowski, Holger ; Mikulski, Richard ; Zalloua, Pierre ; Kivisild, Toomas ; Tyler-Smith, Chris. (2017). Continuity and Admixture in the Last Five Millennia of Levantine History from Ancient Canaanite and Present-Day Lebanese Genome Sequences. *The American Journal of Human Genetics, 101*(2), 274-282.

Hansson, & Foley. (2008). Ancient DNA fragments inside Classical Greek amphoras reveal cargo of 2400-year-old shipwreck. *Journal of Archaeological Science*, 35(5), 1169-1176.

Harney, &., May, H., Shalem, D., Rohland, N., Mallick, S., Lazaridis, I., . . . Reich, D. (2018). Ancient DNA from Chalcolithic Israel reveals the role of population mixture in cultural transformation. *Nature Communications, 9*(1), 1-11.

Hartwell, 2018. *Genetics from Genes to Genomes.* McGraw-Hill Education.

Heun, M. ; Abbo, S. ; Lev-Yadun; S. Gopher, A., 2012 A critical review of the protracted domestication model for Near-Eastern founder crops: linear regression, long-distance gene flow, archaeological, and archaeobotanical evidence. *Journal of Experimental Botany* 63.12 (2012): 4333-341.

Hitchcock, Louise A., et al. 2016. A Pirate's Life for Me. *Palestine Exploration Quarterly*, 148 (4), 2016, 245–264.

Hofreiter, M., Collins, M., Stewart, R, J. 2012. Ancient Biomolecules in Quaternary Paleoecology. *Quaternary Science Reviews* 33, 1-13

Hofreiter, M., Serre, D., Poinar, H.N., Kuch, M., and Pääbo, S. (2001b). Ancient DNA. *Nature Review Genetics.* 2, 353–359.

Joe Uziel ; Aren M. Maeir, 2018. Philistine Burial Customs in Light of the Finds at Tell Eṣ-Ṣâfi/Gath. *Near Eastern Archaeology* 81 (1) 19-21.

Kaniewski, D., Van Campo, E., Van Lerberghe, K., Boiy, T., & Bretschneider, J., 2011. The Sea Peoples, from cuneiform tablets to carbon dating. *Plos One 6 (6),* 1-7.

Kaniewski, Paulissen, Van Campo, Weiss, Otto, Bretschneider, and Van Lerberghe, 2010. Late Second–early First Millennium BC Abrupt Climate Changes in Coastal Syria and Their Possible Significance for the History of the Eastern Mediterranean. *Quaternary Research* 74 (2), 207-15.

Killebrew, Ann E., and Gunnar Lehmann, 2013. *The Philistines and Other "sea Peoples" in Text and Archaeology*. Atlanta, Ga.: Society of Biblical Literature 15.

King, R. J., S. S. Özcan, T. Carter, E. Kalfoğlu, S. Atasoy, C. Triantaphyllidis, A. Kouvatsi, A. A. Lin, C-E. T. Chow, L. A. Zhivotovsky, M. Michalodimitrakis, and P. A. Underhill, 2008. Differential Y-chromosome Anatolian Influences on the Greek and Cretan Neolithic. *Annals of Human Genetics* 72 (2), 205-14.

Laland, Kevin N., Odling-Smee, John, and Myles, Sean, 2010. "How Culture Shaped the Human Genome: Bringing Genetics and the Human Sciences Together. *Nature Reviews Genetics* 11(2), 137-48

Lazaridis, I. (2018). The evolutionary history of human populations in Europe. *Current Opinion in Genetics & Development, 53*, 21-27.

Lazaridis, Iosif, Mittnik, Alissa, Patterson, Nick, Mallick, Swapan, Rohland, Nadin, Pfrengle, Saskia, Furtwängler, Anja, Peltzer, Alexander, Posth, Cosimo, Vasilakis, Andonis, McGeorge, P.J.P., Konsolaki-Yannopoulou, Eleni, Korres, George, Martlew, Holley, Michalodimitrakis, Manolis, Özsait, Mehmet, Özsait, Nesrin, Papathanasiou, Anastasia, Richards, Michael, Roodenberg, Songül Alpaslan, Tzedakis, Yannis, Arnott, Robert, Fernandes, Daniel M., Hughey, Jeffery R., Lotakis, Dimitra M., Navas, Patrick A., Maniatis, Yannis, Stamatoyannopoulos, John A., Stewardson, Kristin, Stockhammer, Philipp, Pinhasi, Ron, Reich, David, Krause, Johannes, and Stamatoyannopoulos, George, 2017. Genetic Origins of the Minoans and Mycenaeans. *Nature* 548 (7666), 214-218.

Leonardi, Michela, Gerbault, Pascale, Thomas, Mark G., and Burger, Joachim, 2012. "The Evolution of Lactase Persistence in Europe. A Synthesis of Archaeological and Genetic Evidence. *International Dairy Journal* 22 (2), 88-97.

Meiberg, L., Tartaron, Thomas F., Betancourt, Philip P., & Koehl, Robert. (2011). *Figural Motifs on Philistine Pottery and Their Connections to the Aegean World, Cyprus and Coastal Anatolia*. University of Pennsylvania. PhD Thesis.

Meiri, Meirav ; Stockhammer, Philipp W, Marom, Guy Bar-Oz, Lidar Sapir-Hen, Peggy Morgenstern, Stella Macheridis, Baruch Rosen, Dorothée Huchon, Joseph Maran, and Israel Finkelstein, 2017. Eastern Mediterranean Mobility in the Bronze and Early Iron Ages: Inferences from Ancient DNA of Pigs and Cattle. *Scientific Reports* 7 (1), 1-8.

Montserrat Hervella, Neskuts Izagirre, Santos Alonso, Rosa Fregel, Antonio Alonso, Vicente M Cabrera, & Concepción de La Rúa, 2012. Ancient DNA from hunter-gatherer and farmer groups

from Northern Spain supports a random dispersion model for the Neolithic expansion into Europe. *PLoS ONE, 7*(4)

Oonk, S., Cappellini, E., Collins, M.J., 2012. Soil Proteomics: An Assessment of Its Potential for Archaeological Site Interpretation*. Organic Geochemistry*. 50, 57–67.

Poinar, Hendrik N.; Höss, Matthias ; Bada, Jeffrey L. ; Pääbo, Svante. 1996. Amino Acid Racemization and the Preservation of Ancient DNA. *Science* 272 (5263).

Richter, K, K. 2014. *DNA Preservation Under Extreme Conditions*. The Pennsylvania State University. PhD dissertation.

S. Bar and D. Knd J.J. Shirley, 2011. Egypt, Canaan and Israel: History, Imperialism, Ideology and Literature: Proceedings of a Conference at the University of Haifa, 3-7 May 2009 *Culture and History of the Ancient Near East*.

Sandars, Nancy Katharine, 1978. *The Sea Peoples : Warriors of the Ancient Mediterranean, 1250-1150 BC*. London: Thames and Hudson.

Shapiro, B., & Hofreiter, M. (2014). A paleogenomic perspective on evolution and gene function: New insights from ancient DNA. *Science* (New York, N.Y.), 343(6169)

Sheratt, S, 1998. 'Sea Peoples' and the Economic Structure of the Late Second Millennium in the Eastern Mediterranean. In S. Gitin, A. Mazar and E. Stern (eds.) *Mediterranean Peoples in Transition: Thirteenth to Early Tenth Century BCE Jerusalem*, 1998. Mediterranean Peoples in Transition (1998) 292-313.

Sosa, Vispe, Núñez, Baeta, Casalod, Bolea, Hedges, and Martinez-Jarreta, 2013. "Association between Ancient Bone Preservation and Dna Yield: A Multidisciplinary Approach." American Journal of Physical Anthropology 151 (1), 102-09.

Tamar, K., G. Bar-Oz, S. Bunimovitz, Z. Lederman, and T. Dayan, 2015. Geography and Economic Preferences as Cultural Markers in a Border Town: The Faunal Remains from Tel Beth-Shemesh, Israel. *International Journal of Osteoarchaeology* 25 (4), 414-25.

Tarlow, S. and Nilsson Stutz, L. (2013). *The Oxford handbook of the archaeology of death and burial.* Oxford: Oxford University Press.

Uziel, Joe, 2007. "The Development Process of Philistine Material Culture: Assimilation, Acculturation and Everything in between." *Levant* 39 (1), 165-73.

Wilkins, Robert. *Oxford Handbook of Medical Sciences.* Oxford University Press, 2016.

Willerslev, E., Cooper, A. 2005. Ancient DNA. *The Proceedings of the Royal Society of Biological Sciences*. 272(1558), 3-16

Wilson, J. 1969. *The War against the Peoples of the Sea. In Ancient Near Eastern Texts Relating to the Old Testament.* Princeton, NJ: Princeton University Press

Yasur-Landau, Assaf, 2010. *The Philistines and Aegean Migration at the End of the Late Bronze Age.* Cambridge: Cambridge University Press.

Figure List

Appendices

Date B.C.E.	Location	Country	Sex	mtDNA	Identified as	Y-chromosome	Identified as
5419±41	Diros, Alepotrypa Cave	Greece	Female	K1a26	Anatolian		
2000-1700	Lasithi, Crete	Greece	Female	U5a1	Northern		
2000-1700	Lasithi, Crete	Greece	Male	H13a1	Anatolian?	J2a1d	Anatolian
2000-1700	Lasithi, Crete	Greece	Male	H	Caucasian, Anatolian	J2a1	Anatolian
2000-1700	Lasithi, Crete	Greece	Female	H5	Northern		
2000-1700	Lasithi, Crete	Greece	Female	H	Caucasian, Anatolian		
1411-1262	Kiriaki, Salamis	Greece	Female	X2d	Near Eastern		
1370-1340	Crete_Armenoi	Greece	Female	U5a1	Northern		
2900-1900	Heraklion, Crete	Greece	Female	J2b1a1	Anatolian, Near Eastern		
2900-1900	Heraklion, Crete	Greece	Female	I5	Anatolian, Near Eastern		
2900-1900	Heraklion, Crete	Greece	Female	H+163	Anatolian?		
2900-1900	Heraklion, Crete	Greece	Male	U3b3	Northern	G2a2b2	Northern
2900-1900	Heraklion, Crete	Greece	Female	K1a2	Anatolian		
1700-1200	Apatheia, Peleponnese	Greece	Female	X2	Caucasian		
1416-1280 ca	Tryfilia, Peleponnese	Greece	Female	H	Caucasian, Anatolian		
1700-1200	Tryfilia, Peleponnese	Greece	Male	X2	Caucasian	J2a1	Anatolian
2558-2295	Isparta	Turkey	Male	H	Caucasian, Anatolian	J1a	Near East, Anatolian
2836-2472	Isparta	Turkey	Female	K1a2	Anatolian		
2500-1800	Isparta	Turkey	Female	T2b	Anatolian		

Appendix 1: Genomic Data (after Lazaridis et al. 2017, 20)

Date B.C.E.	Location	Sex	mtDNA	Identified as	Y-Haplogrou	Identified as
3700	Sidon	Male	N1a3a	Near Eastern	J1-P58	Near Eastern
3650	Sidon	Male	HV1b1	Near Eastern	J2-M12	Near Eastern
3750	Sidon	Female	K1a2	Near Eastern		Near Eastern
3750	Sidon	Female	R2	Near Eastern		Near Eastern
3750	Sidon	Female	H1bc	Near Eastern		Near Eastern

Appendix 2: Genomic Data (after Haber et al. 2017, 275)